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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Evaluation of Processed Cassava Peel Meals as Substitutes for Maize in the Diets of Layers

R. I. Salami [1] and A. A. Odunsi [2]
[1]Department of Agricultural Education (Animal Science Division),
Oyo State College of Education, P. M. B. 1010, Oyo, Nigeria
[2]Department of Animal Production and Health, Ladoke Akintola University of Technology,
P. M. B. 4000, Ogbomoso, Nigeria
E-mail: risalami@yahoo.com

Abstract: The response of Isa Brown layers during 56 to 72 weeks of age to cassava peel meal (CPM) processed by different methods i.e. ensiling (ECPM), parboiling (PCPM), retting (RCPM) and sun-drying alone (SCPM) as substitutes for maize was investigated. The control diet (CD) contained 40% maize and each of ECPM, PCPM, RCPM and SCPM were used to substitute 50, 75 and 100% of the maize in the CD. Dietary protein ranged from 15-16% while metabolizable energy varied between 2,500 and 2,600 Kcal/kg. Performance in terms of hen-day production and egg weight showed that RCPM could satisfactorily replace up to 75% of maize while the other processed CPMs could not replace maize beyond 50% without jeopardizing these two parameters. The terminal body weights of layers fed 100%RCPM and PCPM at the expense of maize were not affected while ECPM and SCPM beyond 50% substitution level adversely affected body weight. Feed conversion ratio showed a slight improvement with the use of CPM, however, layers on 100%ECPM, 100%PCPM and those on SCPM had a worsened feed conversion compared with the CD. Feed cost per egg produced were better with layers fed processed CPM with the exception of those on sun dried peels. Comparatively, sun drying alone was inadequate for processing cassava peels while retting maintained terminal weight, and had higher savings in terms of feed cost per egg produced.

Key words: Layer, maize, cassava peel meal, substitution

Introduction

Maize (*Zea mays*) is a common feedstuff of choice as a major supplier of energy in monogastric animal diets. Its proportion in monogastric tropical diets ranges from 50 to 70%(PAN, 1995), which implies that increasing cost of maize as is being currently experienced due to low level of production and higher consumption rates by man and agro-industries would invariably lead to increased cost of animal feeds. The problem of increasing feed cost in monogastric animal production is an age-long one for which cheaper alternative feedstuffs have been developed to replace the expensive conventional ones. One of such alternatives for partial replacement of maize in animal diets is the processed cassava peel meal (Abu and Onifade, 1996; Ikurior and Onuh, 1996; Eruvbetine *et al*., 1996; Salami, 1999 and 2000). Cassava peel is the outer cover of the tuber, which is usually removed manually with sharp knife with little or no pulp in the process of turning the raw pulp into the various human foods such as gari, fufu, lafun and tapioca among others in many tropical countries (IITA, 1990).

Aside from the lower values of crude protein and energy of the peel relative to those of maize, the greatest limitation in the use of cassava peel as a substitute for maize is that of its hydrocyanic acid (HCN) content which is harmful to the monogastrics. The HCN content of fresh cassava peels (which is a breakdown product of hydrolysis of cyanogenic glycosides in the presence of linamarase) has to be reduced greatly in the peels in order to promote its acceptability and utilization. Several processing methods have been applied to fresh cassava peels to reduce the cyanide content. These include grating and sun drying (Tewe *et al*., 1976), ensiling (Obioha and Anikwe, 1982), fermentation (Tewe and Kasali, 1986), boiling (Longe, 1980), freezing (Obioha *et al*., 1983), oven drying (Tewe and Kasali, 1986; Osei and Twumasi, 1989), sun drying (Osei and Duodu, 1988; Esonu and Udedibie, 1993), parboiling and sun drying (Salami, 2000). The optimal inclusion level and utilization of the processed cassava peel would therefore depend upon the processing method used. Studies (Tewe *et al*., 1976; Obioha and Anikwe, 1982; Tewe and Kasali, 1986) indicated that ensiling and fermentation are the most efficient methods while oven-drying is the least efficient method for cyanide reduction in fresh cassava peels. It is also evident from the studies conducted by Esonu and Udedibie (1993) and Salami (2000) that parboiling prior to sun drying had no advantage over sun drying alone in terms of reduction of cyanide content of cassava peels.

Although the nutrient composition of the peel is affected

Table 1: Composition of layer diets

	Level of CPM in replacement of maize (%)												
	CD	ECPM			RCPM			PCPM			SCPM		
Ingredients	A(0)	B(50)	C(75)	D(100)	E(50)	F(75)	G(100)	H(50)	I(75)	J(100)	K(50)	L(75)	M(100)
Maize	40	20	10	0	20	10	0	20	10	0	20	10	0
[1]CPM	0	20	30	40	20	30	40	20	30	40	20	30	40
Maize offal	10	21.5	22	22.75	21.5	22	22.75	21.5	22	22.75	21.5	22	22.75
Rice husk	16.25	3.25	1.25	0.0	3.25	1.25	0.0	3.25	1.25	0.0	3.25	1.25	0.0
Palm oil	3.0	4.5	6.0	6.5	4.5	6.0	6.5	4.5	6.0	6.5	4.5	6.0	6.5
[2]Concentrate	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75	30.75
Total	100	100	100	100	100	100	100	100	100	100	100	100	100
Calculated Analysis													
Crude protein%	15.7	16.6	15.2	15.5	16.6	15.2	15.5	16.6	15.2	15.5	16.6	15.2	15.5
Crude fibre (%)	7.71	7.61	8.55	8.85	7.61	8.55	8.85	7.61	8.55	8.85	7.61	8.55	8.85
ME(kcal/kg)	2665	2620	2593	2501	2620	2593	2501	2620	2593	2501	2620	2593	2501

[1]CD, ECPM, RCPM, PCPM, SCPM refers to Control diet, Ensiled, Retted, Parboiled and Sun dried Cassava peel meals respectively. CP of 5% and ME value of 2044.8 Kcal/kg were assumed for the processed CPM. Values in parenthesis represent level of CPM as a replacement for maize in the various diets.
[2]Protein and mineral concentrate consisted of: - fish meal (5%), groundnut cake (15.75%), bone meal (2.5%), oyster shell (7.0%), salt (0.25%) and premix (0.25%)

Table 2: Performance and Bioeconomics of egg production in layers fed processed CPM as a replacement for maize during 56 to 72 weeks of age

Performance parameters	Level of CPM in replacement of maize (%)													
	CD	ECPM			RCPM			PCPM			SCPM			
	A(0)	B(50)	C(75)	D(100)	E(50)	F(75)	G(100)	H(50)	I(75)	J(100)	K(50)	L(75)	M(100)	SEM
Initial weight, kg/b	1.89	1.87	1.80	1.79	1.78	1.72	1.75	1.76	1.73	1.83	1.83	1.75	1.79	0.07
Final weight, kg/b	1.93^{a}	1.91^{a}	1.59^{d}	1.63^{bc}	1.77^{a}	1.71^{a}	1.74^{a}	1.76^{a}	1.69^{b}	1.83^{a}	1.85^{a}	1.55^{d}	1.66^{bc}	0.05
Feed intake (g/b)	125.1^{a}	121.8^{b}	105.3^{f}	108.5^{ef}	116.0^{cd}	114.3^{cd}	106.2^{f}	117.9^{bc}	107.2^{f}	118.3^{bc}	112.7^{cd}	99.0^{g}	105.6^{f}	1.1
Hen-day production (%)	64.7^{a}	63.8^{a}	59.9^{b}	55.1^{c}	59.4^{b}	64.8^{a}	54.9^{c}	62.6^{ab}	56.1c	59.4^{b}	52.9^{cd}	53.1^{cd}	50.6^{d}	0.07
Egg weight at56wks(g)	66.4	64.7	64.3	60.2	61.4	61.7	61.5	61.7	64.7	60.4	65.0	60.4	59.4	1.8
Egg weight at72 wks(g)	66.7^{a}	66.6^{a}	63.3^{b}	$62.2b^{c}$	65.3^{a}	62.7^{a}	66.8^{a}	63.8^{b}	66.9^{a}	64.0^{b}	63.1^{b}	61.8^{c}	61.0^{c}	0.92
Feed conversion, (kg feed/kg egg)	2.9^{b}	2.87^{c}	2.77^{c}	3.16^{a}	2.99^{ab}	2.81^{c}	2.89^{b}	2.96^{b}	2.85^{c}	3.11^{a}	3.37^{a}	3.01^{a}	3.42^{a}	2.15
Feed cost (N/kg)	22.4	20.9	20.5	19.8	21.0	20.6	19.9	21.1	20.8	20.2	20.9	20.4	19.6	-
Cost/kg egg (N)	64.9^{a}	59.9^{c}	56.9^{c}	62.8^{b}	62.8^{b}	58.0^{c}	57.7^{c}	62.4^{b}	59.4^{c}	62.9^{b}	70.6^{a}	61.5^{b}	67.1^{a}	1.9

$^{a,b,c,d,e,f \text{ and } g}$ Means bearing identical or no superscripts within rows are similar (P>0.01) while those with unidentical superscripts differ (P<0.01)significantly.
[1]As in Table 1. Values in parenthesis represent level of CPM as a replacement for maize in the various diets

by variety of cassava, soil conditions and rainfall distribution (Osei and Twumasi, 1989), processing method does not seem to influence the chemical composition of the peel meals (Salami, 2000). According to Eshiett and Ademosun (1981) and Salami (2000), oven dried cassava peel meal (OCPM) and parboiled cassava peel meals (PCPM) contain 5.98 versus 5.31% crude protein, 9.3 versus 12.30% crude fibre, 0.65 versus 1.13% ether extract, 65.87 versus 63.29% nitrogen-free extract and 7 versus 9.88% total ash respectively while the metabolizable energy (ME) of OCPM was reported to be 2044.8Kcal/Kg (Eshiett and Ademosun, 1981).

Unlike sun drying and ensiling/fermentation, there is apparent paucity of information on the use of parboiling and retting for processing fresh cassava peels. This trial therefore evaluates cassava peel meal (CPM) processed by ensiling (ECPM), retting (RCPM), parboiling (PCPM) and sun drying (SCPM) as substitutes for maize in the diets for laying chickens during 56 to 72 weeks of age with a view to reducing feed cost per unit of egg output.

Materials and Methods

Source and production of CPMs: Fresh cassava peels of bitter and sweet varieties were collected in batches at a site of a local cassava-processing factory. Each batch of collection was divided into four portions, which were differently processed, by sun drying, retting or soaking, parboiling and ensiling. For the production of sun-dried cassava peel meal (SCPM), fresh raw cassava peels were spread on a clean concrete slab to sundry for 3 to 5 days. The retted cassava peel meal (RCPM) was produced by soaking peels in cold water inside a closed metal drum for 5 days after which it was removed from the sticky water and drained with a basket and followed by sun-drying for 3 to 5 days. The third portion of the cassava peels was processed by heating water to boiling point (100 °C) in a closed metal drum followed by immersion of the peels in the boiled water and source of heat (burning firewood) was removed immediately. The peels were left in the boiled water inside the closed metal drum to cool for 12 hours. After cooling, the peels were removed and drained in a basket followed by sun drying for 3 to 5 days to produce parboiled cassava peel meal (PCPM). The last portion of the peels was used to produce ensiled cassava peel meal (ECPM) by putting the peels in closed polythene bags, covered with nylon sheet and left in the open space for 5 days after which it was sun dried. The peels processed by these methods were separately hammer-milled and stored in polythene bags until needed. Although the fresh cassava peels were collected free of charge, some expenditure was incurred on transportation, processing and milling in the preparation of the cassava peel meals used in the formulation of experimental diets (Table 1).

Diets and management of birds: Thirteen experimental diets were formulated. Diet A contained no cassava peel meal (CPM) but maize at 40% of the diet and served as control. The proportion of maize in diet A was gradually replaced at 50, 75 and 100% levels with the four processed CPM (Table 1). Diets B, C and D contained 50, 75 and 100% ECPM respectively. Diets E, F and G contained 50, 75 and 100%RCPM respectively while diets H, I and J had 50, 75 and 100% PCPM respectively. 50, 75 and 100%SCPM replaced the maize in the last batch of diets K, L and M respectively. Two hundred and sixty, 56 weeks-old Isa Brown layers were divided on equal weight basis into 26 groups of ten birds with two replicates fed per test diet each. The birds had been previously raised in the cage and fed on a pre-test diet. The Californian type battery cage placed in an open-sided poultry house was used to accommodate the experimental birds. The ten birds per replicate of each test diet were housed in one's or two's in a row or column of six equidimensional cage compartments. Each compartment measured 30x38x48cm for breath, length and height respectively. The birds were offered feed and water on an ad libitum basis. The birds were dewormed occasionally with wormazine and protected from coccidial and bacterial infections using furazolidone pure and neocloxin respectively.

Experimental Schedule and Data collection: The experiment was carried out for 112 days concurrently. The experimental period was divided into 4 periods of 28 days each. At the end of each 28-days period, the mean body weight, mean daily feed intake and mean hen-day egg production of birds per replicate were computed. During the last 3 days of each observation period, 10 eggs were randomly sampled from each replicate for the measurement of egg weight. Triple beam balance was used to weigh the sampled eggs from each replicate and the mean egg weight calculated. The mean daily feed intake and egg weight was used to determine feed conversion ratio. The market prices of feed ingredients used for the test diets at the time of the experiment were used to calculate the cost of producing an egg. Production costs of the processed cassava peel meals were determined with respect to the sum of expenditures incurred in the respective processing methods used. The data obtained on the parameters studied were subjected to analysis of variance (ANOVA) and Duncan's Multiple Range Test (Steel and Torrie, 1980) used to compare the treatment means.

Results and Discussion

The effects of replacement of maize with CPMs on performance and economics of egg production of layers from 56 to 72 weeks of age are presented in Table 2. Irrespective of the inclusion rates, the birds on RCPM-substituted diets consistently maintained their initial body weight, as the control while birds fed other CPMS beyond 50% inclusion levels in their diets were unable to maintain initial body weight up to 72 weeks of age. The latter group of birds had highly significant (P<0.01) loss in their final body weights. This indicated that they could not tolerate ECPM, PCPM and SCPM beyond 50% replacement level at the expense of dietary maize. This is in accordance with the findings of Eruvbetine (1996); Esonu and Udedibie (1993) and Salami (2000) that replacement levels beyond 50% of maize in the diets of grower cockerels, weaner rabbits and layers respectively may lead to reduction in weight gain.

Layers on CD recorded a higher feed consumption than those on the processed CPM diets with a further decline in consumption towards the increase in level of CPM irrespective of the processing method employed. This was apposite to the findings of Ijaiya *et al.* (2002) who recorded higher intake with increasing levels of fermented CPM (up to 30%) in rabbit diets. The observation tallies with those of Osei and Duodu (1988) and Odunsi *et al.* (2001) that CPM increased intake when fed at levels between 0-30% replacement of maize in broiler and layer diets. The relationship between voluntary feed intake and caloric content of animal diets is that animals eat more of a low-energy diet than a high-energy diet in an attempt to cancel out energy deficit (Ojewola and Longe, 1999). Therefore, the birds on processed CPM diets were expected to consume more, but this was not observed. It is, thus, evident that the birds showed aversion to CPMs especially at the higher inclusion levels in their diets as previously reported by Salami (1999 and 2000).

Treatment diets had significant (P<0.01) effect on mean hen-day production. Layers fed CD, 50%ECPM, 50%PCPM and 75%RCPM had similar (P>0.01) hen-day production, which were significantly (P<0.01) superior to those of other diets. This observation indicated that layers could tolerate 50 and 75% replacement levels of ECPM, PCPM and RCPM respectively for maize without adverse effect on hen-day production and the values reported were comparatively better than those by Salami (2000). It is noteworthy that layers on sun dried CPM had the worst egg production irrespective of inclusion level among the processed CPMs.

The mean egg weights across the treatment diets were similar at 56 weeks of age. However, at 72 weeks of age, birds fed diets with 75%SCPM, 100%ECPM and 100%SCPM gave the least (P<0.01) egg weight compared with birds fed other diets. Egg weight increases with the age of birds (Adegbola and Olatoke, 1988). Egg size on all dietary treatments increased with age with the exception of those produced on 50%SCPM and 75%ECPM. This shows that inclusion of SCPM and ECPM at the expense of dietary maize at 50% and beyond would not permit increase in egg size with advancing age of the birds. Egg weight at 72 weeks of age ranged from 61.0g (100%SCPM) to 66.9g (75%PCPM) thereby indicating that the eggs were bigger than those laid by the younger birds in the study reported by Eshiett and Ademosun (1981). However, the egg size (66g) at the safe substitution level of PCPM (50%) for maize at 70 weeks of age as observed by Salami (2000) is similar to the egg size of 67g in the present study for diet containing 100%RCPM at 72 weeks of age.

The feed conversion ratio showed a slight improvement with the use of CPM. However, layers on 100%ECPM, 100%PCPM and those on SCPM had a worsened feed conversion compared to the CD. Ijaiya *et al.* (2002) observed that a high dietary crude fibre level due to CPM reduced feed conversion efficiency. Earlier, Oke *et al.* (1986) noted that the decreases in feed efficiency as the percentage of CPM increased was attributed to the dusty and powdery nature of CPM, which prompted the use of underutilized fats by Odunsi *et al.* (2001).

The CPM based diets were cheaper to produce than CD, and this reflected on the lower cost of feed consumed per kg egg produced. Only the sun dried peels had higher values at 50 and 100% of maize replacement. The differences in cost of feed required per egg produced between the CD and the overall average costs for ECPM, RCPM, PCPM and SCPM are N5, N5.4, N3.3 and-N1.5 respectively. These indicated that significant savings were achieved with the use of processed CPM in terminal layer diets with the exception of the sun dried peels. This reduction agrees with previous studies (Salami, 2000; Odunsi *et al.*, 2001). Thus, the use of CPMs (especially RCPM) should be encouraged not only to reduce dependence on maize, but also to reduce cost of feed for table egg production. A higher terminal body weight was also maintained with retted CPM. The preliminary findings indicated that processing of cassava peels by retting possibly reduces more of the cyanide which, could be due to the twin processes of fermentation and leaching of cyanide (IITA, 1990) in the water -soaked peels prior to sun drying unlike the other processing methods.

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