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Substitution of Maize with Cassava and Sweet Potato Meal as the Energy Source in the Rations of Layer Birds

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ABSTRAK

Tiga ratus enam puluh ayam telur (berusia 36 minggu - Isa Brown) diberi makanan berasakan jagung. Semasa 12 minggu tempoh percubaan, ubi keledek dan ubi kayu menggantikan jagung sebagai makanan asas. Pengeluaran telur ayam pada siang hari signifikan (P<0.05) merosot melalui makanan ubi kayu sementara burung-burung yang diberi makanan jagung dan ubi keledek tidak signifikan antara satu sama lain dalam pengeluaran telur ayam hari siang. Makanan ubi kayu secara signifikan mengurangkan (P<0.05) pengambilan tenaga metabolisme dan tiada perbezaan signifikan dalam pengambilan protein mentah oleh burung-burung yang memakan ubi keledek dan ubi kayu. Walau bagaimanapun penggantian jagung kepada ubi keledek dan ubi kayu meninggalkan kesan signifikan terhadap saiz telur, berat, pengambilan makanna, ketebalan kulit, unit Haugh. telur dozen/makanan atau telur kg/makanan (p<0.05). Makanan kawalan jagung adalah lebih baik (p<0.05) dalam mecerna protein mentah sementara ketercenaan tenaga merosot (p<0.05) dengan makanan ubi kayu.

ABSTRACT

Three hundred and sixty layer hens (36 weeks old Isa Brown) were fed a maize based diet in which sweet potato meal and cassava meal replaced maize in the basal diet during a 12-week trial period. Hen-day egg production was significantly (p<0.05) depressed by cassava meal while birds fed diets with maize and sweet potato meal were not significantly different from each other in hen-day eeg production. Cassava meal significantly reduced (p<0.05) metabolizable energy intake while there was no significant difference in the crude protein intake of birds fed sweet potato and cassava meal. There was, however, no significant effect from replacing maize with sweet potato or cassava meal on egg, weight, feed intake, shell thickness, Haugh unit, feed/dozen eggs or feed/kg egg (p<0.05). The maize control diet was superior (P<0.05) in the digestibility of crude protein while energy digestibility was depressed (P<0.05) with the cassava diet.

INTRODUCTION

Going by the fundatemntasl role of energy in animal nutrition and the fact that it constitutes 35-60% of rations for different species and classes of livestock, the sustenance and expansion of the livestock industry, particularly in developing countries, depends to a large extent on the availability of the dietary energy source used in compounding concentrated rations for various classes of livestock. Its energy value is generally used as a standard of comparison for others.

Cassava constitutes a major staple food which is widely cultivated in the lowland humid tropics. Hence, its use as a replacement for maize in animal feed has been advocated. However, it contains a cyanogenic glucoside, linamarin, which is toxic to animals. Studies with poultry and pigs have shown that performance declines progressively as the amount of cassava root meal is increased in the rations, unless such diets are supplemented with additional protein, methionine, lysine and oils (Job *et al.* 1980; Tewe 1982. Tewe (1981) showed that replacement of 30% of maize with sundried cassava peel does not reduce egg production.

The cultivation and use of sweet potato as a replacement for maize in livestock rations has also been advocated in the tropics because there is less competition for this tuber than cassava. Sweet potato is a good source of carbohydrate for livestock, being highly digestible and soluble (Oyenuga and Fetuga 1975). However, it contains some anti-nutritional factors (tannins, phytins, oxalates, etc) which may affect nutrient utilization. Its use in poultry rations has shown that performance is depressed at levels of inclusion above 10% for broilers and 30% for growers (Job *et al.* 1978; Tewe 1984).

This study was carried out to assess the relative feeding values of cassava and sweet potato meal as a replacement for maize in the diet of layer birds.

MATERIALS AND METHODS

Diets

The proximate composition and gross energy of feed ingredients are presented in Table 1 while Table 2 shows the composition and chemical analysis of the diets. Maize in diet 1 was replaced by sundried sweet potato meal and cassava meal in diets 2 and 3, respectively. The unpeeled cassava and sweet potato tubers were chopped and sundried for five days in the dry month of January before grinding.

Animals

A total of 360 36-week-old Isa Brown birds was allotted to three experimental diets. They were housed in pairs in laying cages in an open-sided poultry house and fed the experimental diets shown in Table 2. There were three treatment, each with three replicates of forty birds. The experimental diets and water were supplied *ad libitum* during the trial period of 12 weeks. Data were collected on daily feed intake and egg production, while egg weight measured twice each week was calculated individually to the nearest 0.01 g using a sensitive electronic balance.

Individual eggs were broken on a flat glass plate. Height of the thick albumen was measured, to the nearest 0.01 mm, using a tripod micrometer. Haugh units of individual eggs were later calculated using the formula of Haugh. Shell thickness was measured at the blunt and pointed ends as well as the middle using a micrometer screw gauge. Mean of the three values was taken as shell thickness per egg. Feed efficiency was measured in terms of kg feed/dozen eggs or kg feed/kg egg while the egg size was estimated by the oblong and horizontal circumferences. The circumference was measured using a thin thread and thereafter measuring such lengths along a graduated ruler in centimetres.

A nutrient retention trial was carried out after the birds had been on the diet for two weeks. Hence the two weeks formed the preliminary adjustment period prior to fecal collection. Weighed quantities of feed were supplied and excreta samples collected in weighed aluminium foil spread under the cages during a 72-hour period, using the total collection procedure. Excreta samples were oven dried at 70°C, weighed and ground prior to chemical analysis.

Chemical Analysis

Ingredients, feed and excreta samples were subjected to chemical analysis using the methods of AOAC (1990). Nitrogen was determined using the Kjeldahl procedure while fat was determined by petroleum ether (bp 40-60°C) extraction in a soxhlet apparatus. Gross energy values were determined using the ballistic bomb calorimetre while the hydrocyamic acid contents of the unpeeled cassava were determined using the modification of an earlier established method (Tewe 1975).

TABLE 1
Chemical composition of feed ingredients (%)

Ingredients	DM	CP	Ash	EE	CF	NFE	ME Kcal/g
Maize	91.80	7.40	1.85	4.41	1.32	85.03	3.40
Sweet potato meal	90.86	5.54	7.33	2.31	3.82	81.00	3.20
Cassava meal	90.00	3.50	3.80	0.80	4.20	87.70	3.10
Fish meal	93.45	61.18	2.74	19.34	0.35	15.89	2.80
Groundnut meal	91.85	42.20	6.69	12.00	4.76	31.35	2.50
Dried brewer's grains	92.00	20.00	4.20	6.00	18.00	51.80	2.00

DM = dry matter; CP = crude protein; CF = crude fibre; EE = ether extract; ME = metabolizable energy

TABLE 2
Composition of experimental diets (%)

Ingredients	Diets 1	2	3
Maize	52.3	-	-
Dried cassava meal	-	-	52.3
Dried sweet potato meal	-	52.3	-
Groundnut meal	17.5	17.5	17.5
Fishmeal	5.0	5.0	5.0
Dried brewer's grains	15.1	15.1	15.1
Oyster shell	7.2	7.2	7.2
Bonemeal	2.4	2.4	2.4
Salt	0.25	0.25	0.25
Min-Vit premix*	0.25	0.25	0.25
Total	100.00	100.00	100.00
Chemical analysis (dry matter) basis			
Crude protein	17.86	16.85	15.85
Crude fibre	4.50	5.72	5.98
Ether extract	6.33	5.25	4.11
Calculated			
ME (Kcal/g)	2.66	2.55	2.50
ME/CP ratio	148.94	151.34	157.73

* Supplied per kg diet: Vit. A, 15,000 i.u.; Vit D_3, 2,000 i.u; Vit. E, 25 mg; riboflavin, 3 mg; Vit B_{12}, 0.01 mg; Vit. K, 2.0 mg; niacin, 20 mg; choline chloride, 500 mg; folic acid, 0.25 mg; Co, 0.25 mg; I, 1.0 mg; Cu, 1.0 mg; Fe, 10 mg; Zn, 30 mg; Mn, 50 mg

Statistical Analysis

Data collected were subjected to analysis of variance using the methods of Steel and Torrie (1980). Where significant differences were observed, treatment means were further subjected to Duncan's multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

Performance and egg quality characteristics of the birds are summarized in Table 3. Hen-day egg production was significantly (P<0.05) depressed by cassava meal while birds fed diets with maize and sweet potato meal were not significantly (P<0.05) different from each other in hen-day egg production. This reflects more on the composition of the diets in terms of adequacy of dietary crude protein and metabolizable energy. As earlier reported for pigs by Tewe and Maner (1980), it appears in this study that dietary crude protein and amino acid balance, but not cyanide, were the major factors of concern in the feed intake and thereby affecting the egg production. The value of total hydrocyanic acid content of the cassava diet was 10.24 ppm while Tewe *et al.* (1987) showed that dietary cyanide up to 117.3 ppm did not play any appreciable role in performance and carcass traits of pigs. The results of this present study are also in line with the findings of Job *et al* (1978; 1980) and Tewe (1984).

Egg size, measured by oblong and horizontal circumferences, was not significant (P<0.05). Egg weight, Haugh unit, kg feed/dozen eggs, kg feed/kg egg, energy intake, protein intake and shell thickness were not significantly (P<0.05) influenced by the dietary treatment although birds on the maize diet had higher protein and energy intake.

The egg weight and shell thickness fell within the range reported by Oluyemi and Roberts (1979). Efficiency of conversion of feed to eggs expressed either in kg of feed per dozen eggs or ratio of kg of feed to kg of egg was not significantly different (P<0.05) in the three diets.

The better digestibility of the maize diet may be due to the differences in crude fibre of the diets. As fibre increases, the content of starch and other readily available carbohdyrates

TABLE 3
Performance characteristics of layers fed maize, cassava or sweet potato-based diets

Parameters	1	2	3	SEM[1]
Average hen-day production (%)	88.61[a]	80.27[ab]	75.71[b]	0.94
Feed intake/bird/day (gm)	110.0	108.0	108.4	1.90
ME intake/bird/day (Kcal/g)	292.6[a]	277.95[b]	273.5[b]	0.64
Crude protein intake/ bird/day (gm)	19.65[a]	18.20[ab]	17.18b	0.80
Feed/dozen eggs (kg)	2.10	2.15	2.25	0.04
Feed/kg egg (kg)	1.84	1.94	1.85	0.06
Average egg oblong circumference (cm)	15.98	16.12	16.25	0.33
Average egg horizontol circumference (cm)	13.72	13.90	13.27	0.29
Average egg weight (gm)	58.95	56.16	59.18	0.24
Average shell thickness (mm)	0.35	0.35	0.35	0.34
Haugh unit	71.1	71.3	70.2	0.33
DM digestibility(%)	73.1	72.3	70.9	0.54
Energy digestibility (%)	80.5	78.1	74.1[b]	0.05
Crude protein digestibility	81.6	76.4[b]	73.5[b]	0.33

[1]SEM = Standard error of mean
[ab] Means in the same row with the same superscripts are not significantly different (P<0.05)

decreases (Tewe 1988). In addition, cassava and sweet potato both contain antinutritional factors which may affect digestibility. The digestibility of protein has been shown to be adversely affected by the presence of crude fibre (Sauer *et al.* 1980; Clandinin *et al.* 1981) and tannin (Clandinin and Heard 1968). Also, the physical nature of sweet potato and cassava meals, being rather powdery, might have affected their utilization (Fashina-Bombata and Fanimo 1994). Efforts should therefore be made to improve the physical nature of sweet potato and cassava meal to enhance intake and utilization.

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