Performance of Laying Hens Fed High Copra Meal-based Diets With or Without Exogenous Enzyme Supplementation

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Abstract

The effect of enzyme supplementation of a high copra meal based diet on the performance of laying hens was investigated. A total of 60 Shaver Brown pullets aged 18 weeks were allotted to 12 floor pens in a completely randomised design. A control diet based on fish meal and 2 experimental diets containing 20% copra meal with or without supplemental Allzyme® were fed each to birds in 4 randomly selected pens for a period of 10 weeks. Data were collected on feed intake and egg performance (hen-day production, egg weight, egg mass, and feed: egg). Results showed significantly higher ($P<0.05$) feed intake, hen-day production, egg weight and egg mass on the non-enzyme supplemented copra meal diet. There were no dietary effects on final body weight and feed conversion ratio. It was concluded that at the level 20% of dietary copra meal, the enzyme supplementation is not required. This will beneficially reduce cost of egg production in the study area due to the readily availability and low cost of the test material.

Keywords: protein sources, copra meal, enzyme, layer performance.

Introduction

Poultry, on account of its high prolificacy and short cycle, can play an important role in bridging the animal protein consumption gap in the South Pacific region. In most countries of the region however, feed cost is the primary constraint to commercial poultry production. Conventional protein sources for poultry feeding, are not readily available in most countries; thus imported at exorbitant prices. There are however, several locally available materials which have potential as protein sources (ALFID, 2002; FAO, 2012) but documented information on their optimum inclusion in rations for poultry in the region is still scanty.

Coconut oil is a major commercial product in most countries of the South Pacific region and copra meal, a by-product of the oil extraction, is readily available. Although copra meal has a moderate protein content (Sauvant *et al.*, 2004; Mondal *et al.*, 2008), its use as major source of dietary protein for poultry is limited by its high fibre content (Kim *et al.*, 2001; Sundu and Dingle, 2003; Siebra *et al.*, 2008) and poor essential amino acid profile (NRC, 1998; Sundu and Dingle, 2009). There are several commercial enzymes which are capable of breaking down dietary fibre and release sequestered nutrients within the fibre fraction to the consuming animal (Choct, 2006). Lysine and methionine which are limiting amino acids in most alternative feed ingredients are also available commercially. Enzyme treatment of copra meal based diets has not however, allowed acceptable levels of body weight gain in meat-type birds due to their higher nutrient requirements (Sundu *et al.*, 2012; Diarra *et al.*, 2014). In view of the lower requirements of laying hens compared to broilers, it may be interesting to investigate the effect of enzyme supplementation to high copra meal based diets on laying performance.

Therefore, the present study was conducted to investigate the utilization of high copra meal based diets with or without supplemental exogenous enzyme on the performance of laying hens.

Materials and Methods

Experimental diets, birds and management

Three layer diets in mash form having 16.5% of crude protein were formulated for the experiment (Table 1). The treatments consisted of a control diet based on fish meal as protein source and two (2) other diets containing high (20%) copra meal with or without exogenous enzyme supplemention. The exogenous enzyme used was Allzyme® SSF (from Alltech Inc., Kentucky, USA), a multi-enzyme with seven enzyme activities namely: amylase, cellulase, phytase, xylanase, betaglucanase, pectinase, and protease. All the diets were supplemented with vitamin and mineral premixes to meet the requirements of laying hens (NRC, 1998), and lysine and methionine to make up for their deficiencies in copra meal.

A total of 60 Shaver Brown pullets aged 18 weeks were used for the experiment and managed in compliance with the University of the South Pacific's research ethics guidelines for animal welfare. The birds were weighed individually and allotted to 12 floor pens (1 x 2 m) containing 5 birds each. Each pen was equipped with a trough feeder, and a bell shaped drinker. Each of the formulated layer mashes was fed *ad-libitum* to birds in four selected pens in a completely randomised design for a period of 10 weeks. Drinking water was also supplied *ad libitum* throughout the experimental period.

Table 1: Ingredient composition of the experimental diets

	Diets		
Ingredients (g/kg)	Control	Copra meal	Copra meal + enzyme
Maize	775.5	624.	621.3
Fish meal	136.0	86.8	87.2
Copra meal	-	200.0	200.0
Limestone flour	80.0	80.0	80.0
Salt	3.0	3.0	3.0
*Premix	2.5	2.5	2.5
L-Lysine HCl	2.0	2.0	2.0
DL- Methionine	1.0	1.0	1.0
Allzyme SSF	-	-	3.0
<u>Calculated composition</u>			
Crude protein (%)	16.5	16.5	16.5
Metabolisable energy (kcal/kg)	3,007.7	2,927.7	2,917.4

*Layer premix supplied/kg: Vitamin A 1.000.000 IU., Vitamin D3 200.000 IU, Vitamin E 1.500 mg, Vitamin K3 200 mg, Vitamin B1 150 mg, Vitamin B2 400 mg, Vitamin B6 200 mg, Vitamin B12 1.200 mcg, Niacin 2.000 mg, Calcium pantothenate 500 mg, Biotin 10.000 mcg, Folic acid 40.000 mcg, Choline chloride 40.000 mg, Vitamin C 2.000 mg, Methionine 30.000 mg, Iron 4.000 mg, Copper 800 mg, Manganese 8.000 mg, Zinc 6.000 mg, Iodine 60.000 mcg, Selenium 15.000 mcg, Cobalt 20.000 mcg, Carophyll 2.000 mg, Antioxidant BHT 10.000 mg

Data collection

A weighed quantity of feed was provided daily and the refusals weighed the next day to account for actual consumption. Eggs produced per pen were recorded daily and hen-day production (HDP) calculated as:

$$HDP = \frac{eggs\ produced}{hens\ in\ the\ house}\, x\ 100.$$

Eggs were weighed weekly using a digital scale and mean egg weight recorded per pen. Feed conversion ratio was calculated as unit of feed consumed to unit of eggs produced. The birds were weighed at the end of the experiment and weight change recorded for each pen. Mortality was recorded as it occurred.

Chemical and data analysis

Copra meal, fish meal and the diets were analysed for proximate composition (Table 2) in the Central Laboratory, USP Alafua Campus, according to the Association of Official Analytical Chemists (AOAC, 1995). Data on egg production, egg quality, feed utilisation and weight change were subjected to the one-way analysis of variance (Steel and Torrie, 1980) using the Statistical Package for Social Sciences (SPSS, 2013). Significant differences were reported at 5% level of probability.

Table 2: Analysed composition and calculated ME content of the experimental diets, fish meal and copra meal

Constituents (g/100 g)	Diets				
	Control	Copra meal	Copra meal + Enzyme	Fish meal	Copra meal
Dry matter	88.70	90.10	89.30	97.19	90.25
Crude protein	16.17	16.03	16.04	64.60	24.90
Crude fat	7.70	6.12	6.06	7.27	6.61
Crude fibre	4.92	6.18	6.12	2.66	14.29
Total ash	15.00	16.30	15.40	15.29	10.60
Nitrogen-free extract	44.91	45.47	45.68	7.37	40.46
*Metabolisable energy (kcal/kg)	2,816.30	2,703.02	2,705.98	3,240.71	2,893.04

*calculated according to Fisher and Boorman (1986)

Results and Discussion

Chemical analysis

The protein content of the experimental fish meal was comparable to values reported in literature (NRC, 1998). The copra meal used in the study contained however, more protein than the 19 and 22%% observed by Sauvant *et al.* (2004) and Mondal *et al.* (2008). The variability in nutritive value of copra meals from different sources has been reported. Agronomic factors such as the variety of coconut, harvest age or the methods used in processing the coconuts (drying, oil extraction), have already been reported to affect the composition of the meal (Panigrahi, 1992). Diets based on copra had higher fibre and lower metabolisable energy (ME) contents reflecting the higher fibre in copra meal compare to fish meal.

Laying performance

Results of laying performance of the hens (Table 3) showed significant (P<005) dietary effect on feed intake, hen-day egg production, egg weight and egg mass, with the highest values observed in the group fed copra meal with no supplemented enzyme. Hens fed the enzyme supplemented diet also consumed significantly more feed than the control group fed fish meal. Hen-day egg production, egg weight and egg mass did not differ (P>0.05) between the control and enzyme supplemented groups. There was no dietary effect (P>0.05) on feed conversion ratio. On the fifth week of the experiment, one mortality was recorded in the group fed the control diet.

The higher energy content of the control diet was probably the reason for the reduced feed intake by birds on this diet compared to the copra meal fed groups as birds consume feed to meet their energy requirement. The increased intake of birds fed the high fibre copra meal-based diets was probably an attempt to meet their energy requirement. Increased feed intake by birds fed low energy diets has been reported (Bao *et al.*, 2013). The decreased intake by birds fed the enzyme supplemented diet compared to the non-supplemented group could be probably due to improved breakdown of fibre by the enzyme and increased energy availability. Increased energy availability to broiler chickens following enzyme supplementation of the diet has also been reported by Francesch and Geraert (2009). Highly soluble materials are known to transit rapidly along the small intestine (major site of nutrient absorption) resulting in reduced nutrient absorption. It is possible that the non-enzyme supplemented copra meal-based diet was retained longer in the small intestine which most have resulted in increased nutrient absorption and improved laying performance and heavier eggs on this group. These results may suggest that laying hens require a minimum dietary fibre for optimum performance.

Based on these results it is concluded that laying hens fed 20% dietary copra meal will not require enzyme supplementation. This level of inclusion will beneficially improve laying performance of the hens and reduce feed production cost.

Table 3: Effect of exogenous enzyme supplementation on the performance of laying hens fed high copra meal-based diets

Parameters	Diets			SEM	P value
	FM	CM	CM + Enzyme		
Initial weight (g/bird)	1,401.67	1,400.33	1,400.00	2.44	0.880
Final weight (g/bird)	1,800.00	1,834.33	1,834.00	27.57	0.623
Daily feed intake (g/bird)	63.51[c]	80.50[a]	70.34[b]	0.96	0.000
Hen-day production (%)	54.71[b]	65.17[a]	49.29[b]	1.20	0.000
Mean egg weigh (g)	49.00[b]	56.35[a]	47.62[b]	1.30	0.007
Egg mass (kg)	13.98[b]	17.81[a]	12.72[b]	0.80	0.010
Feed: egg	2.57	2.54	3.12	0.20	0.137
Mortality (%)	1	0	0	NA	

FM: fish meal; CM: copra meal; SEM: standard error of the mean;
NS: not significant (P>0.05); *: significant (P<0.05); NA: not analysed.
[abc] Means in the same row with different superscript differ significantly at p<0.05

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