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Performance of Yankasa Ram Fed Locally Produced Mineral Blocks Supplement and Wasted Fruit Molasses as a Binder in Semi-Arid Environment of Maiduguri Nigeria

Marte[1] A.A., Jibrin[2] T.A., Mustapha[1] A., Benisheikh[1] A.A and Gava[1] I.A
[1]Department of Animal Production Technology, Ramat Polytechnic, Maiduguri, Borno State, Nigeria
[2]Department of Animal Science, University of Maiduguri, Maiduguri, Borno State, Nigeria

Abstract: *The 90 days feeding trial was conducted to determine the performance of Yankasa Rams fed multi-mineral block with fruit waste molasses as a binder. A total of thirty (30) yankasa rams of the non-descript breed was used for this study, the animals were allocated to treatments constitute a 4 x 3 factorial experimental design, four (4) animals were randomly allocated to each treatment each treatment were replicated twice with two rams per replicate. F1 as control (sugar cane molasses), while (F2 (mango fruit waste), F3 (orange fruit waste), F4 (pineapple fruit waste) and F5 (water melon fruit waste) respectively) the animals were balanced for weight before commencement of the experiment and weighed weekly thereafter throughout the experimental period. The experimental diets were offered at 4% of body weight while groundnut haulm was fed ad libitum as basal diet. Feed intake was determined as the difference of the amounts of feed offered and the refusals. The experiment lasted for 90 days (13 weeks). The rams were weighed individually on weekly basis using a hanging weighing balance to estimate body weight change. Feed conversion ratio was measured using mean feed intake (kg) divided by mean body weight gain (kg). The results of all the growth parameter measured shows no significant difference (P< 0.05) among the various treatment groups however, all treatment group are not affected by the treatment diet.*

Keywords: *Yankasa Ram, Mineral Blocks, Wasted fruit, Molassess, Binder.*

Background of the study

Ruminants, such as sheep and goats, play a crucial role in tropical meat production, as acknowledged by Bernstein et al. in 2018. Adu and Ngere (2019) found that in Nigeria, including unregistered rural slaughters, 11% of the meat comes from sheep, while goats contribute approximately 20% to the country's meat supply. Globally, small ruminants account for 35% of total meat production. In southern Nigeria's rural areas, small ruminant meat is significant, although urban areas favor beef consumption over small ruminant meat by a factor of eight (Nomanah and Shadeik, 2015).

However, one of the most pressing challenges facing agricultural nations, particularly those with ruminant production, is the nutritional deficiency in livestock, as highlighted by Nomanah and Shadeik (2015). This issue becomes more critical as the global population continues to grow rapidly, while the available land for producing animal feed diminishes at an alarming rate (Bernstein, Fitzhugh, and Knipscheer, 2018). Feeding ruminants during the dry season is a major obstacle in West Africa's Semi-arid Area, as reported by Abbator *et al.* (2000). The prolonged dry season leads to a decline in both the quality and quantity of available grasses, which are the primary source of feed for ruminants. Furthermore, the nutrient content of these grasses decreases during this period (Crowder and Chheda, 1982), and they are deficient in phosphorus and energy (Norman, 1966). Even with adequate forage availability, reduced animal growth and reproductive issues are prevalent, likely due to the low mineral concentrations in the soil and associated forages (McDowell, 1997).

Materials and Method

Experimental Site

The experiment was conducted at the Ramat Polytechnic Teaching and Research Farm, Maiduguri. Maiduguri lies within latitude $11^0$50'N and longitude $13^0$09'E and has an elevation of 320m above mean sea level (BOSHIC, 2007). The mean ambient temperature could be as low as 23^0C during the harmattan season and gets as high as 40^0C or more during the hot season. The relative humidity is about 45% in August, which usually drops to about 5% in December and January and evaporates 203 mm/year. Day length varies from 11 to 12 hours (BOSHIC, 2007).

3.2 Methodology

This research was involve collection and determination of the chemical composition of the ingredients, local mineral ingredients and formulate and produce the mineral blocks using the listed ingredients. Finally, we determine the effects of feeding multi mineral blocks produced on fattening Rams.

3.3 Collection of test ingredients

The local ingredients that was used in the experiment consist of Salt, Potash, Bone Meal, and Lime Stone was purchased from local markets within Maiduguri metropolitan council. Eggshell was sourced locally from Poultry farmers, restaurants and bakeries was heated for Antisepsis. At the same time, Wood ash was prepared locally from firewood.

Fresh feed samples was sundried properly. For chemical analysis, all samples was ground to pass through a 1mm sieve. For the study, ground feed sub samples was stored in labelled polyethene bags for Chemical Analysis (Table 4) Shows the local feed ingredients that was used in this study. Sub-samples was taken from each Mineral block produced and oven dried until a constant weight is obtained. It was then be stored in an air-tight container for chemical analysis.

3.4 Determination of minerals

All the ingredients to be used for this study was analyzed for Ca, P, Mg, K, and Na. This was carried out as described by Kruis (2002).

3.4.1 Ash

The samples was incinerated at 550 – 600 °C for two (2) hours. After removal, they was kept in a desiccator, and the weight of the crucible was also be taken.

$$\text{Percentage of total Ash} = \frac{\text{weight of Ash x 100}}{\text{Weight of sample on dry matter basis}}$$

3.4.1.1 determination of calcium and magnesium

The digest was pipetted at 10 ml into 250 ml conical flask, 100 ml of distilled water, 30 ml of buffer solution and ten drops each of potassium cyanide solution (KCN), hydroxylamine-hydrochloric solution (NH_2OH HCl), potassium ferrocyanide solution ($K_4Fe(CN)_6$) and TCa were all added and allowed for a few minutes for the reaction to take place. About 10 drops of EBT indicator wasalso be added and titrated the solution with 0.01N Na_2 EDTA to a permanent blue colour at end point. Calcium alone was determined using trimetric method by pipetting l0 ml of the digest in a clean 250 ml conical flask. 10 drops each of potassium cyanide solution (KCN), hydroxylamine — hydrochloric solution ($K_4F_e(CN)_6$) and TCa was added to 20 m1 of sodium hydroxide to rise pH to 12 or slightly higher. A pinch of mireoxide indicator and titrate the solution with 0.01 N disodium ethylenediamine tetra — acetic acid was added to change colour to reddish violet colour.

$$\%\text{Ca} = \frac{\text{a xTCa xV1}}{\text{WxV2}} \times 100$$

Where

a = ml of EDTA used for titration of sample

TCa = titration factor of EDTA against Ca = 0.0002004

Tmg = titration factor of EDTA against Mg = 0.0001216

VI = total volume of digest

V2 = mls of digest used for analysis.

W = weight of sample taken for digestion used.

3.4.1.2 determination of sodium

1. Take the sample material and prepare a digest by adding it to a suitable solvent.
2. Pipette 10 ml of the digest into a 250 ml conical flask.
3. Add 100 ml of distilled water, 30 ml of buffer solution, and ten drops each of potassium cyanide solution (KCN), hydroxylamine-hydrochloric solution (NH2OH HCl), potassium ferrocyanide solution (K4Fe(CN)6), and TCa.
4. Allow the mixture to react for a few minutes.
5. Add about 10 drops of EBT indicator to the solution.
6. Titrate the solution with 0.01N Na2 EDTA until a permanent blue color is reached, indicating the end point of the titration.
7. From the titration, record the volume (in ml) of EDTA used.

To calculate the amount of sodium in the material, we can use the following formula:

$$\%\text{Na+} = \frac{(\text{ppm off curve} - \text{blank x d. f x V})}{1000 \times W!}$$

- ppm off curve: The sodium concentration in ppm obtained from the standard curve.
- blank: The sodium concentration in ppm obtained from the standard curve for the blank solution (without sodium).
- d.f: The dilution factor, representing any dilution of the sample before measurement.
- V: The total volume of the digest (in ml).

- w: The weight of the plant material used for analysis (in grams).

By substituting the appropriate values into this formula, you can calculate the percentage of sodium (%Na+) in the material using the flame photometric method. This method involves the reaction of the sample with various solutions and the subsequent titration with Na2 EDTA to determine the sodium concentration.

3.4.1.3 Determination of phosphorus

1. Start by pipetting 24 ml of the digest into a 25 ml volumetric flask.
2. Add 5 ml of distilled water and 5 ml of vanadomolybdate reagent to the flask.
3. Dilute the solution up to the mark of the 25 ml volumetric flask.
4. Allow the solution to stand for at least 10 minutes for color development. The color is soluble within 24 hours only.
5. Read the absorbance or percentage transmittance of the solution at a wavelength of 400 nm.
6. Create a graph of percentage transmittance against concentration in ppm using known concentrations of phosphorus to establish a standard curve.

Now, let's examine the formula for calculating the concentration of phosphorus (PPm):

$$\mathrm{PPm} = \frac{(\mathrm{a} - \mathrm{b})\ \mathrm{x}\ \mathrm{df}\ \mathrm{x}\ \mathrm{v}}{(\mathrm{w}\ \mathrm{x}\ \mathrm{y}\ /\ \mathrm{t}\ \mathrm{x}\ 10{,}000)}$$

- a: The phosphorus concentration in ppm obtained from the standard curve for the sample digest.
- b: The phosphorus concentration in ppm obtained from the standard curve for the blank.
- df: The dilution factor, which represents the dilution of the sample before measurement.
- v: The volume (in ml) and after color development.
- w: The weight (in grams) of the plant sample.
- y: The volume (in ml) of the digest used.
- t: The total volume (in ml) of the digest used for analysis.

By substituting the respective values into the formula, you can calculate the concentration of phosphorus in ppm. This formula takes into account the phosphorus concentration in the sample digest and the blank, as well as the dilution factor, volume, weight, and total volume used for analysis.

Regenerate response

3.4.1.4 Determination of potassium

1. Utilize the flame photometric method to determine the concentration of potassium (K) in parts per million (ppm) for each sample. This measurement can be obtained from the standard curve, which relates the intensity of emitted light from potassium ions to their concentration.
2. To calculate the amount of potassium in the digest, you have two options:
   a. Option 1:

$$\%K = \frac{(\mathrm{PPm\ off\ curve\ x\ d.f})}{(10{,}000\ \mathrm{x\ w})\mathrm{x}\ 100}$$

- PPm off curve: The concentration of potassium in ppm obtained from the standard curve.
- d.f: The dilution factor, which accounts for any dilution of the sample before measurement.
- w: The weight of the plant sample in grams.

b. Option 2:

$$\%K+ = \frac{(\text{PPm x v / w x d. f})}{10{,}000}$$

- PPm: The concentration of potassium in ppm obtained directly from the sample digest.
- v: The total volume of the digest in milliliters.
- w: The weight of the plant sample in grams.
- d.f: The dilution factor, which accounts for any dilution of the sample before measurement.

By substituting the appropriate values into either of these formulas, you can calculate the percentage of potassium (%K) or potassium cations (%K+) in the digest. The formulas take into account the potassium concentration obtained from the standard curve or directly from the sample digest, the dilution factor, the weight of the plant sample, and the total volume of the digest.

Table 1: Mineral ingredients for block formulation

Categories	Minerals sources
Feed ingredients	Bone Meal
	Egg Shell
	Potash
	Wood Ash
	Salt
	Lime Stone

3.5 Formulation and production of Multi Mineral Block using locally available ingredients.

3.5.1 Sources of feed ingredients

The local mineral sources as mentioned in Table 1, was used in the experiment consisting of salt, potash, bone meal, and Lime stone was purchased from local markets. Eggshell was sourced locally from poultry farmers/bakeries and restaurants was heated for Antisepsis, while Wood ash was prepared locally from known fire wood users/ centres.

3.5.2 Formulation of Mineral Blocks

From the ingredients (bone meal, eggshell, potash, wood ash, salt, and limestone) five formulations was produced with varied levels of the ingredients of the ingredients.

3.5.3 Method of production

The cold process was used for the production of the multi mineral blocks for this study.

3.5.4 Mixing of ingredients

The raw materials was mixed manually but thoroughly in a 200 L drum cut to a height of 50 cm. A batch of 20 kg (ingredients) was mixed in order to get a homogenous mixture as

recommended by Mohammed *et al*. (2007). The mixing was done as described by Aarts *et al*. (1990).

3.4.5 Moulding of the Blocks

After preparation of a homogenous mixture, the content was placed in a wooden container mould lined with a polythene sheet and pressed manually using hand in compartment measuring 15 x 15 x 10 cm (Mohammed *et al.*, 2007). The polythene sheet lining the inner surface of the wooden mould is to facilitate and remove smoothly the multi-mineral blocks when formed. Removal of the blocks was done by knocking the sides of the moulds gently after the block materials have settled and partly dried.

Table 2 Formulations of the Multi Mineral Blocks with graded levels of bone meal

	F1	F2	F3	F4	F5
Bone Meal	0	10	20	30	40
Egg Shell	40	30	20	10	0
Potash	0	5	10	15	20
Wood Ash	20	15	10	5	0
Salt (NaCl)	4	4	4	4	4
Lime Stone	10	10	10	10	10
Acacia Albida Pods	26	26	26	26	26
	100	**100**	**100**	**100**	**100**

3.4.6 Drying of Blocks

After Molding, the blocks was air-dried; and was arranged and allowed to dry in an open space under shade. A dry environment was maintained for proper and quick drying of the blocks

3.5 Performance of Fattening Rams supplemented with Multi–Mineral Blocks.

3.5.1 Experimental Animals and their management

The study wasutilize a total of thirty (30) Rams of the non-descript breed as experimental animals. These animals was obtained from Kasuwan Shanu Livestock Market in Maiduguri, Borno State. Prior to the start of the experiment, the animals wasundergo deworming using Ivermectin 5% to combat both internal and external parasites. The dosage was administered at a rate of 1ml per 50kg of body weight.

Additionally, a long-acting base of Oxytetracycline, a broad-spectrum antibiotic, was given at a rate of 1ml per 10kg of body weight. To reduce stress levels, a multivitamin injection was also be provided for three consecutive days, with a dosage of 1ml per 10kg of body weight.

Before the commencement of the experiment, the animals was undergo a one-week adaptation period. During this time, the diet formulation was consist of Sixty percent (60%) maize husk and wheat offal as a variable ingredient, while groundnut haulm 10%, cowpea husk 15% and cotton seed cake 15% was included in proportions to constitute the remaining fourth

percent (40%). This formulation result in a 14% crude protein (CP) diet. The diets was offered to the animals at a rate of 4% of their body weight. To ensure proper ventilation, the animals was housed in pens equipped with wide windows, which allow for adequate airflow and ventilation within the pens.

3.6 Experimental Design and Feeding

The thirty (30) animals was allocated to 6 treatments with 5 replicates Mineral Block. The animals was randomly allocated in Completely Randomized Design. The animals was balanced for weight before the commencement of the experiment and weighed weekly after that throughout the experimental period. The experimental diets: Forty (40%) of maize husk as a fixed ingredient while wheat offal, groundnut haulm and cotton seed cake in varying proportion was form the 60% in formulating a 14% CP diet, and diets was offered at 4% of body weight. In contrast, sorghum husk was fed *ad libitum* as a basal diet. Feed intake was determined as the difference between the amounts of feed offered and the refusals. The experiment was last for 90 days.

3.7 Data collection

3.7.1 Measurements of productive parameters

3.7.1.1 Feed intake

Feed consumption from each treatment was measured daily by subtracting leftovers from feed served per sheep. Adequate measures was taken to safeguard against spillage and related wastage.

3.7.1.2 Weight change

The rams were weighed individually weekly using a hanging balance to estimate body weight change.

3.7.1.3 Feed conversion ratio

The feed conversion ratio was measured using the formula below:

$$\text{Feed conversion ratio} = \frac{\text{Mean feed intake (kg)}}{\text{Mean body weight gain (kg)}}$$

3.7.1.4 Water intake

Daily water intake was obtained by subtracting the leftover from the total water supply.

3.7.1.5 Blood sample collection for haematological parameters and serum biochemistry determination

At the end of the feeding trial, three (3) animals from each treatment were fasted overnight (12 hours) and bled in the morning (7:00 – 8:00 am) to avoid excessive bleeding. The fasting of animals is to avoid the temporary elevation of blood metabolites following feeding (Jain, 1986). Blood samples was collected from each animal using a sterilized disposable 5ml syringe. Two sample bottles was used; one contains ethylene diamine tetra–acetic acid (EDTA), and the other is blank. The sample blood collected in EDTA was used for haematological studies, while the sample in plain bottles was used for serum biochemistry analyses. The samples in the test tubes was centrifuged for five minutes to separate the serum from the blood for serum biochemical indices.

3.7.1.5.1 Haematological parameters

Packed cell volume (PCV), red blood cell (RBC) count, white blood cell (WBC) counts, Leucocytes differential counts, and haemoglobin concentration (HB) was determined following the methods outlined by Bush (1991).

Erythrocyte indices which include the mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), was computed following the standard formulae of Schalm *et al.* (1975) and Jain (1986) as shown below:

$$\mathrm{MCV} = \frac{\mathrm{PCVx}}{\mathrm{RBC\ Count\ in\ 106/mm3}}$$

$$\mathrm{MCH} = \frac{\mathrm{Hb\ (g/dl)PCVx}}{\mathrm{RBC\ (in\ 106/mm3)}} x10$$

$$\mathrm{MCHC} = \frac{\mathrm{Hb\ (g/dl)}}{\mathrm{PCV\ (\%)}} x100$$

3.7.1.5.2 Serum biochemical analysis

Nessler's reaction wasestimate the blood urea concentration (Tanis and Naylor, 1968). The biuret method wasestimate total serum protein, as Kohen and Allen (1995) described. Albumin was determined by Bromo Cresol Green (BCG) method (Peter *et al*., 1982), while the difference between total protein and albumin wasdetermine globulin concentration. The albumin/globulin ratio was calculated by dividing the albumin value by the globulin value. Aspirate aminotransferase (AST), Alanine Aminotransferase (ALT), and alkaline phosphate (ALP) activities was determined using the spectrophotometric method, as described by Rej and Hoder (1983). Total bilirubin was determined using orbital techniques as described by Stone (1954). The serum glucose was estimated by the orthotoliudine method. In this method, protein was first precipitated by trichloroacetic acid. The glucose in the filtrate reacts with orthotoliudine reagent to give a green colour; this was measured in a photoelectric colourimeter at a wavelength of 630 nm.

$$\mathrm{Concentration\ of\ glucose(mmol/l)} = \frac{\mathrm{AT}}{\mathrm{AR}} \mathrm{x}\ 200$$

Where:

AT = Absorbance of the taste sample.

AR = Absorbance of the reference sample

3.8 Statistical Analysis

All data collected was subjected to analysis of variance (ANOVA) in a Completely Randomized Design using Statistix 10.0 software. Significant differences between means was compared using the Duncan Multiple Range Test (DMRT).

Results and Discussion

Proximate Composition of the Experimental Diet

The chemical composition of the individual feed ingredients is presented in Table 3. Dry matter content of the treatments ranges between (86.00%) in F1 and (88.00%) in F5. This dry matter content indicates all constituents excluding water of the ingredients used in the formulation. The value is comparable to the range obtained elsewhere for based diets as reported by Tona *et al*., (2014). CP level decreases as the minerals concentration increases. Crude protein (CP) content was higher in F1 (8.0 %) and lower in F3 (12.00%). However, the crude protein values recorded for diets in this study were within the critical range of 8 to 12% reported (Isah *et al*., 2012). The highest value of ether extract (EE) was obtained in diet F2 (10.00 %) and the lowest was recorded in diet F1 (9.00). Higher ether extract has the tendency to reduce dry matter feed intake and may decrease effective digestibility. Hence having this diet formulation will be an added advantage to the animal fed with the diets. It has been reported that NDF content of feed can be used to predict the feed intake since it measures the total fibre component of feed.

Table 3. Proximate composition of the experimental diets

Constitutes	F1	F2	F3	F4	F5
Dry Matter	86	87	86	86	88
Crude Protein	8.0	11	9.0	10	12
Ether Extracts	9.0	12	10	11	10
Crude Fibre	15	18	17	19	18
Ash	3.0	3.5	4.5	4.0	4.5
Nitrogen Free Extract	42	42.5	45.5	47	42

Table 4. Growth performance of Rams fed Locally Produced Mineral Blocks Supplement

Parameter	F 1	F 2	TF3	F4	F5	SEM
Induction body weight (kg)	21.39	21.91	23.92	21.91	21.39	2.56^{NS}
Body weight gain (kg)	12.10	13.09	13.61	14.09	12.28	2.22^{NS}
Average daily gain (g/day)	192.10	207.70	216.10	223.6	194.90	35.20^{NS}
Feed intake (g/day)	896.00	983.00	973.00	931.0	911.00	77.00^{NS}
Feed conversion ratio (g/g)	4.71	4.89	4.67	4.23	4.65	0.95^{NS}

SEM=Standard error of mean, NS= Not significant.

The results of all the growth parameter measured shows no significant difference (P< 0.05) among the various treatment groups however, values for F4 where numerically higher than the others, which could be due to higher inclusion level of the minerals.

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