Performance of broilers fed a universal protein concentrate blended with cassava root meal as a finisher ration in Papua New Guinea

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ABSTRACT

The use of local ingredients in poultry diets is a key strategy to mitigate the high cost of commercial feed and improve profitability of small-scale farming. The aim of the study was to assess the growth performance and production costs of broilers fed a diet of milled cassava blended with a locally formulated protein concentrate. The test diet was compared against the commercially available broiler finisher feeds presented as pellets and milled crumble. The three diets were replicated four times with fifteen birds per replicate using a completely randomised design. Broiler chickens (N=180) at 21 days were randomly allocated in 12 pens and the weekly body weights, body weight gains, intakes, feed conversion ratio and production costs based on feed consumed were recorded. The live body weights of birds on the three diets were similar at days 28, 35 and 42. At day 28, feed intake of birds fed the commercial diets as pellets and milled crumble were higher (P<0.05) than that for birds fed the test diet. All feed intakes were similar after day 35. Birds on test diet performed better (P<0.05) in terms of body weight gain and feed conversion at day 28. However, body weight gain and feed conversion did not differ at days 35 and 42. The overall production cost for birds on test diet was 2.3 % higher than the commercial diet. However, the feed cost for test diet was 11 % lower compared to the commercial diet, suggesting that protein concentrate blended with cassava is cheaper to purchase. Further studies are recommended to assess different inclusion levels of cassava root meals as well as other local ingredients with the protein concentrate.

Key words: High feed cost, alternative ingredients, feed conversion ratio

INTRODUCTION

Small scale poultry production in Papua New Guinea (PNG) is a thriving industry due to high demand for meat driven by population growth (2.8 % per annum) and increasing affluence (Kohun et al., 2006). Smallholder broiler production, in particular, is the most common in PNG valued at AUD 67 million and involves more than 50,000 families (Glatz et al., 2013). However, attempts to increase production have long been hampered by high cost of imported or locally manufactured grain-based livestock feeds. Broiler farmers in rural settings to also find it difficult to obtain a regular supply of commercial feed and day old chicks (Ayalew, 2011; Pandi et al., 2011; Dom et al., 2013; Glatz et al., 2013). Retail prices of commercial pig and poultry feeds in past years (2003 to 2011) have increased from 50 to 100 % in tandem with the soaring global market prices of major grains Ayalew (2011).This has lowered the potential for broiler farmers to maximize profit and supply chicken meat for many low income families. The use of local feed resources could be a strategy to reduce cost of production and to improve profitability has been a high priority for the last 15 years in PNG (Ahizo et al., 2015; Nano, 2015; Glatz et al., 2013). The use of local ingredients in livestock feeds will enable small holder farmers to reduce production costs, increase supply of meat and improve

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profits. Consequently in May 2011, National Agricultural Research Institute (NARI) released two concentrate rations (i.e. low-energy and high-energy concentrates) that can be incorporated with sweet potato and cassava respectively in feed for broilers and layers, which has been reported to reduce cost of production by 19 to 30 % and improve profit by 35 % (Glatz et al., 2013; Ayalew, 2011). Following the success of these energy concentrates, a universal protein concentrate was formulated for both poultry and pigs based on specific species nutrient requirements. The universal protein concentrate was blended with milled cassava as a finisher ration of broiler chicken and was tested in an on farms study by Ahizo et al (2015) at the highlands of PNG. As a follow up on those findings by Ahizo et al (2015), a similar study was carried out in a more intensive management system at the lowlands of PNG. The objective of the current study was to assess growth performance and production costs of broilers fed a diet of milled cassava blended with a locally formulated protein concentrate.

MATERIALS AND METHODS

Study site

The study was conducted from 24 August to 2 October 2015 at the Livestock Research Centre of NARI in Lae. The climate is tropical with average temperature of 32 °C and relative humidity between 88 to 90 % during the experimental period.

Experimental diets

The test diet comprising 57 % universal concentrate (UC) blended with 40 % milled cassava (*ManihotesculentaCrantz*) roots (**U**niversal **C**oncentrate + **C**assava - **UCC**) was compared to a commercial finisher ration in mash (Standard diet mash- **STM**) and pellet (Standard diet pellet- **STP**) form. The UCC diet was prepared on-station using locally grown cassava roots. Local lowland cassava cultivars were processed using the mini-mill facilities on station. The fresh cassava roots were grated, sun dried and milled into flour. Composition of the test diet is presented in Table 1.The pellets from the commercial finisher were further reduced to a crumble form with a hammer mill. Composition of all the experimental diets is presented in Table 2.

Table 1. Ingredient composition of the universal concentrate.

Ingredient	Composition (%)
Meat Meal	14.06
Blood meal	9.65
Fish Meal	10.55
Tallow	4.4
Soybean mill	22.0
Millrun	38.4
Choline Chloride	0.11
Rhodimet-88 Liquid (Methionine)	0.51
Mycostat	0.087
Myco-Curb M Dry	0.2
Total	100

Source: Modified from Ahizo *et al*. (2015).

Table 2. Ingredients used in UCC broiler ration and the nutrient values of both diets used in this study

Ingredient	Composition (%)	QTY Used (kg)
Cassava tuber meal	40.00	80.0
Universal concentrate	57.00	114.0
Broiler pre-mix	0.4	6.0
Palm oil	3.0	0.8
Total	100.4	200.8

Nutrient specification of diets used in this experiment as percentage DM (metabolizable energy ME, MJ/kg)

Feed Type	DM	Ash	Fibre	Fat	CP	Ca	P	OM	ME (MJ/kg)
Starter	89.8	9.81	4.1	7.7	21.0	1.26	0.70	79.99	12.13
Finisher	89.7	5.89	5.0	7.5	19.0	1.28	0.71	83.81	12.20
UCC	90.1	7.80	4.2	8.3	22.4	1.23	0.92	82.3	12.44

Source: Modified from Glatz *et al*. (2013) and Ahizo *et al*. (2015). DM = Dry Matter, CP = Crude Protein, Ca = calcium, P=Phosphorous, OM= Organic Matter, ME=Metabolizable Energy. The UC was purchased from Goodman Fielder International (GFI) and other ingredients were purchased from outlets in Lae. The commercial finisher diet in 40kg bags were also purchased from GFI

MATERIALS AND METHODS

Experimental set up and design

A total of 180 day-old-chicks (Ross 308) were purchased from a local hatchery. Upon arrival these day old chicks were feather sexed and raised in two separate spot brooders for 14 days after which the brooders were removed. The experiment was conducted in a naturally ventilated broiler grow out facility. The shed comprised of 20 experimental pens with concrete flooring. Each of the pens had a dimension of 3.9m x 2.5m (9.75m²) with 7.5 cm of wood shavings as deep litter and equipped with one 6 kg feeder trough and one 6 L drinker. The birds were weighed at 21 days of age (Average weight 0.636 ± 0.024 kg) and randomly allocated in groups of 15 into 12 experimental pens. The three diets (UCC, STM and STP) were replicated four times using a completely randomised design. Each group of birds were presented with 7500g of the respective diet types daily and the feed residue measured daily, for feed conversion ratio calculations. Clean water was offered *ad libitum* and live body weights of birds were measured weekly.

Statistical analysis

The performance of birds was assessed by calculating the feed intake, body weight gain and feed conversion ratio (FCR). Parameters were calculated as follows;

- Weekly intake (kg) per bird = intake/ number of chickens
- Weekly weight gain (kg) per bird = (end of week weight - the start of week weight)/number of birds
- Feed Conversion Ratio (FCR) per bird = (weekly intake/weight gain)/number of birds

These parameters were analysed for the treatment effects using the one way analysis of variance using the GenStat Discovery 4th

RESULTS

The performance indices of broiler chickens are presented in Table 3. In terms of body weights, there were no significant differences observed in the weekly body weights of broiler chickens fed the different diets throughout the experimental period (Table 3). In terms of body weight gain, birds fed on the UCC diet had significantly *(P<0.05)* higher gain at 28 days. However, there was no significant difference (*P*>0.05) thereafter at days 35 and 42 compared to the STP and STM diets (Table 3). Birds fed the UCC diet had significantly (*P*<0.003) lower intakes compared to the STP and STM diets at day 28. At days 35 and 42, there were no statistical differences (*P*>0.05) in feed intake among the three treatments. At day 28, Birds fed the STP (2.85) and STM (2.49) diets had poorer (*P*<0.05) FCR values than the UCC (1.95) diet. At days 35 and 42 there was no dietary effect on FCR (P>0.05).

Table 3. Main effects of STP, STM and UCC diets on broiler performance at 28, 35 and 42 days of age

Diets	21 days	28 days	35 days	42 days
		Live body weights (kg)		
STP	0.643	0.929	1.272	1.802
STM	0.613	0.951	1.322	1.932
UCC	0.652	1.003	1.367	1.959
Group Mean	0.636	0.961	1.320	1.898
P-value	0.518	0.386	0.436	0.341
SEM	0.024	0.037	0.049	0.076
CV %	7.7	7.7	7.5	8.0
		Body weight gain (kg)		
STP		0.286[a]	0.343	0.530
STM		0.339[b]	0.370	0.611
UCC		0.351[b]	0.364	0.592
Group Mean		0.325	0.359	0.578
P-value		0.021	0.531	0.19
SEM		0.014	0.017	0.029
CV %		8.6	9.5	10.3
		Feed intake (kg)		
STP		0.813[a]	0.959	1.022[a]
STM		0.844[a]	0.914	1.193[b]
UCC		0.682[b]	0.877	1.228[b]
Group Mean		0.780	0.917	1.148
P-value		0.003	0.17	0.031
SEM		0.025	0.028	0.048
CV %		6.4	6.1	8.4
		Feed Conversion Ratio		
STP		2.85[a]	2.81	1.94
STM		2.49[b]	2.51	1.98
UCC		1.95[c]	2.42	2.08
Group Mean		2.43	2.58	1.99
P-value		<0.001	0.215	0.64
SEM		0.0603	0.1511	0.1087
CV %		5.0	11.7	10.9

Column means for each performance index with similar superscripts are not significantly different (*P*>0.005)

Feed Cost and Cost of production

The feed cost from 1-42days for birds fed on the STP diet and STM diet respectively were 17 % and 21.4 % higher than for birds fed on the UCC diet. This provided cost savings per bird of 11% and 14.3% for the UCC diet compared to the STP diet and STM diet to achieve market weight.

The overall production cost on, the UCC diet was 2.3 % higher than the STP diet while it cost 2.3 % lower than the STM diet. The gross revenue of 1500 PGK each was generated from selling 60 birds from each treatment at 25PGK/bird with a gross margin of 626.90 PGK (STP), 606.53 PGK (UCC) and 585.68 PGK (STM) respectively (Table 5). 2

Table 4. Production Cost of broiler chicken under UCC, STP and STM diets.

Items	Unit Cost in Kina (PGK)	UCC Diet		STP Diet		STM Diet	
		QTY	Amount (PKG)	QTY	Amount (PGK)	QTY	Amount (PGK)
Day Old Chicks (DOC)	3.60	60 birds	216.00	60 birds	216.00	60 birds	216.00
Broiler starter	1.98	93.33 kg*	166.16	93.33 kg*	166.16	93.33 kg	166.16
Broiler finisher	1.88	-	-	167.65kg *	315.68	177.1 kg	333.40
Universal concentrate	1.94	94.48 kg*	182.91	-	-	-	-
Cassava (flour)	0.7	66.3 kg*	46.41	-	-	-	-
Premix	16.36	0.66 kg*	10.85	-	-	-	-
Palm Oil	4.4	4.97 L*	21.88	-	-	-	-
Electricity	0.77	156 kWh	120.00	78kWh	60.00	104kWh	80
Labour	3.50	32 hrs	112.00	28hrs	98.00	29hrs	101.5
Transportation	1.70	10km	17.00	10km	17.00	10km	17.00
wood shaving	0.05	5.33kg	0.27	5.33kg	0.27	5.33kg	0.27
TOTAL PRODUCTION COST (PGK):			893.47		873.10		914.32

PGK = Papua New Guinea Kina; QTY= Quantity; kWh= kilowatt hour; km= kilometre; hrs= hours. *The feed and ingredients QTY were derived or calculated based on feed intake. The QTY for the ingredients (i.e. universal concentrate, cassava, palm oil and premix) in the UCC diet were calculated as total intake (166.412kg) of UCC multiplied by the % of the ingredient used in the diet (Total UCC intake X ingredient % = QTY).

Table 5. Feed Cost, Cost of production and Gross Margin of the STP, STM and UCC feed

Diet	Starter Feed Cost (PGK)	Finisher Feed Cost (PGK)*	Total Feed Cost 1d-42d (PGK)	Cost/bird based on Feed Intake d1-d42 (PGK)	Production Cost/ bird (PGK)
STP	166.16	315.68	481.84	8.03	14.55
STM	166.16	333.40	499.55	8.33	15.24
UCC	166.16	262.04	428.20	7.14	14.89
Diet	No. of Birds Sold	Selling Price/Bird (PGK)	Gross Revenue (PGK)	Total Production Cost (PGK)	Gross Income (PGK)
STP	60	25.00	1500.00	873.10	626.90
STM	60	25.00	1500.00	914.32	585.68
UCC	60	25.00	1500.00	893.47	606.53

* Feed cost at finisher was calculated based on unit cost of 1.94 PGK/kg(USD0.60) for UCC diet and 1.88 PGK/kg (USD0.58) for STP and STM diets respectively, *i.e*. Feed Intake at Finisher x Unit cost.

DISCUSSION

The blended cassava test diet (UCC) has similar dry matter and metabolizable energy compared to the standard finisher diets (Glatz *et al*., 2013; Ahizo *et al*., 2015).The weekly feed intakes in this study for birds fed the UCC diet were comparable to those recommended (704g, 960g and 1141g) by Nutrient Research Council (1994) when male birds are fed well-balanced diets providing 3,200 kcal ME/kg. The differences in feed intake observed at the start could be due to the transition from starter feed to UCC, STP and STM and the adaptation of birds to those diets. It was observed during the changeover period that the birds were better adapted to consuming the standard finisher feed (STP and STM). The average weight gains (52g/d, 50g/d and 85g/d) calculated from the weight gains obtained for birds on the UCC diet were lower than the average weight gain objectives (82g/d, 92g/d and 95g/d) set by Aviagen (2014) for Ross 308 broiler birds when birds are fed on cereal grains and with average daily intake of 220g.Temperature is one of the factors that may have contributed to low weight gain. Broilers when kept at temperature range of 26-30 °C had slower growth (May and Lott 2001). Ahizo *et al.* (2015) also obtained a body weight of 2.5 kg for broilers fed UCC diet in smallholder farm feed trials. The weights in this study were comparable (1.8- 1.9 kg) to those recorded by Glatz *et al* (2013) in broilers fed boiled mashed cassava and sweet potatoes blended with a high and low energy broiler concentrate. FCRs observed for birds fed the UCC diets at day 28, were better compared to those fed the commercial diets, indicating lower intakes and higher weight gains. There were no significant differences in FCR observed thereafter suggesting that birds fed the test diets compensated for the losses in the first week through an increase intake compared to the control diets. Moreover, the change in major diet component from wheat to cassava, for STP against UCC was not an apparent disadvantage to FCR of broiler birds. Similarly, Ochetim (1991) found no difference in FCR (2.11 vs. 2.21) when birds were fed with sun dried cassava as replacement for maize.

The STP diet was more economical based on the overall production cost than the UCC and the STM diets. The higher production cost of 2.3 % and 4.7 % on UCC and STM diets respectively, are due to additional production costs for labour and overheads for milling the UCC and STM feeds. However, the feed cost for UCC diet was 11 % lower compared to the STP diet. This was due to 16 % reduction in purchase costs of feed ingredients in the finisher diet compared to cost of finisher feed at retailers in Lae. Ochetim (1991) also observed a reduction in cost of feed when using locally grown cassava as a replacement for maize meal.

CONCLUSION

Broiler chickens on a diet of 40 % cassava tuber meal blended with 57 % Universal concentrate (UCC) had similar feed intake, weight gain and feed conversion performance to those on a standard pellet (STP) and standard mash (STM) diets. The UCC feed cost was lower compared to the standard diets. The reduced cost of feed is beneficial to small scale farmers and UCC can be used as an optional cost effective diet for broilers. Further studies are recommended to assess different inclusion levels of cassava root meals as well as other local ingredients with UC on the growth of broiler chickens.

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