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Growth performance, nutrient digestibility and carcass characteristics of growing rabbits fed varying levels of urea-molasses treated maize cob as replacement for wheat offal

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Abstract

Dietary fibre is of great importance due to its significant role in rabbit nutrition. The increase in cost of conventional dietary fibre sources necessitated search for suitable alternatives. Processing of non-conventional fibrous ingredient is essential due to low digestibility and economically feasible strategies should be employed to enhance its utilisation. In thisstudy, the effect of graded levels of urea-molasses treated maize cobs (UMTMC) as replacement for wheat offal in diet of rabbits wasinvestigated. A total of 45 rabbits of about 42 ± 1d old were used to investigate the growth performance, nutrient digestibility and carcass characteristics. Rabbits were allotted into five dietary treatments of nine rabbits segregated into three replicates of three rabbits each. The diets contained UMTMC at five (0, 25, 50, 75 and 100 %) replacement levels. Data obtained were subjected to analysis of variance in a completely randomized design. Daily feed intake (36.37g/rabbit) was reduced (P<0.05) in rabbit fed diets supplemented with 50% UMTMC in comparison to 0% UMTMC (42.40g/rabbit). Nitrogen free extract digestibility decreased (P<0.05) with increasing replacement level of UMTMC. Improved (P<0.05) carcass weight (815.67g/rabbit) and dressing percentage (63.50%) were obtained in rabbits fed diets added with 25% UMTMC when compared to 75 (58.49%) and 100% (57.90%) UMTMC. Organ weight were significantly affected with 50% and 100% UMTMC inclusion level showing increased (P<0.05) liver (3.35g and 3.08g) and kidney (0.78g and 0.94g) weight. It was concluded that inclusion of 25, 75 and 100% UMTMC did not adversely affect carcass parameters instead, the inclusion of 50% UMTMC improved growth performance and carcass characteristics.

Keywords: Rabbits, maize cob, urea-molasses, growth performance, nutrient digestibility,carcass

Performance de la croissance, digestibilité nutritive et caractéristiques de la carcasse de la culture de lapins nourris à des niveaux variés d'uréa-mélasse traitée COB de maïs traité comme remplacement du blé

Résumé

La fibre alimentaire revêt une grande importance due à son rôle important dans la nutrition de lapin. L'augmentation du coût des sources de fibres alimentaires conventionnelles nécessitait une recherche de solutions appropriées. Le traitement de l'ingrédient fibreux non

conventionnel est essentiel en raison de la digestibilité faible et des stratégies économiquement réalisables devraient être utilisées pour améliorer son utilisation. Dans cet étude, l'effet des niveaux de grade d'urérés-mélasse traités cobs de maïs traités (UMTCM) est remplacé par le remplacement du blé dans le régime alimentaire des lapins. Au total, 45 lapins d'environ 42 ± 1d ont été utilisés pour enquêter sur la performance de la croissance, la digestibilité des nutriments et les caractéristiques de la carcasse. Des lapins ont été attribués à cinq traitements diététiques de neuf lapins séparés dans trois répliques de trois lapins chacun. Les régimes contenaient UMTCM à cinq niveaux de remplacement (0, 25, 50, 75 et 100%). Les données obtenues ont été soumises à une analyse de la variance dans une conception complètement randomisée. L'apport quotidien des aliments pour animaux (36,37 g / lapin) a été réduit (p <0,05) dans des régimes alimentés par lapin complétés avec 50% UMTCM par rapport à 0% UMTCM (42,40 g / lapin). La digestibilité d'extrait sans azote a diminué (p <0,05) avec un niveau de remplacement croissant de UMTCM. Le poids de la carcasse amélioré (P <0,05) (815,67 g / lapin) et le pourcentage de dressing (63,50%) ont été obtenus chez la Réinitialisation nourri de lapins ajouté avec 25% de UMTCM, contre 75 (58,49%) et 100% (57,90%) UMTCM. Le poids des organes a été significativement affecté à 50% et à 100% de niveau d'inclusion UMTCM montrant une augmentation du foie accrue (p <0,05) (3,35 g et 3,08 g) et du poids du rein (0,78 g et de 0,94 g). Il a été conclu que l'inclusion de 25, 75 et 100% UMTCM n'avait aucune incidence négative sur les paramètres de la carcasse, l'inclusion de 50% UMTCM améliorée les performances de croissance et les caractéristiques de la carcasse.

Mots-clés: Lapins, Cob de maïs, Mélasses d'urée, Performance de croissance, Digestibilité des nutriments, Carcasse

Introduction

The importance of fibre in rabbit nutrition cannot be over emphasized due to its significant role in gut motility of rabbits (Gidenne and Michalet-Doreau, 2002). Dietary fibre is essentially important because it helps in maintaining mucosa functionality and serve as substrate for microbiota (Lukefahr*et al*., 2004). Rabbit with its special attribute, has short generation interval with high prolificacy and good ability in nursing the kittens (Ajani *et al*., 2020). This peculiar advantage has led to the advocate for increase rabbit production to mitigate the shortage of animal protein intake in the country and also shorten the wide gap between supply and demand of animal protein (Sarikhan*et al*., 2010). The increase in rabbit production is now challenged with the high cost of conventional fibrous feed ingredient such as wheat offal in rabbit feed (Asar*et al*., 2010). Therefore, conscious efforts have been made to search for alternatively low cost by-products to serve as substitute for the conventional feedstuffs (Makinde*et al*., 2014).Maize cobs are generally considered as a potential source of fibre in rabbit feeding because of its abundant availability from maize processing and at low cost (Onifade*etal*., 1999). It contains 2104 kcal metabolisable energy, 3% Crude protein, (Gbosh*et al*., 2014). Ruminant animals easily consume maize cobs either processed or not (Akinfemi and Adebayo, 2016). However, non-ruminant herbivores like rabbit can seldom use these cobs without processing because of their simple stomach nature. In order to improve its utilization, strategies that can solubilize the fibre fractions for non-ruminant absorption is neededto be employed.One of the proven methods of processing maize cobs is the use of urea and molasses(Olayemi*et al*., 2020).Urea treatment has been a conventional technique for improving the

quality of fibrous feed material in terms of increasing the nitrogen content (Ubwa*et al*., 2014). Rabbits can efficiently utilize urea as a nitrogen source due to high urease activity in the caecum (Marounek*et al.,* 1995). Molasses increases palatability of diet and acts as readily available energy source to microflora for better utilization (Sheikh *et al*., 2007). The feeding of treated maize cob will reduce the cost of formulated diet and the information on the nutritive value of feeding treated maize cob especially in rabbit will be unlimited. Therefore, this research work investigated the effect of varying inclusion of UMTMC as a replacement for wheat offal on growth performance, blood parameters, nutrient digestibility and carcass characteristics of growing rabbits.

Materials and methods

Experimental site

The experiment was carried out at the Teaching and Research Farm of the Agricultural Technology Department, Yaba College of Technology, Epe, Lagos state. The farm is located on 3^0 58" E and longitude $6^0$47" N. It lies in the low land rain forest within the savannah agro-ecological zones with annual rainfall and temperature of 1694 mm and 27.1^{0}C respectively (Google Earth 2021).The experiment was executed in accordance with the approved guidelines for Animal Research by Nigeria Institute of Animal Science in Nigeria (NIAS).

Preparation of UMTMC

Maize cobs were collected from corn starch processing factory along Sagamu-Ijebu ode express way, Ogun State. It was sun dried, milled and sieved using 2mm size sieve and stored in air tight bags until when needed. UMTMC was prepared by adding 5litres of water to 10kg weight of molasses and 2kg weight of synthetic urea and was thoroughly mixed together in a plastic bucket. 100kg weight of milled dried maize cob was added to the mixture and stirred thoroughly together with a stirring rod and left for 5 minutes according to Reddy (2001). The brownish mix was spread to air-dry for 3days. Later it was oven-dried for 30 minutes at 65^{o}C to achieve a constant weight.

Proximate composition of the untreated maize cob and urea treated maize cob

Samples of the untreated maize and treated cob were analysed for proximate composition according to the methods of the Association of Official Analytical Chemists International (AOAC, 2000). The gross energy was determined using bomb calorimeter (Adiabatic Oxygen Bomb Calorimeter, Par Instrument Co., Moline, IL, USA).

Experimental animals and management

Forty-five weaner rabbits of 5-6weeks of age weighing between 400 – 500g were obtained from Institute of Agricultural Research and Training (IAR&T), Moor Plantation, Apata, Ibadan, Oyo state,Nigeria and were allotted randomly into five dietary treatments in a completely randomize design (CRD). There are nine rabbits per treatment, each treatment has three replicates containing three rabbits per replicate. The experimental animals were maintained in rabbit hutches with wire mesh and wooden floors placed on concrete floor. The drinking and feeding trough were made available to the rabbits. Experimental diets and water were offered *adlibitum*.

Experimental diets

Five experimental diets were formulated consisting a control (0% UMTMC) and four diets containing UMTMC at replacement levels of 25, 50, 75 and 100% for wheat offal (Table 1). Diets were formulated to meet the NRC (2012) requirements for rabbits.

Table 1: Gross composition of experimental diet (g/100g DM)

	Urea-molasses treated maize cob (%)				
Ingredients (%)	**0**	**25**	**50**	**75**	**100**
Maize	30.00	30.00	30.00	30.00	30.00
SBM	10.00	10.00	10.00	10.00	10.00
Fish meal	0.50	0.50	0.50	0.50	0.50
Wheat offal	55.00	41.25	27.50	13.75	-
TMC	-	13.75	27.50	41.25	55.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Oyster shell	1.50	1.50	1.50	1.50	1.50
Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Total	**100**	**100**	**100**	**100**	**100**
Determined nutrients (%)					
Crude protein	18.39	18.00	17.61	17.22	16.84
Crude Fibre	9.72	9.58	10.63	9.50	11.16
Metabolisable energy (Kcal/kg)	2479.00	2502.00	2526.00	2549.00	2573.00

[1]Each 3 kg vitamin and mineral premix provides the following per kg diet: Vit. A 12000000 IU, Vit. D3 750000 IU, Vit. E 10000 mg, Vit. K 2000 mg, Vit B1 1000 mg,vit B2 4000 mg, Vit. B6 1500 mg, Vit B12 10 mg, Pantothenic acid 10000 mg,Niacin 20000 mg, Biotine 50 mg, Folic acid 1000 mg, Choline chloride 500mg, selenium 100mg, Manganese 55 gm, Zinc 50 gm, Fe 60 gm, CU 2.5 gm, CO 6 mg and Iodine 1 gm.

Growth performance

Records of weight gain (g/rabbit), feed intake (g/rabbit), feed conversion ratiowere obtained weekly for eight weeks and mortality was also monitored.

Digestibility study

At the end of the experiment, digestibility trial was conducted using three rabbits randomly selected from each replicate and housed individually in metabolic cages already cleaned, disinfected and equipped with facilities that allow faeces and urine separation. The adjustment period continued for a week before the commencement of the trial. Faecal collection was done for three days. The wet excreta samples collected were dried at 65°C for 36 hours. Feed samples and dried excreta samples were analysed for proximate composition (crude protein, crude fibre, ether extract, ash and dry matter) using (AOAC, 2000).

Carcass characteristics

At the end of the experiment, fifteen rabbits (i.e. three rabbits per treatment) were sampled randomly for carcass evaluations. The rabbits were starved of feed for 12 hours, weighed and manually slaughtered by cutting the jugular vein to allow proper bleeding. The slaughtered rabbits were defurred using flame and eviscerated to evaluate their carcasses, Carcass weight (the main body, head, kidneys, liver, heart and other edible parts) were determined according to (Jensen, 1984). The cut parts and organs were expressed in percentageof live weight (LW). Dressing percentage was determined by dividing the dressed weight by the live weight and multiplied by one hundred.

Statistical analysis

The data collected were subjected to one-way analysis of variance (ANOVA) in a completely randomize design (CRD). The significant means were separated and compared using Duncan Multiple Range Test (Duncan, 1995) of SAS (1999) at 5% level of probability.

Results and discussion

Proximate composition of treated and untreated maize cob

The proximate compositions of untreated maize cob and urea-molasses treated maize cob is presented in Table 2.

Table 2: Proximate composition of treated and untreated maize cob

Parameters (%)	Maize	Untreated	UMTMC
Dry matter	91.24	90.23	87.50
Ash	1.45	3.63	2.49
Crude fibre	3.54	6.00	4.53
Ether extract	2.43	2.35	2.14
Crude protein	9.78	7.7	12.80
Nitrogen free extract	85.76	75.26	73.00
Gross energy (Kcal/kg)	4250	3640	3795

The effect of UMTMC on growth performance of growing rabbits

Growth performance of growing rabbits fed diets containing varying inclusion of UMTMC is presented in Table 3. Final weight (FW), weight gain (WG), daily weight gain (DWG), feed conversion ratio (FCR) and mortality were not significantly ($P>0.05$) affected by inclusion of UMTMC. This implies that replacement rates of UMTMC can be tolerated by the rabbits which confirms the nutritive adequacy of the UMTMC in replacing wheat offal. This agreed with the report of Sobayo*et al*. (2008) who reported no deleterious effect of dietary inclusion of fermented maize milling waste on performance of rabbits.Ly*et al*. (2010) also reported no significant effect of dried and ensiled cassava leaf in the diet of crossbred pigs on final body weight and average daily gain. Rabbits fed control diet had the higher ($P<0.05$) TFI and DFI compared to other treatments. Significant ($P<0.05$) effects were obtained on total feed intake (TFI) and daily feed intake (DFI) of weaner rabbits. Replacement of wheat offal at 75% with UMTMC resulted in the lowest TFI and DFI than those fed diet containing 50% UMTMC. The average daily feed intake of 36.87- 42.40 g/day were higher than the value of 30 to 32 g/day reported by Denli*et al.* (1991) for rabbits of the same age while Taiwo*et al.,* (2005) and Amaefule*et al.* (2005) reported a range of 40.3 to 71.19 g/day. The discrepancies in the level of feed intake could be as a result of differences in fibre composition and solubility of the fibre source as a constituent of the diets. Soluble dietary fiber usually is known to be susceptible to microbial degradation, thus increasing bacteria growth in the lower gut which may influence feed intake (He, 2004). Increasing inclusion of UMTMC from 25- 75% resulted in decreasing feed intake and this suggests that the level of fibre affects feed intake and digestibility of rabbits. Dietary fibre is of special importance in rabbit nutrition because of its role in feed intake and rate of passage in the gastrointestinal tract (Combes*et al*., 2013). Therefore, an optimal level of fibre and adequate balance of digestible fibre should be maintained. There was no significant difference across treatment for FCR. This is similar to the report of Doma*et al.* (1995) who reported no significant difference in FCR of rabbits fed diet containing urea treated cowpea husk. The similar FCR obtained for rabbits also implies the suitability of the diets in terms of nutrient adequacy comparable to the control diet which is associated with the effect of urea-molasses treatment.

Table 3: Effects of UMTMC on growth performance of growing rabbits 42 – 98 days of age

	Inclusion level of urea-molasses treated maize cob (%)					
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Ave. initial weight (g)	470.83	478.33	468.33	470.83	476.67	33.61
Ave. final weight (g)	1113.33	1053.33	1093.33	1040.00	953.33	45.82
Weight gain (g)	642.50	575.00	625.00	569.17	476.67	55.89
Ave. daily weight gain (g)	7.65	6.84	7.44	6.78	5.68	0.66
Total feed intake (g)	3562.50^{a}	3429.33^{b}	3224.67^{d}	3097.00^{e}	3286.50^{c}	0.00
Daily feed intake (g)	42.40^{a}	40.83^{b}	38.39^{d}	36.87^{e}	39.13^{c}	0.00
Feed conversion ratio (FCR)	5.80	6.03	5.23	5.46	7.22	0.62
Mortality (%).	0.00	0.00	0.00	1.00	1.00	1.00

$^{abcde:}$ Means in the same row with different superscripts differ significantly (P<0.05)
SEM= Standard Error of Mean

Nutrient digestibility of growing rabbits fed urea-molasses treated maize cob

Table 4 presents the effect of UMTMC on nutrient digestibility of growing rabbit. UMTMC had no significant (P>0.05) effect on crude protein digestibility. The similar crude protein digestibility across treatment suggests that diet containing UMTMC irrespective of replacement level supplied adequate protein to the rabbits. It is also an indication that the rabbit utilized urea better in the feed

Rabbits fed control diets had elevated (P<0.05) dry matter, ash and nitrogen free extract (NFE) digestibility compared to rabbits fed diets containing 50, 75 and 100% UMTMC. This is contrary to the report of Doma*et al*. (1995) who reported increase in dry matter intake by rabbits with increasing dietary fiber levels. The findings of Fevrier*et al*. (1992) agrees with the outcome of this study. There is reduction in nutrients digestibility in pigs fed diet containing high levels of wheat bran, due to increased rate of digestapassage.This is also in line with the report of Oso *et al*. (2006) which indicated that increasing the level of fibre in diet has a dilution effect which reduces nutrient utilisation. The discrepancies observed in reduced dry matter and NFE digestibility may be due to differences in the solubility of the fibre source. Rabbits fed control diet and those fed diet containing 25 and 100% of UMTMC showed similar digestible ether extract but better than those fed diets with 50% of UMTMC. This observation indicates that despite the sequestration and nutrient encapsulating effect of fibre (Irekhore*et al*., 2006), the rabbits were able to utilise dietary fat. There was a decrease in NFE digestibility as inclusion of UMTMC increases. Similar trend was reported by Onifade and Tewe (1993) on nutrient digestibility of rabbits fed alternative feed resources (Maize offal, unpeeled cassava root meal and cassava peel meal) as a replacement for maize.

Table 4: Main effects of urea -molasses treated maize cob on the nutrient digestibility of growing rabbits between 98-106 days of age

	Inclusion level of urea-molasses treated maize cob (%)					
Parameters (%)	**0**	**25**	**50**	**75**	**100**	**SEM**
Dry matter	78.96^{a}	77.02^{ab}	74.85^{b}	74.50^{b}	74.26^{b}	0.84
Ash	61.29^{a}	58.35^{ab}	46.14^{c}	55.63^{b}	55.45^{b}	1.50
Crude fibre	66.82^{ab}	62.97^{b}	57.74^{c}	68.31^{a}	62.79^{b}	1.24
Ether extract	85.59^{a}	84.57^{ab}	78.46^{c}	82.87^{b}	84.88^{a}	0.55
Crude protein	88.18	87.48	87.96	86.51	87.72	0.46
Nitrogen free extract	78.11^{a}	75.62^{ab}	74.42^{b}	73.30^{b}	72.57^{b}	0.88

$^{abc:}$ Means in the same row with different superscripts differ significantly (P<0.05)
SEM= Standard Error of Means

The effect of UMTMC cob on carcass characteristics of weaner rabbits

Table 5 shows the effect ofUMTMConcarcasscharacteristicsof weaner rabbits. Dressed weight and dressing percentage of rabbits fed diets containing 75 and 100% UMTMC were observed to be significantly ($P<0.05$) lower when compared to groups fed diet containing 25% UMTMC. The dressing percentage of 50.65 to 63.55% recorded in this study was higher than 45.30 to 50.18% reported by Njidda and Isidahomen (2011), for rabbits fed diet containing up to 12% sesame (*Sesamumindicum*) seed meal, but lower than the value of 67.6 to 67.7% reported for rabbits fed millet offal (Uko*et al.,* 1999). Fielding (1991), reported that the dressing percentage of rabbits normally ranges from 50 to 56% and tends to be greater if the rabbits are fully grown and have some fat. The range of dressing percentage obtained in this study which is within the normal range suggests that replacement of wheat offal up to 100% with UMTMC did not impact negatively on tissue accretion. Dietary treatments influenced the head, trotter, legs, rack and whole GIT. The head weight of rabbits fed control diets increased ($P<0.05$) however, similar to those fed diet containing 25 and 100% UMTMC when compared to 50 and 75%. The result obtained from this study is not in consonance with the works of previous researchers who reported no significant effect on the use of various agro-industrial by-products and wastes in place of maize grain in rabbit's diets on these carcass parameters (Odeyinka*et al.,* 2007; Amata, 2010; Njidda and Isidahomen, 2011). The whole GIT weight was highest for rabbits on UMTMC diet at 100% inclusion. The increase in GIT weight may be associated with high level of fibre which subjected the GIT to increase mechanical activity so as to cope with the level of fibre. Values obtained for heart, lungs, kidney and liver weights in this experiment showed significant difference among treatment groups.Rabbits fed diet containing UMTMC at 75 and 100% had increased ($P<0.05$) liver and kidney weight compared to those on control diet. This is contrary to the report of Ekpo*et al.* (2009) who observed no significant difference amongtreatments for heart, lungs, kidney and liver weight ofrabbits fed cassava tuber meals. Increase in weight of organs obtained in this study is not necessarily an indication of impairment because values obtained were similar to those reported by Njidda and Isidahomen (2010). Increased weight of organs has been associated with toxic elements in feed which arises due to accelerated metabolic rate of the organs with the aim of ameliorating the effect of toxic elements or convert anti nutritional agents to non-toxic metabolites.

Table 5: Effects of urea-molasses treated maize cob on the carcass characteristicsof growing rabbits at 98 days of age

	Inclusion level of urea-molasses treated maize cob (%)					
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Live weight (g/rabbit)	1183.33	1283.33	1283.33	1283.33	1183.33	41.81
Dressed weight (g/rabbit)	725.23^{ab}	815.67^{a}	748.27^{ab}	650.67^{b}	663.33^{b}	34.85
Dressing percentage (%)	61.16^{ab}	63.55^{a}	58.64^{ab}	50.65^{b}	56.34^{b}	3.04
Cut parts (% of LW)						
Head	9.07^{a}	8.44^{ab}	7.92^{b}	7.92^{b}	8.83^{ab}	0.28
Trotter	1.74^{ab}	1.50^{ab}	1.51^{ab}	1.32^{b}	1.83^{a}	0.12
Loin	8.48	8.11	7.99	7.48	8.16	0.37
Legs	16.12^{ab}	15.69^{ab}	14.77^{b}	17.07^{a}	15.09^{ab}	0.59
Rack	14.73^{ab}	16.37^{a}	14.47^{ab}	12.87^{b}	14.31^{ab}	0.80
Whole GIT	17.00^{b}	14.61^{c}	16.71^{b}	13.77^{c}	20.31^{a}	0.52
Organs (% of LW)						
Liver	2.39^{c}	3.03^{ab}	3.35^{a}	2.61^{bc}	3.08^{ab}	0.16
Kidney	0.64^{b}	0.74^{ab}	0.78^{ab}	0.92^{a}	0.94^{a}	0.05
Heart	0.68^{b}	0.74^{ab}	0.90^{a}	0.92^{a}	0.85^{ab}	0.05

^{abc}Means on the same row with different superscripts differ significantly (P<0.05)
SEM= Standard error of means.
LW=Live weight

Conclusion

Based on the present findings, the inclusion of urea molasses treated rice husk up to 75% in the diets of growing rabbits has no adverse effect on performance and carcass characteristics. Inclusion of the treatedmaize cob can replace wheat offal up to 100% in the diets of rabbits without any negative effect oncarcass parameters.

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