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Effect of graded levels of maize cob meal as replacement for dietary maize on the carcass characteristics of growing rabbits

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Target Audience*:* Animal Scientist, Feed Millers, Farmers

Abstract

A 12 week feeding trial was conducted with thirty (30) weaner rabbits with average weight of 355.00g of mixed breed (New Zealand X American Chinchilla) and mixed sexes to investigate the effect of maize cob meal (MCM) on carcass characteristics. Thirty mixed breed rabbits were used and randomly assigned to treatments T1, T2, T3, T4 and T5 in which MCM replaced maize at 0, 5, 10, 15 and 20% weight for weights respectively at the rate of six (6) rabbits per dietary treatment. Results obtained showed that MCM contained ME of 2104kcal, CP of 3.0%, cellulose of 34%, NDF of 70.63%, C of 44%. Significant difference was observed on carcass yield, internal organs and gastrointestinal tract characteristics. Dressing percentage values ranged from 54.05 to 62.44%. It was concluded that maize cob meal can replace maize in growing rabbit diet up to 10% without adverse effect on the carcass characteristics.

Key words: Carcass; Maize Cob Meal; Rabbit

Description of Problem

The rising prices of livestock feeds especially in Nigeria and the scarcity of conventional proteins and energy concentrates for the formulation of feeds have forced the animal scientists in Nigeria to search for attractive, cheaper and readily available protein and energy sources. These efforts have produced accumulating evidence that alternatives such as palm kernel cake, bambara groundnut meal, pigeon pea meal, mango seed kernel meal, rubber seed meal and maize cob meal, can be used for feeding livestock, especially poultry, pigs and rabbits with encouraging results.

Maize is a major energy feed ingredient, like other cereals, it is in short supply, leading to very high prices at certain periods of the year (1). To reduce the cost of feeding livestock, which competes directly with human beings for the same feedstuffs, attempts have been made to use alternative sources of protein and energy. These have mostly been of agro-industrial by-products origin which is not directly utilizable by man. A possible potential benefit is dietary inclusion of maize cobs a widely available crop residue that is abundant in the tropical areas of the world, when treated and used in rabbits feeding, it could improve the quality of their carcasses (2). However, in some situation where there may exist readily available high energy feed ingredients, it may be posible to replace part of the maize used in practical type rabbit diet with maize cobs meal.

Maize cobs are a highly fibrous product with many agricultural and industrial

applications. In agriculture, they are used for fuel, litter for poultry and other animals, mulch and soil conditioner, and as fodder for ruminants. Their absorbency and abrasiveness makes them useful for several industrial applications. They are used for the production of chemicals such as furfural or the sugar replacement xylitol. Maize cobs are used to blast and polish many materials, from jewelry, nuts and bolts, to golf club heads. Maize cob was reported to be a potential cheap and promising source for sustainable energy production (3). Maize cobs meal could be considered as a valuable source of relatively digestible fibres (4,5), but this must be employed with caution because of the very high risk of contamination by mycotoxins.

Rabbit production has a considerable potential in the developing countries for the supply of the much needed animal protein due to the low capital investment and space requirements, short generation interval, rapid growth rate, high reproductive potential and ability to utilize the abundant forages and fibrous agricultural by- products (6,7 and 8). In spite of these advantages, rabbit production has not received the desired attention in the tropics. Productivity is usually 50% or less of what is typical in the temperate countries (6).

One of possible solutions to the increasing shortage of meat production problem is by using small ruminant and pseudo-ruminant species, as rabbits (9). Furthermore, rabbit meat is considered an important protein source to human due to the higher quality and lower fat content. It was therefore the aim of the study to investigate the carcass characteristics of growing rabbits using corn cob meal.

Materials and Methods

Experimental site

The experiment was carried out at the Rabbits Unit of the Livestock Teaching and Research Farm of the Federal University of Agriculture Makurdi, Benue State, Nigeria. Makurdi lies within the Guinea Savannah zone and located at latitude 07º 41'N, 08º 37'E Southern Guinea Savannah with a climate that has two distinct seasons. The wet season starts in April and ends in October while the dry season starts from November through March. High temperature is experienced between February and April, while harmattan with cool chilly weather is experienced from December to early February. Annual temperature ranges between 21ºC in January and 35ºC in March, with an annual rainfall of 1500mm-1800mm. Relative humidity ranges between 69% in August/ September and 39% in January (10).

Source of maize cob meal

Maize cobs meal were sourced from the local farmers in Ikom LGA of Cross River State. The cobs were dried in the sun for about 6 days to reduce its moisture content to about 10%. After which the cobs were ground in a heavy-duty high rotation harmer mill to obtain a suitable sieve sizes of 3mm on average particle, for chemical analysis and feed formulation.

Experimental diets

Five experimental diets were formulated such that maize cob meal was included at 0, 5, 10, 15, and 20% levels in diets T1, T2, T3, T4 and T5, repectively replacing dietary maize weight for weight. Five experimental diets were formulated as shown in Table 1.

Table 1: Ingredients and nutrient composition of experimental diets (%)

Ingredients	T_1 (0% control)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)
Maize	43.72	38.72	33.72	28.72	23.72
Maize cob meal	0.00	5.00	10.00	15.00	20.00
Rice Offal	21.80	21.80	21.80	21.80	21.80
Full Fat Soybean	19.54	19.54	19.54	19.54	19.54
Groundnut cake	9.74	9.74	9.74	9.74	9.74
Palm Oil	2.50	2.50	2.50	2.50	2.50
Bone ash	2.00	2.00	2.00	2.00	2.00
Vit./Mineral Premix*	0.25	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated nutrients					
Crude protein	17.01	16.72	16.45	16.13	15.90
Crude Fibre	10.18	10.90	11.80	12.53	13.49
ME (Kcal/kg)	2884.64	2815.09	2745.54	2675.99	2606.44
Calcium	0.85	0.86	0.87	0.87	0.88
Phosphorus	0.59	0.54	0.59	0.60	0.60
Methionine	0.25	0.24	0.23	0.22	0.21
Lysine	0.78	0.77	0.76	0.75	0.73

Each 0.25 kg of vitamin/mineral premix manufactured by BEAUTS Co. Inc. Man, U.S.A., contains Vitamin A 5500, Vitamin D 16,500, Vitamin E 11, 3.5; Vitamin K 22 mg; Vitamin B 3; 0.19 mg; Niacin 280.5 mg, Calcium 6.75%, Phosphorus 2.5%, Iron 0.15%, Zinc 0.0875%, manganese 0.0625%, Copper 0.015%; Iodine 0.0005%, Cobalt 6.5 ppm, Selenium 1ppm, ME = Metabolizable Energy

Metabolizable Energy of the maize cobs was calculated according to the formula of (11). That is, ME = (37 x %CP + 81 X %EE + 35.5 X %NFE) Kcal/kg

Where ME = Metabolizable Energy, CP = Crude protein, EE = Ether extract, NFE = Nitrogen free extract

Design and Management of experimental animals

A total of thirty (30) weaned rabbits of average age of seven (7) weeks, with average weight of 355.00g of mixed breed (New Zealand X American Chinchilla) and mixed sexes were used for the experiment, they were obtained from a local farmer in Ibadan. The rabbits on arrival were allowed to acclimatize for 7 days and maintained on a commercial diet. They were then weighed and randomly allocated to treatments. The rabbits were assigned to the five treatments and six (6) replicate in a completely randomized design (CRD) with one rabbit per replicate. They were then fed experimented diets daily for twelve (12) weeks. The rabbits were housed individually in wire mesh hutches measuring 60 x 40 x 40 cm and containing a feeder and a drinker. Each rabbit was inspected for good health. Standard health/sanitation procedures were strictly adhered to during the experiment.

Chemical analysis

The proximate analysis of maize cob meal and experimental diets was carried out according to (12). The characterization of the crude fibre of maize cob meal was done as

described by (13), while the elemental composition was carried out with the method of CHNSO (Carbon, Hydrogen, Nitrogen, Sulphur and Oxygen) as described by (14).

Carcass evaluation

At the end of the feeding trial, three rabbits per treatment, with live weight approximate their treatment mean live weight, were selected for slaughter and their carcasses were evaluated. The rabbits were starved for 18 hours before slaughter to reduce the volume of the gut contents and therefore reduce the risk of contamination of the carcass during dressing. Each rabbit was weighed and then slaughter by cutting transversely across the trachea, oesophagus, large carotid arteries and jugular veins with a sharp knife and allowing the rabbits to bleed to death under gravity. The carcasses were eviscerated and singed and weighed. The visceral organs namely; the heart, lung, kidney, liver, pancreas, intestines and spleen were carefully removed and weighed, the intestines were emptied before weighing. The carcass was cut into the traditional parts comprising the head, fore limb, loin and hind limb and weighed using an electronic balance. The weights of the carcass cuts were expressed as percentage of dressed weight and the visceral organs were expressed as percentage of the live weight, while the length of the following components of GIT: oesophagus, stomach, small intestine, caecum, and colon were expressed as percentage of the GIT length. The length of the carcass was also measured.

Statistical analysis

All data obtained were subjected to analysis of variance (ANOVA) using (15)

Results and Discussion

Proximate Composition of the test Ingredient-Maize Cob Meal (MCM)

The proximate composition of maize cob meal is shown on Table 2. The crude protein of 3% reported for maize cob meal was higher than the value 2.3% reported by (16), but it corresponds with the value reported by (17) of 3%. The CF level of 34% was not far from the value 35% obtain by (16), and that reported by (17) of 35%. The EE of 0.5% present in MCM was higher than that obtain (0.4%) by (16) and lower than that reported (0.6%) by (17). Ash content of 1.5% was the same as that reported by (17, 16). These differences could be attributed to variations in location and varieties, which are common factors that affect nutrients in feedstuff.

Table 2: Proximate composition of maize cobs meal and maize (%)

Constituents	MCM [1]	Maize[2]
Dry matter	92.00	86.00
Crude protein	3.00	9.00
Ether extract	0.50	4.00
Crude fibre	34.00	2.70
Ash	1.50	1.30
Nitrogen free extract	55.00	83.00
ME (kcal/kg)	2104	3432

[1]Laboratory analysis, [2] (16), ME = Metabolizable Energy obtained using the formula recommended by (11) i.e. ME = (37 x %CP) + (81.8 x %EE) + (35.5 x %NFE)

Characterization of crude fibre content of maize cob meal (MC M)

The characterization of crude fibre content of maize cob meal is shown in Table 3. The values obtained were; cellulose 34.70%, hemicelluloses 19.05%, ADL 6 - 88% where were different when compared to that reported by (18) that, MCM contain 45.6% cellulose, 39.8% hemicelluloses and 6.7% higher on dry basis and were also higher to values reported by (19) who found average values of 31.367% cellulose and 14.9% lignin, on the average for 35 hybrids of maize. These differences could also be attributed to varieties and location.

Table 3: Characterization of crude fibre content of maize cob meal

Constituents	Proportion (%)
Cellulose	34.70
Hemicellulose	19.05
Neutral detergent fibre (NDF)	70.63
Acid detergent fibre (ADF)	51.58
Acid detergent lignin (ADL)	16.88

Mean values of three (3) determinations

Elemental analysis of maize cob meal (MCM)

The elemental analysis of maize cob meal is shown in Table 4. The values obtained as carbon 44.0%, hydrogen 7.0%, oxygen 47.0% and nitrogen 0.4% showed a slight differences from the earlier report of (20) who reported carbon content of 48.4%, hydrogen 5.6%, nitrogen 0.3%, and oxygen 44.3%, on a moisture free basis and , (21) also reported similar values of carbon 46.58%, hydrogen 5.87 %, oxygen 45.46%, nitrogen 0.47%. These differences also may be attributed to varietal and location differences.

Table 4: Elemental analysis of maize cob meal

Elements	Proportion (%)
Carbon	44.00
Hydrogen	7.00
Oxygen	47.00
Nitrogen	0.40
Trace Elements	1.60

Mean values of three (3) determinations

Proximate composition of experimental diets

The proximate composition of experimental diets is shown in Table 5. The dry matter content range of 90.82-92.46% is in agreement with 90.00-93.27% reported by (22). The crude protein levels in the experimental diets were within the range of 16.00-18.38% and similar to 16-18.00% (23) and in line with 15-19% (24) which have been found as being the best for rabbit's performance base on feed intake, weight gain and feed conversion (FCR) in the tropical environment. The ether extract range of 6.98-11.88% was higher than 2.40-4.00% reported by (25,26) , Rabbits are reported to tolerate dietary fat of up to 25% with no adverse effects as earlier reported by (27).The ash levels in the experimental diets 7.85-8.99% were within the range reported by (28). The crude fibre levels of the experimental diets range from 9.84-12.05% and similar to 11.0-15% reported by (29) as being adequate for normal growth and to reduce incidences of gastroenteritis. The nitrogen free extracts which represent the readily available carbohydrate are also within the range reported for rabbits (28). The metabolizable energy in this study is within the range of 2642.48-2954.14 kcal/kg recommended by (30).

Table 5: Proximate composition of experimental diets

Constituents	T_1 (0% control)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)
Dry Matter	90.82	92.46	92.27	92.08	91.98
Crude protein	18.38	17.50	17.00	16.50	16.00
Ether Extract	11.88	7.95	7.57	6.98	7.86
Ash	8.33	7.85	8.99	8.52	8.23
Crude Fibre	9.84	10.40	11.43	11.95	12.05
Nitrogen Free Extract	44.29	49.39	47.29	47.65	48.18
ME (Kcal/kg)	2954.14	2851.16	2741.75	2763.04	2642.48

ME= Metabolizable Energy obtained using the formula recommended by (11) i.e. ME = (37 x %CP) + (81.8 x %EE) + (35.5 x %NFE)

Effect of graded levels of maize cob meal as replacement for dietary maize on carcass characteristics of growing rabbits

The carcass characteristics of rabbits fed diets containing maize cob meal is presented in Table 6. The fasted live weight of rabbits slaughtered for carcass evaluation ranged from 1100 to 1516.67 g, and decreased from rabbits on T_2 to T_5 diets, this follows the same trend as the average final weight of the rabbit. This shows that, there was a decrease in growth rate of the experimental rabbits as 10% maize replacement with MCM was exceeded. Singed weight was also observed to be similar to the fasted live weight, which may suggest that all the rabbits in different treatments had equal fur on their skin and the volume of blood left may also be the reason.

The dressing percentage values of 54.05 to 62.44% in this trial was higher than 52.87 to 57.05% reported by (29) in an experiment to study the effect graded levels of soaked *Alcacia albida* pons on the performance, organ weight of growing rabbits. The dressing percentage values in this study were also about 58-60% obtained by 31) for rabbits weighing 2.0-2.5kg. The dressing percentage of rabbits on T_2 diet was higher than those on T1 and T3 diet. It may be suggested that irrespective of maize or MCM as dietary energy source of rabbit up to 10% level replacement, the available rabbit meat for human consumption is practically the same.

However, in the case of loin and hind limb, it has been reported that forelimb, loin and hind limb constitute over 90% of the carcass weight (32). The loin weight of 14.31 to 19.83% in this study were lower than 25.54-29.83% (33) and higher than 10.84 to 13.23% (34). The weight of hind limb (21.39-25.81%) in this study are higher than 14.69-16.69% (34) and lower than the 22.53 to 35.08% (33), but comparable to 18.30 to 25.80% (35).

Table 6: Effect of graded levels of maize cob meal as replacement for dietary maize on carcass characteristics of growing rabbits

Parameters expressed as % of dressed weight (g)	T_1 (0% control)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)	SEM
Dressed weight	891.67^{ab}	943.33^{a}	875.00^{ab}	758.33^{b}	595.00^{c}	18.62*
Bled	96.69	96.69	97.68	97.49	96.95	0.54
Singed	69.67^{ab}	70.96^{a}	70.42^{a}	70.73^{a}	65.88^{b}	1.20*
Dressing Percentage	61.21^{ab}	62.44^{a}	59.61^{ab}	57.69^{bc}	54.05^{c}	1.33*
Head	9.31	10.44	9.70	10.24	10.72	0.86
Fore limb	16.75	17.65	17.75	16.68	15.91	1.08
Loin	17.60^{ab}	19.83^{a}	14.20^{b}	18.73^{a}	14.31^{b}	1.33*
Hind limb	23.41^{ab}	25.81^{a}	23.36^{ab}	21.39^{b}	23.58^{ab}	1.20*
Linear length (cm)	31.93^{a}	31.50^{ab}	30.67^{ab}	29.79^{b}	27.80^{c}	0.63*

^{abc} Mean on the same row with different superscripts are significantly different ($p<0.05$), SEM = Standard Error of Mean, *= Significant difference ($p<0.05$)

Effect of graded levels of maize cob meal as replacement for dietary maize on internal organ characteristics of growing rabbits:

Internal organ weight of rabbits fed diets containing maize cob meal is shown on Table 7. The weight of the heart 0.19 to 0.21% recorded in this study are in line with 0.19-0.26% (35) but out of range with 0.23-0.75% (36). The weight of the liver obtained 1.65 to 2.04% were similar to 1.99-2.38% (36) the values for the weight of the lungs 0.51 to 0.72% were with the range 0.57-0.65% (29),

0.56-0.68% (36) and 0.50 -0.71% (35). The empty stomach weight values of 0.95 to 1.34 are similar to 0.73 to 1.09% (36) and 0.96 to 1.04 % (35). The empty small intestine value of 1.07 to 1.74% was within 1.40 to 2.71% (33). Other organs such as; heart, liver, spleen, pancreas and lungs were within normal ranges.

Table 7: Effect of graded levels of maize cob meal as replacement for dietary maize on internal organ characteristics of growing rabbits

Parameters expressed as % of Fasted Live Weight (g)	T_1 (0% control)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)	SEM
Fasted Live Weight	1533.33^{a}	1516.67^{a}	1466.67^{a}	1316.67^{ab}	1100.00^{b}	78.62*
Heart	0.21	0.20	0.19	0.19	0.21	0.02^{ns}
Liver	1.65	1.73	2.13	2.04	1.80	0.18^{ns}
Lung	0.72	0.61	0.57	0.51	0.56	0.07^{ns}
Gall bladder	0.02^{ab}	0.02^{b}	0.01^{b}	0.03^{a}	0.02^{ab}	0.00*
Kidney	0.53^{ab}	0.47^{b}	0.49^{ab}	0.54^{ab}	0.60^{a}	0.04*
Pancreas	0.85	0.85	0.81	0.77	0.79	0.06^{ns}
Oesophagus	0.34	0.38	0.28	0.39	0.31	0.05^{ns}
Stomach	1.01^{ab}	0.95^{b}	0.99^{ab}	1.06^{ab}	1.34^{a}	0.12*
Small intestine	1.74	1.58	1.30	1.07	1.29	0.23^{ns}
Large intestine	1.42	1.29	1.00	1.30	1.31	0.14^{ns}
Caecum	1.26	1.21	0.93	0.98	1.22	0.13^{ns}
Spleen	0.03	0.03	0.02	0.03	0.03	0.01^{ns}

^{abc} Mean on the same row with different superscripts are significantly different ($p<0.05$), SEM = Standard Error of Mean, *= Significant difference ($p<0.05$).

Effect of graded levels of maize cob meal as replacement for dietary maize on gastrointestinal tract characteristics of growing rabbits

Results of gastro intestinal tract characteristic of rabbits fed diets containing maize cob meal are presented on Table 8. The average length of GIT in this study varied from 317.63 to 440.90 cm and were almost similar with 404.25 to 473.50 cm (36), in a study to investigate the effect of Kapok (*Ceiba pentandra*) seed meal based diets on growth carcass yield and blood chemistry of weaner rabbits. Oesophagus length values of 2.35 to 2.67% were comparable to 2.46-2.94% (35). The length measurements of small intestine 57.67 to 70.04% expressed as the percentage GIT length are in line with 63.32 to 70.68% obtained by (36). The values of the colon 21.78 to 26.26% obtain during the trail was lower than 30.32 to 31.45% reported by (36), but similar to 23.06-28.98% as reported by (33). The caecum length of 9.71 to 12.49% was similar to 9.79 to 12.17% reported by (33), and higher than 8.27-9.99% (35). The range of values obtained with the internal organ characteristics since no physical damage was observed and there were similar to some other authors reports, it may be concluded that, none of the organ in the experimental rabbits was damaged by replacement of maize with MCM up to 20% level since these organs help to ascertain the health status of farm animals.

Table 8: Effect of graded levels of maize cob meal as replacement for dietary maize on gastrointestinal tract characteristics of growing rabbits

Parameters expressed as % of GIT Length (cm)	T_1 (0% control)	T_2 (5%)	T_3 (10%)	T_4 (15%)	T_5 (20%)	SEM
GIT	440.90^{a}	403.88^{ab}	345.00^{bc}	365.80^{bc}	317.63^{c}	22.69*
Oesophagus	2.39	2.67	2.35	2.53	2.66	0.18
Small Intestine	70.04^{a}	65.08^{ab}	68.87^{a}	57.67^{b}	62.69^{ab}	2.87*
Colon	26.26	25.79	25.14	21.78	23.93	1.46
Caecum	10.64^{ab}	9.71^{b}	12.43^{a}	11.05^{ab}	12.49^{a}	0.71*

^{abc} Mean on the same row with different superscripts are significantly different ($p<0.05$), SEM = Standard Error of Mean, *= Significant difference ($p<0.05$)

Conclusion and Application

1. The values obtained in this study for dressing percentage, singed weight, dressed weight, loin, hind limb and other carcass indices namely; gastrointestinal tract parts, morphometry and internal organs weights were adversely affected by the inclusion of MCM in the diet above 10% level.
2. The visceral organs such as; heart, liver and lungs were not affected by the replacement of maize with MCM, an indication that the health status of the rabbits were not affected.
3. It can therefore be concluded that MCM can be included in growing rabbit diets up to 10% as a source of energy.

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