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Research Article

Study on mineral, antinutrient and blood parameters of goats fed molasses treated rice husk

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Abstract

A study on the nutritional potential of rice husk treated with or without molasses was carried out using 25 West African Dwarf (WAD) bucks. Five experimental diets were formulated such that; 0, 1, 2 3 and 4% molasses were incorporated in goat diets and were fermented for 5days before being fed to 25 WAD bucks of 5 replicates per treatment in a Completely Randomized Design experiment for 84 days. Results showed that, dietary treatments had significant (P<0.05) influences in all the parameters observed. Diet 5 had the highest crude protein (11.29%CP) and least crude fibre (26.51% CF). However, the dietary ash varied from 11.29% (Diet 5) to 19.84% (Diet 1). The mineral contents (Ca, P, Mg, K) of the diets progressively increased with increased inclusion of molasses and were adequate to support the growth of goats. The highest values were recorded in Diet 5 except for sodium which declined across the treatment. The anti-nutrients contents observed in this study were least in Diet 5 with exception of phenol which had the highest value (23.66%). Dry matter intake (DMI) varied from 466.86g/day (Diet 5) to 452.47g/day (Diet 1). Meanwhile, CPI increased with increased molasses in the diet. Bucks fed Diet 5 had the best mineral retention values and best daily weight gain (68.00g/day) as (6.86) feed gain ratio was the least. Consequently, treatment of rice husk with molasses at 4% inclusion level could improve the general performance of WAD bucks without any adverse effect on their health status.

Keywords: Rice husk, Buck, Weight gain, Serum minerals, Ruminant Farmers

Introduction

Rice is grown on every continent except Antarctica region and covers 1% of the earth’s surface. It is a primary source of food for billions of people and ranks second to wheat in terms of area and production (FAO, 2002). During milling of paddy, about 78% of weight is received as rice, broken rice and bran, while the rest 22% of the paddy is received as rice husk (Aderolu *et al.,* 2007), the highest quantity of this by-product has not been used to its maximum, which serves as a nuisance to public health in terms of pollution because majority of these wastes are being burnt. But if this large quantity of rice husk being produced can be channelled into animal feeding, it will not only reduce the cost of production of ruminant but will also serve as an alternative to the major nutritional limitation often encountered in feeding ruminant in the tropics with poor quality and quantity of feed available during the extended dry season, and this will in turn increase the protein intake of Nigerians which is presently very low. Traditionally, rice husk has been used as ingredient in ruminant and poultry feeds but the problem of low nutrient digestibility, high silica/ash content and abrasive characteristics are the limiting factors in its utilization. According to Aderolu *et al.* (2007) rice husk is composed of 96.4%DM, crude protein (2.0-3.6%), oil (8-12%), crude fibre (39-48%) and ash (15-22%). Rice is a good source of carbohydrate, calcium, protein, phosphorus and iron. Most of the nutrients and minerals in rice are concentrated in the outer brown layers known as husk and germs. The mineral content of rice husk has been shown as 0.04% calcium, 0.06% phosphorus (Omotola and Ikechukwu, 2006).

However, anti-nutritional factors (ANFs) can have beneficial or deleterious effects on organisms consuming them. These compounds are known to inhibit nutrient and mineral availability and absorption by animals. But ANFs at tolerable levels, do not exert adverse effects in ruminants because they are degraded in the rumen (Cheeke and Shull, 1995). But then, molasses is a good source of trace minerals, the protein and vitamin level is quite low. It is used often to stimulate eating, to reduce dustiness in feeds, as a pellet binder, and when fortified with a nitrogen source, as a ruminant feed known as a liquid protein supplement (Figueroa and Ly, 1990). Fermentation and bread leavening (using yeast) can help to break down phytic acid due to the activation of native phytase enzymes, reducing the number of phosphate groups. Baker's yeast is the common name for the strains of yeast commonly used as a leavening agent in baking bread and bakery products, where it converts the fermentable sugars present in the dough into carbon dioxide and ethanol. Baker's yeast is of the species *Saccharomyces cerevisiae*, which is the same species (but a different strain) commonly used in alcoholic fermentation, which is called brewer's yeast. Baker's yeast is also a single-cell microorganism found on and around the human body (Tony, 2013). Haematology, being a branch of medicine devoted to the study of blood, blood-producing tissues and diseases of blood could be a good indicator to detect various blood diseases and determine the health status of an animal. Thus, this study concerns itself on the nutritional qualities of different levels of molasses treated rice husk on anti-nutrient and mineral utilization by goats; and their concomitant effects on their health status.

Materials and methods

Study Area

The research was carried out at the Small Ruminant Unit of the Teaching and Research Farm, Federal University of Technology, Akure (Latitude 7^0 18" and Longitude 5^0 10''E) (NMA, 2014) while the chemical analyses were carried out at the Nutrition Laboratory of the Department of Animal Production and Health of the same University.

Collection and processing of feed ingredients

Rice husk was collected from rice milling industry in Ogbese, Ondo State, Nigeria and molasses were sourced from a reputable feedmill industry in Ibadan, Oyo State, Nigeria. Common Salt and yeast are purchased at open market in Akure, Ondo State. Rice husk were divided into five (5) portions, then were mixed with molasses at 0% (control), 1%, 2%, 3% and 4% respectively and were fermented for five (5) days to degrade the fibre content.

Fermentation process

Each portion of the thoroughly mixed rice husk and graded levels of molasses were packed in an air-tight container lined with polythene nylon/bag and sealed for five (5) days to enhance anaerobic biochemical reactions.

Procurement and Adaptation of WAD Bucks

A total number of twenty five male West African Dwarf bucks of 1 - 2 years of age with an average live-weight of 12.99 ± 0.08kg were purchased from an open market in Itaogbolu, Akure North Local Government Area, Ondo State. The goats were quarantined and acclimatized for a period of twenty-one (21) days during which routine managements like feeding of concentrate and grasses. The animals were stabilized and vaccinated against Peste-Petit de Ruminante (PPR / Kata) using Tissue Culture Rinderpest Vaccine to confer immunity on the bucks at the rate of 1ml per animal, treated against ecto- and endo- parasites using ivermectin and were also treated against infections using broad spectrum antibiotics - oxytetracycline LA® at the rate of 1ml per 10kg body weight of animal.

Diet Formulation

Five experimental diets were formulated such that molasses were incorporated in the rice husk based-diets at 0, 1, 2, 3 and 4% respectively (Table 1).

Table 1. Gross composition of experimental diets fed to WAD buck

Ingredient (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Rice Husk	96.00	95.00	94.00	93.00	92.00
Molasses	0.00	1.00	2.00	3.00	4.00
Salt	1.00	1.00	1.00	1.00	1.00
Yeast	3.00	3.00	3.00	3.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Experimental Animal and Management

The twenty five (25) WAD bucks were assigned to five (5) dietary treatments of five (5) replicate. The animals were housed individually in pen measuring 1.8 x 0.5m. An acclimatization period of 7 days was allowed before commencement of data collection. Animals were fed the experimental diets early in the morning (8:00am) and supplied potable water *(ad libitum)* throughout the experimental period of eighty-four (84) days. The daily feed intake was determined by deducting the leftover from the quantity supplied.

Growth Performance

The animals were weighed before the commencement of the experiment and were repeatedly weighed weekly in the morning before feeding to observe any weight change using spring balance (hanging scale).

Blood Collection

Blood sample of about 10ml was collected from each animal through the jugular vein puncture at the end of the experiment. Blood coagulation was prevented by the addition of little quantity of Ethylene Diaminetetra Acetate Acid (EDTA) into the bottle where the blood was collected and another bottles were used to harvest the blood serum. The whole blood were used for haematological studies (PCV, WBC, MCHC etc) while the serum were used for biochemical (Total protein, Globulins, Aspartate Aminotransferase etc) and mineral (Ca, P, Na, etc) analysis according to Cork and Halliwell, (2002).

Faecal and urine collection

Total faeces voided were collected in the morning before feeding and watering during last 7 days of the experiment. The faeces was weighed fresh and 10% of the total faeces collected from each animal was taken and oven dried at 105^0C for 48 hours to determine the moisture content of the faeces. The faecal sample was thoroughly mixed and milled to pass through a 2mm sieve and sealed up in polythene bags. These were all stored in at room temperature until required for analysis. Urine was collected in a bucket placed under the cages, into which 25% of concentrated H_2SO_4 was added to immobilize ammonia from being volatized from the urine. The volume of urine expelled by each animal per day was recorded. 10% of the total urine excreted by each animal was collected and subjected to chemical analysis.

Digestibility trial

Apparent digestibility of the diets was calculated as difference between nutrient intake and excretion in the faeces expressed as percentage of nutrient intake while nitrogen retained by the animals was calculated as difference between nitrogen intake and nitrogen excreted.

The nitrogen free extract (NFE) was calculated as %NFE = 100- (%MC + %CP + %CF + %EE + %Ash). Meanwhile, the gross energy (G.E.) of the diets was determined by the methods of Ekanayake *et al.* (1999) as follows: G.E. (KJ/100gDM) = %CP × 16.7 + %lipids × 37.7 + %CHO × 16.7.

Proximate analysis of feed, faeces and urine

Air-dried sample of feed sample and feaces from all the experimental bucks were analysed for proximate, anti-nutrients and minerals composition according to AOAC (2002) procedures.

Table 2. Nutrient composition of the experimental diets fed to WAD bucks

Nutrients (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Dry matter	92.91^{a}	92.62^{a}	92.08^{a}	91.18^{b}	90.58^{c}	3.03
Crude Protein	6.88^{e}	7.47^{d}	8.49^{c}	9.99^{b}	11.29^{a}	0.02
Crude Fibre	30.99^{a}	29.52^{b}	28.71^{c}	27.88^{c}	26.51^{d}	0.04
Ether Extract	4.14^{e}	4.89^{d}	5.30^{c}	5.37^{b}	5.65^{a}	0.03
Ash	19.84^{a}	19.54^{a}	17.25^{b}	14.33^{c}	11.29^{d}	0.03
Nitrogen free extract	31.06^{c}	31.20^{c}	32.33^{bc}	33.61^{b}	35.84^{a}	0.85
Gross energy (KJ/100gDM)	13.12^{c}	13.21^{bc}	13.62^{b}	13.96^{b}	14.43^{a}	1.08

^{a,b,c} – Mean values within rows with different superscripts are significantly different (P<0.05)

Table 3. Anti-nutrient and mineral composition (%) of experimental diets fed to WAD buck

Parameters (%)	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Alkaloid	5.54^{a}	5.11^{b}	4.56^{c}	4.07^{d}	3.69^{e}	0.04
Oxalate	0.63^{a}	0.54^{b}	0.45^{c}	0.45^{c}	0.36^{d}	0.02
Phenol	16.75^{d}	16.94^{d}	17.54^{c}	19.67^{b}	23.66^{a}	1.12
Phytate	21.42^{a}	20.67^{b}	18.84^{c}	17.30^{d}	16.48^{e}	1.07
Saponin	5.72^{a}	5.02^{a}	4.72^{b}	4.42^{b}	3.15^{c}	0.05
Tannin	0.08^{a}	0.07^{b}	0.06^{c}	0.06^{c}	0.05^{d}	0.01
Minerals						
Calcium	0.16^{c}	0.26^{b}	0.28^{b}	0.29^{b}	0.32^{a}	0.02
Phosphorus	1.72^{c}	2.01^{b}	2.08^{b}	3.11^{a}	3.63^{a}	0.03
Sodium	0.60^{a}	0.52^{b}	0.42^{c}	0.41^{c}	0.29^{d}	0.01
Magnesium	0.45^{d}	0.70^{c}	0.71^{c}	0.89^{b}	0.95^{a}	0.02
Potassium	1.21^{d}	1.36^{c}	1.67^{b}	1.91^{a}	1.99^{a}	0.01

^{a,b,c} – Mean values within rows with different superscripts are significantly different (P<0.05)

Blood analysis

Blood samples collected via the jugular vein puncture (Frandson, 1986) at the end of the experiment from the animals to analyse for both haematological and biochemical components. Blood samples were taken into separate bottles containing anti-coagulant for haematological studies and the other with anti-coagulant free bottle from which was harvested for biochemical analysis. Whole blood count (PCV, RBC, WBC, Hb, Lymphocytes etc) analysis of the blood samples were carried out immediately after blood collection while the serum biochemical (Serum TP, globulin, albumin, AST etc) analysis was carried out according to standards methods of Merck's Veterinary Manual (1979).

Experimental design and statistical analysis

The experimental design was Completely Randomized Design and all data obtained were subjected to one–way analysis of variance (ANOVA) and significant differences means were separated using Duncan New Multiple range Test using SAS (2008).

Results

Nutrient composition of the experimental diets fed to WAD bucks

The proximate composition of the experimental diets fed to West African Dwarf bucks was presented in Table 2. All the parameters observed were significantly (P<0.05) influenced by the dietary treatment. Diet 1 had the highest dry matter content of 92.91%, though statistically (P>0.05) similar to Diets 2 and 3. The crude protein (CP) content of the diets increased with increased inclusion levels of molasses in the diets. 11.29%CP was the highest value recorded for Diet 5 which varied significantly from other diets. Crude fibre of the diets decreased with increased level of molasses and ranged from 26.51% (Diet 5) to 30.99% (Diet 1). The ether extract content was highest in Diet 5 (5.65%) while the ash content of the diets ranged from 11.29% (Diet 5) to 19.84% (Diet 1). The nitrogen free extract (NFE) value was highest in Diet 5 (35.84%). The gross energy (G.E.) content of experimental diets ranged from 13.12 KJ/100gDM (diet 1) to 14.43 KJ/100gDM.

Anti-nutrient and mineral content of the experimental diet fed to WAD bucks

The anti-nutrients and mineral content of the experimental diets fed to WAD bucks was presented in Table 3. Result showed all the anti-nutrients determined were statistically (P<0.05) influenced by the inclusion levels of molasses. Alkaloid content decreased with increased levels of molasses. The highest value (5.54%) was recorded for diet 1 and the least in diet 5. The oxalate content of the experimental diet was least in diet 5 (0.36%). The phenol content of diets progressively increased with increased molasses inclusion and was highest (23.66%) in diet 5. Though, values observed for diets 1 and 2 were statistically (P>0.05) similar. The phytate level of the experimental diets reduced across the treatments, diets 1 had the highest value (21.42%) but Diet 5 had the lowest value (16.48%). The tannin content reduced as the molasses content increased. Diets 5 had the lowest value (0.05%) and Diet 1 that had the highest value (0.08%).

All the minerals elements observed increased with increased inclusion level of molasses with the exception of sodium which retrogressed accordingly. The calcium content positively increased across the treatments. The values ranged from 0.16% (Diet 1) to 0.32% (Diet 5). Phosphorus content of diet 5 (3.63%) was the highest value. The sodium content of the diets was least in Diet 5 (0.29%) and highest in Diet 1. The magnesium and potassium contents of Diet 5 (0.95 and 1.99%) was the highest and least in Diet 1 (0.45 and 1.21%) respectively. Though, the potassium contents of Diets 4 and 5 were statistically (P>0.05) similar but numerically differs.

Nutrient Intake (g/day) of WAD goats fed the Experimental diets

Table 4 presented the nutrient intake by the WAD bucks fed experimental diets. All parameters observed were significantly (P<0.05) influenced by the dietary treatment.

Table 4. Nutrient intake (g/day) by WAD bucks fed experimental diets

Nutrients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Dry matter	452.47^{d}	455.69^{c}	463.06^{b}	463.19^{b}	466.86^{a}	2.12
Crude protein	32.53^{d}	36.75^{d}	42.71^{c}	50.75^{b}	57.69^{a}	1.02
Crude fibre	149.91^{a}	145.28^{b}	141.40^{c}	140.62^{d}	134.46^{e}	1.01
Ether extract	19.13^{e}	23.02^{d}	25.62^{c}	26.27^{b}	28.87^{a}	1.03
Ash	96.60^{a}	96.11^{a}	86.74^{bc}	72.77^{c}	57.67^{d}	0.02
Nitrogen free extract	150.21^{c}	152.48^{c}	161.57^{b}	169.68^{b}	182.09^{a}	1.05
Gross energy(KJ/100gDM)	63.89^{c}	65.00^{c}	68.51^{bc}	70.91^{b}	84.10^{a}	0.04

^{a,b,c} – Mean values within rows with different superscripts are significantly different (P<0.05)

Table 5. Anti-nutrient intake (g/day) of WAD goats fed the experimental diets

Antinutrients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Alkaloid	26.87^{a}	25.04^{b}	22.83^{c}	20.57^{d}	18.76^{e}	0.10
Oxalate	3.07^{a}	2.66^{b}	2.26^{c}	2.28^{d}	1.83^{e}	1.04
Phenol	81.57^{e}	83.00^{d}	87.22^{c}	100.03^{b}	120.40^{a}	0.50
Phytate	104.30^{a}	101.69^{b}	94.76^{c}	87.88^{d}	84.21^{e}	4.01
Saponin	27.81^{a}	24.69^{b}	23.72^{c}	22.48^{d}	16.07^{e}	0.02
Tannin	0.40^{a}	0.33^{b}	0.30^{c}	0.30^{c}	0.26^{d}	0.01

^{a,b,c} – Mean values within rows with different superscripts are significantly different (P<0.05)

Table 6. Nutrient digestibility (%) of WAD goats fed experimental diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Dry matter	76.02^{e}	79.42^{d}	81.08^{c}	84.43^{b}	88.01^{a}	1.73
Crude protein	78.15^{e}	81.07^{d}	84.72^{c}	87.81^{b}	91.42^{a}	3.81
Crude fibre	73.02^{e}	75.44^{d}	78.12^{c}	80.02^{b}	83.06^{a}	5.10
Ether extract	68.17^{e}	71.15^{d}	74.81^{c}	77.88^{b}	81.13^{a}	0.02
Nitrogen free extract	74.04^{e}	77.12^{d}	79.14^{c}	82.08^{b}	84.92^{a}	0.04
Gross energy	83.41^{e}	84.23^{d}	84.89^{c}	85.79^{b}	86.47^{a}	0.57

^{a,b,c} – Mean values within rows with different superscripts letters are significantly different (P<0.05)

The DM intake (DMI) by WAD bucks ranged from 452.47g/day to 466.86g/day (Diet 5). Bucks fed Diets 3 and 4 were statistically (P>0.05) similar but the numerical values varied slightly. The CP intake (CPI) of the bucks fed the test diets increased with increased inclusion level of molasses across the treatments and the values ranged from 32.53g/day (Diet 1) to 57.69g/day (Diet 5), the bucks fed diet 5 had the highest intake (57.69g/day). As the CPI increases, the CFI decreases. The CFI of the diets was highest in Diet 1 (149.91g/day) and least in Diet 5 (134.46g/day). The intake of ether extract increased as the molasses content of the experimental diets increased. The WAD bucks fed Diet 5 had the highest intake value (28.87g/day) which varied significantly (P<0.05) from bucks fed other diets. The highest ash intake was recorded in Diet 1 (96.60g/day), though statistically (P>0.05) similar to bucks fed Diet 2 (96.11g/day). The nitrogen free extract (NFE) intake increased across the treatments, the NFE intake was highest in Diet 5 (182.09g/day) and least in Diet 1 (150.21g/day).

Anti-nutrient intake of WAD Bucks fed experimental diets

The anti-nutrient intake of WAD buck fed the experimental diets was presented in Table 5. The antinutrient intake by the experimental animals were significantly (P<0.05) influenced by the dietary treatment. The least alkaloid intake was observed in bucks fed Diet 5 (18.76%) and highest in those fed Diet 1. Oxalate intake decreased with increased inclusion level of molasses and the highest intake (3.07g/day) was reported for bucks fed Diet 1. Highest phenol intake (120.40g/day) was observed in the bucks fed Diet 5 and least in those fed Diet 1. The intake of phytate, saponin and tannin decreased as the molasses level increased but there was significant variation in the values obtained. Meanwhile, WAD bucks fed Diet 5 had the least values (84.21, 16.07 and 0.26g/day) recorded accordingly.

Nutrients digestibility of WAD bucks fed experimental diets

The Table 6 presented the apparent digestibility co-efficient values of WAD buck fed the test diets. Result showed that the test diets were well digested and were significantly (P<0.05) by the dietary treatments. Diet 5 had the highest recorded digestibility values for all the nutrients. The dry matter digestibility (DMD) values increased as the molasses inclusion increased. The highest DMD value was observed in bucks fed Diets 5 (88.01%). The crude protein digestibility of WAD bucks fed Diet 5 had the highest value (91.42%) and least value was observed in those fed Diet 1 (78.15%). The crude fibre digestibility of WAD bucks was highest in bucks fed Diet 5 (83.06%) and least in those fed Diet 1 (73.02%). The ether extract digestibility was lowest in bucks fed Diet 1 (68.17%) and highest in those fed diet 5 (81.13%). The nitrogen free extract digestibility values ranged from 74.04% (Diet 1) to 84.92% (Diet 5 which was the highest). The gross energy digestibility varied from 83.41% (Diet 1) to 86.47% (Diet 5).

Minerals utilization by WAD bucks fed experimental diets

The mineral utilization by WAD bucks fed the experimental diets was shown on Table 7. All the parameters observed were significantly (P<0.05) influenced by the dietary treatments. Animals fed Diet 5 had the highest calcium intake (1.64g/day), balance (1.56g/day) and consequently, had the best retention value of 95.10%. The retention of phosphorus ranged from 68.10% (Diet 1) to 88.78% (Diet 5); the highest phosphorus retention was recorded for Diet 5. The intake, faecal, urinary and balance values (2.92, 1.04, 0.08 and 1.80 g/day respectively) of sodium was highest in bucks fed Diet 1 but conversely, the retention value (61.64%) by this animals was the lowest which made these animals to be significantly different (P<0.05) from bucks fed other test diets. The intake, balance

Table 7. Mineral utilization of WAD bucks fed experimental diets

Minerals	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Calcium						
Intake (g/day)	0.68^{e}	1.18^{d}	1.31^{c}	1.47^{b}	1.64^{a}	0.10
Faecal (g/day)	0.08^{c}	0.10^{b}	0.10^{a}	0.09^{b}	0.06^{d}	0.42
Urinary (g/day)	0.05^{a}	0.04^{a}	0.02^{b}	0.02^{b}	0.02^{b}	0.01
Balance (g/day)	0.55^{e}	1.04^{d}	1.21^{c}	1.36^{b}	1.56^{a}	0.03
Retention (%)	80.88^{d}	88.2^{c}	92.23^{b}	92.50^{b}	95.1^{a}	2.04
Phosphorus						
Intake (g/day)	8.37^{e}	9.88^{d}	10.47^{c}	15.80^{b}	18.55^{a}	0.01
Faecal (g/day)	2.01^{c}	2.17^{b}	2.47^{a}	2.08^{c}	2.02^{c}	1.04
Urinary (g/day)	0.66^{d}	0.91^{a}	0.83^{b}	0.72^{c}	0.06^{d}	0.02
Balance (g/day)	5.70^{e}	6.80^{d}	8.17^{c}	13.00^{b}	16.47^{a}	1.03
Retention (%)	68.10^{d}	68.82^{d}	77.96^{c}	82.28^{b}	88.78^{a}	3.08
Sodium						
Intake (g/day)	2.92^{a}	2.50^{b}	1.28^{e}	2.08^{c}	1.48^{d}	0.05
Faecal (g/day)	1.04^{a}	0.58^{b}	0.26^{d}	0.39^{c}	0.27^{d}	0.08
Urinary (g/day)	0.08^{a}	0.07^{b}	0.03^{c}	0.03^{c}	0.01^{d}	0.02
Balance (g/day)	1.80^{a}	1.85^{a}	0.99^{d}	1.62^{b}	1.20^{c}	1.03
Retention (%)	61.64^{e}	74.00^{d}	77.34^{c}	79.44^{b}	81.08^{a}	2.05
Magnesium						
Intake (g/day)	2.19^{e}	2.40^{d}	2.57^{c}	3.50^{b}	4.81^{a}	1.04
Faecal (g/day)	0.47^{e}	0.60^{c}	0.37^{d}	0.56^{b}	0.61^{a}	0.01
Urinary (g/day)	0.16^{a}	0.02^{d}	0.20^{c}	0.14^{b}	0.20^{c}	0.02
Balance (g/day)	1.56^{e}	1.78^{d}	2.00^{c}	2.80^{b}	4.00^{a}	0.04
Retention (%)	71.23^{e}	74.16^{d}	77.82^{c}	80.00^{b}	83.10^{a}	3.06
Potassium						
Intake (g/day)	3.83^{e}	4.66^{d}	6.36^{c}	8.11^{b}	10.10^{a}	2.06
Faecal (g/day)	0.89^{e}	0.72^{d}	0.99^{c}	1.21^{b}	1.34^{a}	0.01
Urinary (g/day)	0.13^{e}	0.38^{a}	0.29^{b}	0.20^{c}	0.16^{d}	0.01
Balance (g/day)	2.81^{e}	3.56^{d}	5.08^{c}	6.70^{b}	8.60^{a}	0.01
Retention (%)	73.34^{e}	76.37^{d}	79.85^{c}	82.60^{b}	85.13^{a}	0.02

^{a,b,c} – Mean values within rows with different superscripts letters are significantly different (P<0.05)

Table 8. Performance characteristics of WAD Bucks fed experimental diets

Parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	±SEM
Dry matter intake(g/day)	452.47^{d}	455.69^{cd}	463.06^{c}	463.19^{b}	466.86^{a}	2.12
Initial weight (kg)	12.99	13.00	13.00	12.98	12.98	0.08
Final weight (kg)	15.70^{d}	15.83^{d}	16.28^{c}	16.82^{b}	17.74^{a}	1.04
Weight (kg)	2.71^{d}	2.83^{d}	3.28^{c}	3.84^{b}	4.76^{a}	0.02
Weight gain(g/day)	38.69^{e}	40.43^{d}	46.86^{c}	54.86^{b}	68.00^{a}	0.07
Feed/ gain ratio	11.69^{d}	11.27^{d}	9.88^{c}	8.44^{b}	6.86^{a}	0.09

^{a,b,c} – Mean values within rows with different superscripts letters are significantly different (P<0.05)

and retention of magnesium and potassium by the WAD bucks fed the experimental Diet 5 had the highest values recorded and least in animals fed Diet 1.

Performance characteristics of WAD bucks fed experimental diets

Table 8 presents the growth performance of the WAD bucks fed the experimental diets. There was no significant (P>0.05) variation in the initial weights of the WAD bucks but significant (P<0.05) difference were observed in the final weights of all the animals fed the experimental diets. The daily weight gain was observed to increase as the molasses inclusions in the diets increased. Therefore, the bucks fed Diet 5 (4% inclusion of molasses) had the best daily weight gain. The feed gain ratio had significant (P<0.05) variations as the figures ranged from 6.86-11.69, animals fed diet 5 had the lowest figure (6.86) while those fed Diet 1 had the highest value (11.69).

Haematological parameters of WAD bucks fed experimental diets

Result of effect of experimental diets on haematological parameters of WAD bucks was presented in the Table 9. There were no significant variations (P>0.05) in the values recorded for each Packed Cell Volume (PCV), Haemoglobin concentration (Hb), Red Blood Cell (RBC), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin Concentration (MCHC), but there were variations in the values obtained. The PCV value (28.02%) which was the highest value recorded was found in bucks fed Diet 5, although, those fed Diet 3 and 4 were numerically similar ($13.26x10^6$/ml) and were the highest value recorded. The white blood cell (WBC) was equally highest in those fed Diet 3 ($352x10^3$/ml), followed by Diet 1 ($277x10^3$/ml) and Diet 5 ($274x10^3$/ml). Meanwhile, the haemoglobin concentration (9.30g/dl) was highest in WAD bucks fed Diet 5. Lymphocyte count (61.65%) in those fed Diet 5 was the highest value recorded. The basophil count in bucks fed Diets (1 and 2) and Diets (3, 4 and 5) were numerically similar (1.00 and 1.50%) respectively.

Biochemical indices of WAD bucks fed experimental diets

The biochemical indices were influenced by the experimental diets and the results were presented in Table 10. The biochemical indices evaluated were total protein (TP), Albumin, Globulin, Aspartate aminotransferase (AST) and alanine aminotransferase (ALP). The TP, Albumin and

Table 9. Haematological parameters of WAD bucks fed experimental diets

Parameters	DIET 1	DIET 2	DIET 3	DIET 4	DIET 5	±SEM
Packed Cell Volume (%)	28.00	26.01	28.00	27.91	28.02	0.87
Red Blood Cell ($x10^6$/ml)	11.14	10.87	13.26	13.26	11.63	2.01
White Blood Cell ($x10^3$/ml)	277.00	269.00	352.00	254.00	274.00	4.17
Haemoglobin (g/dl)	9.30	8.70	11.30	9.00	9.30	1.06
MCH (pg)	8.34	8.00	8.52	6.77	7.99	0.42
MCV (μ^3)	25.13	23.91	25.64	35.56	24.10	0.83
MCHC (%)	33.21	33.46	33.23	26.47	33.21	0.69
Lymphocytes (%)	60.42	59.89	61.42	59.75	61.65	2.08
Neutrophils (%)	27.06	27.99	28.50	30.00	29.04	0.07
Monocytes (%)	7.34	7.28	8.23	6.98	7.25	0.49
Eosinophil (%)	2.00	3.02	3.01	2.26	2.57	0.91
Basophils (%)	1.00	1.00	1.50	1.50	1.50	0.07

^{a,b,c} – Means without superscripts in the row are not significantly different (P>0.05). MCHC = Mean Corpuscular Haemoglobin Concentration; MCH = Mean Corpuscular Haemoglobin; MCV = Mean Corpuscular Volume

Table 10. Serum biochemical indices of WAD bucks fed experimental diets

Parameter	DIET1	DIET 2	DIET 3	DIET4	DIET5	±SEM
Total proteins (g/l)	6.90^d	7.10^c	7.14^b	7.14^b	7.26^a	2.03
Albumin (g/l)	3.28^{ab}	2.30^c	3.31^{ab}	3.00^b	3.47^a	1 .02
Globulin (g/l)	3.62^c	4.80^a	3.87^{bc}	4.14^b	3.79^{bc}	0.91
Aspartate aminotransferase (IU/l)	5.30	4.93	5.00	5.16	5.37	3.06
Alanine Phosphatase (IU/l)	6.63^b	6.10^c	6.71^{ab}	6.71^{ab}	6.82^a	1.43

^{a,b,c} – Means without superscripts in the row are not significantly different (P>0.05)

Table 11. Serum mineral contents (mmol/L) of WAD bucks fed experimental diets

Parameter	DIET1	DIET 2	DIET 3	DIET4	DIET5	±SEM
Calcium	1.61^b	1.58^{bc}	1.56^c	1.59^{bc}	1.88^a	0.08
Phosphorus	1.29^b	1.24^c	1.22^c	1.28^b	1.31^a	0.03
Sodium	138.10^a	138.40^a	136.70^b	138.10^a	138.00^a	1.28
Potassium	4.40	4.39	4.28	4.50	4.48	0.13
Magnesium	0.08^d	0.13^b	0.10^c	0.14^a	0.08^d	0.02

^{a,b,c} – Means without superscripts in the row are not significantly different (P>0.05)

ALP values were highest in WAD bucks fed Diet 5. Though, bucks fed Diets 3 and 5 had statistical similar values but there were no significant variations in the AST values observed.

Serum mineral contents of WAD bucks fed experimental diets

Table 11 presented the result of serum mineral content of WAD bucks fed the experimental diets. The minerals investigated were all significantly (P<0.05) influenced by the treatment diets but potassium values were not statistically influenced. Meanwhile, bucks fed Diet 5 had the highest value of Ca, P and Na. Potassium concentration in those fed Diet 4 (4.50 mmol/L) was the highest followed by those bucks placed on test diet 5 (4.48mmol/L). For magnesium, the least value (0.08mmol/L) was recorded for WAD bucks fed Diets 1 and 5.

Discussion

Nutrient composition of the experimental diets fed to WAD bucks

The dry matter contents of the diets were high and dry matter content of the fermented rice husk improved, due to fermentation and addition of molasses as molasses was found to hasten fermentation by easily converting the carbohydrate content into lactic acid and this corroborates the findings of McDonald *et al.* (2002) and Ly *et al*. (2000) that fermentation could improve dry matter content of a feed. Also, the nutrients were enhanced as the crude protein levels increased with inclusion levels of molasses coupled with the effect of fermentation. In fact, the results of Aderolu *et al.* (2007) and Ndams *et al.* (2009) revealed that nutrient contents of rice husk were improved by fermentation. The crude protein content from Diet 3, 4 and 5 were above the minimum CP requirement (8%CP) for maintenance as recommended by Norton, (2003). It was noted that the crude fibre decreases as the crude protein increases and the reduction in the level of crude fibre in this study also agreed with the findings of Aderolu *et al.* (2007) when he treated rice husk with microbiological inoculants. McDonald *et al.* (1995) also reported a gradual decrease in crude fibre level as the crude protein level increases.

The reduction in the ash content of the rice husk was due to fermentation which helped in the breaking down of the silica content of the rice husk because ash content of rice husk contains 85-90% amorphous silica which makes it so abrasive. Molasses also contributed to the easy fermentation of the rice husk due to high dry matter content of the molasses. Report has it that yeast contains high level of protein (Tony, 2013). Fasuyi and Olumuyiwa (2012) reported that ensiling rice husk with molasses at 5% caused a reduction in the fibre content and hence, improved the dietary protein.

Anti-nutrient and mineral composition (%) of experimental diets fed to WAD buck

The concentration of the anti-nutrients was low except phytate; the reduction in the anti-nutrients might be as a result of the processing method (fermentation) adopted. Abeke *et al*. (2008) reported that different processing methods such as sun drying, fermentation, boiling and autoclaving are able to reduce anti-nutritional factors. This was found true as the anti-nutritional factor of the rice husk reduced as a result of fermentation with molasses. Research has revealed that addition of molasses as additives improves fermentation and the nutritive value of non-conventional feedstuffs (Staples, 1995); this was confirmed by the reduction in the anti-nutrients as the molasses inclusion increases.

The mineral content of the experimental diets were adequate for WAD buck in this experiment as mineral requirement is highly dependent on the level of production (McDowell, 1992). Calcium which is one of the most required mineral in ruminant production because of its essentiality in blood clotting is normal in this study for buck goat (McDowell, 1992). The phosphorus level observed in this study is higher than the recommendation of McDowell (1992) who reported values ranging from 0.16-0.38%, but phosphorus content of the experimental diets in this study ranged from 1.72% to 3.63%. This might be due to the available phosphorus in the feedstuff and invariably the high crude protein level of the experimental diets. Treating rice husk with molasses improved phosphorus content from 0.06%-1.09% when fed to sheep as reported by Badr and Abou Akkada (1995).

Nutrient intake by WAD goat fed experimental diets

Badr and Abou Akkada (1995) reported that feeding ground rice hulls improved the feed intake and digestibility of sheep by the addition of molasses and urea. This was manifested in the high feed consumption by all the experimental animals, the level of molasses inclusion seemed to have favourable and beneficial effects on the feed intake as the calculated nutrient intake increased with the increase in molasses inclusion.

The high nutrient intake of the WAD bucks was also as a result of the quality of feed i.e. the nutrient availability of the feed. The high dry matter intake observed in this study agreed with the findings of Ahamefule *et al.* (2006), who reported that higher level of crude protein content of the feed stimulates high dry matter intake. This was observed true as the highest dry matter intake was observed in animals fed diet 5 which had the highest crude protein content. Research has shown that ensiling mulberry forage with molasses increased the total nitrogen from 9% to 11% as this is indicative of breakdown of protein, which in turn affected their crude protein intake (Ba *et al*., 2005). This was also found true as the crude protein intake increased with an increase in molasses inclusion, also the protein intake of the experimental bucks fed diets 3, 4 and 5 were higher than the minimum recommendation of 41.50g/day for goats (NRC, 1981). There was decrease in the crude fibre intake of the WAD bucks as the molasses inclusion level increased. The decrease in the crude fibre intake was a result of reduction in crude fibre content of the experimental diets as the crude protein content increased. The high energy intake of the experimental bucks fed Diet 5 might be as a result of high amount of fermentable energy available to the rumen bacteria. This in turn influenced their growth rate by enhancing digestibility.

Anti-nutrients intake of WAD Bucks fed experimental diets

McDonald *et al.* (2002) reported that addition of molasses up to 6% inclusion in silages increases palatability and utilisation of the ensiled materials. This was found true as the anti-nutrients level in the experimental diets decreased as the molasses inclusion level increased. Furthermore, the high sugar content of molasses reduces the anti-nutrient level in the feed thereby reducing the anti-nutrients intake as the molasses inclusion increased. The tannin and oxalate level was reduced by 79% in taro giant by increasing the molasses level (Hang and Preston, 2007). Hang and Preston (2007) also reported that fermenting taro giant with molasses was effective in breaking linkages of anti-nutrients on fibre and protein. This agrees with the result of this study as the intake of the tannin was lowest in the animals fed Diet5 which had the highest level of molasses (4%).

Nutrient Digestibility of WAD goats fed experimental diets

Mohsen *et al.* (1993) showed that ensiling of rice straw with 6% molasses with or without monensin (5 ppm) increased its digestibility and nutritive value. The TDN% values were 55.03 and 52.83% when rice straw was ensiled with molasses and monensin respectively. This study agreed with their findings as the digestibility of WAD buck fed the experimental diets increased as the molasses inclusion level increased.

Fasuyi *et al.* (2010) reported that fermenting *Tithonia diversifolia* with sugar cane molasses increases intake and digestibility of the dry matter content of the diets when fed to pigs. This was found true in this study as the dry matter digestibility coefficients obtained for animals fed the experimental diets increased as the molasses inclusion level increased to 4%.Nutrient digestibility increases with dry matter intake (Wyatt *et al*., 2004), this was also confirmed in this study as the dry matter digestibility of the animals fed the experimental diets was highest in WAD bucks fed Diet 5 which had the highest dry matter intake. McDonald *et al.* (1995) revealed that there is a positive relationship between digestibility of feed and protein intake. This study agreed with the report as protein intake and digestibility in this experiment was highest in WAD bucks fed Diets 5. Smith *et al.* (1996) reported high nutrient digestibility of rice husk as a result of microbial treatment. This agrees with the findings from this study as the digestibility of crude protein was found highest in Diet 5 which had the highest crude protein content and intake.

Ranjhan (1993) reported that higher protein intake may increase the digestibility of the crude fibre of feeds because the activities of microorganism are increased and this consequently attacks the crude fibre the more. A large portion of the ration energy intake for ruminants comes from the fermentation of plant cell walls, this is the fraction called neutral-detergent fibre. In the effective degradation of plant tissue, NDF is primarily digested via rumen microbial enzymes secreted during microbial adhesion on accessible plant tissue. A primary chemical factor determining microbial progress with respect to NDF digestibility and rate is the presence and amount of indigestible lignin, or plant maturity. Rumen fibre-digesting bacteria (which are anaerobic) are sensitive to oxygen in the rumen as they do not possess the enzymes to detoxify it. Oxygen readily enters the rumen via water, feed and the oxygenated capillary blood supply wrapped around the rumen. Oxygen’s presence reduces rumen cellulolytic bacteria numbers and limits plant fibre adhesion by bacteria and some fungi.

Mineral utilization by WAD goats

The minerals evaluated in this study were adequately utilized. This might be as a result of the protein quality of the diets due to the treatment of the fermented rice husk with varying levels of molasses. Dietary phytate is known to reduce the availability of calcium, zinc, magnesium, iron, manganese and copper among others (Belewu and Ojo-Alokomaro, 2007).

The phytate level of the experimental diet decreased as the molasses inclusion level increased, this enhanced mineral availability and the utilization. Hussein *et al.* (1995) reported that oxalate binds minerals especially calcium thereby forming calcium oxalate which is insoluble. Calcium-oxalate adversely affects the absorption and utilization of calcium in the animals. The result from this study reveals that there was better utilization of calcium, phosphorus, potassium and magnesium, because as the oxalate and phytate concentration in the diets reduced as the molasses increased thereby leading to increased utilization of calcium, phosphorus, potassium and magnesium. Ogle (2006) reported that treating leaves and plant by-products reduce the toxic or harmful components of the materials thereby increasing the digestibility of the anti-nutrient by making it less harmful and breaking their linkages. In this study rice husk which is a fibrous plant by-product was treated by fermenting with molasses and the result agrees with the findings of Ogle, (2006). It was discovered that the digestibility of the anti-nutrient was very high in the entire animals fed Diet 1 to 5. Animal fed diet 5 had highest anti-nutrient digestibility and thus reflected in the weight gain of the animal at the end of the experiment. Oxalate concentration was reduced by 79% in taro giant when molasses inclusion level increased and this in turn increased the anti-nutrient digestibility (Hang and Preston, 2007). This study confirmed this report as oxalate digestibility increased with increase in molasses inclusion. McDonald *et al.* (1995) reported that when oxalate is consumed, it may be degraded by the rumen microorganism to oxalic acid which is harmless to the health of the animals. The concentration of tannin in the diets was adequately degraded by the rumen microbes to tolerable concentration and acceptable to the animals without any nutrient disorder which might have negative effect on the health of the animals.

Performance characteristics

Animals fed diet 5 had the highest weight gain; this might be attributed to palatability of the diet fed, crude protein content and intake, high dry matter intake, better digestibility of the diet and best nitrogen utilization. This is in consonance with the findings of Fadiyimu *et al.* (2010). They reported that weight gain is dependent on dry matter intake, protein intake and the digestibility of the nutrients by the animals. The highest weight gain of animals fed diet 5 can also be due to improved nitrogen intake and retention, which might have improved the microbial population in the rumen, microbial protein available to bucks, improved energy-nitrogen ratio and improved growth of the bucks. Fermenting rice straw (treated or not) with berseem (*Trifolium alexandrinum*) resulted in a clear improvement in the performance and daily live-weight gain of fattening sheep (Nabaweya *et al.,* 1993). This was confirmed in this study as the daily weight gain was observed best in animals fed diet 5. The effective utilization of fermented rice husk based diets by the WAD buck without any visible side effect or mortality showed that the fibre content of the fermented rice husk was within tolerable level for the experimental animals and the treatment of the rice husk by fermenting with molasses was effective in breaking the linkages between the fibre and protein (Hang and Preston, 2007); this was confirmed in this study as no mortality was recorded.

Haematological indices of experimental animals

All the blood variables examined were similar and did not show any particular pattern related to the dietary treatment. The blood variables mostly affected by dietary influences are the RBC count, HBC, plasma protein, PCV and clotting time (Ologbobo *et al.,* 1986). All these tend to suggest that feeding ruminant with fermented rice husk treated with varying molasses level did not have adverse effect on the health status of the experimental animals. The significantly higher values of white blood cell obtained could be as a result of the animal processing a protective system suggestive of a well-adapted immune system (Tambuwal *et al*., 2002). The high packed cell volume (PCV) shows that the animal are not anaemic, the haemoglobin concentration followed similar trend. The values of red blood cell and haemoglobin reported could be due to age of the animals used in the study. Tambuwal *et al*. (2002) reported that age has a significant effect on haemoglobin and red blood cell that is oxygen carrying capacity of blood is higher in adult goats. The high PCV observed in this study can be attributed to the high nitrogen intake and utilization by the bucks. This study suggests that WAD goats have tendency for compensatory accelerated production (CAP) of PCV in case of infection and stress, CAP has been found to return PCV to normal following an infection (Dargie and Allonby, 1975).

Serum Biochemical indices of WAD goats fed experimental diets

Serum protein was higher than the values obtained by Tambuwal *et al*., (2002). Comparison of the result in this study with earlier report suggests packed cell volume (PCV) varies proportionately with serum protein. This shows that PCV is beneficial in assessing the protein status of the diets fed. Daramola *et al*. (2005) obtained a value range of 6.3-8.5g/100ml, the variations may be due to the breed of animals, environmental condition and the crude protein content of the diet fed. The globulin level obtained in this study is higher than values obtained by Opara *et al*. (2010). An increased activity of globulin in serum is a well-known diagnostic indicator of liver injury (Oboh and Akindahunsi, 2005). The high value of albumin obtained suggested an increase in clotting ability of the blood thereby leading to prevention of haemorrhage (Robert *et al.*, 2003). Globulin is known to fight infection, high globulin level fought infection in the experimental animals. Low globulin level could lead to high morbidity and mortality (Akinmutimi and Eburaja, 2010). The observed values for AST, ALT, fell within the range obtained by Tibbo *et al*. (2008).

Serum Minerals of WAD goats fed Experimental Diets

The mineral concentration of serum of the animals fed the experimental diets were normal and within range for goats. Aiello (2002) reported the range of serum minerals to be as follows. Calcium (2.60-3.5mmol/l), Magnesium is between 0.08-2.00mmol/l, Potassium (4.00-6.00mmol/l) and Phosphorus 1.60-2.40mmol/l while Sodium is between the normal ranges of 136-154mmol/l. The result from this study shows that phosphorus level was higher in the serum of WAD goats fed the experimental diets. This might be as a result of high crude protein content of the feed. The high phosphorus content can also be as a result of high digestibility of phytate because phytate is a storage form of phosphorus while phosphorus is an important mineral for energy production and formation of structural elements like cell membrane. The plasma Calcium concentration in sheep and goat is greater than other animals of lower body weight because of maturity which will definitely affect bone mineralisation and formation although younger animals require more minerals than older ones (Ricks, 1996). Normal level of potassium level of WAD goat shows that the substance was able to maintain cellular toxicity, maintain fluid balance, regulate metabolic processes and regulation of neural and muscular functions (Cheesebrough, 2004).

Conclusion

There is no doubt that the molasses fermented rice husk has the nutritional benefits for improved goat production as nutrient and mineral intake and utilization were best in goats fed 4% molasses silage additive. The health indicators revealed that the goats were healthy throughout the experimental period.

Recommendations

From the findings of this present study, the following are hereby recommended.

1. Rice husk could be included at high level in ruminants' diet;

2. The nutritive qualities (nutrients and minerals composition) of rice husk could be improved through yeast-molasses fermentation for 5 days.

3. Biodegrading 92% rice husk with 4 % molasses as sole diet had the best performance for the experimental West African Dwarf bucks and has no deleterious effects on their health status.

References

AOAC. (2002). Association of Official Analytical Chemists. *Official methods of analysis, 16th Eds,* Washington D.C., U.S.A.

Abeke, F. O., Ogundipe, S. O., Dafwang, I. I., Sekoni, A. A., Abu, A. and Adeyinka, I. A. (2008). Effect of duration of cooking on the levels of some anti-nutritional factors of nine varieties of *Lablab purpureus* beans. *Nigeria Journal of Animal Production*, 35(2), 217-223.

Aderolu, A. Z, Iyayi, E. A. and Onilude,A. A. (2007).Changes in the nutritional value of rice husk during *Trichoderma viride* degradation. *Bulgaria Journal of Agricultural Science*, 13, 583-589.

Ahamefule, F. O., Ibeawuchi, J. A and Ibe, S. N. (2006). Nutrient intake and utilization of pigeon pea-cassava peel based diets by WAD bucks. *Pakistan Journal Nutrition,* 5, 419-424.

Aiello, S.E. (2002). The Merck Veterinary manual. 8th Eds. Merck and Co., white house, N.J., U.S.A

Akinmutimi, A. H., and Ebuaraja, A.S. (2010). Effect of processing on nutrient and anti-nutrient composition of African yam beans (*Spheostylis sternocarpa*). *Nigerian Journal of Agricultural,* 4(2), 99-107.

Badr M. F., and Abou-Akkada A. R. (1995). Rice hull as a substitute for wheat straw in feeding sheep. *Alexandra Journal of Agricultural Research,* 13(1), 1-10.

Belewu, M. A., and Ojo-Alokomaro, K.O. (2007). The effect of wattle tannin on intake, digestibility, nitrogen retention and growth performance of goats in South Africa. *Livestock Research for Rural Development,* 19(4), 148-154.

Cheeke, P. R., and Shull, L. R. (1995) Natural toxicant in feed and poisonous plants Avi publishing company, Westport, conn., U.S.A.

Cheesebrough, M. (2004). District Laboratory Practice in Tropical Countries Part 1. Low Priced Edition, Cambridge: Cambridge University Press.

Cork, S. C., and Halliwell R. W. (2002). The Veterinary Laboratory and Field Manual. A Guide for Veterinary Laboratory Technicians and Animal Health Advisors. University Press, Nottingham.

Daramola, S. O., Adeloye, A. A. Fatoba, I. A., and Soladoye, A. D. (2005). Haematological and biochemical parameters of West African Dwarf goats. *Livestock Research for Rural Development,* 17(8), 20-25.

Dargie, J. D., and Allonby, E. W. (1975). Patho-physiology of single and challenge infections of *Haemochus cnotortus* in Merino sheep. Studies of red cell kinetic and self-cure phenomenon. *International Journal of Parasitology,* 5, 147-157.

Hang, D. T., and Preston, T. R. (2007). Taro leaves as a protein source for growing pigsin central Vietnam. MEKARN International Conference on Matching Livestock systems with available resources (Edition T.R Preston and B. Ogle), 26-27 November, 2007, Ha Long Bay Vietnam http://mekarn.org/proham/abstracts /hang.hue.htm.

Ekanayake, S. D., Jansz, E. R., and Nair, B. M. (1999). Proximate composition, mineral and amino acid contents of mature *Canavalia gladiate* seeds. *Food Chemistry,* 66, 115 - 119.

FAO Statistical Database (2002). http://apps.fao.org

Fadiyimu, A. A., Alokan, J.A., and. Fajemisin, A.N. (2010). Digestibility, nitrogen balance and heamotological profile of West African dwarf sheep fed dietary levels of *Moringa Oleifera* as supplement to *Panicum maximum. Journal of American Science,* 6(10), 634 – 643.

Fasuyi, A.O., and Olumuyiwa, T.A, (2012). Evaluating nutritional potential of Bio-fermented rice husk in broilers diets. *American Journal of Food and Technology*, 7, 726-735.

Fasuyi, A. O., Dairo, F. A. S., and Ibitayo, F.J. (2010). Ensiling wild sunflower (*Tithonia diversifolia*) leaves with sugar cane molasses. *Livestock Research of Rural Development,* 22, 568-577.

Figueroa, V., and Ly, J. (1990). Growth performance of pigs fed hand-chopped sugar cane stalk. *Livestock Research for Rural Development,* Vol 16, Art. #14.

Frandson, R.D. (1986), Anatomy and Physiology of Farm Animals. Lea and Fabiger, Philadelphia. USA. Pp 174-189.

Hussein, H. S., Merchen, N. R., and Fahey, G. C. (1995). Effect of forage level and canola seed supplementation on site and extent of digestion of organic matter, carbohydrate and energy steers. *Journal of Animal Science,* 73, 2458-2468.

Ly, N. H., Am, L. V., and Ngoan, L. D. (2000). Evaluation of ensiled shrimps by-product for fattening pigs. Workshop-seminar making better use of local feed resources. SAREC-UAF. *http://www.mekarn –org /sarpro/ngoan.htm.*

McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., and Moran, C.A. (1995). Animal Nutrition, fifth Edition. Pearson Education Limited, Edinburg gate Harlow, Essex, England. Pp.259-262.

McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., and Moran, C.A., (2002). Animal Nutrition, 6th Eds., Longman Scientific and Technical, Harlow, Essex, England.

McDowell, L. R., (1992). Minerals in Animal and Human Nutrition. 1st Eds. Academic Press, New York, USA. 16, 431-436

Merck's Veterinary Manual. (1979). The Merck Veterinary Manual, 5th edition. Siegmund. O. H (Ed.,), Merck and Co. Inc. Rahway, New Jersey, USA. Pp. 1672.

Mohsen, M.K., Santiel, G. E., Mahmoud, S., and Basuni, M. I. (1993). Fermentation characteristicsand Nutritional value of corn cobs and rice straw ensiled with Monensin. *Proceedings of Applied Research*, Alexandria. Pp 104-114.

Nabaweya,E., Abaza, M. A., Nour, A. M., El-Shazly, K., and Naga, M.A. (1993). The nutritive valueof alkali treated rice straw for fattening lambs. *Proceedings of Workshop on Applied Research,* Alexandria. pp 115-121.

Ndams, S. S., Tegbe, T. S. B., and Ogundipe, S. O. (2009). Effect of feeding graded levels of re-fermented brewers' dried grains on performance and carcass characteristics of broilers chicken. *Journal of Agricultural Research,* 1, 37-45.

Ba, N. X., Giang, V. D., and Ngoan, L. D. (2005). Ensiling of mulberry foliage silage for goats in central Vietnam. Hue University of Agriculture and Forestry Hue, Vietnam .

NMA (2014). Akure weather. Nigerian Meterological Agency (NMA) Archives, 1: 1 – 2. Nimet.gov.ng/akure-weather/12.5. Accessed on 12th March, 2017.

Norton, B.W (2003). The nutritive values of tree legumes as dietary supplement for ruminants. In: *Tree legumes in tropica agriculture.(eds) Gutterridge , R.C., and Shelton, H.M. Pp. 59-61.*

NRC (1981). Nutrient requirement of goats: Angora, dairy and meat goats inn temperate and tropical countries. Nutrient Requirement of Domestic Animals No.15. National Research Council, Washington D.C., USA.

Oboh, G., and Akindahunsi, A. A. (2005). Chemical Changes in cassava peels fermented with mixed culture of *Aspergillus niger* and two species of *Lactobacillus* integrated Bio-system. *Applied Tropical Agriculture,* 8, 63-68.

Ogle, B. (2006). Forage for pigs: Nutritional physiological practical implication workshop seminar Forage for Pigs and Rabbits MEKARN cell Agrid, phonom penln, Camboboa, 22 24 August 2006. Article #15 Retrieved Feb 8, 107 from http://www.mekarn.org/proprf/pgle.htm.

Ologhobo, A.D.; Tewe, O.O. and Adejumo, D.O. (1986). Hematological and neutral metabolites in broilers fed soyabean-based rations. Proceedings of 6th International Conference on Animal Production in the Tropics. Ahmadu Bello University, Zaria, pages 322-329.

Omotola, K. M., and Ikechukwu, A. (2006). Rice milling in Nigeria. http://www.ricenigeria.com.

Opara, M.N., Udevi, N. and Okoli, I.C. (2010): Haematological parameters and blood chemistry of apparently healthy West African Dwarf (WAD) goats In Owerri, South Eastern Nigeria. *New York Science Journal.* 3(8): 70-71

Ranjhan, S. K. (1993). Animal Nutrition and feeding practices. 4th edition vikcas publishing House. PVT Ltd. New Delhi, India. Pp.142-150.

Ricks, M. (1996). Minerals: Small Ruminant Series Texas Agricultural Extention Services, Uvalde.Pp.65

Roberts, K. M., Daryl, K. G., Peter, A. M., and Victor, W.R. (2003): Harper Biochemistry, 25th edition, Mc Graw-Hill, New York. 25:765.

SAS. (2008). User's Guide: Statistics. Version 9.2, SAS Institute Inc., Cary, NC. USA.

Smith, J. W., Larbi, A. M., Jabbar, M. A., and Akinlade, J. (1996). Rumen degradation in sheep, goats and cattle in voluntary intake by sheep of four browse species. *Agro-forestry Systems,* 32, 277-286.

Staples, C. R. (1995). Bermuda grass; growing, storing and feeding for dairy animals. Curcular 1140, Florida co-op. Extension Services, Institute of Food and Agricultural Science, University of Florida, USA

Tambuwal, F. M., Angale, B. M., and Bangana, A. (2002). Haematological and Biochemical values of apparently healthy Red sokoto goats. Proceedings of 20th Annual Conference Nigeria Society of Animal Production (NSAP), March, 17-21, 2002 FUT, Akure, Nigeria. Pp.50-53.

Tibbo, M., Jibril, Y., Woldermeskel, M., Daworf A., Aragaw, K., and Rege, J. E. (2008). Serum enzymes levels and influencing factors in three indigenous Ethiopian goats breeds. *Tropical Animal Health Production,* 4(8), 657-666.

Tony, H. (2013). How yeast can improve feed efficiency in ruminant. Cargil dairy news magazine. Tonad Publishers LTD, Ogun, Nigeria. Pp100-101.

Wyatt, D. J., and Weiss, W. P. (2004). Digestible Energy Value of diets with different fat supplements when fed to lactating dairy cows. *Journal of Dairy Science,* 87, 1446-1454.