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UTILIZING FARM WASTE IN RABBITS' DIETS: EFFECT ON PERFORMANCE, SERUM AND HAEMATOLOGY

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Abstract

Investigation was conducted on the utilization of farm waste (Maize cob) on growth performance, serum and hematological parameters of rabbits in an 84 days feeding trial. Forty-five rabbits (New Zealand x California) breed, 4 weeks old weighing about 460-480g were allotted into five dietary treatments having nine rabbits per treatment and three replicates of three rabbits each. The diets contained treated maize cob (TMC) at five (0, 25, 50, 75 and 100 %) levels of substitution for wheat offal in a completely randomized designed

Keywords*:* Fibre, Substitution, Treatment, Urea, Weight.

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experiment. Performances data were harvested weekly while blood collection was on 84th day for blood profile analysis. Data obtained were subjected to analysis of variance. Daily weight gain (7.44g) was highest (p<0.05) among rabbits fed treated maize cob with better feed conversion ratio (5.23) in rabbit fed 50% treated maize cob (TMC) as substitute for wheat offal. Similarly, Packed cell volume (PCV) and red blood cell (RBC) increased (P<0.05) for rabbits fed diets containing 50, 75 and 100% TMC. Dietary substitution of TMC irrespective of the levels resulted in higher hemoglobin (Hb) (P<0.05) than the control diet. The lymphocyte count (69.70%) and mean corpuscular hemoglobin (MCH) (23.06g/dl) was highest (P<0.05) for rabbits fed diets containing 75% TMC whereas substitution of 100% TMC in the rabbit's diet gave the highest (P<0.05) total protein (5.20 g/dl), Serum globulin (1.80g/dl) and glucose (101.20mg/dl). It was concluded that rabbit can tolerate substitution of wheat offal with TMC for increased weight gain, better feed efficiency without compromising their health status.

Introduction

The cost and ease of producing most farm product especially of animal origin has become a bane to most producers. The aftermath of the production which is the sales of such products is another hitch as farmers hardly breakeven instead of making profit and this have generated discouragement on farmer's zeal to produce. The possible panacea here could be to see to the possibility of utilizing farm waste in feeding livestock (Mafimidiwo *et al.,* 2023a). Most farm waste has become a menace to farmer to dispose. Maize cob is one of the farm waste that yield 2.09 million metric tons annually in Nigeria (Jansen, 2012; USDA, 2021). This seldom waste is a wealth resources in the oil industry as an absorbent for spilled oil. It can also be of value in ruminant feeding (Yahya, 2016) as well as grounded to form bed in rabbits and poultry pens. Maize cob's high fiber content has limited its incorporation into the diets of fiber-sensitive animals except it is subjected to enzymatic, biological or chemical treatments (Dairo *et al*., 2017; Mafimidiwo *et al*., 2022b). One of the effective usage of maize cob is to be applied as a fiber

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source to substitute for the now well acceptable but expensive wheat offal (Nsa *et al*., 2023). As a result of the low crude protein (7.7%) and high fiber (6%) found in maize cob (Mafimidiwo *et al*., 2022a), it is therefore imperative that suitable chemical treatment that can sprang up the protein and lower the crude fiber content be done so as to fit into the substitution for that of wheat offal's 14.8% crude protein. Ojai *et al* (2007) propounded the use of urea to solubilize the nutrient content of fibrous materials as well as enhance their protein content via its own non-protein nitrogen (Forsberg *et al.,* 2002). The molasses produced from sugar cane is however required whenever urea is to be used to sweetened back the bitterness of urea hence animal can accept it (Khozeimeh *et al*., 2017). Rabbit (*Oryctolagus cuniculus)* is an easy to feed animal that can obtain its nutrients basically from forages. However, subsidizing its diets with a bit of concentrate is required for improved production and performance (Mafimidiwo *et al.,* 2023b). Rabbit meat is unconditionally relished by all and sundry for its low cholesterol, whitish and soft meat. Rabbit consume less feed to yield more carcass weight and had a shorter production life than most other livestock. Therefore, this research utilizes treated maize cob with urea and substituted it for wheat offal in rabbit's diets.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Teaching and Research Farm, Animal Production Technology Department, School of Agriculture, Yaba College of Technology, Epe, Lagos State. The farm is located on latitude 3° 58" E and longitude 6° 47" N which lies in the savannah rain forest zone having annual rainfall and temperature of 1720 mm and 27.4°C respectively (Google Earth, 2023).

Preparation of treated maize cob (TMC)

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

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2mm size sieve and stored in air tight bags until when needed. TMC was prepared by adding 5 litres 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^{0}C to achieve a constant weight.

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

Samples of the untreated and treated maize cob were analyzed 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). The result is presented in Table 1.

Table 1: Proximate composition of the untreated maize cob and treated maize cob

Parameters (%)	Maize	UMC	TMC
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	7.70	12.80
Nitrogen free extract	85.76	75.26	73.00
Gross energy (Kcal/kg)	4250	3640	3795

Experimental animals and management

Forty-five weaned rabbits of 4 weeks of age weighing between 460 – 480g were obtained from Institute of Agricultural Research and Training (IAR&T), Moor Plantation, Apata, Ibadan, Oyo State, Nigeria and were allotted randomly

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into five dietary treatments in a completely randomized design (CRD). There are nine rabbits per treatment, each treatment has three replicates containing three rabbits per replicate. A drinker and feeder each were made available to the rabbits. The formulated diets and clean, cool water were given to the rabbits' *ad-libitum.*

Experimental diets

Five experimental diets were formulated (NRC, 2012) consisting of a control (0% TMC) and four diets with TMC replacing wheat offal at 25, 50, 75 and 100% levels (Table 2).

Table 2: Nutrients and composition of experimental diet (kg/100g DM)

Ingredients	Substitution levels				
	0	**25**	**50**	**75**	**100**
Maize	40.00	40.00	40.00	40.00	40.00
Soybean Meal	18.00	18.00	18.00	18.00	18.00
Fish meal	0.50	0.50	0.50	0.50	0.50
Wheat offal	37.00	27.75	18.50	9.25	-
Treated Maize Cob	-	9.25	18.50	27.75	37.0
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**
Calculated nutrients (%)					
Crude protein	18.21	16.60	16.96	16.92	17.01
Crude Fibre	8.50	8.82	8.63	8.30	5.12
Ether extract	4.62	4.22	3.84	3.42	3.01
Nitrogen free extract	35.38	30.24	29.58	28.33	27.38

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Calculation of Growth performance.

This was done on a weekly basis all through the twelve weeks of the trial. The average daily weight gain, average daily feed intake, feed conversion ratio were all deduced from the weekly measurements obtained. Record of mortality was also kept. (Table 3).

Blood sample collection and analysis.

At the end of the 12th week of the experiment, blood samples were collected from one rabbit per replicate (three rabbits per treatment) for serum and hematology analysis. The blood samples were collected from each rabbit from the external ear vein using a 2mls sterilized disposable syringe. Prior to bleeding, a cotton swab soaked in 70% ethanol was used to dilate the vein and to prevent infection. 2 ml blood was collected into labeled sample bottles containing Ethylene-Diamine-Tetra-Acetic acid (EDTA) as anticoagulant for the determination of haemoglobin (Hb), red blood cells count (RBC), white blood cells count (WBC), packed cell volume (PCV) and differentials. The MCV, MCHC and MCV were also calculated according to Bush (1991). Another set of 2ml of blood samples was collected into labeled sterile bottles without anticoagulant (allowed to clot) which was used to determine the biochemical components (Tables 4 and 5).

Statistical analysis

The data collected were subjected to one-way analysis of variance (ANOVA) in a completely randomized design (CRD) arrangement. The significance means were separated and compared using Duncan (1955) of SAS (1999). The level of significance were considered at 5% level of probability.

RESULTS

Growth performance of rabbits fed diet containing treated maize cob as replacement for wheat offal is shown in Table 3.

There were no significant difference ($p>0.05$) in the final weight, daily weight gain, feed conversion ratio and mortality record. However, there were significant difference ($p<0.05$) in the total feed intake and daily feed intake. The

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average final weight (953.33g) reduced for group of rabbits fed 100% TMC substituted diet. Average daily weight gain was highest (7.44g) for group of rabbits on 50% TMC substituted diet.

Table 3: Growth performance of rabbits fed diet containing treated maize cob as replacement for wheat offal

Parameters	Substitution levels					
	0	**25**	**50**	**75**	**100**	**SEM**
Initial weight (g)	470.83	478.33	468.33	470.83	476.67	33.61
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
Daily weight gain (g)	7.65	6.84	7.44	6.78	5.68	0.66
Daily feed intake (g)	42.40^{a}	40.83^{b}	38.39^{d}	36.87^{e}	39.13^{c}	0.00
Total feed intake (g)	3562.50^{a}	3429.33^{b}	3224.67^{d}	3097.00^{e}	3286.50^{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

^{abcd} means in the same row with different superscripts differ significantly ($p<0.05$) SEM=standard error of mean

Haematological indices of rabbits fed diets containing treated maize cob as replacement for wheat offal is shown on Table 4.

Increased ($P<0.05$) PCV and RBC were observed for rabbits fed diets containing 50, 75 and 100% TMC as replacement for wheat offal. Haemoglobin was significantly ($P<0.05$) lower for rabbits fed control diet compared to other treatments. Rabbits fed 25% TMC diet had the highest ($P<0.05$) WBC count while those fed 75 and 100% TMC had the lowest WBC count. Lymphocyte count

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was highest (P<0.05) for rabbits fed 75% TMC diet while those fed 25, 50 and 100% TMC had the lowest lymphocyte count. Substitution of 25% TMC in the diet of rabbits resulted in increased (P<0.05) basophil count compared to other treatments. Rabbits fed 50% TMC diet had the highest (P<0.05) monocyte count while those fed control diet and those fed 25 and 50% TMC diets had the lowest monocyte count. Mean corpuscular haemoglobin concentration (MCHC) of rabbits fed 25% TMC was lower (P<0.05) compared to other treatments. Mean corpuscular haemoglobin (MCH) increased (P<0.05) for rabbits fed 75% TMC diet while other treatments had reduced MCH. Mean corpuscular volume (MCV) was higher (P<0.05) for rabbits fed 50% TMC compared to other treatments. Dietary substitution of TMC for wheat offal did not significantly (P>0.05) influence neutrophil and eosinophil counts.

Table 4: Effects of treated maize cob on the haematological indices of weaned rabbits (0-12 weeks)

Substitution levels						
Parameters	**0**	**25**	**50**	**75**	**100**	**SEM**
Packed cell volume (%)	29.00^{b}	29.50^{b}	32.50^{a}	31.50^{a}	33.00^{a}	0.40
Red blood cell ($x10^{12}$/L)	4.90^{b}	4.92^{b}	5.25^{a}	5.30^{a}	5.40^{a}	0.05
Haemoglobin (g/dl)	9.85^{b}	10.75^{a}	10.70^{a}	10.70^{a}	10.70^{a}	0.13
White blood cell ($x10^{9}$/1)	4.54^{b}	5.00^{a}	4.30^{c}	3.10^{d}	3.05^{d}	0.06
Neutrophil (%)	31.00	32.00	30.50	30.00	32.30	0.72
Lymphocyte (%)	66.50^{b}	62.50^{c}	63.50^{c}	69.70^{a}	63.50^{c}	0.73
Eosinophil (%)	0.00	0.50	0.50	0.50	0.50	0.23
Basophil (%)	0.50^{b}	1.50^{a}	0.50^{b}	0.50^{b}	0.50^{b}	0.29
Monocyte (%)	1.00^{c}	1.50^{c}	2.50^{a}	0.50^{c}	2.00^{b}	0.17
MCHC (g/dl)	33.90^{a}	30.91^{b}	33.45^{a}	32.75^{a}	32.32^{a}	0.88
MCH (g/dl)	19.25^{b}	19.45^{b}	19.80^{b}	23.06^{a}	19.65^{b}	2.55
MCV (fl)	60.00^{a}	59.50^{b}	60.21^{a}	56.90^{b}	60.10^{a}	0.29

$^{abc:}$ *Means in the same row with different superscripts differ significantly (P>0.05) SEM= Standard Error of Means, TMC= Treated maize cob, MCHC= Mean corpuscular haemoglobin concentration, MCH= Mean corpuscular haemoglobin, MCV=Mean corpuscular volume, WBC= white blood cell.*

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Serum indices of rabbits fed diet containing treated maize cob as replacement for wheat offal is shown in Table 5

Substitution of 100% TMC in the diets of rabbits resulted in the highest (P<0.05) total protein and those fed control diet had the lowest total protein. Serum albumin increased (P<0.05) for the groups of rabbits fed 25, 75 and 100% TMC substituted diets while other treatment groups had reduced serum albumin. The inclusion of 100% TMC in the diet of rabbits had the highest (P<0.05) globulin while those fed 25% TMC substituted diets had the lowest globulin. The serum glucose was highest (P<0.05) for rabbit group fed 100% TMC diet and lowest for rabbit group fed 25% TMC diet while the groups fed control diet, 50 and 75% TMC diets had intermediate glucose content.

Table 5: Effects of treated maize cob on the serum indices of rabbits (0-12 weeks)

Parameters	Substitution levels					
	0	**25**	**50**	**75**	**100**	**SEM**
Total protein (g/l)	3.95^{c}	4.45^{b}	4.03^{b}	4.50^{b}	5.20^{a}	0.06
Albumin (g/l)	2.40^{b}	2.96^{a}	2.46^{b}	2.95^{a}	3.40^{a}	0.10
Globulin (g/l)	1.55^{b}	1.49^{c}	1.57^{b}	1.65^{b}	1.80^{a}	0.04
Glucose (mg/l)	99.60^{ab}	96.45^{c}	97.40^{b}	97.80^{b}	101.20^{a}	0.49

$^{abc:}$ *Means in the same row with different superscripts differ significantly (P>0.05)*
SEM= Standard Error of Means, TMC= treated maize cob

DISCUSSION

The no significant difference reported for final weight, daily weight gain, feed conversion ratio and mortality recorded in this experiment translated to mean that there is nutrient adequacy available to the rabbits irrespective of the substitution level of the TMC for wheat offal. This is in tandem with the report of Sobayo *et al*., (2021) that fed rabbits with maize milling waste and recorded no hazardous effect. Daily feed intake was highest (42.40g) for rabbit on the control diet although the values observed across the treatments were within the range reported by Taiwo *et al*. (2021) for rabbits of the same weight. The feed conversion ratio (FCR) across the treatments had no significant difference

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($p<0.05$). This agrees with the report of Doma *et al*. (1995) who fed rabbits with diet containing treated cowpea husk. Meanwhile, best FCR (5.23) was observed for rabbits fed 50% TMC substituted diet. No mortality was observed for the 0, 25 and 50% TMC substituted diets but a no fatality record of mortality was recorded in rabbits on 75 and 100% TMC substituted diets.

The increased PCV and RBC observed for rabbits fed diet containing 75 and 100% TMC indicates that the diet is rich in nutrients especially protein which is essential for growth and development. Haematological indices of livestock have been observed as factors determining the response of livestock to the diet they are fed with (Khan Zafar 2005; Madubuike and Ekenyen 2006). The haematological components (PCV, RBC, WBC, Neutrophils, Lymphocytes and Eosinophils) determined were within the normal physiological ranges reported for rabbits of same age (Hillyer 1994; Nuhu 2010). Haemoglobin concentration increased with substitution of TMC irrespective of the substitution level which implies that the substitution of TMC for wheat offal did not impact nutrient availability negatively. Bawala *et al*. (2007) stated that reduced haematological values such as PCV, Hb concentration and RBC counts could be due to the harmful effects of high dietary fibre content but this is not the case in this study. The improved values obtained in this study could be attributed to the positive influence of TMC in the diets. The WBC count reduced for group of rabbits fed diets containing 50, 75 and 100% TMC and this suggests that the rabbits were not challenged with harmful microorganisms. However, these WBC values were below the values reported by Hillyer (1994). The reduction in count of WBC shows the suppression of leucocytes and their production from bone marrow which may affect the rabbit's resistance to diseases (Odesanmi *et al*., 2010). The reduced WBC values observed in the group of rabbits in this study may not necessarily weaken the resistance to disease because increased WBC could be initiation of disease resistant cells through the process of phagocytosis. The WBC differentials did not follow a specific pattern. The lymphocyte count increased for rabbits fed diets containing 75% TMC while those fed 25, 50 and 100% TMC diets had reduced lymphocyte count. Basophil

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and monocyte count did not also follow a specific pattern. This observation further implies that increase in WBC count or its differentials may not necessarily indicate disease invasion. Rabbits fed diets containing 50, 75 and 100% TMC had similar MCHC with those fed control diet. It was also observed that group of rabbits fed diets containing 50 and 100% TMC had similar MCV with the group fed control diet. This suggests that the dietary inclusion of TMC did not have adverse effect on the blood profile of the rabbits. The values of MCH, MCV and MCHC are important haematological parameters that serve as indicators of anaemic condition (Campbell and Ellis, 2007). Therefore, the similar values in MCHC and MCV of rabbits fed diets with TMC with those fed control diet indicates that dietary substitution of TMC did not pose any health threat to the rabbits.

Serum biochemical parameters provides useful information for the evaluation of health status and reflects many metabolic alterations when feeding unconventional feed sources (Kudair and Al-Hussary 2010). The total protein increased for rabbits fed diets containing 100% TMC and serum albumin also increased for group of rabbits fed 25, 75 and 100% TMC diets which suggests better nutrient availability and utilization. The values for total protein and albumin ranged from 3.95 to 5.20 g/L and 2.40 to 3.40 g/dl respectively. Total protein values obtained were slightly lower than the reference values of 5.4 – 7.5 g/dl reported by Hillyer (1994) and albumin values were within the reference range of 2.5 to 4.0 g/dl recorded by Anon (1980). The serum globulin increased for rabbits fed diet containing 100% TMC. The serum globulin values of 1.49 to 1.85g/dl recorded in this trial were within the ideal range of 1.30 to 2.0g/dl reported by Njidda and Isidahomen (2011). The values for albumin and globulin obtained in this study indicate nutritional adequacy of the dietary proteins in the diets used for the weaned rabbits. The serum glucose also increased for rabbits fed diet containing 100% TMC and the values ranged from 96.45 – 101.20 mmol/l which were in the same range of values reported by Igwebuike *et al* (2008) for rabbits fed diets containing *Acacia albida* pod. The higher values obtained in 100% urea molasses treated maize cob (101.12mg/dl) were in

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agreement with the report of Onifade and Tewe (1993). The increased glucose observed for rabbits fed 100% TMC diet indicates availability of energy for proper metabolic and biochemical processes. In addition, Mayes (1996) observed that continuous supply of glucose is necessary as a source of energy especially for the nervous system and the erythrocytes.

CONCLUSION/RECOMMENDATION

The research concluded that rabbits can easily make use of treated maize cob in place of wheat offal better at 50% level of substitution for optimum growth performance while for better serum and haematology, dietary substitution of TMC has no negative effect on the rabbit's health status.

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