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Pacific Island Food Composition Programme - Publication No. 1 - Final Report of the Pilot Programmes.

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By

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PACIFIC ISLAND FOOD COMPOSITION PROGRAMME

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FINAL REPORT OF THE PILOT PROGRAMME

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BACKGROUND

The need for accurate food tables and their many uses is widely recognised. The tables available in the South Pacific are lacking in a number of ways :-

- many important regional foods are not included
- data is usually from other tables and details such as source, sampling, full descriptions and analytical methods are usually lacking
- composition of included foods as consumed in Pacific may be different from where and when they were previously analysed
- the full range of nutrients currently considered essential has not been analysed

With these factors in mind, the Pacific Island Food Composition Programme was initiated by the South Pacific Commission (SPC) in 1986. Funding has been provided by SPC for equipment, training and a pilot study to help identify problems in food sample collection, preparation, handling, storage and especially in the reliability and accuracy of methods of analysis.

For this pilot programme foods were chosen for which literature value were available for comparison purposes. A range of different foods including cooked rice, chocolate cream filled wafer biscuits, full-fat dried milk powder, canned corned beef, canned pears in pear juice, papaya, passionfruit, raw and cooked taro leaves, raw and cooked taro corms and chicken curry were analysed for moisture, protein, fat, sugars (glucose, fructose, sucrose, maltose and lactose), starch, ash, riboflavin, niacin, vitamin C, carotenes (α- and β-carotenes and cryptoxanthin), retinol, sodium, potassium, calcium, iron, magnesium and zinc.

METHODS

SAMPLE COLLECTION AND PREPARATION :

The food sample record sheet for each of the 12 foods includes information on sample collection and preparation. These are available as INR Technical Report 90/06.

ANALYTICAL METHODS :

Moisture

Oven dried at 100 $\pm$ 2°C to constant weight.

Protein

Kjeldahl method was used. Samples were digested with sulphuric acid in the presence of Na_2SO_4 and catalyst tablets. The digest of each sample was made up to 50 mL. A 10 mL aliquot was taken in the distillation apparatus with NaOH and ammonia from the sample was steam-distilled into a receiving flask containing boric acid as indicator to a volume of about 50 mL. This was titrated with HCl.

Fat

The samples were acid hydrolysed with 7N HCl and free fat from each sample was extracted with petroleum ether and diethyl ether. After evaporation of the ethers the fat was determined gravimetrically.

Sugar, Starch

Sugars were extracted from the samples with 85% ethanol. After evaporation of the ethanol, the sugars left in the aqeous solution were separated by HPLC. A portion of the residue of each sample remaining after ethanol extraction was hydrolysed with amyloglucosidase to glucose which was then quantified by HPLC. This value was used to determine starch.

Carotenes

The carotenes were extracted from the samples with a mixture of acetone and hexane (40 : 60). The extract from each sample was washed, dried and its volume was reduced. Carotenes were separated by column chromatography into three fractions containing α-carotene, β-carotene and cryptoxanthin and analysed by visible absorption at 450 nm.

Retinol

The sample was saponified with KOH to release the retinol which was then extracted with petroleum ether and diethyl ether. The solvent was evaporated and the retinol was dissolved in MeOH and quantified by HPLC.

Riboflavin

The method was adopted from AOAC (1984). The samples were digested in acid to release riboflavin which was estimated fluorimetrically.

Niacin

The method was adopted from AOAC (1984). The samples were hydrolysed (acid for non-cereal foods and alkaline for cereal foods) to release niacin which was reacted with cyanogen bromide and estimated by visible absorption at 440 nm.

Vitamin C

The method was adopted from AOAC (1984). The samples were homogenised and ascorbic acid was extracted with HPO_3. This was oxidised to dehydroascorbic acid in the presence of Norit. The oxidised form was then reacted with ortho-phenylenediamine to produce fluorophor which was estimated fluorimetrically.

Ash

Samples were ignited at 550°C until ash became white and then weighed after cooling to room temperature in a desiccator. Constant weight was obtained.

Minerals

The ash of each sample from above was dissolved in 5M HCl and then made up to 50 mL. A series of standards were made corresponding to the linear range of the typical curve for the AA spectrophotometer Perkin-Elmer 2380.

RESULTS :

The nutrient values and a range of published values are included in Appendix I. Full data sheets including recoveries, results for standard reference materials, and individual literature values for these nutrients are published in INR Technical Report 90/06.

NUTRIENTS :

Moisture

All the samples were analysed for moisture in duplicates on the day of sample preparation. Moisture was redetermined on samples whenever they were defrosted for analysis.

Protein

All samples were analysed in duplicates. For the first two samples (cooked rice and biscuit) three levels (low, moderate and high) of standard reference material (citrus leaves) were added. Since most recoveries were in the range 100 $\pm$ 2%, all other samples were run with one recovery. It is seen from the results that the % N in bovine liver and citrus leaves obtained agree well with the literature values.

Fat

All samples were analysed in duplicates. Again for the first two samples (cooked rice and biscuits) three levels of standard material (vegetable oil) were added. Since all recoveries were in range 100 $\pm$ 1%, the remaining samples were run with one recovery. There was a variation in the recoveries of other samples but the majority were between 90% and 105%.

Carbohydrates

Again all samples were analysed in duplicates. Three levels of standard additions were performed for all the samples. Some recoveries were much higher than 100% whereas others were very low, (<50%). No obvious trends could be seen with any of sugars or starch. Although the recoveries were not good almost all sample duplicates are within 10% of the average values. The mixed diet reference material 8431a was analysed with two samples. In both instances, the value

obtained for sugars are lower than literature. However, the starch values are in agreement.

Ash

This analysis was done in duplicates. Comparison could not be made with reference material since ash values are not stated for citrus leaves and bovine liver.

Minerals

At the beginning of the pilot programme the mineral values obtained were unreasonable and thus at the completion of sample collection for the pilot programme all samples were re-ashed along with citrus leaves ref. material. All the 12 samples were analysed together for the minerals.

All the samples were analysed in duplicate. Apart from sodium values, all the other mineral values in the reference citrus leaves agreed well with the literature values. The sodium value was 2.5 times greater than the literature value.

Fresh lot of bovine liver arrived just before all the samples were analysed for sodium. It was also ashed and analysed for sodium. The values obtained agreed well with the literature value. Other elements were also determined in this bovine liver. The same working standards that were used for the 12 pilot samples were used. The values obtained for all minerals except calcium were in agreement with the certified values. The calcium value obtained was one tenth the certified value. The bovine liver values that were obtained are reported with the chicken curry results.

VITAMINS :

Carotenes

This analysis was done in duplicates. Generally with most of the samples the values obtained are higher than the literature values.

Retinol

The analysis was done in duplicates. Apart from one sample the duplicates are within 10% of the average value. The first two samples gave low recoveries (50%) but the final two gave slightly more than 100% recovery.

Riboflavin

All samples were analysed in duplicates for riboflavin. The first few samples gave very low recoveries. However, some of the subsequent samples gave very high recoveries (>100%). Again most of the duplicates were within 10% of the average value.

Niacin

All samples were analysed in duplicates for niacin. The first 6 samples gave recoveries that were either very low to much higher than 100%. The subsequent samples gave more reasonable recoveries in the range 65% to 120%. Again most of the duplicates were within 10% of the average value.

COMPARISON WITH AVAILABLE DATA :

The data obtained for each food can be compared with other literature values. Comparison has been made with data from Food Composition tables of Pacific Islands, East Asia, Near East, Malaysia, Australia, United Kingdom, United States and a number of papers from "Food Technology in Australia". All the published literature have been included in the reference list.

1. Cooked Rice

The moisture, protein and fat are within the range of published values. The starch is lower than that published by Paul & Southgate (1978). The ash value is also lower than the available published values. All the minerals and vitamins are within the range of the published data except for carotenes which were detected but should not be present according to literature. The major nutrients i.e. moisture, protein, fat,

carbohydrate and ash add up to 98.8%.

2. Wafer Biscuits

Apart from Paul & Southgate (1978) and Thomas & Corden (1977) all other published values are for plain or cookie type wheat biscuits. Paul & Southgate (1978) gives data on wafer biscuits and thus is most suitable for comparison. Again, moisture, protein and fat are close to the published data. Among the carbohydrates, the sugars add up to be less than the published data but the starch is more. Ash and the minerals are within the range of the published data except for potassium which is much less than the Paul & Southgate (1978) value. The total carotene is much higher than the only published value from Malaysian tables. The major nutrients add up to 102%.

3. Rewa Full-cream Milk Powder

All the major nutrients along with vitamins are less than the literature values. Apart from iron all the minerals are also less than the literature values. The major nutrients add up to 76% despite repeating the analysis of fat and protein. The carbohydrate analysis had not been repeated since the HPLC has broken down and the replacement parts have not arrived. From literature the carbohydrate value should be between 36 to 39%. If this value is added instead of 14.7 the total would be close to 100. This analysis will be repeated as soon as the HPLC is fixed.

4. Canned Corned Beef

Moisture and protein are within the range of the published data. It is noticed that the fat value is much higher than any of the published data. This tends to support recent claims by nutritionists that inferior quality food is being exported to the islands. The sucrose value is in agreement with the data from the paper by Greenfield et al. (1987). Ash value is lower than all the literature values but the minerals are within the range except sodium which is much lower than the published data. The major nutrients add up to 104.7%.

5. Canned Pears

The moisture, protein and fat values are all higher than the literature values. The sorbitol and glucose could not be separated. The fructose value is lower than that found in fresh pears (Wills and El-Ghetany, 1986). Sucrose and starch have been found which are not present in fresh pears. Ash value is comparative but all the vitamins are much lower and the minerals are higher than the literature values. The major nutrients add up to 97%.

6. Papaya

The values for moisture, fat, individual sugars, ash and the vitamins - riboflavin, niacin and vitamin C agree well with the literature values. However, the protein value is much lower and among the minerals, the iron and sodium are much higher than most of the other literature values. The carotene agrees well with the values stated by Wills et al. (1986). However, cryptoxanthin is much lower than their value. The sum of the major nutrients comes to 95.4%.

7. Passionfruit

The moisture, ash and vitamin C values are within the range of the published data. The protein value is lower than all the literature values and fat value is higher than the literature values. The sugars, riboflavin, niacin and carotenes are all lower than the available literature. Among the minerals apart from calcium which is lower, all the others are in agreement with literature.

The major nutrients add up to 86.7%. According to literature passionfruit has fibre as high as 13.9% and thus the total would come close to 100 if fibre is added.

8. Taro leaves - raw

The values for protein, fat and ash are all higher than the literature values. Moisture is slightly lower. Amongst the vitamins only niacin is much lower than the literature values, the other are in agreement. Amongst the minerals only zinc is in agreement

with literature, potassium and calcium are higher but the rest are lower than the literature values. The major nutrients add up to 92.6%. This does not include fibre which can be as high as 5 to 6%.

9. Taro leaves - cooked

The moisture and ash values are higher but the protein and fat values are close to the published data. Both niacin and riboflavin are much lower and most of the vitamin C seems to have been lost during cooking. The individual carotenes are also reduced due to the effect of cooking. Apart from sodium all other minerals are lower than the raw sample but the values for calcium and iron appear higher than those recorded in the available literature. The major nutrients add up to 97%.

10. Taro corms - raw

The values for moisture and starch are lower than the literature and protein, fat and ash are in agreement. Most of the vitamin values are in agreement with literature. Most of the minerals are also in agreement with literature except for magnesium which is much lower than the literature value. The major nutrients add up to only 89%. Perhaps some of these nutrients have been under-estimated.

11. Taro corms - cooked

The values of moisture, protein, fat and starch all seem to be in agreement with the only available literature i.e. FAO (1972). Ash value is lower but the vitamins seem to be in agreement with literature. The mineral values seem to be similar to values for raw sample. The major nutrients add up to 102%.

12. Chicken curry

There is only one available reference for chicken curry i.e. the Malaysian Tables (Siong, 1985). Compared to this, values obtained for moisture, protein, fat and most of the vitamins are higher. Amongst the minerals only calcium and iron values are stated. The calcium value obtained is much lower than the literature but iron is only

slightly higher. The major nutrients add up to 107%.

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APPENDIX 1

Nutrient Composition of foods per 100g

Food	Water	Protein	Fat	Carbohydrate(g)						Ash
	(g)	(g)	(g)	Glucose	Fructose	Sucrose	Maltose	Lactose	Starch	(g)
Cooked rice	69.0	2.4	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	26.0	0.06
Literature	62.6-71.3	2.2-3.8	0.1-0.4	CHO : 24.4 - 30.0					29.6	0.2-0.3
Wafer biscuits	3.7	6.7	30.1	0.5	0.2	24.8	<0.1	1.9	33.9	0.9
Literature	2.3-8.4	4.5-9.0	7.8-29.9	CHO : 44.7 - 74.3					21.3	0.7-1.9
Milk powder	3.9	22.8	24.5	0.2	<0.1	<0.1	<0.1	14.7	4.6	5.6
Literature	2.5-3.8	25.5-28.5	26.3-27.5	CHO : 36.3 - 38.4				39.4		4.9-6.1
Canned corned beef	54.6	19.4	27.5	<0.1	<0.1	0.3	<0.1	<0.1	0.9	2.0
Literature	55.7-63.4	14.5-26.9	11.2-23.3			0.3				2.4-4.2
Canned pears	86.8	0.6	0.4	2.9	6.1	0.6	<0.1	<0.1	0.2	0.2
Literature	76.2-90.9	0.2-0.4	0.1	CHO : 8.3 - 20.0					0	0.2
Pawpaw	86.8	1.0	0.2	3.4	3.3	<0.1	<0.1	<0.1	0.2	0.5
Literature	86.5-90.7	0.4-1.5	0.1-0.3	3.6	3.3	0			0	0.3-0.6

APPENDIX 1/2

Nutrient Composition of foods per 100g

Food	Water	Protein	Fat	Carbohydrate (g)						Ash
	(g)	(g)	(g)	Glucose	Fructose	Sucrose	Maltose	Lactose	Starch	(g)
Passionfruit	79.2	1.8	2.6	0.3	0.3	1.4	<0.1	<0.1	0.3	0.7
Literature	72.9-84.2	2.2-4.7	0.3-2.2	2.3	1.9	1.5			0	0.6
Taro leaves - raw	83.3	5.8	1.3	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	2.2
Literature	81.4-85.4	4.1-5.0	0.6-1.0	CHO : 0.92-5.0					0.07	1.58-1.6
Taro leaves - cooked	91.2	3.8	0.6	<0.1	0.30	<0.1	<0.1	<0.1	<0.1	1.1
Literature	85.7	3.3	0.6							0.5
Taro corns - raw	64.6	1.2	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	22.7	0.9
Literature	69.1-75.4	1.12-2.2	0.10-0.4	Sugars : 1.01					24.5	0.9
Taro corns - cooked	69.0	1.0	0.5	<0.1	<0.1	0.36	1.12	<0.1	30.6	0.7
Literature	67.8	1.9	0.3							1.2
Chicken curry	64.4	16.4	12.6	<0.1	<0.1	<0.1	<0.1	<0.1	11.16	2.0
Literature	62.2	12.0	11.4	CHO : 12.0						2.4

APPENDIX 1/3

Vitamin and Mineral Composition of Foods per 100g

Food	Ribolavin	Niacin	Vitamin C	Vitamin A (μg)				Minerals (mg)					
	(mg)	(mg)	(mg)	Retinol	α-carotene	β-carotene	Crypt-oxanthin	Sodium	Potassium	Calcium	Iron	Mag-nesium	Zinc
Cooked rice	<0.01	0.5	NR	NR	23.9	9.5	31.4	4.5	28.7	2.5	0.74	7.4	0.36
Literature	0.006-0.01	0-0.6	0	0	Carotenes : 0			2-19	6-56	1-13	0.2-1.4	4-42	0.4-1.3
Wafer biscuit	0.14	0.6	NR	<2	46.5	103.4	33.0	137.8	209.2	66.4	1.7	35.3	0.64
Literature	0.05-0.35	0.4-0.5	0	65	Carotenes : 0-31			70	160	22-116	1.5-2.4	22	0.6
Milk powder	0.09	0.23	1.6	1393.2	<8	139.0	18.6	322.4	1413.2	742.0	0.43	80.8	1.2
Literature	1.00-1.40	0.60-5.40	2-10	210-1238	Carotenes : 170-198			301-445	744-1330	632-1020	0.40-1.5	84-85	3.2-3.34
Canned corned beef	0.18	2.34	9.2	18.7	36.7	133.7	57.1	643.8	207.7	31.6	3.0	15.9	2.1
Literature	0.16-0.23	2.3-3.5	0	5		Trace		950-1300	60-150	10-56	2.6-4.0	15-16	4.5-5.6
Canned pears	<0.01	<0.03	<0.4	NR	<8	<8	<9	21.6	102.6	6.6	0.70	8.9	0.30
Literature	0.01-0.022	0.2-0.3	0-0.3	0	Carotenes : 0			1-5	50-90	5-9	0.2-0.9	4-6	0.08
Pawpaw	0.02	0.37	54.0	NR	269.8	<8	425.7	7.8	274.6	32.7	1.2	23.8	0.10
Literature	0.03-0.07	0.1-0.4	50-73	0	240	0	1350	3-7	16-257	11-28	0.1-0.7	10-14	0.07-0.3

APPENDIX 1/4

Vitamin and Mineral Composition of Foods per 100g

Food	Riboflavin	Niacin	Vitamin C	Vitamin A (μg)				Minerals (mg)					
	(mg)	(mg)	(mg)	Retinol	α-carotene	β-carotene	Crypto-xanthin	Sodium	Potassium	Calcium	Iron	Mag-nesium	Zinc
Passionfruit	0.07	0.82	29.2	NR	126.3	663.9	543.6	15.4	278.8	4.6	1.3	27.1	0.85
Literature	0.1-0.14	1.4-2.5	17-31	1	360	410	370	19-28	200-348	10-13	0.6-1.6	28-29	0.8
Taro leaves - raw	0.32	0.49	89.8	NR	373.1	2904.3	2754.8	4.6	748.3	276.6	2.6	46.7	0.61
Literature	0.3-0.34	1.5	63-100		Carotenes : 5535			7.9-9.0	487-963	162-250	0.62-4.0	90	0.66
Taro leaves - cooked	0.15	0.32	<0.4	NR	327.2	2662.5	444.3	5.4	305.2	214.3	1.7	24.2	0.29
Literature	0.32	1.0	27		Carotenes : 4695					100	0.8		
Taro corns - raw	0.02	0.61	<0.4	NR	<8	<8	<9	6.4	396.8	17.7	1.3	29.4	1.5
Literature	0.025-0.04	0.760-1.0	6-15	0	Carotenes : 0			1.8-10	448-514	32-34	0.48-1.2	115	3.6
Taro corns - cooked	0.02	0.35	<0.4	NR	<8	<8	<9	10.2	298.8	19.3	1.2	23.5	1.4
Literature	0.012-0.05	0.59-0.6	4					11	498	48	0.9		
Chicken curry	0.12	4.86	3.7	68.4	<8	63.1	<9	622.9	229.6	36.2	2.3	21.2	0.65
Literature	0.08	2.1	1.1	100	Carotenes : 47					212	2.8		

NR : Not required for the pilot programme.

The literature values have been taken from the following references :

Bradbury and Holloway, 1988; FAO, 1972; FAO, 1982; Paul and Southgate, 1978; Greenfield et al., 1987; Siong, 1985; SPC, 1983; Thomas and Corden, 1977; US Department of Agriculture, 1976; US Department of Agriculture, 1982; Wills et al, 1986; Wills et al., 1982; Wills and El-Ghetany, 1986.