Performance of broiler chickens fed copra and cassava chip meals in free-choice feeding system

William Nano

ABSTRACT

Five high protein choice feeding diets (CFDs) were formulated containing 20 , 30 , 40 , 50 and 60 % copra meal, which were coded CFD1, CFD2, CFD3, CFD4 and CFD5.The copra meal concentrates had high crude protein and crude fiber content. As the CM content of the CFDs increased from 20 to 60%, their crude fibre contents also increased from 8.8 to 18.5 % respectively. The daily intake of the different choice feeding combination was variable. It ranged from CFD2, and CFD5 which were lower as compared to the rest CFDs which were higher but similar respectively. The mean intake of cassava meal was higher for CFD1, CFD3 and CFD4 but was similar, while CFD2 and CFD5 had the lowest and similar. BWG ranged from the lowest to the highest for chickens fed a CFD1 and CFD5, CFD2, CFD3 and CFD4 g/day respectively. This is reflected in the FCRs where CFD1and CFD5 had the poorest FCR while CFC4 had the best FCR compared to the rest of CFDs. The ANOVA detected significant differences ($P<0.01$) only in FCR among all the choice feed combinations in all the variables measured. The choice feeding combination of CFD4 had significantly ($P<0.01$) lower FCR compared to the rest, while CFD5 had a significantly ($P<0.01$) higher FCR than the rest. Apparently effect of the choice feed diets on the FCR was similar to that of BWG.

Key words: choice feed combination, choice feeding diets, feed conversion ratio

INTRODUCTION

Broiler chicken production in Papua New Guinea (PNG) involves large-scale commercial producers and smallholder farmers. It is the only meat industry in PNG that meets the domestic demand sufficiently. Broiler production by small holders is based on hatchery sales of approximately 130,000 day-old chicks per week, amounting to an annual production of 6.76 million birds for local sector markets. This is an equivalent of approximately 162.25 million kina per year (Glatz, 2007; Glatz, 2012). The broiler market provides a major source of income for the local poultry farmers. An estimated 55, 000 families benefit from this industry (Deklin *et al*., 2005; Glatz, 2007; Deklin, 2007; Glatz, 2012). In this industry, feed accounts for up to 70-80 % of the total production cost of a broiler chicken and it is the main factor in determining profitability. Most of the feed ingredients used in the commercial broiler rations are imported. This has resulted in continued increase in feed costs and it is the major concern for the sustainability of the smallholder chicken industry in the country (Glatz, 2007; and Deklin, 2007; Glatz, 2012).

The Australian Centre for International Agricultural Research (ACIAR) South Australia Research and Development Institute (SARDI) of South Australia has been doing some very promising work in collaboration with the National Agricultural Research Institute (NARI), Non-Governmental Organisations (NGOs), Papua New Guinea University of Technology (UNITECH) and church run organisations (CRO). They did grow out trials with farmers and used some kind of free choice system whereby they formulated a very high quality imported poultry concentrate and use with local feed ingredients such as sweet potato, cassava, sago and others (Deklin *et al*., 2005; Deklin, 2007 Glatz, 2007; Glatz, 2012).

Smallholder broiler chickens production is a booming industry that is worth millions of kina per year (Moat and Bilong, 2000;

University of Technology, Department of Agriculture, PMB, LAE, Papua New Guinea
Corresponding author: e-mail: wnano@ag.unitech.ac.pg

Moat, 2000; Deklin, 2007; Glatz, 2007; Glatz, 2012). The high cost of commercial feeds ingredients and formulated ration have been a major factor limiting the profitability of smallholder farms. The use of local feed ingredients and agro-industry by-products in the animal feed rations and an alternative management system (choice feeding) could help to alleviate this problem (Ahlers *et al*., 2009a,b; Glatz, 2012).

The scope of this study is mainly to match and focus on chickens ability to select and identify its nutrient needs and the use of the local fed ingredients especially cassava as a major energy source and agro- by products copra meal as major protein source in chicken meat production. To identify and match a possible diet for broiler chicken farming for the local farmers and the introduction of free choice farming system. The objective this study was to study the performance of broilers chickens fed five formulated copra meal concentrate combination diets with dry cassava meal in a free choice feeding system.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Papua New Guinea University of Technology (UNITECH) Agriculture Farm (147° E and 6° 41" S and 54 m above sea level (a.s.l). It was conducted under an open shaded house to protect the study from weather effect and natural predators.

Experimental birds

One hundred day-old broiler chicks (Sheavers) purchased from a local firm, Farmset Limited, Lae. The chicks were vaccinated against Fowl Pox and debeaked at day old. An open sided shed with deep litter floor and chick guard was used to brood and rear the chicks to 14 days of age. A total of sixty 14 days of age were selected from the batch of one hundred chickens to be used in this experiment. The broilers were individually weighed using a Salter^{O} top weighing balance (5kg x 10g division). The birds that were heavier than 350±46.08 g and lighter than 150±46.08 g were excluded to minimize body weight variation and the selected broilers 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 mmm were acclimatized to the cage condition and the CFD rations for a week. After which, their initial average 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 total feeding period of 42days.

Experimental diets (treatments)

Five high protein choice feeding diets (CFD) were formulated containing 20 , 30 , 40 , 50 and 60 % copra meal, which were coded CFD1, CFD2, CFD3, CFD4 and CFD5 (Table 1) using the methods of the UNE-Form Microsoft Office Excel 97-2000.These formulated diets were provided each as a choice feed in combination with chipped, dried cassava meal. Duplicate samples of each of the formulated diets and cassava meal were collected for proximate analysis, according to the procedures of AOAC (1990).

Preparation of cassava chip meals

Cassava tubers were purchased from the local farmers (fresh). The tubers were weighed to obtained fresh weight, and cleaned, and then chipped in the chipping machine. After chipping, the chipped cassavas were spreaded evenly on a black plastic sheet and left to sundry. The drying process took 3-4 days in good sunny days. When the chipped cassava were thoroughly dried (10-12 % moisture) they were put into empty bags and stored in a properly aerated place until required. During the trial period if and when the dried cassava chips were needed for feeding. Then they were milled in a local wooden processing mill (ton-tong). The dried cassavas were offered in pure form. The product (cassava meal) had the following composition (%): moisture=12.1, crude protein=2.5, crude fibre=3.5, ether extracts=0.3, ash=1.8, nitrogen free extracts=79.8

Experimental design

A completely randomised design was used in a manner where each of the five choice feeding diets (CFDs) were fed to 10 broiler meat chickens as replicates in different cages per dietary treatment. Assignment of chickens to the different CFDs and cages were done randomly.

Data collection

The main variables measured and analysed in this experiment were total feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), as well as intakes of CFDs and cassava meal (CMI). BWG was measured by weighing each chicken on the same day of each week during the feeding period. Feed was withdrawn from the chickens at 1700 hrs on the previous day and restored only after the weighing was done the next morning. BWG was calculated as the difference between the initial weight and the weight at the end of the feeding period. FCD and CM offered to each of the chicken were recorded on a weekly basis. Fresh feed (g) was weighed and added to each container on a daily basis and at the end of each week the residual feed left was weighed. Weekly feed consumption was calculated as the difference in weight between feed supplied and residual feed. The total CFD intake for each of the choice feed combination (CFD) was calculated as the sum of the weekly FCD intake and CM intake over the 6 weeks feeding period and FCR was calculated as total feed intake (g) divided by total body weight gain (g). The data collected were collated in MS Excel and an analysis of variance (ANOVA) performed using GenStat Discovery Edition 3 (VSNI, 2008). Where ANOVA detected significant differences among the treatments, mean separation was done using Turkey's test (Underwood, 1999). Additionally, Pearson' correlation was also performed to assess which two variables are linearly related.

RESULTS

The copra meal formulated concentrates (CFDs) had higher crude protein and crude fibre content (Table 1). As the CM content of the CFDs increased from 20 to 60 %, their crude fibre contents also increased from 8.8 to 18.5 % respectively. The daily feed intake of the different CFDs was variable (Table 3). There were significant differences (P<0.01) only in FCR among all the choice feed combinations in all the parameters measured (Table 3). The choice feeding combination of CFD4 has significantly (P<0.01) poor FCR compared to the rest of CFDs, while CFD1 has a significantly (P<0.01) better FCR than the rest of CFDs. There was no difference in the mean daily feed intakes of all CFDs. The consumption of cassava meal was also not significantly (P<0.05) different in combination with all CFDs. Apparently, the effect of the CFDs on the FCR was similar as to that of BWG.

Table 1 Ingredients composition of dietary treatments (%).

	CFD1+	CFD2+	CFD3+	CFD4+	CFD5+
Copra meal	20.00	30.00	40.00	50.00	60.00
Mill run	27.00	26.00	10.00	10.00	11.00
Rice mill	28.00	22.00	31.00	26.00	15.00
Molasses	5.00	2.00	4.00	4.00	4.00
Fish meal	20.00	20.00	15.00	10.00	10.00

+Concentrates formulated diets with increasing levels of copra meal from 20- 60 % (CFD1- CFD5) respectively

Table 2 Chemical composition of treatment feeds (%).

	CFD1+	CFD2+	CFD3+	CFD4+	CFD5+
Dry matter	91.07	90.22	90.58	90.32	89.51
Crude Protein	27.00	24.44	23.31	20.31	21.31
Crude Fibre	8.8	10.50	12.50	15.60	18.50
Ether Extract	1.10	1.40	1.40	1.40	1.60
NFE	51.88	48.37	48.91	52.17	50.01
ASH	6.79	10.51	11.96	11.34	11.09
ME (MJ/kg)	10.83	9.03	9.00	9.00	8.20
ME:CP	0.40	0.37	0.34	0.34	0.30

+ Concentrates formulated diets with increasing levels of copra meal from 20- 60 % (CFD1- CFD5) respectively.

Table 3 Growth performance of choice fed chickens

Variables	CFD1+	CFD2+	CFD3+	CFD4+	CFD5+	SEM	Significance
BWG	22.98	24.66	25.36	27.40	22.94	4.38	NS
CFD intake	72.15	68.11	71.68	72.77	71.66	6.49	NS
CM intake	41.48	37.64	41.57	40.70	38.47	8.09	NS
Total Daily intake	113.63	105.76	113.24	113.47	110.14	10.13	NS
% cassava/total FI	36.30	36.70	36.30	35.63	36.60		
FCR	4.94[a]	4.29[b]	4.47[ab]	4.14[b]	4.84[a]	0.20	*
Cost/kg feed	1.21	1.21	1.20	1.26	1.45		

+Concentrates formulated diets with increasing levels of copra meal from 20- 60 % (CFD1- CFD5) respectively.

(a, b) Values in the same row with different letters are significantly (P<0.05) different.

. *significant (P<0.05)

NS: Nit significant (P>0.05)

DISCUSSION

The broilers chickens were able to self-select CFDs and CM when fed on a free choice basis. This was reflected by similarities of all variables measured in this study. The only results of the study that showed performance of the broiler chickens otherwise was reflected by the FCR which was significantly better (P<0.05) only in CFD 1 and poor in CFD 5 as compared to the rest of the CFDs. This is bit difficult to explain because the well documented effect of fibre was not reflected in this study. It is apparent that fibre levels in this study were high and therefore one would expect a negative trend as the level of CM in the CFDs increased and thus will have poor FCR with increasing CM levels as result of increased FI and poor BWG. However one explanation that may be considered is the innate self- selection ability of the broiler chickens of nutrients to meet their requirements which was what this study is trying find out. Most authors in the field of choice feeding would agree that chickens have ability self- select their nutrients but will caution the better performance with increasing fibre levels in this study. Panigrahi *et al.* (1987) did similar work and 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 chickens gain a better ability to handle copra meal as they get older. In this study, older chickens were used and the results, however, suggest that inclusion of up to 50 % copra meal, comparable to the findings of Creswell and Brooks (1971) and Bilong (1990), suggested that 40 % CM in the concentrate is adequate as a choice feeding diet in combination with cassava meal to achieve optimal production. Bakau and Cummings (1985 unpublished) raised Hy-line strain of broiler pullets on free choice feeds with and different levels of methionine and they found that birds that were choice–fed with cassava meal had poorer performance than those fed commercial mash feeds. They however recommended that addition of 10 % methionine gave the best and improve results for the birds on the free choice feeds. In a choice feeding study, Nano (1985) observed improved performance of cross-bred cockerels (white leghorn x Australorp) raised from 28 to 49 days on feeds containing cracked corn, sorghum and boiled Irish potatoes compared to those on a commercial mash feed. However, the study found that the performance of chickens choice fed boiled Irish potato were poorer than those fed cracked corn and sorghum indicating the comparative advantage of grain feeds over those of tuber crops like sweet potato and cassava. 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) fed broiler chicks with different levels of copra meal and concluded that increased levels of copra meal in the diet impaired feed digestibility and therefore productivity in young 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

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). Furthermore, cassava may contain anti-nutritive factors (cyanogenicglucosides) which are the most important problem preventing a wider use of the cassava crop as a source of livestock feed (Kohun and Grant, 2004). Nevertheless, this study has demonstrated that the FCR were comparable with increasing levels of copra meal in the CFDs, although there is no correlation between the ratio of copra meal concentrate to cassava meal and the FCR. It can be concluded that 50% CM in a choice feeding with cassava meal will reduce cost of rearing without compromising performance of broiler chickens. This will be beneficial under smallholder conditions where feed access is the most limiting factor. Further work is needed in the components of the choice feeding diets to determine their apparent metabolisable energy and protein digestibility to be able to corroborate this finding.

ACKNOWLEDGEMENT

The work was funded by the Papua New Guinea University of Technology. Dr. T. Okpul helped with the statistic analysis and proof reading of the manuscript. Final year students (Joy Pulagis, Gwendolyn Ban and Jubilee Aibung) assisted in data collection.

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

ALDERS, R. G., SPRADBROW, P. B. & YOUNG, M. P. 2009a. Village chickens, poverty alleviation and the sustainable control of Newcastle diseases. ACIAR Proceedings No.131.Australia Centre for International Research: Canberra, 235pp. from http://aciar.gov.au/system/files/node/11133/PR 131 % 20 part % 201.pdf

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.

DEKLIN, J. A. 2007. Evaluating local energy feed sources for broiler production Post Graduate Diploma Thesis. Depart. Of Agric. Papua New Guinea University of Technology

DEKLIN, J. A., KOHUN, P.J. & HUGHES, R.J. 2005. Use of locally available feeds for broiler chickens, In: Project trial report, ACIAR Poultry Feeding Systems Project (AS2/2001/077), NARI, Lae, Papua New Guinea.

GLATZ, P. 2007. Poultry feeding systems in PNG, Australia Government, ACIAR., SARDI. http:// www.sardi.sa.gov.au from http://www.aciar.gov.au/project/LPS/2001/077 as retrieved on 29 Feb 2008

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. Mcl. 2004. Cassava as a source of livestock feed. National Agricultural Research Institute (NARI). Proceedings of the Cassava Workshop., Proceeding No. 4 January, 2004.

MOAT, M. & BILONG, P. 2000. Past labu poultry research and extension Efforts. In Quartermain , A. R. ed. Proceedings of the NARI Poultry Workshop. NARI Proceedings Series No.1 National Agriculture Research Institute, Papua New Guinea.pp8

MOAT, M. 2000. Broiler Chickens Production: Experiences from peri-urban areas. In: Allen, M.G., Bourke,R.M. and Salisbury J. G. (Ed) Food Security for Papua New Guinea. Proceedings of Papua New Guinea Food and nutrition Conference, PNG University of Technology, Lae, Papua New Guinea, 26-30 June 2000, ACIAR Proceeding. No. 99, Canberra, Australia, p637.

NANO, W. E. 1985. Root crops as a source of energy for growing chickens in a free-choice feeding systems. Diploma in Science Agriculture. Thesis. Department of Biochemistry and Nutrition. University of New England, Armadale, Australia.

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 **28**: 589-600.

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.