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Feed intake, haematological and biochemical indices of West African dwarf does fed graded levels of urea-molasses treated rice husks diets

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Abstract

A sixty-three-day feeding trial was conducted to evaluate the feed intake, haematological and biochemical indices of West African dwarf does fed maize offal substituted with urea-molasses treated rice husks diets. Twenty-five does aged 2-2½ years with weight of 14.78 ±0.31kg were used. Five experimental diets were formulated such that maize offal was replaced with urea-molasses treated rice husks meal at ratio 0, 20, 30, 40 and 50%. The twenty-five does (5 does per group) were randomly allocated to each of the five diets in completely randomised design. Chemical composition of diets revealed that dry matter ranged from 91.26 to 91.69%, the diet E had the highest crude protein (16.23%). Neutral detergent fibre ranged from 41.18 to 46.00 % and the highest energy was 16.62 KJ/100gDM. Nutrients intake was significantly (p<0.05) influenced by inclusion of urea-molasses treated rice husks meal in the diets. The highest dry matter (559.46g/day), crude protein (79.78g/day) and energy (21.88kcal/g) intake were obtained in does fed diet C. Nutrients digestibility was significantly (P<0.05) influenced by the treatment, an indication that the diets were palatable and digestible. All does maintained normal haematological and biochemical indices, thereby keeping all does on healthy condition. Does fed diet B that contained 20 % urea-molasses treated rice husks meal had the best weight gain (63.81 g/day) and feed to gain ratio (8.42). It can be concluded that does fed B performed better than other does thus; the diet would be a better source of protein and energy to support the performance of West African dwarf does.

Keywords: Blood indices, does, performance, rice husks, urea-molasses,

Introduction

The world's livestock producers are having difficulties in meeting the demand for animal production due to high cost of production and this disparity has led to serious malnutrition (Onimisi *et al.,* 2006). Goats play a significant role in livelihoods of the rural populace in most developing countries. Apart from serving as a vital protein source, it also provides income for meeting urgent household needs (Peacock *et al.,* 2005). In Nigeria the rearing of goats is mainly traditional and as a result, it is characterized by inadequate feeding. This has necessitated the search for non–conventional feedstuffs which are cheap and not in high demand by humans (Amaefule, 2002). If small ruminant industry must continue to survive in a developing country like Nigeria, alternative and cheaper energy sources must be sort for. A practical way of addressing the problem of feeding ruminant livestock and reducing cost of production in the dry season is by using silage or hay and various post harvest crop residues such as cassava peels, rice straw and husks, cocoa bean shells, theobroma cacao pod husks.

Farm by-products have been known to constitute an important feed resource during the dry season. However, most agro-industrial by-products are known to be particularly deficient in protein, minerals and vitamins; they are highly lignified and their digestibility is low. These characteristics keep intake and productivity low hence, the need to improve the nutritional value of these feed resources. The principles for improving the use of these poor quality feed resources by ruminants according to Sansoucy *et al.* (1988), include, satisfying the requirements of the rumen micro-organisms to ensure efficient fermentation of fibre and increased production of microbial protein relative to volatile fatty acids; balancing the products of fermentative digestion with dietary nutrients (mainly through the use of bypass protein) to meet the needs of growth, milk, meat and wool production. Experiments with sheep and goats have shown that this can be achieved through protein supplementation or enhancement (Rokomatu and Aregheore, 2006). Protein supplementation and or enhancement are known to enhance utilisation of poor-quality feeds like crop residues as it maximises roughage degradation and optimises rumen microbial protein synthesis (Rokomatu and Aregheore, 2006). However, most of the supplements used such as soya beans, cotton seed cake and groundnut cake are expensive and not readily available. Urea offers a cheap and good alternative source of protein (Wanapat *et al.,* 2009), thus enhancing their digestibility, intake and nutrient availability through optimization of rumen fermentation. Urea and molasses have been used extensively for the feeding of ruminants under experimental conditions. When they are fed as such to a ruminant, it is hydrolyzed instantly in the rumen and the ammonia and energy released are utilized efficiently for microbial protein synthesis (Nisha, *et al.,* 2005). Breed, sex, age, reproductive status, environmental factors, stress and transportation are known to affect haematological and biochemical parameters (Balikci *et al.,* 2007) are thought to play major roles in the differences in haematological and biochemical parameters observed in West African dwarf goats (Opara and Fagbemi 2009). Haematological and biochemical indices of animals may give some insight into the production performance potentials of West African dwarf goats (Orheruata and Akhuomobhogbe 2006). While it is apparent that a lot of work have been done and reported on the feeding values of maize offal, cassava peels and groundnut haulms little or no work have been reported on the haematological and serum biochemical indices of West African dwarf goats fed maize offal and urea-molasses treated rice husks. The present study was therefore, designed to evaluate feed intake, haematological and biochemical indices of West African dwarf does fed graded levels of urea-molasses treated rice husks diets.

Materials and methods

Study location

The experiment was conducted at the small ruminant unit of Teaching and Research Farms of the Federal University of Technology, Akure (FUTA) Ondo State. The area was located in the rainforest zone, South West, Nigeria with about 1000 to 1200 mm of rainfall per annum. The laboratory analyses were carried out at the Nutrition laboratory unit of Department of Animal Production and Health.

Collection of feed materials

The rice husks were collected in a rice milling centre at Ogbese town of Ondo State. Molasses and other feed ingredients were purchased from a reputable feed miller in Akure while the urea fertilizer was collected at Crop production unit of Teaching and Research Farm FUTA.

Ensiling procedure

A 100 litre capacity plastic drum was used to prepare urea –molasses solution. 5 kg each of urea fertilizer and molasses were measured poured into the plastic drum and water was added to make 100 litres of urea-molasses solution. Consequently, 200 kg of rice husks was weighed and mixed thoroughly with 100 litres of urea-molasses solution at ratio 2:1 (w/v). The urea-molasses treated rice husks was ensiled in a big "drum" of about 150 litres capacity that has its inside lined with nylon. The rice husks were pressed into it so as to remove any traces of air in the drum. The urea-molasses treated rice husks was covered with nylon and sand was put on top of the nylon to prevent air penetration The ensiled rice husks was left for 15 days to ferment thereafter sun-dried for 5 days before used.

Gross composition of experimental diets

Five experimental diets were formulated such that maize offal was partially replaced with sun-dried urea-molasses treated rice husks meal at ratio 0% (diet A), 20% (diet B), 30% (diet C), 40% (diet D) and 50% (diet E) while other ingredients included palm kernel cake, poultry litter, bone meal, salt and vitamin-mineral premix (Table 1).

Table 1: Gross composition of varying levels of urea-molasses treated rice husks diets fed to West African Dwarf does

Ingredients (g/100g)	Diets				
	A	B	C	D	E
Maize offal	50.00	30.00	20.00	10.00	-
Rice husks	-	20.00	30.00	40.00	50.00
Palm kernel cake	30.00	30.00	30.00	30.00	30.00
Poultry litter	12.00	12.00	12.00	12.00	12.00
Wheat offal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50

Animals and management

The study was conducted using twenty-five (25) West African dwarf does sourced from the small ruminant unit of University's Teaching and Research farm, each weighed 14.78 ± 0.31kg and aged 2 - 2½ years. The does were treated against external parasites and dewormed with Albendazole® (2.5% oral suspension) and were prevented against infections by using Oxytetracycline LA® at the rate of 1 ml per 10 kg per doe. Each doe was housed individually in a pen equipped with feeding and watering troughs. The does (5 does per treatment) were allotted to the five formulated diets in Completely Randomized Design. Each doe within a treatment received daily feed of an assigned diet for 63 days excluding 14 days adaptation. The does were fed the experimental diets daily early in the morning (7:00 am) and fresh water was given *ad libitum* throughout the experimental period. The last 14 days of the experimental period were used for collection of faeces and urine for laboratory analysis. The does were weighed before the commencement of the feeding trial and were repeatedly weighed weekly in the morning before feeding to determine weight changes using spring-balance (hanging scale)

The parameters determined were nutrients composition of experimental diets, feed intake, digestibility, daily weight gain, nitrogen balance; feed to gain ratio, haematological and biochemical indices.

Blood collection

At the end of the feeding trial, two sets of blood samples were taken from each doel via a jugular vein puncture using a 10mL 25 gauge syringes and needles. One set of the blood samples (5mL) was collected into plastic tubes containing the anti-coagulant ethylene diaminetetraacetic acid (EDTA) for the determination of haematological indices. The other set of blood samples (5mL) was collected into anti-coagulant free plastic tubes, allowed to coagulate at room temperature and centrifuged for 5min at 3000rpm.

Laboratory analysis

Samples of the experimental diets and faeces were analyzed to determine their chemical composition in the laboratory using AOAC (2000) method, fibre fractions were determined according to Van Soest *et al,* (1991). Urine samples were analyzed for nitrogen. Gross energy was determined by the method of Ekaneyake *et al.* (1999). The blood samples were analysed for haematological and biochemical indices (Scalm *et al.,* 1975).

Experimental design and statistical analysis

The experimental design was of Completely Randomized Design and all data generated were subjected to analysis of variance (ANOVA) as described by SAS (2008) and treatment means were compared by the methods of Duncan (1955).

Results and discussion

The nutrients composition of the urea-molasses treated rice husks diets are shown in Table 2. The dry matter (DM) content of the diets ranged 91.26 - 91.69%. The highest dry matter was obtained in diet A. The dry matter values were comparable to 83.13 – 88.21% reported by Onwuka (1999) for molasses-urea multi-nutrients blocks. Crude protein (CP) content of the diets was adequate and ranged between 10.14% (diet A) and 16.23% (diet E). The observed CP values compared favourable to the CP values reported by Ntiranyibagira *et al.* (2015) when urea treated roughage based supplements were fed to camels. The crude fibre contents recorded decreased with increased inclusion of urea-molasses treated rice husk meal in the diets, the CF was highest in diet A and least in diet E. However, the CF contents were lower compared to values reported by Ntiranyibagira *et al.* (2015). The ether extract values of the diets ranged between 5.54% and 8.93%, as diet A had the least value while diet B had highest value. Diet E had the highest nitrogen free extract (NFE) (52.96%) while diet B had the least value (50.41%). The neutral detergent fibre of diet E was the highest while the least acid detergent fibre was obtained in diet B. The energy content ranged between 15.89 (diet A) and 16.62 KJ/100gDM (diet B).

Table 2: Chemical composition of urea-molasses treated rice husks diets fed to West African dwarf does

Parameters	Diets				
	A	B	C	D	E
Dry Matter	91.69	91.39	91.56	91.27	91.26
Crude Protein	10..14	13.05	14.26	15.19	16.23
Crude Fibre	21.18	15.84	15.30	14. 09	13.72
Ether Extract	5.54	8.93	7.70	7.10	7.05
Ash	11.80	11.77	11.66	11.59	10.04
Nitrogen Free Etract	51.34	50.41	51.08	52.03	52.96
Neutral detergent fibre	43.14	41.18	43.14	44.00	46.00
Acid detergent fibre	31.37	32.08	34.62	35.29	35.29
Acid detergent lignin	13.29	14.97	16.05	17.39	17.59
Hemicelluloses	11.76	9.10	8.52	9.71	10.71
Cellulose	18.08	17.11	18.57	17.90	17.70
Gross energy (KJ/100gDM)	15.89	16.62	16.36	16.26	16.50

The results of nutrients intake by the does are presented in Table 3. The results revealed that nutrients intake was significantly (P<0.05) influenced by the urea-molasses treated rice husks meal in the diets. The does fed diet C had the highest dry matter intake while the goats fed diet A consumed the least quantity of their diet and this might be attributed to the protein quality and coarse texture of the diet. However, the dry matter values reported were higher than the values reported by Fajemisin *et al.* (2015) when chemically treated corncob based diets were fed to WAD sheep. The Crude protein intake of the does ranged between 44.93 (diet A) and 79.78 g/day (diet C). This observation was comparable to CP intake values reported by Fajemisin *et al.* (2015). The crude fibre intake was highest in does fed diet A (93.84g/day) and least in does fed diet E (63.35g/day), this might be due to fibre quantity of diet A (Table 2). Does fed diet C had the highest soluble carbohydrate intake (285.77g/day) while does fed diet A had the least (227.47g/day). This implied that the diet contained enough crude protein and energy that improved the intake of the does. The improved NDF, ADF and ADL intake could be attributed to the improved crude protein quality of diets B, C, D and E which was more than critical 7% CP required by ruminants (Norton, 2003). The Energy intake ranged between 16.83 (diet A) and 21.88 kcal/g which was favourably comparable to energy intake suggested by McDonald *et al.* (1995).

Table 3: Nutrients intake (g/day) by the West African Dwarf does fed urea-molasses treated rice husks diets

Parameters	Diets					
	A	B	C	D	E	SEM
Dry matter	443.06^{e}	537.63^{b}	559.46^{a}	487.73^{c}	461.75^{d}	11.84
Crude protein	44.93^{d}	70.16^{c}	79.78^{a}	74.09^{b}	74.94^{b}	3.31
Crude fibre	93.84^{a}	85.16^{b}	85.60^{b}	68.72^{c}	63.35^{d}	3.08
Ether extract	24.55^{d}	48.01^{a}	43.09^{b}	34.63^{c}	32.55^{c}	2.26
Ash	52.28^{c}	63.28^{a}	65.23^{a}	56.53^{b}	46.36^{d}	1.90
Nitrogen free extract	227.47^{e}	271.02^{b}	285.77^{a}	253.77^{c}	244.54^{d}	5.47
Neutral detergent fibre	191.14^{e}	271.02^{a}	241.35^{b}	214.60^{c}	212.41^{d}	7.36
Acid detergent fibre	138.99^{d}	172.47^{b}	193.85^{a}	172.12^{b}	162.95^{c}	4.75
Acid detergent lignin	58.88^{c}	80.48^{b}	89.79^{a}	84.82^{b}	81.22^{b}	2.90
Hemicelluloses	52.10^{a}	48.92^{ab}	47.67^{c}	47.36^{c}	49.45^{ab}	0.59
Cellulose	80.11^{d}	91.99^{b}	103.89^{a}	87.30^{c}	81.73^{d}	2.31
Energy (kcal/g)	16.83^{c}	21.36^{ab}	21.88^{a}	18.95^{bc}	18.21^{c}	0.60

abcde =Means within the same row with different superscripts are significantly different (p<0.05).

The apparent digestibility co-efficient of the does fed urea-molasses treated rice husk meal diets are shown in Table 4. The apparent digestibility of the nutrients assessed was significantly (P<0.05) influenced by the treatment except acid detergent lignin. However, the dry matter digestibility of the does fed diet E was the highest (75.35%) compared to 56.85% observed in does fed diet A. This is an indication that the diets were palatable and digestible (McDonald *et al.,* 1995) thus there is positive relationship between apparent digestibility of feed and protein intake. Crude protein apparent digestibility coefficient ranged between 72.10 (diet A) and 79.66% (diet E), these values were higher than the average value (58.60%) reported by Nisha *et al*. (2005) when goat kids were fed sola (Aeschonomene indica Linn) grass-based diet supplemented with urea molasses mineral granules. Crude fibre and nitrogen free extract were better digested by does fed diet E, the apparent digestibility coefficient of CF and NFE was in agreement with the observation of McDonald *et al.* (1995). Fibre fractions digestibility with exception of hemicelluloses was best in does fed diet E. The energy digestibility was least in does fed diet A; this could be attributed to the fibrous nature and least crude protein quality of diet A.

Table 4: Apparent digestibility (%) of West African Dwarf does fed urea -molasses treated rice husks diets

Parameters	Diets					
	A	B	C	D	E	SEM
Dry matter	56.85^{d}	61.45^{c}	63.57^{bc}	66.14^{b}	75.35^{a}	1.67
Crude protein	72.10^{b}	73.54^{b}	75.09^{ab}	76.79^{ab}	79.66^{a}	0.97
Crude fibre	63.90^{c}	66.32^{c}	70.36^{b}	72.50^{b}	77.59^{a}	1.34
Ether extract	57.22^{d}	61.60^{c}	65.22^{c}	71.03^{b}	78.08^{a}	2.02
Nitrogen free extract	51.44^{c}	62.75^{b}	64.97^{ab}	67.75^{a}	68.57^{a}	1.72
Neutral detergent fibre	64.26^{d}	68.00^{cd}	70.02^{bc}	73.50^{ab}	75.48^{a}	1.22
Acid detergent fibre	57.01^{d}	61.01^{cd}	63.82^{bc}	66.61^{b}	73.13^{a}	1.56
Acid detergent lignin	64.64	65.90	65.27	66.74	66.79	0.52
Hemicelluloses	55.51^{d}	67.59^{c}	67,76^{bc}	70.29^{ab}	72.03^{a}	1.58
Cellulose	55.94^{d}	62.87^{c}	68.01^{b}	69.44^{b}	73.49^{a}	1.69
Energy (kcal/g)	56.72^{e}	61.56^{d}	66.58^{c}	68.83^{b}	71.35^{a}	1.43

abcde =Means within the same row with different superscripts are significantly different ($p<0.05$)

The daily weight gain, feed/gain ratio and nitrogen balance of the does fed urea-molasses treated rice husk meal diets were significantly ($P<0.05$) influenced by the treatment (Table 5). The result revealed that nitrogen balance of the does ranged 5.27 (diet A) – 8.26g/day (diet D). The daily weight gain ranged between 20.32 and 63.81 g/day, the does fed diet B had the highest value while the does fed diet A had the least (20.32g/day). This agreed with the findings of Adebowale and Taiwo (1996) that weight gain was dependent on dry matter, protein intake and digestibility of the nutrients. However, the best feed to gain ratio (8.42) was obtained in does fed diet B, indicating the ability of does fed diet B to convert their feeds to flesh better than does fed other diets and this might be attributed to adequate dry matter intake and protein quality of the diet. It may also imply that diet B met the nutrient requirement of the does thus; the diet supplied adequate energy and protein that sustained the growth of the does without adverse effect.

Table 6 shows the results of haematological indices of the does fed urea-molasses treated rice husks meal diets. The result showed that the haematological indices were significantly ($p<0.05$) influenced by the inclusion of urea-molasses treated rice husk meal except haemoglobin, neutrophils, basophils mean corpuscular haemoglobin concentration (MCHC) and Mean corpuscular volume (MCV). The mean Parked Cell Volume compared favourably to 25 - 30% reported by Opara *et al.,* (2010). It implied that the protein content of the diets was adequate since the values were within normal range for healthy

Table 5: Nitrogen balance, weight gain and feed to gain ratio of West African dwarf does fed urea-molasses treated rice husks diets

Parameters	Diets					
	A	B	C	D	E	SEM
Nitrogen intake	7.19^{b}	11.23^{a}	12.76^{a}	11.85^{a}	11.99^{a}	0.59
Nitrogen Feacal	1.14^{c}	4.44^{a}	4.68^{a}	2.78^{b}	4.55^{a}	0.37
Nitrogen Urine	0.78	0.66	0.72	0.81	0.63	0.08
Nitrogen Balance	5.27^{c}	6.13^{bc}	7.36^{ab}	8.26^{a}	6.81^{abc}	0.34
Initial weight	14.78	14.77	14.78	14.79	14.78	0.30
Final weight	17.92	18.79	18.52	16.07	16.39	0.56
Weight gain	3.14^{a}	4.02^{a}	3.74^{a}	1.28^{b}	1.61^{b}	0.32
Daily weight gain	49.84^{c}	63.81^{a}	59.37^{b}	20.32^{e}	25.56^{d}	4.37
Feed/gain ratio	8.89^{c}	8.42^{c}	9.42^{c}	24.00^{a}	18.07^{b}	1.70

abcd =Means within the same row with different superscripts are significantly different ($p<0.05$)

Table 6: Haematological indices of West African dwarf does fed urea-molasses treated rice husks diets

Parameters	Diets					
	A	B	C	D	E	SEM
ESR (mm)	1.65^{a}	1.67^{a}	1.05^{b}	1.37^{ab}	1.17^{b}	0.08
Packed cell volume (%)	16.67^{b}	23.33^{a}	21.67^{a}	23.33^{a}	22.33^{a}	0.80
Red blood cells (X 10^6/mm^3)	723.33^{c}	872.00^{a}	826.33^{ab}	843.33^{ab}	790.00^{b}	15.17
White blood cells (X 50/mm^3)	193.33^{b}	251.00^{a}	257.00^{a}	212.67^{ab}	251.67^{a}	8.73
Haemoglobin g/100ml	5.43	7.47	6.97	7.10	7.33	0.34
Lymphocytes (%)	52.67^{b}	60.67^{a}	60.33^{a}	61.00^{a}	61.67^{a}	0.95
Monocytes (%)	6.00^{c}	6.67^{b}	6.67^{b}	7.67^{a}	7.33^{a}	0.17
Neutrophils (%)	23.33	27.33	27.67	27.67	27.00	0.77
Basophils (%)	1.00	1.00	1.33	1.67	1.33	0.07
Eosinophils (%)	1.67^{d}	2.33^{b}	2.33^{b}	2.00^{c}	2.67^{a}	0.10
MCHC (%)	33.30	33.34	33.30	33.30	33.32	0.49
MCH (μ^2g)	8.66	8.64	8.45	8.30	8.46	0.13
MCV (μ^3)	26.02	25.82	25.37	24.91	25.38	0.36

abc= Means within the same row with different superscripts are significantly different ($p<0.05$).

WAD goats (Daramola *et al.,* 2005). Haemoglobin concentrations ranged between 5.43 and 7.47 g/100mL but higher than the 5 - 6g/100mL reported by Belewu and Ogunsola (2010) for goats fed fungi-treated *Jatropha curcas* kernel cake rations. Thus, the dietary treatments seemed to be capable of supporting high oxygen carrying capacity blood in the does. The lymphocytes concentrations ranged 52.67 – 61.67 %; these values were within the broad range of 47–82% reported by Daramola *et al.* (2005) while the obtained neutrophils compared favourably to the concentrations (17 – 36.4%) reported by Tambuwal *et al.* (2002) These concentrations of lymphocytes and neutrophils are suggestive of a well developed immune system in the West African Dwarf does with such number of immune cells to proffer good health (Daramola *et al.,* 2005).

The result of serum biochemical indices is shown in Table 7. The result revealed that biochemical indices were significantly (P<0.05) influenced by the treatment with exception of globulin, alkaline aminotransferase and blood urea. Serum protein obtained compared favourably to the values reported by Daramola *et al.* (2005) and Tambuwal *et al.* (2002). This implied that the diets supplied adequate protein to prevent haemorrhage (Robert *et al.,* 2003). Albumin concentration recorded for West African dwarf goats were between 4.35 and 4.88g/L. Does fed diet D had the highest globulin, while does fed diet A had the least globulin however, the concentrations were higher than 0.61 – 1.60g/dl reported by Daramola *et al.* (2005) for WAD goats. Albumin/globulin ratio recorded for does ranged between 1.07 (diet B) and 1.32 (diet D).

Table 7: Serum biochemical indices of West African dwarf does fed urea-molasses treated rice husks diets

Parameters	Diets					
	A	**B**	**C**	**D**	**E**	**SEM**
Total protein g/dL	5.29^{c}	6.17^{ab}	5.42^{bc}	6.87^{a}	6.10^{abc}	0.18
Albumin g/dL	2.84^{c}	3.18^{bc}	3.01^{bc}	3.92^{a}	3.42^{b}	0.12
Globulin g/dL	2.45	2.90	2.41	2.95	2.68	0.09
Alb/globulin	1.16^{c}	1.07^{d}	1.25^{b}	1.32^{a}	1.27^{ab}	0.02
Aspartate aminotransferase IU/L	31.52	29.67	32.00	26.33	31.67	0.66
Alkaline aminotransferase IU/L	10.81	8.33	10.33	11.33	11.00	0.32
Alkaline phosphate IU/L	2.58^{bc}	2.27^{c}	2.80^{b}	3.32^{a}	2.68^{b}	0.10
Creatinine mg/Dl	2.31^{a}	2.27^{ab}	1.92bc	1.86^{c}	2.11^{abc}	0.06
Blood urea	21.23	22.45	23.05	23.65	24.10	0.43

abc = Means within the same row with different superscripts are significantly different (p<0.05).

Conclusion and recommendations

The present study extends frontiers of knowledge on the potentials of urea-molasses treated rice husks meal as a nutritive feed that could be incorporated in the diets of ruminants such as sheep and goats. This study revealed that maize offal when substituted with urea-molasses treated rice husks meal could meet the nutritive requirement of West African dwarf does. The diets used in this study did not significantly affect the globulin and blood urea levels in the serum of the does, thus indicating the safety of these urea-molasses treated rice husks diets fed to WAD does. Considering the best weight gain (63.81 g/d) and feed to gain ratio (8.42), it could be concluded that does fed B performed better than other does thus; the diet would be a better source of protein and energy to support the growth performance of goats.

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