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Supplementation of Rice Straw with *Leucaena leucocephala* Leaves for Improved Growth Performance and Haematological Parameters of Goats in Northwestern Nigeria

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Abstract

The research was carried out to determine the influence of supplementing rice straw with dried *L. leucocephala* leaves to improve growth performance and haematological indices of two different goat breeds. The experiment consists of Twelve (12) growing Sahelian goats and Red Sokoto bucks with an average weight of 14. ± 2.2 kg randomly assigned to four treatment groups: Treatment I consisted of Sahelian goats fed with Rice straw, Treatment II comprised of Red Sokoto bucks fed with Rice straw, Treatment III consisted of Sahelian goats fed Leucaena leaves supplement while Treatment IV consisted of Red Sokoto bucks fed *Leucaena* leaves supplement. All the experimental animals were fed a concentrated diet of 2 % body weight. The experiment was laid in a Randomized Completely Block Design (RCBD) with three (3) replications for 84 days. Growth performance was measured using standard methods while haematological parameters were determined using standard laboratory assay. Data obtained were analyzed using analysis of variance with Duncan's New Multiple Range Test used to separate significant means at a 5% level. The result obtained revealed a significant difference ($p \leq 0.05$) in the growth parameters and haematological profile of the experimental animals. The result indicated significant improvement in average daily weight gain, final weight gain, feed intake, and feed efficiency among the experimental animals compared to their controls. However, a similar result was found in terms of haematological parameters with Sahelian goats producing the highest values for PCV, Hb, WBC, and RBC while Red Sokoto bucks had the highest values for Lymphocytes which indicated their high relative health status compared to other groups. Red Sokoto bucks therefore respond better to *Leucaena* leaves supplementation; thus, recommended for use in feeding trials involving such goat breeds.

Keywords: Breed, Feed, Goats, *Leucaena leucocephala,*

Introduction

The increasing spate of malnutrition, food crises, and pricing in Nigeria with subsequent increased poverty and crime rates have made ensuring food security a major challenge for the Nigerian government (Nzegbule *et al*., 2020). This calls for a search for alternative sources of nutrients that are cheaper and easily available in the vicinity of the local environment. The livestock sector provided 15% of the overall gross domestic product (GDP), 44% of the agricultural GDP, and nearly 50% of the workforce engaged in the sector in West Africa (Kamuanga *et al*., 2008). In North-western Nigeria, the livestock sector became a primary or secondary source of livelihood dependent sector for many people (AU-IBAR, 2015). It accounts for one-third of Nigeria's GDP, providing income, employment, food, farm energy, and manure transport with the potential to boost the nation's economy (Shehu, 2013). However, the limited supply of quality feed is the most important factor limiting livestock productivity in Nigeria. Having a systematic inventory of available feed resources and identifying the main challenges and potentials for improvement is the first step toward designing development strategies to improve feed quality and quantity (Amole *et al*., 2021). In addition to the rangelands, many livestock farmers depend on crop residues, which are an important feed resource during the dry season (Teferedegne, 2000). These crop residues are becoming a dominant feed resource as rangelands are being converted into crop fields (Herrmann et al., 2020) leading to

to occasional farmers-herders clashes. More so, feed scarcity becomes more critical during the dry season when feed is inadequate, and the quality becomes extremely poor (Birnin-Yauri and Umar, 2014). The scarcity of high-quality feed especially in the dry season poses a threat to successful livestock production in Nigeria (Anyanwu *et al*., 2021). All these factors affect the growth performance and quality of meat produced from livestock negatively. Goat meat is valued for its advantages of tender meat, unique flavor, vitamins, and proteins, among others (Cashman and Hayes, 2017). As a main source of red meat, it has important effects on human health and nutrition. With the increased population growth and the current economic situation, the demand for goat meat as a cheap source of animal protein has increased significantly (Godfray *et al*., 2018). However, meat quality is evaluated based on its nutritional composition and other physico-chemical characteristics such as haematological parameters (Cheng *et al*., 2021) which are affected more by animal diet. In recent years, efforts have been made to improve goat meat quality by supplementation of their diets with legumes and have shown success (Wang *et al*., 2021; Su *et al*., 2022).

Leucaena leucocephala is a multi-purpose tree that is available in farms all over the North-western part of Nigeria and provides a suitable alternative to grasses (Anyanwu *et al*., 2021). It improves soil fertility and thrives and multiplies on farms, thus availing its resources all year round, which can be used in supplementing ruminants. Leucaena leaves are highly palatable, digestible, and nutritious (Barwani *et al*., 2022). These good nutritional characteristics make the leaves suitable for supplementation in ruminant diets and have been shown to increase fat, and protein contents (Yusuf *et al*., 2023). Thus, this study aimed at supplementing rice straw with dried *L. leucocephala* leaves to improve the growth performance and haematological indices of goats.

MATERIALS AND METHODS

Study Location

The study was conducted at Professor Lawal Abdu Saulawa Teaching and Research Farm, in the small ruminant Unit of the Federal University Dutsin-Ma, Katsina State (latitude 12° 27' N and longitude 07°29˙E and an elevation of 605 m above sea level). The Departmental Livestock Teaching and Research Farm, according to a field survey (2018) using GPS was reported as 6.46 hectares (64,616M^2).

Sources of Experimental Feeds

Leaves of *Leucaena leucocephala* were collected from the field around Dutsin-ma Katsina State and transported to the Animal Science Department, Federal University, Dutsin-Ma. The samples were authenticated at the Herbarium of the Department of Botany, Ahmadu Bello University, Zaria. The rice straw was procured from the market in Dutsin Ma, Katsina state. A concentrate diet containing wheat bran (WB) and cowpea husk mixed in a ratio of 2:1, (1% salt and 1% bone meal) was mixed and given at 2 % body weight to all the experimental animals once daily. The experimental diets were given twice a day at 8:00 am after concentrates feeding and afternoon at 4:00 pm while rice straw was fed *ad libitum* to all the experimental animals. After the adaptation period the experiment lasted for 12 weeks (84) days. Other feed ingredients were purchased from the same market. All the experimental feeds were bagged properly and stored until required for use.

Experimental Animals

Two different male goat breeds (Sahelian goats and Sokoto Red) are available in the study area and were procured from the Dutsin-ma market. A total of Twelve (12) growing bucks (Six for each breed) with an average body weight of 14. ± 2.2 kg were purchased for the experiment.

Experimental Treatments, Management and Design

The experimental goats for each breed were randomly divided into two groups: (i) the control group in which goats were fed a normal diet and (ii) the experimental group in which goats were fed a diet containing 150 g of *L. leucocephala* dried leaves a supplement to rice straw. After an acclimatization period of 7 days under the experimental conditions, and quarantined. The animals were dewormed against internal and external parasites before the experiment. The goats were fed the experimental treatments for 84 days. Water was given *ad libitum* to all

experimental animals. The experiment was laid down in a Randomized Completely Block Design (RCBD) with three replications.

Performance parameters

Feed intake was determined by the difference between the amount of feed offered and that which was left over the next day. The animals were weighed weekly and the weight gains were determined. Before weighing feed and water were withdrawn for six hours. Other parameters calculated include average daily gain (ADG), total feed consumed, feed efficiency, and feed-to-gain ratio.

Blood Samples Collection

Blood samples (5 ml) were collected from the jugular vein of each experimental animal in the morning before feeding on the last day of the trial using hypodermic syringes into sample bottles containing anticoagulant, ethylene diamine tetra acetic acid (EDTA) used for the determination of haematological parameters such as Red blood cell (RBC), White blood cells (WBC), Hemoglobin (Hb), Packed cell volume (PCV), Granular (Gran) and Mean cell volume (MCV).

Statistical Analysis

The data obtained was analyzed using Analysis of Variance (ANOVA) using the SAS package (SAS, 2008) with Duncan's New Multiple Range Test used to separate means that were significant at the 5% level.

RESULTS

The result for the proximate composition of the experimental diets is presented in Table 1. The result showed a significant difference ($p \leq 0.05$) in all the proximate constituents of the diets. The highest values of crude protein (26.80%), ether extract (4.22%) and energy (288.2 Kcal) were found in the concentrate diet. Rice straw had the highest values for dry matter content (93.41%), crude fiber (35.69%), ash contents (12.42%), Neutral detergent fiber (74.25%) and Acid detergent fiber (43.24%). However, *Leucaena* had the highest values for Nitrogen extract (46.78%) and Lignin contents (24.10%).

The result for the growth performance of the two different growing goat breeds fed with *L. leucocephala* leaves as the supplement is shown in Table 2. The result revealed a significant difference ($p \leq 0.05$) in all the growth parameters except initial body weight; where no significant difference was found. Red Sokoto bucks fed *Leucaena* leaves as a supplement to rice straw showed the highest values for final weight gain (18.67 kg), weight gain (4.67 kg), average daily gain (0.151 kg), concentrate intake (448.83 kg), supplement intake (325.61 kg) and total feed intake (827.53 kg). The Sahelian bucks had the highest value for feed efficiency of 0.206.

However, the result for the influence of *L. leucocephala* leaves supplement on the haematologcal parameters of two different goat breeds is presented in Table 3. A Significant difference ($p \leq 0.05$) was found in all the parameters except in MCV values. The Sahelian bucks fed with the supplement had the highest values for PCV (49.33%), Haemoglobin (Hb) concentration (67.00%) and Red Blood Cells (RBC) concentrations (106.00%). The Red Sokoto bucks on the other hand had the highest value for Lymphocytes (LYMP) concentration (82.50%).

DISCUSSION

Given the excellent possibilities to enhance the growth performance and health status of ruminant animals, supplementation of their feeds with legumes such as *Leucaenaleucocephala* provides a good yardstick to adjudge. *Leucaena leucocephala* was reported by De Angelis *et al.* (2021) to serve as an alternative protein source in feeding ruminants. The present study reported high proximate values for protein and energy among the experimental diets which make the dietary supplement-feed to provide enough energy for the growing goat breeds and improve their health statuses. This finding agrees with that of Millam *et al.* (2020) who reported improved growth performance of Red Sokoto bucks fed Soybean supplementation feeds. The proximate analysis of *L. leucocephala* is stated that it contains high energy, protein, fibre, and carbohydrates. The crude protein value reported by the present study conforms with the findings of Li *et al.* (2013) who reported a 27 % protein level in the soybeans supplement diet and asserted that the protein in the diet is of good nutritional value and has a greater protein efficiency ratio which is an indication for a prospective source of protein for livestock feeds.

Table 1: Proximate Composition of Experimental diets fed two growing goat breeds

Constituents (%)	Concentrate	*Leucaena*	Rice Straw
Dry matter	89.70[b]	89.12[b]	93.41[a]
Crude protein	26.80[a]	18.67[b]	4.58[c]
Crude fiber	19.08[b]	17.86[c]	35.69[a]
Ether extract	4.22[a]	1.35[b]	1.20[c]
Ash	3.85[b]	4.53[b]	12.42[a]
Nitrogen free extract	35.76[b]	46.78[a]	46.11[ab]
Neutral detergent fiber	38.34[c]	42.75[b]	74.25[a]
Acid detergent fiber	30.06[c]	32.20[b]	43.24[a]
Lignin	6.13[b]	24.10[a]	5.16[b]
Energy (Kcal)	288.2[a]	273.87[b]	194.34[c]

N.B: Values with the same letter across a row are NOT significantly different at p=0.05

Table 2: Growth performance of two growing goat breeds fed Rice straw with *Leucaena lecocephala* leaf supplement

Parameters	Treatment I	Treatment II	Treatment III	Treatment IV	Mean	p-value
Initial Weight (Kg)	14.50	14.33	14.00	14.00	14.21	0.94
Final Weight (Kg)	17.17[c]	16.67[d]	17.60[b]	18.67[a]	17.38	0.24
Weight gain (Kg)	2.67[c]	2.33[d]	3.60[b]	4.67[a]	3.17	0.09
Average Daily Gain(Kg)	0.085[c]	0.085[c]	0.122[b]	0.15[a]	0.11	0.009
Concentrate intake	386.77[c]	350.19[d]	396.18[b]	448.83[a]	395.49	0.51
Supplement intake	0.00[c]	0.00[c]	128.81[b]	325.61[a]	113.60	0.008
Roughage intake	292.76[a]	279.57[b]	68.65[c]	53.09[d]	173.52	0.0001
Total feed intake	679.53[b]	629.75[c]	593.64[d]	827.53[a]	682.61	0.186
Feed Conversion Ratio	8.36[a]	7.89[b]	4.99[d]	5.44[c]	6.67	0.141
Feed Efficiency	0.126[c]	0.135[c]	0.206[a]	0.191[b]	0.16	0.103

N.B: Values with the same letter across a row are NOT significantly different at p=0.05, Treatment I: Sahelian Control, Treatment II: Red Sokoto Control, Treatment III: Sahelian Experimental group, Treatment IV: Red Sokoto Experimental group

Table 3: Haematological Indices of two goat breeds fed Rice straw with *Leucaena lecocephala* leaf supplement

Parameters	Treatment I	Treatment II	Treatment III	Treatment IV	Mean	p-value
PCV%	36.00[c]	27.00[d]	49.33[a]	47.00[b]	39.83	0.0000
Hb	44.33[c]	44.67[c]	67.00[a]	66.33[b]	55.58	0.0000
WBC×10^9/L	31.33[a]	29.73[a]	26.83[b]	23.57[b]	27.69	0.0001
RBC×10^9/L	76.33[c]	60.67[d]	106.00[a]	102.67[b]	86.42	0.0000
LYMP%	65.20[c]	46.60[d]	72.30[b]	82.50[a]	66.65	0.0000
MCV(L)	46.00	45.90	46.23	47.20	46.33	0.3733
GRAN%	32.13[b]	42.30[a]	23.37[c]	12.13[d]	27.48	0.0000

N.B: Values with the same letter across a row are NOT significantly different at p=0.05, Treatment I: Sahelian Control, Treatment II: Red Sokoto Control, Treatment III: Sahelian Experimental group, Treatment IV: Red Sokoto Experimental group

More so, Wang and Cavins (1989) reported that protein from legumes supplementation is of high quality for enhancing the growth performance of livestock. The fibre present in the experimental diet reported by this study is digestible in the rumen which provides available vital health gains to the body of the ruminant animals as stressed by Periago *et al.* (1997). The effectiveness of *Leucaena* leaves as an alternative source of supplementation was reported by previous findings of Katunga *et al.* (2014) and Barwani *et al.* (2022) who individually reported *L. leucocephala* leaves have high nutritional composition to enhance growth performance and are highly palatable.

There is an improvement in the growth performance of both Red Sokoto bucks and Sahelian goats fed with *Leucaena* leaves supplementation as reported by this study. This could probably be attributed to their high nutritional quality and palatability. The increase in final weight gain average daily gain and total feed intake of the experimental groups above those of the controls supported the assertion that *Leucaena* leaves are good alternative protein sources for growing ruminants. This agrees with the work of Mohammed *et al.* (2014) who similar findings among ruminants fed with Soybean curd waste meal and who attributed the high nutritional characteristics of soybean waste-rich in energy and protein as stressed by Knaus *et al.* (2012) or more or less to its nutritive value and its excellent property as reported by Rahman *et al.* (2013).

The variation in the growth performance among the two different breeds (Sahelian and Red Sokoto Bucks) could probably be due to the response of the breeds to the supplements utilizing the nutrients present in the feeds differently. This is consistent with the findings of Oddy and Sainz (2002) who reported similar findings. The reduction in live-weight gain of the control groups was not unexpected because previous studies reported that animals cannot meet their maintenance need on carbohydrate sources alone but require supplementary diets for higher physiological performance as stressed by Adegbola *et al.* (1985).

The higher feed intake observed on animals fed with the experimental diet could be an indication of increased palatability as reported by Nuwam (2015) who reported supplementation with legume forage significantly enhances feed intake in ruminants such as red Sokoto. A similar finding was reported by Okafor *et al*. (2012) with groundnut supplementation for enhanced feed intake and performance of ruminants. Furthermore, Dan Abba *et al.* (2021) fed Yankasa ram with basal rice straw supplemented with cowpea hay and groundnut haulms (300 g/day) and reported a higher nutrient intake and increased live weight gain. The high feed intake reported in the present study may be attributed to feed palatability, animal preference, or the high rate of degradation of *leucaena* leaves. This agrees with the report by McMeniman *et al*. (1988) that supplementation of legumes to low-quality roughage increases intake as well as nutrient digestibility. Feed intake increases with legume supplementation. This conforms to the work of Yashim *et al*. (2016) in goats. Significant improvement in feed intake of most nutrients reported in this study due to supplemented feeding of *Leucaena* could be justified by the relatively better intake of Crude Protein. This finding is also in line with that of Musa (2016) who reported that feed intake generally increased with increasing levels of legume supplementation. The finding also agrees with that of Adamu (2015) who reported the average daily weight gain of Yankasa rams fed with graded levels of groundnut haulms supplementation to be 150 g/day.

Haematological parameters are essential components that indicate the relative health status of growing animals (Ramprabhu *et al.,* 2010). The comparison of an animal's haematological indices with a reference interval provides evidence for numerous conditions such as infection, malnutrition, and stress as reported by Clifford and Briggs (2007); hence, laboratory tests on blood are vital tools to detect any deviation from the normal in the animal body as stressed by Alemede *et al.* (2010). This is because, as Togun *et al.* (2007) put it, when the haematological values fall within the normal range reported for the animal it is an indication that diet did not have any adverse effect on haematological parameters. The presence of a high amount of Lymphocytes in Red Sokoto

bucks revealed the high health status of the breeds conferred by *Leucaena leucocephala* leaves supplementation. Lymphocytes are the most important segment in the body's defense against infections.

CONCLUSION

It was concluded that *Leucaena leucocephala* leaves supplementation improved the growth performance and haematological qualities of goat breeds. The feed-to-gain ratio was lowest among treatments supplemented with *Leucaena leucocephala*; indicating that animals in these groups were more efficient in feed utilization and may not cause any harmful effect if fed to ruminant animals gradually at the initial stage.

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