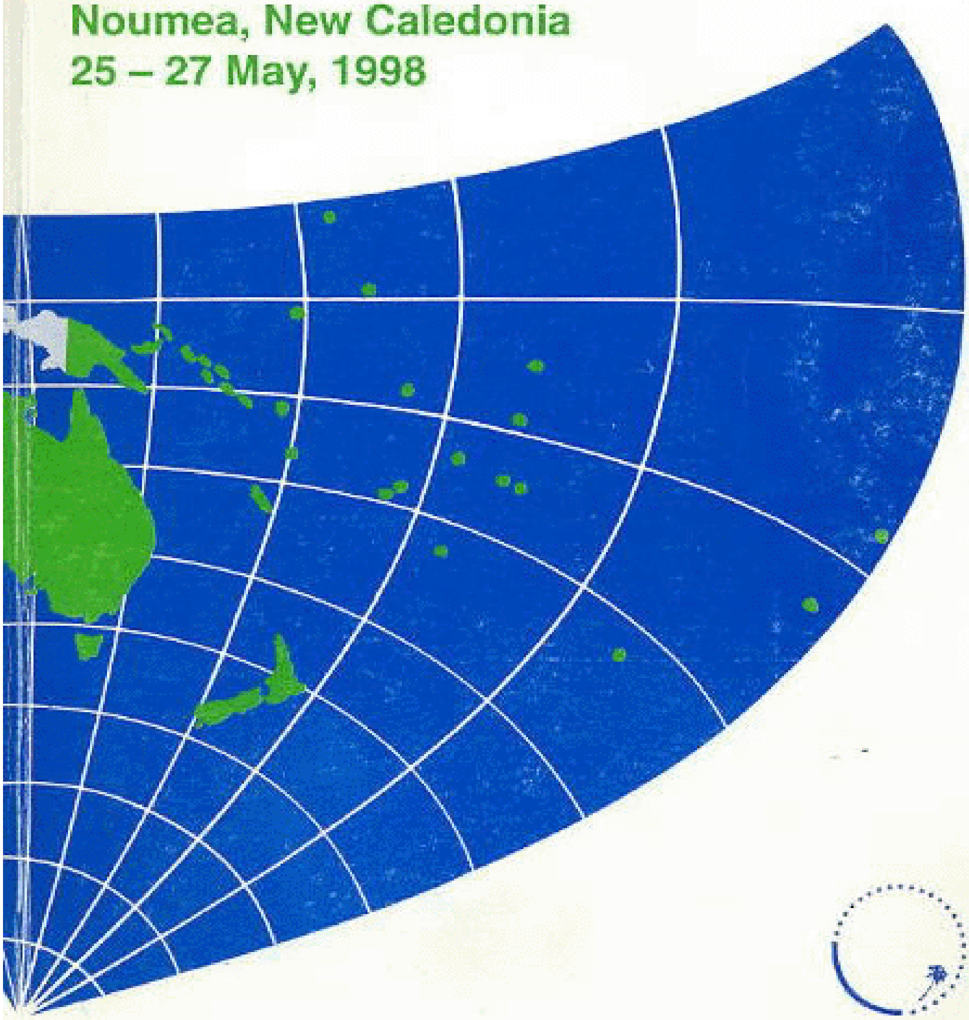
Proceedings of the fifth OCEANIAFOODS Conference

Noumea, New Caledonia
25 – 27 May, 1998



The University of the South Pacific

&

The Secretariat for the Pacific Community

Proceedings

of the

fifth

OCEANIAFOODS

Conference

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As Coordinator of OCEANIAFOODS I give permission to FAO to reproduce the Proceedings of the OCEANIAFOODS meetings of May 1998 and December 1991, and to disseminate these freely on the FAO website.

Yours sincerely,

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The Australia New Zealand Food Authority has especially supported the publications of these proceedings.

Further assistance was provided by the University of the South Pacific and the Secretariat of the Pacific Community, which hosted and helped organise the conference. Robert Hughes and Taiora Matenga-Smith should especially be thanked along with their support team.

The organisers were especially pleased at the attendance at the conference from the United Nations organisations UNICEF and FAO.

A final thanks to all those who delivered such interesting and high-quality presentations.

FOREWORD

OCEANIAFOODS is a regional group of the International Network of Food Data Systems (INFOODS), working to facilitate interaction and collaboration amongst the three regional member food composition programmes which are Australia, New Zealand and the South Pacific. Conferences are held every two to three years. The first OCEANIAFOODS Conference was held in Canberra in May, 1987, organised and hosted by the Nutrition Section of the Commonwealth Department of Community Services and Health; the second was held in Suva in November 1989, again organised by the Commonwealth Department of Community Services and Health. The third OCEANIAFOODS Conference was organised by the New Zealand Department of Scientific and Industrial Research (Crop Research Division) and held in Auckland. The fourth OCEANIAFOODS Conference was organised by the University of the South Pacific in association with the National Food and Nutrition Committee (Fiji) and held in Suva.

At the fourth conference the Health Section of South Pacific Commission (SPC) in Noumea, which in the interim changed its name to the Secretariat for the Pacific Community, offered to host the fifth conference, whose proceedings follow under the convenership of Professor Bill Aalbersberg of the Chemistry Department at the University of the South Pacific (USP). This collaboration between SPC and USP worked very well and a wide range of speakers were attracted to the conference. Several participants attended an OCEANIAFOODS Conference for the first time including the regional head of UNICEF, several New Caledonian nutritionists, the traditional Chief Raoul Bouacou who leads a local yam project, representatives of the Queensland Health Scientific Services and nutritionists from the Federated States of Micronesia and Papua New Guinea (PNG). The conference was especially pleased to hear of the progress made by UNITECH staff at PNG in food composition analysis work.

The constituent programs of OCEANIAFOODS all reported continued development, especially in the impressive increase in food covered in the New Zealand database, the completion of the 1995 Australian Nutrition Survey and the publication by the USP laboratory of a book on food composition of previously unreported traditional foods.

A number of papers were delivered on how food composition data are being used to help manage disease in the region, especially micronutrient shortages, chronic diseases and diabetes. On technical issue special areas of concentration were on folate analysis, quality assurance and reference materials. Papers were also delivered on emerging issues which may affect food composition scientists in the future such as Codex Alimentarius guidelines for nutrition labelling and nutrition claims and proposed revised concepts in carbohydrate classifications.

The coverage and importance of OCEANIAFOODS papers continue to develop and these proceedings, I am sure, will be of interest beyond the OCEANIAFOODS region.

At the end of the conference, the following communique was released:

Members of OCEANIAFOODS, having met for the Fifth time in Noumea from 25-27 May, 1998.

1.Re-affirm the importance of accurate data on the nutrient composition of foods in contribution to the health of the people of OCEANIA and national and regional food and health policy.

2.Recognise the growing importance of food composition in trade-related issues under the World Trade Organisation.

3.Congratulate the success of the Australia, New Zealand and especially the Fiji Program in food composition analysis.

4.Recommend the expansion of food composition analysis in the Pacific to UNITECH in Papua New Guinea.

5.Further recommend that additional efforts need to be made to increase the use of food composition data in improving the nutritional status of people in Oceania.

6.Further recognise the nutritional superiority of most traditional subsistence foods in the Pacific and strongly recommend that governments and their agriculture and health ministries recognise this in the development of their policies and programs.

In editing the papers I have been impressed by their quality and the number of significant contributions that they make in a wide variety of fields. I am confident that readers will agree and find these proceedings interesting and edifying. Significant progress has been made in implementing the recommendations of the fourth OCEANIAFOODS Conference and an ambitious program has been mapped out for the next two years.

Bill Aalbersberg

EDITOR
March,
1999

SUMMARY OF RECOMMENDATIONS AND RESOLUTIONS FROM THE FIFTH OCEANIAFOODS CONFERENCE

Adherence of OCEANIAFOODS members to the guiding principles of OCEANIAFOODS shall be regularly reviewed.

Administration

1.Australia (Janine Lewis) will be appointed as Convener and so official contact person and representative of OCEANIAFOODS until the Sixth OCEANIAFOODS meeting.

2.The Sixth OCEANIAFOODS meeting will be held in either Brisbane, Suva or Noumea in mid-2001.

Action: Convening group

3.OCEANIAFOODS recognises the USP Laboratory as a regional centre of excellence for Pacific island food composition analysis and strongly recommends continued (financial) support for it from FAO and other development partners to continue to analyse priority Pacific foods and, further, to assist other Pacific Island countries to set up and undertake food composition analysis.

4.OCEANIAFOODS will assist UNITECH in obtaining assistance, in the first instance, for a technician and to participate in the Wageningen workshop through a UNU fellowship and South-South technology transfer with USP or training in Australia via APFAN.

Action : Betty Amoa, Barbara Burlingame, FAO, Bill Aalbersberg

5. Articles in the Proceedings of the OCEANIAFOODS Conference will be submitted to CAB Abstracts and Reviews, for which authors will provide abstracts of their article to be included in the Proceedings.

Action : Authors to Conference Proceedings, Editors

6. Bill Aalbersberg will submit the Proceedings of the Fifth OCEANIAFOODS Conference to the Journal of Food Composition and Analysis for review as a book review along with a precis of the proceedings that he will prepare.

Action: Bill Aalbersberg

7. The Proceedings from the Fifth OCEANIAFOODS meeting will be made available electronically on the INFOODS web site either directly or by link to the SPC web site.

Action: Barbara Burlingame

8. New Zealand and Australia, wherever possible, will continue *to* facilitate the provision of assistance for food nutrient analysis to Pacific island countries.

Action : Convener

9. A working group (one representative from each program) will investigate the possibility and necessary harmonisation of combining the three major OCEANIAFOODS food tables and software.

Action: Convener

10. A report from this meeting will be prepared and sent to ACC/SCN Newsletter.

Action: Barbara Burlingame

11. OCEANIAFOODS strongly support the continuation of the beneficial collaboration with ASEANFOODS.

Action: Convener

12. OCEANIAFOODS continue to explore collaboration with the University of Hawaii.

Action : Convener

13.OCEANIAFOODS appreciates the attendance of UN agencies at this meeting and strongly supports their continued involvement in OCEANIAFOODS.

14.Member of OCEANIAFOODS should be supported in efforts to attend the Third International Food Data Systems meeting to be held in Rome 5-7 July, 1999.

Technical Issues

15. The PIFCTs and data base should be revised before the next *meeting* to include new analytical data, % edible portion and common measures or serving sizes.

Action : SPC

16. All food composition-related publications by OCEANIAFOODS members should be shared with other appropriate OCEANIAFOODS members.

Action: All

17. A capability statement identifying sources of expertise for food analysis and for training will be prepared by AGAL and USP.

Action : Pieter Scheelings, Bill Aalbersberg, Barbara Burlingame

18. OCEANIAFOODS laboratories developing new analyses are encouraged to facilitate other laboratories to test out the methods. These include:

Dietary fibre	:	John Munro
Carotenoids by UV	:	Bill Aalbersberg
Niacin by HPLC	:	Don Buick

Action : As above

19. In-house standards will be shared among the three analysis programs and ASEANFOODS for analysis and comparison.

Action: Bill Aalbersberg

20. OCEANIAFOODS will help facilitate the provision of a simple, easy-to-read summary document, concerning the importance of Codex Alimentarius standards, codes of practice and guidelines for Pacific Island countries and world trade, especially in the areas of food labelling and food analysis.

Action : FAO, Ruth English, Barbara Burlingame

21. OCEANIAFOODS members should explore a common description for indicators of quality of food composition data.

Action: Convener

22. John Monro and Janine Lewis will help keep OCEANIAFOODS members informed on possible new nomenclature for carbohydrates, the implications of these changes for food analysis and labelling and their relationship to nutrition.

Action : Janine Lewis and John Monro

23. A listing of available reference materials and contact information be prepared and circulated.

Action : Pieter Sheetings, Bill Aalbersberg

Dissemination Information to End Users

24. Because of the significantly higher nutrient content of beta-carotene, iron and other micronutrients in traditional/subsistence leafy green vegetables of Pacific Island countries, promotion/production of these vegetables should be supported in preference to the growing of imported vegetable seeds, of low nutritional value.

Action: All

25. SPC in conjunction with other agencies and National Food and Nutrition Committees to explore effective ways of making existing food composition data more accessible to the general public (e.g. bar graphs by nutrient in relation to certain diseases).

Action : SPC, UNICEF, Fiji NFNC

26. SPC to coordinate a study of the current use of PIFCTs in the Pacific and seek funding for a regional follow-up to the 1994 launch of the PIFCTs with assistance to participants for software and hardware.

Action : SPC, Convener

27. OCEANIAFOODS liaise with United Nations agencies and regional organisations to encourage the consideration of food composition in relevant national projects and program in the Pacific region e.g.

Food Balance Sheets Ag.
Research & Extension Use
of Code Alimentarius
Nutrition programs Food
legislation

28. Jayashree Arcot will gather information from all laboratories in the Oceania region involved in Food Composition analyses on the problems that might be encountered during analyses (whether inherent or due to different food matrices). This will be shared with developing laboratories to anticipate such problems.

Action: Jayashree Arcot

OPENING SPEECH

Julie MacKenzie
NZ Consul General

E nga mana, E nga rea, tena koutou,

On behalf of the Government of New Zealand, I wish to extend New Zealand's warm support to this 5th OCEANIAFOODS Conference.

The OCEANIAFOODS forum provides an opportunity to draw on regional expertise to facilitate cooperation within the Pacific on community health issues. The fact that you are all here today confirms the importance of this goal. Your combination of knowledge and skills will make a significant contribution over the coming days to policy formulation in this vital area.

Pacific Island Governments realise that nutrition is key to the continued health and wellbeing of our societies. At all stages of life, people need an appropriate balance of food to maintain good health and to guard against illness and disease. Food is an important part of the Pacific lifestyle, not only in terms of health, but because of its social, cultural and spiritual significance.

The issues surrounding the link between nutrition and disease extend to many sectors beyond health or agriculture. It is important, therefore, that nutrition problems be addressed at both the national and community levels.

An increasing trend of diet-related diseases in the region highlights the need for improved nutrition knowledge. Access to high quality data on what is actually in the food we eat every day will only become a reality through a major investment in nutrition information. This calls for the development of appropriate government policies and strategies. Good quality data can also help us better understand the inter-relationship between food, environmental standards and agriculture.

Malnutrition includes both over-nutrition and under-nutrition. Under-nutrition Tnainly affects women and children. There has been concern in the Pacific 'region about this for many years. The good news is that under-nutrition in 'Pacific Island populations overall has been slowly declining. This has been 'achieved through improved economic growth, education and infrastructure and the efforts of Pacific Island health departments, the SPC and other non-government organisations. But under-nutrition still exists, especially in the more remote areas of Melanesia and Micronesia. It continues to be monitored by the Pacific Community's health and nutrition departments, working closely with UNICEF and WHO.

A third nutrition concern for the region is that of food security. Many PICs are dependent on imported food supplies. Over the years, traditionally-grown crops have been replaced by imported staples. Agriculture is changing from subsistence to cash crops. Distribution and market systems are also changing. Market economies have replaced socio-cultural "safety nets", which used to care for those who are nutritionally the most vulnerable.

This process has brought about a "nutrition transition". It has also marginalised many households and families, placing them at risk in terms of access to sufficient amounts of food of adequate quality. In some Pacific urban environments, under-nutrition and non-communicable diseases - the "diseases of affluence" - exist side-by-side. Under-nutrition persists even in the face of plenty. The outlook is for urbanisation in the PICs to continue to grow, bringing increased food security risks to many families.

The general consensus today is that a complex set of factors determines hunger and malnutrition. These factors relate not only to food and agriculture, but also to people's knowledge and behaviour. Government policies in health, education and agriculture can strongly influence personal food choices.

In order to design effective policies, it is necessary to have a clear understanding of the linkages between food security, agriculture and nutrition.

When considering the costs of nutritional improvement programmes, it is also necessary to weigh up the costs of inaction. Focussing on spending and ignoring the resultant benefits is misleading. The guiding principle should be: what is the most cost-effective policy instrument to achieve a defined nutritional goal rapidly and durably.

It is crucial that governmental nutrition initiatives and the activities of non-governmental interests be well coordinated at the national level. National food and agricultural strategies are essential for sustained and consistent action.

Coordination at the national level can be strengthened by international organisations and regional cooperation. For example, the Pacific Islands Food Composition Data Base, drawn up by the New Zealand Institute of Crop and Food Research and the Pacific Community, has stimulated follow-up action in several PICs. The New Zealand representatives to this conference will doubtless be providing an update on progress in this area and other new initiatives underway.

The New Zealand Government is committed to the principle of partnership in development. The NZODA South Pacific Regional Health Programme, established in 1997 by Minister of Foreign Affairs and Trade Don McKinnon, reflects the New Zealand concern about adverse health trends in Pacific Island countries. This programme aims to support the development of more efficient, good quality, primary and public health care services. Activities funded through NZ's regional programme include:

- •Health sector capacity building
- •Non-communicable diseases
- •Communicable diseases
- •Health promotion
- •Research and development, and
- •Special projects focused on disadvantaged groups such as people with disabilities.

The NZODA Regional Health Programme represents a significant investment and reinforces the already solid partnership between New Zealand and the Pacific Community. Planning is underway to implement more projects: a Regional TB Programme; a Regional Health Management Training and Development Programme; updating of the Regional Cancer Registry and Training of Specialists, and the continued development of the Nutrition and Lifestyle Disease Project.

The OCEANIAFOODS Conference provides an important opportunity to put health development issues in the spotlight, and to decide how the region should be addressing them. I know you will tackle this task with great gusto. I wish you all the best in your deliberations.

It is a privilege to officially open the 5th OCEANIAFOODS Conference.

WELCOMING ADDRESS

Dr. Bob Dun
Director General
SPC

It's my pleasure to welcome delegates to the Jacques lÈekawÈ Conference Room for the opening of the Fifth OCEANIAFOODS Conference. We in SPC are proud to be your hosts - in association with the University of the South Pacific. I hope that while you are with us you enjoy the opportunity of seeing something of our organisation and its people. Also I trust that the weather will be kind so that you can enjoy the ambience of this beautiful island state and its Francophone capital, Noumea. This is a very special part of the Pacific and SPC is privileged to have its headquarters nestling against the beach at Anse Vata.

I understand that this meeting brings together the members of the food composition network - nutritionists from the Pacific Islands, Australia and New Zealand : people from international, regional and donor organisations -all those who are committed to the improvement of the quality, coverage and accessibility of food data in the Pacific region.

SPC has been long associated with this programme, going back to the first meeting convened in 1981 in association with UNDP - exploring the theme -"The effect of urbanisation and western diet on the health of Pacific Island people". Over the years, food composition tables for use in the region have been produced and improved through collaborative workshops. Our Nutrition and Lifestyle Section has extended this basic contribution through information leaflets and food handbooks - the provision of practical, helpful information for the island peoples. Our advisers strive towards better informed decision making by families about their choice of available foods. Achieving social change is never an easy road - but in this case it's a very important one given the severity of nutrition associated health disorders in many of our island member states and territories. I've been impressed with the impact of local leadership in stimulating lifestyle change - and I must congratulate our own Taiora Matenga-Smith for her innovative concept of a lifestyle award, the first going to the King of Tonga. The Kingdom has responded with a greatly increased interest in the value of exercise and rational eating.

In concluding I'll comment on just two features of this long-term work. The first to note the obvious. SPC is a very small organisation and our contribution in nutritional advocacy only attains any significance through association with our colleagues. Collaboration has always been the name of the game and the very nature of this Conference means that the nutritional network is as active as ever. As an example I'm told that our nutritional unit plans to work with the 'Pacific Islands Foods" analyses produced by the cooperative efforts of the Australian Centre for International Agricultural Research, the University of the South Pacific and the Australian Government Analytical Laboratories, in updating SPC's food composition software. Nutritionists through their collaborative style are obviously something of a model for the Pacific where fragmentation has often been a feature of our approach to regionalism.

Secondly I want to mention the crucial role of aid donors. Without New Zealand's long-term committed support, SPC's nutrition programme would have perished in the 90s at a time when the organisation was operating under increasing financial stress. SPC can only contribute regionally these days through contracted project support coming from our donor partnerships. As I said before, New Zealand aid has been at the core of our nutritional contribution for a very long time. Fortunately the donor base is broadening given recent major contributions by AusAID and just now, by the Government of Taiwan. This is my opportunity to thank our New Zealand Consul-General, Julie MacKenzie, for her opening remarks stressing the importance of nutritional health education in the region. The donors have got it right and it's my hope {hat they'll continue to see value in a regional contribution by SPC in helping to meet this priority need of our island members.

Finally, please accept my best wishes for a successful Conference - following In the footsteps of those that came before - and leading into the sequence yet to come. Pacific nutritionists and their supporters have a major social problem on their hands. They have to be prepared for the long haul.

COUNTRY REPORT FOR AUSTRALIA

Janine Lewis, Catherine Deeps
Australia New Zealand Food Authority
Canberra, AUSTRALIA

INTRODUCTION

Since the last OCEANIAFOODS meeting, the focus of the Australian food composition program at the Australia New Zealand Food Authority has been to expand the number of permanently employed program staff, to develop a large nutrient composition database for the 1995 Australian Nutrition Survey, to redevelop the computer data bank and to continue to publish updates to the official references on nutrient composition.

In July 1996, the former National Food Authority expanded its regulatory role to include New Zealand and was thus renamed the Australia New Zealand Food Authority. The change of name caused some confusion, in that the Authority's expanded role applied only to food regulation. Monitoring activities such as the food composition program continued to apply only to Australia.

The South Australian division of the Australian Government Analytical Laboratory (AGAL), which is responsible for conducting the nutrient analyses for the Authority, ceased operation as a laboratory during 1996, and the nutrient analysis function was transferred to the Victorian division of AGAL.

1. PUBLICATIONS

Composition of Foods, Australia series

In mid 1995, volume 7 of Composition of Foods, Australia[1] (COFA) was released. The volume contains data on 27 main nutrients for some 120 commercially-available ethnic foods including restaurant dishes and processed foods as well as 24 entries for turkey, duck and rabbit as well as updates to the data appendices including an expanded amino acid appendix. A new appendix of niacin equivalents, estimated from crude protein or tryptophan content where available, was also included.

NUTTAB (Nutrient Data Table for Use in Australia)

NUTTAB95[2] was released on diskette in November 1995, replacing NUTTAB91-92[3]. The NUTTAB95 database provides data on 27 nutrients and energy for some 1800 foods including 200 new foods from volumes six and seven of the COFA series. In addition, the last remaining British data from the previous NUTTAB versions were replaced by Australian nutrient values.

Preliminary work has commenced on publishing a supplement to NUTTAB 95 which will provide, in electronic form, previously published COFA data for amino acids, fatty acids, organic acids and carbohydrate components.

2. DEVELOPMENT OF NUTRITION SURVAY DATABASE

The Authority program devoted most of 1996 to the development of a nutrient composition database for use in processing the results of the 1995 Australian Nutrition Survey. The database includes over 4 500 foods including over 1 000 recipe foods. Further information about the development process will be presented separately at this meeting.

3. ANALYTICAL PROGRAMS

Meat Programs

The program continued its well-established approach to collaborate with major meat producers to ensure regular updates to the reference nutrient publications and databases that reflect the current food supply. Programs were undertaken to analyse raw and cooked samples of kangaroo and quail.

Chicken Program

The Australian Chicken Meat Federation Inc. (ACMFI) accepted an invitation to join the Authority in funding a collaborative chicken analysis program. Nineteen samples of raw and cooked chicken cuts were analysed for a comprehensive range of nutrients. In contrast to existing Australian chicken data for lean, plus skin and fat, samples for analysis were dissected into 3 components: lean, skin, and separable fat. To expand the use of the data, wet and dry cooking methods were requested.

Folate

Very few Australian total folate results exist because of past difficulties in establishing a reliable analytical method suitable across a broad range of foods.

Recent improvements in total folate analysis have provided an appropriate methodology to enable a folate analysis program to be commissioned. The Department of Health and Family Services (DHFS) provided funds to the Authority to commission AGAL to analyse 80 foods for total folate and water content.

The results are now being checked and validated. Total folate is now routinely included in the Authority's commissioned analytical work.

Other Analysis Work

As part of the ongoing food composition program, AGAL analysed an assorted 20 foods for a comprehensive range of nutrients. Additional 'catch-up' nutrients were commissioned for the 80 foods sampled for folate analysis.

4. INFORMATION TECHNOLOGY

Australian Nutrient Data Bank (ANDB)

During 1996-97, the ANDB was redeveloped to enhance its efficiency, improve its functionality and to add some new features. After some experience with the new system, work is continuing to fix minor problems and to build further enhancements.

5. CONSULTANCY SERVICES

The Authority provided resources for three external projects:

i) to contribute to a review of the nutrient analysis work carried out at the University of the South Pacific, and funded by the Australian Centre for International and Agricultural Research;

ii) to prepare a 1 000-food database containing a subset of nutrients from NUTTAB95 for use in an interactive Multimedia CD ROM, which is designed to provide information on nutrition, exercise and a healthy lifestyle for secondary school students.

iii) to validate nutrient data from the Australian Meat and Livestock Corporation's (AMLC) 1996 Lamb study and to compile comprehensive nutrient composition data for selected lamb cuts, raw and cooked.

6. FOOD ANALYSES BY OTHER AUSTRALIAN GROUPS

Several reports from other groups of analysis of Australian foods for a broad range of nutrients have been published, some in refereed journals. These include data for Indian restaurant foods[4], breakfast cereals[5], Yolla (mutton bird)[6], crocodile meat[7], lamb[8,9] and the folate content of food available in Western Australia[10].

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COUNTRY REPORT: NEW ZEALAND

Barbara Burlingame, Nelofar Athar, Elizabeth Reynolds,
Tom Spriggs, John Monro, and Grant Taylor
NZ Institute for Crop & Food Research,
Palmerston North, NEW ZEALAND

BACKGROUND

Many developments have taken place since the 4th OCEANIAFOODS Conference. This country report will review developments that have taken place since those reported during the meeting in April 1995 (Burlingame et al., 1996)

ANALYTICAL PROGRAM

Comprehensive nutrient analyses were carried out on major categories of foods from April 1995 -April 1998.

The major categories of foods analysed in this period include mutton, pork and pork products, confectioneries and frozen confectioneries, pastas and specialty breads, breakfast cereals, sports beverages and meal replacements, soups, savoury snack foods, salad dressings and condiments, herbs and spices, and many miscellaneous individual foods.

The number of new foods added to the database was 528, totalling 2320 foods in March 1998, up from 1792 in March 1995.

Sampling for the mutton, pork and pork products was conducted at three population centres in New Zealand during one season, and all samples were purchased at retail outlets. All other samples were relatively standardised manufactured products, collected in one centre during one season.

All other samples were relatively standardised products, and were collected from retail outlets in Palmerston North, for the convenience of the analysts and because geographical sampling was unlikely to show any differences.

A comprehensive range of nutrients, analysed mainly by AOAC methods, includes proximates (water, protein, available carbohydrate, fat, dietary fibre and ash), vitamins, elements, sterols, fatty acids, amino acids and available carbohydrate constituents. Dietary fibre is measured as soluble and insoluble non-starch polysaccharides (Englyst, 1987, 1992) and also by the newly developed method (Monro, 1993) with improved physiological relevance. Folate analyses had been conducted using a RIA technique, but all folate analyses have been temporarily suspended pending a methodology review. In 1997, four food components were dropped from the "core" components for which complete information is obtained; these were biotin, pantothenate, sulphur and chloride. The number of components for which complete information is provided is now 48, down from 52 prior to 1997.

Specialty analytical capabilities continue to be in the areas of fibre and fibre fractions, lipid classes and individual fatty acids, and some fat soluble vitamins. Additionally, fatty acid isomers, cholesterol, several carotenoids and several isoflavones have been added to the analytical repertoire, as have capabilities in organic acid and HPLC mono- and disaccharides. More frequently, routine proximate, vitamin, and elemental analyses are subcontracted to other commercial laboratories.

The number of different food components identified by tagnames (Klensin, et al., 1989) in the data base is 505, up from 421 in 1995. The majority of these new tagnames relate to our specialty analytical capabilities for individual carotenoids and isoflavones. And the number of mean values in the database was 205 000 in March 1998, up from 163,000 in March 1995.

Interlaboratory trials are undertaken with AOAC, AOCS, andASEANFOODS to assure the quality of the information.

NUTRITIONAL INFORMATION SYSTEMS

Several important developments have occurred in the information systems area, with the extended documentation features, additional data integrity routines and data quality indicators, and developments in using WWW browser capabilities for data compilation and for data users. Use of the raw analytical data program since 1994 is providing outstanding data quality assurance.

The analytical program allows capture of individual sample results when multiple samples have been collected, and individual replicate determinations on a single sample. All values can be captured, including suspicious ones, and any individual value can be excluded from further processing. Analytical data can be included on either a wet weight, dry matter, or freeze-dried basis, and wet weight data will be calculated. The program processes the statistical information that can include precision assessment (from replicate data) and biological variability in the food samples. Data can then be presented as modes, medians, means, and ranges, along with standard deviations and standard errors. Trace data, captured as the limit of detection or limit of quantitation, can be processed in any of three ways: as zero, as one-half the value, or as the value itself. Analytical methods are also captured.

Recent changes in New Zealand's food legislation have illustrated the benefits of the data auditing feature that was included in 1992. This feature allows food composition data to be date-stamped. This is particularly relevant since vitamin and mineral fortification of many food products has been permitted because of mutual recognition and dual standards development with Australia.

Compact disks continue to be an important part of our information systems. Data and images of foods - occupying more than 100 MB of disk space - are being supplied to users in New Zealand on CD-ROM. Information systems software is also being supplied to other regional data centres on CD-ROM.

DATA BASE PRODUCTS

Several new data products have been released. These include the third edition of the Concise New Zealand Food Composition Tables (Burlingame et al., 1997); releases number 7, 8 and 9 of FOOD files (1996,1997,1998), plus new users' guides; versions 4, 5, and 6 of DIET1/NZ; two new dietary assessment packages, Serve NZ and NZ Food Works, for Windows and Windows '95 environments; and a booklet of recipes for food records in the database (Reynolds et al., 1997). Information on ordering all products can be found on the Crop & Food Research Web site <http://www.crop.cri.nz/pubprod/foodcomp.htm>

The recipe booklet was requested by many data users who needed to know how well the recipes used for the nutrient analyses and/or calculations compared with the recipes used in the clinical of home setting. It is not meant to be equivalent to a cookbook.

CONSULTATION

Consultation is an important feature of our work. Wide consultation has taken place, and continues to take place with the Ministry of Health, the National Food Composition Steering Committee and associated technical committees, the Ministry of Agriculture and Forestry, the Dietitians Association, hospitals and regional health authorities, three universities in New Zealand, several producer boards and industry groups, INFOODS and many Regional **Data** Centres, UNU and FAO.

Consultation with industry gives us important information for designing sampling procedures, e.g. market share data for determining the most widely consumed items in a food category, details of product formulation to help determine appropriate foods for composite sample preparation, and circumstances under which geographic or seasonal variability may be a factor.

FUTURE DEVELOPMENTS

Future activities nationally for NZ will include increasing the number of food records in the data base, developing methodologies and conducting analyses for more effective monitoring the nutrients in the food supply (e.g. folate with tri-enzyme extraction), delivering more data to more users via the World Wide Web, and linking more closely with regional and international standards development (WTO, Codex). Future developments with OCEANIAFOODS will include more technical and sectoral harmonisation efforts, closer affiliation of activities, and infrastructural support for developing countries in the OCEANIAFOODS Network, Support for New Zealand's food composition programme comes from the Foundation for Research, Science and Technology and the NZ Ministry of Health.

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SECRETARIAT OF THE PACIFIC COMMUNITY (SPC) NUTRITION & LIFESTYLE DISEASE SECTION REPORT

Robert Hughes
Nutrition & Lifestyle Disease Section
Community Health Programme
Secretariat of the Pacific Community

The Nutrition and Lifestyle Disease Section's goal is

> " to enable Pacific Island Countries to improve the nutritional health of their populations by providing assistance to develop policies, improve food security and control NCD through effective and sustainable food and nutrition monitoring and surveillance"

The section has two specialist staff, a Nutritionist/NCD Epidemiologist and a Nutrition Information Training Officer and two support staff. We provide training and advice on a wide range of food and nutrition topics, such as:

- •conducting nutrition/NCD projects
- •MCH nutrition and breastfeeding
- •food security issues
- •NCD monitoring/management/control
- •dietary and NCD surveys
- •research, analysis & interpretation
- •nutrition/NCD policies
- •workshops/conferences
- •food safety & hygiene

Some examples of current promotion materials produced by the Section include:

- •Pacific Island Nutrition Newsletter
- •dietary leaflets & posters
- •Pacific Nutrition Worker's Directory
- •Pacific Food Composition Tables
- •health education flip charts
- •nutrition videos & books
- •food guides & leaflets
- •height & weight charts
- •community nutrition handbooks

The Nutrition and Lifestyle Disease Section has been a successful section of the SPC since 1950. We cover a whole range of activities to do with food, nutrition and health, of which, food composition is a small but important part. We work closely with other Sections of the Community Health Programme, especially the Health Promotion Section. We also work closely with other organisations in the Pacific, such as USP, WHO and UNICEF.

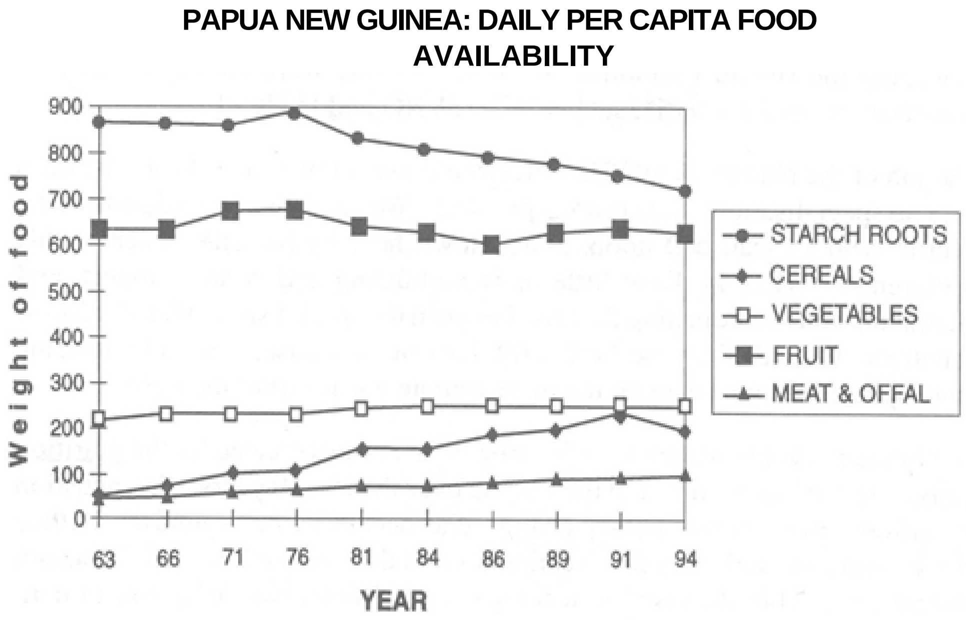
The job of the Nutritionist/NCD Epidemiologist is rather a Jack-of-all-trades with no specialisation. This is not a problem. We have plenty of experts in the Pacific who we can call upon, as is shown here by the attendance at this conference. What we have little of is mobilising action and support, and facilitating and co-ordinating the links between the specialists and Pacific Island countries. We at SPC try our best to fill that role. Because, as we all know, the more specialised we become, the more remote we are from the public.

The Section's activities are now focused on the issues created by the nutrition transition that has occurred in the Pacific over the last 50 years. The nutrition transition describes the dietary change that occurs within countries as they move from subsistence to cash economies and the associations with urbanism and poverty. This shift is also accompanied by a corresponding rise in non-communicable diseases.

Figures 1-5 show different stages of the nutrition transition by country using food availability data. The figures show the top five foods available (by weight) for consumption for each country. From Figure 1, Papua New Guinea shows all the characteristics of a subsistence economy. The quantities of home-produced root crops, fruits, vegetables and meat greatly exceed those of imported cereals (mainly rice and wheat flour). In the Solomon Islands (Figure 2) the picture is a little different. The availability of root crops has declined and the quantities of fruit, vegetables and meat has fallen behind that of cereals. In 1994 the availability of cereals was second only to root crops.

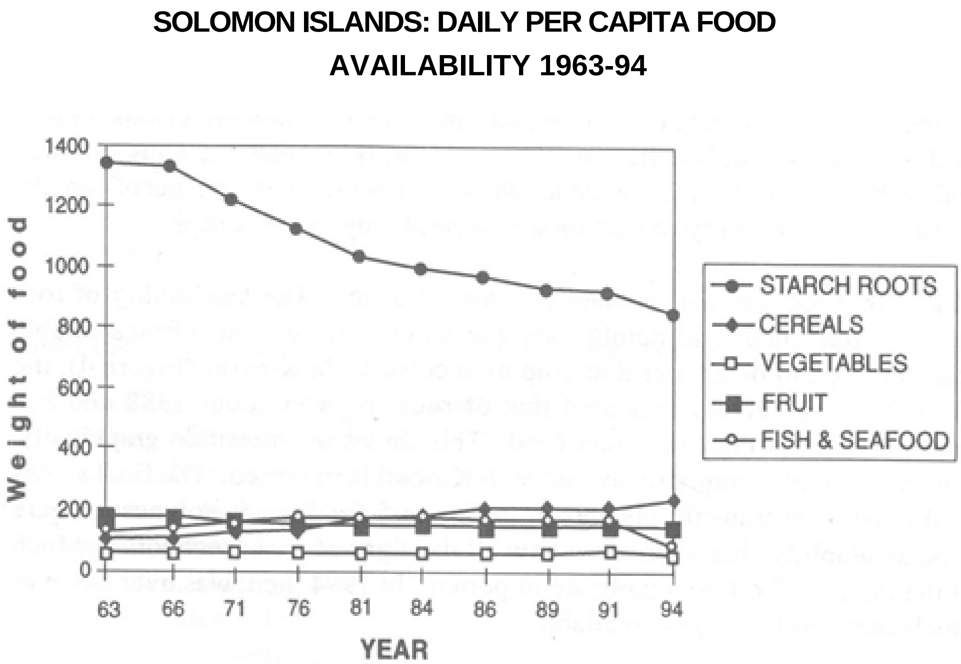
In Figure 3 we see that Vanuatu is different again. The availability of root crops has remained in the number one spot, whereas the weight of fruit available has increased to be greater than imported cereals. In Kiribati (Figure 4), the availability of cereals exceeded that of root crops in about 1988 and has remained greater than any other food. This shows the transition graphically. The major food commodity available in Kiribati is imported. The final stages of the nutrition transition is shown in Figure 5 for French Polynesia where food availability characteristics show all the signs of a cash economy. Much of the top four foods available are imported. In 1994 there was over twice as much cerals as root crops available.

Figure 1



Source: FAO 1996

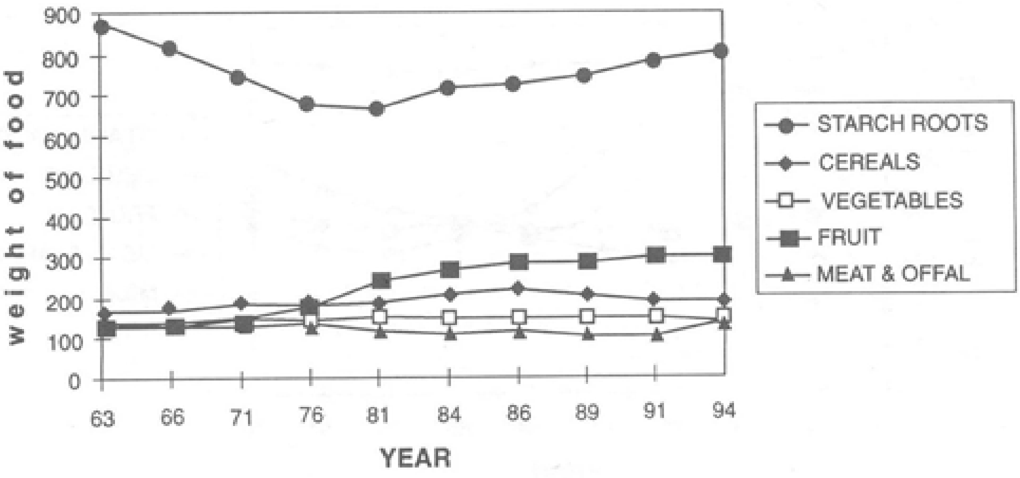
Figure 2



Source: FAO 1996

Figure 3

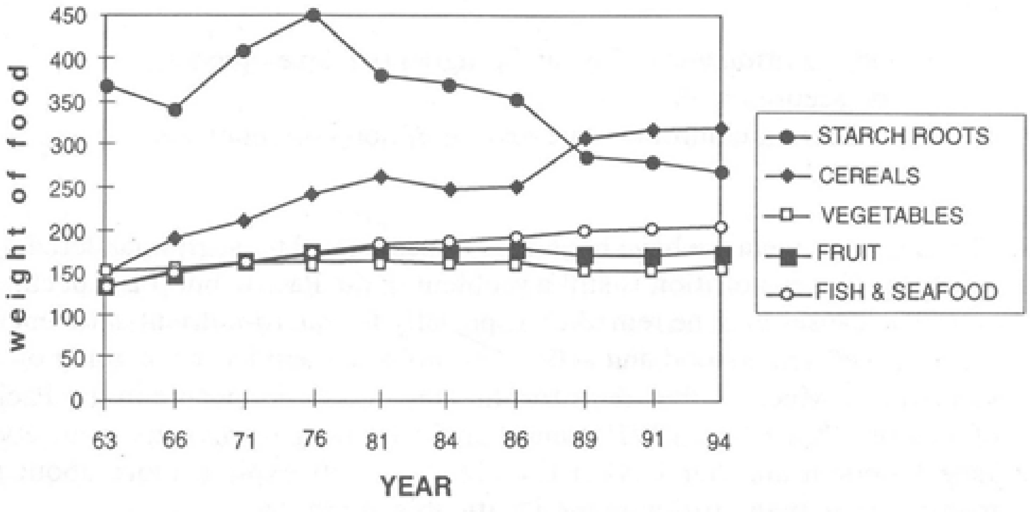
VANUATU: DAILY PER CAPITA FOOD AVAILABILITY 1963-94



Source: FAO 1996

Figure 4

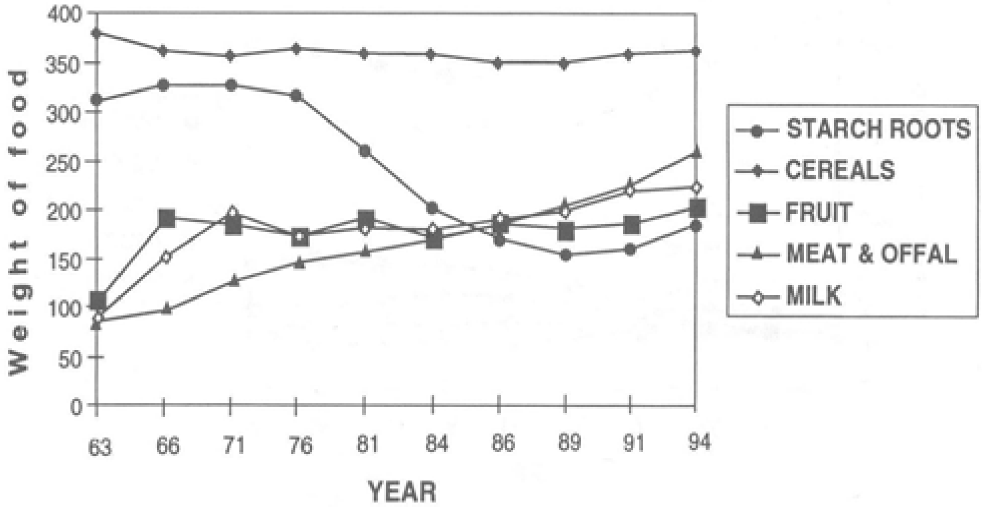
KIRIBATI: DAILY PER CAPITA FOOD AVAILABILITY 1963-94



Source: FAO 1996

Figure 5

FRENCH POLYNESIA: DAILY PER CAPITA FOOD AVAILABILITY 1963-94



There has been a dietary change in the Pacific which has been accelerated by increasing dependence on imported foods and has resulted in rapid increases in chronic diseases. These factors have greatly influenced the focus of activities of the Nutrition and Lifestyle Disease Section of SPC.

The section's activities are channelled into three action areas:

1.food, nutrition and policy and programme development;
2.food security and,
3.monitoring, control and prevention of non-communicable disease.

This does not mean we have neglected issues related to nutritional deficiency diseases. Under-nutrition is still a problem in the Pacific but it is a declining one. The causes and the remedies, especially for micro-nutrient deficiencies, are now well understood and action to eliminate them has been going on for some time. Much of the credit for this must go to the people in the Pacific offices of UNICEF and WHO and Pacific Island governments themselves. Jane Paterson and her UNICEF colleagues will explain more about the micronutrient malnutrition in the Pacific this afternoon.

On the other hand, the fight against non-communicable disease is just beginning. Over-nutrition and the problems associated with it are increasing. The causes and remedies are not well understood. We have yet to find an effective programme to control, not to mention, reduce non-communicable disease. And it is very encouraging to know that the same priorities of our section are those expressed by the NZ Consul-General, Julie MacKenzie, earlier this morning in her opening address.

As far as food composition is concerned, the Section has been deeply involved in the development of food composition tables in the Pacific for a long time. In 1957, SPC produced the fore-runner of the modern food composition tables. It was called the "Chemical composition of South Pacific foods". In 1983 SPC together with the Fiji Food and Nutrition Committee and the Fiji School of Medicine produced the first food composition tables for use in Pacific Islands. The latest tables, the Pacific Islands Food Composition Tables, produced in 1994 by SPC, INFOODS and the NZ Institute for Food Crop Research, is the culmination of the many years of work that have gone before it.

Still the work on food composition has not finished. It has taken over a year to translate the tables into the French language. Marie-Odile Bayle, one of the very able SPC translators, who is presenting later, will tell you all about the trials and tribulations of translating nutrition data accurately.

The South Pacific Food Composition Tables are by no means perfect. Revisions will still need to be made. We also need to know who uses the tables and why. We need to evaluate the publication. Perhaps a simplified version could be produced for the general public to use. We need to translate food composition data into something tangible for Pacific Island people - maybe along the lines of a handbook series. It could be of great assistance for people fighting non-communicable diseases such as obesity, diabetes, hypertension and heart disease. Additionally, it could be used as an education tool or part of disease prevention or reduction strategies used by Pacific Island governments.

We are at present attempting to include the 78 Pacific foods analysed in the publication, "Pacific Island Foods", which was produced by the University of the South Pacific, the Australian Centre for International Agricultural Research and the Australian Government Analytical Laboratories. We wanted to include the foods into the Diet3 software (Pacific Foods) produced by the Brisbane company, Xyris. The software is used mainly by dietitians and researchers across the Pacific. Again, this is an attempt to get more information to the people. The 78 additional foods would also be included into the next edition of the Pacific Islands Food Composition Tables.

We are also producing a series of food manuals about Pacific foods called "The foods we eat series". The first one "The leaves we eat" was a great success. The next two in the series "The staples we eat" and "The fruits we eat", are almost up to the final editing stage and hopefully, will be published this year. Like the food composition tables they are also not perfect. They are the first attempt to gather relevant information about Pacific foods. Many people were consulted to gather information for the manuals, including some of you attending this conference. I have no doubt that later editions will improve on the old. The consultation process will continue. We have just started the ball rolling.

We are also interested in gathering and recording information on food preservation methods and techniques from across the Pacific with the view of producing a publication. We have a few contacts who have collected a wealth of information. We now need to find the necessary funding to produce a publication. Additionally, information about Pacific herbs, spices and medicinal foods should be documented. Maybe we could add this to the SPC Food Handbook series.

There are a whole host of activities to be completed by SPC to do with food composition. Besides the continuing problem of finding funds, our greatest problem is to determine where the need is greatest, as our priorities are the priorities of Pacific Island countries. SPC's role in the food composition process is one of the facilitator and the implementor and I think we have proven that we have this capacity.

FIJI COUNTRY REPORT

Professor Bill Aalbersberg
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At the time of the last meeting the Food Composition Laboratory at the Institute of Applied Science (IAS) *of* the University of the South Pacific (USP) had completed a bit more than a year of its ACIAR (Australian Centre for International Agricultural Research)-assisted project to help develop the laboratory into a quality food composition laboratory. The laboratory had begun its work in 1987 as part of a regional project coordinated by the South Pacific Commission (now the Secretariat for the Pacific Community) to develop quality Pacific Islands Food Composition Tables (PIFCT). Funding for this initiative ceased in 1990 but the Third OCEANIAFOODS meeting, in recognition of the accomplishments of the USP laboratory in successfully setting up several nutrient analyses, recommended that approaches be made to Australian aid for renewed support of the laboratory. This was achieved in 1994 and the partnership established among USP, ACIAR and the Australian Government Analytical Laboratories (AGAL).

In the first year training was held in vitamin analysis by high precision liquid chromatography and equipment obtained to shift to this more accurate method from colorimetric ones. In addition gas chromatography was made available to develop fatty acid and cholesterol analyses. The challenging dietary fibre analysis was also developed.

With these newly developed analyses as well as ongoing ones about 120 food samples were analysed from 1994-1997. These were mainly priority foods identified by regional nutritionists at the workshop launching the PIFCT as missing from these tables. The main food categories were: green leaves, other vegetables, fruits, nuts and seeds, seafood and coconut products. The need to make these data accessible to Pacific people sooner than an update of PIFCT was realised by publication in 1997 of the book "Pacific Island Foods : Description and Nutrient Content of 78 Local Foods".

A major emphasis of the last three years has been in the area of quality assurance. Rapid deterioration of machinery and chemicals and changing personnel exacerbate the normal problems of keeping nearly 30 analyses "in control". Advice from AGAL and through OCEANIAFOODS meetings has been applied in the accurate documentation of methods and development of in-house standards with demonstrated homogeneity and stability. Among those currently in use:

white wheat flour :		moisture, protein, ash, starch, thiamin, niacin, total dietary fibre and eight minerals
cod-liver oil		retinol, fatty acids and cholesterol
milo powder	:	individual sugars
Tang crystals		vitamin C

One nutrient for which stability has not been achieved in a food matrix is riboflavin. We are currently exploring multi-vitamin capsules which, although they are not part of a food matrix, may provide a constant reference value to be used regularly with occasional use of a standard reference material certified for riboflavin.

Such in-house materials can detect deterioration of method proficiency and give a measure of precision but for accuracy of results frequent participation in proficiency studies has been found to be a critical need. Several samples from the Food Analysis Performance Assessment Scheme (FAPAS) are analysed each year and cover most of the analytes studied in our laboratory. The discipline of quality assurance that OCEANIAFOODS presentations have repeatedly emphasised over the years have made an impression in our program and this will provide the basis for our application for NATA registration in 1998.

USP is owned by twelve Pacific island countries and the IAS laboratory feels it should make use of the generous support it has been provided to assist as widely as possible. Efforts have therefore been made to assist countries outside of Fiji in analysing their priority foods. Problems such as transport and quarantine can create problems in getting fresh foods from overseas to our laboratory in an "as-eaten" basis. Therefore, efforts have been made in the last three years to work with groups in Kiribati and Papua New Guinea to prepare samples and perform analyses up to their level of competence. Kiribati foods grown in atoll soils are likely to have significantly different nutrient content compared to the same food from Fiji. Papua New Guinea has many foods not eaten elsewhere in the Pacific. Analyses not performed in Kiribati or PNG can men be performed on die processed or extracted sample in Fiji. We will be hearing more on these promising efforts in Papua New Guinea in a few minutes.

One area in which efforts need to be focused is the promotion of the use of food composition data in the Pacific. The PIFCT have been published and many missing foods analysed but mere is concern mat only a few professionals in the region are making full use of this data. The exciting work of the National

Food and Nutrition Committee is taking over the responsibility for production of their own Food Balance Sheets which will be described in a paper tomorrow shows what can be done with this information. An impressive start was made with the 1994 workshop that launched the new tables. However, besides the follow-up work in the food analyses, other recommendations from that meeting such as assistance with equipment and follow-up training has not, to my knowledge, been provided. It would also be very interesting and useful to have a regional project in which local food and nutrition committees present some of these food data to communities in an attempt to change food habits and monitor the effects of this intervention.

In Fiji, for example, where 40% of the population is anaemic, a common sea mollusc, *Anadara antiquata*, was found in our project to contain 21 mg of iron per 100 g of material. This information could be used as part of a program to encourage consumption of this bivalve by at-risk groups. Fiji has a large trilateral health-promotion project occurring that could certainly be a partner in this effort. Hopefully SPC in their next programming cycle will include such follow-up work to the 1994 workshop on the use of food composition data. In my thinking this is one area that has not been as fully addressed as issues of generating and management of the food composition data.

COUNTRY REPORT: PAPUA NEW GUINEA

Betty Amoa, Aisak Pue and Mohammed R. Khan,
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University of Technology,
Lae, PAPUA NEW GUINEA

One of the recommendations of the Fourth OCEANIAFOODS Conference was that assistance should be sought for the Papua New Guinea University of Technology laboratory to become a center of excellence in food analysis. There has been very little progress in that direction due to a number of factors, the main one being skepticism from past experience with the major laboratories in the country.

Papua New Guinea became involved with the analysis of Pacific Island Foods program when the two main laboratories namely, National Analysis Laboratory (NAL) and National Agriculture Chemistry Laboratory (NACL) took part in the analysis program which ended in 1991. NAL is now a fully commercial laboratory and neither this lab nor NACL is involved with investigative food composition analysis of the type being discussed at this meeting.

My department already has most of the required equipment for a food analysis project as indicated in the country report of the 4th OCEANIAFOODS Conference. Serious manpower constrains, however, prevented the department from giving the project the full-time attention it deserves. We are however seriously trying to remedy that this year. Recognizing that no progress can be made unless we have dedicated Papua New Guinea permanent academic and technical staff members in the group, Mr. Pue, a Papua New Guinea academic and myself have started working on the coefficients of variation for the methods we plan to use on foods peculiar to PNG. We are limiting ourselves for the time being to the proximates, minerals and vitamin C.

We purchased jointfir leaves *(Gnetum gnetum)*, a common green leafy vegetable in Papua New Guinea not found in other Pacific Island countries and analyzed them ten times (analytical precision) for some of the proximates and minerals. We were mindful of the problems that could arise from nonhomogenous samples, dirty glassware, imprecise methodology etc. and tried to avoid them. We included three blanks and a reference leaf sample which NAL kindly gave us.

As you can see from the result (Table 1), the less than 2 relative standard deviation (RSD) values obtained for the ten replicates indicates good precision for the nutrients analyzed. A similar exercise will be carried out for starch, sugars and vitamin C. We have and will continue to liaise closely with Professor Aalbersberg to get all the methods working.

We still have a problem with low fat values due to choice of methodology. We normally use the soxhlet solvent extraction method which is not really suitable for plant materials but this can be remedied once the department acquires some mojonnier tubes for acid hydrolysis. There are currently only two such tubes in the department.

Table 1. Analytical Precision Testing (Nutrients/100g edible portion)

	CA (mg)	**Mg** (mg)	**K** (mg)	**Fe** (mg)	**Zn** (mg)	**Water** (g)	**Ash** (g)	**Protein** (g)	**Fat** (g)
1.	30.8	63.83	682.1	3.22	1.22	79.55	1.65	5.41	1.14
2.	29.5	64.80	682.7	3.24	1.22	79.53	1.65	5.39	1.16
3.	29.5	64.86	686.6	3.22	1.21	79.47	1.61	5.42	1.17
4.	30.0	62.44	660.0	3.22	1.21	79.50	1.66	5.42	1.14
5.	30.8	64.56	685.0	3.19	1.21	79.61	1.62	5.41	1.14
6.	30.3	64.80	688.2	3.29	1.22	79.52	1.70	5.30	1.13
7.	30.3	63.89	682.9	3.29	1.18	79.58	1.64	5.38	1.12
8.	29.1	64.77	689.9	3.29	1.21	79.55	1.65	5.42	1.11
9.	30.0	64.77	690.5	3.14	1.22	79.52	1.65	5.41	1.17
10.	30.7	63.96	688.3	3.17	1.28	79.54	1.66	5.43	1.15
MEAN	30.1	64.27	683.6	3.23	1.22	79.54	1.65	5.40	1.14
SD	0.56	0.73	8.4	0.05	0.02	0.04	0.02	0.04	0.02
RSD	1.87	1.13	1.23	1.53	1.94	0.05	1.39	0.66	1.66

We strongly feel the expertise, capability and commitment are there to make a lot of progress provided we have a full time technical and consumables support. Not much progress was possible in the past because of lack of such support in addition to budgetary constraints. We ask this meeting to address the issue and help us keep the momentum of what we are currently doing going.

ASEANFOODS: ACTIVITIES 1995-98

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INTRODUCTION

ASEANFOODS was established 12 years ago, with 6 member countries including Brunei, Darussalam, Indonesia, Malaysia, the Philippines, Singapore and Thailand. In 1996, Vietnam was included as a new country member. Activities carried out in the first 9 years were presented in the Second, Third and Fourth OCEANIAFOODS Conferences. This paper emphasises the activities of the regional centre and some at the nation level during the year 1995 to 1998.

STATUS AND PROGFESS OF ACTIVITIES OF ASEANFOODS 1995-98

At regional level

The main activities carried out from 1995 to 1998 were to fulfill the specific objectives of ASEANFOODS in developing the regional food composition data and to strengthen the analytical performance of food analysis laboratories in ASEAN.

1. Creation of the first ASEANFOODS food composition database

Although some National Food Composition Tables have been developed in most ASEAN member countries, incomplete information surrounding nutrient data and certain common food items is a persistent problem facing users. Having ASEANFOODS regional food composition database available to obtain, retrieve, compare and exchange food composition data among ASEAN countries will help fulfill the data needs of ASEANFOODS member countries and others in the nearby regions where food composition data are lacking or not completely available.

To establish the ASEANFOODS food composition database, a technical committee was formed. It comprises coordinators from Malaysia (Dr Tee E Siong), Philippines (Dr Aida Aguinaldo) and Thailand (Dr Prapasri Puwastien) as well as one expert from NZ (Dr Barbara Burlingame). Aplan for a workshop entitled "Creation of the first ASEANFOODS Composition Database" was made and the proposal was submitted to and approved by the Japan International Cooperation Agency (JICA). The Workshop was therefore convened in Bangkok, Thailand in March 1996.

This workshop was crucial since it was the first stage for developing a regional food composition database. Pre-workshop activities were carried out. The existing national food composition databases were modified based on the members' agreement in terms of format, food groups (18 food groups) and analysed nutrients were identified by INFOODS tagnames. Compilation and installation of the prepared database from each country, as spreadsheets, were then pre-processed into a compilation system at the New Zealand Database Centre.

In March 1996, nineteen ASEAN delegates from Indonesia, Malaysia, the Philippines, Singapore, Thailand and Vietnam, and two experts from New Zealand participated in the Workshop, held at the Institute of Nutrition, Mahidol University. The policy decision for harmonisation and standardisation of the data files took place and the group discussed and agreed upon a set of criteria for evaluation of the national food composition databases for inclusion into the ASEANFOODS food composition database. The participants were then divided into 3 working groups, each composed of a representative from each country. Each working group evaluated the assigned data files for the following aspects:

- ensure identity of food items and food code in each country data file
- select the relevant food items from the national FCTs
- evaluate the identity (based on the available nutrient data) and the completeness of the data files
- identify the selected data of similar foods from different countries to be merged for inclusion into the ASEANFOODS data files. About 5,500 food items were categorised into 18 food groups. Most foods consisted of 22 different nutrients and percent edible portion.
- standardise all the food descriptors according to the agreed criteria

The identified data files (archival files) were then reviewed and examined by the computer experts and pre-merged data files of more than 1,800 food items were prepared. At present, the database is being edited, completed and finalised by experts in New Zealand together with the ASEANFOODS technical coordinator. Missing data may be completed with "borrowed" data from other databases, preferably within ASEAN, or outside sources e.g. New Zealand and Australia, if necessary. A camera-ready food composition tables (FCTs) will be prepared by INFOODS experts with the database on CD-Rom. Publication of the ASEANFOODS FCTs will be carried out at the regional centre in Thailand and should be available in a short while.

2. Development of regional reference materials (RMs)

As reported earlier (Puwastien, et al., 1996), four different food RMs - rice flour (AS-FRM1), soybean flour (AS-FRM2), cereal-soy (AS-FRM3) and fishmeal (AS-FRM4), with consensus values of main nutrients and minerals, were developed and are available at the regional centre. These reference materials have been used as RMs for laboratory quality control programme and as test materials for standardisation of analytical methods and for laboratory performance studies in ASEANFOODS member and other developing countries.

With the collaboration between 14 laboratories in Australia, New Zealand, Fiji, the Netherlands, USA and ASEANFOODS member countries, a new set of ASEANFOODS RMs - weaning food (AS-FRM5) and fishmeal2 (AS-FRM6) - with 16 consensus values of nutrients mainly for nutrition labelling are being developed at the regional centre under the support from the National Science and Technical Development Agency. Homogeneity and stability testing of some nutrients are being carried out at INMU. The samples were sent to participating laboratories to be analysed within a specific period. The evaluation of the data has just finished. The reference materials will be available at the regional centre soon. Summary of the study, issues and problems involved is presented in another session of this proceedings.

3. Laboratory performance study

In 1997-98, the regional centre has conducted a laboratory performance study using the new set of developed RMs. About 21 private and government laboratories in ASEAN, one laboratory in Nepal and one in Papua New Guinea participated in the study. Laboratories with satisfactory, questionable and unsatisfactory results were identified. The preliminary reports are being distributed among participants. Activities at national level, e.g. technical workshops, discussions, training and exchanging information to improve/ upgrade laboratories with unsatisfactory and questionable results are encouraged. Identified laboratories with satisfactory results will be invited to participate in future studies to develop regional RMs.

4. Strengthening the activities at national level of ASEANFOODS member country

In 1997, Indonesia, at the Research and Development Centre for Applied Chemistry, LIPI, Bandung, under responsibility of Dr Julia Kantasubrata, developed a programme on *"Development of quality food analysis laboratories in Indonesia"* . The project objective was in line with one of the main objectives of ASEANFOODS: to strengthen the ASEANFOODS members in developing good quality food composition data. The programme was supported by an AusAid-funded project under the collaboration of 3 countries, Indonesia (LIPI, Bandung), Thailand (INMU) and Australia (QHSS). Details of the programme are presented by Dr Shawn Somerset in this Conference. Participants from 24 government and industry food laboratories across Indonesia have made commitments to the series of workshops. The technical coordinator of the ASEANFOODS regional centre coordinated this programme as follows:

(1)being a consultant, organised a one-week workshop in Thailand for background information and experience transfer on laboratory performance study. All needed documents for the laboratory performance study in Indonesia were prepared in the Workshop. Three types of ASEANFOODS reference materials were selected; cereal-soy product (AS-FRM3) was used as a test material for subsequent analytical training whereas soybean flour (AS-FRM2) and fishmeal (AS-FRM4) were used for conducting laboratory performance study among food analysis laboratories in Indonesia. Working and strategic plans for the following workshops were also developed during the Workshop.

(2)being one of the technical committee members and lecturers, contributing information and experience, both *theory and practice, in* 3 *consecutive* Workshops during November 1997 to April 1998 on

- Laboratory performance study
- Laboratory quality control and quality assurance
- Development of Indonesian reference materials

The ASEANFOODS coordinator found such a programme develops strong mutual benefits to the participating laboratories and the three counterpart countries. Organisation of similar systematic programmes as soon as possible should be encouraged among other developing countries, especially at the place where newly developed food analysis laboratories are setting up. Such a programme can strengthen the technical and analytical capabilities, standardise the analytical performance as well as provide the guidelines to develop a quality assurance programme in food analysis laboratories. It can eventually strengthen laboratories to generate good quality food composition data. However, participants' enthusiasm and dedication to the programme as well as a financial support for the whole activity is required for success.

5. Progress in other activities

5.1 Methods of nutrient analysis in ASEAN countries:

Analytical methods used in ASEAN were collected and summarised (ASEANFOODS Workshop report, 1996) by Dr Tee E Siong, the technical committee and national coordinator of Malaysia. It was based on the available printed analytical methods for nutrient analysis from Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. Subsequently, Dr Tee E Siong intended to submit a paper on this aspect to a scientific journal and will distribute the information to the member countries.

5.2 ASEANFOODS sampling guideline

An outline for ASEANFOODS sampling guidelines was made by the technical committee and national coordinator of the Philippines, Dr Aida Aguinaldo. ISO sampling method developed by ISO, THAIFOODS practical guideline based on the methods proposed by Drs Greenfield and Southgate in "Food Composition Data: Production, Management and Use" (1992, Elsevier Science Publishers, Ltd.) and the draft sampling guideline developed by ASEANFOODS members in 1989 (Proceedings ASEAN Workshop on Food Data System, pages 159-160, 256, 1989) were reviewed together with the guidelines developed in the Philippines in 1991. ASEANFOODS guidelines for food sampling for food composition table development will be formulated and distributed to the national coordinators for comments. Subsequently, the final guidelines will be published and distributed to the member countries. The sampling guidelines will include the following items:

- Type of sampling plan
- Sample size
- Method of approach
- Collection/handling/transport
- Type of laboratory sample
- Preparation of laboratory sample
- Type of sample source
- Details of sample record

Documentation of samples by conventional or digital photography may be included.

At national level

Status of food composition table (FCT) in various ASEAN countries

The status of national food composition tables in ASEAN countries was last surveyed in 1996 and summarised in Table 1 (ASEANFOODS Workshop 1996). All countries have their own FCT except Brunei. English language is used as the standard in all tables except those of Indonesia and Vietnam where English is provided in the index only.

Table 1. Status of food composition tables in various ASEAN countries (1996)

Status	*Indonesia*	*Malaysia*	*Philippines*	*Singapore*	*Thailand*	*Vietnam*
Edition year	1995	1988	1990	1993[c]	1992	1994
To be revised	2000	1997	1997	1999[c]	1998	1998
Number of food groups	10	17	7[a] and 9[b]	20 and 15[c]	13	16
Food items	525+	783	1315	2700 and	519	504
Nutrients:	14 (28)	16	28	**13[c]**	17(28)	28+
Proximate with DF	(+)			+	+	
Proximate with CF	+	+	+		+	+
Minerals						
Ca,P	++	++	++	+	++	++
Na, K	(++)	++	++ (limit #)	+	(++)	++
Mg	(+)		+(limit#)		(+)	+
Fe	+	+	+	+	(+)	+
Zn	(+)		+ (limit #)		(+)	+
Cu	(+)		+ (limit #)		(+)	+
Others (I,	Mn, *Co*, Cr)		(Min, I (limit #)		(Se)	>10 minerals
Vitamins						
- Thiami n	+	+	+		+	+
- Riboflavin	+	+	+		+	+
- Niacin	+	+	+		+	
- Pyridoxin			+ (limit #)			+
- Folate	(+)		+ (limit #)		(+)	+
- B 12	(+)		+ (limit #)		(+)	+
- Biotin						+
- Pantothenate						+
- Vitamin C	+	+	+		+	
- Vitamin A	+	+	+	+	+	+
- b-carotene		+	+	+		
- Vitamin E					+	+
- Vitamin D						+
Fatty acid	(+)	+	(+)			
Cholesterol	(+)		+	+	(+)	
Amino acids	+		+		+ 369 items	
Anti nutrients						
oxalate			+ 119 items		(+)	
- phytate			+ 128 items		(+)	
tannin					(+)	
Source of data						
Self-generated	82	100	100	?	100	36
Borrowed data	18					64

Note: (a) Raw and cooked foods, (b) Processed foods, (c) Hawker foods
Items in brackets represent unpublished data, may be included in the next edition of the FCT.

Some current information on national FCTs follows:

Indonesia: English information will be included in the national FCT to facilitate the international uses. New version is expected in the year 2000.

Malaysia: *(Tee E Siong, et al. Nutrient Composition of Malaysian Foods, 4th Edition, 1997)*

The 4th edition of Nutrient Composition of Malaysian Foods was published in 1997, data were largely based on the 1988 edition. Out of 783 food items, 580 items are raw and processed foods and another 203 items are cooked traditional Malaysian meals and dishes, as well as a number of fast foods. There are two major changes in the new edition, namely data presentation format and new data. Nutrient content in several common serving sizes for each food is presented, in addition to per l00g. The new data included are cholesterol of some raw and cooked foods; zinc, copper and magnesium content of about 200 foods; vitamin A and carotenoid composition of a variety of foods. Some funding from the government has been given to the Malaysian Food Composition Database Programme for the activities in 1996-98. The Co-organiser of the programme, Dr Tee E Siong, reported that the same four institutions cooperate on the work and the current phase of the programme is to focus on ready-to-eat meals and processed foods and on the additional nutrients including dietary fibre, cholesterol, minerals, and fatty acids. Since they have an updated manual of methodologies for food analysis, a new edition with improved quality data will be available in 1999.

Philippines: *(Teresita R Portugal, et al. The Philippine Food Composition Tables, 1997)*

The Philippines Food Composition Tables 1997 was the first version which was harmonised with the ASEAN Food Composition Tables. Format and contents were modified based on the suggestions of the FCT Task Force, and selected Philippines users, to suit local needs. The main modification in terms of format were: data for raw, cooked and processed foods were presented together; tables of amino acids, trace elements, cholesterol, phytins and some vitamins from the 1990 edition were not included; information on number of analyses was deleted and a column for total vitamin A was added; food group code and food ID were given, however, no INFOODS nutrient tagnames have been incorporated. In terms of food names and food groupings : English is used for food names and description which permits ease of use internationally. The number of food groupings was expanded from 16 (7 raw and cooked, and 9 processed) to 17 with the cooked and processed foods under each food group. Other data processing included merging the same food items with similar nutritive values, deleting some food items with incomplete or no matching data, standardising all food descriptors, and updating scientific names of food items. Main modifications in terms of nutrients and analytical data were: replacing the crude fibre data with dietary fibre values from local and international data, and recomputing the carbohydrate and energy values using 4-9-4 energy factors for protein, fat and carbohydrate, respectively. Many non-tabular contents were also included, e.g., background on the development of FCT, index for foods, description, and alternate names, sampling, methods of analyses and calculation, etc. The modifications of the FCT have made the new published Philippines food composition table more user-friendly, especially for the international users.

Singapore *:* About 800 locally cooked foods are being analysed. Additional nutrients data i.e. thiamin, riboflavin, vitamin C, potassium, phosphorus, zinc, selenium, total sugars and total starch are included. The new version FCT is expected in 1999.

Thailand: Although the current version of the nutrient composition table of Thai foods, 1992, covered self-generated data of more than 500 food items including cooked one-plate dishes and desserts and data on total dietary fibre of some foods, it is still not complete in terms of nutrients data and food items. Lots of additional information, published and unpublished, have been generated by the Institute of Nutrition, Mahidol University over the years. Other sources of data are also available in many published and unpublished papers and reports. Nevertheless, these data have not been compiled or included in the printed nutritive values of Thai foods. Thus, a systematic compilation of the available food composition analytical data, both published and unpublished, is being carried out. Its development is based on the agreement of ASEANFOODS and the INMU adhoc FCT technical committee (food analysts, data compilers and users), which was established in line with INFOODS recommendations. Published and unpublished food composition data, as nutrient per 100 g food, were selected according to the agreed criteria. For example, it must be original analytical data with documented methods for sampling, sample preparation and analysis; the origin of analytical data can be traced back; it should contain minimum data of proximate composition or minerals or vitamins, and moisture content. The compiled data have been installed into a computerised system as spreadsheet data files. The Microsoft Word - Excel was selected as the compilation system for food composition data in the production of the archival files. Wherever possible, sources and data descriptors are attached to the analytical data in the archival file. The identity of food items, Thai common and scientific names, have been carefully checked, according to the documents from Ministry of Agriculture and Cooperation, Thailand, and other references with illustration-. Food items were categorised into 18 food groups and the assigned food codes were given in accordance with the ASEANFOODS food composition database.
The nutrients in the database were identified by INFOODS tagnames. With the criteria for acceptance of the analytical data, the compiled database is being scrutinised. At the end, a user database of more than 1240 food items

of fresh, cooked and processed foods is expected. An index of food items in each food group was alphabetically arranged by generic names (common English names) with their assigned food codes and ID number, Thai names and scientific names.

The main objective of this activity is to disseminate the Thai food composition database in the form of a computer database with applications software, and printed tables. It is expected that future food and nutrition research on nutrition assessment and other related aspects will be based on the same national food composition tables which will facilitate the possibilities for all kinds of food and nutrition comparative studies. This national food composition database is being included in the ASEAN food composition database.

CONCLUSION

Activities at the regional level during 1995-98 were mainly on development of regional food composition database, development of reference materials, organising a study for analytical assessment and providing technical support to the member countries. Activities at the national level have been on improvement of the national food composition databases in terms of nutrient and food items, completeness, standardisation of the information to facilitate its uses, and development of quality food analysis laboratories. The available regional resources can help fulfill the needs and strengthen the activities of the members as well as other countries in the nearby regions and in other developing countries.

All ASEANFOODS member countries deeply appreciate the linkages, cooperation, collaboration, financial and technical support from the many organisation: UNU/INFOODS and FAO, the ASEAN Sub-Committee on Science and Technology, the Inter-ASEAN Technical Exchange Programme, the Japan International Cooperation Agency (JICA), the National Science and Technical Development Agency (Thailand), the Aus-Aid-funding and APFAN.

OCEANIAFOODS member countries, and other institutions in different regions which had involvement with and contributed to the success of the regional and national activities are also thanked.

The ASEANFOODS Technical Committee and the Technical Coordinator are greatly impressed by the spirit of collaboration, contribution and goodwill among all member countries for the achievement of all activities and would like to record our heartfelt thanks to all.

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INFOODS ACTIVITIES AND REGIONAL DATA CENTER FOR THE COUNTRIES IN THE OCEANIAFOODS REGION

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When INFOODS was created in 1983, one of its goals was to establish regional data centres around the world, to improve the quality and quantity of food composition data, especially in developing countries; and to enhance and encourage development of standards, harmonisation efforts, and interchange of food composition data. Most countries in the world are now part of a regional data centre. The country by country association with regional data centres is determined by those countries, and can be based on common culture, language, geographic proximity or trading bloc agreements.

OCEANIAFOODS was one of the earliest of the Regional Data Centres, along with LATINFOODS, EUROFOODS, and ASEANFOODS. It is one of the very well-functioning Data Centres, and some of its activities have been used as models for other Data Centres.

Since the last OCEANIAFOODS Conference, UNU/INFOODS has assisted the region by providing a fellowship for the OCEANIAFOODS Regional Data Centre coordinator to attend Food Comp '96 in Wageningen. From 1991 -1995 INFOODS supported the publication of the Pacific Islands Food Composition Tables, the Food Composition Training Workshop, and the purchase of a computer for SPC for data compilation activities.

Recent activities of INFOODS have included some technical standards development and some strategic alignments related to technical standards.

Topics currently being addressed, or soon to be readdressed, include:

•Interchange protocols for international exchange of food composition data
•The extension of INFOODS tagnames and identification of food components; empirical vs rational methods of analysis
•Food nomenclature, terminology and classifications systems
•Food composition data and food trade
•Food composition data , food balance sheets, and hunger mapping
•Representations of data quality

INFOODS strives to keep the entire professional food composition community advised of activities around the world. On the research side, it does this mainly through the Journal of Food Composition and Analysis and through the International Food Data Conference. For interactive dialogue, it does this through the food-comp discussion list. And for provision of information, it does this through its World Wide Web (WWW) site.

Journal of Food Composition and Analysis WWW site <http:// academicpress.com/jfca>

INFOODS WWW site <http://www.crop.cri.nz/foodinfo/infoods/infoods.htm>

Food Composition Discussion list <food-comp-request@infoods.crop.cri.nz>

keywords: INFOODS, OCEANIAFOODS, UNU, regional data centres, food composition

REVIEW OF FAO FOOD COMPOSITION ACTIVITIES

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FAO has a long history of producing and disseminating food composition tables and related information. FAO started its activities in this field in the late 1940s and its first food composition table was published in 1949. In the 1960s and 1970s, FAO prepared regional food composition tables for Africa, Asia, Latin America and the Middle East in collaboration with both the US Departments of Agriculture and Health, the Institute of Nutrition of Central America and Panama (INCAP), as well as various nutrition institutes. This series of publications was completed in the late 1970s and are some of FAO's most requested publications. Although many countries have produced new data since then, these FAO tables are still in use and still in high demand because they are the principle documents presenting food composition data at the regional level in a comprehensive manner.

FAO's direct involvement in the generation or compilation of data on food composition received new impetus from the International Conference on Nutrition (ICN), jointly sponsored by FAO and the World Health Organization (WHO), and held in Rome in December 1992. The ICN emphasized the long-standing importance of food composition information in formulating policies and programmes to improve nutrition and the need to respond to new developments in food standards, food labelling, food trade and the integration of nutrition concerns in agricultural policies. The ICN plan of action explicitly recommended the establishment of updated food composition tables.

FAO and the United Nations University have been cooperating since the ICN on renewed and collaborative food composition work. This collaboration was discussed at an informal meeting on international food composition activities at FAO Headquarters (February 1993) and at a meeting in Tunis (March 1994). From the Tunis discussions a framework was developed for cooperation at national, regional and international levels. The regional orientation of joint work among collaborating institutions was seen as an appropriate context for future activities.

More recently, the World Food Summit (WFS) Plan of Action, Rome 1996, endorsed the ICN goals. In addition, the WFS recommended that governments, in partnership with all involved agencies and groups, monitor the availability and nutritional adequacy of food supplies and reserve stocks. Governments are also recommended to encourage, where appropriate, the production and use of culturally appropriate, traditional and underutilized food crops. Since governments cannot make informed decisions on meeting the food and nutritional needs of the population through an improved food supply without an understanding of what is eaten, energy and nutrient composition of the diets needs to be determined.

To assist governments in this endeavour, FAO's food composition programme is promoting the generation, dissemination and use of reliable food composition data that meet the needs of local users in both the public and private sectors. Because of the nature of work in food composition and its complexity, collaboration among different institutions and sectors is highly desirable, not only at the national, but also at the international level. To assist countries to effectively develop this work, FAO will concentrate in the coming years on the following areas of work:

(1)Promoting and expanding activities at national, regional and international centres active in food composition work in order to increase national and regional capacity to generate, manage and disseminate, in a timely manner, food composition information targeted to regional and national users;

(2)Assisting in formulating standards on terminology for the identification of food and nutrients, sampling procedures for food, requirements for handling food samples, analytical methodology and assessment criteria for data quality that will make the network data more compatible and harmonious across regions;

(3)Promoting the dissemination and appropriate use of food composition data; and

(4)Strengthening and building the capacity of institutions and individuals to work on all aspects of food composition work.

The importance of renewing efforts to promote food composition programmes and activities is based on both traditional and new needs for accurate data. Food composition information is needed by dieticians for evaluating the adequacy of diets and investigating diet/health relationships, for hospitals, schools and other institutional feeding programmes, for overall planning for improved nutrition, etc. Emerging broader applications of food composition data are related to world trade, international food standards and consumer information. The largest change in the last few years is the need for food composition data to address issues of domestic and international food trade.

Many countries have now adopted voluntary or mandatory nutrition labelling rules and regulators and producers of packaged foods must be sure that such labelling is correct.

In the food marketing chain adequate quality control procedures are necessary to assure that food is safe and of high quality as well as being nutritionally sound. This element applies whether the food is a raw commodity, semi-processed, processed, manufactured or prepared. Implementing food control practices to assure food quality, safety, and nutritional value is of paramount importance. Food quality encompasses the basic composition of foods and aspects concerning food safety which are areas of particular interest to our Organization. During the last decade FAO has provided over US$ 7 million for improving facilities and analytical capacities for food control in more than 20 countries. FAO has also produced a range of manuals and guidelines, that cover most aspects of food control and related laboratory analyses of foods.

As FAO undertakes the renewal of its nutrient food composition work, there is a need to link these activities to the Organization's ongoing activities aimed at strengthening food control systems. As national food composition programmes are initiated and strengthened, there are clear benefits in terms of resource to linking such programmes as much as possible to ongoing food control system activities, including laboratory facilities. This is particularly important where materials and human resources are limited. Food composition work can be expensive, especially in developing countries and countries in transition. The strategy envisioned by FAO is a regional model for action, a model that allows local control of food composition activities and promotes direct working relationships. FAO supports regional collaboration as a possible way to reduce costs but still meet the needs for accurate food composition data. In addition, such cooperation can best be accomplished when effective national capacities are developed.

FAO's role is to assist Member Countries to formulate and implement national food composition programmes, as well as to help in establishing effective and reliable regional technical cooperation networks on food composition. FAO's work is carried out within a framework of mandates and activities:

- FAO has the United Nations' mandate for activities that span all sectors related to food at the international level including food trade, food quality, and the Codex Alimentarius.

- FAO also has a broad international mandate for food and nutrition related issues that require food composition data and has published food composition tables for use in developing countries.

- FAO has an established system of communication with national governments and regional agencies.

FAO activities implemented to date include:

- Support to regional meetings to identify needs relative to strengthening national data generation programmes and to encourage regional collaboration and linkage with food control activities.

- Participation in, and support for, the organization of training courses on food composition:

- In 1995, a course was held in Santiago, Chile. This course included training in the areas of laboratory based data compilation, and multimedia approaches to data dissemination. A publication on this training course is available in Spanish from the FAO Regional Office for Latin America.

- In 1996, other courses were given in Argentina, Guatemala and Mexico.

- In addition, FAO participated in the training course of the Agricultural University of Wageningen in 1996.

- In 1997, FAO participated in and supported the First ECSAFOODS Course on the Production and Use of Food Composition Data in Nutrition. University of the Western Cape, Cape Town, South Africa, 23 June- 11 July, 1997.

- Direct support to the establishment of regional networks. For this, FAO has largely used its funds earmarked for technical cooperation among developing countries. In this context, funds are provided to facilitate an exchange of experts in food composition.

- Provision of direct support in specific developing countries where conditions for generating data are difficult. For example, assistance to the Ethiopian Nutritional Institute for laboratory upgrading, staff training and the preparation of a new food composition database has been completed.

- Operation of over one hundred projects since 1968 to strengthen national capacities for government and industry control of food quality and safety and carry out competent food inspection, sampling and analysis.

- Promotion of a wide range of policy and operational publications on the management of food quality and safety programmes, laboratory operations and quality control, food inspection, sampling, chemical and microbiological analysis of foods, etc.

On-going activities include:

- The publication of Guidelines for an Effective National Food Composition Programme. The guidelines are to be targeted to government officials, laboratory managers, and food composition analysts in developing and transitional nations. These guidelines are in preparation.

- Participation in, and support for, the First MEXCARIBEFOODS Course on the Production and Use of Food Composition Data in Nutrition. This course will be held from 25 May - 6 June 1998 in Santo Domingo, the Dominican Republic.

- Provision of support for the publication of revised food composition tables in various countries.

- In parallel with this support to regional networks or national institutions for the establishment of databases on food composition, FAO has started updating the calculation of the nutrient content of the national food supplies for each of the countries for which FAO Food Balance Sheets are published.

FAO has also received and is currently revising, requests from several countries for technical cooperation aimed at strengthening food composition work including, among others, Cyprus, China, Ghana, Nicaragua, and Morocco.

FAO intends to promote training opportunities as well as cost-effective generation, dissemination and appropriate use of data. I hope that the discussions at this workshop will allow you to further develop and strengthen food composition activities in your respective countries. We look forward to the recommendations arising from this workshop.

MICRONUTRIENT MALNUTRITION IN THE PACIFIC AND ITS PREVENTION

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INTRODUCTION

This paper focuses on the micronutrient interventions in which the United Nations Children's Fund (UNICEF), internationally, has been providing assistance for many years. Here in the Pacific, our involvement in this specific area of nutrition has been more recent.

Two global conferences took place at the beginning of this decade, and they were critical to the current thinking and activities in public health nutrition. They were the World Summit for Children in 1990 and the International Conference on Nutrition in 1992. These conferences set specific goals and targets for reducing micronutrient deficiencies and improving child nutrition (UNICEF 1991; FAO/WHO 1992). They helped form a global political consensus that not only could these goals be achieved, but that they should be achieved by the Year 2000(Alnwick 1998).

There were three goals specifically related to improving the micronutrient status of children and women:

- the virtual elimination of Iodine Deficiency Disorders (IDD)
- the virtual elimination of Vitamin A Deficiency (VAD) and its consequences (including blindness);
- a reduction in iron deficiency anaemia (IDA) in women by one third of 1990 levels.

The term virtual elimination was used to indicate the elimination of the deficiency as a public health problem, and all of these goals were set to be achieved by the year 2000.

In 1990, it was not really clear which countries had a problem of public health significance in relation to Iodine or vitamin A, nor was it clear which indicators could be used to monitor progress toward achievement of these goals. Much has been done to clarify indicators since that time. In the Pacific, the quantification of the problems is still not completely clear.

For prevention of micronutrient deficiencies, a combination of interventions and strategies is required. These include supplementation, fortification, and dietary improvement, as well as breastfeeding and improved public health measures such as provision of safe water and sanitation. The supplementation, fortification and dietary improvement were almost seen as mutually exclusive once upon a time, with supplementation being seen as "short-term", and with dietary diversification as a "long-term" strategy. It is now clear that a combination of all available interventions will be needed, depending on the circumstances, and that what were once perceived as "short-term" solutions may need to be part of a longer term response.

Iodine Deficiency Disorders (IDD)

Iodine deficiency and its outcome as goitre and cretinism has been known since ancient times. The thyroid gland requiring iodine for producing its hormones enlarges in iodine deficiency making goitre (enlarged thyroid) the best known sign of deficiency. Goitre is now known to be just the tip of the iceberg, thus the term iodine deficiency disorders has been developed to cover the milder physical and mental retardation, the miscarriages and still births, and the reduced IQ that comes with low intakes of iodine. Globally, iodine deficiency is the most common cause of preventable mental retardation. Around 1.6 billion people live in areas that lack sufficient iodine and about 655 million have goitre. The aetiology of IDD is different from the other two major micronutrient deficiencies in that it is geological, and not a result of social or economic conditions.

The iodization of edible salt supplies to combat what is now known as IDD was introduced in Switzerland, in the USA and in New Zealand in the 1920's, and proved to be safe and effective in reducing Iodine Deficiency. Salt iodization is probably the best known example of an effective fortification programme. Yet its implementation is not completely straightforward, and some areas remain ambiguous and challenging. In countries where IDD is severe and cretinism occurs, IDD control activities also include the administration of iodized oil, orally or by injection, while efforts are made to establish iodised salt programmes.

Monitoring of the virtual elimination of IDD, is done by using one or all of the following indicators:

- % of population in iodine deficient areas consuming adequately iodised salt
- proportion of school-age children with any grade of goitre by palpation (TGR)

- proportion of school age children whose thyroid volume (measured by ultrasonography) > 97th percentile

- percent newborns having serum Thyroid Stimulating Hormone (TSH) levels > 5mIU/l

- percent population (school aged children or general population) with urinary iodine < 10 mcg/dl (WHO/UNICEF 1993).

The existence of laws or policies is also one of the more straightforward indicators of progress that can be monitored at the global level.

Tracking what has happened in Fiji is instructive. Goitres were well known in Fiji in the 1930's with rates of approximately 80% reported from the Sigatoka Valley. Surveys, focusing on the Ba and Sigatoka valleys continued to confirm the presence of goitres. In 1994, Government requested a consultant to verify the presence of IDD at a level that warranted any kind of action. A UNICEF consultant travelled to Suva and the Ba and Sigatoka valleys and worked closely with Ministries of Education and Health to undertake ultrasound examination of thyroid glands and to collect urine samples in July 1994 from 324 school children and 30 pregnant women. His findings were that:

- the high goitre rates and low urinary iodine levels indicated a mild *to* moderate rate of IDD (that was independent of cassava consumption);

- that IDD was prevalent in Fijians and Indians, in boys and girls and also among pregnant women in Suva;

- that all salts tested were not sufficiently iodized.

Since that time, Fiji, in 1995, through the mechanism of its Coordinating Committee on Children developed a Cabinet Paper which proposed new legislation. All salt being imported into the country was to be iodized (and non-iodized salt for human consumption was relegated *to the status of* a prohibited import along with fire-arms). In 1996, this was enacted into law, and the importers and wholesalers of salt were advised that there was a grace period up until the end of 1996. During 1997, with the assistance of another UNICEF consultant, an WHO-sponsored IDD monitoring workshop was held. Since then, the Health Inspectors have been working with the relevant customs and other officials to set up a functioning monitoring system.

There were a number of recommendations made in late 1997:

- That legislation state that "all food grade salt that is imported is iodised, including that intended for human, livestock and food industry-based use. This excludes salt intended for use in the dyeing and tanning industry".

- Only iodized salt should be included as a commodity in the "Pure Food Act". The industrial-grade salt that is not intended for human consumption should be mentioned and a clear distinction made.

- All salt imported should contain 50ppm of elemental iodine (approximately 85ppm of potassium iodate or 64 ppm of potassium iodide) and a maximum level of 80 ppm of elemental iodine (which corresponds to approximately 135ppm of potassium iodate or 105 ppm of potassium iodide).

- That a workshop for salt importers, major wholesalers and health inspectors be convened, to convey to them the importance of IDD and to increase awareness of their roles and responsibilities;

- That when salt enters the country and is not iodized, one written warning will be given followed by actions such as publishing information on brands not meeting the standard, imposing fines, and restricting or revoking import licences;

- Import permits should include the following information - Brand name of salt manufacturer; iodine compound used, ie KI or $KI0_3$; level of iodization;

- That testing of salt be done for shipments of salt entering the country and at the warehouse level;

- That periodic surveys be conducted, in schools or villages, to asses the coverage of population groups with adequately iodized salt. At a later stage a similar sample, ie a total sample size of 300, say 10 students in 30 schools or say 10 households in 30 villages, of urinary iodines would be collected and analysed to assess the trends in relation to urinary iodine for a biochemical monitoring of the situation.

One of the interesting issues for the IDD prevention efforts in Fiji is that we have had to be very careful not to give mixed messages about increasing consumption of salt. A lot of education work has been done so that the general population is aware of the risks of excess salt consumption and hypertension. Hence the legislation in Fiji has focused on ensuring that salt being used in snack foods, breads, and for human consumption generally is also iodized.

Links with chemist's analytical skills in the area of IDD are clearly needed, and we will defer to the PNG presentation to discuss more on this. Suffice to say, Fiji is proud of the changes it has made to its laws to improve the health and IQ of its population. UNICEF has suggested to the governments of Vanuatu and Solomon Islands, that they too may benefit from verification or otherwise of their urinary iodine status, and if necessary some of the same steps taken in Fiji could be supported in those two countries over the next few years.

Vitamin A Deficiency (VAD)

VAD is the single most important cause of childhood blindness in developing countries, and is the second largest cause of global blindness after cataracts. It also contributes significantly, at subclinical levels, to morbidity and mortality from common childhood infections such as diarrhoea and measles. A meta-analysis of ten different trials, which was commissioned by the United Nations Sub-Committee on Nutrition determined that there was conclusive evidence that improving vitamin A status of young children in areas where VAD occurred reduced mortality rates by 23% (Beaton et al 1993). Based on this work, UNICEF and other agencies gave priority to reducing the prevalence of VAD in younger children.

Clinical signs of VAD begin when a child can no longer see in dim light and thus suffers from what is known as "night blindness". As the affliction continues, the eye's conjunctiva and cornea become dry, lesions then appear on the cornea and, in the severest (clinical) form, the cornea just melts away causing total blindness.

VAD exists in more than 60 countries, at a clinical and or sub/clinical level. It is estimated that 2.8 million children 0-4 years of age are clinically affected by VAD, while those subclinically affected number around 251 million (WHO/ UNICEF, 1995).

The major cause of VAD is inadequate dietary intake of the preformed retinol or precursors of vitamin A. Increased vitamin A requirement in certain physiological or pathological conditions, inadequate absorption, or loss of intestinal contents in diarrhoea may also contribute to VAD.

The criteria for VAD are both clinical and biological (WHO/UNICEF 1995). The classification of xerophthalmia and prevalence criteria constituting a public health problem are :

Criteria	*Minimum Prevalence*
Night blindness (XN)	> 1.0%
Bitot's Spots (X1B)	>0.5%
Corneal Xerosis and /or ulceration (X2,X3,X3B)	>0.01 %
Xerophthalmia-related corneal scars	>0.05%

Prevalence of VAD in children >= 1 year of age of serum values =< 0.70 micromol/1 is defined as follows:

Level of public health problem	*Prevalence*
Mild	>=2-<10%
Moderate	>=10-<20%
Severe	>=20%

For the Pacific, there are many gaps in the data available, however it is clear that we are dealing with some of the highest VAD rates in the world in the Micronesian countries.

Around of clinical surveys was undertaken in the late 1980's and early 1990's, mostly under the auspices of USAID funding of a group called "VITAL". Other surveys in Micronesia were conducted opportunistically (unpublished reports, VITAL or UNICEF 1989-1997). From 1994, USAID completely withdrew from the Pacific, and the opportunity for follow-up by those groups has been lost.

Cook Islands (atolls)*	no cases of xerophthalmia found
Kiribati*	14.7% of pre-school children from 6 Gilbert islands with clinical signs of VAD
Marshall Islands	4.0% clinical signs (part of their National Nutrition Survey)
Federated States of Micronesia Chuuk State	46% abnormal serum retinol with Conjunctival Impression Cytology (n=455 aged 3-7 years)
Palau	no case of xerophthalmia found (opportunistic survey)
Solomon Islands*	1.5% (from 7 islands)
Tuvalu*	no cases of xerophthalmia found
Vanuatu*	0.05% clinical signs

* Surveys were conducted by VITAL

Subclinical assessment of VAD using serum retinol as an indicator have been undertaken in Chuuk and Pohnpei in Federated States of Micronesia and Marshall Islands. They reveal extremely high rates of VAD, and in a recent global review on prevalence rates only Lesotho appeared to be worse than the situation in Micronesia (Alnwick 1998).

Vitamin A Status	*Chuuk*	*Chuuk*	*Pohnpei*	*Marshall Islands*
	18-36 months	3-6 years	24-47 months	1-5 years
	n=218	n=137	n=361	n=444
Normal	45%	23%	49%	37%
<0.7micromol/l	44%	56%	44%	55%
<0.35micromol/l	11%	20%	7%	8%

VAD prevention programs have been ongoing for up to seven years in four Pacific Island Countries. Pohnpei State will launch its first ever VAD campaign in September 1998.

In Marshall Islands and Chuuk, vitamin A capsules (VAC) are distributed prophylactically every 6 months to children aged 1 year to 12 years, as well as to post partum *mothers* within 1 month of birth. In Chuuk, monitoring of their distribution program has always been good, and though it dropped in 1997, it has been consistent, with generally more than 80% of children receiving their VAC on each round of distribution. Marshall Islands is starting to improve its monitoring which of distribution of VACs which began in 1995. It is exemplary on Majuro, but less is known about Ebeye and the outer islands. In the protocols for both places, anti-helminths are also provided at the time of the VAC distribution, and this is regarded as rather innovative with only one other country in the world reported as doing this at present (Alnwick 1998).

In Kiribati, the VAC distribution is every 4 months, for children 6 months to 6 years and for post partum women within one week of parturition. Monitoring of coverage rates has been weak in the past, but 1997 data indicate that coverage on Tarawa is around 100%, on outer Gilberts it ranges from 50-80%, and in the very distant Line and Phoenix Islands, coverage is unknown.

Efforts to incorporate nutrition and health education outreach activities with schools, youth groups, and the general population; improvement of availability of foods rich in vitamin A and the pre-cursors through family food gardens, and other activities with agriculture departments; along with promotion and support of breastfeeding, are ongoing with the VAC distributions.

Determination of the impact of large-scale routine vitamin A supplementation programmes on survival, health or growth is a big challenge for the Pacific at this stage. Costs and logistics can be quite daunting, for example, the finger prick test that is being developed for rapid assessment of VAD is looking like it may cost around $20.00 per test at this stage of its development.

The challenges to understand more in the area of VAD are tremendous, especially among adolescents (there are many anecdotal reports of nightblindness among secondary school children, especially those in boarding schools) and among pregnant women. The implications are clear, if mothers to be and adolescents are vitamin A deficient, their resistance to infection and their health generally will be impaired. We have previously concentrated our efforts on the young child, but adolescents and mothers to be appear also to be at risk.

Similarly, there is much more work to be done to understand the nature of the Pacific foods we eat. Recent work has indicated that the conversion of pre-carotenoids into vitamin A from green leaves may not be as efficient as once thought, that red coloured fruits and vegetables may be "better converters"(de Pee at al, 1996), and since these foods and strategies have been so important in the Pacific, a better understanding is needed.

Also, besides the supplementation, dietary improvement, and improved public health strategies, VAD in other parts of the world is being tackled through food fortification. Sugar in Guatemala, margarine in the Philippines, Vanaspati or hydrogenated fat in India, milk and milk powder in refugee situations are some examples. The scope for this food fortification intervention seems more limited in the Pacific, but is worth consideration.

Iron Deficiency Anaemia (IDA)

IDA is the world's most prevalent nutritional deficiency. Approximately 2 billion people are said to be at risk globally, and almost half of all women and children in developing countries have anaemia (WHO 1992). Pregnant women with IDA are at significantly increased risk of birth complications and of giving birth to a low birth weight child. IDA in adults causes fatgue and contributes to low work capacity. Awareness of the importance of IDA in young children is growing, particularly because of the strong associations between IDA and impaired mental and motor development among infants and young children, and poor school achievement in older children (Draper, 1997).

There is less global consensus on indicators for global monitoring progress, or even on optimum strategies for pregnant women at present (Alnwick, 1998). A recent workshop on IDA in Fiji revealed that doctors were taking very individual approaches to diagnosis and treatment of IDA in pregnancy. The value of folate along with the iron supplement in pregnancy has not been sufficiently emphasised in most of the Pacific Island countries to date.

Only scant data are available for the Pacific and those listed below were compiled at the time of the International Conference on Nutrition in 1992, and are therefore somewhat dated, but indicative nonetheless (WHO 1993).

Country	**Prevalence of Anaemia in pregnancy %<11g/dl**
FSM	40
Fiji	40
Kiribati	69
Northern Marianas	11
Palau	16
PNG	81
Polynesie France	45
Solomon Islands	30
Tonga	38
Vanuatu	10-73
W Samoa	56

Despite inclusion of prevention of anaemia in the "Safe Motherhood" and other global initiatives, it is clear that not enough attention has been given to the basics on IDA all over the world as well as in the Pacific. Is there a policy on IDA supplementation during pregnancy, does the primary health care system reach women during pregnancy, are the supplements available, are they the correct dose, is there counselling about side effects and compliance? These are all questions which need to be answered and too often are not (Yip, 1996).

Similarly, there is evidence of the adverse effects of IDA on young children, but this evidence has yet to be translated into clear programming to improve the lives of children.

The fortification of a variety of food stuffs with iron has been a success in some countries, for example with wheat flour in Venezuela. Other foods which have been chosen for iron fortification include infant foods, salt, sugar, rice, curry powder and fish sauce.

The Government of Fiji is very keen to persue the possibility of iron fortification, and UNICEF will work with them to identify appropriate technical expertise in this new area for the Pacific. The steps in the development of a food fortification program are many, and all of them need attention for any such program to work.

These steps include the following (MI/IAC 1996):

1.Determination of the prevalence of micronutrient deficiency.
2.Segment the population if prevalence data indicate the need.
3.Determine the micronutrient intake from a dietary survey.
4.Obtain consumption data for potential vehicles.
5.Determine micronutrient availability from the typical diet.
6.Seek government support (policymakers and legislators).
7.Seek food industry support.
8.Assess the status of potential vehicles and the processing industry chain (including raw material supply and product marketing).
9.Choose the type and amount of micronutrient fortificant or mixes.
10.Develop the fortification technology.
11.Perform studies on interactions, potency, stability, storage, and organoleptic quality of the fortified product.
12.Determine bioavailability of the fortified food.
13.Conduct filed trials to determine efficacy and effectiveness.
14.Develop standards for the fortified foods.
15.Define final product and packaging and labelling requirements.
16.Develop legislation and regulation for mandatory compliance.
17.Promote campaigns to improve consumer acceptance.

CONCLUSION

Micronutrient deficiencies in the Pacific pose a significant threat to the health and well being of the population. There are tremendous opportunities to work more closely with the OCEANIAFOODS scientists gathered here today to both better understand these problems as well as finding solutions to them, and to monitoring their continued success.

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AN OVERVIEW OF IRON DEFICIENCY ANAEMIA IN FIJI

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INTRODUCTION

Anaemia has been long recognised as a public health problem in Fiji, mainly affecting young children, women and the poorer sections of the population. Women of child bearing age are particularly vulnerable. Early medical research indicated that anaemia was a relatively rare disorder among Fijians and only recognised as a health problem amongst Indians'. However, trends over the years indicate an increasing prevalence of anaemia amongst Fijians.

Methods of Assessing Anaemia

Most of the studies that have been undertaken to assess the anaemia status of persons in Fiji have used WHO standard for serum haemoglobin levels.

Except for the 1993 National Nutrition Survey[2], it is difficult to compare findings from other studies due to differences in methods of determining haemoglobin levels and other limitations in the study methods used. Nevertheless, the findings do provide some basis for comparison over the years and appear to indicate an increasing trend in the prevalence of anaemia.

Findings

The most recent 1993 National Nutrition Survey found that 27% of the total population were anaemic. The problem was prevalent in both children and adults: 40% of young children under 5 years, 32% of the female and 22% of the male population were anaemic. Indian women of child bearing age had the highest rate of anaemia at 40% compared to Fijian women at 26%. This survey also reported a high prevalence rate of anaemia in pregnant women with 62% amongst Indians and 52% amongst Fijians.

A similar observation for children under 5 years was made by Chand[3] (1995) while examining factors contributing to anaemia in pregnant women and pre-schoolers in Fiji. She found 32% of children under 5 years anaemic. It was also reported that there was no significant difference in the rate of anaemia between Indian and Fijian pregnant women. Chand's study found that 25% of pregnant women were anaemic, whilst the National Nutrition Survey reported 56%. The difference may be due to differences in small sample size.

Although other studies have been undertaken to assess the status of anaemia in the country, it would be difficult to attempt a direct comparison of these studies due to the different study methods, sample sizes and locations. However, their findings, tabulated below, provide an indication of the general trend of anaemia in Fiji.

Prevalence of Anaemia: 1969-1993

Year	Locations	Children Under 5 years	Men % (sample no)		Women % (samph no)	
		%	Fijian	Indian	Fijian	Indian
1969	Koronubu[4]	24 (309)	9 (22)	7 (221)	11 (28)	27(295)
1975	Suva, Nausori, Lomaivuna and Rewa Valley[5]	20 (261)	6 (947)	7 (946)	8 (589)	33(616)
1982	Suva, Wainunu & Sigatoka[6] (NNS)	36 (103)	38 (102)	37 (35)	42(101)	44 (66)
1986	Suva, Lakeba & Sigatoka[7]	-	25 (664)	24 (504)	30 (763)	40 (597)
1991	Central & Western[3]	32 (522)	-	-	*23(204)	*26(196)
1993	National[2] (NNS)	40(512)	25 (627)	20 (668)	24 (674)	40 (665)

*pregnant women (Food & Nutrition in Fiji, Volume Two; NNS 1993)

Admitted hospital cases reported by the Ministry of Health showed that anaemia is increasing. It is high amongst Indians than Fijians and also high amongst females than males[3] (see Table 1). This report is in line with trends observed in other studies that have been carried out.

Table 1: Anaemia cases reported by race and sex: 1993 -1996 (provisional figures)

	Race				Sex	
Year	**Fijian**	**Indian**	**Others**	**Total**	**Male**	**Female**
1993	167	217	18	**402**	179	223
1994	173	233	14	**420**	205	215
1995	163	255	16	**434**	182	252
1996	176	231	16	**423**	191	232

(MOH, 1998)

Some government-implemented programmes already exist to improve iron deficiency anaemia. For example, the Ministry of Health is currently implementing the iron supplementation programme for pregnant women who attend ante-natal clinics. UNICEF has been active in the prevention of anaemia in the country through funding programmes such as "Family Food Production and Nutrition Project". This programme was carried out through the National Food and Nutrition Committee aimed at improving the nutritional and health status of mothers, infants and pre-schoolers who are the most vulnerable to nutritional deficiencies.

Significance of Anaemia

The overall effect of anaemia is of great concern to the country. The negative aspects are enormous. These include poor growth and development of children, low birth weight babies and reduced productivity of adults. At national level, millions of dollars may be lost due to low work productivity and morbidity associated with generally poor health.

Possible Causes

Past studies cite poor dietary intake of iron and hookworm infestation as possible causes of anaemia in the country. Chand (1995) suggested that a nutritional cause, lack of iron containing foods, was the primary contributing factors causing anaemia in Fiji.

Similarly, the 1993 National Nutrition Survey, attributed the high prevalence of anaemia to the following possible causes:

- Low consumption of foods which provide iron and protein e.g meat and dark green leafy vegetables;

•Infections and hookworm infestations as a result of poor sanitation especially in rural areas;

•Frequent pregnancies with short birth intervals (leaving mothers highly susceptible to anaemia); and

•Lack of continuation of antenatal and postnatal care, particularly among teenage unsupported women.

Furthermore, the 1993 National Nutrition Survey confirmed the change in food preference from a traditional diet to a cereal-based diet with high consumption of sugar, cereals, vegetables, animal fat and low dietary fibre and animal protein. This change may contribute to heart disease, diabetes and iron deficiency anaemia as many of these foods are low in nutritional value.

What can be done

Public health measures to improve this situation should include measures recommended in the Fiji Plan of Action for Nutrition[8] (FPAN) which was approved by Cabinet recently. These were some of the actions recommended in this FPAN:

•Introduction of policy measures and increase public awareness on ways to prevent anaemia and the negative implications of the disease;

•Iron (and folic acid) supplementation should be continued with pregnant women, and possibility to expand the regime to include children be investigated;

•Iron fortification of food be seriously considered as a preventive measure;

•Promote the growing and consumption of iron rich foods in the community.

CONCLUSION

The high rate of anaemia in Fiji is alarming. This disease has negative effects on the growth and development of children and on their academic performance, as well as the poor health of anaemic mothers and their babies. It also reduces the economic productivity of adults. It is hoped that the relevant ministries and NGOs will mobilize their efforts to reduce the prevalence of anaemia in all segments of society in Fiji.

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EXPERIENCES IN THE USE OF IODISED SALT IN PAPUA NEW GUINEA

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INTRODUCTION

Several forms of malnutrition have been identified in Papua New Guinea (PNG). Those of public health importance are protein energy malnutrition (PEM), nutritional anaemia and iodine deficiency disorders (IDDs). In addition to these are the problems of non-communicable diseases (NCDs). Deficiencies of other nutrients such as vitamin A and zinc also exist in the country.

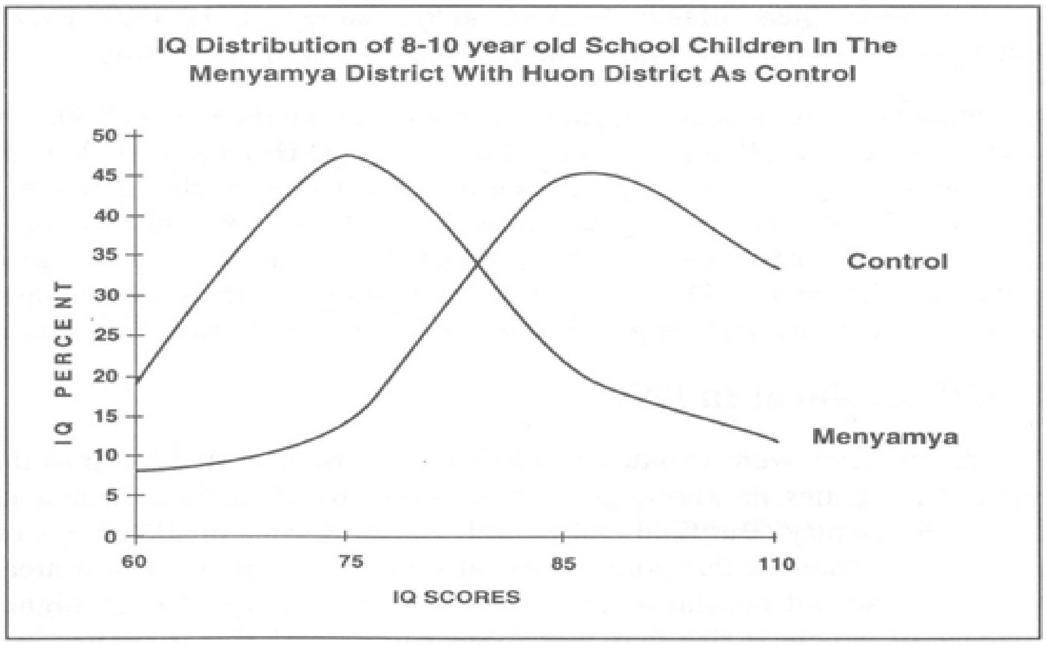
That iodine deficiency occurs in many areas of the country is well known (Buttfield and Hetzel, 1967, Heywood *etal.*, 1986 and Heywood and Verrall, 1987). Out of the 423 million people currently at risk of iodine deficiency disorders in the Western Pacific region, including China, two million are in PNG (WHO/UNICEF/ICCIDD, 1993), representing nearly 50% of the total population of the country. This makes PNG the country with the second highest percentage of the country's population at risk in the region after Philippines.

The IDD Problem In PNG

Iodine deficiencies were identified in PNG as far back as 1957. Up to the seventies and eighties, the known goitrous areas were mostly in the mountainous areas on the country (Buttfield and Hetzel, 1967). Recent small surveys on school children indicate that goitre is not only common in mountainous areas but also in lowland coastal areas, raising the possibility of even higher percentage of people at risk than was formerly thought. This translates into the possibility of more intellectually impaired or permanently brain damaged children, more neonatal and infant deaths, more cases of infertility in women and perhaps even more cretins.

That iodine deficiency affects the brain is now universally accepted. The early surveys in New Guinea (1970-1987) revealed reduced cognitive and motor performances in children borne to iodine deficient mothers. The series of investigations showed a constant significant correlation between a variety of measures of the child's performance over a period of years and the level of maternal thyroid hormones (Pharoah and Connelly, 1993). Psychomotor function is closely related to skillful and nimble exercises, so severe iodine deficient individuals will perform poorly in tasks requiring skillfulness and agility. Intelligence Quotient (IQ) distribution studies in IDD endemic areas in China showed a definite left shift of 10-15 IQ points in IDD endemias (Ma, 1994). This is a 10-15 points loss of intrinsic IQ which will reduce the individual's potential competitiveness.

Our own observations using Raven's Progressive Matrices Test in a limited preliminary studies in 1996 of 8-10 year old school children in the Menyamya district of the Morobe Province of Papua New Guinea seem to support this (Fig. 1) (Amoa *et al.* 1997), although the results should be interpreted with caution. This is because IQ conversion score sheets established for use with rural Chinese school children were used in the absence of any standards for Papua New Guinea. It may be incorrect to place too much emphasis



on the absolute IQ scores. What may safely be deduced from the results is the difference in the performance between the school children from the IDD and non IDD control areas.

The low median iodine levels in the urine samples which we collected from the school children in the same survey further supports the endemic status of Menyanya area (Table 1). The levels were all below the International Commission for Control of Iodine Deficiency Disorders (ICCIDD) cut off point of lOmg/dl. In the absence of any re-evaluation of the known goitrous areas in the country, it is reasonable to assume that IDD is still a major problem and efforts to bring about development in the country may be limited by a passive iodine deficient population including particularly children.

Table 1. <u>IDD Severity and the Need for Correction</u>

Stage*	Goitre*	"types Goitre Prevalence*	Median Urinary Iodine mg/dl*	Need for Correction*	Menvamva District Study'	
					Median Urinary Iodine mg/dl	TGR %
Mild	+	5 - 19.9%	5.0-9.9	Important	7.5(Kwaplalim) 7.8(Kapo)	15.0 3.1
Moderate	++	20 -29.9%	2.0-4.9	Urgent	4.6(Menyamya)	25.4
Severe	+++	>30	<2.0	Critical	-	-

+, ++, +++, = present, with +++ being most severe.

* = Dunn *et* a/.(1993)
l=Amoaeta/.(1997)

IDD Control Measures

Various measures have been suggested by ICCIDD *to control the IDD* epidemic in the world. These include:

- •Iodinated salt
- •Iodinated oil
- •Iodinated water supplies

The two most frequently used control measures for iodine deficiency are iodised salt and iodised oil. The pioneering use of iodised oil in PNG for the control of IDDs and the gazetting of food regulations for iodization of salt took place in the early seventies. The iodised oil program came to an end in the mid seventies and there was virtually no monitoring of iodine levels in salt. Ninety percent of salt samples collected from various areas in the country in 1994 were either not iodised or inadequately iodised (Ma, 1994). The gazetting of the amendment to the salt legislation in 1995 sought to strengthen control measures in the country. It also indicated that the authorities have chosen salt iodization as their method of combating IDDs in the country in the long term.

Since then, has there been any progress in the provision of adequately iodised salt to communities in the country? All salt sold in the country is imported. Papua New Guinea has three main ports and seven small ports of entry for goods into the country. So on paper, it should be relatively easy for Department of Agriculture and Livestock (DAL) and Department of Health quarantine officers at all these ports to monitor iodine content of salt imports. It should also be easy for health inspectors to regularly check iodine content of salt in the supermarkets and trade stores. There is virtually no monitoring activity at the seven small ports.

Of the three major ports, salt imports into Lae and Rabaul were not monitored for iodine content in the period up to the end of 1997. Quarantine officers did not monitor salt imports into Lae and Rabaul unless a complaint was made to them about a particular consignment. Such instances were quite rare. Salt at the wholesale and retail outlets in these two cities was not regularly checked by health inspectors either. Our own periodic monitoring in 1996 and 1997 in Lae indicated an increase in the percentage of wholesale salt samples containing more than the standard 30ppm iodine from 61.5% in 1996 to 90.9% in 1997. The level of improvement was not so great with the retail samples during the same period (73.5% to 87.1%). Not all the households in the city were consuming adequately iodised salt either (Amoa *et al*., 1998). The story is not different this year. Uniodised salt, salt iodised but in the prohibited potassium iodide not iodate form and salt packaged in water permeable containers which are also prohibited are still available in the supermarkets (Table 2). Lae is the gateway of food imports to the highlands and Morobe Province where IDDs hale been shown to be particularly problematic. The story of inactivity in the monitoring area is the same in Port Moresby.

Table 2. Iodine content of salt samples in Lae city

Trade Name	*Country of Origin*	*Declaration on Packaging*	*Packaging Material*	*Iodine Level (ppm) (iodate test kit)*
Black and Gold	Australia	Iodised KI 25-40ppm	Polypropylene	Nil
Nambawan	Germany	Iodised $KI0_3$ 70ppm	Polyethylene	75
Cerebos	Australia	Iodised KI or KIO,	Polypropylene	75
Saxa	Australia	KI or $KI0_3$	Paper box	75
Home and Garden	U.S.A.	Iodised KI 0.01%	Paper tube	Nil
La Paz Margarita	U.S.A	None	Polypropylene	Nil
Kooka	Australia	Iodised	Polyethylene	75

Guidelines for Monitoring

So with this rather bleak picture, where do we go from here? At this rate, will PNG meet the year 2000 deadline set by WHO/UNICEF/ICCIDD for the global eradication of IDDs? The answer is obviously no but a lot can be done to bring the country closer to achieving the goal by simply following the WHO/ UNICEF/ICCIDD guidelines for monitoring iodine status and adequacy of iodine levels in salt (WHO/UNICEF/ICCIDD, 1996). According to the guidelines:

- **An IDD committee of qualified individuals who are responsible for program monitoring and evaluation must be set up.**

A lot of flourish was made in late 1994 and early 1995 about the setting up of a committee as part of an IDD control program, in the lead up to the launching of the amendment to the salt legislation, but nothing eventuated. Activities to help eradicate IDDs in the country did not even warrant a mention in the 1997 five year development program of the health department, even though micronutrient deficiencies, including IDDs, have been highlighted in the current (1995) national nutrition policy. Apparently IDD is currently not a priority in PNG, yet we know the devastating effects which IDDs have on the development and welfare of a nation.

- **There must be regular quality control of iodine concentration in salt at the ports of entry in the country by using reliable test kits and rechecking of suspect consignments by titration.**

- **An independent laboratory capable of carrying out salt titration and urine iodine analysis must be set up to ensure external quality control.**

Currently the health department uses the National Agriculture Chemistry Laboratory for salt titration tests on a very infrequent and ad hoc basis. However, my laboratory seems to be the only one interested in and actually carrying out urinary iodine analysis in school children and pregnant women.

- **There must be periodic monitoring of salt iodine levels in retail shops and households using test kits.**

All health inspectors at the provincial and district levels and city authorities have been issued with test kits. A system must be set up whereby the *inspectors* are required to submit test results at set intervals through their provincial offices to the quarantine officer in the national health department. This officer must be a member of the IDD monitoring committee. Spot checks should be carried out to ensure that tests are actually carried out and figures returned by the health inspectors are accurate.

- **A nationwide survey must be conducted to ascertain the current prevalence of IDDs.**

This was one of the recommendations at the UNICEF sponsored IDD training workshop in Mount Hagen in 1994 but yet to be implemented. Subsequent surveys after this nationwide one, should be limited to occasional ones only. Small surveys conducted in certain areas in the country returned goiter rate figures of 0.5%-54%. Some of these are yet to be confirmed. The exercise will also provide the opportunity to identify areas where very little salt is consumed for the relevant intervention program to be set up for those areas. The per capita salt consumption which is currently unknown can also be determined during the exercise. My data for Lae is 6.95g/day (Amoa *et* a/.,1998). The figure for other areas in the country need to be ascertained.

Finally, the WHO/UNICEF/ICCIDD guidelines stipulate that regular urinary iodine measurements must be carried out. The results, together with the other monitoring results, will provide the basis for adjusting salt iodine levels. The current PNG salt legislation was based on the assumption of lOg/day salt consumption.

On the web site of WHO IDD prevalence and control program data, against all the indicators for PNG are the words "No data available". The question that can be asked is "When are the blank spots going to be filled?". This is because IDD problems in the country are real and urgent actions need to be taken. With commitment from the relevant government departments to ensure that all salt imports are adequately iodised as well as pressure on the salt exporting companies outside the country to send only qualified salt to PNG, political commitment together with interagency, public and private sector collaboration backed up with adequate funding, Papua New Guinea should be able to pull herself out of the IDD stranglehold. If Africa with her deteriorating trend of protein-energy malnutrition can report spectacular successes in the fight against IDD (Kavishe, 1997), why can't we achieve the same thing in PNG? This is a major challenge but it can be done.

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APPLICATIONS OF NUTRIENT DATA TO RISK FOR CHRONIC DISEASE

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INTRODUCTION

With the increasing prevalence of chronic/non-communicable diseases in the world today, in both developed and developing countries, and the links between diet and the risk for these diseases, interest is now focusing on the relationship between individual nutrients in our diet and the incidence/prevalence of these diseases. This interest not only covers the associations with the macronutrients in foods, but also the micronutrients, specifically the antioxidant vitamins and minerals. Then, the increasing identification of non-nutrient components in foods with anti-oxidant properties also focuses on the need to analyse these biologically active compounds to further identify risk factors for chronic disease.

MACRONUTRIENTS

The risk for cardiovascular disease (CVD) has been linked to the intake of a number of macronutrients in foods. These include total fat, fatty acids (particularly in terms of saturated, monounsaturated and polyunsaturated classes of fatty acids, and specific fatty acids, such as stearic, palmitic, myristic etc), carbohydrate including dietary fibre, protein and alcohol levels in foods, as they contribute to dietary intake.[12] The macronutrients associated with risk for cancer have been identified as fat and its components, dietary fibre, and alcohol.[3] Alcohol level in beverages and in the diet is a major determinant of cirrhosis of the liver and other associated disorders.[4] The contribution of macronutrients to the energy value of foods and so diets is linked to risk for a range of chronic diseases, through the impact of total energy intake on the development of overweight and obesity.[5] In particular, an increase in the energy density of diets in Pacific Island countries has been identified as a major cause of the high prevalence of overweight and obesity, associated with the current epidemic of non-insulin dependent diabetes, reported in some of these countries.[6] Overweight and obesity are also risk factors for cardiovascular disease and some cancers.[7]

MICRONUTRIENTS

In relation to coronary heart disease and cancer, reduced risk for these chronic diseases is associated with the increase in level of micronutrients with anti-oxidant properties, in foods and the total diet. These micronutrients include carotenes, particularly alpha- and beta-carotene, vitamins C and E, folate, zinc and selenium.[8] Sodium, potassium and calcium levels in food are implicated in risk for hypertension and so stroke.[5] Sodium levels in salt-cured and salt-pickled foods are associated in populations that frequently consume these foods with some cancers, particularly of the oesophagus and stomach.[3] Some evidence has accumulated for a role of magnesium in identifying risk for coronary heart disease, and chromium status and metabolism have been associated with the development of diabetes.

NON-NUTRIENT COMPONENTS IN FOODS

Though not covered in the Session's title of "Applications of nutrient data", non-nutritive components of foods are now attracting considerable interest for their proposed role in reducing risk for some chronic diseases, through their anti-oxidant properties. So analysis of these components in foods is becoming a major activity of research into diet and chronic disease and advice is being given to the community to increase their intake of these antioxidants as a protective measure against such diseases as coronary heart disease and some cancers. Non-nutritive food components under investigation include:

> Polyphenols, including the flavonoids and flavanoids of quercitin and catechins, occurring in red wines, vegetables, such as onions and garlic, and green and black teas,[9]
>
> Lycopene - a carotenoid - found in fruits and vegetables, particularly tomatoes and tomato products,[10] and
>
> Phytoestrogens - naturally occurring oestrogens, such as genistein, occurring particularly in soy products.[11]

Research has shown that many of the polyphenols in tea and red wine act in a variety of ways that could be beneficial in the prevention of cardiovascular disease and cancer.[9] Lycopene-rich diets have been associated with reduced risk for cancers of the bladder, pancreas, and digestive tract.[10] Phytoestrogens may reduce the risk of some cancers. In soy products, they have been shown to inhibit cell formation and growth and may play a role in the prevention of hormone-dependent cancers, such as breast cancer." However, for the above antioxidants, more information will need to be known about their absorption and distribution in the body before it is possible to quantify their contribution to the body's antioxidant defences and the role they may play in the promotion of health and prevention of disease.

APPLICATION OF FOOD COMPOSITION DATA TO REDUCE RISK FOR CHRONIC DISEASE

In a recent consultancy in Solomon Islands, I was able to use regionally available food composition data to highlight the value of traditional and subsistence foods in the development of a national food production and nutrition policy and food production plan of action (FAO/TCP/SOI/6711). The country's food and nutrition situation mirrored that of many other Pacific Island countries, with decreasing production and consumption of traditional/subsistence foods, and increasing Westernisation of the diet with increasing reliance on imported food, particularly rice, wheat flour, noodles and foods high in fat and sugar. Apart from reduction in the micronutrient content of the diet, this change had significantly increased the energy density of the diet. The following adverse health effects have been an increase in the prevalence of overweight and obesity and in the prevalence of non-insulin dependent diabetes and cardiovascular disease in the country population.

The explanation for the increased risk for chronic disease resulting from these dietary changes is clearly illustrated in the following tables of the macro- and micro-nutrient composition of traditional versus imported and non-traditional foods. The values for leafy green vegetables are those reported in the recently published *"Pacific Island Foods - Description and nutrient composition of 78 local foods"*, funded through ACIAR Project 9360, Nutrient Composition of Some Pacific Island Food Crops and Wild Foods.[12] The reference for other nutrient composition values is *"Pacific Islands Food Composition Tables"*.[13]

TABLE 1 - NUTRIENT VALUES OF TRADITIONAL AND OTHER FOODS (per 100g)[13,14]

FOOD, cooked	Protein *g*	CHO *g*	Energy *kj*	Fat *g*
Yam, boiled	2.0	18	340	0.6
Sweet potato, boiled	1.4	30	365	0.5
Taro, boiled	0.8	19	339	0.4
Taro chips, fried	2.0	66	2070	25.5
Bread, White	2.0	47	990	1.1
Rice, white, cooked	2.3	28	510	0.3
Potato, baked	3.0	17	438	2.8
Potato chips, fried	4.0	26	1010	13.9
Potato crisps packet	7.0	48	2200	34.6
Reef fish,	24.1	-	542	3.4
Fish, battered, fried	14.2	14	1050	15.7
Sugar, white	0	100	1650	0
Soft drink, cola*	0	11	180	0
Soft drink, cola, 1 can**	0	42	638	0
Beer, 1 can**	1.1	7.5	540	0

* 100 ml
** 375 ml

As noted earlier, risk for non-communicable or chronic disease is closely linked to the energy value of the foods that comprise daily diets in relation to the energy expended in daily activity. If energy in the diet exceeds the energy expended each day, weight increases and overweight and obesity develops. *Table 1* gives some indication of the energy values of traditional foods and of non-traditional Pacific Island foods. It can be clearly seen how Westernisation of Pacific Island diets is increasing the risk for overweight and obesity and so the risk of chronic disease. The more traditional root crops of taro, sweet potato and yam are being replaced by rice and bread (manufactured from imported wheat flour), the higher is the energy intake almost three times as great in the case of bread. Another interesting comparison is the increase in energy density with the addition of fat to food, eg traditionally baked fish compared to fried fish and the imported "Irish potato", frequently eaten as fried potato chips or packaged potato crisps, the popular snack food. The energy values detailed in *Table 1* are all based on the same weight of food (100 g), except for a can of cola drink and a can of beer.

TABLE 2 - NUTRIENT VALUES OF LEAFY GREEN VEGETABLES (per 100 g)[12,13]

FOOD	B-Carotene *ug*	Vitamin C *mg*	Iron *mg*	Zinc *mg*	Fibre *g*
Amaranth	9510	45	4.9	0.7	3.7
Slippery cabbage	9669	26	1.9	1.4	3.8
Cassava leaves	9336	220	3.1	2.9	6.0
Chinese	3449	38	1.0	0.5	1.3
Drumstick leaves	11570	147	2.7	0.5	5.2
English	29	30	0.5	0.2	1.1
Fern	2976	7	4.0	2.8	3.6
Lettuce*	1	0.5	0.5	1.0	
Pumpkin leave	3117	28	2.5	0.9	3.4
Sweet potato leaves	1056	25	2.5	0.4	5.2
Taro leaves	6090	81	2.8	0.6	5.7

*Imported seeds

From the above table of the micronutrient and dietary fibre values of leafy green vegetables, it is clear the traditional Pacific Island vegetables are rich in micro-nutrients with antioxidant properties, namely B-carotene (which converts to vitamin A), vitamin C and zinc. The most outstanding differences are for B-carotene, eg 9669 ug/l00g for the commonly eaten slippery cabbage or bele compared to lug/l00g for lettuce and 29ug/100g for English cabbage. The traditional leafy greens also have a much higher level of dietary fibre, associated with decreased risk for coronary heart disease and some cancers.

CONCLUSION

It is only through the work of the food analyst that many of the associations between diet and risk for chronic disease can be investigated and confirmed. Dietary data from dietary surveys and national food balance sheets can link the consumption and availability of foods or food groups to risk for chronic disease. Until food composition data are available on these foods, the specific nutrients or non-nutritive components in these foods associated with reduced or increased risk for chronic disease lack identification. This in turn compromises the ability at country, regional and international level to both promote the health of its population and reduce risk for chronic and other diseases.

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FOOD COMPOSITION DATA : AN ESSENTIAL PART OF FOOD AND NUTRITION MONITORING IN NEW ZEALAND

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INTRODUCTION

Food composition data are an essential part of policy development for fo and nutrition in New Zealand. Within the New Zealand Ministry of Hea policy development for food and nutrition is the responsibility of the Pub Health Group. The Food and Nutrition Section of the Public Health Gro has policy areas for food standards, food safety and nutrition. This paper w focus mainly on the setting of nutrition policy.

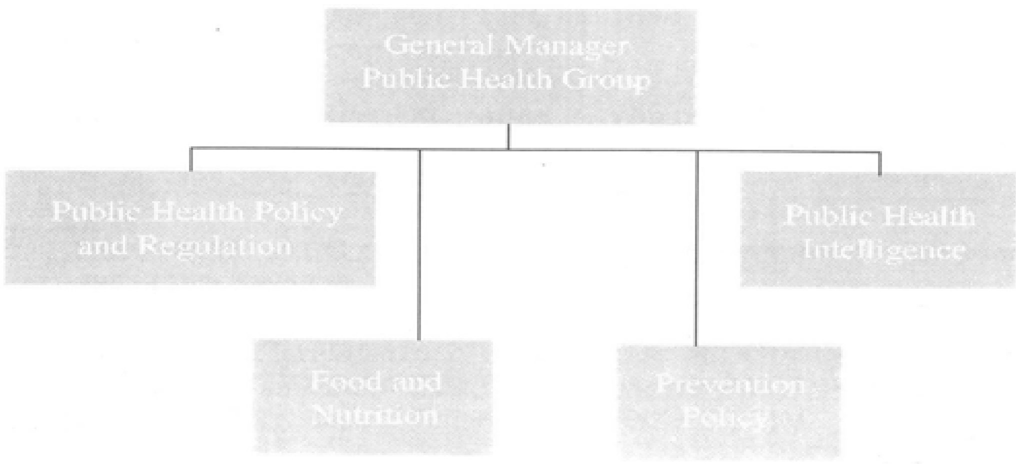

Figure 1 Structure of the Public Health Group

The Public Health Intelligence Section works across the Public Health Group, gathering and analysing information on health status and determinants of health. Public Health Intelligence staff skills include nutrition, social science, epidemiology, environmental health, statistics and communicable diseases.

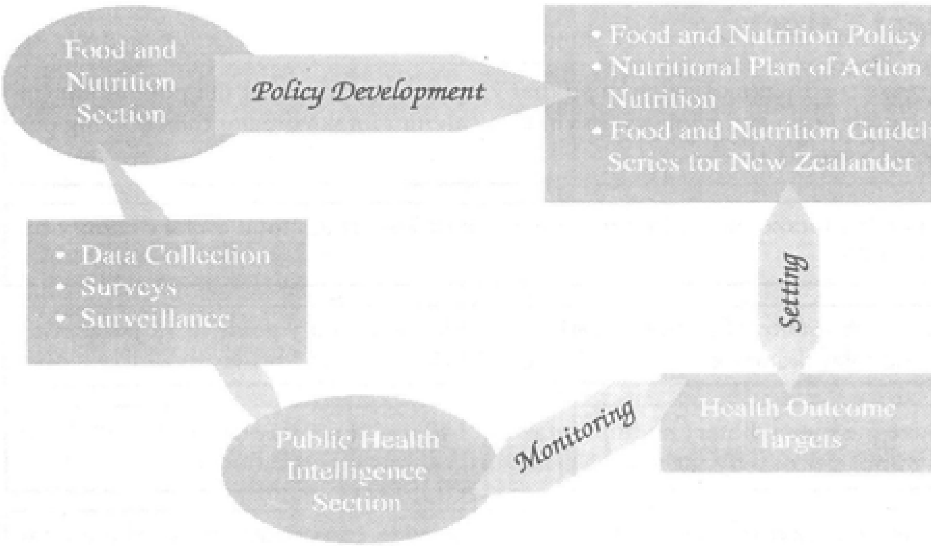

Figure 2 Food and Nutrition Policy Development

Figure 2 shows the flow of information in the setting and monitoring of policy. Food and nutrition policy is set out in New Zealand's National Plan of Action for Nutrition (Public Health Commission 1995). The National Plan of Action is a ten year strategic plan, one of a series of issue-based policy documents outlining the Ministry of Health's advice to the Minister of Health.

All policy papers develop health outcome targets. The targets are designed to operationalise policy and be measurable indicators toward public health goals and objectives. Each target identifies a measurable change in health status or risk, for a specified population group, within a defined time period. The targets are intended to be challenging yet achievable. They are set using historical baseline and trend data, this defines the business as usual path, or what is currently happening. Analysis of the effectiveness, availability and cost of policy and programme strategies is used to define the health gain considered realistically achievable for each target.

Seven targets have been set for nutrition, two related to consumption of foods and five to nutrient intakes (Public Health Commission 1995).

Food Targets

To increase the consumption of breads and cereals so that 75 percent or more of the population are consuming at least six servings per day by the year 2000.

To increase the consumption of vegetables and fruit so that 75 percent or more of the population are consuming at least five servings per day by the year 2000.

Nutrient Targets

To increase the intake of calcium so that 75 percent or more of the population (in particular, children and adolescents) have a calcium intake greater than 600 mg per day by the year 2000.

To reduce the intake of total fat to 33 percent or less of the total dietary energy by the year 2005.

To reduce the intake of saturated fatty acids plus trans-fatty acids to 12 percent or less of the total dietary energy by the year 2005.

To reduce the mean dietary sodium intake to 140 mmol per day or less by 1997 and to 120 mmol per day by the year 2005.

To ensure that sucrose and other free sugars provide 15 percent or less of the total dietary energy by the year 2005.

The seven targets were set using baseline data from the 1990/91 Life in New Zealand Survey (Russell and Wilson 1991). Targets are monitored annually, where new data are available and a report produced entitled *Progress on Health Outcome Targets.* This is the Director General of Health's annual report on the health status of New Zealanders (Ministry of Health 1997).

The monitoring of targets requires a programme of periodic surveys and surveillance.

Survey Programme

For nutrition the survey programme includes:

National Nutrition Survey

The National Nutrition Survey (NNS) is the third national survey that has gathered information on the nutritional status of New Zealanders. Data collection for the Survey was completed in 1997 and analysis is underway. The target population for the Survey was adults 15 years of age and over.

A Technical Advisory Committee has advised the Ministry of Health on all aspects of the planning, development and analysis of the Survey.

Child Nutrition Survey

In 1998 the Ministry of Health began planning for a Child Nutrition Survey. This will be the first national survey of children's nutritional status in New Zealand.

The Ministry of Health has appointed a Technical Advisory Committee which will advise the Ministry on the development, field work and analysis of the survey. The Technical Advisory Committee includes experts with skills in nutrition, survey design, paediatrics, Maori health, and the health of Pacific people. The planning and development work for the Survey will be conducted in 1998 and 1999 with field work in the year 2000.

Infant Care Practices Survey

The Infant Care Practices (ICP) Survey is a national periodic survey which collects data on infant care practices, predominantly risk factors for sudden infant death syndrome.

The ICP Survey collects limited data on infant feeding, including breastfeeding. - The last ICP Survey was completed in 1995/96 (Tuohy et al 1997). A review of the Survey methodology was undertaken in 1998 and planning has begun for a new Survey.

New Zealand Health Survey

Data collection for the New Zealand Health Survey (NZHS), which was linked to the NNS, was completed in 1996/97. A consequence of linking the two concurrent surveys was that the sample frame for the NNS was dependent on the sample frame for the NZHS.

Surveillance Programme

Surveillance projects provide a regular and ongoing source of data about the New Zealand food supply. Key nutrition related surveillance projects include:

The New Zealand Food Composition Database

The New Zealand Food Composition Database (NZFCDB) contains over 2,300 foods for which 49 core nutrients are reported. The NZFCDB includes both New Zealand analysed foods and values from overseas databases.

The Therapeutic Database

The Therapeutic Database (TDB) collects information on ingredients of manufactured foods, as reported by the manufacturers. The main use of the TDB is to provide advice and information about potentially allergenic components of food, for example, egg, wheat and peanut.

More recently the TDB has started to monitor the introduction of foods fortified with vitamins and minerals. The data collected is supplied by the manufacturer and is not analytical. Fortification of a wider range of foods became permissible in January 1996. The New Zealand Government adopted the Australian standard for the addition of vitamins and minerals to foods, just prior to the commencement of the joint food standard setting system in July 1996.

Food Balance Sheets

Food Balance Sheets (FBS) indicate food available for consumption, using data on production, export, import and waste of food. FBS can be used to estimate per capita consumption of macro nutrients, when combined with food composition data.

In 1997 a decision was made to discontinue a central collection of agriculture production statistics in New Zealand. One of the results has been the production of FBS, using the current method, is no longer possible. The Ministry of Health has purchased a feasibility study to investigate whether other data sources exist which would enable continued generation of FBS. The feasibility work will be completed in 1998.

The New Zealand Total Diet Survey

The New Zealand Total Diet Survey (NZTDS) is a periodic survey which analyses selected foods for a range of contaminant elements, pesticide residues and nutrients. The last survey was completed in 1990/91 (Hannah et al 1995; Vannoort et al 1995; Pickston and Vannoort 1995; Vannoort et al 1995). Results from the analytical work are combined with model diets to estimate exposure to contaminants and nutrients in different age groups of the population.

Sampling and analytical work for the 1997/98 NZTDS is currently underway.

DISCUSSION

The importance of food composition data in the setting and monitoring of policy is well illustrated in the following two examples.

1. Iodine

Iodine is a nutrient of particular interest in New Zealand, because soil concentrations of iodine are low. As a result foods grown in New Zealand tend to be low in iodine.

Goitre is the symptom most commonly associated with iodine deficiency, however, over the last ten years, scientists have come to realise that iodine deficiency results in many other health consequences. The term Iodine Deficiency Disorders (IDD) is now used to cover the wide range of effects iodine deficiency can have on growth and development. These effects can occur at all stages of the life cycle, but are particularly important during the foetal, neonatal and infancy phases, which are periods of rapid growth (WHO/ FAO/IAEA 1996).

In the 1920's and 1930's, prior to the introduction of iodised salt, iodine deficiency was fairly common in New Zealand (Hercus and Purves 1939). Salt was originally fortified with 4mg iodine/kg salt in 1924 and then in 1939 increased to the current level of 40-80mg iodine/kg salt. By the 1950's endemic goitre had virtually disappeared.

The 1990/91 NZTDS investigated the concentrations of selected pesticide residues, contaminant elements and nutrients, including iodine in a range of foods. Intake of iodine was estimated using model diets for five different age groups, young child (1-3 years old), child (4-6 years old), young female adult (25 years old), young male adult (19-24 years old) and male adult (25 years and over). The results for estimated modelled iodine intakes were below the recommended dietary intake for all groups (Hannah et al 1995). The estimated intakes did not include discretionary salt.

Recent regional studies carried out by the University of Otago indicate that iodine intake may be sub-optimal in some groups. Two studies, one of healthy adult blood donors in two centres and the other a random sample of Dunedin school children found urinary iodine excretion consistent with mild iodine deficiency (Thomson et al; SA Skeaff, personal communication, April 1998).

Children are particularly sensitive to sub-optimal iodine intakes. The Ministry of Health is currently negotiating with the University of Otago to undertake a more extensive study of iodine deficiency disorders in school children.

Quantification of total dietary iodine intake is difficult, mainly because of the problems associated with quantifying discretionary salt intake. Urinary iodine excretion is routinely used as an estimate of dietary intake, as reported values for urinary iodine excretion tend to reflect dietary estimates (Gibson 1990). The inadequacy of dietary iodine intake as a measurement of status was highlighted in the Dietary and Nutritional Survey of British Adults, 1990, where correlation between urinary iodine excretion and dietary iodine intake was weak. This is not unexpected as no allowances were made for discretionary salt intake (Gregory et al 1990).

The British Survey included qualitative questions on discretionary salt. More than three quarters of respondents reported that salt was generally added to their food during cooking. Men were more likely to "generally add salt to food at the table", whilst women were more likely to add salt either "sometimes" or "rarely/never" (Gregory et al 1990).

In New Zealand it is unlikely that a national nutrition survey will collect urine samples routinely. In the 1996/97 National Nutrition Survey collecting urine was considered, but not included, because of the effect on respondant burden. It is possible that in future surveys urine samples could be collected from a sub-sample of the survey population.

Iodine is not a core nutrient in the NZFCDB, however, in light of recent research on iodine status and the indication that iodine content of the New Zealand food supply may be decreasing, this has been reviewed. At present only 2 percent of the 2320 foods have values for iodine (all of which are New Zealand analysed values). To date, when foods have been "borrowed" from other databases values for iodine have not been completed, even where they exist.

Results from the New Zealand 1990/91 Total Diet Survey indicate that iodine levels in dairy foods have declined since the 1980's. The decline is consistent with the reduction in use of iodophores for cleaning and sterilising equipment which has occurred in the dairy industry (Hannah et al 1995).

While iodine is not a core nutrient on the New Zealand Food Composition Database (NZFCDB) several projects purchased by the Ministry of Health have collected data on the iodine composition of foods, including:

Iodine in Dairy Products (Cressey and Vannoort 1998)

Assessment of Selected Pesticides and Elements, including Iodine in Infant Formulae and Weaning Foods (Vannoort and Cressey 1997) 1997/98 New Zealand Total Diet Survey (in progress)

There is currently no health outcome target for iodine, however, policy documents such as the National Plan of Action for Nutrition recommend that the iodine status of New Zealanders' be closely monitored (Public Health Commission 1995). Food composition data for iodine are needed to track changes in the iodine composition of foods.

2. The National Nutrition Survey

Knowledge about the food and nutrient intake and nutritional status of New Zealanders is critical to the work of the Ministry of Health. The need for improved knowledge was the driving force behind the development of the NNS. The NNS is the third national survey of nutrition to be carried out in

New Zealand. Planning began in August 1995, with an internal Ministry working group and a Technical Advisory Committee of external experts. The University of Otago was selected to develop and carry out the Survey after a tendering process in late 1995. Planning and piloting of the Survey occurred in 1996 and the Survey data collection began later that year. Data collection continued for 12 months, finishing in November 1997.

The clean data set will be delivered to the Ministry of Health in August 1998. The Ministry and the University of Otago will both be involved in analysing the data and producing reports. A final summary report will be available by August 1999.

The NNS was linked to the New Zealand Health Survey (NZHS). The NNS sample frame was dependant on the NZHS sample frame. The sample frame was selected by Statistics New Zealand, who undertook the NZHS. The target population was the civilian, usually-resident population aged 15 years and over. In order to achieve sufficient numbers, over sampling for Maori and Pacific people was included. The final survey sample size was 4,700. The response rate for the NZHS was 74 percent, of whom 80 percent agreed to have their names passed on to the NNS. Eighty-three percent of those who agreed to their names being passed on completed the NNS, giving an overall response rate of 49 percent.

A 24-hour dietary recall was chosen as the primary method for collecting quantitative data. One of the Survey objectives was to monitor the impact of increased fortification of New Zealand foods with vitamins and minerals. For this reason, brand information was collected on all foods where fortification is permitted.

A great deal of time was put into developing a direct data capture programme for the 24-hour dietary recall. The recall was entered directly onto a lap-top computer, in the respondent's home. A bar code scanner was connected to the computer allowing easy identification of the food product if the package was handy.

The multiple pass 24-hour dietary recall draws on the techniques used in the Australian Commonwealth Department of Health and Family Services' National Nutrition Survey and the US Department of Agriculture's Continuing Survey of Food Intakes by Individuals (Quigley and Watts 1997).

A great deal of work has been undertaken to ensure the food composition data needed for the analysis of the survey are available. While the Survey was still in the field frequency data for three, six and nine months were generated from the 24-hour dietary recall. Commonly consumed foods not already on the

NZFCDB were analysed and 200 relevant foods "borrowed" from the Australian Food Composition Database. The Institute of Crop & Food Research worked closely with the University of Otago in the coding of the Survey food list to the foods on the NZFCDB. Over 6,000 recipes were calculated for the Survey database.

In order to quantify the intake of nutrients from dietary supplements a project was undertaken to collect dietary supplement composition data. The values are manufacturer reported label information, not analytical. These values have been included on the NZFCDB.

Analyses will be done to determine mean daily intake of nutrients. Fortified foods will be assumed to have composition as at the start of the Survey, to give baseline data on fortification. The contribution of dietary supplements to nutrient intake will be identified as part of total nutrient intake and separately. The quality of the Survey results is very much dependant on the food composition data available.

Without quality data on food composition it is not possible to make considered decisions about food and nutrition policy. The New Zealand Food Composition Database provides a wealth of information which is utilised in many aspects of monitoring and policy work at the Ministry of Health. The NZFCDB is an essential tool in the setting and monitoring of policy for food and nutrition.

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FOOD COMPOSITION AND THE PACIFIC ISLAND PEOPLE

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HISTORY

From 1948 to the present day the SPC has been concerned with improving the nutrition status of the Pacific Island communities. The programme in the early days collected existing data on the diet of communities and individuals and on maternal and infant welfare.

FOOD COMPOSITION SPECIALISTS

The SPC pioneer of Food Composition in the Pacific was the biochemist F.E. Peters from 1951-1957. He carried out research on the nutritional value of Pacific foods. He operated a laboratory to analyse the nutrient values of the food and produced publications based on his work. In 1957 the *Chemical Composition of the South Pacific Food* was printed with 55 analysed foods as a result.

During the next 20 years this work lay dormant. In 1979 several nutrition surveys were conducted in the PIC's. These reported the increase in lifestyle problems and diseases. A 1981 United Nations Development Programme workshop recommended the formulation and the implementation of National Nutrition Policies to address these emerging problems. In 1982 a technical group considered and agreed that the SPC's Food Composition Tables for Use in the South Pacific be the most suitable publication for nutrition work to be used in the hospitals as well as in the communities by the nutrition workers.

In 1987 Heather Greenfield was appointed as the Food Composition Coordinator. She purchased equipment and arranged training for two Pacific laboratories. She also produced a user questionnaire to determine which Pacific foods should be analysed.

Her replacement John Bailey (1989-1991) coordinated the analysis of 19 commonly-eaten vegetables. The publication *Leaves We Eat* was developed and printed as a result.

NUTRITIONISTS AND FOOD COMPOSITION

Cecily Dignan, a nutritionist and jack of all trades, took over from where John Bailey left off. From then until 1994, the idea of the Food Composition for the Pacific Islands was further developed. This resulted in the publication of the 1994 edition of the Pacific Islands Food Composition Tables. A computer software was also developed as an alternative,

The Nutrition Information and Training Officer, in November, 1994, along with the SPC Agriculture Section coordinated the SPC Pacific Food Composition workshop for regional agriculture and nutrition workers. The Pacific Islands Food Composition Book was launched as well as the Introduction of the Diet 1 software on Pacific Islands Food Composition by Barbara Burlingame, the trainer and facilitator. At the end of the workshop the participants were also able to identify over 300 Pacific foods that were not found in the 1994 Food Composition Book.

Dr Bill Aalbersberg of USP with his staff and students took up the commitment of the missing parts and analysed 78 foods. The results were published in the Pacific Islands Food book in 1996. This data will be added in the future revised 1994 Pacific Islands Food Composition Tables book and the Diet 1 software.

In 1998 a milestone we would like to highlight has been that the translation of the Pacific Islands Food Composition Tables into French. A huge sincere appreciation is extended to Ms Marie Bayle, Mr Herve Pichon (translators) and Ms Caroline Beisner (personal assistant) of the SPC translation unit for the patience and endurance they have shown in order to complete this task. These French language tables are in the draft stage. All this was made possible with AusAID funding.

TARGET GROUP AND FOOD COMPOSITION

Our target groups include everyone from the nutrition workers, chief cooks like the mothers and fathers in the homes, students, teachers, medical students, researchers and all those interested and who are able to use the book. SPC has also continuously used the Food Leaflets to promote the nutrient values and the use of these foods through recipes. Other SPC nutrition/health resource materials are available.

The following are examples of the typical problems/drawbacks communicated to us at SPC:

1. Recently a Wallisian mother with a sick 5 year old girl (kidney problems) had called into the office to seek help. Her litle girl was on a dietary

prescription of 25 g protein per day. The mother who had seen the SPC Pacific Islands Food Composition Book wanted some advice and information on how to use the book. She was interested in the local foods. The problem was that the lady was a French speaker and the book is in English. Fortunately she understood some English.

2.A request had come from the Fiji Food and Nutrition Committee for the nutrient values of the green leaf rosella which was not found in the 1994 Food Composition book. I then asked them to check with Dr Bill Aalbersberg about analysing the nutrient values. Dr Aalbersberg is now working on it. We get to hear about the foods that are not found in the tables. These also tend to be the unusual or less widely used foods in the Pacific Islands.

3.Analysing different mutton flaps, some samples have more fat than others, e.g. to find out the percentage of fat in the mutton flap imported by Tonga, or Samoa compared to Fiji's mutton flaps which has 33% fat.

4.Using graphs to show the nutrient values of the different staple foods, fruit and leaves is a good way of describing the nutrient values of food but need to be reinforced by educating the household family members so that the meanings of the graphs are understood.

5.Xyris software

Any new information from Xyris is normally passed on through the PIN to alert everyone. In March this year, there was a query from USP-Samoa concerning the Diet 1 software. USP-Samoa had already installed a Diet 1 Program before the Food Works and wanted to know if Food Works contain all the information already on Diet 1. The Food Works was mentioned in the December 1997 PIN.

Xyris has also asked if the Pacific Community could make some kind of arrangements to maximise the availability of the Diet 1 software, particularly where multiple copies in a country are needed.

The release of the Diet 1 software in 1994 was a real development but it had come at a cost. In the past most things were provided free through aid funds. Today this data is being offered commercially. Since its introduction its availability to those in need of it in the Pacific is problematic. A good example is the PNG university which cannot input the single software on its server and is required to purchase individual copies of the software.

CONCLUSION

We have witnessed the progress of the food composition from the past to the present day. Two resource materials have stood out, the books being used by the laypersons and the software by the academics who have access to computers. The Food Composition Programme was begun by food composition specialists and ended with the nutritionists at the Pacific Community.

This is the 5^{lh} OCEANIAFOODS conference. As a secretariat member in the SPC nutrition program and a Pacific Islander and having been involved with this group for 4 years I see the value and the merit in the existence of the Food Composition Programme and the support from the OCEANIAFOODS group. This regional and consultative body is like a mother who should remain to look after this specialist job.

I wish you all the best in your future activities.

FIJI FOOD BALANCE SHEETS

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INTRODUCTION

The National Food and Nutrition Committee in 1997 published the first Food Balance Sheets (FBS) report for Fiji relating to the year 1992. This was made possible through the assistance from government ministries and food industries who provided data on production, imports and exports. We also consulted and corresponded with Food and Agriculture Organisation (FAO) statisticians in Rome throughout the compilation of the Food Balance Sheet.

The production of the 1992 FBS was a big achievement for Fiji, where previously we have been relying on FAO to supply data on food availability. Since then, we have published in February this year the second 1993 FBS and are currently working on the 1994 data which will be published soon.

A Food Balance Sheet presents a detailed picture of a country's food supply for a given period of time. It shows the quantities and type of food potentially available for human consumption, sources of supply, and the use of both primary and processed commodities[1]. The daily per capita nutrient content of the available food supply in terms of calories, protein and fats are calculated using FAO International Nutritive Factors[2].

The construction of the Food Balance Sheet involves compiling a wide variety of data from relevant government ministries (e.g Ministry of Agriculture Forests and Fisheries and Bureau of Statistics) and the private sector (food industry). The total amount of food available for consumption is established after adding up all data on local production and imports, less exports and domestic nonfood use and waste. Every attempt is made to account for all losses in the food chain from the farm until it reaches the consumer.

The regular compilation of Food Balance Sheets will show trends in the overall food supply over time, and the changes taking place in the types of food consumed[3]. It will also indicate the extent to which the food supply of a country is likely to meet the nutritional requirements of its population, and the degree of dependence on imported food supply (import dependency ratio). It then becomes a useful tool for planners for a variety of situations including developing trade, food and agriculture policies, and subsequently agriculture and health promotion programmes. The information provided by food balance sheets is also useful to researchers concerned with the food and nutrition situation in the country.

At the macro level, the trend established by the FBS data over the years shows an increasing reliance on imported food. In nutritional terms, this means that imports currently account for more than half of the available food energy. A similar trend has also been observed at the micro level: the decennial nutrition and health surveys undertaken at Naduri Village in the West of Fiji, including a one week household weighed food record, have established similar trends.

It should be noted that FBS cannot give any indication of dietary differences that may exist among different population groups e.g. between low and high income groups, urban and rural areas, and seasonal variations. This kind of information must be derived from dietary surveys throughout the year among different population groups.

FINDINGS

A comparison of the findings of the 1993 FBS against that for 1992 and 1985 is undertaken in this section. Throughout the discussion, food energy is reported in kilocalories.

From 1985 to 1993 the findings indicate an increase in the total nutrients available per capita per day. A corresponding increase in the proportion of nutrients imported is also reported for the same period (see Table 1). This increase in food imports may be attributed to the devastating effects of Cyclone Kina and may also reflect the evolution in agriculture policy to a more export oriented approach.

Table 1: Total Nutrients Available per capita per day and Percentages of Calories imported: 1985 -1993

Year	Kilocalories		Protein		Fat	
	kcals	% imported	Gms	% imported	gms	% imported
1985	2819	42	65	52	67	46
1992	2879	57	73	60	80	64
1993	2910	63	78	65	82	70

(Fiji FBS 1993)

Other significant findings include the following:

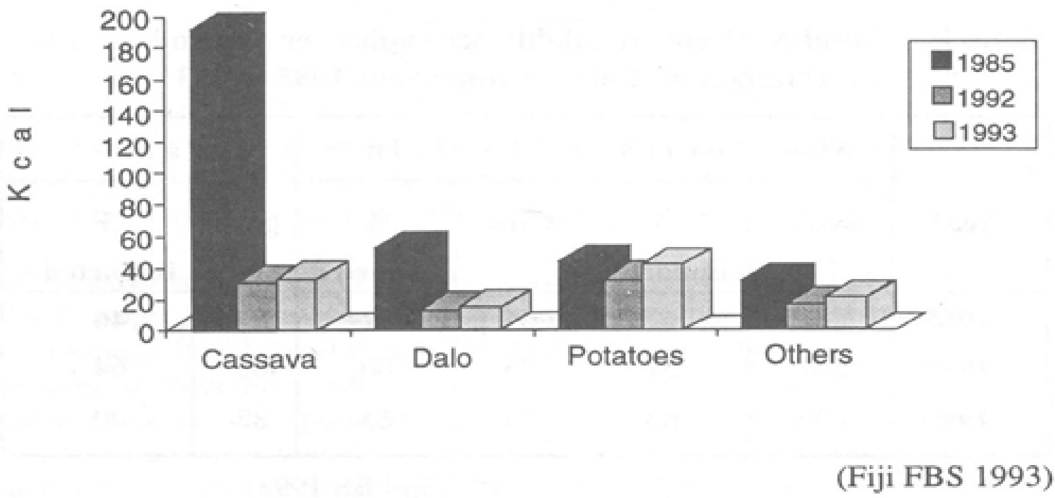
- Cereals - Cereals continued to be the major contributor of food energy to the diet accounting for 47% of total calories available per capita per day in 1993. Daily per capita consumption of cereals has increased over the years from 1089 kcals in 1985, 1351 kcals in 1992 to 1368 kcals in 1993.

Findings from the 1993 National Nutrition Survey confirmed this pattern where cereals are the most frequently consumed energy food especially increasing amongst Fijians[5]. A decennial dietary study carried out in 1994 on a predominantly Fijian population in Naduri Village[6] also reported an increase in cereal consumption.

The change in consumer preference for cereals, due to its ready availability at low cost, and its convenience in preparation for cooking and storage could also be a factor contributing to this increase. Government's deregulation policy and export orientation of agriculture policy may have also favoured this shift in preference from a traditional diet based on root crops to a more cereal-based one.

- Root crops - Of the total 2819 kcals available in 1985 root crops contributed 316 kcals. By comparison, it contributed 107 kcals to the 2910 kcals available in 1993. This declining trend in the consumption of staple root crops is demonstrated in Figure 1 below.

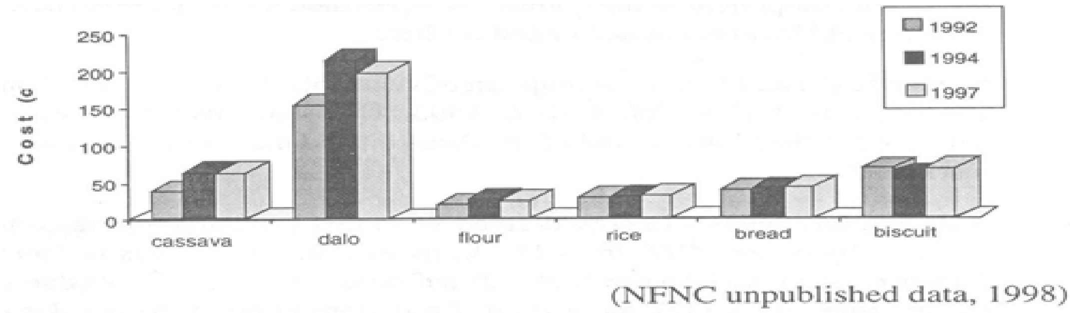
Figure 1: Sources of Kilocalories from Root Crops:



(Fiji FBS 1993)

The export orientation of current agriculture policies may have contributed to the shift in consumption pattern evident from the FBS, by pushing up the price of local staples in the domestic market and consequently making cereals cheaper alternatives. For example in 1994, the average cost of 1000 kcals[7] from dalo (the most nutritious of the root crops) was calculated at $2.00, while that from rice and flour had cost only 32c and 26c respectively. It should, therefore, not be surprising to find more Fijians preferring cereals to replace the more expensive and nutritious traditional staples in their diet.

Figure 2: Cost for 1000 Kilocalories: 1992 - 1997



(NFNC unpublished data, 1998)

•Sugar - Actual sugar available for consumption declined from 32,885mt in 1992 to 29,500mt in 1993. This was a direct result of increased exports despite an increased production over the same period. As expected, total energy available from sugar decline from 446 kcals in 1992 to 382 kcals in 1993, contributing 13% to the total kilocalories available in 1993.

•Pulses - Imports of pulses continued to increase over the years from 4,000mt in 1985 to 7,000mt in 1993. Availability of pulses for consumption increased from 6kg per capita in 1985 to 8.5kg in 1993. Some of this increase may be attributed to the increasing popularity of pulses, especially dhal, amongst Fijians as a cheaper alternative source of protein. Food energy availability from pulses recorded a corresponding increase from 54 kcals in 1985 to 79 kcals in 1993.

•Meats - Meats available for consumption increased from 20kg per capita in 1985 to 33kg in 1993. This increase may be attributed to the high demand for sheep meat which is a cheaper source of protein than beef or poultry. Imports of sheep meats such as lamb chops which recorded 6,000mt in 1985, almost doubled in 1992 and 1993. Poultry imports increased four-fold from 583mt in 1992 to 2,357mt in 1993 due to damage to the industry from Cyclone Kina. As a result, energy availability increased from 118 kcals in 1985, 174 kcals in 1992 to 178 kcals in 1993.

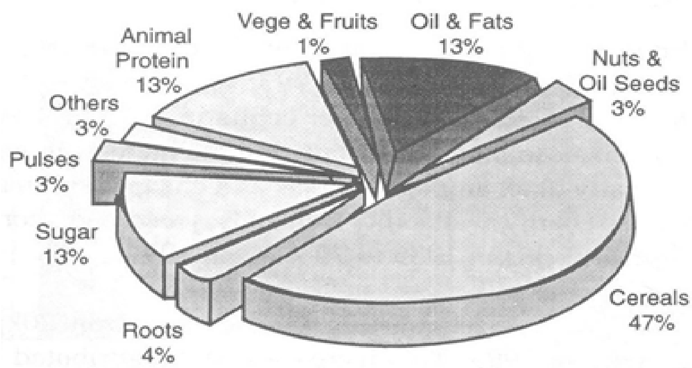
•Fish & Sea foods -More fresh fish was imported by the country's canning industry in 1993 due to shortage of fish from the local suppliers. This resulted in an increase of imports from 5,300mt in 1992 to 10,000mt in 1993. Kilocalories available from fish also increased from 94 kcals in 1985 to 120 kcals in 1993. It should be noted that although fish is still an important component of the traditional Fijian diet, the bulk offish eaten at household level is not accounted for here.

•Vegetable Oil and Fat - Consumption of vegetable oil has doubled from 128 kcals in 1985 to 260 kcals in 1993. This sharp increase may be attributed to the high demand of soyabean oil and margarine in the local market.

•Nuts and Oil Seeds - Energy derived from this category continued to decrease by almost 50% from 183 kcals in 1985 to 93 kcals in 1993. This decrease may be a result of reduced production in coconuts due to falling price of copra in the market. An important point to consider is the exclusion of coconuts consumed at the household level from this analysis.

Following is a summary of the percentage contribution of the above major food groups to the total kilocalories available in 1993.

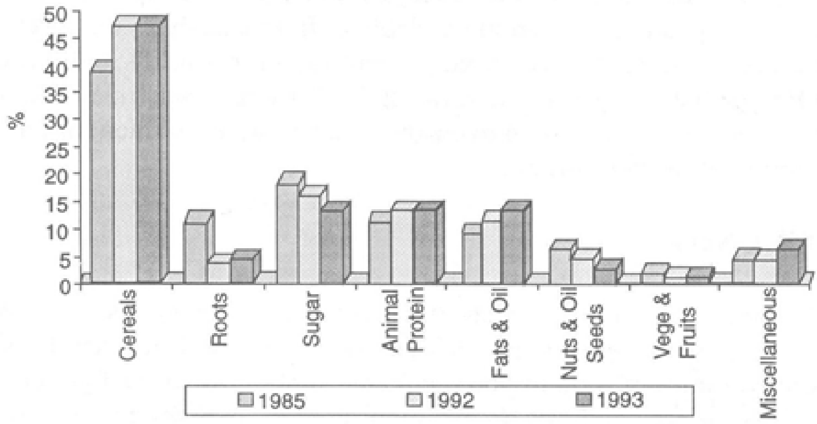
Fig 3: Sources of Dietary Calories - 1993



(Fiji FBS 1993)

Figure 4 below shows trends of the percentages contributed by major food groups to the total available food energy, observed over the period reported on in this paper (1985- 1993).

Fig: 4 Percentages of Total Kilocalories Contributed by Major Food Groups: 1985 -1993



(Fiji FBS 1993)

LIMITATIONS

Preparation of this Food Balance Sheets involved a difficult and painstaking process of data collection. Admittedly, some underestimation is expected due to the following reasons:

a. Unavailability of subsistence production data

A major problem is the unavailability of subsistence production data with the Ministry of Agriculture. The exclusion of data on subsistence production in this analysis meant that an important part of the country's food supply was not accounted for. Subsistence data is always difficult to collect nevertheless its inclusion provides a more accurate picture of food availability in the country.

b. Unavailability of **data from the private sector**

Another major problem faced was the unavailability of data which can adversely affect the accuracy of the Food Balance Sheet. Response to repeated requests for information from food industries was very poor.

c. Lack of consistency in the method of data collection

Data collected by other agencies is undertaken for their own purposes and not for FBS requirements. For example, some food items listed in the FBS worksheet are not classified separately in the trade report or in the agriculture report.

d. Food Composition Tables

Fourthly, the use of a Food Composition Table that aptly reflects our food composition was another problem. In this analysis the FAO Food Composition Table was used, to ensure compatibility with previous FBS published by FAO, and to establish trends over time. This issue needs to be resolved soon to ensure an accurate assessment of our food supply situation in future.

CONCLUSION

Looking at the result of the FBS, the trend to rely on overseas food supplies to supplement domestic production has become more evident over the years. Increasing volumes of food imports will be a continuing trend if government does not place more emphasis on the importance of local food production for local consumption.

Admittedly, more work is still required to refine the methods of data collection and compilation of our Food Balance Sheets. However, the trends established for food availability have been confirmed by food intake studies at the micro-level. The findings have provided a stronger basis for negotiating a range of policies affecting food, nutrition and health in Fiji.

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THE FOOD SUPPLY, FOOD COMPOSITION AND HEALTH

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INTRODUCTION

Associations between population dietary patterns and chronic diseases such as cardiovascular disease, non-insulin dependent diabetes and hypertension are well accepted (Better Health Commission 1986). In the Pacific Islands and Queensland, mortality and morbidity from these diseases are high, particularly amongst Indigenous people and those of low socio-economic status (Coyne 1984, Health Information Centre 1996). Additionally, morbidity and mortality from diet-related diseases are significantly higher in non-metropolitan areas (Balanda and Ring 1990, Epidemiology and Health Information Branch 1993, 1992a, 1992b).

Dietary guidelines for Australians provide recommendations for dietary change in the population (National Health and Medical Research Council 1991) and for many people there are few barriers to implementation of recommended dietary practices because they have easy access to a wide range of good quality food. However, there are population groups where high food cost, poor availability of recommended foodstuffs, poor quality and/or lack of variety may be significant barriers to making dietary change.

This is particularly so in Pacific Island countries undergoing a nutrition transition. The nutrition transition describes the dietary change that occurs within countries as they move from subsistence to cash economies and the associations with urbanism and poverty. This shift is also accompanied by a corresponding rise in non-communicable diseases.

Most Pacific Island countries are becoming increasingly more dependent on imported foods. Most imported foods are highly refined and high in fat, salt and sugar. As a result, consumption of locally grown roots crops, fruits and vegetables has declined. Barriers in the distribution of foods like these are the basis of food insecurity which eventually creates ill-health (Maxwell and Frankenburger 1992).

Information gathered in other studies in Australia indicates that most of the inequalities in the distribution of food occur at the geographic and economic fringes (Gough et al 1995, Hughes RG 1995, Hughes, Lund-Adams, Hey wood 1993). Rural and remote communities fall into these categories and, to compound the issue, there are indications that the socio-economic status of rural dwellers in Queensland is falling (Hughes R 1995). Most Pacific Island countries fall into these categories.

From a public health nutrition perspective the above disparities present a series of questions. Do health patterns reflect differences in the distribution of food? What are the differences in dietary behaviour between people in urban and rural areas? Are these differences attributable to variation in the foods supplied or demanded?

And, what factors influence that demand or supply? Lastly, what issues are raised for nutrition project and program planners?

The hypothesis explored in this paper is that for people who *depend* on food supplied from outside their communities, the types (composition) of foods change with increasing distance and remoteness from the major commercial distribution centres. As a result, the populations of those communities experience different health outcomes.

This particularly applies to Pacific Island countries, where distance and remoteness were not problems in the past because most islands were self-sufficient in food and traded locally. But now most Pacific Island countries depend on an imported food supply controlled by others and subject to change, particularly in price. They are not only on the geographic fringe of food supply systems but now some countries are also on the economic fringe in terms of bargaining-power and economies-of-scale (Hughes AV 1998). For individuals, living on the economic fringe means that they are close to living in poverty.

For individuals, an example of the above hypothesis would be an infant's total dependence on the mother for food (in the form of breast-milk). A change in supply can result in a rapid decline in the health of the infant. An example is a change from breast-milk to formula feeding in developing countries where safe water, sanitation and post natal care are not available and where infectious diseases are endemic. The infant will be placed at risk by the change in supply (and composition).

For dependent populations the associations between the cause and the effect are not as clearly apparent. The lead-time is very much longer and there are many other influencing and confounding factors including heterogeneity, ethnicity and socio-economic status of populations.

In an attempt to understand and explain some of these issues, this paper discusses some of the findings from a major project undertaken to describe the food supply in Queensland and identify the major factors that influence food availability, price, quality and variety, with particular emphasis on rural and remote areas (Hughes RG et al 1997). The implications in the context of food composition and distribution, health and nutrition policy and program development and implementation are also discussed.

Some results from the Queensland study

The aim of the study was to describe the food supply system in rural and remote Queensland, and to identify factors which influence that supply. The study was part of ongoing investigations by the Nutrition Program, University of Queensland, into the food and nutrition system and was funded by Queensland Government.

The study involved a whole range of activities. These included:

•the construction of a database containing details of over 550 food retail establishments throughout Queensland;

•field trips to over 50 Queensland communities and consultations with over 250 people involved in the supply of foods

•the consultation process was supported by surveys of food prices, where a standardised basket of foods was priced and compared to the same basket of foods bought in Brisbane. Other surveys were also made on the availability of fruit and vegetables and food quality.

The focus of this paper is on the way foods are distributed and how the distribution influences not only the types of foods that are available and.ultimately, consumer food choice but also whole community consumption patterns.

The study's first major finding was that the community type was the major determining factor of food availability in most communities. Food availability varied from place to place along with the types of food stores, the prices and quality of food. This was consistent across most of the communities studied and therefore was generalised into community types. These community types can be described as:

1.towns with a national supermarket chain store

2.towns with no national supermarket but with other stores in competition

3.towns with only one food store, and

4.Indigenous communities

This paper will concentrate on examples describing the distribution of food using the first two community types.

In towns which have national supermarket chain stores, all the services you would associate with urban shopping are to be seen (ATMs, specials, LNS, fast-food). The major difference, as one would expect, is that prices were found to be higher, between 6 - 9% more than Brisbane. But differences are more covert in the way foods are distributed.

An example of these differences can be shown in Mt Isa. In the mid '80s, 3 big fast food chains, KFC, McDonalds and Pizza Hut opened in the city. Before they arrived, commercial food service was conducted through corner takeaway shops, milk bars and counter meals in hotels. These were supplied by 3 local grocery and fruit and vegetable wholesalers. A whole range of people were involved in the supply of foods from a variety of sources. When the big 3 opened, they broke their own national records on the amounts of hamburgers, chicken and pizzas which could be sold in the first week of operation. They have become very popular with the people of Mt Isa.

In 1996 there were only two wholesalers left in the city, and those remaining did only 40% of the trade they did before. There are no milk bars, very few small takeaway shops and limited counter meal trade in hotels. However, on most days you'll find large numbers of people queuing for breakfast at McDonalds. Who would have thought 15 years ago that people anywhere in Queensland would be consuming fast-food for breakfast!

The effects not only changed the distribution of food in Mt Isa (that is, the types of foods available) and the composition of the diet but the economy of the city as well. Most of the big fast-food and retail chains are vertically integrated. All their supplies are freighted from their own distribution centres in Brisbane. The only contribution they make to local economies is through employment of a few local people. But more importantly, this kind of distribution has created dependence on an outside food supply, controlled by others, far away just like the supply to Pacific Island countries.

This kind of urbanised, or globalised dependence has, on the one hand, increased individual food choice, but on the other, made an informed choice more difficult. (This seems to be the case in Pacific Island countries.) In other words, there may be more foods to choose from, but the chance of choosing correctly is more difficult, mainly because the control of that choice is taken away from the consumer. This has implications for compliance with such things as dietary guidelines.

In towns with no national supermarket chain (Woolworths or Coles) things are a little bit different. Access to ATMs, EFTPOS and banks are more difficult and costly. Therefore, stores offer more credit facilities because of difficulties accessing cash. Food prices are 9%-58% higher than Brisbane, a much wider range than in the towns with national chain stores.

Some Queensland towns are economically strong and are growing. They do not rely on agricultural production. Good examples of these are the mining towns. They are new (up to 20 years old) and most of the inhabitants are ex city dwellers who earn high salaries and pay very low rents (an example for one Central-West Queensland town was $1500/week and $15 rent for a 3 bedroom house respectively), and are highly mobile (do not intend to stay). But more importantly, these towns are highly urbanised and have an urbanised food supply; just as though a suburb of Brisbane or Sydney were plonked into the Australian bush. The towns have all the characteristics of urban centres (modern air-conditioned shopping centres, cul-de-sacs etc.). They are economically immune to the environment in which they are set.

In rural Queensland there is now a state of transition from the more traditional bush town economy to the urbanised one. From a sustainable, independent, semi-self sufficient one to a temporary, dependent one controlled by the company not the market. The ways and the types of foods supplied and distributed are different. The transition is from the convivial to the more convenient (ie. from pre and post World War 2, European influenced cuisine and food behaviour to one influenced by modern fast-food cuisine). This is now reflected by what is on the supermarket shelves.

Factors that influence the supply of foods

Factors influencing the food supply in rural and remote Queensland can be described and discussed in three distinct areas:

1.Factors involving barriers to access, which involve price, quality and range of foods.

2.Economic factors.

3.Factors involving the access to food and nutrition information, education and services.

Below are details of some factors influencing supply. The list is by no means exhaustive. It is intended to give the reader a feel for the issues involved in the supply of foods.

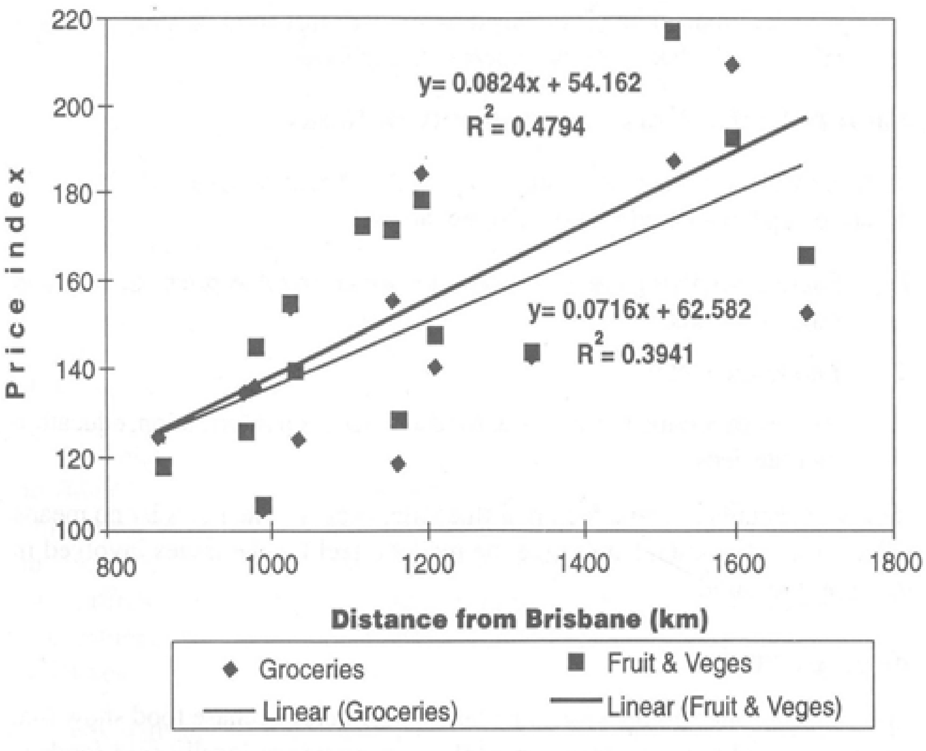
Food prices

Information collected on why and where consumers purchase food show that many rural and remote consumers feel that the price of locally sold foods is high and therefore a barrier to access. Consumers travel long distances to purchase cheaper foods. However, in many cases the savings made from grocery purchases in larger centres is often exceeded by the costs of travelling there. Travelling to the nearby centres seems to be driven by cultural and social reasons as well as economic ones.

Distance and all the logistics associated with it (transport costs, road quality, community size and remoteness) will always be a barrier to the supply of food. With distance prices invariably increase and the range and quality of foods decline. It seems that this is the price one pays for living on the geographic fringe. For those who are also on the economic fringe, their food security will be compromised.

Figure 1 shows that distance only explains 39% of the variation in price for groceries and 48% of the variation in price for groceries plus fruit and vegetables, which translates into an 8% increase for every lOOkms away from Brisbane.

FIGURE 1
Relationship between price indices of fresh fruit and vegetables and grocery with distance from Brisbane in Central West Queensland 1996



Source: Hughes, Read & Marks 1997

9 What explains the rest of the variation in price is the behaviour and actions of:

•store operators,

•government, major institutions and organisations (banks, big business etc.) and

•communities (consumers attitudes and behaviour)

The evidence presented in the findings suggests that the price of foods is a barrier to access for some population groups, which are not identified in this study. However, other studies suggest that those likely to be at risk are the elderly, those without access to transport, those of low socio-economic status and Indigenous people. The factors influencing the price of foods in rural and remote Queensland are economically, culturally and socially based and are complex in nature.

The range of foods available

The range of foods available decreases with distance from Brisbane and remoteness to a lesser extent than price increases. In some Indigenous communities and small towns it is questionable whether the range of foods available is adequate enough to meet dietary guideline requirements. Additionally, the range of foods offered by store operators is fashioned by consumer demand to a greater extent than operator behaviour. However, influences on the operator, such as advertising, tourism and wholesaler specials can have the effect of increasing the range of foods offered in retail food outlets.

Food quality

It seems that all sectors have their own definition of food quality. From the project officer's viewpoint, the quality of food arriving at rural and remote retail outlets is good. However, incorrect transport and storage procedures can quickly reduce the quality, particularly for fresh fruit and vegetables. As a consequence rural consumers in small towns and Indigenous communities tend to buy their fresh produce on the day of delivery.

Urban and rural

With improved communications, sealed roads, television, advertising and the influence from city people (who have migrated to rural towns to work for government and industry), some rural and remote communities are now in a state of transition between the "old ways" and dependence on an imported food supply, an urbanised food supply.

There are nutrition benefits and costs associated with both forms of supply. Traditional economies rely on the skills and ability of individuals to produce, select and prepare their own foods. Urban economies do not. In other words, the foods supplied to urban consumers tend to be value added. The supply of foods relies on the skills of others. Some broad generalisations about characteristics of food supply systems and consumers are listed in Tables 1 and 2. Although there will be exceptions to the generalisations, they show the characteristics of the extreme stages of the transition from rural to urban economies.

One particular exception seems to exist in remote communities in Queensland with only one food store. This especially applies to remote Indigenous communities. A free market economy does not operate in these communities.

Many rural and remote food stores provide a community service over and above the parameters of a commercial enterprise. These include the provision of unofficial banking and credit facilities, personal home deliveries to the aged and infirm (which is a crude form of health monitoring) and the provision of

TABLE 1. General characteristics of food supply systems in Queensland

Rural and remote	Urban
1. Small general grocery stores. Few specialty outlets	1. Large shopping centres including supermarkets and many specialty food outlets
2. Fruit and vegetables available from grocery stores and home gardens. Very few specialty fruit and vegetable outlets	2. Fruit and vegetables avalable from grocery stores and specialty fruit and vegetable outlets in shopping centres
3. Food service mainly from hotels, takeaway shops and service stations	3. Food service mainly from takeaway shops, canteens, cafes and restaurants
4. Relies on personal relationships	4. Impersonal
5. Supplies delivered once or twice per week	5. Supplies delivered every day
6. Small consumer base, of which, a large majority have conservative food habits and demand traditional food stuffs and show resistance to try new and different foods	6. Large consumer base, which includes a large proportion of people demanding pre-prepared ready-to-eat, novel and new foods.

TABLE 2. General characteristics of consumers in Queensland

Rural and remote	Urban
1. Conservative	1. More willing to try and accept new and different foods
2. Independent	2. More dependent on pre-prepared foods
3. Majority able to plan and budget	3. Large proportion with low planning and budgeting skills
4. Majority have high food production and preparation skills	4. Large proportion with low food production and preparation skills
5. Fixed ideas about nutrition	5. No fixed ideas about nutrition
6. Have little contact with nutrition education programs	6. Have many avenues for nutrition education available to them
7. Consume low proportions of fast-foods	7. Consume high proportions of fast-foods
8. Make conscious pre-meditated food choices	8. Make instant food choices from the range offered at stores

communications through fax and telephone and use of store transport links with the major centres. This is particularly so for Indigenous communities where the amount of government control ensures that monopolistic conditions exist.

The lack *of* government support for small business in rural and remote Queensland has been blamed for the downturn of some local economies. In recent years, state, federal and local governments have expressed concern about finding ways to support small business. From the information collected for this paper, rural and remote businesses receive very little support or trade opportunities with government.

Implications for public health nutrition

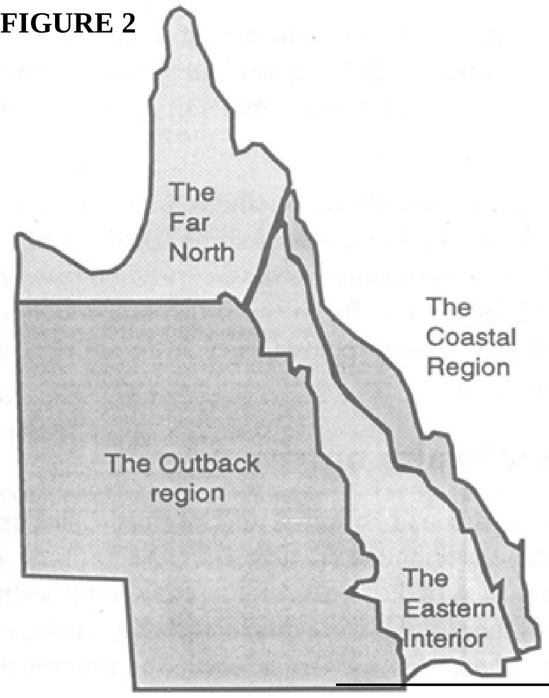
The incidence of diet-related disease in rural and remote Queensland is significantly higher than that experienced in urban areas (Balanda & Ring 1990). Additionally, the majority of key informants connected with health provision in rural and remote Queensland were concerned about the increasing incidence of diet-related disease amongst local residents. Their major concerns were about the high prevalence of overweight and obesity, especially amongst school children, and diabetes and cardiovascular disease.

Figure 2 shows a map of Queensland produced by the Epidemiology and Health Information Branch of Queensland Health. The regions shown are determined by selected mortality rates from chronic diseases between 1983 and 1988. There are significant differences in the rates of individual diet related diseases between these regions as shown in Figure 3. Mortality is the lowest on the Gold and Sunshine Coasts for all chronic diseases except one (skin cancer). However, the further we get from the coast, the higher the rates of diet-related disease.

What is more interesting, and taking a closer look at the boundaries between these regions, we notice that this far-eastern boundary runs along the great dividing range. The interior boundary coincides with the 700mm (or 30in) rainfall line; a very significant line for farmers who grow grain. The northern boundary marks another geo-physical boundary; that of the northern monsoon.

These boundaries not only mark differences in mortality but also geo-physical and climatic boundaries. These boundaries, in turn, reflect the limits of agricultural systems also. In the past, agricultural systems were the strongest influence on the food supply in those regions but now with modern transport, technology and infrastructure, encroaching urbanism, that's not the case. The regions depicted in Figure 2 reflect a past diet, a past lifestyle.

FIGURE 2

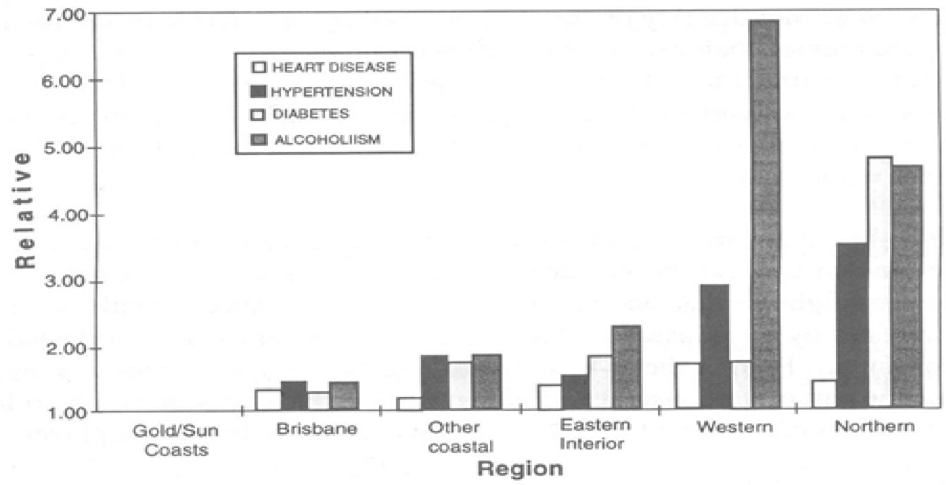


Mortality Regions in Queensland

Adapted from Balanda & Ring 1990

FIGURE 3

Queensland Regional Mortality 1983-88: Selected Diet-Related Diseases



Region

Why should there be such significant differences in these diseases across these regions? Lack of health services looks a highly likely reason but even if the health services were inadequate, the causes (diseases) of mortality are different in different geographic regions.

Through the research done during the Queensland food supply project these same boundaries now seem to follow socio-cultural and economic differences which are replacing the old agricultural systems boundaries. Recent studies in Queensland have found that the socio-economic status of rural Queenslanders is declining (Hughes R 1995) Other studies around the world have shown that socio-cultural and economic differences are more and more reflecting dietary differences. Those who live on the fringe are again the most vulnerable. This is what is happening in Pacific Island countries.

CONCLUSIONS

The study identified that a transition is taking place in remote and rural Queensland from a traditional country economy to an urbanised one. Accordingly, and as part of the transition, food supply systems have changed. In the past, remoteness and distance from distribution centres meant that the range and quality of foods were reduced and foods were more expensive. Now the distribution of food is fast, direct and efficient and very similar to that of the larger cities. It has become an urbanised food supply and is reflected by consumption patterns as indicated by the foods that are available for consumption in remote and rural areas. A similar transition is occurring in Pacific Island countries.

There are nutrition benefits and costs associated with both forms of supply. Traditional economies rely on the skills and ability of individuals to produce, select and prepare their own foods. Urban economies do not. Foods supplied to urban consumers tend to be value added. In general, urban food supply systems create consumer dependence because production, preparation and selection of foods is done elsewhere by industries that define food quality in different terms to that of consumers.

Nutritionally, there are differences between the two diets. However, both are fat-dominated and can be criticised by nutritionists as not adequate. The difference might be that one is a fat-dominated diet independently selected and prepared by the consumer. The other is a fat-dominated diet selected by the consumer. From a diet where the individual has some control (requires skill on the part of the consumer, selection, cooking) to one which is controlled by "market forces" where the consumer is a receiver rather than a player.

The incidence of diet-related non-communicable disease in rural and remote Queensland is significantly higher than that experienced in urban areas, especially heart disease, hypertension, diabetes mellitus and alcoholism. The mortality rates of these diseases appear to increase westward and northward from the south-east cost of Queensland. Socio-economic status also appears to decline with increasing distance from Brisbane.

Geographically, the boundaries of present non-communicable disease mortality regions appear to reflect geo-physical and climatic boundaries. These boundaries, in turn, reflect the limits of specific agricultural systems also. In the past, agricultural systems were the strongest influence on the food supply in those regions but now with encroaching urbanism they are not. Thus, the regions reflect a past diet, a past lifestyle.

Though present mortality reflects a past lifestyle, it is not known how this present transition will be reflected in future mortality patterns. However, it is becoming increasingly apparent that the widening health gap between those who live in urban areas and those who live in remote places is not just about where people live, although those who reside on the geographic and economic fringe seem most vulnerable. It is about people being able to make an informed choice about the foods they eat from an independently controlled food supply.

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GENETIC IMPROVEMENT OF THE PACIFIC ISLAND ROOT CROPS TO INCREASE THEIR NUTRITIONAL VALUES

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INTRODUCTION

Rootcrops, bananas and plantains have been the traditional staples of Pacific Islands peoples for centuries but they have been relatively neglected by most international research institutes and by national food supply planners. However, it is now accepted to give high priority to production and consumption of roots and tubers in view of their important role in improving food security. The genetic improvement of these neglected and under-exploited crops can be oriented towards the improvement of their nutritional values and/or their potential for processing. New products are now necessary to compete with the imported rice in urban markets.

Their genetic improvement is not easy. The traditional crops of the Pacific Islands (bananas, plantains, yam, taro, sweet potato, and kava) are all vegetatively propagated. The high ploidy level of most crops contribute to infertility. Polyploidy also enhances the survival of somatic mutants. Hundreds of cultivars exist as a result of intensive selection conducted by the farmers themselves during centuries. These selected distinct morphotypes are the product of variation in qualitative traits such as pigmentation and variegation due to somaclonal chimeras. Unfortunatelly, genetic erosion is now occurring among local cultivars. It is assumed that many cultivars will eventually disappear if no major steps are taken to preserve them. It is therefore urgent to evaluate their physico-chemical characteristics and to attempt to improve them.

This paper presents our ongoing major projects on four major traditional rootcrops (yam, taro, sweet potato and kava).

1 - YAM *and the South Pacific Yam Network: SPYN*

The greater yam, *Dioscorea alata* L., is the most widely distributed species of the genus *Dioscorea* in the humid and semi-humid tropics. It is an important food in Pacific Islands where it has considerable social and cultural importance. Traditionally, farmers maintained a wide range of genetic diversity, but as pressures on land availability have increased, fewer cultivars are grown. In addition, the lack of information on starches hinders the prospective utilization of yam as a high quality vegetable. As a first step, a thorough evaluation of genetic resources of the crop is required.

Yam genebanks exist in several countries as a result of collecting activities of the 1980s. Some descriptions and evaluations have been made, but the information has not been collated properly, so that selections can be made, bulked and distributed to growers. Collections are poorly conserved and international exchange is impossible due to quarantine concerns. This neglect of the crop has led to a decline in production and a loss of genetic resources. No one country is self-sufficient in yam genetic resources, so there is much to be gained from developing a regional network which facilitates the sharing of resources, safeguards germplasm for future use, keeps countries informed of activities worldwide, and provides a means to achieve a more strategic approach to yam improvement generally and to select varieties of desirable characteristics for processing.

The *South Pacific Yam Network* is presently:

reviewing yam genetic resources in five Pacific Islands countries (New Caledonia, Vanuatu, Fiji, the Solomons, and Papua New Guinea), characterizing and evaluating the germplasm to rationalize collections and to select cultivars of interest.

A computerized database is being developed containing morphological and molecular descriptors on at least 1,250 cultivars, allowing:

a)comparison and rationalization of collections; and
b)selection of 150 cultivars for compact tuber shape, unstaked cultivation, tolerance to anthracnose and acceptable cooking and processing characteristics.

This project is funded by the European Union and involves five yam producing countries, working with research institutions in Europe over a period of 4 years. The project builds on the results of work previously carried out on yams in Pacific Island countries, aiming to solve the problems which still exist by developing regional collaboration and by using modern biotechnologies.

Physico-chemical characteristics of starches. For yam, the starch quality is of upmost importance. It is, therefore, essential to study the physico-chemical characteristics of the starches from all the cultivars selected for the core collection. Analyses include: percentage starch yield on a dry basis, viscosity, swelling power and solubility, gelatinisation temperature range, amylose content, least gelling concentration and gel consistency. The 150 selected genotypes will be grown in a controlled environment to avoid genotype/ environment interactions affecting starch quality. CIRAD is conducting the tests.

Preliminary Results

During the first phase of this study, isozyme variation was analyzed among 269 cultivars originating from the Pacific, Asia, Africa, the Caribbean and South America in order to have an idea of the genetic variation existing within *D. alata* at the isozyme level. In the second phase, 131 local cultivars were grown in a common garden in New Caledonia and their morphological, isozymic and physico-chemical variations were analyzed and compared in order to reveal potential agreements between distinct levels of variation and to identify potential molecular markers.

Physico-chemical characteristics of the tubers: Fresh tubers were hand-harvested and peeled. A central transverse section of the tubers was cut for each accession and their heads were removed. Approximately two to three kilograms of fresh weight were manually sliced in chips by hand and sun dried. The dried chips were ground in a stainless steel mill to pass through a l mm screen. *Nutrient analyses:* Residual humidity, nitrogen (N), total minerals (M), Potassium (K), Phosphorus (P), starch (STA), and total tannins and polyphenolic compounds (TA) were determined according to AFNOR (Association Francaise) or EEC methods. Crude protein contents (PRO) were calculated as N x 6.25. The calcium detection was based on a flame photometric method after acid mineralisation.

Results obtained by the physico-chemical analyses of the tubers are presented in Table 1. Most of the physico-chemical characteristics are highly variable as shown by the minimum and maximum values. Consequently, future clonal selection will have to take into consideration the values of the major characteristics (DM, PRO, STA, TA), especially if processing is envisaged. Simple linear correlation analysis between various variables are presented in Table 2. Only two cultivars (nos. 90 & 205) had a dry matter content lower than 20% of the fresh weight, 36 cultivars had a DM content between 20 and 30%, and only one (no. 247) had a DM content above 40%.

Cluster analysis conducted on the matrix 131 cultivars x 7 variables (M, **PRO,** Ca, P, K, STA, TA) clearly differentiated three major groups and one individual, characterized by a very high starch content. A first group with only four cultivars (nos. 90, 100, 205, PC2) had a starch content of less than 65% of DM, a low DM and a very high polyphenolic compounds content (>0.3 %). A second group represented cultivars with tannins and polyphenolic compounds content close to nil (< 0.1 %) and a starch content above 75%. A third group was represented by cultivars with starch content comprised between 65 and 75% and polyphenolic compounds content between 0.1 and 0.3%. The four morphological groups revealed in New Caledonia are not in agreement with the three zymotypes groups. Closely related morphotypes are found in different zymotypic groups and related zymotypes are found in different morphological groups. For example, the limits of the morphological classification are emphasized by the fact that two selected and popular cultivars known as *'Noumea blanche'* and *'Noumea rouge'* are classified in groups 1 and 3 respectively, but are just distinct somatic mutants of the same clone exhibiting identical zymotypes.

The morphological and chemotype groupings do not correspond to the isozyme groups. Our results show that no correlations and agreements could be found between morphological patterns (pigmentation, lamina shape and color), the physico-chemical characteristics of the tubers (DM, PRO, Ca, P, K, STA, TA) and the isozyme banding patterns. The same could be said for the physico-chemical variation, many of these characteristics have probably been selected empirically by farmers over centuries (dry matter, starch and polyphenolic compounds contents, for example). No correlations of any characteristics could be connected to "good taste" or specific palatability and it is therefore assumed that other compounds might be involved. However, cultivars with high dry matter content would be desirable for processing into dried chips for potential urban markets. The variability of the physico-chemical characteristics is so important that future characterization of germplasm will have to consider it before clonal selection of elite cultivars.

Dioscorea alata is a traditional crop in many societies and methods of cultivation are consistent with maintaining the fragile ecosystems of the lowland areas where they are cultivated. It is also a crop with potential for increased commercial exploitation. However, several problems are limiting its development: tuber shape is often irregular making harvest time-consuming and labor-intensive, anthracnose disease is always a threat, and staking is expensive and demands materials that are often in short supply. In addition, the lack of information on starches hinders the prospective utilization of yam as a high quality vegetable. As a first step, a thorough evaluation of genetic resources of the crop is required. Our study has shown that characterization techniques are useful for organizing germplasm collections and screening numerous accessions. The same approach could be used successfully to screen several hundred accessions throughout Melanesia.

Table 1: Variation of tuber physico-chemical characters from 131 New Caledonian cultivars *of Dioscorea alata* (expressed in %).

	DM	HR	M	PRO	Ca	P	K	STA	TA
Mean	31.4	4.4	3.77	8.52	0.05	0.19	1.54	74.5	0.06
Std-deviation	3.7	0.99	0.43	1.43	0.01	0.04	0.19	4.17	0.11
CV%	11.8	22.6	11.4	16.8	20.0	21.1	12.3	5.6	18.3.3
Variance	13.6	0.99	0.18	2.05	0.00	0.00	0.04	17.	0.01
Minimum	15.1	1.5	2.9	4.9	0.02	0.10	1.10	56.5	0.00
Maximum	40.1	8.3	4.7	12.4	0.10	0.32	2.12	83.2	0.5

DM = Dry matter after sun drying (% of fresh weight) ;
HR = Residual humidity at 103°C (% of DM) ;
M = Minerals (% of dry matter);
PRO = Proteins, N x 6.25 (% of DM);
Ca = Calcium (% of DM) ;
P = Phosphorus (% of DM);
K = Potassium (% of DM);
STA = Starch (% of DM) ;
TA = Tannins and polyphenolic compounds (% of DM)

Table 2: Simple linear correlations between various tuber physico-chemical characters

	DM			PRO				STA	TA
DM	1.0								
HM	-0.972*	1.0							
M	-0.369*	0.410*	1.0						
PRO	-0.102	0.114	0.536*	1.0					
Ca	0.031	0.012	0.016	0.064	1.0				
P	-0.284*	0.31*	0.625*	0.460*	-0.160	1.0			
K	-0.327*	0.360*	0.727*	0.412*	0.032	0.464*	1.0		
STA	0.523*	-0.572	-0.404*	-0.334*	0.027	-0.374*	-0.264*	1.0	
TA	-0.442*	0.440*	0.142	0.034	-0.066	0.150	0.087	0.453*	1.0

*** significant at 1% level, tabular value for r: 0.2540**

DM = Dry matter after sun drying (% of fresh weight) ; HM = Humidity of total minerals (% of dry matter); M = Minerals (% of dry matter); PRO = Proteins, N content x 6.25 (% of DM); Ca = Calcium (% of DM); P = Phosphorus (% of DM) ; K = Potassium (% of DM); STA = Starch (% of DM); TA = Tannins and polyphenolic compounds (% of DM).

2 - TARO *and the Taro Network for Southeast Asia and Oceania: TANSAO*

Taro has much potential in terms of processed and fresh products. Even though taro corms have been available for years and have been processed into a few products, it is one of those crops which is not readily adapted to modern processing technologies. From the food technologist's standpoint, there are several major problems which we must overcome in order to fully utilize this particular crop (the corms) for processing. Taro corms do not present a uniformed shape at harvest, thus making it difficult for mechanical peeling, and marketing. Internal color of raw taro corms ranges from white, yellow, pink to a combination of colors. Food ingredient manufacturers probably would like to have the color of taro as light as possible. The texture of taro corms varies themselves after cooking. One of the major problem in using taro as a fresh vegetable is the presence of acridity principle in the corms and the leaves. The lack of information on the physico-chemical characteristics of the starches hinders the prospective utilization of taro as a high quality vegetable. The shelf-life of fresh taro corms ranges from two to three weeks or several months depending on the variety.

The overall objective of our project is to enhance the competitive position of taro in cropping systems of S.E. Asia and Oceania and to select varieties with high commercial potential, fresh and processed. This will be achieved by improving quality and resistance to pests and diseases of taro cultivars, and by increasing the efficiency of production.

The specific objectives of this four year (1998-2001) project are:

- to characterize approximately 1,700 taro accessions and analyze its genetic diversity using morpho-agronomic traits (30 international standardized descriptors) and molecular markers, using both isozymes and AFLPs;

- to make available a wider range of germplasm to participating countries as part of a regional network of *in vitro* genotypes exchange. About 170 selected and indexed genotypes will be distributed to broaden the genetic bases of national breeding programmes;

- to identify sources of *DMV, ABVC* viruses and *Taro Leaf Blight* resistances and to introduce them in targeted crosses (not more than 50 crosses in each participating country);

•to assess the genetic diversity existing between *Phytophthora colocasiae* isolates originating from participating countries using isozymes and RAPDs markers;
•to study the physicochemical characteristics of starch from 170 selected genotypes;
•to identify and overcome barriers to progress in taro breeding and develop adequate breeding strategies based on data obtained from molecular and agronomical studies;
•to implement the *TAro Network for South-East Asia and Oceania (TANSAO)* and coordinate evaluation and breeding efforts, to enhance cooperation between participating countries and to establish an efficient means of sharing information.

The participants are: *CIRAD*, *WAU* in the Netherlands, *LIPI* in Indonesia, *UPM* in Malaysia, *DAL* in Papua New Guinea, *PRCRTC* in the Philippines, *HRI* in Thailand and *INSA* in Vietnam.

Chemical and physicochemical characteristics of cultivars selected as parents for targeted crosses are studied for the characteristics of their starch: percent yield calculated on a dry basis, viscosity, swelling power and solubility, gelatinisation temperature range, amylose content, least gelling concentration, gel consistency and oxalate crystals content (and its relation with acridity). The selected genotypes (170) are grown in a controlled environment to avoid genotype/environment interactions affecting starch quality

3 - KAVA, *the improvement of a traditional beverage*

Analysis of the composition of kava rootstock indicates that fresh material on average is 80% water. In very humid climates, the recovery of dry kava from green kava is about 25-28%. When dried, rootstock consists of approximately 43% starch, 20% fibers, 12% water, 3.2% sugars, 3.6% proteins, 3.2 % minerals and 15% kavalactones, although the kavalactone component can vary between 3% and 20% of rootstock dry weight, depending on the age of the plant and the cultivar.

Although such kavalactones as kavain and methysticin can now be synthesized, these synthetics do not induce the same physiological effects as the natural extract. The efficacy of kava evidently does not stem from a single active substance but rather from a mixture, a blending of several kavalactones that results in a synergistic physiological effect. The six major kavalactones account for 96% of the lipid extract. These kavalactones are numbered to define cultivars chemotypes (1= demethoxy-yangonin, 2= dihydrokavain, 3= yangonin, 4= kavain, 5= dihydromethysticin, 6= methysticin). Chemical compositions can be coded by listing in decreasing order of proportion the six major kavalactones in the extract. These six active substances comprise a natural cocktail that induces different physiological effects according to the particular kavalactone mixture. This is because different kavalactones have different physiological properties and are metabolized differently.

Drinkers generally do not appreciate the effects of cultivars containing high percentages of dihydrokavain and dihydromethysticin; chemotypes with high percentage of kavain and low percentage of dihydromethysticin induce the most desirable psychoactive effects. This can be explained by the fast absorption of kavain, which causes a sudden high, compared to the much slower absorption of dihydromethysticin and dihydrokavain, major components of the so-called " two-days kava " that frequently produce nausea. For example, a good variety has a chemotype of 421635 and unpleasant ones have 521634. Kava cultivars were selected by farmers who based selection on assessments of pharmacological effects produced from daily consumption of kava. Traditional use in the South Pacific has not been associated with any severe side effects or toxicity, although frequent use of high doses causes a reversible dermatological condition (known as *kanikani* in Fiji). However, it is unclear yet why this kava dermopathy is fairly unusual in Vanuatu, although occuring, where the roots are always consumed fresh.

Kavalactones cause a greater biological effect when given in combination, possibly because these compounds are more readily absorbed when consumed as part of the mixture. Kava constituents have been shown to have sedative, hypnotic, anticonvulsant, muscle relaxant, anesthetic, antimycotic, anxiolytic properties and the pharmacological effect is obviously dose dependent. The Aboriginal experience indicates that very heavy use may possibly lead to adverse health effects from chronic high dose ingestion. However, clinical trials with standardized kava extracts and with synthetic kavain have shown pharmacological activity comparable to benzodiazepines without the associated side effects. Unlike benzodiazepines, kava has not been shown to be addictive or to lead to dose tolerance. Thousands of years of kava consumption in the Pacific Islands have not produce noticeable harmful effect. There is tremendous potential for improvement and the study of genetics of kava (our ongoing project) might produce varieties with more than 40% of kavain content.

4 - SWEET POTATO selection for high beta-carotene content

Our current collaboration with the *International Potato Center* (CIP) in Bogor, Indonesia, focuses on the genetic improvement of sweet potato for tuber shape, skin color, flesh color, dry matter content and beta-carotene content.

Half-sibs progenies are produced via controlled crosses and are highly heterozygous (sweet potato is tetraploid). Tremendous segregations of the desired characteristics are therefore exhibited in the field. The first selection process consists in screening hundreds of cultivars and eliminating undesirable traits, such as white skin color and white flesh color. This is fairly easy to conduct in the field and is unexpensive. High beta-carotene content is assessed visually and white fleshed genotypes are discarded.

Dry matter content is evaluated during the first two cycles and tuber shape and yield are scored only during the last two cycles. Overall, only four cycles are necessary to screen more than a thousand genotypes. The variability of scored traits is recorded and given to breeders who select the next parents accordingly.

CONCLUSIONS

The Pacific Islands traditional rootcrops can be genetically improved to enhance the characteristics of their nutritional values. However, hundreds of cultivars exist that need to be collected and analyzed for the physico-chemical characteristics of their starches, before suitable parents are selected for breeding programmes. There is also tremendous potential for new processed products targeting the urban markets but more data are needed on the variability of the useful characteristics for the food industry.

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MICROBIOLOGICAL ASSAY OF VITAMINS – RECENT IMPROVEMENTS AND QUALITY ASSURANCE

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Microbiological assays are the most commonly used methods of analysis for vitamins in foods. However, as in any chemical assay, it is essential that all data generated using this assay are reliable. Data quality is governed by the system of activities that are designed to ensure production of values of appropriate quality.

In microbiological assays, three important areas where activities need to be controlled are in the control of the environmental factors, treatment of the microorganism including the medium of growth for the organism and the steps in the procedure followed for the analysis. This paper will discuss the steps in the analysis where precautions have to be taken to assure quality of the data.

The microbiological assay has been widely used in the quantitative determination of vitamins. The microbiological assays for the B-group of vitamins was first proposed by Snell and Strong (1939). It is important to minimize error and obtain precise, accurate results just as in any chemical assay. This calls for a good quality assurance system to be followed to achieve reliable data through this assay.

In practice, quality assurance is the sum of all the activities taken to ensure that the information generated by the laboratory is correct (Wilcox *et al*, 1978). This has to be a system deliberately used and not left to chance (Greenfield and Southgate, 1992). Quality assurance is implemented in three major modes:

1. **Preventive-** steps taken prior to the analysis intended to ensure accuracy

in analytical testing (e.g., maintenance and calibration of instruments, testing of reagents, training of personnel).

2.**Assessment**- procedures undertaken during testing to determine whether the test systems are performing correctly (e.g., the use of standards and blanks, maintenance of calibration charts, etc.)

3.**Corrective**- action taken to correct the system when error or possible error is detected (e.g., equipment recalibration, replacement of reagents, etc.)

This paper will deal with quality assurance procedures for microbiological assays of vitamins in particular.

The first procedure is of utmost importance for any microbiological assay and this paper will highlight the importance of the preventive measures to be undertaken for the assay to be valid.

Preventive measures

Preventive steps could be taken in the control of environmental factors such as ensuring a clean sterile laboratory to avoid any contamination. The assay itself should be performed in a laminar flow cabinet in order to ensure that there is no contamination.

The analyte is susceptible to light destruction and hence UV rays should be avoided during the actual analysis. Special lighting for this purpose may be useful. However, in the absence of special lighting, precautions such as covering the assay tubes with aluminium foil have been found to be effective.

Reagents

The microorganism is considered to be one of the main reagents for the assay and it is important to make sure that the right organism is used and is authentic. The test organism on arrival in the laboratory has to be reactivated depending on the form in which it arrives. The reactivation itself is done by incubating the test organism in appropriate agar medium for 24-48 hours at 70°C followed by at least consecutive stab cultures before preparation of the inoculum. During the subculturing process the organism is tested for its validity by streaking it on to the agar appropriate for the microorganism (lactobacillus agar for folic acid). The distinct colony of the organism is isolated and grown on the right medium. The nutrient broth if stored in the refrigerator should be wanned to 37°C to avoid stress for the bacteria. Saline washing for the cells before inoculation is also maintained at 37°C to avoid stress of the cells due to temperature change.

All reagents including the standards (pteroyl glutamic acid) should be pure as far as possible. All equipment involved in the analysis such as analytical balance, pH meters, incubators and spectrophotometer should be calibrated. Sterile dedicated glassware is ideal. Only fresh distilled water should be used throughout the assay.

Procedure

Preparation of the sample extract is crucial and should be adjusted to the correct pH. In the preparation of the actual assay tubes, it is important to maintain an anaerobic environment at the bottom of the tube. For this reason, the standard and the sample solutions are first added followed by the buffer and then the media for growth.

The inoculum size is important for the assay i.e., the amount of inoculum and the concentration of the inoculum in saline is crucial. To avoid problems with the growth of the organism, the absorbance of the pure washed cells suspended in the saline is measured on the spectrophotometer before the actual inoculation into the standard and sample tubes. The sole aim is to ensure that the inoculum itself does not contribute to the turbidity after incubation.

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FOLATE ASSAY - IMPORTANCE AND PROBLEMS

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Microbiological assays are becoming more important in the analysis of folic acid in foods, one of the main advantages being the ability of the assay to detect low concentrations in foods. However, there are several problems in obtaining reproducible data as the assay itself depends to a large extent on the skills of the analyst. This makes quality assurance procedures very important. The concentration of the de-conjugation enzyme used on the test sample for the measurement of total folates and the inoculum size/concentration of the microorganism *(L.casei)* used for the assay seem to be crucial as these have been identified to be the main areas of concern which when ignored can result in very inconsistent results. This paper will highlight the steps at which problems can occur during the analysis.

The microbiological assay of vitamins still poses a big challenge to the analyst. Problems are usually encountered in laboratories which are not familiar with the nature of the assay, and also with first-time analysts themselves apart from the inherent problems of the assay. The technique and skills of the analyst are considered to be extremely important in producing reproducible results.

A majority of the problems can be solved with having a proper quality assurance system in place. This paper will highlight some of the problems in analyzing folic acid in foods using the microbiological assay.

Problems that are inherent to the assay are:

1.Time (the total time for the assay as well as the stringent time schedule to be followed for every step during the assay).

2.Routine subculturing of the microorganism *(Lactobacillus casei).*

3.The need for repetitive assays to be run using known concentrations of the standard solutions in order to ensure reproducibility of the data obtained.

Some of the other problems encountered during the assay are:

1. Extraction procedure that can have an effect on the folate content of the sample.

2. Concentration of the enzyme for de-conjugation used for the hydrolysis *of* polyglutamate into monoglutamate forms that are measurable. The paper will focus on two major problems encountered in our laboratory.

The main difficulty encountered with the assay was with the analysis of total folate, particularly when chicken pancreas enzyme was used for the de-conjugation procedure. Several assays were considered invalid initially because of very high deconjugase enzyme blank readings on the spectrophotometer. The reason for this problem can be attributed to the fact that chicken pancreas itself contained considerable amounts of folate (Keagy, 1985).

Some of the steps taken to counter this problem are now discussed. Different concentrations of the chicken pancreas enzyme were taken to identify the correct concentration to be added to the samples (in this case the sample was pasta). The lowest concentration was 0.5mg/ml. The folate levels in the samples were considerably lower than when higher concentrations (3mg/ml and 5mg/ml) were used. This indicated a possibility that the effectiveness of deconjugation was lowered as a result of using low concentrations of the enzyme. However, this was not without further problems as very high enzyme blank readings were encountered and the assays had to be invalidated. This further suggested that the enzyme may not be effective on high carbohydrate foods such as pasta. The problem could be solved by the use of higher volumes of the sample (6-8ml instead of 1ml). This clearly indicates that the concentration of the chicken pancreas enzyme should be determined for every food type.

The second most important problem was that the inoculum concentrations needed to be determined for every assay. The growth response should not exceed the 1 ng reading on the spectrophotometer. Correlation between the different concentrations of the standards and the growth response is crucial for every set of assays run.

On a number of occasions the assay was made valid based on the inoculum concentrations used for the assay indicating that this aspect of the assay is very important.

The two steps namely, the use of chicken pancreas for the de-conjugation step and the concentration of the inoculum are crucial in the analysis as these are the stages during the assay where extreme care needs to be taken in order that the assay is made valid.

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FOLATE ANALYSIS: IMPORTANCE AND ROBLEMS.

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INTRODUCTION

Folic acid is a vitamin which is essential to sustain the rapid growth of cells. Folic acid exists mainly in the reduced form in the body as well as in food but is usually attached to a series of glutamate residues. Folates are important in several reactions including the synthesis of purines and thymidylate, which are precursors of DNA, and in the conversion of homocysteine to methionine (Christopherson, 1996). Folate deficiency therefore results in an increase in plasma homocysteine and inability of cells to divide due to the lack of synthesis of DNA. (Christopherson, 1996).

Folate deficiencies in the diet have been associated with an increased risk of neural tube defects during pregnancy and there is evidence that folate deficiency may increase the risk of cancer. Supplementation of the diet with folate is therefore likely to reduce the incidence of birth defects, may reduce the incidence of cancer and may also reduce cardiovascular disease by lowering the levels of homocysteine arising from metabolic problems. (Bower, 1996) (Wilcken, 1996) (Fenech, 1996).

As a consequence considerable interest exists in the levels of folate in the diet which can only be calculated from reliable food composition data and food consumption patterns established from dietary surveys.

FOLATES : WHAT ARE WE TRYING TO MEASURE?

Considerable confusion exists amongst members of the food industry and perhaps in nutrition circles regarding the form in which folates occur in nature and those which may be used for fortification of food.

Folate is a term which includes all forms of folic acid, many of which can be found to occur naturally in food. The many forms include free folic acid, the reduced forms of folic acid and the polyglutamate forms of folic acid. It appears that folate in all its forms contributes to the folate content of the diet. Natural folates exist as reduced forms of tetrahydrofolate and are predominantly attached to a polymeric chain of glutamate, the most common forms in food being 5 methyl tetrahydrofolate (5MeTHF), tetrahydrofolate (THF) and 5 formyl tetrahydrofolate (5CHOTHF). 5MeTHF predominates and is the circulating form in humans. Free folic acid otherwise known as Pteroylglutamic acid (PGA) is the monoglutamate of pteroic acid and is produced synthetically. It is used for fortification of foodstuffs and supplements. The good sources of folates include yeast, liver, wholegrain cereals, selected fruits and green leafy vegetables.

In measuring the levels of folates in foods we therefore need to use methods which are capable of measuring either the total folate content of food including all forms or to measure the individual forms of folate and therefore arrive at a total folate level by calculation. Whilst the latter approach provides more information which may prove to be useful in the future as the role of individual folates in the diet is better understood it is more difficult and until recently not a practical option.

A simpler approach is to convert all forms of folate to one that can be measured and hence arrive at a total folate content of the food under examination.

METHODS OF ANALYSIS

The most commonly used method of analysis is by microbiological assay following a deconjugation step which converts the polyglutamate forms of folic acid to the mono or di glutamate and then measures the total folic acid.

Individual forms of folic acid can be measured by high performance liquid chromatography (HPLC). Methods have been developed to measure PGA, THF, 5MeTHF and 5CHOTHF. The deconjugation of polyglutamate forms of folic acid is a neccessary step prior to HPLC. The HPLC methodology can be described as complex due to the need to cleanup sample extracts or separate the individual folates from interfering materials and concentrate the extract prior to injection into the HPLC.

MICROBIOLOGICAL ASSAY OF TOTAL FOLATES

The assay consists of three main steps including extraction, deconjugation and the determination.

EXTRACTION

Extraction is generally performed using a buffered solution adjusted to a specific pH. Various workers have used different buffers and pH conditions to achieve complete extraction of all forms of folate. The folate compounds are all water soluble and therefore relatively easy to extract. Extraction must be carried out in the presence of an antioxidant such as ascorbic acid as the reduced forms are unstable resulting in an underestimation of total folate.

DECONJUGATION

Deconjugation is necessary prior to the determination step to convert the polyglutamate forms to a form which can be measured. This deconjugation is performed using an enzyme known as conjugase which splits of the glutamate chain at the-mono or di chain length depending on the source of the conjugase enzyme and the conditions of the deconjugation.

Several different sources of conjugase enzyme have been used including chicken pancreas, hog kidney, rat serum and human plasma. Conjugase from chicken pancreas produces the diglutamate form, other sources produce the monoglutamate form (Goli, 1992). The specific conditions used for the enzyme to successfully achieve complete deconjugation are critical to the success of the assay. The choice of the most appropriate source of the deconjugase enzyme is dependant on the availability, cost, efficiency of conversion of all forms of folate to one which is measurable and the influence of inhibiting factors extracted from selected foods.

We have chosen not to use chicken pancreas due to the lower response of the organism used in the microbiological assay to the diglutamate of folic acid compared to the monoglutamate (Goli, 1992). Hog kidney is an alternative used in some laboratories but is not always available in Australia in purified form being subject to importation restrictions adding to the problem of reliability of supply. Purification of local hog kidney requires special equipment and was not considered an option in AGAL. Rat serum is difficult to obtain and may also require purification. Human plasma is readily available from Red Cross, requires no purification and effectively converts all forms of folate to the monoglutamate form that the microorganism will respond to. It is also the source of the conjugase which converts the folate we eat into forms usable in the human body.

It is reported that decojugation using hog kidney, human plasma and chicken pancreas is inhibited by citrate and other unnamed compounds extracted from food (Goli, 1992). The use of excess deconjugase is considered a solution to the problem however it is difficult to generalise as no detailed study has been performed on deconjugation efficiency covering a broad range of foods and limited work has been performed to identify those foods where inhibition may cause a significant underestimation of folates.

MICROBIOLOGICAL ASSAY

The microbiological assay measures the growth response of a particular organism which is folate dependant. The most common organism used is Lactobacillus casei var. rhamnosis although Streptococcus faecalis has been used by some workers.

The response of the organism to the various forms of folate was considered to be equivalent however this has been shown to be dependant on the conditions of the assay. One of the criticisms of the early data published in McCance and Widdowson's "The Composition of Foods" is that the folate levels reported are low due to the lesser growth response under the conditions of the assay. An adjustment of the pH from 6.9 to 6.2 was seen as essential to obtain equivalent growth response for all forms of folate.

The microbiological assay has a narrow window or range where the level of folate in the sample extract produces a measurable growth response which can be compared with a standard curve for calculation of the result. Growth response is measured by determination of the turbidity of a suspension of cells in a spectrophotometer. Too much growth and the transmission is near 0%, too little growth and the transmission is 100%. The % transmission (growth response) for the appropriate dilution of the sample extract is compared with a standard curve produced from a series of standards of different concentrations provided the sample extract response coincides with the linear portion of the standard curve.

With many chemical methods if the response is too high the sample extract can be diluted and remeasured or reinjected without repeating the whole assay. This is not possible with microbiological assays measuring turbidity and results in a repeat of the entire assay including standards using a different dilution and the consequential loss of several days work. A crystal ball would be useful when deciding on appropriate dilutions when analysing unknown samples.

FORTIFIED PRODUCTS

Fortification of selected foods with PGA has been approved under the Australia New Zealand Food Standards Code. In fortified products much of the folate is present as PGA which may allow alternative methodological approaches. For labelling purposes where total folate is required the analysis should proceed as for unfortified foods with the result including both PGA and natural folates. In new product development or testing of premixes it may be more practical to measure only the PGA by HPLC without deconjugation.

As a commercial laboratory advising clients on the method most suitable for producing a result to meet their need the disclosure of formulation information, the form of folate added and the principle ingredients is essential. Unfortunately this information is not always provided making the analyst's task more difficult, more time consuming and hence costly with the outcome not always as expected. The stability of PGA under the conditions of manufacture and cooking is not well understood and requires some trial and error to fortify at the appropriate level.

QUALITY CONTROL MEASURES

The importance of the quality control measures which form part of each analytical batch cannot be overemphasised with microbiological assays. In this laboratory all batches include a blank to provide evidence that there is no folate in the media, in the human plasma nor in the other reagents used for growth of the micro-organism. The blank also provides evidence that the culture has not lost its dependancy on folate and become capable of growth without folate.

All batches contain a small percentage of duplicates. Performing all analyses in duplicate is not justified on statistical grounds nor due to the added expense involved. All batches include a recovery performed by spiking a sample with PGA at a known level and measuring the amount of folate recovered by the assay. All batches include a control sample or a reference material. The control sample is an in-house prepared food in which the level of folate has been determined via a reproduceability study. This level may not reflect the true level but provides a means of monitoring results over time using a control chart. The control chart provides evidence of consistency from batch to batch and whether the individual batch is within statistical control or not.

Reference materials are also used although not with every batch due to the high cost. These provide evidence of the ability of the operator and the method to produce a result which is in agreement with results obtained by a pool of laboratories experienced in folate analysis. Reference materials available include VMA 195, a mixed cereal diet and SRM 1846, an infant formula. Recently enriched milk powder, wholemeal flour, lypholised mixed vegetable and pig's liver materials have become available from the Institute for Reference Materials and Measurements (IRMM). These latter four materials were certified following the Fourth EU MAT Intercomparison Study conducted in 1996 in which AGAL was a participant.

ACCEPTANCE AND REJECTION CRITERIA

For results to be accepted for reporting from an analytical batch the blank must be negligible, the duplicates in close proximity, the recovery within a range of 80 to 110 %, the control sample results within +/- 2 standard deviations of the reproducability mean *or the reference* sample result within +/- 2 standard deviations of the consensus or statistical *mean.* These criteria are strictly applied with the consequence that batches are rejected when all criteria are not met.

The frequency of rejection of batches is higher for microbiological assays than most chemical methods because of the reliance on the behaviour of a micro-organism and the need to maintain tight analytical parameters. The method cannot be said to be robust nor rugged and is not recommended for laboratories lacking in experience nor able to maintain the laboratory environment at constant conditions of temperature and humidity nor without constant and reliable power and water supplies.

THE FUTURE FOR FOLATE ANALYSIS

The development of HPLC methods for the determination of folates is without doubt the future means of measuring folates at both natural levels and in fortified foods. The application of HPLC has been limited in the past due to relatively low levels of folates in food (typically 5 to 100 ug/l00g) and the lack of sensitivity of detectors in particular ultraviolet detectors. PGA does not absorb very strongly in the UV and does not fluoresce. The reduced forms of folate fluoresce hence they can be measured with a fluorescence detector at lower levels than PGA. With the development of means of concentrating sample extracts and removing interfering materials the successful measurement of PGA, THF, 5MeTHF and 5CHOTHF at levels down to about 5 ug/l00g is now possible and rivals microbiological assay in sensitivity.

The use of fluorescent detectors or mass spectrometry will in the future permit folates to be routinely measured at levels low enough for food composition purposes. These methods will continue to rely on a reliable source of deconjugase to convert the large polyglutamate molecules to smaller molecules able to be separated and detected on chromatographic systems.

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THE DEVELOPMENT OF CHROMATOGRAPHY-BASED TECHNIQUES FOR THE ESTIMATION OF FOLATES IN FOODS

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INTRODUCTION

Interest in the development and validation of reliable methods for the determination of folates in foods has increased considerably over the last 5 years with research showing the important role of folates in public health. In particular there is good evidence that increasing dietary levels of folic acid for prospective mothers reduces significantly the incidence of neural tube defects (NTD) in newborn whilst more recent studies have reported on the value of folates in reducing heart disease.

Folate levels in food

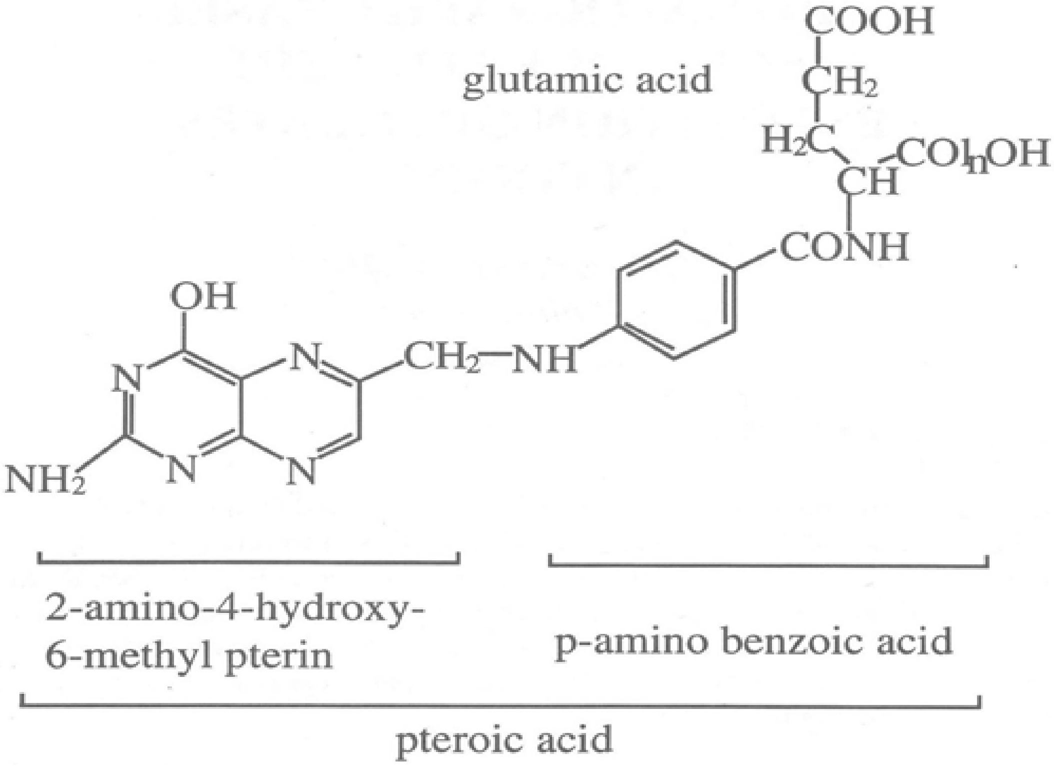
Whilst there is increasing support by governments and industry for improving dietary intake of folate through vitamin supplements and food fortification programs, there are many basic foods which provide adequate levels of folates (Table 1)

Most, if not all of the folate data currently reported in food composition tables are derived from microbiological assays of the deconjugated poly-glutamates of folic acid. These methods are very operator-dependent, are subject to cross-reactivity with other components in the food and operate in a limited concentration range.

Chemical structure

The chemical structures of folic acid and its analogues are shown in Figure 1.

Figure 1. Structure of folic acid



Attributes of ideal methods

The ideal characteristics of analytical methods are as follows:

- •high specificity for analyte
- •matrix independent
- •provides reliable data
- •quick, cheap, technically simple
- •robust (operator independent)
- •adequate sensitivity
- •linear over a large detector range

Current methods in use

Essentially there are three principal methods currently in use for the determination of folates in foods each with different approaches and attributes. The microbiological assay (MBA) and high performance liquid chromatography (HPLC) methods both require enzymatic hydrolysis of the poly-glutamates to mono- or di-glutamates prior to quantitation. The third method is the Radio Protein Binding Assay.

The advantages and limitations of these 3 key methods are summarised in Table 2.

Chemical Methods

Chemical methods based on comparative chromatography and detection represent 'proven' technology. Modern chromatographic methods are generally robust and highly specific in terms of what is being measured. The modest sensitivity of HPLC can be improved by the use of specific detectors such as mass spectrometers. The sensitivity and specificity of the analytical process can be further improved by interfacing the chromatograph with a tandem mass spectrometer such as with GC/MS/MS. Whilst MS/MS is not a technique used routinely in chemical analysis due to its high set-up costs, the instrumentation is highly suited for method development particularly where a number of chemical analogues and homologues may be present.

Data correlation between folate methods

At present, the correlation between MBA and HPLC data on folates in foods is not particularly good with the chromatography-based methods generally providing lower vitamin values. It is unclear at this stage whether this is due to over-estimation of folates by MBA or whether the chemical methods are failing to characterize all the folates present. The recent collaborative studies coordinated by Finglas have focussed primarily on the determination of four key folate isomers viz, pteryl-glutamic acid (PGA), tetrahydro-folic acid (THF) 5-methyl tetrahydro-folic acid (5-MeTHF) and 5-formyl tertahydro-folic acid (5-CHOTHF).

Although correlation on specific folate isomers between the participating laboratories was sufficiently good for assigning folate values to the reference foods under study, further developmental work needs to be done to improve the correlation of data between the different methods. Essentially, when two or three methods all provide similar data on the analytes under study, we can have reasonable confidence in the accuracy of the data.

HPLC/MS/MS methodology

A project proposal has been submitted to and approved by the QHSS Executive to investigate the application of HPLC/MS/MS to the determination of natural folates in foods. Whilst unique identification of any isomers can be assured using MS/MS, standards of the isomers will be necessary for quantitation. Further development, validation and routine usage of chemical methods however will depend on the ready availability of the appropriate folate standards.

TABLE 1. FOLATE CONTENT OF COMMON FOODS*

FOOD	FOLATE CONTENT (mg/100 g)
Green Beans (frozen)	56
Beetroot (raw)	150
Broccoli (raw)	90
Brussel sprouts (raw)	135
Cabbage (raw)	75
Potato (raw)	25
Tomatoes	17
Spinach	150
Steak	9
Liver (calf, raw)	240
Yeast	4000
Orange Juice	20
Bread (brown, toasted)	40
Cornflakes	250
Eggs (chicken, raw)	50

*McCance and Widdowson The Composition of Foods, 5th Edition

TABLE 2. ATTRIBUTES OF PRINCIPAL METHODS USED FOR FOLATE ANALYSIS

ADVANTAGES	LIMITATIONS
Microbiological Assay	
• Low equipment set-up costs • Non-specific response to most folate isomers • Very sensitive compared to chemical methods	• Deconjugase activity may be enhanced or inhibited by food enzymes • Micro organisms not highly robust • Micro organism response limited to small concentration range
High Performance Liquid Chromatography	
• High specificity towards folate isomers • Proven/reliable technology • Unambiguous identification of isomers • Minimal interference from food enzymes	• High equipment set up cost • Require standards for all isomers • Lacks sensitivity of MA methods
Radio Protein Binding Assay	
• High specificity towards folate isomers • Do not need to deconjugate polyglutamates • Rapid, relatively inexpensive	• Method very pH sensitive • Considerable variation between different kits

CONSIDERATION OF INTERNATIONAL RECOMMENDATIONS ON CARBOHYDRATE

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In April 1997, FAO/WHO convened a joint expert consultation on *Carbohydrates in Human Nutrition* to review the state of knowledge on the role of carbohydrates in the human diet and to formulate practical recommendations where interpretation is needed or controversy exists.

The Interim Report from the meeting[1] contains many recommendations under several headings.

My presentation will focus on the first eight recommendations listed under the heading: *The Role of Carbohydrates in Nutrition,* which are particularly relevant to analysts and compilers of food composition databases, as well as end users of food composition data.

In summary, these recommendations are to:

1.Standardise the terminology used to describe dietary carbohydrate with carbohydrates classified primarily by molecular size into sugars, oligosaccharides and polysaccharides. Nutritional groupings can then be made on the basis of physiological properties such as digestion in the small intestine. (Table 1, adapted from Interim Report).

2.Adopt the concept of glycaemic carbohydrate 'providing carbohydrate for metabolism'.

3.Reject the terms extrinsic and intrinsic sugars, complex carbohydrate and available and unavailable carbohydrate.

4.Ensure food laboratories measure total carbohydrate as the sum of the individual carbohydrates and not 'by difference'.

5.Qualify the term dietary fibre by a statement itemising those carbohydrates and other substances intended for inclusion. Dietary fibre is a nutritional concept, not an exact description of a component of the diet.

6.Gradually phase out the use of the terms soluble and insoluble dietary fibre.

7.Analyse and label dietary carbohydrate on the basis of the chemical divisions recommended. Groupings additional to sugars, starch and non-starch polysaccharides such as polyols, resistant starch, non-digestible oligosaccharides and dietary fibre could be used, provided the included components are clearly defined.

8.Reassess the energy value of all carbohydrate in the diet using modern nutritional and other techniques. For carbohydrates that reach the colon, the Consultation recommends that the energy value be set at 8 kJ/g for nutritional and labelling purposes.

Table 1: The Major Dietary Carbohydrates

Class (Degree of Polymerisaton)	**Sub-Group**	**Components**	**Absorption from Small Intestine: Available (A)**
Sugars (1-2)	Monosaccharides	Glucose, galactose, fructose	A
	Disaccharides	Sucrose, trehalose	A
	Polyols	Sorbitol xylitol, erythritol, lactitol etc	A/U
Oligosaccharid (3-9)	Malto-oligosaccharide	Maltodextrins	A
	Other oligosaccharide	Raffinose stachyose, fructo-oligosaccharides	
Polysaccharides	Starch	Amylose, amylopectin	A
		Modified starches	U
		Resistant starch	U
	Non-starch	Cellulose, hemicellulose, pectins, polysaccharides hydrocolloids	U

Most of the above recommendations (1-3, 5-6) refer to changing commonly used terminology to:

•rearrange current definitions;
•introduce new terms;
•delete some terms; and
•qualify other terms.

The classification of the components in the above table, according to their absorption in the small intestine, clearly indicates that each broad chemical class contains both available and unavailable types of carbohydrate. The major points of contention centre on the inclusion of polyols in total sugars, and the recommendation to eventually replace dietary fibre. New food ingredients such as inulin and fructo-oligosaccharide are poly disperse compounds that often span the classes of degrees of polymerisation for oligosaccharides and polysaccharides.

Broad agreement on these recommendations by analysts, nutrition scientists including those involved in food regulation and nutrition education would need to be reached before carbohydrate components are likely to be redefined in food composition databases. If adopted, some nutrients such as total sugars, dietary fibre, or oligosaccharides, would require recalculation or analysis . These changes to data would then be expected to find their way into nutrition education and labelling, although for such purposes, the science is usually simplified and relies on use of uncomplicated 'consumer-friendly' terms.

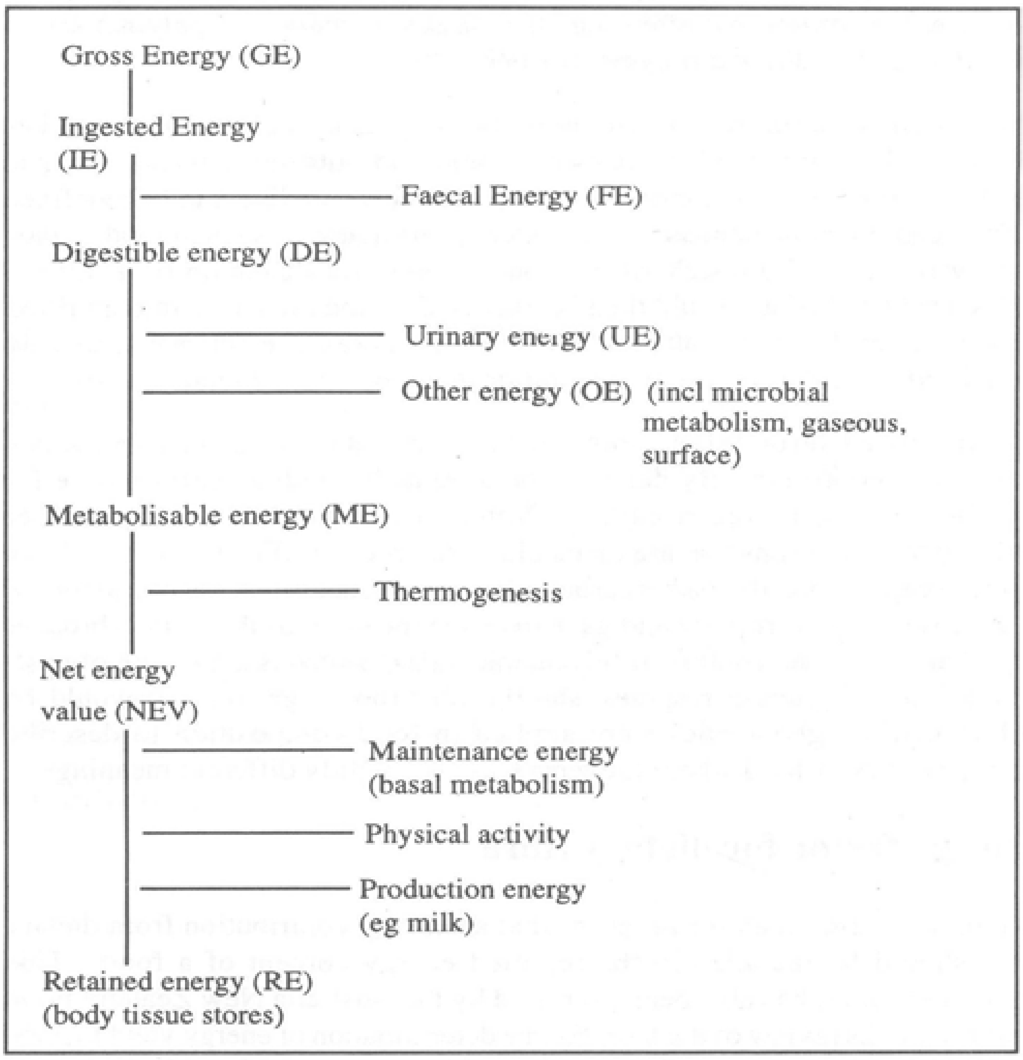
The proposed term 'glycaemic' in recommendation 2, may introduce unintended confusion. By defining the term as 'providing carbohydrate for metabolism', it includes carbohydrates either as glucose or as other carbohydrate fractions that are metabolised to produce ATP and energy. In an effort to capture metabolisable carbohydrate components that are not *absorbed* as glucose such as fructose and galactose, the meaning of the term is broader than that used in the context of 'glycaemic index' which is a measure of post-prandial blood glucose response shortly after food ingestion. It would be unfortunate if 'glycaemic' were applied in food composition to describe characteristics of food where the term had two slightly different meanings.

Energy factor for dietary fibre

Recommendation 8 above proposes that an energy contribution from dietary fibre should be included in the reported energy content of a food. This recommendation has also been proposed by the Australia New Zealand Food Authority in its review of the basis for the determination of energy yield factors. The Authority proposes to adopt metabolisable energy as the basis for all energy factors used for nutrition labelling purposes and, based on the original work of Livesey[2], agrees to 8 kJ/g as an appropriate factor for dietary fibre. According to the Australian Food Standards Code and the New Zealand Food Regulations (1984), dietary fibre is that which is measured by AOAC method 985.29, and by AOAC method (Prosky method - JAOAC 67, No. 6, 1044-1052, (1984) respectively.

An overview of the food energy utilisation and disposition process is shown in Figure 1.

Figure 1: Overview of food energy utilisation and disposition



Livesey's factorial model that apparently results in no bias over a range of *diets* of variable carbohydrate content is:

Metabolisable Energy = 16.7 P+ 37.6 F + 15.7 C_m + 8.4U
where
P = protein (g)
F = fat (g)
Cm = available carbohydrate expressed as monosaccharide equivalents (g)
U = unavailable carbohydrate [NSP + **RS]** (g)

Basis for determination of metabolisable energy content of food

Livesey also proposed that the energy content of foods should preferentially be calculated empirically because of the direct measurement of the gross energy of the food and according to the formula:

Metabolisable Energy = 0.96E - 8.4UC - 30N
where
E = gross energy (kJ)
U = unavailable carbohydrate [NSP + RS] (g)
N = nitrogen (g)

How would adoption of these recommendations affect current food composition data bases in the Oceania region?

The current derivation of carbohydrate and energy values in the Oceania region's food tables are shown below in Table 2.

Table 2: Derivation of Australian, New Zealand and Pacific Island Carbohvdrate and Enerpv values

	(AVAILABLE) CARBOHYDRATE			**(UNAVAILABLE) CARBOHYDRATE**
Country	**Definition**	**Component**	**Energy factors (kj/g)**	
Australia	monosac + disac	Sugars	16	AOAC Dietary Fibre
	+ starch/glycogen/ dextrins	Starch + Dextrins	17	+ galacto-oligosaccharides
	(+ polyols)	Polyols	16	
New Zealand	monosac + disac + starch/glycogen/	Sugars Starch +	15.7	Dietary Fibre (AOAC, Englyst,
	dextrins (+ polyols)	Dextrins Polyols		Southgate)
Pacific Island	monosac + disac + starch/glycogen/	Available Carbohydrate	16.5	Dietary Fibre (AOAC, Englyst,
	dextrins (+ polyols)			Southgate, unknown)

Australia, for example, would be required to:

•recalculate total sugars content of those foods for which polyol data were available;
•recalculate energy content of those foods for which dietary fibre data were available;
•conduct more analyses of non-starch polysaccharides and resistant starch, and oligosaccharides; and
•conduct a broad analytical program to obtain data on the gross energy content of foods.

Given the resource constraints on the Australian food composition program, any changes would first be made through recalculation of existing values. These would most likely occur in tandem with any similar change to nutrition labelling requirements. Providing funds continue to be available to conduct analytical programs, new information could be collected, although such a move would not occur unless there was broad consensus among nutritionists of the value of such data, and reliable analytical methods were available.

The Australia New Zealand Food Authority is reviewing all food regulation in Australia and New Zealand, including nutrition labelling, for the purposes of introducing a joint set of food standards for Australia and New Zealand by the turn of the century. Now that the Authority has formally proposed adoption of an energy factor for dietary fibre, it is expected that it will be a reality for food labelling before the next meeting of OCEANIAFOODS. The Australian food composition program is planning to include in the next data release, energy contents of food calculated with and without a contribution from dietary fibre.

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AVAILABLE CARBOHYDRATE DATA IN DIETARY MANAGEMENT OF GLYCAEMIA

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THE PROBLEM

Available carbohydrate (CHOAVL) content has long been used in food selection for managing diabetes. Such use of CHOAVL is not, however, appropriate to control of glycaemia, because the same amount of CHOAVL in different foods can cause vastly different degrees of post-prandial glycaemia, which is a function of much more than absolute amount of carbohydrate in a food (Truswell, 1992).

Glycaemic index (GI) is being increasingly used in controlling glycaemia, but it is not a practical value to use in food exchange. It can be misleading to consumers as it is often treated as a property of a food rather than of a component within a food.

The current definition (Frost *et ai*, 1993) of GI is:

$$GI = \frac{\text{incremental area under blood glucose response curve for a food}}{\text{corresponding area after equi-carbohydrate portion of reference food}} \times 100$$

The above expression shows why GI is difficult to apply directly in food exchange:

(1) GI is based on the CHOAVL component of a food, yet food items as consumed nearly always contain many components in addition to CHOAVL. Different foods with the same GI may therefore induce very different glycaemic responses on a weight for weight basis.

(2) GI is a unitless ratio so cannot be related directly to quantities of food, whereas in practice one must deal with amounts of foods, and usually in common standard measures (CSM's).

A SOLUTION

We have derived two sets of variables in which CHOAVL and GI are combined in different ways to facilitate practical dietary management of glycaemia, in which one must deal in whole foods and with quantities. Both of them may be calculated from readily available tables of GI (Foster-Powell and Brand Miller, 1995) and food composition (eg. Burlingame *et al.*, 1997; Monro and Burlingame, 1998). They are permissable derivations in the context of glycaemic control because the relationship between CHOAVL dose and glycaemic response is approximately linear within the range 0-50 g of carbohydrate (Wolever and Bolognesi,1996), which covers most carbohydrate intakes in practice.

(1) Relative glycaemic potency (RGP)

RGP is a value representing the potential of an entire food to induce glycaemia relative to that of an equal weight of glucose (RGP = 100). RGP is essentially the glycaemic index adjusted for the available carbohydrate content of the food, so can be regarded as a "Food GI" based on the theoretical glycaemic response to a food rather than solely to its CHOAVL component.

$$\text{RGP} = (\text{CHOAVL}/100) \times \text{GI}$$

Or where P is the proportion of carbohydrate in the food.

$$\text{RGP} = \text{P.GI}$$

Using RGP

RGP values give an immediate indication of the relative impact that different foods have on glycaemia on a weight for weight basis (Table 1). RGP values are useful in exchanging foods in proportion to their relative effect on glycaemia. For instance, a food with an RGP of 60 could be exchanged for twice its weight of a food with an RGP of 30. The quantity of lentils (RGP = 3.0, 1 cup = 209 g)) that could replace a medium sice of bread (26 g, RGP = 30) is given by

$$\begin{aligned} 30/3\text{x}26 &= 260 \text{ g lentils} \\ &= 260/209 \\ &= 1.3 \text{ cups of lentils} \end{aligned}$$

RGP values can also be used to rank foods according to their likely impact on glycaemia **(Table 1).** GI or CHOAVL alone could not enable such a comparison although they have often been mistakenly used as if they could. Table 1 shows that glycaemic impact and rankings of foods adjudged by GI and RGP may be quite different.

An RGP value for a meal can be calculated from the sum of products of the proportion by weight of each food in a meal and its RGP value **(Table 2).** The change in meal RGP as a result of food substitutions is easily calculated as the difference in whole meal RGP before versus after substituting.

(2) Glycaemic index adjusted exchange value (EVG)

EVG is the theoretical weight of an entire food that would give the same glycaemic response as 10 g of glucose. As EVG is a weight it can be converted to common standard measures.

EVG is derived from the exchange value (EV) of a food, that is, from the weight of food containing one exchange of CHOAVL, the definition of a carbohydrate exchange varying from country to country.

In general, where one exchange is defined as weighing n g, P (= CHOAVL/ 100) is the proportion of a food that is CHOAVL, GI_f = glycemic index of the food, GI_r = GI of an CHOAVL reference food:

$$EVG = nG_r/P.GI_f$$

In New Zealand, for instance, where an exchange of CHOAVL is 10 g, and using glucose (GI_r = 100) as the reference carbohydrate source,

$$EVG = EVx(100/GI)$$
$$(10/P) \times (100/GI_f)$$
$$EVG = 1000/P.GI_f$$

Using EVG

EVG is a particularly useful quantity. Being the *weight* of a food theoretically inducing a glycaemic response equivalent to that of 10 g glucose it can easily be converted to common standard measures (CSMs) of a food.

By dividing EVG by the weight of a CSM, to give the amount of a food in CSMs delivering a dose of 10 g of CHOAVL , a value for *Available carbohydrate Specific Volume Gl-adjusted* (ASVG; **Table 3** and **Table 4)** is obtained. Foods may thus be exchanged by CSMs using ASVG values, as the quantities shown are all theoretically equivalent in glycaemic impact. Similarly, to determine the amount of a food that can be exchanged for one CSM of a reference food one need only divide the ASVG of the former by that of the latter.

DATA TABLES FOR FOOD EXCHANGE

Avail CHOdata for about 2 200 foods are held in the New Zealand Food Composition Database and of these about 800 are presented in the *Concise New Zealand Food Tables* (Burlingame *et al.*, 1997), which focusses on commonly consumed New Zealand Foods.

A more detailed breakdown of carbohydrate components is given for about 1 500 foods in *Sugars, Starch and Fibre in New Zealand Foods* (Monro and Burlingame, 1998). The latter also contains a separate table in which the various values derived from CHOAVL and/or GI, including EV, EVG, RGP, ASV, ASVG are presented for all New Zealand foods for which an equivalent could be found in the *International Tables of GI* (Foster-Powell and Brand Miller, 1995). The first page of the table is shown here in **Table 4.**

A further set of tables intended for those who wish to combine CHOAVL and GI in glycaemia managment is nearly completed, along with instructions for use. The tabulated data are based on SADG values and were calculated in a spreadsheet in which 1 CSM of each food shown at the head of a column can be related to the amount in CSMs of each other food, listed at the side of the page, that in theory induces the same glycaemic response. Such tables will in theory enable direct food exchange, with zero impact on glycaemic response, of all foods for which both CHOAVL and GI values are available. Our spreadsheet at present contains over 100 x 100 values appropriate to New Zealand foods. The format of the table is shown in **Table 5.**

DISCUSSION

Using CHOAVL and GI values combined to give RGP, or GI and exchange values combined to give EVG, one obtains a very different estimation of the relative effects of foods on glycaemia than is obtained with either CHOAVL or GI data alone. Food quantities for exchange based on \EVG are often very different from those based on traditional carbohydrate exchanges and the ranking of foods by RGP differs from that based on GI.

EVG, RGP and AS VG were derived specifically for use when glycaemic control is the aim of food exchange. The data set employed will, however, depend very much on circumstances, and furthermore, all values discussed here relate only to CHOAVL, but must be employed in the context of the whole diet in which the impact of all food components on any condition should be considered during dietary interventions.

In theory, food exchange for glycaemic control would be greatly improved by including a factor for GI. But one needs to keep in mind several things when applying GI:

1. *GI* values have been measured *for very few* New Zealand foods, *so* calculation of EVG and RGP values must rely on GIs published in international journals.

2. Variability intrinsic in values for both GI and carbohydrate composition accumulate in combined measures such as EVG and RGP. Although one can derive specific figures for EVG and RGP from CHOAVL and GI data, one must be aware that there is a high degree of uncertainty associated with the measures.

3. Interactive effects of carbohydrates and various non-carbohydrate food components in a mixed diet may affect glycaemic response to a food.

4. As GI is dependent partly on food structure it and values derived from it are subject to variability as a result of food processing (Truswell, 1992).

5. There is considerable disagreement about the definition, analysis, and expression of CHOAVL within databases throughout the world (Monro and Burlingame, 1996), which could lead to a lack of international comparability of RGP and EVG values.

6. CHOAVL and GI are measured independently by well-validated methods, but the validity of EVG and RGP, in which CHOAVL and GI are combined, for predicting relative glycaemic response has not yet been experimentally established.

Nevertheless, RGP and EVG are likely to be more useful for dietary management of glycaemia than either simple carbohydrate exchanges values or glycaemic indices alone, particularly as glycaemic responses to food carbohydrates differ considerably between foods, and the custom of assigning GI values to foods can be misleading.

CONCLUSION

Food exchanges based on GI and CHOAVL content combined in the variables RGP and EVG are potentially very useful for managing CHOAVL intakes for control of glycaemia. Use of such values could be improved with more GI data measured using local foods. Meanwhile the ability of RGP and EVG to predict relative glycaemic response when based on literature-sourced GIs and CHOAVL values from national Food Composition Databases needs to be tested, as these are the major sources of information presently available in most countries.

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Table 1: Glycaemic Index (GI) and Relative Glycaemic Potency (RGP) and ranking of foods according to each.

	P (CHOAVL/100)	GI	Rank by	RGP	Rank by
Glucose	1	100	1	100	1
Parsnip, boiled	0.12	97	2	12	10
Rice bubbles	0.78	95	3	74	2
Potato baked	0.19	85	4	16	9
Corn flakes	0.85	84	5	71	3
Pumpkin	0.04	75	6	3	17=
Swede, boiled	0.037	72	7	2.7	19=
White bread	0.434	70	8	30	5
Croissants	0.39	67	9	26	6
Cane sugar	1	65	10	65	4
Porridge, cooked	0.105	61	11	6	14
Pizza, cheese/tomato	0.19	60	12	11	11
Orange	0.077	44	13	3	17=
Meusli	0.525	43	14	23	7
Spaghetti.boiled	0.2	41	15	8.2	13
Apple, raw	0.11	38	16	4	16
Yams, boiled	0.27	34	17	9	12
Lentils, boiled	0.1	26	18	3	19=
Barley, boiled	0.25	25	19	5.5	15
Fructose	1	20	20	20	8

Table 2: Determining effect of food exchange on meal RGP : Effect of substituting an equal weight of lentils for potato chips and bread

Food	RGP	Food weight (g)	Pf[1]	RGPp[2]
Before substituting				
Potato chips	21.5	60	0.31	6.7
Bread	30.4	26	0.13	4.0
Fish fingers	6.6	50	0.25	1.7
Peas	1.9	60	0.31	0.6
Total (meal RGP)				13.0
After substituting				
Lentils	**2.7**	**(60 + 26)**	**0.44**	**1.2**
Fish fingers	6.6	50	0.25	1.7
Peas	1.9	60	0.31	0.6
Total (meal RGP)				**3.5**
% reduction in RGP (ie. predicted decrease in glycaemic response to meal)				(-73%)

[1] Pf = food as a proportion of meal.

[2] RGPp = RGP x Pf = proportional contribution of food RGP to meal RGP.

Table 3: Available carbohydrate specific volume with and without adjusting for GI

Food	CSMWt g)	EV (g)	EVG (g)	ASV[1]	ASVG[2]
Lentils, boiled	209	96	370	0.5 cup	1.8 cups
Barley, boiled	165	40	158	0.2 cup	0.9 cup
Spaghetti, boiled	148	50	122	0.3 cup	0.8 cup
Potato baked	90	52	62	0.6 potato	0.6 potato
Yam, boiled	158	37	109	0.2 cup	0.7 cup
Parsnip, boiled	160	81	83	0.5 parsnip	0.5 parsnip
White bread	26	23	33	0.9 slice	1.3 slices
Meusli	110	19	44	0.2 cup	0.4 cup
Porridge	260	95	156	0.4 cup	0.6 cup
Rice bubbles	14	13	14	0.9 cup	1 cup
Apple	121	93	246	0.8 apple	2.0 apples
Orange	128	130	295	1 orange	2.3 oranges
Fructose	4	10	50	2.5 teasps.	12.5 teasps.
Cane sugar	4	10	15	2.5 teasps.	3.8 teasps.
Glucose	4	10	10	2.5 teasps.	2.5 teasps.

[1] ASV=Available carbohydrate Specific Volume = EV/CSMwt = number of CSMs containing 10 g CHOAVL

[2] ASVG=ASV adjusted for glycaemic index = EVG/CSMwt = number of CSMs theoretically giving the same glycaemic response as 10 g glucose.

Table 4: Table of available carbohydrate, GI, and derived values for New Zealand foods : first page only

GI: Glycaemic index: Blood glucose response to available carbohydrate in a food as % of response to an equal weight of glucose

RGP: Relative glycaemic potency: Theoretical blood glucose response to a whole food (ie all components) as % of response to an equal weight of glucose.

EV: Exchange value: Weight of food containing one exchange (10 g) of available carbohydrate.

EVG: Gl-adjusted exchange value: Weight of food inducing the same glycaemic response as an exchange (10 g) of glucose.

ASV: Available carbohydrate specific volume: The quantity of food in common standard measures (CSMs) containing 10 g of CHOAVL.

ASVG: Gl-adjusted ASV: The number of CSMs of a food containing sufficient CHOAVL to induce the same glycaemic response as 10 g of glucose.

Key	Foods	GI	RGP	EV	EVG	ASV	ASVG
A	Bakery Products						
A54	Bagels.plain	72	34	21	30	0.3 pieces	0.4 pieces
A4	Biscuit.digestive.plain	58	37	16	27	1.1 biscuits	2.0 biscuits
A7	Biscuit.oatcake	54	31	18	32	1.2 biscuits	2.2 biscuits
A63	Biscuit.shortbread	64	36	18	28	1.3 biscuits	2.0 biscuits
A12	Biscuit, wafer.plain	76	47	16	21	1.7 biscuits	2.2 biscuits
A16	Bread.currant	47	22	21	45	0.6 med.slices	1.3 med.slices
A42,	Bread,multigr, "light"	52	19	27	52	l.Omed.slices	1.9 med.slices
A43	Bread,multigr,"heavy"	52	23	23	44	0.8 med.slices	1.6 med.slices
A40	Bread,roll,white,soft	70	34	20	29	0.4 rolls	0.6 rolls
A52	Bread, roll,wholemeal	69	30	23	34	0.3 rolls	0.5 rolls
A18	Bread, white,sliced	70	30	23	33	0.9 med.slices	1.3 med.slices
A23	Bread,wholemeal	69	26	27	39	l.Omed.slices	1.4 med.slices
A25	Bun,currant	47	23	20	43	0.3 buns	0.5 buns
A77	Cake,sponge,plain	46	28	17	36	0.2 slices	0.4 slices
A30	Chapati,high fat	57	25	23	40	0.6 chapatis	1.1 chapatis
A31	Chapati,low fat	57	23	25	44	0.7 chapatis	1.2 chapatis
A32	Crispbread,rye	65	42	16	24	2.6 biscuits	4.0 biscuits
A101	Croissants,small	67	26	26	38	0.4 croissants	0.7 croissants
A101	Croissants,large	67	26	26	38	0.3 croissants	0.4 croissants
A34	Doughnut,ring	76	33	23	30	0.5 doughnuts	0.7 doughnuts
A96	Muffins,toasted	55	23	24	44	0.3 muffins	0.6 muffins
C	**Beverages, nonalcoholiic**						
C46	Juice.apple	41	4	102	249	0.4 cups	1.0 cups
C12	Juice,grapefruit,unsw.	48	4	127	264	0.5 cups	1.0 cups
C14	Juice,orange,unsw.	52	4	130	250	0.5 cups	1.0 cups
C18	Lucozade	95	15	64	67	0.2 cups	0.3 cups
D	**Breakfast cereals**						
Dl	Bran cereal	42	16	27	64	0.6 cups	1.4 cups
D32	Corn flakes,Kelloggs	84	71	12	14	0.4 servings	0..5 servings

Table 5 Tables for exchanging New Zealand foods by common standard measures in amounts of equivalent glycaemic effect: first page only

			1	2	3	4	5	6	7
			Bagels	Biscuit digestive plain	Biscuit oatcake	Biscuit shortbread retail	Biscuit wafer plain Cream	Bread current	Bread multi grain light
CSM			1 bagel	1 biscuit	1 biscuit	1 biscuit	1 biscuit	lmedslice	lmed slice
	Bakery product								
1	Bagels,plain	bagels	**1.0**	0.2	0.2	0.2	0.2	0.3	0.2
2	Biscuit.digcsuve	biscuits	4.9	**1.0**	0.9	1.0	0.9	1.5	1.1
3	Biscuit.oatcake	biscuits	5.4	1.1	**1.0**	1.1	1,0	1.6	1.2
4	Biscuit.shonbread	biscuits	5.0	1.0	0.9	**1.0**	0.9	1.5	1.1
5	Biscuil.wafer.cream	biscuits	5.6	1.1	1.0	1.1	**1.0**	1.7	1.2
6	Bread,current	med slices	3.3	0.7	0.6	0.7	0.6	**1.0**	0.7
7	Bread,mullgrain light	med slices	4.6	1.0	0.9	0.9	0.8	1.4	**1.0**
8	Bread.multgrain hvy	med slices	3.9	0.8	0.7	0.8	0.7	1.2	0.8
9	Bread,roll,white,soft	rolls	1.4	0.3	0.3	0.3	0.3	0.4	0.3
10	Bread,roll,wholemeal	rolls	1.2	0.2	0.2	0.2	0.2	0.4	0.3
11	Bread, white,sliced	med slics	3.2	0.7	0.6	0.6	0.6	1.0	0.7
12	Bread.wholemeal	med slices	3.5	0.7	0.6	0.7	0.6	1.1	0.8
13	Bun,currant	buns	1.4	0.3	0.3	0.3	0.2	0.4	0.3
14	Cake,sponge,plain	slices	1.0	0.2	0.2	0.2	0.2	0.3	0.2
15	Chapati, high fat	chapatis	2.8	0.6	0.5	0.6	0.5	0.8	0.6
	ChapatMow fat	chapatis	3.0	0.6	0.6	0.6	0.5	0.9	0.7
17	Crispbread,rye	biscuits	10.0	2.1	1.8	2.0	1.8	3.0	2.2
18	Croissants	croissants	1.7	0.3	0.3	0.3	0.3	0.5	0.4
19	Doughnut,ring	doughnuts	1.8	0.4		0.4	0.3	0.5	0.4
20	Muffins,toasted	muffins	1.4	0.3	0.3	0.3	0.2	0.4	0.3
Beverages, nonalcoholic									
21	Juice,apple	cups	2.4	0.5	0.4	0.5	0.4	0.7	0.5
22	Juice,grape fruit,unsw	cups	2.6	0.5	0.5	0.5	0.5	0.8	0.6
23	Juice,orange,unswee	cups	2.4	0.5	0.4	0.5	0.4	0.7	0.5
24	Lucozade	cups	0.6	0.1	0.1	0.1	0.1	0.2	0.1
Breakfast cereals									
25	Bran cereal	cups	3.6	0.7	0.7	0.7	0.6	1.1	0.8
26	Corn flakes,Kelloggs	servings	1.2	0.2	0.2	0.2	0.2	0.4	0.3
27	Muesli,toasted,sweet	cups	1.0	0.2	0.2	0.2	0.2	0.3	0.2
28	Porridge,prep milk&w	cups	1.5	0.3	0.3	0.3	0.3	0.5	0.3
29	Rice,puffed/Ricies'	cups	2.6	0.5	0.5	0.5	0.5	0.8	0.6
30	Wheat,puffed	cups	3.8	0.8	0.7	0.8	0.7	1.1	0.8
31	Weet-Bix" wh,wheat	cups	3.8	0.8	0.7	0.8	0.7	1.2	0.8
Cereals and pseudo-cereals									
32	Barley,pearl,boiled	cups	2.4	0.5	0.4	0.5	0.4	0.7	0.5
33	Barley,wh grain flake	cups	0.7	0.1	0.1	0.1	0.1	0.2	0.2

Foods containing > 10% edible weight as fat

COMMON METHODS FOR FOOD COMPOSITION ANALYSIS

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INTRODUCTION

For many nutrients in foods several methods of analysis are used to provide analytical data for incorporation into food composition tables or for food labelling. The diversity of methods reflects choices made by food analysts for a variety of reasons. Sometimes the choice is dictated by availability of equipment or reagents, sometimes by current experience or knowledge of a particular method which may therefore demonstrate a lack of knowledge or training in alternative methods.

In ideal circumstances the choice of method should be based on sound professional judgement resulting from an understanding of the form in which the nutrient occurs in food, the chemistry and composition of the food to be analysed and an understanding of what the method is actually measuring.

In order to present a summary of the methods of analysis in use in the Asian Pacific region I requested a number of analysts involved in OCEANIAFOODS to complete a questionnaire shortly before this conference. The questionnaire was designed to provide information on whether there are 'common' analytical methods in use in the region and also whether the methods in use are suitable for their intended purpose.

To expand the range of information I selected two proficiency study reports issued by the Food Analysis Performance Assessment Scheme (FAPAS) involving laboratories worldwide but predominantly in Europe. One study was on proximates and minerals in fishpaste, the other on minerals and vitamins in breakfast cereal. A third proficiency study report issued by BRI in Australia was also included. This study was on nutrient panel requirements including proximates, sodium and potassium. These three reports included a summary of the methods of analysis used in the studies.

A summary of the methods of analysis used by the many laboratories is included in tables 1 to 5.

RESULTS

There are many methods for moisture determination in use. The diversity can be explained by the considerable variation in the proximate composition of food. High sugar food tends to caramelise and then char on heating at 100°C requiring a lower temperature and pressure to restrict weight loss on drying to loss of moisture. Most foods can be successfully dried at 100°C without special treatment.

There are more methods for fat than any other common nutrient. The number of laboratories using soxhlet extraction without prior acid hydrolysis is of concern particularly for commodities such as cereal products. It has been demonstrated in a number of studies that the soxhlet method gives low results when compared with acid hydrolysis methods due to the lack of extraction of more polar lipids and those bound to the matrix. Some use of instrumental methods for fat analysis is evident from the FAPAS study.

The kjeldahl method remains the most common method of measuring total nitrogen although the use of the dumas combustion method is increasing in Australia and Europe. The factors for conversion of total nitrogen to protein remain unchanged. The difference between kjeldahl and dumas results are generally small.

All laboratories perform ash determinations in much the same way however there is considerable variation in the temperature of ashing from less than 500°C to 600°C. The use of temperatures towards the ends of this range may result in incomplete combustion at the lower temperature or loss of volatile metals if heating at the higher temperatures for prolonged periods.

Sugars are analysed by HPLC or by titration, the former giving individual data on mono and di saccharides the latter restricted to reducing sugars, i.e. glucose and fructose.

Dietary fibre remains the most common fibre method in the region, the situation in Europe may be different. It is noted that several laboratories in the ASEANFOODS group continue to measure crude fibre even though the information is of little nutritional relevance.

Most minerals are determined by atomic absorption spectrophotometry (AAS) however an increasing number of laboratories in Australia and Europe are using inductively coupled plasma optical emission spectroscopy (ICPOES) or inductively coupled plasma mass spectroscopy (ICPMS) depending on the levels of detection required for various elements. A small number of laboratories continue to use colourimetric methods presumably because they do not have access to instrumental techniques.

An increasing number of laboratories are using HPLC for vitamin analysis in particular for vitamins A, E and carotenes. The use of column chromatography for carotenes will result in over estimation of provitamin A activity due to the lack of separation from carotenoids which do not exhibit vitamin A activity.

Microbiological assay (MA) is a common method of analysis for many vitamins which is a little surprising as MA's are difficult to perform, require considerable operator skill and are not robust methods. In AGAL we are progressively replacing MA with chromatography methods. HPLC of vitamins Bl and B2 is relatively simple and we expect to publish an HPLC method for niacin shortly which could replace the use of the colourimetric method using a toxic reagent or MA.

CONCLUSION

Although the data presented is limited for some nutrients it is evident that increased use of instrumental methods of analysis is occurring in laboratories. It will be difficult for laboratories in the developing countries to keep up or perhaps even catch up with the changes due to lack of funding, the lack of access to service and supply of parts and consumables and with the training necessary.

It is essential that the use of inappropriate methods such as soxhlet fat extraction on cereals and crude fibre be eliminated.

With some exceptions the use of 'common' methods of analysis has been achieved in the OCEANIAFOODS group. The exceptions are where more automated methods have been introduced in Australia and New Zealand. To ensure compatability of data the importance of quality assurance and quality control practices is paramount.

It is essential that all laboratories participate in inter-laboratory studies preferably including a larger pool of laboratories than exist in the OCEANIAFOODS group. The use of in-house control samples, secondary reference materials and certified reference materials is also essential to ensure the compatability and validity of the data produced.

Summary of methods used for food composition analysis. Proximates - table 1

Nutrient	**Method**	**Comment**	Fapas (3,4)	Aus (2)	Asean (1)	USP	NZ	AGAL	QHSS
		Number of laboratories	152 (76)	12	6	1	1	1	1
Moisture	Oven drying® 100*C	Most foods	123	4	4	1	1	1	1
	Oven drying® 130*C	Cereals		7					
	Vacuum oven drying @ 70*C	High sugar foods	5	3	3		1	1	
	Vacuum oven drying @ 95-100*C								
	Instrumental	CEM	5						
Fat	Acid hydrolysis/ solvent		33	9	2	1	1	1	1
	extraction (mojonnier)								
	Acid hydrolysis/soxhlet		64		2			1	
	extraction								
	Soxhlet/soxtec extraction	Meat, chicken		4	4		1	1	1
	Alkaline hydrolysis/ solvent	Dairy products			2			1	
	extraction								
	Mixed solvent extraction						1		
	Instrumental	Fosslet, CEM	18						
Protein	Traditional kjeldahl		68		6		1		1
	Automated kjeldahl, e.g Tecator		49	7		1	1	1	
	Dumas combustion Other		20 6	5					1
Ash	Ignition at 500 - 600*C		151	12	5	1	1	1	1

Summary of methods used for food composition analysis. Carbohydrates- table 2

Nutrient	Method	Comment	Fapas (3,4)	Aus (2)	Asean (1)	USP	NZ	AGAL	QHSS
		Number of laboratories	152 (76)	12	6	1	1	1	1
Sugars	Fehlings titration for reducinng sugars			1	2				
	HPLP for glucose, fructose			8	3	1	1	1	1
	Enzyme method			1					
Total Dietary Fibre	Enzymatic/gravimetric method as per AOAC				4				1
	Englyst method								
	Monro method						1		
Crude Fibre	Acid/alkaline hydrolysis/gravimetric				5				
Starch	Enzyme method					1			
	Hydrolysis, determination of glucose by HPLC				1				
	Hydrolysis, determination of glucose by tiration				1				

Summary of methods used for food composition analysis, lipids- table 3

Nutrient	Method	Comment	Fapas (3,4)	Aus (2)	Asean (1)	USP	NZ	AGAL	QHSS
		Number of laboratories	152 (76)	12	6	1	1	1	1
Cholesterol	Gas chromatography				3		1		
	Capillary gas chromatography					1		1	1
	Enzyme method								
Fatty acid profile	Gas chromatography				2		1		
	Capillary gas chromatography			1			1		1

Summary of methods used for food composition analysis.Minerals- table 4

Nutrient	Method	Comment	Fapas (3,4)	Aus (2)	Asean (1)	US P	NZ	AGAL	QHSS
		Number of laboratories	152 (76)	12	6	1	1	1	1
Na&K	Atomic absorption spectrophotometry		41	5	3	1			1
	Inductively coupled plasma-optical emission spectroscopy		12	5			1	1	1
	Flame photometry		29	1					
	Other		6						
Ca	Atomic absorption spectrophotometry		(45)	4	1				1
	Inductively coupled plasma-optical emissionn spectroscopy		(19)				1	1	1
	Titrimetry						1		
	Colourimetry				4				
Fe	Atomic absorption spectrophotometry		(50)		2	1			1
	Inductively coupled plasma optical emission spectroscopy	ICPMS	(17)				1	1	
	Colourimetry		(1)		5				
Zn&Cu	Atomic absorption spectrophotometry		(48)		2	1			1
	Inductively coupled plasma-optical emission spectroscopy	ICPMS	(18)				1	1	
P	Inductively coupled plasma-optical emission spectroscopy						1	1	1
	Colourimetry				4	1			
	Gravimetric				3				

Summary of methods used for food composition analysis.Vitamins- table 5

Nutrient	**Method**	**Comment**	Fapas (3,4)	Aus (2)	Asean (1)	USP	NZ	AGAL	QHSS
		Number of laboratories	152 (76)	12	6	1	1	1	1
Retinol (a)	HPLC Column chromatography				5	1		1	1
Carotenes, alpha, beta	HPLC Column chromatography				4 4	1	1	1	
alpha tocopherol (E)	HPLC Gas chromatography Coiourimetry				2 2		1	1	
Ascorbic acid	Indophenol titration Fluorimetry HPLC Coiourimetry	Total ascorbic acid			4 1 2	1	1	1	1 1
Thiamin (Bl)	HPLC Fluorimetry Microbiological essay		(34)		5 2	1	1 1	1	1
Riboflavin	HPLC Fluorimetry Microbiological essay				4 2	1	1	1	1

Continued

Summary of methods used for food composition analysis.Vitamins- table 5 *continued*

Nutrient	**Method**	**Comment**	Fapas (3,4)	Aus (2)	Asean (1)	USP	NZ	AGAL	QHSS
		Number of laboratories	152 (76)	12	6	1	1	1	1
Niacin	Colourimetry HPLC Microbiological assay				3 2	1	 1	 1	
Vitamin B6	HPLC Microbiological assay				1 2		 1	1	1
Pantothenic acid	Microbiological assay							1	
Vitamin B12	Microbiological assay				3	1	1		
Total folates	Microbiological assay HPLC				3			1	
Biotin	Microbiological assay							1	

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THE AVAILABILITY AND USE OF QUALITY CONTROL MATERIALS IN NUTRIENT ANALYSIS

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The question that haunts an analytical chemist at the end of an analysis is the reliability of the data produced. This is especially important in food analyses as, based on these values, important decisions may be made on government food and nutrition policy, nutrition education, health promotion, consumer protection and food product development. There may also be legal issues involved if the analysis was conducted to meet some legislative requirement such as nutrient labelling laws. Analytical accuracy is also part of successful performance in a Laboratory Accreditation Scheme.

Adherence to broad quality control and quality assurance protocols can provide some place of mind. These have been well discussed at previous OCEANIAFOODS meetings and are summarised below (Scheelings, 1991):

Quality Control refers to a planned system of activities whose purpose is to control the quality of a product or service.

Quality Assurance refers to a planned system of activities whose purpose is to ensure that the quality control program is effective.

Standard Quality Control Activities

•employment of qualified and experienced analysts

•use of standard or official methods validated for the test sample

•use of reagent blanks, spikes, laboratory controls and certified reference samples

•use of control charts

•use of replicate analyses

•adherence to principles of Good Laboratory Practice in regard to:

•staff training

•equipment maintenance and calibration

•staff management and supervision

•sample management including identification, integrity and control
•data reporting and audit
•accreditation by external organisations

Standard Quality Assurance Activities

•in-house test sample program
•external check sample program
•participation in interlaboratory proficiency studies
•regular audits of adherence to principles of Good Laboratory Practice particularly in regard to:
•instrument calibration and maintenance
•acceptable recovery rates of spiked and reference samples
•sample integrity (particularly when testing for labile analytes)
•data recording and interpretation
•audits by external organisation

The use of external benchmarks such as reference materials are a key element of a quality assurance program. They can provide assurances that the extraction method has fully removed the analyte without change and that no bias has been introduced by the method, machinery, or analyst in performing the analysis and interpreting the data.

A reference material is defined by the ISO Guide 43 (1996) as "a material or substance one or more properties of which is or are homogeneous and established to be used for the calibration for an apparatus, assessment of a measurement method or for assigning values to other materials".

A good food reference material should have the following qualities (Sullivan & Carpenter, 1993):

•be representative of natural foods or food products, fresh or dried form, with various food matrices and should be easily available
•appropriately prepared with sufficient homogeneity and stability with respect to macro and micro nutrient content over time
•containing desirable amounts of components of interest, with minimal or no contamination from other materials or equipment
•covering a wide range of components and supplying each certified or consensus value with its degree of uncertainty
•reasonably cheap and relatively easy to obtain

Unfortunately no material meets all these requirements. The process of preparing a sample and documenting adherence to the first four criteria is a costly process which makes such reference materials very expensive. Until recently most reference materials were not certified for labile components especially many vitamins. Even these newly developed samples represent only a few of the possible real food matrices with the various interactions of lipids, protein, carbohydrate, water and micronutrients. Despite these limitations, increasing efforts are being made to produce reference materials as their use has been strongly recommended in recent years by a variety of international groups and certification bodies. Principal sources of reference materials are the National Institute of Standards and Technology (NIST), U.S.A., the Community Bureau of Standards (CBR) located in Belgium and the International Atomic Energy Agency (IAEA) located in Austria.

These laboratories attempt to prepare certified reference materials. To be a certified value, besides meeting homogeneity and stability criteria, the analyte must be measured several times by the certifying laboratory and several other expert laboratories which will provide for analyses by a variety of accepted methods. If strict criteria are met for agreement of these various values with small uncertainties, that analyte for the material will be considered a certified value and the material a certified reference material (CRM). For lesser agreement among values, if the agency itself does not perform the analysis or if a range of analytical methods are not used a concensus value with uncertainty is given. The least reliable results may still be averaged to be given as a reference value without uncertainty.

Since the last OCEANIAFOODS meeting NIST has released four certified reference materials covering a range of food nutrients. Their pioneering total diet reference material SRM 1548 of the early 1990s has been replaced by a typical diet sample SRM 1548a. Like its predecessor it is only certified for the minor elements Ca, C1, Mg, P, K, Na and S. The certification process (six independent analyses at NIST and six independent analyses at ten proficient laboratories) did not provide data for the analytes that met NIST standards for certification but are provided as consensus values with uncertainties. These analytes include proximates (carbohydrate by difference) and nine vitamins. Noncertified values without uncertainties are provided for several trace elements plus one vitamin. The cost of this material is US$445 for 50 grams.

A listing of the materials available in the current NIST catalogue are given below:

SRM 1846, a milk-base infant formula powder (cost US$216/50 g), is certified for the following analytes:

Vitamin A
Vitamin E
Vitamin C
Vitamin B_2
Vitamin B_6
Niacin
13 trace elements

Reference concentrations are also provided for proximates (including total dietary fibre but with carbohydrate by difference). These are not certified as the required confirmation by a variety of analytical techniques was not done.

SRM 2383, Baby Food Composite (cost US$265/50 g), achieved certified values for Vitamins A and E and several carotenoids. Consensus values with uncertainties are provided for proximates, cholesterol, seven B vitamins and trace elements. Values for types of fats, total dietary fibre, sugars and five vitamins could not be assigned uncertainties due to divergence of values using different methods.

SRM 8435, Whole Milk Powder (cost US$156/50 g), has best estimates only for certain elements as analyses were not performed at NIST. RM 8413a, Mixed Diet, had recommended values plus uncertainty for minerals and proximates (including total sugars and starch) and data on individual sugars and fibre content but is no longer available.

The European Union Bureau for Reference Standards (BCR) has a variety of matrices for trace elements. In addition it has the following materials with useful nutrients:

CRM 380	**CRM 381,382**	**CRM 383**	**CRM 384**
Whole milk powder	**Flours**	**Beans**	**Pork**
Lactose	Nitrogen	Glucose	Nitrogen
Nitrogen	Fat	Fructose	Fat
Fat	Polysaccharides*	Sucrose	Ash
Ash	Monosaccharides *	Nitrogen	Niacin*
Thiamin*	Dietary Fibre (Englyst)*	Dietary Fibre (Englyst)*	Vitamin E
Niacin*	Ash	Ash	6 Essential Elements
Vitamin E*	5 Essential Elements	Vitamin C*	
Retinol*		Thiamin*	
5 Essential Elements		Niacin*	
		Vitamin E*	
		5 Essential Elements	

Starred values are not certified. The cost of these CRMs is about 150 pounds Sterling/100 g. CRM 162 and 163, soya oil and a beef-pig fat blend, are certified for a number of fatty acids and cholesterol.

The Swedish Meat Research Institute provides a 200 g sample of meat matrix for 68 pounds Sterling with certified values for proximates, starch, lactose, salt and five essential elements. A variety of other suppliers have food matrices but only certified for elements. The Office of Reference Materials of the U.K. Laboratory of the Government Chemist (orm@gc.co.uk) provides a Reference Material Advisory Service on all major producers of CRMs.

In developing countries, especially in newly established laboratories, spending precious resources on high cost CRMs is not necessarily a top priority. There is a need to establish precision first and this can be done usually with less expensive materials.

Data Reliability - Accuracy versus Precision

The terms accuracy, precision and reliability are often interchanged by people wanting to describe some correct or factual information. Even scientists may use any of these descriptions to define the quality of their experiments, data or conclusions. Because sources of error may differ, it is important to use the correct terminology to describe the 'quality' of data derived from a set of experiments or measurements.

> Accuracy is getting the right result Precision is getting the same results Reliability is getting the same results right

Whilst both accuracy and precision are important from the end-users' view, it is perhaps more relevant from a 'management' point of view that the analyst or process gives the same result every time (within acceptable limits).

One of the first recollections of analytical practicals is a simple acid-base titration. The instructions are to undertake the analysis in triplicate. Considerable importance is placed on establishing and improving the student's repeatability i.e. get the same result every time.

It is generally easier to correct or adjust for a systematic bias or error than to correct random variations due to operator inexperience or inattention.

Too many analysts participate in proficiency and other collaborative studies when they do not have adequate experience in the methodology or with the matrix under test. This was particularly evident in a recent proficiency study on the composition of prepared food samples undertaken in Indonesia. For every determination, several laboratories reported unacceptable within-laboratory precision suggesting poor analytical skills or unfamiliarity with the methodology.

It is important for analysts and laboratories to take steps to improve operator precision before focussing on data accuracy. It is therefore more relevant for laboratory managers to employ suitable control samples to establish and maintain acceptable levels of precision than to allocate valuable resources on certified reference materials or proficiency studies.

There are many off-the-shelf food products which are suitable as laboratory control samples provided that they are appropriately packed, have acceptable within-batch homogeneity and are stable over time.

Reference Foods and Check Samples

Whilst many off-the-shelf food items provide some guide to the levels of nutrients through a nutritional panel, it is often unclear whether the data is based on ingredient composition, calculated from food composition tables or based on direct analysis.

There are now more organisations which are producing 'reference' foods to meet specific industry or laboratory needs. These materials, whilst not pretending to have data quality of certified reference materials, are often more readily available at modest cost and therefore affordable as laboratory control samples. The value of these samples is that they generally have proven stability and homogeneity and have assigned values based on the consensus of a number of competent collaborating analysts. They provide a useful 'benchmark' on analyst accuracy without the high cost of CRMs.

Additional reference foods and check samples are available as follows:

1. RACI flour check sample:
   Nutrients: protein, ash, moisture
   Available from: Grain Quality Laboratory, SARDI, South Australia
   Cost - $20 per 100 gram lot

2. BRI reference foods (various):
   Nutrients: protein, ash, fat, TDF, sugars, thiamin, Na, K, Ca
   Available from: Bread Research Institute, New South Wales
   Cost - $50 per 40 gram lot

3. AACC reference flour:

   •VMA reference flour for proximates, vitamins and minerals
   •HFW hard wheat flour for proximates and 'falling number'
   •BG reference flour for bega-glucan

Available from: American Association of Cereal Chemists, Minnesota
Cost - ~$US 120 for 300 gram VMA

4. NATA:
Nutrients: various relating to previous proficiency studies
Available from: NATA or proficiency study organisers

An especially useful scheme is the Food Analysis Performance Assessment Scheme (FAPAS) of the Central Science Laboratory in the United Kingdom, which is used as a certifying exercise for European Union laboratories. A wide range of food nutrients and contaminants are tested. About 40 samples are offered annually, with usually more than one round of similar samples. For example in 1997 three canned meal samples were offered roughly one every four months for analysis of moisture, ash, fat, C1, N, K, Na, Ca, Fe and Zn. Samples were also offered (biscuit powder) to analyse for moisture, oil, N, Cu, Mg, sugar, starch and Vitamins A and Bi. Samples are also offered to analyse for individual fatty acids and cholesterol. Participation costs are about 100 pounds Sterling per sample but excess materials with consensus values from 100-200 participating laboratories are available at half this cost. Similar samples analysed for the same nutrients are offered annually so participant can compare their performance over time.

An ambitious check sample program has also been carried out by ASEANFOODS under the leadership of Dr Prapasri Puwastien. In 1989 SF1, soybean flour, and RF-1 (rice flour) were developed and studied by about twenty laboratories. In 1993 two new samples, cereal-soy product (CS-2) and fish meal (F-2) were studied for moisture, protein, fat, dietary fibre, ash and eight elements. In 1997, two new materials, Cerelac and fish meal, which for the first time included two B vitamins, were distributed and we may hear some preliminary results later in this presentation. This exercise has been very useful to ASEANFOODS laboratories and the OCEANIAFOODS laboratories that have participated. The limited number of laboratories and large standard deviations has led to values that do not qualify for consensus status. In 1993, for example, only 3 of 28 value could be classified as consensus. Nonetheless, once the reference values are determined the extra material can be used by laboratories to monitor the quality of their analyses. These samples are especially appreciated as OCEANIAFOODS has decided it is impractical to develop such samples of our own. The 1993 samples, for example, were recently analysed by a Papua New Guinea laboratory wishing to further develop their food analysis capabilities.

A third kind of useful reference material is in-house standards. These are usually store-bought packaged products available cheaply in large quantity and batch processed. These materials can be used for initial precision testing and also test homogeneity. Once homogeneity has been established individual samples can be stored and analysed periodically to determine stability. If stable, these materials can serve as a control in some aspects of quality assurance. Of course, since all analyses have been performed in one laboratory, biases associated with method or instrumentation will not be detected. It would be useful for OCEANIAFOODS and perhaps ASEANFOODS laboratories to share their in-house control samples as simple and an inexpensive quality assurance method. Among the materials used as in-house standards at IAS and AGAL are:

Material	**Analyte**
Tang (powdered orange drink)	Vitamin C
Wheat Germ	Thiamin Riboflavin Niacin Fatty Acids
Spam	Cholesterol Fatty Acids
Fish Oil	Fatty Acids
Milo Powder	Individual Sugars
Wheat Flour	Moisture Protein Ash Starch Thiamin Niacin Total Dietary Fibre Minerals

With this increasing array of available reference materials, ranging from in-house standards through certified reference materials, the food analyst can rest more easily about the reliability of the data they generate.

THE ROLE OF APFAN FOR FOOD SCIENTISTS IN DEVELOPING COUNTRIES

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APFAN is a special project of the Federation of Asian Chemical Societies. It is primarily a network of food analysts and scientists operating in the Australasian, Oceania and the ASEAN region.

The aim of APFAN is to serve the needs of food analysts and thereby to promote food safety and food nutrition. By promoting and supporting (reliable) food analysis in developing countries, APFAN indirectly contributes to the improvement of food security in these regions.

APFAN was formed at the Second Asian Chemical Congress which was held in conjunction with the 10th RACI Analytical Chemistry Conference in Brisbane, 1989. The Network was the concept of Howard Bradbury (ANU) and Graham Craven (GCL). Dr Bradbury accepted the role of APFAN Coordinator.

APFAN membership is open to anyone interested in food analysis. Membership is granted by completing a standard questionnaire and there is no membership fee. Members are mainly chemists, biochemists, microbiologists, nutritionists and food scientists. There is a category of Sustaining Membership for instrument and chemical suppliers.

Current membership is more than 350 people from 28 different countries of Asia, Pacific and East Africa.

APFAN OPERATIONAL STRUCTURE

APFAN is "managed" through the coordinator, who is assisted by a number of country contracts. APFAN relies on financial support from funding organisations, professional societies and industry. These funding agencies include the Crawford Fund (Melbourne), the Australian Agency for International Development (AusAID), the Australian Centre for International Agriculture Research (ACIAR), the Asia Oceania Network for Biological Sciences, the Australian Institute of Food Science and Technology (AIFST) and the Royal Australian Chemical Institute (RACI).

APFAN's key activities are:

1.Asia Pacific Food Analysis Workshops

2.Asia Pacific Conferences on Food Analysis

3.APFAN Short Courses and Special Projects

4.Reference Materials

1. Asia Pacific Food Analysis Workshops

Five one-week workshops have been held since 1991 at the QHSS Laboratory campus. To date 93 members from 12 countries have attended these workshops. Workshops cover formal lectures and hands-on training in selected areas of food analysis (chemical and microbiological). Selection of participants is based on country needs, merit of applicant and support funding. The Crawford Fund has been the major sponsor of overseas applicants. QHSS charges a nominal fee to cover direct costs of the workshops.

Workshops provide a valuable networking opportunity for participants and include a number of social activities. Workshop participants continue to seek guidance from QHSS staff on methods and techniques that they have studied.

Workshop topics include:

•Food and water microbiology
•Pesticide analysis
•Trace metal analysis
•Water and fat soluble vitamins
•Fatty acid profile
•Proximates
•Dietary fibre
•Aflatoxin analysis
•Rapid methods for microbiological analysis

1. Asia Pacific Conferences on Food Analysis

APFAN has hosted 3 conferences:

•Penang (1990)
•Kuala Lumpur (1992)

•Manila (1995) in conjunction with the 6th Asian Chemical Conference
•A fourth Conference (4AC) is planned for November 1998 in Chiang Mai, Thailand, which may be preceded by a hands-on workshop on Pesticide Immunoassays.

1. APFAN Short Courses and Special Projects

These consist of short practical courses of 4 weeks to 4 months duration tailored to the needs of individual developing countries. Approximately 20 persons from 7 countries have been trained in food and soil analysis at Australian laboratories.

Another project is the AusAID project to upgrade food analysis laboratories in Indonesia.

2. Reference Material

Modestly priced reference foods have been prepared and consensus values assigned by Dr Prapasri Puwastien at Mahidol University. Whilst this project is primarily a ASEANFOODS initiative, it has attracted some financial and technical support from APFAN and its members.

DEVELOPMENT OF THE NUTRIENT COMPOSITION DATABASE FOR THE 1995 AUSTRALIAN NUTRITION SURVEY

Janine Lewis, Gregory Milligan, Ann Hunt
Australia New Zealand Food Authority

THE 1995 NATIONAL (AUSTRALIAN) NUTRITION SURVEY

The 1995 National Nutrition Survey collected information from February 1995 to March 1996 on the food intake, eating habits and physical measurements of approximately 13 800 Australians aged 2 years and over, in all States and Territories across urban and rural areas. The Survey was jointly conducted by the Australian Bureau of Statistics, and the federal Department of Health and Family Services. Food intake data were collected by 24-hour recall from all respondents or their care givers, and a second non-consecutive 24-hour recall was obtained from 10% of respondents. A food frequency questionnaire was also completed by a large proportion of survey participants aged over 12 years. Selected highlights [1] of the Survey as well as a user guide[2] and the confidentialised unit record file[3] have been published to date.

SURVEY NUTRIENT COMPOSITION DATABASE

Because the Australia New Zealand Food Authority is responsible for production of official Australian nutrient composition data, the Authority was approached to develop the custom nutrient composition Survey database to enable conversion of foods consumed into nutrient intakes. The database was developed in 1996 in parallel with the Department's coding of the Survey food intake records. This meant that as new foods were added to the food coding system (ANSURS), the Authority devised the corresponding nutrient profiles.

Foods

The Authority was not required to develop nutrient composition data for all foods consumed because ANSURS had the facility to calculate the nutrient composition of home-prepared dishes based on respondents' recipe information.

The Authority and ANSURS used the same approach in calculating recipe data. At the completion of coding, the final nutrient database contained data for 4 550 foods of which 1 286 are standard recipes comprising:

•single foods - raw and cooked;
•commercial products;
•recipe ingredients; and
•recipe foods - commercial and home-prepared.

Nutrients

Data for energy and 28 nutrient components comprising 12 proximate constituents, 10 vitamin components and 6 minerals (excluding sodium) are reported in the database. All values are expressed per 100 g edible portion. The consistent use of the 100-gram reference quantity for all foods including fluids, differs from that used in the Australian food tables where data for many fluids are expressed per 100 mL.

Sources of nutrient data

Many reference sources were consulted to obtain nutrient composition information. These sources are listed below in order of data contribution.

•Composition of Foods, Australia (COFA)[4]
•Unpublished food composition data commissioned by the Authority
•Australian scientific literature
•Food industry data
•British food tables[5]
•United States food tables and standard reference data base[6, 7]
•New Zealand food tables and FOODFiles database[8,9]
•Other data

Development of the Nutrient Database

Nutrient composition data for the Survey foods were derived by a range of methods:

1) Single COFA food matched to a single Survey food

Where the description of a food published in COFA matched that of a Survey food, the COFA nutrient data were used without amendment.

2) Several COFA foods aggregated to produce a single Survey food

Where the description of a Survey food was less specific than for relevant COFA foods, nutrient data from several COFA foods were aggregated to produce a representative nutrient profile for the Survey food. Market production or consumption data were generally used to provide the weighting factors. For example, the different cultivars of peeled pear were weighted according to the relative market share to produce the representative nutrient composition of 'Pear, Not Specified as to Type, Raw, Peeled'.

3) Unpublished laboratory data

Unpublished laboratory data commissioned by the Authority's food composition program were used for several foods, particularly cereals and meats.

4) Modification of COFA data

Where the description of a food published in COFA was similar to that of a Survey food except for a particular characteristic such as low fat, the appropriate nutrient data of the COFA food were modified to account for the pertinent characteristic. For example, the nutrient composition of low fat *plain* yoghurt was derived by applying the difference in fat, vitamin A, and fatty acid content between full fat *fruit* yoghurt and low fat *fruit* yoghurt to full fat *plain* yoghurt.

5) Food industry data

Nutrient composition data for commercial products were available from some manufacturers. Generally, the range of provided data divided into two categories: comprehensive analytical or calculated data, or a more limited range of values given in nutrition labelling.

The data were used in one of two ways depending on the amount available.

•comprehensive nutrient data were used directly, providing data quality criteria were satisfied; and
•nutrition label and ingredient list information were primarily used to guide recipe calculation.

For vitamin- and mineral-fortified foods such as the majority of breakfast cereals, label values indicating average vitamin and mineral content were used in preference to other available data, because such data were considered to be more representative of the likely variability in content from batch to batch.

6) Recipe calculation

Nutrient data for many commercial products and simple cooked foods were obtained through recipe calculation. The method selected for recipe calculation was the retention factor method*", which involves the following steps:

i) applying appropriate vitamin and mineral retention factors to the individual ingredients;
ii) summing the values to the uncooked recipe stage;
iii) applying moisture gains or losses, as appropriate, to the uncooked recipe;
iv) expressing the results per 100 g cooked recipe.

The retention factors and most weight changes used in these calculations were taken from official US references.

Recipes for commercial products were developed using label ingredient lists which rank ingredients according to ingoing contribution. The proportion of each ingredient was adjusted to derive nutrient values which approximated the label information or food industry data.

Home-prepared recipes were calculated by ANSURS according to the same method.

7) Substitution of nutrients

Data for specific nutrients such as fatty acids were adjusted to take account of the composition of the cooking medium. For example, the fatty acid content of each egg fried in a different fat was adjusted to account for the fatty acid profile of that frying fat.

8) Overseas data

Where Australian nutrient data were not available, data from overseas references were used, mainly the official food tables of the United Kingdom and the United States. Because of British copyright requirements, official permission was obtained for the use of up to 4 000 total folate values and general nutrient data for up to 1000 foods from the 5th edition of McCance and Widdowson's *The Composition of Foods* and its supplements[5]. Foreign modes of expression such as monosaccharide equivalents for carbohydrate were adjusted to conform to the modes of expression used for Australian data.

9) Food descriptions with unspecified characteristics

Two types of food descriptions were devised to accommodate foods for which respondents were unable to specify certain characteristics:

i Not Specified as to [characteristic]

where one or two relevant nutrient or physical characteristics of the food were not specified by the respondent; and

ii Not Further Specified

where only the most general characteristics of the food could be specified.

The derivation of this category of nutrient data used a probability approach to develop data representative of those Survey foods with a common core description but which varied with respect to the characteristic of interest. The approach is outlined as follows.

Not Specified as to [characteristic]

For food descriptions containing one or two unspecified characteristics, the nutrient composition of all foods whose *core* food description matched the food under development but which varied according to the characteristic of interest, were aggregated in proportion to market availability or to other indicators of relative consumption. Generally, the less detailed the food description, the greater the number of appropriate fully described foods which contributed to the ultimate nutrient composition. For example, the nutrient composition of 'Milk, Not Specified as to Fat Content' was developed by weighting the data of milks of different fat contents, according to their individual market share.

Not Further Specified

The process for this category was an extension of that used to develop nutrient composition of foods for which only one or two characteristics were not defined. For example, 'Milk, Not Further Specified' was derived by aggregating data for those milks contributing to 'Milk, Not Specified as to Fat Content' in addition to the data for all other milks characterised according to other criteria such as animal source, calcium content or lactose content.

The weighting factors used to generate representative nutrient data relied on indicators of usual consumption. If possible, market share information was obtained, however, this was often not available. A secondary source of information was the Survey itself. The relative consumption of foods as recorded during the coding process was used to derive some of the weighting factors; it was assumed that the relativity of consumption remained unchanged throughout the Survey.

Meat, A Special Case

Food descriptions for meat were not required to be as detailed as the variety of meats listed in COFA. Generally, nutrient data for the relevant selection of individual cuts and cooking methods were weighted according to carcase proportions.

Trimming

COFA meat data are given at two levels of trimming, 50% and 75% trimmed, based on a mathematical adjustment of the physical composition of untrimmed retail cuts. This approach is uniformly applied irrespective of the amount of separable fat present in untrimmed cuts, except for untrimmed cuts containing less than 6% separable fat, in which case, no data for trimmed cuts are published.

The Survey database contains only one fat-trimmed version of each meat description. Rather than adopting the same approach to trimming as in COFA, a new approach was devised in which the proportion of trimming was determined on the basis of the relative proportions of lean and separable fat such that:

% Separable Fat	**Selected % Trim**
0-4	nil
5-10	50
11-20	75
>20	90

This approach assumes that consumers would trim to approximately the same residual amount irrespective of the original amount of separable fat.

CONCLUSION

The development of the National Nutrition Survey nutrient composition database has afforded the opportunity to considerably expand the amount of data available for use in Australia, principally by increasing the number of foods, but also by officially adopting British folate values as an interim measure. Such rapid expansion of a database that had been predominantly derived from Australian analyses has, of necessity, introduced many lines of data derived by imputation and recipe calculation. It will be important for end users to be made aware of the significant change in the basis of the published values when these data are made available.

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CODEX GUIDELINES FOR USE OF NUTRITION CLAIMS

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INTRODUCTION

One of the major uses of data on the nutrient composition of foods is to provide a reference basis for nutrition claims for foods and nutrient labelling of food products, particularly of packaged foods.

Over the past decade, there has been a growing interest by consumers in the nutritional value of foods, as research has shown the significant associations between the nutritional value of diets and risk for chronic diseases, including cardiovascular disease, some cancers, and non-insulin dependent diabetes mellitus. As consumers, particularly in the more developed countries, become more dependent on processed, packaged foods to provide dietary needs, the food industry has become well aware that the provision of information about the nutritional value of their foods is an effective marketing factor to increase the purchase and consumption of these foods. So there is an increasing level of nutrition claims being made by the food industry in the marketing of their products, either in advertising or on food labels. To control these claims, countries such as Australia have produced sets of guidelines for nutrition claims, many of which are voluntary, rather than implemented as regulations.[1]

THE IMPORTANCE OF CODEX STANDARDS, CODES OF PRACTICE AND GUIDELINE

This paper will focus on the Codex Guidelines for Use in Nutrition Claims, which were approved at the 22nd Session of the Codex Alimentarious Commission, Rome, 1997.[2] With the growing internationalisation of trade in food, many countries in Oceania, small and large, have joined the World Trade Organization (WTO), which involves commitment to and acceptance of Codex standards, codes of practices and guidelines. The Final Act emerging from the Uruguay negotiations which established the World Trade Organization (WTO), has appended to it a series of Agreements and Ministerial Decisions and Declarations.[3] The Multilateral Agreements on Trade in Goods includes two Agreements which have particular relevance for the international trade in foods and the food standards, codes of practice and guidelines adopted by countries. These are:

•Agreement on the Application of Sanitary and Phytosanitary Measures (SPS)

•Agreement on the Technical Barriers to Trade (TBT)

In joining the WTO, a number of Pacific Island countries are now subject to the provisions of these Agreements. In effect this essentially means compliance with the requirements of SPS and TBT Agreements, including recognition of Codex standards as (justified) or benchmark standards for the purpose of achieving harmonisation of standards world-wide, both in regard to protecting the health of consumers and ensuring fair practices in the sale of food. Thus the Codex standards, codes of practice, and guidelines now establish internationally accepted and "justified" practices for both the exporting and importing of foods, that are protected within the World Trade Agreements. An exporting country is given the opportunity of challenging on a scientific basis any prohibitions placed on its food exports by importing countries. The importing country is given the opportunity to impose import requirements on a scientific basis to adequately protect the health of its consumers, animals and plants. If those requirements match Codex standards they are considered to be "justified" requirements capable of withstanding challenge.[4]

Concerning food labelling, under these agreements the measures that governments adopt concerning technical regulations and standards, including those for packaging, marking and labelling, should be applied only to the extent necessary to achieve an adequate level of consumer protection and not to create unnecessary obstacles to international trade. Hence there is now a growing interest in Codex labelling standards and guidelines as the international benchmarks for world food trade. So for nutrition labelling provisions, the Codex standard is the international benchmark, not the USA Nutrition and Labelling Act of 1995, as discussed at the Fourth Conference of OCEANIAFOODS in Suva.[5]

GUIDELINES FOR USE OF NUTRITION CLAIM

The development of guidelines for the use of nutrition claims has been under the consideration of the Codex Committee on Nutrition and Foods for Special Dietary Uses and the Committee on Food Labelling for some years. The specific nutrition claims considered in these Committees relate to the levels in foods of the following nutrients or food components:

Energy
Protein
Fat - saturated
Sugar
Dietary fibre
Cholesterol
Vitamins
Minerals

RECENT DEVELOPMENTS TO FINALISE THE GUIDELINES THROUGH CODEX ALIMENTARIOUS

In 1997, the 24th Session of the Codex Committee on Food Labelling (CCFL) advanced the Draft Guidelines for Use of Nutrition Claims to Step 8 and asked the Codex Committee on Nutrition and Foods for Special Dietary Uses (CCNFSDU) to consider conditions for the expression of nutrients on the basis of servings and to define the conditions for "cholesterol free", "low sugar", "energy free" and "saturated fat free".[6] Following consideration of these issues, the 20th Session of the CCNFSDU (1997) agreed that, as consensus had been reached on Part A of the Draft Table of Conditions for Nutrient Contents with some amendments and additions to the previous draft, it should be included in the Draft Guidelines, while further work was still required on Part B of the Draft Table (Fibre, Protein, Vitamins and Minerals), and on the expression of conditions for claims per serving.[7]

The CCNFSDU agreed to forward Part A of the table to the Commission for adoption at Step 8 as part of the Draft Guidelines for use of Nutrient Claims, and to return Part B to Step 6 for further comments and discussion at the next session (21-25 September 1998).

At the 22nd Session of the Codex Alimentarious Commission (CAC), the Commission adopted the Guidelines for Use of Nutrition Claims (including Part A of the table) as finalised with the understanding that additional work was needed on the expression of claims per serving and further considerations should be given to the issues raised in government comments, when finalising the table of conditions.[7] The Guidelines including Part A of the table are given at Appendix 1 to this paper.

CODEX ACTION ON HEALTH CLAIM

There has also been much interest in the issue of Health Claims within the Codex Committees. At the 21st session of the Codex Committee on Food

Labelling (CCFL) in April 1996, it had been agreed that Health Claims would not be included in the Draft Guidelines for Use of Nutrition Claims at this stage.[8] While there was a consensus to exclude claims relating to the prevention, cure and treatment of disease and adverse health-related conditions, the Committee could not come to an agreement on other health claims. All references to health claims throughout the text were therefore deleted, including the definitions. The Committee agreed that further consideration could be given to this issue in the future in the light of additional information.

At its 22nd session in April 1997, CCFL agreed that although national regulations on health claims differed considerably from one country to another, this issue deserved careful and continuous attention, in view of increasing interest concerning health claims by many parties, including consumers.[6] Therefore the committee agreed that there was a clear need to develop an internationally agreed definition for Health Claims on the basis of the work already done by the Committee.

The Committee agreed to circulate the sections on Health Claims as previously contained in the Draft Guidelines for Use of Health and Nutrition Claims, as proposed draft recommendations for government comments at Step 3 with a view to developing a draft amendment to the Guidelines for Use of Nutrition Claims, subject to their adoption by the Commission. For information these sections are detailed at Appendix 2.

IMPLICATIONS FOR NUTRIENT ANALYSIS

To continue to meet the needs of the food industry for nutrient composition data for food labelling and advertising of products for national consumption or export, and the needs of compliance bodies, it will be important for food analysts to be aware of labelling developments within Committees of the Codex Alimentarius, including both the list of nutrients that will require analysis and approved methods of analysis. In relation to nutrition labelling, these guidelines were finalised within the Codex Committee of Food Labelling and adopted by the Codex Alimentarious Commission in 1985. The Committee on Labelling is now proposing to review the Guidelines on Nutrition Labelling in its next work program. With the onus on WTO countries to comply with the provisions of the Uruguay Agreements, the nutrients listed for declaration in the current Guidelines constitute (as will any updated Guidelines) the "justified standard" for nutrition labelling of packaged foods for international trade.

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APPENDIX 1
GUIDELINES FOR USE OF NUTRITION CLAIMS

Nutrition claims should be consistent with national nutrition policy and support that policy. Only nutrition claims that support national nutrition policy should be allowed.

1. SCOPE

1.1These guidelines relate to the use of nutrition claims in food labelling.

1.2These guidelines apply to all foods for which nutrition claims are made without prejudice to specific provisions under Codex standards or Guidelines relating to Foods for Special Dietary Uses and Foods for Special Medical Purposes.

1.3These guidelines are intended to supplement the Codex General Guidelines on Claims and do not supersede any prohibitions contained therein.

2. DEFINITIONS

2.1 Nutrition claim[1] means any representation which states, suggests or implies that a food has particular nutritional properties including but not limited to the energy value and to the content of protein, fat and carbohydrates, as well as the content of vitamins and minerals. The following do not constitute nutrition claims:

(a)the mention of substances in the list of ingredients;

(b)the mention of nutrients as a mandatory part of nutrition labelling;

(c)quantitative or qualitative declaration of certain nutrients or ingredients on the label if required by national legislation.

2.1.1 Nutrient content claim is a nutrition claim that describes the level of a nutrient contained in a food. (Examples:[2] "source of calcium", "high fibre and low in fat")

2.1.2Comparative claim is a claim that compares the nutrient levels and/or energy value of two or more foods. (Examples: "reduced", "less than", "fewer", "increased", "more than")

2.1.3Nutrient function claim is a nutrition claim that describes the physiological role of the nutrient in growth, development and normal functions of the body. (Examples: "Calcium aids in the development of strong bones and teeth"

"Protein helps build and repair body tissues", "Iron is a factor in red blood cell formation"

"Vitamin E protects the fat in body tissues from oxidation"

"Contains folic acid : folic acid contributes to the normal growth of the fetus").

3. NUTRITION LABELLING

Any food for which a nutrition claim is made should be labelled with a nutrient declaration in accordance with Section 3 of the Codex Guidelines on Nutrition Labelling.

4. NUTRITION CLAIMS

4.1 The only nutrition claims permitted shall be those relating to energy, protein, carbohydrate, and fat and components thereof, fibre, sodium and vitamins and minerals for which Nutrient Reference Values (NRVs) have been laid down in the Codex Guidelines for Nutrition Labelling.

5. NUTRIENT CONTENT CLAIMS

5.1 When a nutrient content claim is listed in the Table *to these* Guidelines or a synonymous claim is made, the conditions specified in the Table for that claim should apply.

[1]This definition is identical to the definition in the Codex Guidelines on Nutrition Labelling (CAC/GL 2-1985, Rev. 1-1993)
[2]Examples included for clarification of definitions

5.2 Where a food is by its nature low in or free of the nutrient that is the subject of the claim, the term describing the level of the nutrient should not immediately precede the name of the food but should be in the form "a low (naming the nutrient) food" or "a (naming the nutrient)-free food".

6. COMPARATIVE CLAIMS

Comparative claims should be permitted subject to the following conditions and based on the food as sold, taking into account further preparation required for consumption according to the instructions for use on the label:

6.1The foods being compared should be different versions of the same food or similar foods. The foods being compared should be clearly identified.

6.2A statement of the amount of difference in the energy value or nutrient content should be given. The following information should appear in close proximity to the comparative claim:

6.2.1The amount of difference related to the same quantity, expressed as a percentage, fraction, or an absolute amount. Full details of the comparison should be given.

6.2.2The identity of the food(s) to which the food is being compared. The food(s) should be described in such a manner that it (they) can be readily identified by consumers.

6.3The comparison should be based on a relative difference of at least 25% in the energy value or nutrient content, except for micronutrients where a 10% difference in the NRV would be acceptable, between the compared foods and a minimum absolute difference in the energy value or nutrient content equivalent to the figure defined as "low" or as a "source" in the Table to these Guidelines".

6.4The use of the word "light" should follow the same criteria as for "reduced" and include an indication of the characteristics which make the food "light".

7. NUTRIENT FUNCTION CLAIMS

Claims relating to the function of a nutrient in the body should be permitted provided the following conditions are fulfilled:

7.1 Only those essential nutrients for which a Nutrient Reference Value (NRV) has been established in the Codex Guidelines on

Nutrition Labelling or those nutrients which are mentioned in officially recognized dietary guidelines of the national authority having jurisdiction, should be the subject of a nutrient function claim.

7.2The food for which the claim is made should be a significant source of the nutrient in the diet.

7.3The nutrient function claim should be based on the scientific consensus which is supported by the competent authority.

7.4The claim should not imply or include any statement to the effect that the nutrient would afford a cure or treatment for or protection from disease.

8. CLAIMS RELATED TO DIETARY GUIDELINES OR HEALTHY DIETS

Claims that relate to dietary guidelines or "healthy diets" should be permitted subject to the following conditions:

8.1Only claims related to the pattern of eating contained in dietary guidelines officially recognized by the appropriate national authority.

8.2Flexibility in the wording of claims acceptable, provided the claims remain faithful to the pattern of eating outlined in the dietary guidelines.

8.3Claims related to a "healthy diet" or any synonymous term are considered to be claims about the pattern of eating contained in dietary guidelines and should be consistent with the guidelines.

8.4Foods which are described as part of a healthy diet, healthy balance, etc. should not be based on selective consideration of one or more aspects of the food. They should satisfy certain minimum criteria for other major nutrients related to dietary guidelines.

8.5Foods should not be described as "healthy" or be represented in a manner that implies that a food in and of itself will impart health.

8.6Foods may be described as part of a "healthy diet" provided that the label carries a statement relating the food to the pattern of eating described in the dietary guidelines.

TABLE OF CONDITIONS FOR NUTRIENT CONTENTS (Part A)
GUIDELINES FOR USE OF NUTRITION CLAIMS

COMPONENT	CLAIM	CONDITIONS
A		NOT MORE THAN
Energy	Low Free	40kcal(170kj)perl00g (solids) 20 kcal (80 kj) per 100 ml (liquids) 4 kcal per 100 ml (liquids)
Fat	Low Free	3 g per 100 g (solids) 1.5 g per 100 ml (liquids) 0.5 ger 100 g/ml
Saturated Fat	Low[1] Free	1.5 g per 100 g (solids) 0.75 g per 100 ml (liquids) and 10% of energy 0.lgper 100 g (solids) 0.1 g per 100 ml (liquids)
Cholesterol	Low[1] Free	0.02 g per 100 g (solids) 0.01 g per 100 ml (liquids) 0.005 g per 100 g (solids) 0.005 g per 100 ml (liquids)
and for both	claims less than:	1.5 g saturated fat per 100 g (solids) 0.75 g saturated fat per (liquids) and 105 of energy of saturated fat
Sugars	Free	0.5 g per 100 g/ml
Sodium	Low Very Low Free	0.12 g per 100 g 0.04 g per 100 g 0.005 per 100 g

'In the case of the claim for "low in saturated fat", trans fatty acids should be taken into account where applicable. This provision consequently applies to foods claimed to be "low in cholesterol" and "cholesterol free".

APPENDIX 2

PROPOSED DRAFT RECOMMENDATIONS FOR THE USE OF HEALTH CLAIMS[1]

(At Step 3 of the Procedure)

2.2 [Health claim means any representation that states, suggests or implies that a relationship exists between a food or a nutrient or other substance contained in a food and a disease or health-related condition].

Examples:

A. Health-related effects on the body attributed directly to a food or nutrient or substance

"X fish oil lowers serum triglycerides and increases clotting times"

"X bran lowers blood cholesterol levels"

"X vegetable oil is low in saturated fat and will help reduce blood cholesterol levels"

"Contains soluble fibre that lowers blood cholesterol levels"

"Contains sorbitol. Polyols are more slowly absorbed than sugars and decrease the insulin response".

B. Disease prevention attributed to nutrient or substance contained in a food

"X contains soluble fibre which reduces risk of heart disease"

"X is low in saturated fat which reduces risk of heart disease".

C. Disease prevention or health-related to diet

"A low fat diet will reduce risk of cancer. X is a low fat food"

[1]The title of this text should be "proposed draft Amendment to the Guidelines on use of Nutrition Claims" if the current Draft Guidelines are adopted by the 22nd Session of the Commission

"Saturated fat raises blood cholesterol levels. A diet low in saturated fat will reduce blood cholesterol levels and reduce risk of cardiovascular disease. X is low in saturated fat".

7. HEALTH CLAIMS

7.1Without prejudice to Section 8, a health claim that a food or nutrient or substance contained in a food has an effect on an adverse health-related condition in the body should not be permitted.

7.2A claim that the consumption or reduced consumption of a food, nutrient or substance contained in a food, as part of a total dietary pattern, may have an effect on a [disease] or health-related condition [should/should not] be permitted subject to the following conditions:

7.2.1There is a scientific consensus supported by the component authority that a relationship exists between the food, nutrient or substance and the disease or adverse health-related condition.

7.2.2The wording of the claim is within the context of a total dietary pattern.

7.2.3"The food for which the claim is made should be:

(i) a significant source of the nutrient or substance in the case were increased consumption is recommended, or

(ii) "low" in or "free" of the nutrient or substance in the case where reduced consumption is recommended".

1.1.1 The claim should not state or imply that the consumption of a particular food would cure, prevent or treat a disease, and

7.2.5 [The claim should not be made if the consumption of the food would result in the intake of a nutrient or substance in an amount that would increase the risk of a disease or health-related condition.]

INTELLECTUAL PROPERTY AS A FOOD COMPONENT: POTENTIAL IMPLICATIONS FOR SOUTH PACIFIC NATIONS

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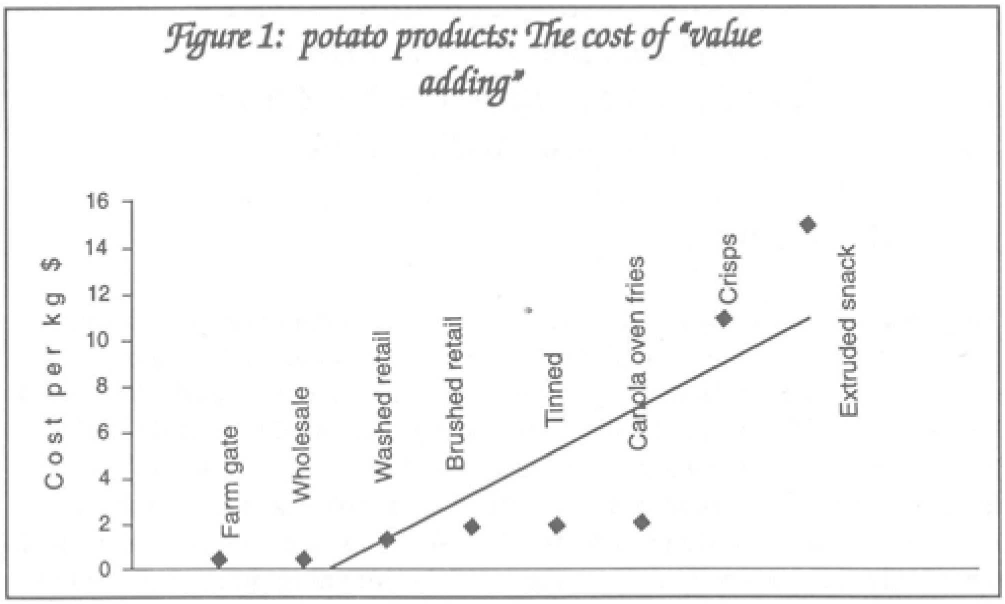
INTRODUCTION

This paper discusses, in general terms* the growing importance of intellectual property (IP) in the emerging global food system. Of particular interest is the development of standards for the introduction of Genetically Modified Organisms (GMOs) in the food system, being addressed in part through the *Proposed draft recommendations for the labelling of foods obtained through biotechnology*, currently at Step 3 of the Codex process. This development poses significant challenges to food analysts, since current analytical technologies cannot easily differentiate GMO-containing products from non-GMO products (Konietzny and Greiner 1997). This paper uses a «cost composition» model to understand some of the consequences of the evolving global food system for smaller nations, such as those of the South Pacific.

Cost composition: the intellectual property component of food

Restaurant meals often seem disproportionately expensive compared to the individual food component costs, ie. the raw food ingredients. Even when plant and salary costs are considered, a net «profit» remains. A significant proportion of this profit is attributable to intellectual property - IP (ie. know how). Factors such as how food is cooked, how recipes are developed, and how the menu is constructed all add significant value, and potentially cost, to the meal.

The same general process can be seen in supermarket foods. Figure 1 shows the results of a brief survey in a Brisbane supermarket comparing the cost of various potato-based products in comparison to raw potatoes. The processed products are generally more expensive than the raw produce, although there is not necessarily a linear relationship between extent of processing and price, since other issues such as marketing strategies also affect price. Where are the potential opportunities to add an intellectual property component to food? Table 1 lists a range of such possibilities in a processed food product. There has generally been less potential to add an IP component to unprocessed food until fairly recently.



Genetic modification, a recent new application of biotechnology to food, represents an opportunity to add a significant IP cost component to raw produce. Genetically Modified Organisms (GMOs) is a term which refers to plants, animals and microorganisms which have had DNA introduced into them by means other than by combination of an egg and a sperm (ie. using recombinant DNA technology) (Position of the American Dietetic Association 1993). This represents a quantum technological step compared to traditional selective breeding methods, and therefore has attracted close scrutiny in terms of reductionist laboratory-based toxicology studies. However, less attention has been placed on the potential impact of these innovations on «health» as defined by the World Health Organization in 1948 (Beaglehole et al 1994):

Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.

Table 1: Entry Doints for intellectual property in processed food production

- **Raw food materials**
  - Production/harvest technology
  - Plant-based research and development
  - Fertiliser/agricultural chemical technology
- **Packaging**
  - Raw materials (eg. plastics, paper) Artwork
- **Transport**
- **Marketing**
  - Promotion/Advertising Research Intelligence
- **Food processing**
  - Plant technology
  - Food technology
  - Nutritional attributes

Commercial potential of modern biotechnology

Modern biotechnology presents substantial commercial potential for owners of the corresponding IP. Intellectual property is a highly mobile commodity and can be exported at very minimal cost, compared to food commodity export for which expenses such as packaging, transport, labelling and spoilage are substantial. Another major interest is in the significant potential savings in food production costs through:

•Reduced production costs (ie. cheaper)
•Reduced chemical usage (ie. cheaper)
•Higher yields (ie. cheaper)
•Improved product characteristics (ie. cheaper to process) (INFORM Editorial 1998)

In Australia we often see situations where processed food products manufactured in Australian factories by Australian workers using Australian raw materials result in a significant «royalty» being sent to a foreign IP owner. An extention of this situation arises in the cultivation of crops with large IP components, so that the planting, harvesting and growing of a food may occur locally, but royalties for the privilege of doing so are exported to the country owning the IP. Farmers could even be restricted from planting the seed they produce, subject to the payment of royalties (Hulse 1993). This process seems inconsistent with strategies to alleviate food dependency.

The above situation may seem of little consequence for nations which import a large proportion of their food supply. At first glance, making food cheaper as suggested above might appear a desirable outcome. However, as Drewnowski and Popkin (1997) propose, cheaper mass-produced foods, especially edible oils, may actually enhance the effects of «nutrition transition* (a general trend away from high complex carbohydrate and fibre intakes towards a higher fat, saturated fat and simple sugar intake), some of which are already apparent in some South Pacific nations (Cavalli-Sforza et al 1996). The extent and speed with which GMOs appear in the global food system will be heavily influenced by how these issues are addressed through the Codex Alimentarius system.

The Codex Alimentarius system.

The Codex Alimentarius (Food Code) is a compilation of standards covering all major foods, food hygeine, food additives, pesticides and residues, food labeling, and methods of sampling and analysis. As of March 1998, there were 162 member countries, each of which must consider and adopt Codex standards as they are developed. Each member country has a National Codex Committee which coordinates national responses to Codex issues. For contemporary information oh Codex, their home page can be found at the following website: http://www.fao.org/es/esn/codex/codex.htm.

The Codex Alimentarius Commission (CAC) was established in 1962 by FAO Conference and the World Health Assembly. At that time, the Statutes and Rules of Procedure for Codex were also established. These Statutes are the legal basis for Codex, providing its terms of reference.

Article 1 (Statutes of the Codex Alimentarius Commission) states that the Codex Alimentarius Commission be responsible for «making proposals to, and be consulted by, the Directors-General of FAO and WHO on all matters pertaining to the implementation of the Joint FAO/WHO Food Standards Programme».

The purpose of the Joint FAO/WHO Food Standards Programme is to:

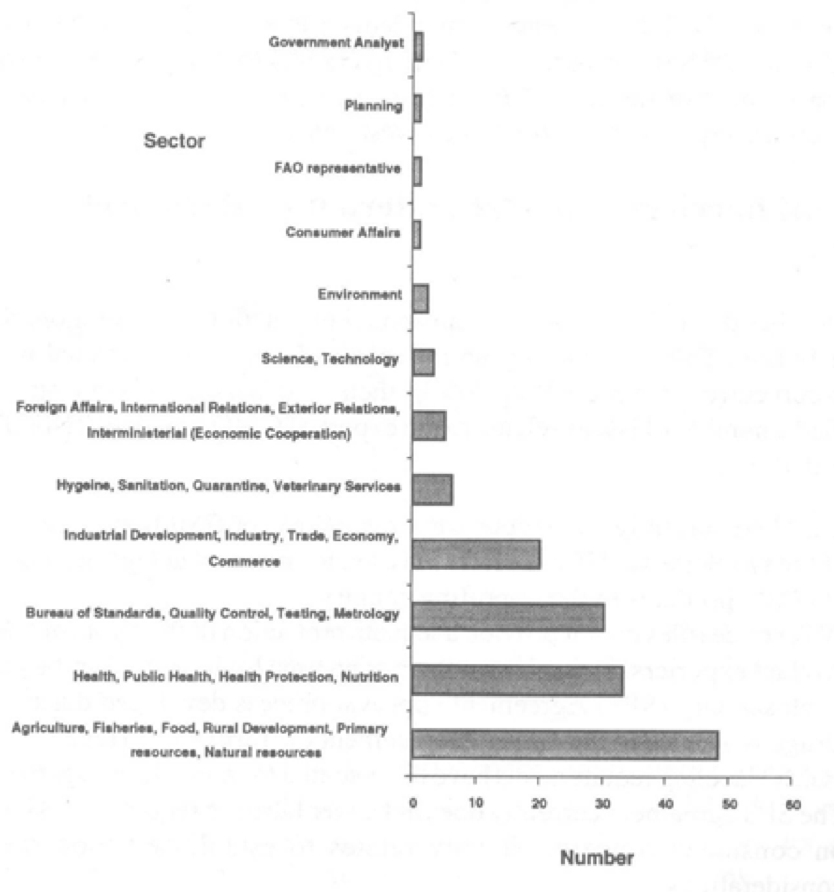
•Protect the health of the consumers and ensure fair practices in food trade;
•Promote coordination of all food standards work undertaken by international governmental and non-governmental organisations;
•Determine priorities and initiate and guide the preparation of draft standards through and with the aid of appropriate organisations;
•Finalise elaborated standards and, after acceptance by governments, publish them in a Codex Alimentarius either as regional or world-wide standards, together with other finalised international standards, wherever this is practicable;
•Amend published standards, after appropriate survey in the light of new developments.

The health of consumers features very prominently in article 1, yet does not specifically identify which consumers it refers to. Codex is a global organisation, with representation from 162 countries said to equate to at least 98% of the world's population, so it is assumed that consumers refers to the whole world population. However, from a member country perspective, «consumers» could quite conceivably be considered as the consumers of their own country. These two interpretations may have very different consequences for global health outcomes.

Is the Codex Alimentarius system well-placed to meet its objective of protecting consumer health?

The location of National Codex Committees within government (whether in the health, agriculture, industry or export ministries) will have a bearing on how Codex issues are interpreted and prioritised, and how national responses are prepared and presented. Less than half of the National Codex Committees worldwide are administered within the government health sector (see Figure 2), and are therefore at arms length from public health considerations, despite the prominence of health protection in article 1 of the CAC Statutes. How then do health issues maintain their deserved prominence on the Codex agenda?

Figure 2: Location of National Codex Representatives according to government sector



This situation is consistent with the observation by Dwyer and Mayer (1975) over 20 years previously that it was a traditional practice of governments to let nutrition status be secondary to imperatives such as agricultural policy, foreign trade, and economic conditions.

Food industry has realised the value of active Codex involvement and is becoming more proactive in the Codex process at the NCC level. The American Institute of Food Science and Technology (Newsome 1996) identified a number of opportunities for food industry involvement in Codex:
•Helping to develop discussion papers
•Developing comments on committee agenda topics
•Serving as a scientific resource to government delegations and FAO/WHO consultations

Non-commercial interests (eg. population health, consumer groups, non-government organisations) also need some representation at the NCC level. Obviously, the above activities require resources, resources which are often only available to large commercial interests. Therefore, how do health issues receive the prominence that their position in article 1 of the Codex Statutes demands? The CAC has at least acknowledged that this question has some merit. At the 22nd Session of the CAC (ALINORM 97/93) it was decided that the enhancement of the role of international non-government organisations and consumer organisations should be investigated.

Current barriers to the free international trade of GMOs

The US oilseeds industry represents an annual production value of more than $US31 billion. This is obviously an influencial force in international trade, with export currently representing 30% of their total market. This industry has identified a number of issues related to the export of GMO products (INFORM Editorial 1998).

•The USA currently has a regulatory framework for GMOs in place. Most of the problems for US exporters have been caused by delays in approval of GMO products in the importing country.
•WTO trade rules do not provide adequate protection of the rights of GMO product exporters. In particular, there is no time limit on the Sanitary and Phytosanitary (SPS) Agreement approval process developed during the Uruguay Round of the General Agreement on Tariffs and Trade.
•«GMO labeling requirements have the potential to seriously disrupt trade». The SPS agreement currently does not cover labeling requirements based on consumer concerns, it only relates to established food safety considerations.

To address these and other issues, the US food industry have resolved to participate in discussions on trade rules for products of biotechnology during the 1999 negotiations. The above issues not only give industry a direction for their Codex participation, they also provide direction for those in other sectors that are advocating a more cautious approach to the introduction of GMOs into our food system.

Key issues for South Pacific nations

•Modern biotechnology *per se* presents many opportunities to enhance food quality and production, and therefore prosperity and health. Modern biotechnology also has the potential to intensify the existing divisions of wealth, a process detrimental to the health of the world's poor (Kumar 1993). Each country must assess the value of biotechnological innovations with respect to long term health implications and convey this assessment to the CAC.

•Intellectual property is not a new phenomenon. Traditional cultures are important repositories of technological «know how» in a range of areas including food production. This IP has been in the public domain for many years and its value seems to have been downplayed, possibly due to its limited commercial value. Traditional intellectual property deserves to be valued more highly, a strategy which is consistent with the reexamination of traditional food habits by nutritionists in many South Pacific countries.

•Decisions made in the CAC are driven to some extent by those who participate. The private sector realises this and are encouraging active participation in the Codex process (Newshome 1996). Advocates for local health concerns in the South Pacific nations also must become more actively involved in National Codex Committees.

•Constructive input into the Codex system requires resources often not available to smaller countries. Networks to pool resources (monetary and information-based) can counteract some of these disadvantages, especially now that international collaboration via the internet is relatively accessible. There are currently 10 South Pacific CAC member countries (Table 2), providing possible links for such networking.

•Intellectual property is becoming increasingly important as a food component, and has the potential to revolutionise the global food system. Whilst this presents many opportunities, the potential risks for global health, as defined by WHO in 1948, require closer scrutiny.

Table 2: South-West Pacific member countries of the Codex Alimentariu; Commission as at March 1998.

Australia	Cook Islands
Federated Republic of Micronesia	Fiji
Kiribati	Papua New Guinnea
New Zealand	Samoa
Tonga	Vanuatu

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LOGISTIC CONSIDERATIONS IN SETTING UP A FOOD COMPOSITION LABORATORY IN A DEVELOPING COUNTRY

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INTRODUCTION

The setting-up of a food composition laboratory in a developing country represents a formidable challenge for the organisers.

Food composition analysis for food composition tables is a technically demanding science requiring the practice of a broad range of analytical skills, as well as exercising a high level of competence in associated activities such as sampling, sample preparation and food data evaluation to enable publication of the composition data.

Laboratories in developing countries more often than not need to operate with limited funding often resulting in uncertain work contracts for personnel as well as dated equipment and sub-standard accommodation. In addition, laboratory locations away from the main suppliers can cause considerable delays in the acquisition of chemicals and delivery of instruments as well as maintenance and related support services. These handicaps make day-to-day operations difficult and require long-term planning to reduce the impact of disruptions to laboratory services and supplies.

Food analysis

Foods are presented for laboratory analysis for a variety of reasons which may include the determination of gross composition, the presence and levels of additives and preservatives and residues arising from agricultural practices or take-up of environmental contaminants. In addition, foods may be examined for fitness for consumption based on microbiological status or possible spoilage due to poor manufacturing practice during processing, packaging and storage prior to sale. Finally foods may be tested for compliance with labeling requirements and nutritional composition.

A knowledge of the nutritional composition of foods is essential for studies in human nutrition, applications in the treatment and management of disease, the development of appropriate diets for *at risk* individuals or the fortification of staple foods for nutritionally-deficient communities. This is particularly relevant to communities in developing countries where food supplies may not be evenly distributed and agricultural productivities lag behind population growth. Furthermore, the *«westernisation»* of local diets for reasons of convenience or necessity may result in poorer nutrition and associated health problems such as diabetes and heart disease for the more affluent population segments whilst the poorer population groups are faced with undernutrition.

The availability of reliable and current data on the nutritional composition of regional and «traditional» foods is considered a key tool in improving the nutritional status of populations in third world countries. There is an active commitment by international fund organisations such as the U.N. Food and Agriculture Organisation (FAO) to promote and support the development of food laboratories in third world countries. The key function of the laboratories is to undertake nutritional analyses of regional and indigeneous foods in order to address local nutritional deficiencies and improve regional food security.

Due to more pressing and urgent government and industry priorities, scientific agencies in developing countries often operate on very limited budgets with tight constraints on employment of qualified staff, training and development programs, suitable building environment, laboratory fit-out, equipment and laboratory infrastructure. These funding constraints place these laboratories at considerable disadvantage when trying to operate somewhere near internationally acceptable if not ' industry best practice' levels. Increasing international requirements for the certification and labeling of food commodities in trade however has placed increasing pressure on governments to upgrade laboratories involved in export certification to ISO Guide 25 *(General Requirements for the competence of Calibration and Testing Laboratories)* technical standards.

Quality requirements of food composition data

Important commercial and public health decisions are frequently made using analytical data on food composition often derived from a number of different and sometimes unknown sources with unstated reliability. In many instances foods have been sampled and analysed in a different part of the world (and sometimes after long transport and storage if it originated in the developing country) making the appropriateness of the food compositional analysis problematical.

In order to make food composition data readily available to nutritionists, dietitians and research workers, data generated by laboratories are compiled in food composition tables and reported in the literature and government publications. Once tabulated and published, the data become accepted as reference values and may be used to support research findings and public health policies until new data are reported. Accordingly, the published data will continue to have currency for many years or even decades and may influence national nutrition policies and public health strategies over a considerable period of time. This places considerable professional and quality demands on the laboratory to ensure that the data reported are reliable and fairly represent the compositional status of the food under study.

Attributes of a reputable Food Composition Laboratory

It is generally acknowledged that laboratories involved in food composition analysis and particularly in analysis for food composition tables need to have the following attributes:

•a well-established or proven reputation in food analysis
•a set of analytical methods validated for the foods under test
•a high level of quality assurance
•a good knowledge of food sampling, sample handling and preparation
•an understanding of the climatic, seasonal and varietal factors influencing nutrient levels in the food
•general compliance with ISO Guide 25
•employment security for and continuity of staff
•a high level of knowledge of factors which influence data reliability

Operational difficulties in developing countries

In addition to the considerable professional demands, food composition laboratories in developing countries have a number of additional difficulties arising from their relative professional isolation and financial position. Some of the difficulties are the result of having:

•no past history of comprehensive food composition programs
•strong competing demands for government funding
•limited professional networks or support structures within the country or region.
•no national agency or government priority for laboratory technical accreditation
•laboratories which are often poorly funded, ill-equipped and with a contract (insecure) workforce

•laboratory staff which may have limited access to professional training
•limited access to supplier support - particularly for repair and maintenance of major equipment
•laboratories which may not have local support expertise in food sampling, sampling priorities or regional nutrition'priorities.
•program organisers who may not have access to data on market share or types of cultivars of local foods to assist in the formulation of rational sampling plans
•library resources of relevant books and journals which may be difficult to access or even be non-existent
•long delays in filling orders for basic consumables and equipment.
•hot and humid climatic conditions which tend to cause more rapid deterioration of equipment and reagents and increase the opportunity for contamination and deterioration of samples

Some key issues to consider in setting up a food composition program in a developing country:

•goals, objectives and public health outcomes of the program,
•criteria for selecting an existing laboratory,
•criteria for a new laboratory,
•technical requirements/capabilities,
•identification of «interested» government agencies,
•identification of non-government stakeholders,
•identification of funding sources and support,
•role of program steering committee,
•role of program management committee,
•sampling plan,
•technical support from external/international agencies,
•training of staff

Laboratory selection and set-up

In order for food composition data to achieve the data acceptability criteria developed by Holden and co-workers, the laboratory needs to have in place a detailed sampling plan, sample handling procedures, validated methods and a sound quality assurance program. These are generally covered by the operational elements of ISO Guide 25 and it is important that laboratories operate within the key elements of this international standard which has been adopted by most accreditation bodies. The elements of ISO Guide 25 are:

•Organisation and Management
•Quality system, audit and review

•Accomodation and testing environment
•Personnel
•Equipment and reference materials
•Measurement, traceability and calibration
•Calibration and test method
•Handling of calibration and test items
•Records
•Certificates and reports
•Sub-contracting of calibration or testing
•Outside support services and supplies
•Complaints

Whilst not all elements of ISO Guide 25 are critical, it is important that all elements of the guide are given appropriate consideration when planning and operating the laboratory facility.

Some key organisational issues

As noted earlier, the setting up of a reliable food composition laboratory capable of undertaking analysis for food composition tables in a developing country requires planning, long term financial commitment and professional support from external agencies. The project may be underpinned by regional nutrition programs or food certification requirements for international trade.

The Laboratory

The successful and speedy implementation of a regional food composition program depends on the availability of a suitable laboratory which already operates within the spirit of ISO Guide 25 and which preferably has a proven record in food analysis. If the laboratory facility needs to be set up from first principles, considerable funding will be required for purchase and/or development of a site, equipment and staff training. There will also be consirable delays before the facility is sufficiently skilled to produce consistently reliable data.

The Role of Government

It is preferable that any significant food composition data program is government initiated and highly desirable that it is government financed.

Other Stakeholders

It is useful to identify and seek the support and involvement of potential stakeholders such as universities, industry and public health professionals. These will help to give credibility and momentum to the program.

<u>International Agencies</u>

It is useful to seek the support of International agencies such as FAO, WHO and INFOODS. Support from these organisations can provide status and credibility to the program and may provide financial support through funds for training and equipment. Linkage through INFOODS will enable access to a global network of food scientists who are involved in regional food composition programs. This is particularly valuable in resolving technical difficulties associated with sampling and methods of analysis.

THE PACIFIC ISLAND EXPERIENCE

The Pacific Island Food Composition Program (PIFCP) which began in 1987 originally investigated the use of three laboratories in the Pacific Island region (two in Papua New Guinea (PNG) and one in Fiji) to perform food nutrient analysis.

The experience of these laboratories is useful in indicating the requirements for the development of a successful food nutrient laboratory in a developing country. The PNG laboratories achieved limited success during the pilot phase of the PIFCP. The government laboratory in PNG had been well equipped with foreign assistance and had government staff available to perform the required analysis but did not seem to have the commitment or leadership to enthusiastically pursue the requirements of this demanding kind of work. The other PNG participant was a university laboratory which was successful in developing a number of analysis but their interest waned when the principal investigator left the university. The Fiji laboratory at the University of the South Pacific was able to develop all the required analyses and performed well in an exercise determining the variation coefficient of ten replicate samples. Based on this an OCEANIAFOODS recommendation was instrumental in achieving funding to further develop the analytical capability of the USP laboratory and begin analysis of local Pacific foods. A number of characteristics have been identified that assisted in the success of the USP laboratory.

1. A committed group of chemists and nutritionists.

The job of development of a successful food composition program requires the cooperation of a number of people with various skills. Especially in a developing country the pool of such people may be limited and people are often reassigned to different jobs, sent overseas for lengthy training or are expatriates who leave the country. Therefore there must be a pool of people committed to the project so that the loss of one or two key people will not endanger the project. Commitment is also critical as there will inevitably be requirements beyond normal work duties and disappointments which will require people who appreciate the importance of the task and can respond to its challenges. This group of people should form a management committee which meets regularly to co-ordinate project activities. In the Fiji experience the National Food and Nutrition Committee provided nutrition and food expertise while the USP Chemistry Department had several analytical and organic chemists who were involved. The original proposal to set up a food analysis laboratory and a description of its requirements was itself made at a regional workshop of chemists and nutritionists in 1986. It was also useful that the University had a section called the Institute of Applied Science which performed consultancy analyses. This Institute had dedicated technicians who could provide the continuity of experienced personnel critical for the food composition laboratory. The traditional university model of work being performed by postgraduate students is less satisfactory as personnel will change as they graduate and new students need to be trained. We have actually had considerable success in a mixed-model with long-term technicians who have responsibility for any day-to-day analysis working with postgraduate students who may explore new methods or analyses or study possible variations in a method or interesting results in more detail. After some experience the postgraduate students' data may be included as food composition data.

2. A chemical laboratory in a university

The Pacific experience indicates that the laboratory should be in a university. This should supply a number of chemists who, if committed to the project, can supply the necessary expertise. Government laboratories are often subject to changing priorities and limited financing and are unlikely to provide ongoing commitment to food composition work. Most developing countries are under pressure to reduce their civil service which creates an environment in which development of a new program is unlikely to be possible.

3. A laboratory with experience in some nutrient analyses

The principles of good laboratory practice requires years of experience to fully develop. It is unlikely to secure funding to start a laboratory "de novo" which would be funded long enough to achieve such practice, develop the required analyses and then start analysing foods. It takes some time to develop and prove expertise in a new analysis and the fewer "new" analyses that need to be developed the better. Therefore a laboratory already performing proximate analyses and or metal analyses for other purposes could provide a sound basis to build on.

GRADUAL APPROACH

With these characteristics in mind there is also a preferred approach in the development of a food composition laboratory. A gradual approach should be taken. The laboratory should first apply analyses that are familiar (perhaps in other contexts) to a variety of food matrices representing different possible proportions of proximates. Methods used in developed country laboratories should be obtained to determine if methods currently used in the developing country laboratory are acceptable. For example in our case we had to change our fat analysis when we discovered in many foods extraction of fat without hydrolysis gave low results. Concepts such as representative sampling and careful documentation need to be learned and practiced.

Performance on these analyses should be verified internally using duplicates, recoveries and reference materials if available. Coefficients of variation on several replicates of one sample should be determined. Once these are acceptable the laboratory should participate in overseas proficiency studies and share samples with an established laboratory to check the accuracy of their analyses.

Only once these analyses can regularly be performed with appropriate accuracy should the laboratory begin the study of new methods. What new analyses should be developed needs to be decided based on nutritional priorities, equipment and analyst skills. In a university setting it may be possible to have method development performed as project work by students and then the skills transferred to the project staff.

In the case of the USP laboratory analyses were developed as follows:

Pre-1987 capability	Moisture, Protein, Fat, Ash, 6 Minerals.
1987-1988	Fat method changed. Sugar, Starch, Retinol by HPLC. Four Vitamins by colorimetry (vitamin C, Thiamine, Riboflavin, Niacin). Carotenes by UV.
1989	Carotenes by HPLC. Dietary fibre.
1994	Two new minerals (nutritional reasons). Thiamin, Riboflavin and Vitamin C by HPLC.
1995	Fatty acid profiles and Cholesterol

If possible it is best to attempt to develop methods internally and only receive training once problems have been identified or skills can be upgraded. If necessary, for example if several new analyses are to be started using a new machine, training in method development should be in the developing laboratory and overseas training only used later to share experience with others engaged in the same analyses and to share skills.

In the Pacific we are using this approach to expand the analyses work of the PIFCP to two other countries, Kiribati and Papua New Guinea (PNG). In the Pacific Island region it has been identified that the unique environment of atolls necessitates analysis of foods grown in their islands rather than the same food grown on a fertile volcanic island such as Fiji. Quarantine restriction make it difficult to import some fresh foods into Fiji. PNG has a large number of unique foods that should best be analysed in PNG. The approach being taken is to assist laboratories in Kiribati (at a USP institute) and PNG (at the University of Technology, UNITECH) to develop analyses up to their level of potential expertise and instrumentation. Additional analyses of the food extracts could be performed at USP or at AGAL. Training would also be necessary in sampling in these areas.

In PNG the analyses they normally perform (mainly proximate analyses) for other purposes have been challenged with food matrices provided by ASEANFOODS. They should also be able to develop mineral analyses fairly readily. While proficiency in these analyses is being developed carbohydrate and vitamin analyses on the extracts could be performed elsewhere. Once quality assurance measures indicate that all analyses are "in control" new analyses can be developed.

FINANCING

It is unlikely that a developing country can meet the full, in any, expenses in the development of a food composition laboratory. Thus foreign assistance will likely be necessary. FAO is playing an increasingly active role in this area. Traditional bilateral aid partners are also possible sources of assistance. Again there is, in my mind, a preferred approach to achieve funding. It is best to start with a small pilot project with limited, if any, outside funding. Some assistance may be needed in training and for consumables but at this point new equipment should not be purchased. Following the approach outlined in the previous section the laboratory should display a capacity to develop a proper sampling program and accurate analyses of various food matrices for a range of nutrients and a long-term commitment to the initiative. Once these have been established it is likely that larger scale assistance can be achieved as the donor partner can be more confident that this assistance will be well utilised.

In the USP example a modest sum has been used given the importance of the work. About US$50,000 was used in the pilot phase and US$250,000 in the last four years. Some in-kind support was provided by USP in existing equipment, staff seconded to the project and consumables.

PARTNERSHIP

It is useful at an early stage to develop a partnership between the developing country laboratory and an established food composition laboratory, especially one whose methods are similar to those it will use. This partnership can serve many purposes:

•provision of methods and advice on them - many methods, especially AOAC ones, are quite terse and more detailed methods, especially with likely pitfalls, are very useful for a developing laboratory, so that they are not continuously "reinventing the wheel"

•training - this is necessary in many areas including food sampling, handling, preparation, documentation and analysis as well as quality assurance and data handling and validation. This is likely supplied best by the partner laboratory and done in the developing country so that a large number of people can be trained at one time. This partnership also allows for follow-up questions to be answered in a timely fashion. Once the basic training has been performed in the developing country individuals can be further trained overseas, again preferably by attachments to the partner laboratory. In our region we have also benefited by the existence of APFAN, the Asia Pacific Food Analysis Network, and its regular training workshops held in Brisbane

•provision of consumables - one problem in remote areas like the island Pacific is the long time it takes to order and receive chemicals. It has therefore often been useful to ask for a small amount of chemicals from another laboratory in emergency situations while waiting for an order to be filled

•advice on books and journals - there are certain key publications in food composition analysis that should be available to any laboratory about to embark on developing a laboratory. Such a list of "required" literature and "recommended" literature should be easily prepared by an experienced laboratory to assist the developing laboratory

- machine maintenance - it may be possible for the established laboratory to provide training and/or technical expertise in this important area. On the other hand, it may be possible to address these needs in other ways. At USP we have a technical assistance program with Perkin-Elmer under which they visit every six months to maintain equipment bought from them. The expense of these trips is divided among sections of USP and government departments which use this service. In recent years USP has established a senior position of chief technician (electronics) to assist in the maintenance of machinery.

•sharing of samples - a useful exercise, especially for package goods which can be easily transported over distances without nutrient loss. Both laboratories analyse the same samples and then discuss possible sources of differences in their results, usually after repeating analyses for results that differ significantly

•development of a quality assurance regime - this is one of the most important aspects of food analysis but one that is often seen by managers as unproductive as it does not "produce results". Advice on what combinations of duplicate analysis, spiked recoveries, in-house standards and certified reference materials should be analysed at what frequency is needed. In addition advice on availability of the latter two and participation in proficiency studies can be provided. These materials have been discussed in more detail in a previous presentation.

CONCLUSION

If organised in such a way using a gradual approach and with some moderate level of assistance, laboratories such as USP and others in Asia have demonstrated that it is possible for a quality food composition laboratory to be established in a developing country.
A couple of aphorisms come to mind in thinking of our experience in establishing pretty much from scratch a food composition laboratory,

> "Rome wasn't built in a day"
>
> "They put their pants on one leg at a time"

It can be intimidating at first to interact with established food composition analysts and have them talk about Youden pairs and quality control charts and have them tell you about the need to use a mathematical equation to determine how many single samples must be collected and analysed before the final value is significant (and even in the best case this number is probably greater than 50).

In a developing country compromises will have to be made. Due to financial constraints for a given food a composite of four samples may be analysed instead of 50 individual ones. The development of a quality assurance program cannot all be put into place immediately but must be done step-by-step. Everyone has been in this same position and *it* is important *not* to feel overwhelmed by the task at hand and to slowly develop new skills as other ones are mastered.

ASEANFOODS FOOD REFERENCE MATERIALS : ISSUES AND PROBLEMS

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INTRODUCTION

Reliable and accurate analytical data are required by both food analysts and data users. Standardisation of the analytical methodology and development of a quality control system in a laboratory can help ensure analytical measurement and increase data quality and reliability. Most of food analysts strive to produce their analytical results with both precision and accuracy. To assess the precision, the in-house quality control food materials and establishment of quality control charts can serve the need. However, checking the accuracy needs more effort in terms of budgets especially when certified reference materials are required. According to the last survey conducted in 1996[(1)], in-house quality control samples and a limited number of commercial RMs have been used among ASEANFOODS member countries, which might be due to their prohibitive cost and lack of comprehensive coverage of nutrients in commercial certified food reference materials. Since reference materials play key roles in assuring the analytical data quality, the Institute of Nutrition, Mahidol University (INMU), as the ASEANFOODS Regional Centre, has therefore continued to put forward an objective to undertake the development of food reference materials to be used in the ASEAN region.

RATIONAL

With the collaborative study among expert laboratories in Australia, New Zealand, USA (USDA), Austria (IAEA), and laboratories in ASEANFOODS member countries, four food reference materials namely, rice flour (AS-FRM1), soybean flour (AS-FRM2), cereal-soy product (AS-FRM3), and fish flour-1 (AS-FRM4), with consensus values of main nutrients (total solid, protein, total lipid, ash, dietary fibre) and some minerals (calcium, phosphorus, sodium, potassium, magnesium, iron, copper and zinc) were developed during 1989-1993[(2,3)]. These materials have been used for laboratory performance studies and laboratory quality control programmes in Thailand, certain ASEAN, South Pacific and South American countries.

CURRENT ACTIVITY

In 1997-8, a new set of RMs, weaning food (AS-FRM5) and fish flour-2 (AS-FRM6), to be used for nutrition labelling analytical quality control programmes, were developed. The same expert laboratories as before as well as laboratories from Fiji and the Netherlands participated in the development of the RMs. The consensus values of nutrients aimed to be developed were total lipid, saturated fat, cholesterol, protein, dietary fibre, sugars, sodium, vitamin A, thiamin, riboflavin, iron and calcium. These materials are being used for the third round laboratory performance study among government and private laboratories in ASEAN and other regions. Use of these reference materials to establish good quality food composition data in ASEAN and other developing countries is the ultimate goal of this activity.

DEVELOPMENT OF FOOD RMS : ISSUES AND PROBLEMS

According to the previous experience on development of ASEANFOODS RMs, some successes and problems can be addressed as follows:

1. Selection of foods as potential reference materials

Selection of the appropriate food samples to be used as test materials for RM development is the first step in developing food RMs. The following are characteristics of good food reference materials(1567) criteria, in practice, not all of the criteria can be reached.

Characteristics of good food reference materials:

•be representative of natural foods or food products, fresh or dried form, with various food matrices and should be easily available

•be appropriately prepared with sufficient homogeneity and stability with respect to macro and micro nutrient content over time

•contain desirable amounts of components of interest, with minimal or no contamination from other materials or equipment

•cover a wide range of components and supply each certified or consensus value with degree of uncertainty

•be reasonably cheap and relatively easy to obtain

The Subcommittee AOAC Task Force on Methods for Nutrient Labelling has suggested the "Food Triangle"[(5)] as a scheme by which all kinds of foods with varying levels of protein, fat and carbohydrate can be considered. As a lot of effort and money must be devoted to the development of reference materials, in practice, food samples that can cover as many of the nutrients of interest are selected. This can result in non-matching of the sample matrix and some reference materials may contain low levels of specific nutrients. In our studies, rice and soybean were chosen as plant-based samples while two types of fish flour, with and without bone, were selected as animal-based samples and two types of weaning food as mixed foods. Milk powder would have been a good RM owing to its proper level of various nutrients, but due to the quarantine restriction in most of the expert countries, it cannot be included.

2. Sample preparation with homogeneity

Dried commercial products were used in all ASEANFOODS studies. They were kindly provided, homogenised, sub-sampled and re-packed by the product manufacturers. In the last set of RMs, consensus values for vitamins were required, sub-samples of weaning food (AS-FRM5) must therefore be vacuum packed. Vacuum packing needs a special instrument and packaging materials which must be considered in advance. In our experience there was some problem in getting a required quantity of vacuum packaging materials, which finally were given by a manufacturer. It was realised that cooperation between organiser and the food manufacturers can help overcome some of the problems.

Since the commercial products we have selected as test materials are all uniform powder, the process of sample preparation to ensure uniformity has been omitted. According to the results of previous homogeneity studies, acceptable degree of homogeneity was obtained.

Although the appropriate batch size could be determined on the basis of its coverage and stability of nutrients of interest and the rate of use in a given laboratory, the maximum quantity we have made for each RM is only 15-20 kg which resulted in about 300-350 sub-samples. After we went through the whole process of checking homogeneity, stability, analyses to get consensus values of nutrients, about 200 to 250 samples of RMs remained.

3. Homogeneity and stability testing

When bulk material is prepared as a reference material, it should be sufficiently homogeneous for each test parameter. Homogeneity testing must establish the extent of variability between units in the RMs and indicate whether material variability contributes significantly to overall uncertainty[5-67].

After a batch of material is divided in a number of units, a *set of* strict randomly selected samples, minimally 10, must be checked for homogeneity of each test parameter. However, the AOAC Task Force on Methods for Nutrition Labelling has suggested testing of homogeneity on the selected analytes that are representative of one or more classes of compounds. For example, in our previous study, we decided to analyse total N, water and ash as main nutrients, calcium for macro-elements, iron for trace elements using highly precise, unbiased methods. In addition we analysed also the cholesterol, vitamin A, C and vitamin B2 content as this was our first study to include these constituents. To study the homogeneity, samples must be measured in a single laboratory using the same instrument and calibrants and, if possible, on the same day and by the same operator for each nutrient.

This can be done but not so easily as duplicate analyses were requested for precision checking. In our previous study, we divided and assigned the work to 3 laboratories. Each laboratory analysed the same nutrients in each test material. To evaluate the data derived from the homogeneity study, without excluding outliers, we applied paired t-test for precision checking (within-sample variation) and one-way analysis of variance for between-sample variation (evaluation of homogeneity). Ideally, homogeneity testing should be carried out prior to the distribution of the items to the participating laboratories. Because (1) the samples we selected were uniform powder, (2) the analysis process for homogeneity took a long period of time and (3) we included vitamins as one of the studied parameters, we decided to analyse the assigned nutrients for homogeneity concurrently while samples were being sent to participating laboratories. If serious differences were found, the particular nutrients would not be included in the consensus list.

The ideal RM should be physically and chemically stable for an indefinite period. However, due to the difficulties and expenses involved in making an RM, most producers aim at a minimum life of around 5 years. In the previous study, pre-stability testing of vitamin A in weaning food and fishmeal and vitamin C in weaning food for a specific period were conducted to study the feasibility for incorporation of the nutrients into the study programme. Once the project started, the stability of vitamin A, Bl, B2 and C was checked in the samples that were kept at room temperature (30-32°C) for the first 2 weeks to ensure that no significant changes would occur during shipment of samples, and regular checking has been conducted on the samples that are kept under the storage conditions (-20°C) for long-term stability tests. It was found that after one month at room temperature, vitamin C, Bl and B2 were stable but about 85% of vitamin A in fish flour remained. Vitamin A in weaning food fluctuated, it cannot be used for a stability study. About 60-90% of these vitamins remained after 9 months storage at -20°C.

4. Establishing reference values

Various procedures exist to establish reference values of nutrients in test materials depending on the desired degree of accuracy. Three types of RMs -primary, certified and secondary - can be classified according to their levels of accuracy and their place in the traceability chain[(8)].

The primary RM is usually a pure compound or a mixture of pure compounds of precisely known composition and concentration. It is prepared according to definitive methods using calibrated instruments and glassware. It is usually used as a primary standard for measurement of a component in an unknown sample to produce certified and secondary reference materials and for routine food analysis.

For certified reference material (CRM) the best approach to establish the certified values of nutrients is by collaboration among specialist laboratories. The Community Bureau of Standards in Belgium (BCR) recommend not fewer than 6 laboratories, working independently['7)] and using several independent reference methods of analyses which give very low bias.

For ASEANFOODS programme on development of food RMs, there is no intention to prepare the certified food reference materials. The objective was to prepare the RMs with consensus values of analytes that can be used for internal and external analytical assessment among laboratories. In spite of that objective, we have tried our best to follow the international guidelines in producing certified reference materials[(4,5'6'7)]. The selected test materials were analysed by a group of well-recognised laboratories using standard reference methods. Analytical methods used and the quality control system in the laboratories were collected and considered whenever appropriate. This is the best procedure in our circumstances for determining the consensus values of analytes in representative materials.

Twenty laboratories participated in the first and second study but for the previous round in 1997-8, 16 out of the first and second study who have shown good performance and are well recognised laboratories were invited. However, not all laboratories have facilities to analyse the same kinds of nutrients. In addition, some of them were outliers for some measurements which are quite normal for this type of study. These resulted in insufficient statistical results for some constituents, for example, in the latest study fatty acid values in weaning food were given by only three laboratories, but all were promising values. To evaluate the analytical results a robust z-score(9) has been used, instead of the more complicated Grubb's test which was applied for the first and second studies. After statistical analysis, the consensus values of each component were provided with the uncertainties as mean ± SD.

Since these samples are being used for laboratory performance studies among laboratories in ASEAN and other countries, the values of components resulting from good performance laboratories can be collected and pooled into the previous consensus values. After re-evaluation of all pooled results, better reliable consensus values of components can be obtained. The consensus values of the first four reference materials, AS-FRM1, 2, 3 and 4, are shown in Table 1A. A preliminary report on consensus values of components in AS-FRM5 (weaning food) and AS-FRM-6 (fish flour-2) from the recent study is also presented in Table 1B for information.

CONCLUSION

There is an imperative need to develop and provide RMs for analytical measurements to ensure accuracy and reliability of the analytical data. Preparation of reliable food RMs is time consuming, costly and requires considerable effort. Adherence to the standard protocol and methodologies as much as possible will ensure reliable development of the analytical values obtained. Financial support and contributions from both government institutions and private companies are an important part of the programme. It is vital that a close partnership exists between expert governmental and private laboratories at national and international levels to develop and improve the quality of reference materials and analytical laboratories in ASEAN and other developing countries. The ASEANFOODS regional centre, as the organiser of the programme, would like to acknowledge them all for their valuable contribution.

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TABLE 1A. CONSENSUS VALUES (Mean ± SD) OF NUTRIENTS IN AS-FRM 1 TO AS-FRM 4

Nutrients (unit)	Amount per 100 g dry weight		Amount per 100 g sample	
	AS-FRM 1	AS-FRM 2	AS-FRM 3	AS-FRM 4
	Rice flour	Soybean flour	Cereal-soy	Fish meal
Total solid (g)	88.5 + 0.7 (95)[a]	91.7 + 0.4 (65)	96.3 ±0.4 (70)	93.8 ±0.6 (62)
Crude Protein (g)[c]	8.8 ±0.2 (43)	41.8 + 0.3 (26)	14.8 ±0.3 (38)	59.6 ± 0.4 (32)
Total lipid (g)[d]	2.3±0.1[b] (39)	19.4 + 0.3 (35)	9.5±0.1 9.6(10)	6.9 ± 0.2[b] (49)
Ash (g)	1.1+0.03 (31)	5.1 ±0.2 (40)	2.8 ±0.1 (34)	26.0 ± 0.6 (48)
Calcium (mg)	8.4±1.2[b] (18)	280±16[b] (29)	493 ± 20 (22)	5919±215[b] (39)
Phosphorus (mg)	262 ± 10 (20)	615 + 28 (24)	238 ±9 (22)	2627 ± 94[b] (30)
Magnesium (mg)	89 ±7 (14)	216± 12 (20)	89 ±7 (24)	280 ± 30 (30)
Sodium (mg)	5.7 ± 0.9[b] (22)	3.7 ± 0.9[b] (20)	162± 12 (24)	893 ± 34[b] (34)
Potassium (mg)	189±7 (13)	1598 ±95 (20)	542 ±44 (28)	967 ± 62 (30)
Iron (mg)	1.4 + 0.4 (26)	10.0±0.8[b] (26)	9.4 ± 0.4[b] (35)	176±12[b] (44)
Copper (mg)	0.18 ±0.01 (10)	1.5±0.2[b] (20)	0.44 ± 0.04 (20)	0.6 ± 0.04[b] (17)
Zinc (mg)	2.2 ±0.2 (20)	5.0 ±0.5 (20)	6.3 ±0.3 (22)	7.6 ±0.3 (21)

(a): number of values
(b): 95% confident interval, given as recommended values for nutrients with a large variation of values, most of them due to their low concentration in the samples by nature
(c): N x 5.95 for AS-FRM 1, N x 5.71 for AS- FRM 2 and N x 6.25 for AS-FRM 3 and 4
(d): Acid digestion prior to solvent extraction

Updated August 1997

TABLE 1B.CONSENSUS VALUES (Mean ±SD) OF NUTRIENTS IN AS-FRM 5 AND AS-FRM 6

NUTRIENT	AMOUNT PER 100 g	
	AS-FRM 5 Weaning food	**AS-FRM 6 Fishmeal 2**
Total fat (g)	8.90 + 0.28 (8)[1]	10.63 ± 0.48 (8)
Saturated fat (g)	3.22 ±0.17 (3)	3.41[2]±0.70 (5)
Cholesterol (mg)	5.4[3] ±2.5 (9)	334 ± 29 (5)
Protein (g) (N x 6.25)	15.12 ±0.25 (10)	66.08 ± 0.53 (7)
Dietary fibre (g)	3.31[2]±0.45 (8)	-
Sugar (g)	23.91 ±1.66 (9)	-
Sodium (mg)	269 + 17 (8)	1008 ± 66 (11)
Calcium (mg)	573 ± 36 (8)	2930 ± 207 (11)
Iron (mg)	8.5 ±0.78 (7)	22.34[2]± 3.09 (11)
Vitamin A (mg)	616 ±56 (5)	476 ±81 (9)
Vitamin C (mg)	60[3]±15 (4)	-
Vitamin Bl (mg)	0.94 ±0.18 (6)	0.04[3] + 0.03 (9)
Vitamin B2 (mg)	0.46[2] ± 0.08 (5)	0.39 ± 0.06 (5)
Moisture (g)	1.90(2)±0.36 (11)	9.62 ±0.54 (12)
Ash (g)	3.32 ±0.10 (11)	13.66 ±0.17 (11)

(1): Number of values included in each consensus or suggested value

(2): " Suggested value", given when robust CV of the consensus value is > 15 to 20%

(3): Value with wide variation (robust CV >20%), no consensus value of the nutrient can be given

ANALYTICAL QUALITY ASSURANCE FOR INDONESIAN FOOD LABORATORIES : RATIONALE, PROGRESS TO DATE AND FUTURE DIRECTIONS

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INTRODUCTION

This paper describes the progress to date of an AusAID-funded project (AAECP program) to assist the technological development of a group of food laboratories in Indonesia. The project is a collaboration between:

•the Research and Development Centre for Applied Chemistry, LIPI, Indonesia;
•the Institute of Nutrition, Mahidol University, Thailand; and
•Queensland Health Scientific Services, Australia.

FOOD ANALYSIS : A MULTISECTORAL ISSUE

Food analysis has an important role in the development of the Asia-Pacific region, providing a sound basis for international food trade and for the development of health and nutrition programs.

Food exports must meet food labeling and food composition requirements of the country of import. Although Codex Alimentarius provides a reference for international food standards, it is the US food labeling system (NLEA 1994) which is fast becoming the international standard for labeling of food exports

(Shapiro 1995). Food analysis programs therefore need to be developed to consider both of these systems.

Food must be labeled accurately. The rejection of food products at the site of import is very costly. Each country requires a comprehensive analytical laboratory capability which can measure food components to international standards. This current project is focusing on national and international coordination, consistency and standardisation, which are implicit in such a capability.

Diet is an important determinant of disease risk. Data on the nutrient, additive and contaminant content of national food supplies are essential for a range of activities across several sectors including health, agriculture, education, trade and social security (Somerset and English 1998).

These data are applied in most nutrition activities at all levels, from the national level, through to the community and household level. In the professional context they are used for the development and evaluation of food and nutrition policies and programs, research on diet and health, disease treatment regimes, and health promotion programs. Food composition data assist decision-making in a number of other government sectors, as well as food industry and trade. All these activities rely on high quality, relevant food composition data.

Each sector has its own range of analytes for which information is required. Because there is often significant overlap of food composition data requirements between sectors, collaborative partnerships between organisations requiring the same information on food composition can reduce duplication, and therefore costs of monitoring the quality of the national food supply. A long-term aim of this project is to facilitate intersectoral collaboration on food analysis in Indonesia.

PREVIOUS WORK LEADING UP TO THE PROJECT

Queensland Health Scientific Services (via the Asia-Pacific Food Analysis Network - APFAN) has conducted food analysis workshops for scientists in the region since 1989 (Bradbury 1995). Feedback from over 80 scientists (from countries such as Fiji, Papua New Guinea, Indonesia, Thailand, Philippines, Malaysia, Nepal, India, Sri Lanka and Mozambique) who have participated in APFAN workshops to date indicates that training programs now need to be conducted in the target countries to enable more scientists to access training in advanced analytical techniques. In-country training also enables trainers to align workshops more closely to local technologies and issues.

The current project in Indonesia emerged from the relationship between RDCAC-LIPI, INMU and Queensland Health Scientific Services established through mutual involvement in the APFAN workshops over many years.

The Indonesian food analysis system is at a stage in its development where advanced analytical capabilities for food and water will significantly enhance Indonesia's economic development and standard of living. Importantly, other countries in the region are also now well-positioned to sustain subsequent developments which will arise from such technology transfer.

Indonesia has a substantial food analysis resource, with a range of well-established government and industry food laboratories across the country, and dedicated, enthusiastic laboratory personnel to run them. The large geographical area that Indonesia covers necessitates a network of capable laboratories, rather than relying on one central food analysis laboratory, which would be *uneconomical* and impractical. Some of the barriers to producing more consistent food analysis data are fairly typical for many countries in the region. Within Indonesia there was a perception that the enhancement of interlaboratory coordination and collaboration would be an invaluable component of improving this nation's food analysis capabilities. A national accreditation system for food analysis was proposed as one potential endpoint for this direction.

Development of Food Reference Materials (FRMs) was seen as a major area of focus for this project, providing a tool for activities such as method standardisation, quality assurance programs and proficiency trials. FRMs on their own, without appropriate networks and workforce development, are of limited use. The program design (Table 1) reflects this and was designed to address the technology transfer required to make optimal use of FRMs.

Table 1. Staged project plan: Analytical quality assurance for Indonesian food laboratories.

Stage 1	Availability of Food Reference Material (FRMs), comprising 3 sets of 30 with assigned values of 9 nutrients, which will be used in the workshop and proficiency testing. Documents for laboratory proficiency testing ie. Questionnaire for compilation of methods of nutrient analyses and in-house quality control systems, study instructions, report forms, FRM documentation, documentation of analytical methods for the workshop and proficiency testing by Indonesian laboratories.
Stage 2	Food analysis workshop. Participants from 26 laboratories across Indonesia. Workshop consisting of lectures and lab sessions on general rationale (nutrition and chemistry) of food analysis, production of high quality food analytical data, proximate analysis, mineral/metal analysis, amino acid analysis, vitamin analysis, individual sugar analysis, fatty acid analysis, additive analysis, aflatoxin analysis, pesticide analysis, instrument troubleshooting. Intralaboratory testing of FRM 1.
Stage 3	Interlaboratory testing of FRM-2 and FRM-3. Analysis of FRM-1, FRM-2 and FRM-3 by QHSS, to be used as a reference for proficiency testing between 26 Indonesian laboratories.
Stage 4	Evaluation of proficiency testing. Course (lectures and workshops) on QC and QA covering: overview of QC and QA, robust z-score, advanced statistics, sampling design, sample preparation for various purposes, calibration, methods validation and verification, workshop on statistics and control charts, information management, internal and external auditing, seminar on proficiency testing results.

Stage 5	Preparation of IFRMs - Indonesian Food Reference Materials. Course (lectures, workshops, exercise and group discussion) on FRMs covering: reference materials, QC samples: selection by food or nutrient type, statistics used in RM development and QC samples, QC sample development, QC sample development plan, shopping for appropriate QC samples, QC sample preparation, homogeneity testing and QC charting, group presentation: status of sample homogeneity and decision making on QC data, development of regional reference materials, the plan for development of regional reference materials, presentation of participant experiences in organising proficiency testing, development of Indonesian Food Analysis Network.
Stage 6	Interlaboratory testing of IFRM-1 & 2 to obtain consensus. Analysis of IFRM-1 &2
Stage 7	Intensive course for laboratories with unsatisfactory results, focussing on specifically problems identified in outputs 1-6.
Stage 8	**1. National seminar program *(*held in Indonesia)** Seminar 1Presentation to analytical laboratories in Indonesia (including other laboratories not participating in the workshop program). Seminar objectives: to communicate the outcomes of the workshop program to laboratory managers throughout Indonesia; and to develop strategies for a sustainable Indonesian accreditation svstem to the ISO-25 level. Seminar 2. Intersectoral seminar to disseminate the outcomes of the workshop program to potential beneficiaries, including representatives from industry, university sectors and the government departments of health, agriculture, science/ technology, and trade. The objectives for this seminar will be: to communicate workshop program outcomes; to communicate broader health and economic implications of a coordinated food analysis accreditation system; and to canvass support for the establishment of a sustainable analytical laboratory accreditation system to ISO-25 level in Indonesia. **2. Communication** of **workshop outcomes** Presentation of program outline to the DSN (Indonesian national standards organisation) conferences 1997 and 1998. Broad dissemination of project outcomes in national and international literature and professional society meetings.

ACHIEVEMENTS TO DATE

For Indonesian food laboratories

•Hands-on experience of in-house QC use
•Raised the knowledge of the importance of QA in the production of food composition data
•Introduced new practices (esp. basic QA activities like balance calibration) in some laboratories
•The Indonesian laboratories, upon their own imdative,have established a formal Indonesian Food Analysis Network (see Table2). The laboratory managers identified six elements which require particular attention, and a network member allocated to chair each of six corresponding streams. Dr Kantasubrata from RDCAC was elected as president, to coordinate and oversee activities of the entire network. QHSS and INMU have been invited as members of this network.

Table 2: Indonesian Food Analysis Network

Goal: to maintain and improve analysis for food quality	
Element 1	FRMs and proficiency
Element 2	Method standardisation
Element 3	Method development
Element 4	Human resource development
Element 5	Network promotion
Element 6	Database collection and distribution

• Initiated intersectoral communication on food analysis and food quality issues

For QHSS, INMU, RDCAC

•Enhanced knowledge of key issues in Indonesia (QHSS, INMU)
•Enhanced knowledge and skills in project delivery (QHSS, INMU, RDCAC), including the development of a model for assessing laboratory capacity for continuous improvement (QHSS)
Strengthened professional collaborative links (QHSS, INMU, RDCAC)

FUTURE DIRECTIONS

For this project

Stages 1, 2, 3, 4, 5 and 7 are now complete. Stage 8 is crucial to the broader dissemination and implementation of what we have learnt from this project, and will facilitate multisectoral advancement in Indonesia's food analysis capability. It is essential that the outcomes from this project be communicated at several key levels:

•Indonesian food analysts
•Other Indonesian food professionals
•Food related sectors including Agriculture, Health, Industry
•The above sectors in other countries in the Asia-Pacific region

Subsequent projects

•Food composition database development
•National quality accreditation system for food analysis
•Development of professional networking, esp. in Food Chemistry
•Expansion of networking beyond Indonesia frontier
•Application of the food chemistry model to other disciplines, eg. Food Microbiology

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FIFTH OCEANIAFOODS CONFERENCE

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