GROWTH PERFORMANCE OF BROILER CHICKENS ON DIETS FORMULATED FROM LOCAL INGREDIENTS.

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ABSTRACT

An experiment was conducted to study growth performance of broiler chickens fed five treatment diets formulated using sorghum, copra meal (CM), palm kernel meal (PKM), sweet potato wagi besta (SPWB) variety and sweet potato SI.172 (SPIL) variety as energy sources and to correlate this performance with estimates of metabolisable energy content of the diets. There were five chickens per replicate and four replicates per treatment and feeding period was five weeks after three weeks of brooding. Replicates were randomly assigned to 20 rooms located in an open shed at the National Agricultural Research Institute, Lae, Papua New Guinea. A rapid bioassay method was used to estimate metabolisable energy content (in mJ/kg) of the diets to be 13.64, 13.53, 13.44, 13.55 and 13.54 for Sorghum, PKM, CM, SPWB and SPIL diets respectively. Body weight gains of chickens on the five diets were not significantly different indicating that the local ingredients could be used to feed chickens. However feed intake and feed conversion ratios varied between diets. Feed intake was found to be inversely related to energy content of the diets generally.

Key words: *Papua New Guinea, chicken, feed, locaL ingredient, sweet potato, copra meal, palm kernel meal, metabolisable energy.*

INTRODUCTION

Village chicken production for meat, eggs and feathers is a widespread agricultural activity throughout Papua New Guinea (PNG) and the South Pacific Island countries (SPICs). According to Bangunan *et al.* (1996) there were between 550,000-570,000 rural households in PNG in 1996 out of which 155,000 raise poultry. Until the mid 1970's indigenous breeds of chickens formed the backbone of chicken production and currently they far outnumber the genetically improved genotypes used for commercial chicken production in PNG. Recently however, the trend in some rural and peri-urban areas of PNG has been towards small scale, intensive production of chickens for commercial purposes (Low and Low 2000). The economic value of this activity has been estimated at about 67 million Australian dollars annually (ACIAR 2008).

These small scale commercial broiler producers use genetically improved strains and commercial feeds. Generally feed costs account for over 70% of running costs in chicken production and this is probably the most important constraint to production of chickens in PNG and the SPICs (Aregheore 2001). Cost of commercial feeds in PNG are high because some of the ingredients used in their preparation are imported. According to Kumar (1996), some 50,000 tonnes of feed grains costing over eight million kina are imported each year for commercial livestock production in PNG. Other important feedstuffs imported into PNG include soybean meal, fish meal and blood meal. It is therefore thought that the use of locally available and novel feed ingredients to formulate and manufacture chicken feeds could contribute to lowering the cost of chicken feeds (Preston 1995). This intervention in PNG and the SPICs could potentially decrease product prices with positive effects on human nutrition, sustainability of the chicken industry and farmer incomes and livelihoods. In this respect, protein and energy content of feeds are the two most important considerations in formulating diets for chicken because they are related to cost and efficiency of chicken production.

PNG has high energy staples such as sweet potato, cassava, banana and agro-industrial by-products such as palm kernel and copra meal that can be used as base for feed formulation to substitute for imported grains. However, to effectively use these ingredients for feeding chickens, information is required on not only the nutrient composition of the feed ingredients and their utilization but also actual performance of chickens on such diets. Such information is generally neither well developed nor available in PNG and other SPICs (Aregheore 2001).

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The main objective of this study was therefore to measure the growth response of broiler chickens which were fed five diets formulated from local ingredients and to correlate this performance with estimates of energy content of the diets.

MATERIALS AND METHODS

Two experiments were conducted. In the first experiment, growth performance of broiler chickens which were fed five experimental diets was measured. The second experiment was necessitated by lack of equipment for direct measurement of energy content of the treatment diets so a rapid bioassay method was used. Both experiments were conducted at the Animal Research Unit of the National Agricultural Research Institute (NARI) at Labu situated at latitude 06° 40' South and longitude 146° 54' East.

In the first experiment 208 one-day old chickens of the commercial Ross hybrid broiler breed were bought from a local commercial supplier and reared in a brooder for 20 days using commercial broiler starter feed. One hundred of these chickens were selected (50 males and 50 females) on the basis of uniformity of body weight at the end of the brooding period to be used in the experiment. Five experimental diets for feeding broiler chickens were formulated using sorghum, copra meal, palm kernel meal, sweet potato wagi besta (SPWB) variety and sweet potato SI.172 (SPIL) variety as energy sources. The two sweet potato varieties were chipped, oven dried and ground to meal form before mixing. Other ingredients were available in dried meal form. These ingredients were mixed with a protein concentrate prepared by a local feed mill. The composition of the diets and protein concentrate are shown in Table 1.

All five diets were used as treatments labeled as Sorghum, PKM, CM, SPWB and SPIL (see Table 1). Each treatment was replicated four (4) times with two of the replicates assigned to female chickens and the other two assigned to male chickens. A completely randomized experimental design was used whereby the treatments were randomly assigned to 20 rooms with deep litter floor located in an open, well ventilated poultry shed at NARI.

There was a one-week adaptation period followed by 4 weeks feeding and measurement period. During the trial, chickens were fed ad libitum. The amount of feed given each day and the residual feed in each feed container was measured at the end of each day to obtain a value of the total feed intake for each treatment. The total intake was divided by the number of chickens to obtain the average feed intake (FI) for each treatment. Other response variables measured were average body weight gain per bird (BWG) and feed conversion ratio (FCR). BWG was measured as the difference between average body weight at the start and end of the feeding period and FCR was calculated as FI divided by BWG. Analysis of variance (ANOVA) was carried out on each of the response variables to study the effect of diets on these variables.

In the second experiment a rapid bioassay method combined with the proximate values of nutrients in the diets and faeces of chickens was used to obtain estimates of the metabolisable energy content of each diet. During the bioassay

Table 1. **Percentage of ingredients and proximate composition of experimental diets for broiler chickens.**

	Treatment diets				
Ingredient	Sorghum	PKM	CM	SPWB	SPIL
Sorghum	57.5	43.1	43.1	43.1	43.1
Palm kernel meal (PKM)		25			
Copra meal (CM)			25		
Sweet potato waghi besta (SPWB)				25	
Sweet potato (SIL) (SPIL)					25
Protein concentrate	42.5	31.9	31.9	31.9	31.9
Total	100	100	100	100	100
Proximate nutrient composition (dry matter basis)					
Crude protein	22.9	18.4	23.5	18.9	18.4
Fat	6.8	8.5	6.9	5.3	4.9
Crude fibre	2.0	4.0	2.8	1.7	2.2
Ash	6.7	5.9	6.4	5.0	5.1

trial each of the same five diets used in the feeding trial were fed to groups of four chickens which were three weeks old and of the same breed as those used in the feeding trial described above. There were six replicates per diet, three replicates being assigned to female chickens and the rest three to male chickens. Each replicate was located in a cage in an open shed at NARI. The first three days of the bioassay period were regarded as adaptation period during which birds were fed test diets but no measurements were taken. From the fourth day (inclusive) to the seventh day total faeces output from each cage was collected. Each faeces sample was dried in an oven and subjected to proximate analyses. Each of the five diets were similarly subjected to proximate analyses. Since poultry pass out faeces and urine together metabolisable energy content of the diet was measured as the difference between the energy contents of each diet and its corresponding faeces using the following formula:

EME = [(GE in diet x FI) – (GE in faeces x Total faecal output)]/FI.

Where: EME is estimated metabolisable energy (mJ/kg DM) in test diet; GE is total gross energy of test diet (mJ/kg DM) and FI is total feed intake (g) during the bioassay period.

The GE content of proteins, fats, crude fibre and nitrogen free extract were taken from the literature (McDonald et al., 1995) to be 24.5 MJ/Kg, 39.0 MJ/Kg, 15.6 MJ/Kg and 17.7 MJ/Kg respectively.

RESULTS

A summary of the results of ANOVA of the response variables measured during the feeding trial are shown in Table 2. The EME content of each diet are shown in Table 3. Results of ANOVA showed that diet had highly significant effect (P<0.01) on FI and FCR but no significant effect on BWG. These results showed that, even though the EME content of the diets varied, chickens ate enough of each diet to obtain similar average body weights by the end of the feeding period. Sex of chicken also had highly significant effect on BWG and FI (P<0.01) but not on FCR. Mean FI and FCR for the five experimental diets are shown in Table 3. PKM had the highest FI and FCR of all diets and these values were significantly higher than the FI and FCR of all other diets except CM. However, chickens on CM diet had similar FI and FCR to those on Sorghum, SPWB and SIL diets.

DISCUSSION

At the end of the experiment chickens on all experimental diets attained statistically similar body weights even though EME content of the diets were different (Table 3). In this experiment the

Table 2. **Summary of ANOVA of response variables measured on broiler chickens fed different experimental diets.**

Parameter	Response variable measured		
	Body Weight Gain (mean = 2511g)	Feed Intake (mean = 4482g)	Feed Conversion Ratio (mean = 1.78)
Diet	ns	hs	hs
Sex	hs	hs	ns

Note: ns: non-significant effect (P<0.05); hs: highly significant effect (P<0.01).

Table 3. **Estimated metabolisable energy content of diets and growth performance of broiler chickens.**

Diet	Estimated Metabolisable Energy (MJ/Kg)	Feed Intake (g)	Feed Conversion Ratio	Body Weight Gain (g)
1. Sorghum	13.64	4310[a]	1.63[a]	2642[a]
2. PKM	13.53	5483[b]	2.12[b]	2585[a]
3. CM	13.44	4735[ab]	1.9[ab]	2495[a]
4. SPWB	13.55	3862[a]	1.59[a]	2432[a]
5. SIL	13.54	4019[a]	1.67[ab]	2403[a]

Note: Values within columns which have different superscripts are significantly different (P<0.05) from each other.

diets were provided ad libitum and it appears that the chickens ate enough of each diet to meet their nutrient requirements for growth and maintenance. Dietary energy level is the main factor influencing feed intake as birds will, under normal circumstances, eat to satisfy their energy requirements. Chickens fed on low energy diets tend to eat more of that diet than if they were fed a higher energy diet (Olomu and Offiong, 1980; Olomu, 1995). This feeding behaviour of chickens was demonstrated in this study. The PKM and CM diets had the lowest EME compared to all other diets and chickens on these diets had the highest feed intakes and poorest FCR as well. The FI and FCR values calculated for chickens on CM PKM diets was not statistically different.

Another important finding from this study was that the performance of chickens on SPWB, SIL and CM were not significantly different to those on the Sorghum diet. Sorghum is a grain that is commonly used in some standard and commercial poultry diets as energy source so performance of chickens on the Sorghum diet might give an indication of performance on commercial diets which were not used in this study. Studies elsewhere have also shown that performance of chickens on sweet potato diets were comparable to those of some grain crops (Yoshida and Morimoto 1958; Fetuga and Oluyemi 1976). However Gerpacio *et al.* (1978) reported that the poorer performance observed for chickens on sweet potato diets could be attributed to unidentified chemical factors in sweet potatoes which inhibit digestive and metabolic processes in chickens. Among the two sweet potato varieties SPWB had slightly higher EME than SIL and this reflected in the slightly better performance of chickens on SPWB compared to SIL in terms of FI and FCR. Of all the treatment diets only PKM had significantly poorer values of FI and FCR compared to the Sorghum diet. The significantly poorer FI of PKM may be due to its lower EME (see Table 3) so the chickens had to eat more of this diet to satisfy their requirements for energy. Also, in this study PKM had the highest crude fibre content (Table 1) which could contribute to poor performance of chickens. Sundu *et al.* (2006) also reported that, although PKM has no anti-nutritional factors its high fibre content leads to low digestibility and high feed intake in chickens.

CONCLUSION

At the end of this experiment broiler chickens on the five diets attained similar body weights. This indicates that the local ingredients used in the various diets in this study could be suitable sources of energy for feeding chickens. Also feed intake was found to be generally inversely related to estimates of metabolisable energy content of the various diets. However differences were found in feed intake and feed conversion ratios among the diets reflecting the chickens innate ability to satisfy its energy requirements when feeding. These differences may indicate differences in the utilization of the diets by chickens and this could have implications on cost of the diets. Further studies are therefore needed to fully assess the nutritional value of these diets and their cost structure and also to compare these diets to commonly used commercial diets in order to arrive at a clearer understanding of the use of the various local ingredients for feeding broiler chickens.

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