The Grain Replacement Value of Processed Cassava in Broiler Finisher Rations

By

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SUMMARY

EIGHT hundred Starbrow day-old broiler chicks were raised on deep litter on a commercial broiler starter ration. At the end of seven weeks the chicks were randomly and equally allotted to five experimental broiler finisher rations in which maize and gari constituted the main carbohydrate source in the proportions 58:0, 39:16, 29:24.5, 19:33 and 0.49% of ration, respectively. The protein source, groundnut cake, was varied accordingly such that the five rations were isonitrogenous and isocaloric. All other ingredients were mixed in the same amounts for all five rations which were balanced for essential nutrients. All chicks received *ad libitum* intake of feed and water from the eight week to the thirteenth week when the experiment was concluded. Feed consumption, growth rate, feed efficiency, dressed carcass percentage, liver weight and abdominal fat percentage were used as parameters to evaluate the relative efficacy of the five ration treatments.

Birds on gari rations consumed 3.2% less feed on the average, than those on the Control maize ration, for nearly identical gains. Feed/gain ratio was, therefore, slightly lower for the gari treatments, the lowest value coming from the ration in which maize/gari ratio was 29%:24.5%. Average body weights, rate of gain and feed/gain ratio were not significantly different. Variations in carcass and organoleptic measurements indicated no significant differences from dressed carcass percentage, liver weight percentage, tenderness, juiciness, colour or general acceptability. However, abdominal fat percentage was significantly [$P < 0.001$] larger in the gari rations than the control maize ration. This value was highest in the ration that contained only gari as the major carbohydrate source. There was no significant difference in the iodine number of the abdominal fat of the five treatments.

The results of this study suggest that gari can replace all the maize in broiler finisher rations or constitute up to 49% of the whole ration, without any decrease in growth rate or carcass quality of broilers, provided such a ration is balanced for protein and amino acids. The best substitution level from this study appears to be at 50%, or 29% of the whole ration.

INTRODUCTION

GRAINS constitute from 50 to 65% by weight of balanced animal feeds and usually not less than 40% of the total cost of the raw ingredients. Considering that as much as 70% of the running cost of a poultry enterprise is due to feeds feed cost is easily the most limiting factor in poultry production today. It becomes eminently clear that the bulk of price increases in mixed feeds can be traced directly to price increases in grain. By its share bulk in rations, grain is the most cost-sensitive ingredient in mixed rations.

The search for grain substitutes in animal feeds has been a subject of numerous cost-oriented studies in which tubers and roots are considered logical substitutes from point of view of their rich energy content and lower costs. Cassava in particular is widely recognised as a cheap caloric source on the basis of some agronomic and economic advantages which the crop enjoys over grain crops. These include high dry matter and caloric yield per hectare; low production cost and relatively low susceptibility to insect and pest attack.

Cassava mixed with appropriate amounts of high protein feedstuffs produces

cheaper feeds than if cereals alone are used. Cassava products are imported by many European countries and incorporated in large quantities in animal feeds. For example Philips (1974) reported that Belgium, France, Italy, Germany and the Netherlands incorporate as much as 47.5%, 14.7%, 14.5%, 60.1% and 31.5% cassava in their broiler finisher diets, respectively. These levels are constrained by legislation as a protection for slaughter houses against fat carcasses because cassava is classified as a fattening agent. Experimentation on the substitution of cassava in its various processed forms for cereals in poultry rations is reported by Temperton and Dudley (1941), who observed that laying hens could tolerate up to 40% substitution of cassava meal for corn meal, wheat middlings and oats. Another study in Guatemala by Squibb and Wyld (1951) utilized seven levels of cassava meal as a replacement for ground corn and concluded that cassava should be used in chick diets up to but not exceeding 47.5% of the ration. Vogt (1966), concluded from his studies that the most satisfactory substitution level was 10% for broilers and 20% for layers. Soares, Campos and Conrad (1968) also found no significant difference between chick performance from dried cassava and maize rations. Their fastest gain came from regimes in which cassava replaced 10% of the maize while their highest feed efficiency lay between substitution levels of 0 to 30%. The most economical level was at 18% substitution. Numerous other studies conducted in the tropics concluded that cassava meal can be included in the ration up to 60% without a decrease in chick performance and without producing toxic effects from hydrocyanic acid (Muller-Chou and Choo 1971; Tejada de Hernandez and Brambila 1969; Enriquez Ross, (1972).

MATERIALS AND METHODS

Eight hundred day-old Starbow chicks were raised for seven weeks on a commercial broiler starter mash.

Subsequently the chicks were randomly and equally allotted to five broiler finisher ration treatments. All chicks were fed and watered *ad libitum* under identical environmental and management conditions on deep litter.

Ration treatments comprised a standard broiler finisher ration in which maize, palm-kernel cake, rice bran ground nut cake, oyster shell, meat and bone meal, fish meal and common salt constitute the ration ingredients (ration 1) and four other rations containing equal amounts of other ingredients except maize which was progressively replaced by gari as shown in table 1. All rations were made isonitrogenous and isocaloric by adjusting levels of groundnut cake in consonance with levels of maize and gari in rations 2,3,4 and 5. All five rations were balanced for amino acids and minerals. Table 1 shows the ingredient composition of the five treatment rations and the calculated energy, protein and energy-protein rations. Table 2 shows the proximate composition of the same rations on dry basis. All rations were balanced for amino acids and minerals.

The chicks and left-over feeds were weighed weekly to determine average growth rate and feed consumption. At the end of 13 weeks a final weight of all the birds was taken and a 5% sample was slaughtered for carcass evaluation. Slaughter weight, plucked and dressed weights, liver weight and abdominal fat were also recorded. The abdominal fat is the layer of fat which lies within the ischium and surrounds the bursa of fabricus and cloaca where it is attached to abdominal muscles. Analyses of

TABLE 1
Composition of Experimental Ration

Ingredients (%)	Rations				
	1	2	3	4	5
Maize	58.0	39.0	29.0	19.0	0.0
Gari	0.0	16.0	24.5	33.0	49.0
Palm Kernel Meal	6.0	6.0	6.0	6.0	6.0
Rice Bran	10.0	10.0	10.0	10.0	10.0
Groundnut Cake	18.0	21.0	22.5	24.0	27.0
Oyster Shell	1.0	1.0	1.0	1.0	1.0
Meat and Bone Meal	2.0	2.0	2.0	2.0	2.0
Fish Meal	4.5	4.5	4.5	4.5	4.5
Common Salt	0.5	0.5	0.5	0.5	0.5
Total	100.0	100.0	100.0	100.0	100.0
Calories: GE: Kcal/kg	3265.22	3249.20	3241.59	3233.98	3217.28
Crude Protein: gm/kg	183.00	182.74	182.25	181.77	181.51
Energy/Protein Ratio (Kcal/gm protein)	17.84	17.78	17.79	17.79	17.73

TABLE 2
Analysis of Rations [% of Dry Matter]

Composition (%)	Rations					Means	S.E.
	1	2	3	4	5		
Dry Matter	90.20	90.33	90.24	89.99	89.75	90.10	0.104
Crude Protein	20.91	20.88	21.15	19.49	19.30	20.34	0.392
Crude fibre	6.43	6.43	6.11	4.72	4.52	5.64	0.849
Ether extract	5.68	4.72	5.35	5.34	5.34	5.24	0.317
NFE	57.18	58.28	57.63	60.44	60.82	58.87	1.484

variance were performed to test significant effects of treatments and period.

Tuckey's W - procedure was used where appropriate to identify significant means at the appropriate level of significance established from the analysis of variance.

RESULTS AND DISCUSSION

Growth Rate, Feed Consumption and Feed/Gain Ratios

The average feed consumption is presented in table 3. There were no significant treatment differences in the average

feed consumption figures ($P < 0.05$). However, birds on ration 1 (without gari) consumed on the average 3% more feed than the overall average, while birds on the various gari rations consumed on the average 0.7% less feed than the overall average.

Birds on ration 3 which contained equal proportions of maize and gari consumed the least amount of feed (96% of the average.) Average feed consumption increased significantly with age ($P < 0.01$) in all the treatments. The data on feed consumption are supported by the findings

of Tabayoyong (1939) who fed three lots of growing chicks with rice bran, a combination of rice bran and cassava refuse meal and cassava refuse meal alone. He found that chicks on rice bran consumed more feed, gained as much and cost more to raise than the chicks on a combination of rice bran-

cassava refuse ration.

Average body weight data are presented on table 4. The highest mean body weight was 1.25kg in ration 5 which had no maize. This value was significantly ($P < 0.05$) higher than the value for ration 4 but not significantly different from the other treatments.

TABLE 3

Average Feed Consumption [grammes per bird per day]

Period (weeks)	Rations					Means	SEp
	1	2	3	4	5		
8	37.88	37.88	32.47	32.47	36.87	35.51d	2.885**
9	37.34	56.82	57.87	57.34	56.31	57.14c	
10	76.45	75.76	80.13	86.01	86.01	80.87b	
11	80.13	77.16	86.80	91.74	90.09	85.18b	
12	120.19	115.74	98.04	98.30	92.59	104.97a	
13	121.36	122.55	109.33	115.74	115.74	116.94a	
Means	82.23	80.98	77.44	80.27	79.60		
			S.E.t	2.635 (N.S.)			

SEp = Standard error of mean (Period).

E.t = Standard error of mean (treatment)

N.S. = No Significant difference ($P > 0.05$)** = Highly significant difference ($P < 0.01$)

a,b,c,d Means followed by the same letters are not significantly different.

TABLE 4

Average Body Weights. [kg]

Period (Weeks)	Treatment Rations					Means	S.Ep
	1	2	3	4	5		
8	0.77	0.73	0.68	0.70	0.74	0.72a	0.018**
9	0.90	0.88	0.83	0.92	0.97	0.90b	
10	1.12	1.10	1.04	1.09	1.13	1.10c	
11	1.23	1.21	1.28	1.24	1.25	1.24d	
12	1.56	1.49	1.55	1.47	1.57	1.53e	
13	1.77	1.70	1.80	1.66	1.83	1.75f	
Means	1.23ab	1.19ab	1.20ab	1.18bc	1.25ab		
			S.Et	0.015*			

S.Ep = Standard error (period)

S.Et = Standard error (treatment).

** = Highly significant difference ($P < 0.01$)* = Significant difference ($P < 0.05$)

a,b,c .. Means followed by the same letters are not significantly different.

Average body weights also increased significantly ($P < 0.01$) from the 8th week to the 13th week. Growth response expressed as average daily gains (table 5) did not show any significant differences due to treatment or period, although the no-maize treatment (ration 5) gave the highest mean average daily gains.

Efficiency of feed conversion (table 6) did not vary significantly between the treatments ($P < 0.05$) but varied significantly ($P < 0.01$) from the 8th week to the 13th week. The lowest feed efficiency was in the 11th week when the chicks required an average of 4.02 kg of feed to produce 1 kg of gain.

TABLE 5
Average Daily Gains (gm per Bird per day).

Period (Weeks)	Treatment Rations					Means	SEp
	1	2	3	4	5		
8	32.85	27.14	20.00	22.86	28.57	26.28	3.128 N.S.
9	18.57	21.43	21.43	31.43	32.86	25.34	
10	31.43	31.43	30.00	24.28	22.86	28.00	
11	25.70	30.00	34.28	21.43	17.14	25.71	
12	37.14	24.28	38.57	32.86	45.70	35.71	
13	30.20	22.86	35.71	45.70	37.14	34.32	
Means	29.32	26.19	30.00	29.76	30.71		
		S.Et	2.864	N.S.			

S.Ep = Standard error (period)
S.Et = Standard error (treatment)
N.S. = No significant difference.

TABLE 6
Feed/Gain Ratios

Period (Weeks)	Treatment Rations					Means	SEp
	1	2	3	4	5		
8	1.15	1.40	1.62	1.42	1.29	1.38b	0.312*
9	3.09	2.65	2.70	1.82	1.71	2.89bc	
10	2.43	2.41	2.67	3.54	3.76	3.96abc	
11	3.12	4.91	2.53	4.28	5.26	4.02a	
12	3.24	2.89	2.54	2.99	2.03	2.74abc	
13	4.09	4.08	3.06	4.26	3.12	3.72ac	
Mean	2.85	3.06	2.52	3.05	2.86		
		S.E.t=0.285	(N.S.)				

S.E.p = Standard error (period)
S.E.t = Standard error (treatment)
** = Highly significant ($P < 0.01$)
N.S. = No significant difference
a,b,c... Means followed by the same letter are not significantly different.

TABLE 7

Carcass Evaluation Data

Treatment	Av. slaughter wt (gm)	Av. Plucked wt (gm)	Dressing (%) @	Liver wt (gm)	Liver wt (%) @	Abdominal fat (gm)	Abdominal fat (%) @	Iodine (gm)
1	22202.32	2080.96	94.5	53.00	2.5	12.62	0.6	24.65
2	2558.72	2428.20	94.9	72.42	3.0	27.20	1.1	24.05
3	2229.32	2098.02	94.1	58.16	2.8	19.90	0.9	24.05
4	2246.46	2111.90	94.0	60.18	2.8	15.26	0.7	25.55
5	2268.34	2137.32	94.2	55.46	2.6	25.32	1.2	24.25
Mean	2301.03	2171.28	94.34	59.84	2.74	20.06	0.90	24.60
Standard Deviation			0.36		0.195		0.255	0.58

@ Percent of Plucked weight.

Carcass Data

The carcass evaluation data are presented on table 7. There was very little variability between dressing percentage, liver weight percentage and iodine number of abdominal fat between the carcasses from the various ration treatments. Abdominal fat percentage was however highly variable with the highest value from the all — gari ration. On the average, birds on gari rations had 38.5% more abdominal fat than those in the all-maize ration. However the lack of variability in the iodine number of the various treatments suggests that the nature of body fat laid down was not affected by the dietary carbohydrate source, probably an indication of the ability of the growing chick to attain a characteristic body fat from a variety of dietary fats.

Work on the substitution value of cassava for maize in poultry rations is reported by Temperton and Dudley (1941) for layers and by Squibb and Wyld (1951) for broilers. In the former report, laying hens tolerated up to 40% substitution of cassava meal for corn meal, wheat middlings and oats without any decrease in performance. The latter authors found that chicks on cassava meal gained

significantly faster and utilized feed more efficiently than those on corn diets. They concluded that cassava should be incorporated in chick diets up to 47.5% of the ration. Soares, Campos and Conrad (1968) replaced a maximum of 42% corn with cassava meal and obtained no statistical differences in the performance of chicks between the corn and cassava meals, although the 10% replacement level gave the fastest rate of gain, and the 18%, the most economical level of substitution. On the other hand Muller *et al* (1971) found that cassava meal substituted for corn up to 60% in broiler rations providing that the diet was balanced and the cassava meal pelleted at higher levels of substitution. Similar results were obtained in Mexico by Tejada de Hernandez and Brambila (1969) who used up to 50% cassava meal in rations for young chicks and obtained similar growth rate but lower feed efficiency than chicks on corn starch. It could appear from most published data that cassava has a substantial replacement value for grains as a cheap source of calories. According to Phillips (1974) and Nestel (1974), utilization in broiler diets in various countries of Europe varies from 14.5% in Germany to 60.1%

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