EFFECTS OF GRADED LEVELS OF MAIZE OFFAL ON NUTRIENT DIGESTIBILITY AND MINERAL AVAILABILITY IN DIETS OF LAYING HENS

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ABSTRACT

Effects of diatary levels of maize offal (MO) (0, 10, 20, 30, 40, and 50%) on nutrient digestibility and mineral availability were investigated with 32 - week old laying hens. Apparent dry matter, crude protein and crude fibre digestibilities compared very favourably (P > 0.05) in all dietary treatments. Apparent availability of calcium, magnesium, manganese, copper and iron was significantly (P < .05) depressed as levels of MO increased in the diets. Phosphorus availability insignificantly increased with increasing levels of MO but that of potassium, sodium and zinc was relatively stable in all dietary treatments.

Key words: Maize offal, nutrient digestibility, mineral availability.

INTRODUCTION

Information on the use of MO in poultry rations as it affects nutrient digestibility and mineral availability are scarce, however, research efforts have been made on related fibrous agro-industrial by-products. South gate and Durnin (1970) reported that as intake of dietary fibre in creased, apparent digestibility of other constituents of the diet decreased. In a similar report, Nwokolo *et al* (1985) noted that as dietary fibre increased in the diets of chicks, apparent dry matter digestibility decreased. The abrasive nature of fibre and greater volume of ingesta could have caused an increase in metabolic nitrogen excretion (Hedge *et al* 1978).

Several workers (Reinhold *et al.* 1976; Calvert *et al.* 1978; Hunter, 1981 and Ann-Sofie *et al* 1982) had implicated crude fibre an a factor depressing mineral availability in feedstuffs. Nwokolo and Bragg (1977) studied the influence of phytic acid and crude fibre on availability of calcium, copper, magnesium, phosphorus and zinc in diets of growing chicks and observed a significant inverse relationship between the tested minerals and both phytic acid and crude fibre. Using different fibre sources, Nwokolo *et al.* (1985) noted that increasing dietary levels of rice hull or wheat bran caused corresponding dereaseses in availability of calcium, magnesium, copper, zinc; and phosphorus only at 45% inclusion. The fibre itself may reduce trace mineral retention by binding the minerals to the matrix (Ismail-Beigi *et al.* 1977).

The experiment was conducted to evaluate the influence of MO, which is presently gaining recognision in Nigeria as a major dietary component in poultry rations, on nutrient digestibility and mineral availability to laying hens.

MATERIALS AND METHODS

Two hundred and sixteen laying hens of Hubbard strain, 32 weeks of age at the start of the study were maintained in battery cages for 8 weeks. MO was obtained from Ladokun Feeds, Ibadan.

The hens were randomly alloted into six dietary experiments (containing three- replicates each) with thirty six hens per treatment. Varying levels (0, 10, 20, 30, 40, and 50%) of MO replaced yellow maize as indicated in Table 1. On the 8th week of experimental feeding, a total of fifty four hens were randomly selected from the two hundred and sixteen hens, involving nine hens per treatment (3 x 3)); then transferred to metabolic cages. They were housed individually in stainless steel cages with separate feed and water troughs made of aluminium. While water was

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TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS.

Ingredients	DIETS 1	2	3	4	5	6
Yellow Maize	54.0	44.0	34.0	24.0	14.0	4.0
Groundnut cake	22.0	22.0	22.0	22.0	22.0	22.0
Fish meal	1.5	1.5	1.5	1.5	1.5	1.5
Rice bran	11.9	11.9	11.9	11.9	11.9	11.9
Maize offal		10.0	20.0	30.0	40.0	50.0
Bone meal	6.0	6.0	6.0	6.0	6.0	6.0
Oyster shell	4.0	4.0	4.0	4.0	4.0	4.0
Common salt	0.5	0.5	0.5	0.5	0.5	0.5
Vitamin-mineral Premix*	0.1	0.1	0.1	0.1	0.1	0.1

*Composition per kg (Uni - Vit. 15, Roche) of diet. Vitamin A, 8,000 iu; D3, 1,500 iu; E, 3.0iu; K, 3.0mg; B2, 2.5mg; B6, 0.3mg; nicotinic acid, 8.0mg; calcium pantothenate, 3.0mg; B12, 8.0g/tonne; iron, 5.o mg; manganese, 10.0mg; copper, 0.2mg; zinc, 4.5mh; iodine, 0.15mg; cobalt, 0.02mg; seleniuum, 0.01mg.

TABLE 2. ANALYSED COMPOSITION OF DIETS AND MAIZE OFFAL (% D.M)

Nutrients	DIETS 1	2	3	4	5	6	MO
Dry matter (%)	90.18	90.25	90.42	91.09	90.84	691.84	89.7
Crude Protein (%)	16.89	17.14	16.98	17.01	17.12	17.22	9.5
Crude fibre (%)	5.83	6.19	6.65	6.99	7.47	7.98	6.2
Phytic acid (%)	-	-	-	-	-	-	0.082

- Not determined.

given *ad libritum*, feeds offered were as predetermined.

Metabolism trial comprised of a one-week preliminary feeding followed by a one-week faecal collection. Daily faecal output for each hen was collected and stored in deep freezer (-18°) until end of the collection period; then bulked together, dried in an air-draught oven (at 85°C for 72h) and weighed. Dried faecal, feed and MO samples were grounded and analysed for their proximate constituents (A.O.A.C. 1975). Sample of MO was dtermined for its phytic acid content using the method of Wheeler and Ferrel (1971). Samples of diets and faecal output were analysed for calcium, magnesium, potassium, sodium, manganese, iron, copper and zinc using atomic absorption spectrophotometry. Phosphorus was determined colorimetrically according to standard procedure (A.O.AC 1975).

All data were analysed statistically using analysis of variance (Stell and Torrie, 1960). Differences between means were determined by multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The effect of MO on apparent dry matter, crude protein and crude fibre disgestibilities is presented in Table 3. Increasing levels of MO insignificantly and inconsistenly depressed dry matter digestibility. Crude protein digestibility was not affected ($P > 0.05$) while that of crude

TABLE 3. EFFECT OF VARYING LEVELS OF MAIZE OFFAL ON NUTRIENT DIGESTIBILITY (%)

Nutrients	DIETS						S. E.
	1	2	3	4	5	6	
AV. dry matter	85.54	80.89	81.63	80.73	81.44	78.52	0.89 NS
AV. Crude Protein	80.64	79.03	81.16	79.42	82.44	81.46	0.58 NS
AV. Crude fibre	22.54	22.62	23.17	23.08	23.14	23.40	0.42 NS

S.E. = Standard error of estiminate; N.S. = Nonsignificant difference.

fibre inconsistently improved ($P < 0.05$) with increasing levels of MO. The relatively low level of crude fibre content (6.2%) of the test material (MO) must have been responsible for the contrary observations reported in this study as against ealier reports (Southgata and Durnin, 1970; Hedge *et al.*, 1978 and Nwokolo *et al.*, 1985).

Result of mineral contents of the diets is shown in Table 4. There was an increase in phosphorus, magnesium and potassium content and a decrease in calcium and iron content with increasing levels of MO in the diets. Sodium, manganese, copper and zinc contents were relatively stable. The increases or decreases of the levels of test minerals were indicative of the levels of these minerals in MO. In fact, grains are generally reputable for high content of phosphorus, fair sources of mangnesium and potassium but poor sources of calcium.

The influence of MO on apparent availability of the tested minerals is presented in Table 5. Increasing dietary levels of MO exerted a depressive effect (P 0.05) on apparent availability of five of the test minerals (calcium and magnesium at 20% MO, manganese at 40 and 50% MO, copper at 30% MO and iron at 10% MO) Phosphorus availability insignificantly increased with increasing dietary MO except at treatment 6 where it became depressed ($P > 0.05$). Availability of potassium, sodium and zinc remained unaffected ($P > 0.05$).

The depressive action of fibre sources on mineral availability has been ascribed to several mechanisms (Partridge 1978, and Ismail-Beigi *et al.* 1977), however, selective sequestering looked more likely in this study since all the minerals

TABLE 4. MINERAL CONTENTS OF THE DIETS CONTAINING GRADED LEVELS OF MAIZE OFFAL

Minerals	DIETS					
	1	2	3	4	5	6
Phosphorus (%)	0.94	0.95	0.99	1.20	1.17	1.33
Calcium (%)	3.14	3.13	3.09	3.06	3.06	3.03
Magnesium(%)	0.21	0.24	0.25	0.27	0.29	0.30
Potassuim (%)	0.55	0.59	0.63	0.63	0.66	0.69
Sodium (%)	0.21	0.20	0.20	0.21	0.19	0.21
Manganese (ppm)	55.0	53. 0	54.0	52.0	54.0	54.0
Copper (ppm)	14.0	15. 0	14.0	15.0	14.0	14.0
Iron (ppm)	751.0	708. 0	668.0	690.0	670.0	656.0
Zinc (ppm)	145.0	143. 0	146.0	147.0	145.0	146.0

TABLE 5: AVAILABILITY OF MINERALS IN DIETS CONTAINING GRADED LEVELS OF MAIZE OFFAL (%)

Minerals	DIETS						S. E.
	1	2	3	4	5	6	
Phosphorus	85.4	87.6	87.7	88.2	87.8	83.6	0.82 NS
Calcium	84.1[a]	78.8[a]	72.3[b]	66.0[b]	63.4[c]	60.6[c]	4.13*
Magnesium	78.7[a]	76.8[a]	66.8[b]	66.1[b]	65.5[b]	59.9[b]	3.25*
Potassium	81.6	80.4	78.1	78.0	79.9	79.0	0.63 NS
Sodium	86.5	86.1	84.6	86.7	80.4	82.0	1.18 NS
Manganese	89.4[a]	83.8[a]	87.8[a]	84.5[a]	71.1[b]	71.2[b]	3.65*
Copper	78.5[a]	74.0[a]	72.6[a]	68.3[b]	58.6[c]	60.5[c]	3.52*
Iron	82.8[a]	70.0[b]	66.7[b]	60.5[c]	55.0[c]	46.5[c]	5.65*
Zinc	83.8	84.5	78.6	81.8	78.8	79.6	1.35 NS

NS = Nonsiggnificant difference

* = Means with different superscripts in the same row are significantly different ($P < 0.05$).

were not equally affected. This mechanism is again supported by the fact that phytic acid content (0.082%) of the MO, another agent know to tie down mineral availability, is low and inconsequential. Although, the present findings are in agreement with those of Nwokolo and Bragg (1970) and Nwokolo *et al* (1985) on calcium, copper, iron, magnesium and phosphorus availability, the study did not indicate similar significant sequestering of zinc. The disparity is probably due to low phytic acid and crude fibre content of the MO, the two experimental samples used by the authors. This study is also in contrast with observations of Ann-Sofie *et al.* (1982) who reported a significant decrease on availability of zinc by wheat bran but apparent absorption of iron increased with increasing levels of fibre; calcium and magnesium were observed to be constant. the contradictory observations, again, may be attributable to the different sources of fibre used by the latter authors.

Finally, results of this work showed that inclusion of MO in the diets of laying hens has no deleterious effects on nutrient digestibility, however, apparent availability of some minerals was significantly ($P < 0.05$) depressed. Interestingly, our earlier work (Uko *et al.*, 1990) indicated that the performance of laying hens was not grossly decreased by MO once the conventional levels of the affected minneral sources are incorporated into the diets.

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