PERFORMANCE AND ECONOMIC EVALUATION OF BROILER CHICKENS FED TWO CULTIVARS OF CASSAVA

Asifo O Ajuyah[1] and Mareko Tofinga

ABSTRACT

Two hundred and seventy broiler chickens were fed a sorghum-soybean meal control diet and two cassavas–soybean meal based test diets separately. The two cassava cultivars were the local white (LWCC) and local yellow (LYCC) cultivars. At weekly intervals and at slaughter age physical traits and economic performances of the birds were measured. Birds' fed the sorghum-soybean meal control diet performed better than the groups fed the two cassava cultivar based diets for live weight, feed conversion and weight gain. There were no significant differences between both cassava cultivars for the traits measured. Similarly, differences in chemical composition between the local white and local yellow cassava cultivars had no effect on all the production traits. However, taking into account the yield potentials of both cassava cultivars per hectare it can be calculated that the white cultivar would supply the feed requirements for 52% more broiler chickens than the yellow cultivar. The complete replacement of sorghum with either cassava cultivar did not impair broiler performance in terms of livability and feed intake. This observation is of significance to broiler producers involved in the production of their feed, and also as a marketing strategy for cassava farmers.

Key words: *Cassava, broiler chickens, physical and economic performances*

INTRODUCTION

In commercial broiler production feed constitutes approximately 60 to 80% the cost of producing broiler chicken meat. A major component of this cost (40 to 60%) is the energy-supplying ingredient of the feed. In developed countries such as USA, Canada, Australia and New Zealand, traditionally cereal grains (maize, wheat, barley or sorghum) supply the energy component of the chicken feed, as a result of which most local feed millers and animal nutritionists in the South Pacific region tend to formulate poultry feed using mostly imported cereal grains from as far as Canada and USA. However, a local feed energy substitute for imported cereal grains in the diet of broiler chickens in the region is cassava (*Manihot esculenta*). Cassava, or tapioca, is high in gross energy and is an important staple food in Fiji and also an alternative to taro, sweet potato, yam and plantain in Samoa, Tonga and the Cook Islands (FAO 1991).

Apart from its high water content, low and poor quality protein content, some of the major constraints in the use of cassava as poultry feed include, a long production cycle (9 to 18 months), hydrogen cyanide content and limited storage of the fresh tuber (4 to 5 days). This is in-addition to problems of drying at high humidity with constant rainfall. Research studies conducted in the South Pacific region have shown that raw, dried cassava flour supplemented with high quality protein rich in methionine, and fortified with adequate amount of minerals and vitamins, could replace up to 40% of maize, or up to half the cereal grains in a typical broiler diet. Ochetim (1987) observed no adverse effects on physical performance (weight gain and feed consumption), carcass yield and dressing percentage in his studies when 40% of dried-ground cassava was replaced with maize. However, Naidu (1988) reported that with 70% water content, cassava as an energy feed source for poultry on a dry matter basis is more expensive (F$0.54) than imported maize (F$0.27) for Fiji feed millers, even without any further processing. Recently, at the University of the South Pacific, School of Agriculture, Samoa, results from cassava evaluation trials have indicated significant differences in the yield, protein and water content of two local cultivars (Tofinga 1995; Hazelman 1997).

In this study, the physical performances of broiler chickens and the economics of producing broiler chicken meat were evaluated when 100% of imported sorghum was replaced by two cultivars (local white and local yellow) of cassava with different yield and chemical composition.

MATERIALS AND METHODS

Three hundred (300) day-old straight-run (mixed sex) Cobb broiler chicks were obtained from a hatchery

[1]The University of the South Pacific, School of Agriculture, Alafua Campus.

in New Zealand. Thirty (30) chicks were randomly distributed into each of nine pens containing wood shavings as litter, two tube feeders and one automatic watering device. Three pens were placed on each of the following experimental diets:

- diet 1, ground sorghum-soybean meal as the control diet;
- diet 2, ground local white cassava cultivar-soybean meal based diet, and
- diet 3, ground local yellow cassava cultivar-soybean meal based diet (Table 1).

The two cultivars of cassava were obtained from the University plot of Dr. M. Tofinga and some selected local farmers. Fresh cassava tubers were cut into chips using a bush knife, dried by solar drying for 2 to 3 days and ground into fine powder with dry matter content of about 90.0%. The chemical composition and yield of the two cassava cultivars are shown in Figure 1 and Table 1. Crude protein analysis was based on spectrophotometric technique after digestion using the digesdahl apparatus (Hite 1996). Approximately 0.25 grams of ground dried cassava sample was weighed into a digestion flask, and 4.0 ml of concentrated sulfuric acid added. Digestion was facilitated at 440°C for 4 minutes, followed by the addition of 10-ml hydrogen peroxide. The digestate was allowed to cool and distilled water added to the 100-ml mark. The absorbance of a 1.0 ml aliquot containing 5 ml polyvinyl alcohol and 1.0 ml Nessler reagent was determined at 425 nm against a blank containing 1.0 ml of distilled water, 5 ml of polyvinyl alcohol and 1.0 ml of Nessler reagent. Percent crude protein in the cassava was calculated from a regression equation ($y = -1.31 + 28.4x$, where y = percent crude protein and x = absorbance.) obtained from primary standard set for Kjeldahl nitrogen as described by Hite (1996).

The diets were formulated to contain similar amounts of metabolisable energy (isocaloric), that is 3159 and 3082 Kcal/kg, respectively, by the inclusion of 7% animal tallow (Table 1). However, it was not possible to formulate an iso-nitrogenous diet because of the low levels of protein in cassava compared to sorghum, 3% and 8.9% respectively. The three diets were mixed using a cement mixer and diet preparation was done on a weekly basis. The experimental diets and water were provided for *ad libitum* consumption. The lighting program during the first three weeks of the experiment was continuous (24 light: 0 dark) and, thereafter, until slaughter natural daylight (14 light: 10 dark). Throughout the duration of the experiment the following records were kept on per pen basis, weekly feed intake, liveweight and daily mortality. The weights of all dead birds were recorded prior to post-mortem analysis and disposal. At 6 weeks of age, 5 birds per pen or 15 birds per treatment were randomly selected, slaughtered, processed and eviscerated according to standard commercial procedures (Ajuyah et al. 1991).

Table 1. **Ingredient Composition of Broiler Diets (g/kg)**

INGREDIENTS	Control	Cassava (whiteor yellow Cultivar)
Ground Sorghum	536	-
Ground Cassava	-	536
Soybean meal	330	330
Fish meal	20	20
Animal tallow	70	70
DiCal Phosphate	20	20
Limestone	10	10
[1]Broiler premix	5	5
Salt	3	3
Lysine	3	3
DL-Methionine	2	2
Calculated Analysis		
Energy ME, kcal/kg	3159	3082
Dry Matter (%)	90.05	90.59
Crude Protein (%)	20.1	17.0
Calcium (%)	0.98	1.14
Total Phosphorus (%)	0.77	0.65
Lysine (%)	1.45	1.36
Methionine& Cystine(%)	0.90	0.70

Economic evaluation of the treatments was based on the cost of feed per kilogram liveweight and yield of cassava per hectare.

The data were analyzed using one-way analysis of variance, and the estimate of error variation was pens within treatment (Steel and Torrie 1980). Significant differences between treatment means were tested using Least Significance Difference (LSD) at 5% probability level (P<0.05). Computation was done using the Pacific Regional Agricultural Biometrics Service.

RESULTS AND DISCUSSION

The economic feasibility of using cassava as the major source of energy in diets for broiler chickens depends on the cost of traditional energy ingredients such as maize and sorghum. In most cases it is usually cheaper to import maize for use in poultry feed as opposed to the use of locally grown cassava. However, there are different cultivars of cassava with different yield potentials (Table 3) and chemical composition (Figure 1). The data on weekly performance traits for the broiler chickens are presented in Table 2. The complete replacement of sorghum with either cassava cultivar had no significant effect on feed intake. It could be inferred that the linamarin and lotaustralin content (precursors of hydrogen cyanide) of the sun-dried cassava cultivars did not seem to interfere with feed consumption. The range of hydrogen cyanide in sweet cassava cultivars in Samoa has been shown to be within safe limits for the inclusion of 40-60% raw dried ground cassava flour in livestock feed (Udo *et al.* 1980). To reduce the level of hydrogen cyanide in raw cassava the following processing options have been recommended; maceration, soaking or fermentation, boiling, sun drying, roasting and dehydration. This is in-addition to adequate level of sulpur containing amino acids in the cassava-based diets that may be involved in the detoxification of free hydrogen cyanide. In contrast liveweight, weight gain and feed conversion ratio were significantly depressed amongst the groups of birds fed the cassava-based diets. This might be as a result of differences in dietary protein between the control (20.1% CP) and cassava based diets (17% CP). In previous studies Udo *et al.* (1980) and Ochetim (1986) attributed poor performance of birds to the low protein, vitamin and mineral contents and lack of sulfur-containing amino acids such as methionine in cassava based diets. Although there were slight differences between the two cultivars of cassava for protein and dry matter content (Figure 1), these differences were not reflected in the production traits measured (Table 2) to 42 days of age. However, at 35 - 42 days of age the group of birds fed the local white cultivar had significantly higher weight gain than the group fed the yellow cassava cultivar based diet. This difference could be attributed to slightly higher feed intake by the group fed the local white cultivar based diet.

The percent mortality from week 1 to slaughter (6 weeks) was 4, 6 and 5 for the control, white cultivar and yellow cultivar fed group respectively. The two major causes of death were sudden death syndrome and starvation of runts. The highest mortality for the cassava based diets were recorded on day 35, which might explain the reduced feed intake compared to

Figure 1. **Chemical composition (g/kg) of dietary cassava cultivars - the local white cassava cultivar (LWCC) and local yellow cassava the local white cassava cultivar (LYCC).**

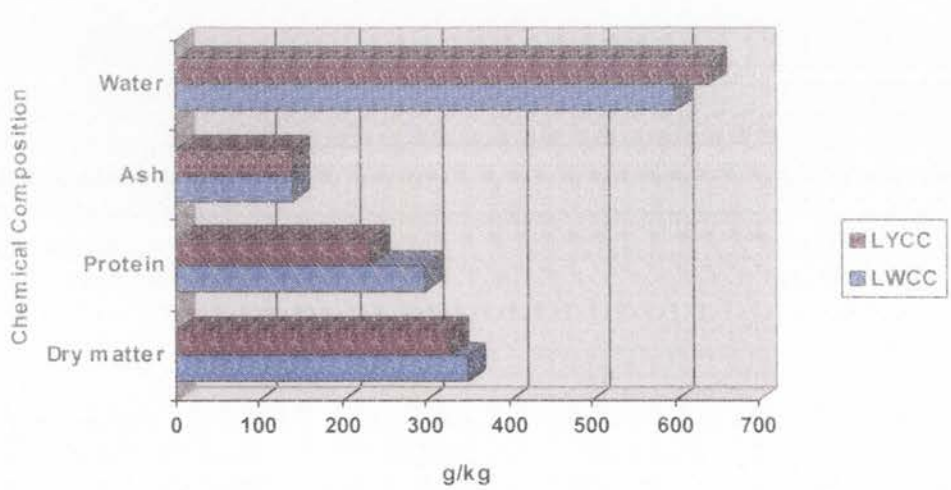

Table 2. **Weekly Performances of Broiler Chickens Fed the Test Diets**

[1]Diets	7	14	21	28	35	42
			Age in Days			
			Live Weight (g/bird)			
Control	147[a]	329[a]	665[a]	1046	1521[a]	2031[a]
LWCC	140[b]	295[b]	595[b]	974	1261[b]	1723[b]
LYCC	140[b]	291[b]	596[b]	965	1249[b]	1673[b]
SEM	1.5	6.7	12.4	16.6	46.9	58.1
			Feed Intake (g/bird/week)			
Control	136	274	589	731	990	1233
LWCC	130	267	568	852	753	1398
LYCC	129	265	602	851	751	1340
SEM	1.4	6.3	10.9	28.7	50.0	35.0
			Weight gain (g/bird/week)			
Control	107[a]	182[a]	336[a]	382	474[a]	511[a]
LWCC	100[b]	155[b]	300[b]	379	287[b]	463[b]
LYCC	100[b]	151[b]	305[b]	369	284[b]	424[c]
SEM	1.5	5.6	6.7	10.5	32.8	13.7
			Feed Conversion Ratio			
Control	1.3	1.5[b]	1.8[b]	1.9[b]	2.1[b]	2.4[b]
LWCC	1.3	1.7[a]	1.9[ab]	2.2[a]	2.6[a]	3.0[a]
LYCC	1.3	1.7[a]	2.0[a]	2.3[a]	2.6[a]	3.2[a]
SEM	0.0	0.0	0.0	0.1	0.1	0.1

[a-c] Means within a column with no common superscripts are significantly different (P<.05)
[1] LWCC = Local White Cassava Cultivar; LYCC = Local Yellow Cassava Cultivar.

day 28.

The economic feasibility of total replacement of sorghum with cassava is shown in Table 3. Although feed cost per bird was higher for the control group compared to birds on the cassava-based diets, cost per kilogram liveweight was cheapest for the control group. For the small-scale broiler farmer in the South Pacific region with 50 to 500 birds the difference between the white and yellow cultivars is of little significance. However, for a farmer that intends to plant his energy feed ingredient, the local yellow cultivar has the best potentials as a local feed resource. For example in terms of available feed resource, birds per hectare are approximately 4000 and 6000 for the white and yellow cassava based cultivars respectively. This is because with 33 and 35% dry matter content, the dry matter yield per hectare will be 13.2 and 8.75 tons for the yellow and white cultivar respectively. Fernando and Tofinga (1986), suggested that maize production on a large scale should be encouraged to meet current feed crisis in the region. However, Ainu'u (1986) reported that most countries in the region lack the capacity to produce maize solely as livestock feed. Instead, it was suggested that cassava, which is well adapted to many countries in the region, should be mass-produced.

[1]Broiler premix supplied the following nutrients per kilogram of diet. Vitamin A 1500IU, vitamin D 200ICU, vitamin E 10IU, vitamin K 0.5mg, riboflavin 3.6mg, pantothenic acid 10mg, niacin 27mg, vitamin B_{12} 0.009 mg, choline 1300mg, biotin 0.15mg, folacin 0.55mg, thiamin 1.8mg, pyridoxine 3.0mg, magnesium 600mg, manganese 60mg, zinc 40mg, iron 80mg, copper 8.0mg, iodine, 0.35mg and selenium. 0.15mg

Table 3. **Production Traits and Economics of Production of Broiler Chickens Prior to Slaughter.**

[1]Production traits	Control	LWCC	LYCC
Live weight (kg)	2.0[a]	1.6[b]	1.6[b]
Carcass wt. (kg)	1.3	1.0	1.0
Dressing (%)	64.7	64.7	65.4
Economics of Production			
Total feed intake (g)	3953	3968	3938
Cassava intake (g)	-	2127	2111
Feed cost $/kg DM	1.93	1.88	1.91
Feed cost $/bird	7.63	7.46	7.52
Cost of chick	2.50	2.50	2.50
Broiler cost at 6 wk.	10.13	9.96	10.02
Cost/kg live wt.	5.07	6.23	6.26
Yield/Hectare (tons)	-	25	40
DM/hectare (tons)	-	8.75	13.2
Fresh Wt. Cost/kg Cassava	-	$0.30	$0.30
Cost/kg Dry matter	-	$0.86	$0.91
[2]Number of Broilers per hectare	-	4114	6253

[a,b]Means within a row with no common superscripts are significantly different ($P < .05$).
[1]Production traits based on 15 birds per treatment
[2]Number of broilers per hectare based on total cassava yield (kg) /cassava intake (g) per bird.
LWCC = Local White Cassava Cultivar; LYCC = Local Yellow Cassava Cultivar
Cost based on Samoan tala 1 T$ = 0.288 US$

In summary, birds fed the sorghum-soybean meal control diet performed better than the groups fed either cassava cultivar. There were no differences to 42 days of age between the cassava fed group for all the traits measured. However, the economics of producing broiler meat could be affected by cassava yield per hectare, with high yielding cultivars reducing feed cost per unit area. This observation is of significance to broiler producers involved in the production of their feed and also as marketing strategy for cassava farmers in the region. In addition satisfactory performance traits were maintained when cassava completely replaced sorghum.

ACKNOWLEDGEMENTS

We wish to express sincere gratitude to Mr. Steve Hazelman for the supply of data on cassava yield in Samoa, and Mr. David Hunter for statistical analysis. Also Miss Dorcas Olori, Miss May Pitakere and Mr. Uga Luaupu for care of the birds. The University of the South Pacific Research Committee provided financial support for this research.

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