Growth performance and economic benefits of West African dwarf goat fed diets containing treated rice husk (rh) as a replacement for wheat bran.

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Abstract

Avoidance of some feeds which could be consumed by humans in ruminant feeding is a major key to sustainable ruminant production in developing countries. Rice husk is a by-product of rice, which is known to be non-competitive with humans. The study was conducted to find out effects of treated rice husk as a replacement for wheat bran supplement on the growth performance of West African Dwarf (WAD) goats. Twenty (20) WAD goats were subjected to five dietary treatments in a Completely Randomized Design (CRD) with four (4) animals per treatment and each serving as a replicate. The treatments are 0% RH (T1), 25% RH (T2), 50% RH (T3), 75% RH (T4) and 100% RH (T5). The animals were fed 5% of their body weight. The growth performance and economic benefits are measure. The result showed that T2 and T1 are relatively high in crude protein, low in crude fiber, moderate in crude fat, high in carbohydrate and equally had lowest values of ADF, ADL and NDF among the treatments. The total weight gain (TWG), average daily weight gain (ADWG), total daily feed intake (TDFI) and feed conversion ratio (FCR) were all significantly ($P < 0.05$) influenced by the dietary treatments. The goat on, T1 had highest TWG, ADWG and TDFI values among the other goats. The goat fed 25% RH replacement level (T2) converted and utilized feed better and had better growth performance comparable to goats fed T1. In conclusion, at 25% level of treated rice husk as replacement of wheat bran gave better growth performance in the goats. The result demonstrated the qualitative benefits and financial returns of using treated rice husk to replace wheat bran diets for WAD goats. Thus, the use of treated rice husk up to 50% in the diet of WAD goats is recommended for appreciable growth performance and better economic benefits.

Key words: Treated rice husk, West African Dwarf goat, weight gain, feed conversion ratio, feed intake

Performance de croissance et avantages économiques des chèvres naines de l'Afrique de l'Ouest nourries avec des régimes contenant de la balle de riz traitée (BR) en remplacement du son de blé

Résumé

L'évitement de certains aliments qui pourraient être consommés par les humains dans l'alimentation des ruminants est une clé majeure pour une production durable de ruminants dans les pays en développement. La balle de riz est un sous-produit du riz, connu pour ne pas être en concurrence avec les besoins humains. L'étude a été réalisée pour déterminer les effets de la balle de riz traitée en remplacement du complément de son de blé sur la performance de croissance des chèvres West African Dwarf (WAD). Vingt (20) chèvres WAD ont été soumises à cinq traitements alimentaires dans un plan complètement randomisé (CRD) avec quatre (4) animaux par traitement, chaque groupe servant de répétition. Les traitements sont 0% BR (T1), 25% BR (T2), 50% BR (T3), 75% BR (T4) et 100% BR (T5). Les animaux ont été nourris avec 5% de leur poids corporel. La performance de croissance et les avantages économiques ont été mesurés. Les résultats ont montré que T2 et T1 étaient relativement élevés en protéines brutes, faibles en fibres brutes, modérés en graisses brutes, élevés en glucides et avaient également les valeurs les plus basses de ADF, ADL et NDF

parmi les traitements. Le gain de poids total (TWG), le gain de poids quotidien moyen (ADWG), l'ingestion quotidienne totale de nourriture (TDFI) et le rapport de conversion alimentaire (FCR) ont tous été significativement (P < 0,05) influencés par les traitements alimentaires. La chèvre alimentée avec T1 a eu les valeurs les plus élevées de TWG, ADWG et TDFI parmi les autres chèvres. La chèvre nourrie avec un niveau de remplacement de 25% de BR (T2) a mieux converti et utilisé la nourriture, et a eu une meilleure performance de croissance comparable à celle des chèvres nourries avec T1. En conclusion, un niveau de 25% de balle de riz traitée en remplacement du son de blé a donné une meilleure performance de croissance chez les chèvres. Les résultats ont démontré les avantages qualitatifs et les retours financiers de l'utilisation de la balle de riz traitée pour remplacer les régimes à base de son de blé pour les chèvres WAD. Ainsi, l'utilisation de balle de riz traitée jusqu'à 50% dans l'alimentation des chèvres WAD est recommandée pour une performance de croissance appréciable et de meilleurs avantages économiques.

Mots-clés : Balle de riz traitée, chèvre West African Dwarf, gain de poids, rapport de conversion alimentaire, ingestion alimentaire

Introduction

Goat has been an important source of protein to man since their domestication 10,000 years ago and it has since been distributed in different cultivars across the globe (Hanke and Barkmann, 2017). Goat values and relative importance vary according to different agro-ecological zones, production system and socio-cultural context in which they are found (Kosgey *et al.*, 2008; Oluwatayo and Oluwatayo, 2012). Its uses hinges on the fact that they provide meat, hides, fibre, and milk for home consumption (Midgley *et al.*, 2012). Goat is significant for different socio-economic purposes, such as festive, religious and ceremonial occasions (Garrine *et al.*, 2010). It serves as an important source of income to farmers in order to meet immediate social and financial obligations. Goat is often described as the "village bank" (Gracinda *et al.*, 2021). and at the time source of revenue to government especially at the grass-root (Gracinda *et al.*, 2021).

However, the production of this categories of animal is constrained by inadequate nutritional supplement especially during the dry season period of the year. Thus, efforts to feed adequately ruminant livestock during the long dry season generally poses a lot of challenge to the small holders who represent the greater percentage of goat producers in Nigeria and other parts of the tropics (Ocheja *et al.*, 2019). During the long dry season, feeds become scarce; most grasses are dried-up and left with low nutritive value and thus, this condition is not suitable enough for good quality animal production (Ocheja *et al.*, 2019). The prices of conventional feed ingredients such as maize, soya beans, fish meal and wheat bran in the market have always being on the increase. The competition for some of these feed ingredients in the market for human food and at the same time as animal feed ingredients has further worsened the condition of their ready availability for animal feed (Adejinmi *et al.*, 2007). Therefore, there is the need to seek alternative feed materials that are readily available, cheap, safe and not in direct use by humans for food with a view to reducing the cost of animal protein, thereby making it more affordable for livestock feed by farmers.

Feeding of ruminants especially goats in Nigeria during dry season has always been a challenge to farmers since good quality pastures and forages are dried-up and so become scarce with poor nutritive value, hence the growth performance of these animals are seriously retarded. The animals are unable to meet their nutritional requirement from the available poor quality herbage resulting in significant weight loss and reduced productivity (Gabriel *et al.,* 2022). In an attempt at improving animal nutritional performance in Nigeria, we must first address the perennial shortage of feed and dry season fodder for ruminant livestock. One possible way to alleviate this challenge is to conduct studies on the

utilization of locally available and cheaper feed resources such as agro-industrial by-products which cannot be consumed by man but can be converted by ruminants into desirable feed supplements. This will reduce the cost of animal production without a decrease in productivity (Oduguwa *et. al.,* 2013).

Different research findings in the past have shown the use of some crop plants by-products in treated form used as goat nutritional supplement such as maize husk, rice hull, groundnut husk etc. (Babayemi *et al.,* 2010; Jiwuba and Ezenwaka, 2016**;** Okoruwa and Agbonlahor, 2016). However, there is a dearth or fewer available information on the use of treated rice husk as feed supplement on the growth performance of West African dwarf goat in Nigeria. This study, therefore, was designed to determine effect of treated rice husk as a replacement of wheat bran on the growth performance of WAD goats.

Materials and Methods

This research work was carried out at the Small Ruminant Unit, Teaching and Research Farm, Faculty of Agriculture, Kwara State University, Malete, Nigeria. Rice husk was obtained from a reputable rice milling industry within the study area. 500g of the rice husk was introduced into a cooking pot containing 3 liters of boiling water. The mixture was allowed to boil for 150 minutes with continuous stirring to obtain a homogenous mixture. The cooked rice husk was strained to remove excess water and dried to 35% dry matter. After which the rice husk was packed inside an air-tight polythene bag and it was allowed to ferment for 20 days after which it was dried, packed and weighed to formulate experimental diets (Table 1).

Twenty (20) WAD goats with an average weight of 8.6 kg used in the study were randomly allocated in a Complete Randomized Design (CRD) into five treatments with four animals per treatment. The treatments consisted of different levels of replacement of wheat bran with the treated rice husk as follows: (T10% rice husk), (T2, 25% rice husk), (T3, 50% rice husk), (T4, 75% rice husk) and (T5, 100% rice husk). The feeding trial covered a period of 84 days during which the experimental diets were served at 5% of their body weight and clean water was provided *ad libitum* daily. The feed was measured and served to the animals by 8:00am daily; while leftover was weighed the following morning before serving a fresh feed. The difference between the feed served and the leftover gives the feed intake per day. The data obtained were used to determine daily feed intake (DFI). Initial weights of the animals were taken at the beginning of the trial and weekly subsequently using a hanging scale. The data obtained were used to determine daily weight gain (DWG) and total weight gain (TWG). FCR was calculated at the end of the experiment using the formulae:

$$\frac{\text{Total feed intake (kg)}}{\text{Total weight gain (kg)}}$$

Where: Total weight gain = Final weight - Initial weight

Statistical Analysis

Data collected for growth parameters were subjected to Analysis of Variance (ANOVA) and differences between treatment means were separated by least significance difference using General Linear Model procedure of Statistical Analysis System (DSAASTAT, 2011).

Results and Discussion

Proximate composition

The chemical composition of the experimental diets used in this study is presented in table 2. All the parameters examined were significantly different ($p < 0.05$) among the treatment groups. The maximum value of crude protein (CP) was found in T2 (13.0%) and minimum in T5 (7.5%) while a greater crude fiber content was recorded in T4 (75%RH) than the others T3 (50%RH), T5 (100%RH), and T1 (0%RH).

Table 1: Composition of the experimental diets (%).

Parameters (%)	Treatments				
	T1 (0%RH)	T2 (25%RH)	T3(50%RH)	T4(75%RH)	T5(100%RH)
Rice husk	0	12.5	25	37.5	50
Wheat bran	50	37.5	25	12.5	0
Cassava peel	30	30	30	30	30
SBCW	10	10	10	10	10
PKC	5	5	5	5	5
Bone meal	3	3	2.8	2.6	2.4
Lime stone	1	1	1	1	1
Salt	1	1	1	1	1
Urea	-	-	0.2	0.4	0.6
Total	**100**	**100**	**100**	**100**	**100**

T1,0%RH, T2,25%RH, T3,50%RH, T4,75%RH, T5,100%RH, SBCW = Soybean cheese waste.; PKC = Palm kernel cake.

All the diets had crude protein (CP) values above the 6 - 8% CP the minimum requirement for ruminants (NRC, 1985) in nutrient requirements of domestic Animals. The crude protein levels of the experimental diets were far above the 8% needed to provide the minimum ammonia levels required for microbial activity in the rumen. Faisal *et al.* (2017) reported that low cost of concentrate diets with more than 8% CP could be a good maintenance ration for ruminant animals during dry season. The crude fibre content of the experimental diets in the study was lower than the value (34.85%) reported by Oladotun *et al.* (2003). The contrast could be as a result of the treated rice husk inclusion in the diets.

Ash content increase with increasing amount of rice husk quantity, the same trend was observed in ADF. However, the carbohydrate content recorded a declining trend as the rice husk quantity increases. The crude protein, crude fibre, crude fat, ash and CHO values obtained for the experimental diets used in this study were similar to the values reported by Fasuyi *et al.* (2010). The values of ADF, NDF and ADL for all the experimental diets were lower than the values 62.29% NDF, 47.83% ADF and 20.25% ADL reported by Oladotun *et al.* (2003). According to Robert (2013), ADF is used to produce energy content of feed which goes with the T5 (100%RH) having the highest ADF with higher energy content implying, higher energy.

Table 2: Chemical composition (%) of the experimental diets.

Treatmt	DM	CP	CFAT	CF	ASH	CHO	NDF	ADF	ADL	HMC	CELL
T1	96.15^{c}	12.23^{b}	3.55^{c}	11.62^{e}	10.03^{e}	58.81^{a}	39.62^{e}	20.18^{e}	14.05^{e}	19.44	6.13
T2	97.31^{a}	13.04^{a}	3.59^{b}	15.81^{d}	13.18^{d}	51.69^{b}	39.67^{d}	29.08^{d}	19.03^{d}	10.59	10.05
T3	96.13^{c}	9.12^{d}	2.88^{d}	20.55^{b}	14.86^{c}	48.69^{c}	43.76^{b}	34.38^{c}	21.93^{c}	9.38	12.45
T4	97.20^{b}	11.47^{c}	3.92^{a}	20.94^{a}	15.26^{b}	45.61^{e}	44.12^{a}	42.25^{b}	29.55^{a}	1.87	12.7
T5	97.31^{a}	7.59^{e}	2.42^{e}	19.50^{c}	17.15^{a}	50.64^{c}	42.12^{c}	42.34^{a}	27.95^{b}	0.22	14.39
S.E.M	1.52	5.77	4.47	5.38	1.55	4.94	5.37	5.38	5.28	0.01	5.38
P-value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Treatmt= Treatment; WB=Wheat Bran, RH-Rice Husk, DM= Dry matter, CP= Crude protein, CFAT=Crude Fat, CF=Crude fibre, CHO= Carbohydrate, NDF= Neutral detergent fibre, ADF= Acid detergent fibre, ADL= Acid detergent lignin, HMC= Hemicellulose, CELL= Cellulose, T1 (RH0%), T2 (RH25%), T3 (RH50%), T4 (RH75%), T5 (RH100%).

Growth performance

On growth performance and feed intake of WAD goats fed the experimental diets is presented in Table 3. The total body weight gain (TWG) of WAD goats fed the different treatments/diets showed significant differentes ($P > 0.05$) from each other with the goats fed T_1 (0%RH) showing the best total body weight gain of 3.35kg while goats fed with T5 (100%RH) had the lowest total body weight gain of 2.73kg. The goat on T1 also had the highest ADWG values among the goats. Thus, goats fed with T1 0%RH gain more body weight of 39.88g/day than the rest of the goats. It is to be noted that goat fed 25% RH replacement level (T2) also had appreciable value for TWG and ADWG and thus, had appreciable growth performance comparable to goats fed T1. Variation in the weight gain of the WAD goats as obtained in this study could be attributed to difference in palatability and nutrient supply from the diets. The total daily feed intake (TDFI) decreased as the inclusion level of treated RH increases. Thus, total feed intake significantly increases with decrease in the treated rice husk inclusion level in the diets. This is consistence with the reports of Olorunnisomo (2011); Ajayi and Omotosho (2018) and Akinwade *et al.* (2019).

The higher intake of the diets in T1(0%RH), T2(25%RH) and T3(50%RH) by the goats could be due to the palatability, succulent nature, taste, structure, improved microbial degradation and high CP of the diets with higher percentage of wheat bran with high fermentable CHO making it more palatable and digestible. The lower feed intake in T4 (75%RH) and T5 (100%RH) could be due to low fibre degradability in the rumen and roughness, poor nutritive value & induced irritation in the digestive tracts (Kim *et al*., 2003). Babayemi (2009) reported that higher feed intake of diets could be due to sweet and pleasant lactic acid aroma of the feed.

The lowest FCR (10.44) obtained in this study was recorded in goat fed T2 (25%RH), the value is however not significantly different from other treatments. The FCR value of 10.44 obtained in T2 (25%RH) indicates that the goats fed T2 convert feed better and are more efficient feed utilization than the rest of the animals. Aswanimiyuni (2018) reported that animals that have a low FCR are considered efficient users of feed. The better feed conversion ratio obtained in goats fed T2 and T4 compared to goats fed T1, T3 and T5 may be due to the differential variability of individual goat. The range value of 10.44 – 11.28 obtained for FCR in this study is comparable to 7.68-11.68 reported by Naseer *et al.,* (2017).

Table 3: Growth performance of West Africa dwarf goats fed experimental diets.

	Treatments						
Parameters	T1	T2	T3	T4	T5	SEM	P-value
IW (Kg)	8.15	8.13	8.15	8.15	8.2	0.51	0.9999
FW (kg)	11.50	11.35	11.20	11.03	10.98	0.46	0.9173
TWG (kg)	3.35^{a}	3.15^{a}	2.90^{ab}	2.88^{ab}	2.73^{b}	0.17	0.1401
ADWG (g)	39.75^{a}	37.50^{ab}	34.50^{ab}	34.25^{ab}	32.25^{b}	2.14	0.1596
FDFI (g)	192.75^{a}	174.00^{b}	172.00^{b}	165.00^{b}	165.50^{b}	3.56	0.0004
CDFI (g)	227.50	215.00	212.50	205.00	197.50	10.35	0.3572
TDFI (g)	420.25^{a}	389.00^{ab}	384.50^{b}	370.00^{b}	363.00^{b}	11.25	0.0232
FCR	11.02	10.44	11.17	10.83	11.28	0.77	0.9433

IW= Initial weight, FW= Final weight, TWG=Total weight gain, ADWG=Average daily weight gain, FDFI=Forage daily feed intake, CDFI=Concentrate daily feed intake, TDFI=Total daily feed intake, FCR=Feed conversion ratio, T1=0%Rice husk, T2=25%Rice husk, T3=50%Rice husk, T4=75%Rice husk, T5=100%Rice husk, abcde= Means with the same letters within the column are not significantly different (P > 0.05).

Economics of Production of Experimental Diets fed to WAD goats

The prevailing market prices of the feed ingredients at the time of the experiment were used to estimate the unit cost of the experimental diet. The variable cost of feeding the goats considered as the cost of the feeds was the same for all the treatments. Feed cost (₦) per kilogram, cost per kilogram of weight gain and cost benefit ratio were calculated accordingly.

The value for feed cost/weight gain as shown in table 4 was lowest for the goats fed T5(100%RH, ₦ 446.52 k) and correspondingly highest for T1(0%RH, ₦ 801.68 k) animals. This implies that feeding WAD goats with higher inclusion of rice husk percentage is cheaper. The cost/benefit ratio showed significant (P< 0.05) differences with goats on diet T5,100%RH having the best value of 1:2.24. In this study, the cost of producing feed for experimental WAD goats decreased from T5 (100%RH) to T1(0%RH). The decrease in the cost of producing feed for the animals could be attributed to the inclusion of treated rice husk in the diets and this is in agreement with the observation reported by Jiwuba *et al.,* (2016), who stated that the inclusion of unconventional feedstuff like *Moringa oleifera* leaf meal or agro-industrial waste such as rice husk in the diets for goats significantly reduced the cost of feed. The value for cost/weight gain was lowest for the goats fed T5,100%RH (₦446.52k) and correspondingly highest for T1,0%RH animals. This implies that feeding WAD goats with higher inclusion of rice husk percentage yielded moderate meat at lower feed cost. The cost/benefit ratio showed significant (P < 0.05) differences with goats on diet T5,100%RH having the best value of 1:2.24. This result is in agreement with the results of earlier studies by (Jiwuba *et al.,* 2016). The result demonstrated the qualitative benefits and financial returns of using treated rice husk to replace wheat bran diets for WAD goats with T5,100%RH, having the highest ratio and T1,0%RH the lowest. This entails an expected benefit of ₦2.24 (two naira twenty-four kobo) for every 1kg in cost for T5,100%RH.

Table 4: Economics of production of experimental diets fed to WAD goats.

	Treatments						
Parameters	T1	T2	T3	T4	T5	SEM	P-value
Cost/100kg feed (₦)	7608[a]	6633[b]	5754[c]	4876[d]	3998[e]	0.58	<0.01
Cost/kg feed (₦)	7608[a]	66.33[b]	57.54[c]	48.76[d]	39.98[e]	0.015	<0.01
TFC (kg)	35.31[a]	32.68[b]	32.31[c]	31.08[d]	30.49[e]	4.49	<0.01
Total cost of feed (₦)	2685.62[a]	2167.66[b]	1855.87[c]	1515.46[d]	1218.99[e]	0.59	<0.01
Daily feed cost (₦)	35.29[a]	32.68[b]	32.29[c]	31.08[d]	30.95[e]	5.38	<0.01
TWG (kg)	3.35[a]	3.15[b]	2.90[c]	2.88[d]	2.73[e]	2.63	<0.01
FC/WG	801.68[a]	688.15[b]	640.88[c]	526.20[d]	446.52[e]	5.38	<0.01
Cost/kg live weight	1000	1000	1000	1000	1000	-	-
Cost benefit ratio	1:1.25	1:1.45	1:1.56	1:1.90	1:2.24	-	-

TFC= total feed consumed, TWG= total weight gain, FC/WG= feed cost/weight gain, T1 = 0% rice husk, T2= 25% rice husk, T3 = 50% rice husk, T4 = 75% rice husk, T5 = 100% rice husk, abcd means in the row with different superscript are significantly different (P < 0.05).

Conclusion

Findings from this study revealed that 25% and 50% treated rice husk replacement level of wheat bran (T2) was more nutritious, palatable with less crude fire and appreciable carbohydrate content and more consumed by the goats among the diets. Diets with 25% and 50% rice husk replacement level (T2 and T3) converted and utilized feed better and also gave appreciable growth performance with better economic benefits in terms of cost.

Recommendation

It is recommended that goat farmers could use treated rich husk to replace wheat bran up to 50% replacement level to ensure improved growth performance and health status of the animals to mitigate feed shortage during the lean period of the year.

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