

EFFECT OF PROCESSING AND ENZYME SUPPLEMENTATION OF CASSAVA ROOT MEAL ON PERFORMANCE OF BROILER CHICKS

J.U. OGBONNA¹, K.J. McCracken^{2,3}, J. LILLEY³ AND A. McALLISTER³

Institute of Agricultural Research and Training, P.M.B. 5029 Moor Plantation, Ibadan Oyo State, Nigeria.

2 Agricultural and Environmental Science, Dept, The Queen's University of Belfast

3 Department of Agriculture, Northern Ireland, Newforge Lane, Belfast.

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ABSTRACT

The effects of processing by mashing, cold-pelleting, heat-pelleting and extrusion, and enzyme supplementation of diets containing 0 and 400g cassava root meal (CRM)/kg on the performance of broiler chicks were studied. During the first week, DM intake was higher ($P < 0.05$) for the chicks on Diet 1 and in the absence of CRM while feeding mash as against pellets reduced feed intake from 7 - 28d ($P < 0.05$), weight gain ($P < 0.001$) and feed to gain ratio ($P < 0.001$). Heat-pelleted and extruded diets did not result in significantly higher intakes ($P > 0.05$) and weight gains compared with the cold-pelleted diets. Supplementation with Enzyme premix improved feed to gain ratio ($P < 0.05$) during the first week but had no effect over the 3 week period of the study. Ileal viscosity tests showed that dietary CRM inclusion had significant effect ($P < 0.001$) on the intestinal viscosity.

Key Words: Broiler Chicks, Cassava, Extrusions, Pellets, Enzyme, Performance.

INTRODUCTION

Cassava root meal (CRM) is a useful energy source in poultry nutrition and has been used successfully at up to 500g/kg in broiler diets (Stevenson and Jackson, 1983). Substantial efforts have been made in the past few decades to replace the cereals traditionally used in poultry diets with CRM (Enriquez and Ross, 1967). These workers have shown that the energy and fibre requirements of poultry can be adequately met through the use of CRM without necessarily affecting production, growth and carcass quality of the birds. In Nigeria, cassava root/peel meal has been used

to partially replace maize in maize/groundnut cake diet (Obioha, 1975; Aina, 1990; Ogbonna and Adebowale, 1993) but most studies have been done using mash rather than pelleted diets. The primary reasons for pelleting poultry diets (Pettersson *et al.*, 1991) are to kill bacteria and reduce mould growth. The productive value of low-fibre diets based on maize or wheat is generally improved by pelleting (Arscott *et al.*, 1958; McIntosh *et al.*, 1962). Heat treatments (autoclaving) or pelleting of fibre-rich poultry diets based on barley or rye, on the other hand, may reduce their productive values (Misir and Marquardt, 1978). Furthermore, high temperature treatments (e.g. extrusion) may increase the content of soluble dietary fibres and form resistant starch at high moisture levels (Bjorck *et al.*, 1984; Siljeström *et al.*, 1986).

In Europe, dietary supplementation with microbial enzyme preparations capable of hydrolysing endosperm cell walls has increased the performance of broiler chickens receiving cereal-based diets (Scholtyssek and Knorr, 1987; Pettersson and Aman, 1988). Published data in the United Kingdom (Finnfeeds International, 1992) have shown that a strong relationship exists between intestinal viscosity and the subsequent performance of broiler chickens fed wheat, barley, triticale or rye-based diets. In Nigeria such data are not available for broiler chickens fed maize or cassava-based diets containing enzymes.

The present study was, therefore, conducted to evaluate the effects of processing CRM by mashing, cold-pelleting, heat-pelleting and extrusion, and enzyme supplementation of maize/CRM diets on the performance and intestinal viscosity of broiler

chickens.

MATERIALS AND METHODS

A total of 144 day-old male (Ross) broiler chicks were used for this study. They were reared in electrically heated battery brooder house at an initial environmental temperature of 34^oc at day old which was reduced to 30^oc by 7d. During the first week, they were fed a commercial pelleted broiler starter diet. At 7d of age, they were weighed, transferred from the brooder house into 24 individual treatment cages located in a room with a light; dark regime of 24hr: 2 hr where they were randomly assigned to the treatment cages. There were three replicates of 24 birds in each treatment. The initial room temperature was 31^oc and relative humidity was 45-55%. The temperature was reduced 1^oc every 2 d to 24^oc by 21 d of age.

Three experimental diets were formulated (Table 1) The diets were designed to be both isocaloric and isonitrogenous in composition. Each diet was sub-divided into 4 equal parts for subsequent processing as mash, cold-pelleted, heat-pelleted/conditioned and extrusion. Each batch was further divided into

TABLE 1: COMPOSITION AND CHEMICAL CONTENTS OF EXPERIMENTAL DIETS

Ingredient Composition (g/kg)	DIETS		
	1	2	3
Maize	627	424	186
Cassava Root Meal	-	200	400
Groundnut Cake	180	191	218
Herring Meal	60	70	98
Meat and Bone Meal	30	30	30
Pollard	68.8	50	30
Vegetable Oil	-	5	17
Limestone	12.0	10.0	4.0
Dicalcium Phosphate	2.8	3.0	3.0
Methionine	3.0	2.5	2.0
Lysine	3.4	2.5	1.0
NaHCO ₃	8.0	8.0	8.0
Trace Minerals/Vitamins Premix ¹			
Calculated Analyses ²			
Crude Protein(%)	21.93	22.17	22.19
Ether Extract (%)	3.25	2.88	3.97
Metabolisable Energy (Kcal/kg)	2965.53	3156.40	3237.01

¹The Trace mineral and vitamin premix supplied per kg diet; Vit. A (I.U) 4,000,000; Vit. D (I.U) 1000,000; Vit E (I.U) 4,800; Vit K (g) 0.8; Vit. B₁ (g) 0.4; vit B₂ (g) 1.2; Nicotinic acid (g) 4.8; folic acid (g) 0.12; Ascorbic acid (g) 20.0; Choline chloride (g) 120.0; Mn (g) 40.0; Fe (g) 20.0; Zn (g) 18.0; Cu (g) 0.80; I (g) 0.62; Co (g) 0.09; Se (g) 0.04;

² Calculated according to the Swedish Feed Tables (Eriksson et al. 1972).

2 (with (+) and without (-) a 1g/kg diet enzyme premix, Finnfeeds International Ltd.). Thus, a total of 24 treatments were created, representing a 3 (Diets) x 4 (Processing) X 2 (Enzyme) factorial arrangement of treatments. Enzymatic activity was measured in centipoise (cps) units by the enzyme manufacturers using the viscometric enzyme bio-assay technique (Finnfeeds International, 1992). This is a technique which Finnfeeds International (FFI) has pioneered in the study of feed enzymes for broiler diets. This technique enables the effect of the feed enzymes to be evaluated *in vivo*, with environment and management effects minimised. The lower the viscosity, the lower the cps units, the better the results.

The mash diet was milled to pass a 3.5mm screen. The cold-pelleted diets were produced in a Lister 7.5HP using a 3mm dye cylinder. The heat-conditioned diets were steam-heated to 75-80^oc for 10 minutes prior to pelleting. The extruded diets were produced using an Insta Pro Model 600 single band extruder. The appropriate diets and water were provided to the birds *ad-libitum* from 7 to 28 d of age. Feed intakes (air dry weight, corrected for feed wastage) and individual chicken weights were recorded on a weekly basis. At the end of the experiment, the chickens were killed by cervical dislocation and the ileal contents were removed for intestinal viscosity evaluation. The effects of the dietary treatments on the parameters under investigation were analysed using an ANOVA procedure and the differences between the treatment means were tested using the Probability Difference Comparison (SAS, 1987).

RESULTS

During the first week, DM intake was higher (P<0.05) for the birds on Diet 1 and in the absence of CRM. Gain to feed ratio was affected by maize (P<0.05) and CRM (P<0.001) inclusions, resulting in significant effects on weight gain. However, over the remaining period of the experiment, DM intake was not affected by enzyme, maize or CRM inclusion. Gain to feed ratio was higher

PROCESSED AND ENZYME-SUPPLEMENTED CASSAVA FOR BROILERS

TABLE 2: EFFECTS OF FEED PROCESSING ON BROILER PERFORMANCE

	Weeks	Mash	COLD-Pelleted	Pelleted	HEAT-Extrusion	SEM ¹	P ² =
DMI ³ (g/d)	1	30.4	36.1	35.7	36.2	0.71	<0.001
	2	54.9	69.6	70.2	72.9	1.19	<0.001
	3	80.2	98.6	103.9	103.6	2.00	<0.001
MEAN DMI		55.2	68.1	70.1	71.2	1.20	<0.001
GAIN (g/d)	1	24.4	31.7	31.7	31.3	0.63	<0.001
	2	40.7	55.2	56.6	58.0	1.08	<0.001
	3	54.6	65.6	71.5	70.1	1.77	<0.001
Mean gain		39.9	50.8	53.1	53.4	0.90	<0.001
GAIN: FEED	1	0.80	0.88	0.86	0.87	0.008	<0.001
	2	0.75	0.79	0.81	0.80	0.006	<0.001
	3	0.68	0.67	0.69	0.68	0.009	<0.294
MEAN		0.72	0.75	0.76	0.75	0.003	<0.05

¹Pooled standard Error of Means. ² Statistical Significance of difference ³ Dry Matter Intake

in the absence of CRM (P<0.01) and for maize diets (P<0.01). There was a significant maize/CRM interaction (P<0.05) for weight gain which was highest for Diet 1 (52.7g/day) and least for Diet 3 (47.0g/day) birds. DM intake, weight gain and gain to feed ratios were markedly reduced for the mash

gains compared with the cold-pelleted diets. The only significant effects of enzyme inclusion were in gain to feed ratio during the first week (P<0.05). The improvement with enzyme inclusion was about 2% in weight gain in the second week (P<0.05).

Table 3 shows the effects of the dietary

TABLE 3: EFFECTS OF DIETARY TREATMENTS ON INTESTINAL VISCOSITY

Form	Mash		Cold-Pelleted		Heat-Pelleted		Extruded		SEM ¹	P ² =
	+	-	+	-	+	-	+	-	468	549
Enzyme	+	-	+	-	+	-	+	-	.331	.720
CASSAVA									.405	<.001
CEREAL									.331	<.001
(DIET 1)										
0	2.85	2.54	4.34	2.35	2.80	2.55	2.75	3.20		
(DIET 2)										
20	2.20	3.75	2.45	2.20	3.00	2.00	2.70	2.55		
MAIZE										
DIET 3										
40	2.30	2.15	2.50	2.80	2.80	2.65	2.75	3.30		

¹Pooled Standard Error of Means; ² Statistical significance of difference

compared with the other three processing treatments. (Table 2). The reductions observed were due, probably, to the fact that the mash diet was light, fluffy and dusty and so reduced intake by the chickens. The reductions in gain to feed were observed during the first two weeks of the study but not in week 3 and the overall reduction (P<0.001) was approximately 5%. Though just failing to attain statistical significance, there was a trend for the heat- conditioned and extruded diets to result in slightly higher intakes and weight

treatments on the ileal viscosity. The viscosity was influenced (P<0.001) by the maize/CRM interaction. The best result or viscosity (3 cps) occurred in the chickens fed the un-supplemented but heat-pelleted Diet 2 while the worst viscosity (4.34 cps) was observed in the chickens fed the enzyme-supplemented, cold-pelleted Diet 1.

DISCUSSION

At the end of the study, the floor of the cages housing the chickens fed Diet 3 was frothy and sticky, thus supporting the finding of Stevenson and Jackson (1983), who used CRM up to 500 g/kg in broiler diets. Also the observation in the present study that gain to feed ratio was higher in Diet 1 ($P < 0.01$) supports the reports of other workers (Nir *et al.* 1994), who observed that DM intake is related to the energy content of the diet. The reductions ($P < 0.001$) in gain to feed ratios observed during the first 2 weeks of the study could be attributed to the behavioural factors of the chickens or to the tendency of their gastro-intestinal tracts to adapt to the diets as they grow older. The results of the present study showed that feeding mash compared to pellets significantly reduced feed intake ($P < 0.001$), body weight gain ($P < 0.001$) and feed to gain ratio ($P < 0.001$), thus supporting the observation of other workers. Petterson *et al.* (1991) reported that pelleting increased weight gain for chickens receiving un-supplemented diet by 30% and for those on enzyme supplementation by 20% for 21 day old broilers. Nir *et al.* (1994) related the effects of pelleting on food intake and body weight gain to the degree of pelleting, stressing that feed utilisation is improved by pelleting, independent of the amount consumed.

The main effect of pelleting on feed utilisation is a reduction in feed energy devoted to maintenance and, therefore, improved productive energy (Petterson *et al.* 1991), and reduction in the eating time. The mash-fed chickens recorded 2% mortality during the study and they consistently spilled more feed than the pellet-fed chickens which recorded no mortality. These findings are in accord with those of Eley and Hofeman (1949), and Shreck *et al.* (1963).

In the present study, the observation that pelleted diets were converted more efficiently ($P < 0.001$) than the mash may be because the chickens spent less time feeding on pellets and 8⁰ expended less energy than on mash. (Savory, 1974; Nir *et al.*, 1994). However,

Stevenson and Jackson (1983) reported that feed conversion efficiency was un affected by dietary treatments. This study revealed that heat-pelleted and extruded diets did not result in significantly ($P > 0.05$) higher intakes and weight gain compared with the cold-pelleted diets although those fed on the heat-pelleted diets, on average, had a significantly ($P < 0.05$) higher weight gain and feed intake and hence the feed conversion was not significantly ($P > 0.05$) efficient, Petterson *et al.*, (1991). In the present study, enzyme supplementation improved feed to gain ratio by 2% ($P > 0.05$) during the first week of the study but had no effect over the 21 d period although this contrasts with the finding of Petterson and Aman (1988), who had earlier reported that an adaptation to the diets was apparent as the chicks grew older and this reduced the beneficial effects of enzyme supplementation. However, the authors observed significant ($P < 0.05$) effects at 34 d of age.

The influence ($P > 0.05$) on ileal viscosity by the cereal/CRM interaction supports the finding of Petterson and Aman (1988) but contrasts with the observation of Petterson *et al.* (1991) that supplementation with an appropriate enzyme preparation can reduce ileal viscosity and increase nutrients in the small intestine, thus improving the performance of mash-or pellet-fed chickens.

In conclusion, These results confirm that cassava can be included at high levels in broiler diets with success. The data for the first week suggest that there may be some initial reluctance by the chicks to accept the diets due, probably, to the gastro-intestinal tract adaptation process to the diets as the chicks grew older or to the differences in the rate of passage of the diets through the tracts. It is clear that the effect, relative to body size, was greatest during the first 2 weeks. Presumably, the poor gain to feed ratios at this stage were features of the reduced intakes relative to the maintenance requirements. The different processing methods employed in the present study, with or without enzyme addition therefore had no adverse effects on the performance of the broiler chickens.

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