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EVALUATION OF THE REPLACEMENT VALUE OF MAIZE COB MEAL FOR MAIZE IN DIETS OF GROWING RABBITS

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Abstract
One hundred and fifty (150) grower rabbits of mixed sexes and breeds (Chinchilla, California and New Zealand white), aged 5 weeks were used to examine the effect of replacing maize cob meal (MCM) for maize as an energy source on growth performance and carcass characteristics of rabbits using a Completely Randomized Design (CRD). The rabbits were divided into five groups designated 1, 2, 3, 4, and 5 and allotted into five dietary treatments formulated to have 0, 20, 25, 30 and 35 % MCM, respectively. All diets were formulated with equal amounts of non-test ingredients. Parameters measured showed that the inclusion of maize cob meal up to 35% in the rabbit diet, which is a source of high crude fibre, did not interfere with the absorption of nutrients and chemicals by the rabbits. The data on performance showed that the rabbits gained weight in all the treatments but was highest in the 20% and 25% inclusion levels but numerically 25% inclusion of MCM had the highest values in growth parameters. The values obtained in this study for dressing percentage and other carcass indices including the gastrointestinal tract parts were not adversely affected by the different levels of inclusion of MCM in the diets. The visceral organs did not also indicate any visual abnormalities, an indication that the health status and performance of the rabbits were not affected adversely, which was demonstrated with the absence of mortality and other body abnormalities. Finally, it has been established in this study that, MCM can be added in rabbit diets up to 25% comfortably as revealed from the daily weight gain and feed conversion ratio analysis of rabbits fed diet containing maize cob meal. It can therefore be concluded that MCM can be included in growing rabbit diets up to 25% as a source of energy which would reduce pressure on the conventional maize feed ingredient used for the production of monogastric animals, which will not only aid to accelerate the attainment of national food security, but also in a reduction in cost of production. Based on the results obtained from the present study, it could be recommended that, for optimum performance of rabbits, maize cob meal (MCM) should not exceed 25% level of inclusion in the diet of growing rabbits. Pelletizing of MCM based diets for rabbits is also suggested for maximum utilization and the use of sweeteners is equally recommended to improve the palatability of MCM which will further improved feed intake in rabbit's diets.

Keywords: Maize cob meal, Rabbits, Growth response, Carcass, Organ weights.

1.0 Introduction

With Nigeria's growing population projected to hit 250 million by 2030, the challenges of food insecurity and hunger will be on the front burner more than ever before because of the increased demand for food. This increase will be mainly driven by population growth, urbanization and income improvements. With crop production being the main driver of the agricultural sector, meeting the demand for staples and vegetables might pose little or no challenge but sufficient supply of affordable animal protein will become most critical in the Nigerian food basket crisis Adebayo, 2024).

The demand for animal protein in Nigeria has been on the decline in the last 16 years. Nigerians are unable to consume 59gr/cap/day of total protein to meet FAO/WHO daily RNI for total protein. The animal based protein consumption which stood at 6.7 gr/caput/day as at 2020 as a far cry from the recommended value of 28 gr/caput/day. This low protein consumption is not as a result of inadequate production of animal protein but the lack of purchasing power of Nigerian consumers particularly in the present Nigerian bad economy. The indications are that there is a gross shortage of animal protein in the diet of Nigerians, whereas adequate protein intake is important for nourishing the body since protein is needed for tissue development, repairs and overall good health (FAO, 2013). As a result of animal protein inadequacy, serious malnutrition has been reported among children and pregnant women of the poor/low income people that form the majority in the society (Taiwo *et al*., 2006).

To provide a lasting solution to these problems, we must adopt a holistic approach, giving equal attention to all elements of getting Animal Agriculture products from the farm to the consumers' table and this among others, should be tackled by the proper feeding of our livestock.

Globally, feed availability, quality and cost are critical parameters for livestock development, and are of great significance to all livestock farmers and this is greatly affecting animal protein intake in low income countries (Omoikhoje *et al.*, 2006).

Part of our research target should be focused on improving the efficiency of feed utilization through improved feeding and management. Our research should shift to between production systems with a view to increasing the sustainability of animal protein and enhancing food security; and on which type of livestock animal should be consumed, how much is consumed, and the production system in which it is raised (Adebayo, 2024).

One of the possible solutions in increasing shortage of meat production problem is by using pseudo-ruminant species, like rabbits (Mahsoub, 2007). Rabbit production has a considerable potential in 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 (Cheeke, 1986; Biobaku, 1994; Joseph *et al*., 1997; Akpet and Gboshe, 2022). Furthermore, rabbit meat is considered an important protein source to humans due to the higher quality and lower fat content. Other advantages of rabbit as a meat producer animal, is that, rabbit diets have the good advantage of lower price when compared to other livestock.

Even with these potentials, rabbit production has not been given the desired attention in our country. Its productivity is still at the rudimentary state, usually less than 50% of what is typically done in the developed countries (Cheeke, 1986). The author added that though the environment, particularly high temperatures (causing heat stress and discomfort) may also have contributed to the low productivity, Cheeke (1992) emphasized that inadequate and high cost of feed ingredients is mainly the impediment affecting productivity. This is due to the stiff competition between people and monogastric animals such as the pig, rabbit and poultry for grains.

The formulation of feed for livestock and poultry has always relied on the use of conventional feedstuffs with a resultant great pressure on the limited conventional feed resource; and conventional energy feedstuff constitute 45-60% of balanced livestock rations (Sarwo *et al*., 2006). Seventy percent (70%) or more of the cost of raising commercial livestock is attributed to feed due to high cost of the commonly used energy feed ingredients like maize (Atteh, 2002). The high cost of this feedstuff is linked to the competition between man and animals since this ingredient is also a human staple in many parts of the world particularly Nigeria where the cost of things are always on the increase on daily basis. Maize accounts for the largest proportion of about 50-60% of conventional rabbit concentrate diet; therefore the substitution of maize in rabbit concentrate diet may significantly bring down the cost of production (Oso *et al*., 2007). It becomes necessary therefore, to look for alternative feedstuffs like maize cob that is cheap, available and less competed for by direct human consumption and industry.

Maize is the main energy feed ingredient, like other cereals but it is in short supply, leading to very high prices at certain periods of the year (Rhule, 1999). To ameliorate the pressure on conventional feed resources, the use of agro-industrial by-products has been suggested (Isikwence *et al*., 2005). This will equally help in reducing livestock production costs generally, which is seen by many as the solution to animal protein malnutrition of Nigerians because it will bring the price of animal products within the reach of the majority of the populace (Ilo *et al*., 2011).

Estimates of agro-by-products resulting from the processing of Agricultural products in Nigeria far exceed requirements for livestock feeds (Omole and Tewe, 1991). On the average, 61million metric tons of crop residues can be obtained annually from major cereals and legumes alone (Fetuga and Tewe, 1985). These by products which are unavoidable in many Nigerian communities are crop residues (Cassava peels, Rice milling by-products, garri sievate, cowpea chaff, maize sievate, maize cob, maize straw) and animal waste (Crayfish dust, dung, shrimp waste, hatchery waste). These are either allowed to decompose or are burnt. The heat and smoke generated by these actions pollute the environment and have implication for global warming.

These wasted and/or polluting by-products can be harnessed for the formulation of livestock rations and thereby saving costs and the pollution that they would have caused in the environment. Many studies have been conducted to investigate the feed value of these by-products in various livestock diets (Isikwence *et al.,* 2005; Idowu *et al*., 2006; Sanwo *et al.,* 2006; Awesu *et al*., 2002; Abeke *et al.,* 2006; Ibom *et al*., 2012 Olomu

1995, Enaku *et al.,* 2017; Akpet and Gboshe 2022). They specifically reported that, when these agro-by products are reasonably priced, they can be used in low energy holding diets. These efforts have produced accumulating evidence that the agro-industrial by-products can be used for feeding livestock, especially poultry, pigs and rabbits with encouraging results (Adeyemi *et al*., 2000).

A readily available source of the ingredient that have the potential to be investigated further is the maize cobs which have no direct use by human and is a widely available crop residue that is abundant in the tropics. If processed and used in rabbit feeding, it could reduce the cost of production and improve the quality of their carcasses (Enaku *et al.,* 2017). Its utilization by rabbits will be possible since rabbit can digest fibrous foodstuff in their diets because of the large caecum that harbour microorganisms that aid in the digestion and also with the phenomenon of caecotrophy that allow re-ingestion of the caecotropes (Awadalla and Mohamed, 1997). However, in some areas where high energy feed ingredients may readily be available, it may still be possible to replace part of the maize used in practical type rabbit diet with maize cobs meal so as to reduce the cost of production.

Maize Cob is classified as a lignocellulose material, mainly composed of cellulose, hemicellulose and lignin. Lignin is the most stable component of biomass, followed by cellulose and hemicellulose (Aregheore, 2000). The easily digestible component, that is, the cellulose is an organic compound consisting of several hundreds of glucose units with β (1-4) linkages. Unlike cellulose, hemicellulose consists of several hundreds of different monomers, not just glucose, with different linkages too. Its proximate analysis shows that it contains 3% crude protein, 35% crude fibre, 0.6% fat, 1.5% ash, 10% moisture, 0.12% calcium, 0.04% phosphorus, (Feed Composition Tables, 2012).

Maize cob is generally considered as a potential source of fibre which is one of the nutrients required in rabbit feeding (Onifade *et al*., 1999). It is actually used as either one or the main source of fibre in basal diets for various experiments in rabbits (Eleraky, 1996). Muriu *et al*. (2002) used the inclusion levels that vary from 5-6% for specific studies, such as digestibility studies. Nevertheless, when increasing proportions of maize cobs were studied, best growth results, i.e. results non-significantly different from the basal diet, were observed with an inclusion level that does not exceed 10-15% (Gippert *et al*., 1988a; Marai *et al*., 1996). A preliminary study using 5-20% inclusion levels of maize cob meal was carried out on rabbits with a promising results in all the parameters evaluated (Enaku *et al.,* 2017). It was therefore the aim of this study to assess the effect of feeding higher levels of the maize cob meal as a partial replacement of maize on the growth performance and carcass characteristics on rabbits.

1. Materials and methods

2.1 Experimental site

The experiment was carried out at the rabbit unit of the Livestock Teaching and Research Farm of the Department of Animal science, Faculty of Agriculture and Forestry, University of Cross River State, (UNICROSS), Obubra campus. Obubra lies at latitude 6^0 5'8.47"$_N$ and longitude 8^0. 19'40.83"^0_E of the equator (GPS Coordinates of Obubra), with a warm weather and ambient

temperature of about 21 – 30^0C and an annual rainfall of 500 – 1070 mm (Google Map).

2.2 Experimental animals, housing, design and duration of study

A total of one hundred and fifty (150) weaned rabbits were used for the feeding trials. The rabbits were individually housed in wooden cages measuring 63.50 x 63. 50 x 63.50 cm (length x width x height) and raised 25.0 cm from ground level. Each cage was provided with a feeder and a drinker. These cages were housed in a building with a half wall roofed with corrugated iron sheets to prevent direct sunlight and rain. A Completely Randomized Design was used. They were ten replicates in each treatment with three animals serving as a replicate. The study lasted for 3 Months (90 days).

2.3 Collection of experimental ingredients, processing and chemical analysis

The experimental ingredient, maize cob (MC), was sourced from the local farmers and business men and women that shell maize for sale within Obubra LGA of Cross River State. The cobs were dried in the sun for about 6 days to reduce its moisture content. After which the cobs were ground in a heavy-duty high rotation hummer mill to obtain a suitable meal for the diets formulations and for chemical analysis according to the procedures outlined by (AOAC, 2010).

2.4 Experimental diets and its calculated nutrients

Five experimental diets were formulated such that maize cob meal was included at 0, 20, 25, 30, and 35% levels in the diets. The experimental treatments were represented by T0, T1, T2, T3 and T4. Five experimental diets were formulated as shown in Table 1.

Table 1: **Composition of experimental diets (%)**

Ingredients	T_0 (control)	T_1 (20%)	T_2 (25%)	T_3 (30%)	T_4 (35%)
Maize	59.57	35.42	29.40	23.36	17.33
Maize cob meal	0.00	20.00	25.00	30.00	35.00
Rice Offal	15.00	15.00	15.00	15.00	15.00
Full Fat Soybean	5.23	9.38	10.40	11.44	12.47
Groundnut cake	15.00	15.00	15.00	15.00	15.00
Palm Oil	2.50	2.50	2.50	2.50	2.50
Bone ash	2.00	2.00	2.00	2.00	2.00
Vitamin/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	**Composition (%):**				
Crude protein (%)	15.00	15.00	15.00	15.00	15.00
Crude fibre (%)	7,77	14.84	16.61	18.37	20.14
ME (Kcal/kg)	2,877.28	2,346.43	2,213.85	2,081.29	1,947.67
Analysed nutrients (experimental diets):					
Crude protein (%)	15.88	14.95	14.85	14.98	14.86
Ether Extract (%)	8.88	7.95	7.85	6.98	6.86
Ash (%)	6.33	7.85	8.49	8.52	8.93
Crude Fibre (%)	9.84	11.40	13.43	13.95	14.05
Nitrogen Free Extract (%)	59.07	57.85	55.38	55.57	55.30
ME (Kcal/kg)	3,403.83	3,233.02	3,151.29	3,092.37	3,068.63

*Each 1kg of vitamin/mineral premix manufactured by BEAUTS Co. Inc. Man, U.S.A., contains Vitamin A 220,000, Vitamin D 66,000, Vitamin E 44, 014; Vitamin K 88 mg; Vitamin B_{12}; 0.76 mg; Niacin 1122 mg, Calcium 27%, Phosphorus 10%, Iron 0.6%, Zinc 0.35%, manganese 0.25%, Copper 0.06%; Iodine 0.002%, Cobalt 26 ppm, Selenium 4pp. ME = Metabolizable Energy. Metabolizable Energy of the experimental diets were calculated according to the formula of Panzenga (1985). 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.

2.5 Experimental Procedure

At the beginning of the experiment, all the animals were provided with anti-stress (Vitalyte) agents, 3 g each. They were also de-wormed and given cocciodiostat using piperazine citrate and proccox, respectively. The experimental diets and water were served *ad libitum*. The rabbits were individually weighed using Swan top loading digital weighing scale. They were grouped

into ten in such a way as to ensure uniformity of initial body weights in all the groups and allotted to different treatments in agreement with the design of the study.

2.6 Data collection/parameters measured

Data for growth performance included feed consumed, body weight gain and feed conversion ratio. Each rabbit was offered a weighed quantity of feed daily. The rabbits were fed in the morning hours between 7.00-8.00 am. Feeding was *ad-libitum* and had access to fresh and clean drinking water always. Left over feeds were collected into clearly labelled envelopes and weighed with a sensitive scale daily. The feed intake was computed by deducting from the quantity offered, the amount left over. The animals were weighed individually at the beginning of the experiment and weekly thereafter. The body weight gain was determined by difference. A sensitive weighing scale was used for the weighing of the animals.

Feed conversion (FCR) was calculated as the ratio of feed intake to body weight gain.

FCR= Weight of feed/weight gain.

2.7 Carcass evaluation

On the last day of the experiment, ten rabbits per treatment, with live weights that approximate their treatment mean live weights, were selected for slaughter and their carcasses evaluated. The rabbits were starved for 18 hours before slaughter to reduce the volume of the gut contents which also helps to reduce the risk of contamination of the carcasses during dressing. Each rabbit was weighed and then slaughtered by severing the neck transversely across the oesophagus, trachea, jugular veins and large carotid arteries with a sharp knife and allowed to bleed to death under gravity. The carcasses were eviscerated, singed and weighed. The visceral organs which include the heart, lung, kidney, liver, pancreas, intestines and spleen were carefully removed and weighed using the electronic weighing balance. The intestines were emptied before weighing. The carcasses were cut into the traditional parts comprising the head, fore limb, loin and hind limb and weighed using the digital weighing balance. The weights of the carcass cuts were expressed as percentage of dressed weights and the visceral organs were expressed as percentage of the live weights, while the length of the following components of GIT such as oesophagus, stomach, small intestine, caecum, and colon were expressed as percentage of the GIT lengths. The length of each of the carcasses were also measured.

2.8 Statistical Analysis

All data obtained were subjected to Analysis of Variance (ANOVA) using Minitab Statistical Software Version 16. Where means were significant, they were separated using procedures contained in the statistical package.

3. Results and discussion

3.1. Performance of Rabbits fed diets containing Maize Cob meal

The performance of Rabbits fed diets containing maize cob meal is presented in Table 2. The rabbits were equalized in weight before they were assigned to the various diets. Significant differences ($p<0.05$) were observed in final weights, daily weight gains and feed conversion ratios while daily feed intake had no

significant difference ($p>0.05$). There was no record of mortality throughout the duration of study.

This result obtained in this study disagrees with the results reported by Enaku *et al*. (2017) when they worked on 5-20% of the effect of maize cob meal (MCM) on the performance and economy of feed conversion of growing rabbits. The lack of difference in average feed intake by the rabbits is an indication that the animals were able to tolerate the increased fibre level resulting from the inclusion of MCM in the diets. The result of this study is in agreement with the finding of Attah and Ekpeyong (2011), who reported non-significant differences in feed intake when melon seed offal replaced rice offal in rabbit diets between 0 and 30% but contrasts with the findings of Aduku *et al*. (1998) who reported higher feed intake with increasing levels of crude fibre.

Results on the performance of rabbits revealed that average daily feed intake decreased with increase in levels of maize cob meal in the diets above 25%. This decrease in feed intake is probably due to high level of fibre content in the diet which makes it unpalatable when compared to the control (0%) and 20 - 35% MCM diets. These results do not agree with the findings of Abdelsamine *et al.* (1983), who reported that the rabbits can tolerate a wide range of crude fibre in the diet provided energy density is adequate.

The highest daily feed intake 58.36g/day/rabbit was observed in treatment 2 with 25% MCM, while the lowest daily feed intake of 56.08 g/day/rabbit was obtained in rabbits fed diet T_4 containing 35% MCM. The figures reported here (56. 06 to 58.36 g/day/rabbit) were higher than 4.84 to 50.01g/day/rabbit reported by Enaku *et al*. (2017), 18.20 to 19.20g/day/rabbit reported by Aduku *et al*. (1988); and also the value range of 47.02 to 50. 38g/day/rabbit reported by Akpet and Gboshe (2022) who worked on the growth response and carcass characteristics of weaned rabbits fed diets containing cassava peel meal as substitute for maize as source of energy; but lower than 77.64- 87.51 g reported by Attah and Ekpenyong (2011) and 60.86- 62.86 g that was reported by Agunbiade *et al*, (1999) for rabbits in the tropics.

The daily weight gains reported in this study (10.64g/day to 14.36g/day) were similar to value range of 10.46g/day to 15.17g/day, reported by Enaku *et al*. (2017), but the values were in agrees with 10.99 to 15.18g/day/rabbit (Nworgu and Ogbosuka, 2003) but less than 18.60g/day to 21.18g/day/rabbit reported by Akpet and Gboshe (2022). This difference may be attributed to the different locations of the study or the different methodologies used. There was a decline in weight gain in this study as the levels of MCM inclusion increased from 0 to 35%. This could be attributed to the increasing level of fibre posing a diluting effect on the energy composition of the diet. It has been reported by Gidenne and Lebas (2002) that increasing fibre in feed leads to dilution of energy of the diet. This possibly explains the lower weight gains observed for rabbits on diets 35% level of MCM inclusion.

The feed conversion ratios of 3.94 to 4.75 obtained in this study were almost similar to the 3.91 to 4.61 values reported by Enaku *et al*. (2017), comparable to 4.57-5.01 observed by Onu and Aja (2011) but inferior to 2. 65 to 3.92 of Akunmutimi *et al* (2011), 3.08 to 3.69 reported by Asar *et al*. (2010) and 2.46 to 2.67 by Akpet and Gboshe (2022). It however, indicated a better feed utilization than the value of 5.33 to 7.43 reported by Attah and Ekpeyoung (2011) and the values 4.81 to 6.0 obtained by (Nworgu and Ogbosuka, 2003). The differences in the observations of these workers might be due to generic differences, environmental differences and differences in feed properties in the various studies. Feed conversion ratio (FCR) for the rabbits that received no maize cob meal and those that received 20 and 25% maize cob meal were similar and better than for rabbits in other treatments. From these results, it can be suggested that FCR was improved by the dietary inclusion of MCM at that level of inclusion. These results agree with previous findings reporting that dietary inclusions of many agricultural by-products including cassava peel meal, lower level of maize cob, carrot-top, dried watermelon, wheat bran and pea pods hulls resulted in better FCR values when fed to rabbits (Akpet and Gboshe 2022; Enaku *et al*. 2017; Eleraky, 1996; Genedy *et al*., 2000; Falcão-e-Cunha *et al*., 2004 and Sarhan, 2005), respectively.

TABLE 2: Performance of Rabbits Fed Diets Containing Maize Cob Meal

Parameters	T_0 (control)	T_1 (20%)	T_2 (25%)	T_3 (30%)	T_4 (35%)	SEM
Av. Initial Weight (g)	553.00	550.00	550.00	556.00	557.00	
Av. Final Weight (g)	1761.61^{ab}	1645.00^{a}	1555.00^{bc}	1445.83^{cd}	1425.83^{d}	58.06
Av. Daily Feed Intake (g)	57.85	58.01	57.38	57.07	56.84	1.20
Av. Daily Weight Gain (g)	14.74^{a}	13.17^{ab}	12.50^{bc}	11.60^{c}	11.46^{c}	0.70
Feed conversion Ratio	3.94^{a}	4.10^{ab}	4.59^{b}	4.61^{b}	4.75^{b}	0.28

[abcd-] Means on the same row with different superscripts are significantly different ($p<0.05$);

Av. = Average; SEM = Standard Error of Mean

3.2 The results of carcass characteristics of rabbit fed diets containing maize cob meal

The results of carcass characteristics of rabbits fed diets containing maize cob meal is presented in Table 3. The result shows that, the mean values for the dressing percent 57.69- 65.61% and rack 12.85-14.45% obtained in this study did not seem to follow a definite order, making it difficult to be attributed to a particular factor. Singed weights were also observed to be similar which may suggest that all the rabbits in different treatments had equal fur on their skins.

The dressing percentage values of 57.69-65.61% in this trial were comparable to the range value of 47-66.53 obtained by Akumutimi *et al.* (2006) for weaner rabbits, 55.05 to 62. 45% reported by Gboshe *et al*.

(2017) when they worked on effect of the lower graded levels of maize cob meal as replacement for dietary maize on carcass characteristics of growing rabbits and 60.72 to 62.45% by Akpet and Gboshe (2022) when they worked on the growth response and carcass characteristics of weaner rabbits fed diets containing cassava peel meal as substitute for maize as source of energy. The dressing percentage of rabbits on T_2 diet was higher than those on T_0 and T_1 diets. This may suggest that irrespective of maize or MCM as dietary energy source for rabbits up to 25% level of inclusion, the available rabbit meat for human consumption is practically the same. The non-significant differences ($p>0.05$) for weights of singed, head, shoulder and fore limb is an indication that those carcass cuts were not affected by the different levels of inclusion of the test ingredient. This implies that, the animal did not show any differential ability in terms of the development of various body parts. The similarity in carcass is an indication of uniformity in muscle development and growth (Lala *et al*., 2011).

However, in the case of loins and hind limbs, it has been reported that forelimbs and hind limbs constitute over 90% of the carcass weight (Blasco *et al*., 1993). The loin weights of 14.20 to 18.73% in this study were similar to 14.20 to 20.10% reported by Gboshe *et al*., (2017) but lower than 25.54-29.83% reported by Agunbiade *et al.* (2001) but higher than 10.84 to 13.23% observed by Oluremi *et al. (*2005). The weights of hind limbs recorded (21.39-25.81%) in this study were higher than 14.69-16.69% obtained by Oluremi *et al. (*2005) but lower than 22.53 to 35.08% (Agunbiade *et al.*, 2001), but comparable to 18.30 to 25.80% (Hon *et al*., 2007).

TABLE 3: Carcass characteristics of Rabbits fed diets containing Maize Cob meal

Parameters expressed as % dressed Weight	T_0 (control)	T_1 (20%)	T_2 (25%)	T_3 (30%)	T_4 (35%)	SEM
Slaughter Weight (g)	1833.33^{a}	1716.67^{ab}	1666.67^{b}	1516.67^{c}	1500.00^{c}	78.62*
Singed (%)	69.97	71.96	72.42	70.73	72.88	1.20
Dressing Percentage (%)	61.21^{ab}	62.44^{ab}	65.61^{a}	57.69^{b}	64.05^{a}	1.33*
Head (%)	9.31	10.44	9.70	10.24	10.72	0.86
Shoulder (%)	18.15	17.40	18.50	18.20	18.00	1.00
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*
Rack (%)	13.20^{ab}	13.50^{ab}	14.45^{a}	12.85^{ab}	14.06^{a}	0.31
Hind limbs (%)	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} Means on the same row with different superscripts are significantly different ($p<0.05$); SEM = Standard Error of Mean, *= Significant difference ($p<0.05$)

3.3 Internal organs/offal Characteristics of Rabbits fed diet containing Maize Cob meal

The results of the internal organs/offal characteristics of rabbits fed diet containing maize cob meal is presented in Table 4. There were no significant ($p>0.05$) differences observed across treatment groups for all visceral organs investigated. Lala *et al.* (2011) had reported that similarity in percentage weight of internal organs indicated a uniform growth pattern and development across treatment groups. This probably explains the trend obtained in this study. This implies that the levels of inclusion of the MCM (0-35%) did not have any adverse effect on the development of these internal organs.

The weights of the hearts 0.21 to 0.23% recorded in this study were agrees with 0.19-0.26% (Hon *et al.*, 2007), and 0.19 to 0.23 (Gboshe *et al*., 2017). The weights of the livers obtained, 2.53 to 2.65%, was higher than 1.99-2.38% recorded by (Ochefu, 2006) but less than 2.76 to 2.99 reported by Akpet and Gboshe (2022). The values for the weights of lungs, 0.42 to 0.52%, were less than 0.57-0.65% (Igwebuike *et al.,* 2001), 0.56-0.68 (Ochefu, 2006), 0.50 -0.71% (Hon *et al.,* 2007) and 0.57-0.65% (Gboshe *et al*., 2017). The empty stomach weight values of 1.04 to 1.23% were similar to 0.73 to 1.09% (Ochefu, 2006) and 0.96 - 1.04 % (Hon *et al*., 2007). The empty small intestine values of 1.35 to 1.74% are within 1.40 - 2.71% (Agunbiade *et al*, 2001) and within the value range of 1.72 to 2. 68% (Gboshe *et al*., 2017). Other organs listed on table 4 were also comparable to values in literature.

TABLE 4: Internal organ weights of Rabbits fed diets containing Maize Cob meal expressed as percent of the live weight

Parameters expressed as % of Fasted Live Weight (g)	T_0 (control)	T_1 (20%)	T_2 (25%)	T_3 (30%)	T_4 (35%)	SEM
Heart	0.21	0.20	0.23	0.22	0.21	0.02
Liver	2.65	2.63	2.53	2.64	2.65	0.18
Lungs	0.52	0.45	0.44	0.42	0.50	0.07
Gall bladder	0.07	0.08	0.07	0.07	0.08	0.01
Kidney	0.56	0.57	0.59	0.54	0.60	0.04
Pancreas	0.15	0.15	0.11	0.10	0.09	0.06
Visceral fat	0.39	0.38	0.38	0.37	0.31	0.05
Stomach	1.23	1.05	1.09	1.06	1.04	0.12
Small intestine	1.74	1.58	1.38	1.37	1.35	0.23
Large intestine	1.12	1.29	1.00	1.30	1.13	0.14
Ceacum	1.02	1.01	0.93	0.90	1.00	0.13
Spleen	0.04	0.05	0.03	0.04	0.04	0.01

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

3.4 Gastro intestinal tract morphometric of rabbits fed Maize Cob Meal (MCM)

The results of the Gastro intestinal tract morphometric of rabbits fed Maize cob meal (MCM) is presented in Table 5. The results shows that, there were no significant ($p>0.05$) differences observed across the treatment groups for all the GIT parameters measured. The result of this study may imply that the inclusion of the maize cob meal at levels of between 20 and 35% in grower rabbit diets did not result in disproportionate elongation or shortening of the GIT tract. The average length of GIT in this study ranged from 436.20 to 467.63 cm and were almost similar to 404.25 - 473.50% (Ochefu, 2006), 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. They were also almost similar to the value range 317.63 – 440.90 cm reported by Gboshe *et al*., (2017). Oesophagus length values of 2.35 to 2.66% were comparable to 2.46-2.94% (Hon *et al.,* 2007). The length measurements of small intestine 57.67 - 70.04cm were in line with 63.32 - 70.68cm obtained by (Ochefu, 2006). The values of the colon 21.78 - 26.26% obtained during the feeding trial were lower than 30.32 - 31.45% reported by Ochefu (2006), but almost similar to 23.06 -28.98% as reported by (Agunbiade *et al.,* 2001). The caecum length of 9.71 - 12.49% was similar to (9.79 to 12.17%) reported by (Agunbiade *et al.,* 2001), but higher than 8.27-9.99% (Hon *et al*., 2007). The range of values obtained with the internal organ characteristics may suggest that none of the organs in the experimental rabbits were damaged by the inclusion of MCM up to 35% level. These organs help to ascertain the health status of farm animals.

TABLE 5: Gastro intestinal tract characteristics of rabbits fed diets containing maize cob meal (MCM)

Parameters expressed as % of GIT Length (cm)	T_0 (control)	T_1 (20%)	T_2 (25%)	T_3 (30%)	T_4 (35%)	SEM
GIT	457.00	445.20	436.20	448.00	467.63	22.69
Oesophagus	2.09	2.07	2.05	2.03	2.06	0.18
Small Intestine	62.04	63.08	64.07	63.06	64.60	2.87
Colon	27.36	26.70	26.15	26.58	25.93	1.46
Ceacum	9.65	9.71	9.53	9.55	9.49	0.71

[abc] Means on the same row with different superscripts are significantly different ($p<0.05$),
SEM = Standard
Error of Mean; *= Significant difference ($p<0.05$)

4. Conclusion

It was observed in this study that the inclusion of maize cob meal up to 35% in the rabbit diet which is a source of high crude fibre did not interfere with nutrient and chemical absorption by rabbits since dietary fibre can act by changing the nature of the contents of the gastrointestinal tract and by changing how other nutrients and chemicals are absorbed.

The data on performance showed that the rabbits gained weight in all the treatments but was highest in 20% and 25% inclusion levels but numerically 25% inclusion of MCM had the highest values in growth parameters.

The values obtained in this study for dressing percentage and other carcass indices including the gastrointestinal tract parts were not adversely affected by the different levels of inclusion of MCM in the diets. The visceral organs did not also indicate any visual abnormalities, an indication that the health status and performance of the rabbits were not affected. This was demonstrated by the absence of mortality and other body abnormalities.

Finally, it has been established in this study that MCM can be added in rabbit diets up to 25% comfortably as revealed from the daily weight gain and feed conversion ratio analysis of rabbits fed diets containing maize cob meal. It can therefore be concluded that MCM can be included in growing rabbit diets up to 25% as a source of energy which would reduce pressure on the conventional maize feed ingredient used for the production of monogastric animals. This, no doubt, will aid in accelerating the attainment of national food security through the reduction of cost of production.

Based on the results obtained from the present study, it could be recommended that for optimum performance of rabbits, maize cob meal (MCM) should not exceed 25% level of inclusion in the diet of growing rabbits. Pelletizing of MCM base diets for rabbits is also suggested for maximum utilization and the use of sweeteners is equally recommended to improve the palatability of MCM which will further improve feed intake in rabbits observed to be low at the higher levels of inclusion. Further study should be carried out to know the best level of inclusion of MCM between 25% and 30% since these two levels were not significantly different.

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