Performance of choice fed Australorp cockerels on copra and cassava chip meals

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ABSTRACT

Choice feeding experiment was carried out using young Australorp cockerels to study their biological performance. Forty-eight, 12 weeks old young cockerels were tested for 3 weeks (15 weeks of age). Copra meal (CM) was used to prepare four different protein concentrate diets labelled as CFD1,CFD2,CFD3 and CFD4 containing 30 %, 40 %, 50 %, and 80 % CM respectively. Dried cassava chip meal was offered in different feeders used as a separate ingredients supplied in combination with the four concentrates. The response variables measured were final body weights (BW), total feed intake (FI) and feed conversion ratio (FCR). The daily intake of the different CFDs was variable and ranged from 133 g/day (CFD4) to 159g /day (CFD1). The mean intake of cassava meal was higher for CFD4 while CFD1 had the lowest but it had the highest mean daily feed intake. BWG ranged from 11.8 g/day for chickens fed CFD4 to 25.3 g/day for those fed on CFD3. This result is reflected in the FCRs where CFD4 had the highest FCR of 13.3 while CFD3 had the lowest FCR of 6.0. The consumption of the copra meal concentrate was significantly ($P<0.01$) higher for CFD1. The consumption of cassava meal was significantly ($P<0.05$) higher when fed in combination with CFD2 and CFD3 then those fed with CFD1. The chickens fed on CFD4 grew significantly ($P<0.01$) slower with a BWG when compared to those fed on the other three choice feed diets. The effects of the CFDs on the FCR were similar to that of BWG.

Key words: feed cost**,** alternative ingredients, self-selection, cockerel growth.

INTRODUCTION

Rural chicken production uses mainly the free range farming system to raise chickens for food security, social status and cash purposes and often is very inefficient and uneconomical Ahlers *et al.* (2009); Dakpogan *et al.* (2011); Yrjö-Koskinen *et al*. (2011); Glatz (2012).The cost of feed is an important factor that continues to hinder chicken production in rural communities of Papua New Guinea (PNG). Sustainable and efficient feeding and production of chickens is based on sound knowledge of the nutritional requirements of the chickens, as well as the nutritional composition and availability of feed ingredients and appropriate management systems. Commercial chicken producers often use complete diets to meet the nutritional requirement of chickens that are usually kept in confinement or rearing units. One problem arising from this approach as feeding is based on the average requirement of the flock. Furthermore, feed cost may be increased during feed preparation processes such as grinding, mixing and pelletizing (Pousga *et al*. 2005; Alhers *et al*. 2009; Glatz 2012). An approach adopted by some farmers to reduce feed cost is the use of local feed ingredients and by allowing the chickens to self-select diets to regulate their nutrient intake, particularly in terms of their protein and energy Pousga *et al*. (2005); Alhers *et al*. (2009); Glatz (2012).

In PNG's smallholder or village setting, chickens are raised using a free range system where they satisfy their nutritional requirements by feeding on available feed of their choice feeding system). The daily meal of a village chicken may comprise of crop residues, seeds of weeds, insects, worms and organic wastes among others. It is plausible that over several generations of breeding, some chicken breeds may accumulate genetic adaptations to this system of nu-

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(2006); Glatz (2012).

The Australorp chicken is a hardy, dual purpose breed (meat and eggs) which was introduced to PNG in the 1960s (Bilong (1990) and distributed to many smallholders and village farmers. It is, therefore, important to find more suitable choice feed combinations for the Australorp chicken under smallholder and village conditions where free range system is appropriate. Objective of study the growth performance of young Australorp cockerels fed on choice feed combinations of copra meal concentrate (CMC) and cassava meal (CM) in a choice feeding system.

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the Animal Husbandry Research Centre of the National Agricultural Research Institute (NARI), formerly, DAL, Poultry Research Centre, Labu (6° 41' S 146° 4' E), Morobe Province. The station is situated at about 20 m above sea level, has an average relative humidity (RH) of 80 %, receives an average annual rainfall of about 2300 mm, and an average daily temperature of 27 °C.

Diets (treatments) and experimental design

Four choice feeding diets (CFD) were used as the treatments in this study. The CFD comprised of rations of copra meal concentrate (CMC) and chipped (dried) cassava meal (Table 1). Copra meal concentrate is prepared by mixing copra meal (copra industry by-product) with other ingredients shown in Table1. The protein quality of Copra meal (CM) has been found to be less than 50 % protein digestibility and organic matter digestibility of 83.7 %. The amino acids composition shows that it is low in lysine, isoleucine, leucine and histidine and lysine appears to be most limiting; all Copra meal require supplements, however, because they are deficient in lysine of the nutritionally essential amino acids. It has to be mixed with animal protein to supply the lysine low level and in this case meat and bone meal was supply to all the different levels of copra meal levels tested. After right proportions of copra meal and other ingredients were weight and added together, they were than thoroughly mixed by spades by scooping from one side to the other side. This process is repeated several times until the mixed is done well, look well, and smells well. They then are bagged according to the levels of CM treatment and put in a cool dry place before used in the experiment. The copra meal content of the concentrate was varied to give different levels of crude protein. Four levels of copra meal used were 30 %, 40 %, 50 % and 80 %, and the formulated concentrates were coded as CFD1, CFD2, CFD3 and CFD4 (Table 2). The copra meal concentrates were formulated using the methods of Scott *et al.* (1976). Samples of each of the formulated copra meal concentrates and cassava meal were collected for proximate analysis following the procedures of AOAC (1990).

Cassava meal processing

Cassava tubers were bought from local farmers and they were than washed and all soils and dirt were removed. They were grated with a locally made cassava granter (4-5mm diameter). The grated cassava were then spread thinly (4mm thick) on a black plastic sheet and let in good hot sun to dry. The spread grated sun dry cassava is stir or turned at 12noon and 4pm and then they are covered by folding over the drying grated cassava meal with the ends of the plastic sheets and left overnight. The next day the plastic sheets are open up again for the sun to continue its drying process while we repeat our turning process. The cassava meal drying takes about 3-4 days in a good sunny days (28 ^{0}C- 33 ^{0}C) and 5-7 days if days are so hot. During the drying the quality of the cassava is checked by texture feeling and smelling the drying product. A well dried grated cassava will feel good and dried and smell well and dried. The dried cassava is than bagged after drying and then are pounded in a local pounder (tong tong) and then put through a sieve (5-8 mm size). This gives its grittiness and coarseness for choice feeding. The sieved Cassava are treated as cassava meal and then bagged and stored in cool dry place ready for choice feeding.

Experimental design

The trial was laid out using a completely randomized design where four CFD were fed to 10 Australorp cockerels (replicates) in different cages. The CFDs were offered in partioned feed troughs to allow choice feeding. Allotment of the chickens to the different CFD and cages were done randomly.

Experimental birds and feeding

Two hundred day-old mixed sex Australorp chicks were hatched in the Centre's Hatchery and the chicks were subsequently vaccinated against Fowl Pox and Mareks diseases. An open sided shed with deep litter flooring and chick guard was used to brood and they were feed chick starter (20 %CP and ME- 2900 kcal/kg) and reared to 28 days of age. At the end of brooding chick guards were removed and the birds were reared to 12 weeks (84days) and they were fed chick grower (18% CP and ME- 2750kcal/kg). After the 12 weeks, one hundred cockerels were weighed individually using a Salter[O] top weighing balance and forty young cockerels that had an average weight of 1266.92±40.10g were then randomly assigned to individual single-tier cages. Each cage had feeding troughs that were partitioned equally in the middle to separate the cassava meal from the copra meal concentrate mash. The birds were acclimatized to the cage condition and the CFD rations for a week. After which, their initial weights were recorded before the onset of the choice feeding experiment. Conventional nipple-type drinkers were used to supply water to each cage. Water and feed choices were offered *ad libitum* for a feeding period of 21days.

Table 1: Composition of the Formulated copra meal concentrates (CMC)

Ingredients	Copra meal concentrates (%)			
	CMC1	CMC2	CMC3	CMC4
Copra meal	30.00	40.00	50.00	80.00
Mill run	37.00	27.00	17.00	12.00
Sorghum	10.00	10.00	10.00	0.00
Maize	10.00	10.00	10.00	0.00
Meat & bone meal	10.00	10.00	10.00	5.00
Premix[1]	3.00	3.00	3.00	3.00

1. Premix NIUGINT Tablebirds Lfd

Table 2: Choice feeding diets (CFD) used in this study

Choice feeding Diets	Choices feeding rations
CFD1	CMC, plus Cassava meal
CFD2	CMC, plus Cassava meal
CFD3	CMC, plus Cassava meal
CFD4	CMC, plus Cassava meal

Table 3: Analyze composition of choice feeds (CF) concentrates and cassava meal

Chemical analysis.	Formulated diet				Cassava meal
	CMC1	CMC2	CMC3	CMC4	
Crude protein (%)	31.60	30.10	32.30	30.40	2.40
ME (MJ/kg Cal.)*	8.81	9.18	8.75	8.33	11.21
Crude fiber (%)	10.00	12.30	13.90	20.30	4.40
Ether Extract (%)	3.50	4.00	4.70	8.50	0.04
ME:CP ratio	0.31	0.27	0.27	0.27	-

CMC = copra meal concentrate, CM = cassava meal

*ME = metabolizable energy calculated, CP = crude protein.

Variables measured

The main parameters measured in this experiment were feed intake (FI) and body weight gain (BWG). Fresh feed was weighed and added to each container on a daily basis. The left over feed was weighed at the end of each week. Weekly feed consumption was calculated as the difference between feed supplied and the left over. The total feed intake for each of the CFD rations was calculated as the sum of the copra meal concentrate and cassava meal intakes over the 3-week trial period.

Body weight change was monitored by weighing each cockerel on the same day of each week during the three weeks of trial. Feed was withdrawn from the chickens at 1700hrs on the previous day and restored only after the weighing the next morning. Body weight gain (BWG) was calculated as the difference between the initial weight taken at the start and the weight at the end of the week. Feed conversion ratio (FCR) was calculated as the ratio of feed consumed to body weight gained.

Statistical analyses

Data collected were collated in MS Excel and an analysis of variance (ANOVA) performed using GenStat Discovery Edition 3 VSNI (2008). Where significant differences were detected among the treatments, mean separation was done using Turkey's test (Underwood, 1999). Pearson' correlation was also performed to assess which two variables are linearly related.

RESULTS

The CFDs had higher crude protein and crude fiber content (Table 3). As the copra meal content of the CFDs increased from 30 % to 80 % so as their crude fiber contents also increased from 10 % to 20 %. The daily intake of the different CFDs was variable (Table 4), and ranged from 133 g/day (CFD4) to 159g /day (CFD1). Contrastingly, the mean intake of cassava meal was higher for CFD4 (39.5 g/day) while CFD1 had the lowest (36.2 g/day), but it had the highest mean daily feed intake. On the other hand, the growth indicators showed similar levels of variation: BWG ranged from 11.8 g/day for chickens fed a CFD4 to 25.3 g/day for those fed on CFD3. This is reflected in the FCRs where CFD4 had the highest FCR of 13.3 while CFD3 had the lowest FCR of 6.0. They were significant differences ($P<0.01$) amongst the CFDs in all the parameters measured. The choice feeding combination of CFD4 has significantly ($P<0.01$) lower mean daily feed intake (133.1 g/day) compared to the rest, while that of CFD1 was significantly ($P<0.01$) higher (159.1 g/day) than the rest. There was no difference ($P>0.05$) in the mean daily feed intakes of CFD2 and CFD3. Further, the consumption of the copra meal concentrate was significantly ($P<0.01$) higher for CFD intake. There was no difference ($P>0.05$) in the mean intakes of copra meal concentrate between CFD3 and CFD4, while CFD2 had the least significant ($P>0.05$) consumption (87.6 g/day) compared to the rest. There was no difference ($P>0.05$) in the mean copra meal concentrate intake of CFD3 and CFD4. The consumption of cassava meal was significantly (P<0.05) higher when fed in combination with CFD2 g/day, and CFD3 g/day, but the otherwise when fed with CFD1 g/day. Nonetheless, the chickens offered CFD1 consumed more than three times the amount of copra meal concentrate than they did for the cassava meal. While those offered CFD2, CFD3 and CFD4 consumed only twice more. On the other hand, chickens fed on CFD4 grew significantly (P<0.01) slower with a BWG of 11.8 g/day (Table 4) compared to those fed on the other three choice feed diets. The chickens that were fed to CFD1, CFD2 and CFD3, however, performed similarly. Apparently, the effects of the CFDs on the FCR were similar to that of BWG.

Table 4: Mean daily feed intake (DFI), body weight gain (BWG), feed conversion ratio (FCR), copra meal concentrate intake (CMC) and cassava meal (CM) intake under the different choice feeding diets (CFD)choice feed diets as feed(DM)

Variable	CFD1	CFD2	CFD3	CFD4	SEM	Significance
Mean daily feed intake (g/bird)	159.05^{c}	144.11^{b}	148.80^{b}	133.09^{a}	0.04	**
Mean CMC intake (g/bird)	123.10^{c}	87.58^{a}	98.18^{b}	93.61^{b}	1.32	**
Mean CM intake (g/bird)	36.20^{a}	52.23^{d}	50.92^{c}	39.48^{b}	0.63	**
CMC:CM	3.40	1.68	1.93	2.37		
Mean BWG (g/day)	24.30^{b}	20.90^{b}	25.30^{b}	11.80^{a}	0.23	**
FCR	6.72^{a}	7.12^{a}	5.95^{a}	13.26^{b}	0.24	**
Cost of feed (PNG Kina/kg)^{2}	0.89	1.10	0.90	1.00		

CMC = copra meal concentrate, CM = cassava meal

^{a,b,c} Means in the same row with different letter subscripts are significantly (P<0.01) different between treatment.

* Significant at P<0.05

** Significant at P<0.01

NS not significantly

^{2}One Papua New Guinea (PNG) Kina = 0.46 US Dollar .

DISCUSSION

The cockerels were able to self-select proportions of copra meal concentrate and cassava meal when fed on a free choice basis. Interestingly, higher amounts of copra meal in the copra meal concentrate seemed to have a negative impact on the performance of the cockerels. Nevertheless, several authors have reported that poor performance of chickens may be due to low concentration of limiting amino acids, heat damage of the copra meal during processing and high dietary fiber content of copra meal (Knudsen 1997; Sundu *et al*. 2006). Sundu *et al* (2006) also concluded that increased levels of copra meal in the diet impaired feed digestibility, and therefore productivity, in broilers. Balasubramaniam (1976) found that the non-soluble polysaccharides (NSPs) in the fiber of copra meal is in the form of mannan (26 %), galactomannan (61 %) and cellulose (13 %), all of which have been found to have anti-nutritional properties in legumes. These NSPs contribute to low digestibility of protein and lipid by blocking the access of enzymes to cell contents (Knudsen 1997). Cassava may also contain anti-nutritive factors (cyanogenic glycosides), which is the most important problem preventing a wider use of the cassava crop as a source of livestock feed (Kohun and Grant 2004). Although work on copra meal showed that chickens fed on copra meal-based diets generally perform at a lower level than those on commercial diets; however the gain in body weight in the rural areas where proper commercial cannot be obtained is encouraging and can be accepted. Panigrahi *et al.* (1987) found that birds fed 25% copra meal had lower body weight in the first 5 weeks but accelerated their growth in the following weeks suggesting that the ability of chickens to handle copra meal increases with age. The present study used birds age 12 weeks and terminated at 15 weeks of age; and the results suggest that inclusion of up to 40 % copra meal is best for both body weight gain and feed conversion ratio and is adequate as a choice feeding diet in combination with cassava meal to achieve optimal production in this present study with the young roosters. This clearly indicates the need to increase sample size of the experimental units and increase the trial period in future studies to fully appreciate the effects of such feeding regime. Also, the components of the choice feeding diets needs to be studied to determine their apparent metabolisable energy and protein digestibility to be able to corroborate this finding.

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REFERENCES

AHLERS, C., ALDERS, R., BAGNOL, B., CAMBAZA, A. B., HARUN, M., MGOMEZULU, R., MSAMI, H., PYM, B., WEGENER, P., WETHLI, E. & YOUNG, M. 2009b. Improving village chicken production: a manual for field workers and trainers. ACIAR Monograph No.139. Australia Centre for Internal Agriculture Research: Canberra.194 pp, from http://aciar.gov.au/publication/mn139

AOAC 1990. 'Official Methods of Analysis.' (Association of Official Analytical Chemists: Washington, D. C.).

BALASUBRAMANIAM, K. 1976. Polysaccharides of kernel of maturing and mature coconuts. Journal of Food Science. **41**: 1370-1373.

BILONG, G. P. 1990. Dual purpose chickens: Are they suitable for PNG rural communities? Village livestock newsletter.1990 12:2-6

CRESWELL, D. C. & BROOKS, C.C. 1971. Composition, apparent digestibility and energy evaluation of coconut oil and coconut meal. Journal of Animal Science (1971), **33**:366-369.

DAKPOGAN, H. B., KYYSGAARD, N. C., CHRYSOSTOME, C. & PERMIN, A. 2011. Chick Survivability in Free range Production system Research Report\Rapport De Recherche\Infore De Inversigacion No.1 Family Poultry Communication\Communications en Aviculture Familiale\Comunicaciones en Avicultura Familiar Vol.20,No.12/36

FERKET, P.K. & GERNAT, A.G. 2006. Factors that affect feed intake of Birds: A Review. International Journal of Poultry Science 5 (10)905-911.

GENSTAT., DISCOVERY, EDITION 3,. 2008.

GLATZ, P. 2012. Poultry feeding systems in PNG, Australia Government, ACIAR., SARDI. http://www.sardi.sa.gov.au

KNUDSEN, K.E.B. 1997. Carbohydrate and lignin content of plant materials used in animal feeding. Animal Feed Science Technology.67:319-

KOHUN, P. J. & GRANT, I. 2004. Cassava as a source of livestock feed. National Agricultural Research Institute (NARI). Proceedings of the Cassava Workshop. Proceeding No. 4 January, 2004.

NANO, W. E., DANBARO, G. & BILONG, G.P. 2006. Copra meal as protein source and cassava chips as energy source in free-choice feeding of chickens. 5th Huon Seminar Sept. 13th-15th 2006, Papua New Guinea University of Technology.

PANIGRAHI, S., MACHIN, D. H., PAR, W. H. & BAINTON, J. 1987. Responses of Broiler chicks to dietary copra cake of high lipid content. British Poultry Science Br. Poult. Sci. **28**: 589-600.

POUSGA, S., BOLY H. & OGLE, B. 2005. Choice feeding of poultry: A Review. Livestock Research For Rural Development vol.17, Art. # 45 Retrieved May 21, 2010, from http://www.lrrd.org/lrrd17/4/pous17045.htm

SCOTT, M. L., NESHEIM, M. C. & Young, R. J. 1976. Nutrition of chickens. ML. Scott and Associates, ITL ACA: New York.

SUNDU, B., KUMAR, A. & DINGLE, J. 2006. Response of broiler chickens fed increasing levels of copra meal and enzymes. International Journal of Poultry Science **5 (**1) 13-18; 2006

YRJO-KOSKINEN, A., OLAF, T. & RUSHTON, J. 2011. How economics and add values to small-scale poultry research. Family Poultry Communication\Communications en Aviculture Familiale\Comunicaciones en Avicultura Familiar Vol.20,No.1 1/36