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Preference and Acceptability of Crop Residues Treated Indigenous Salt Licks (Toka) by Red Sokoto Goats in Guinea Savana Zone of North-Eastern Nigeria

Kubkomawa, H. I.
Department of Animal Health and Production Technology,
The Federal Polytechnic, Mubi, Adamawa State, Nigeria.
Correspondence: kubkomawa@yahoo.com, 07066996221

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ABSTRACT: *The objective of this study was to determine preference and acceptability of crop residues treated indigenous salt licks (toka) using Red Sokoto goats in Guinea Savana Zone of North-Eastern Nigeria. Twenty adult Red Sokoto goats comprising 10 males and 10 females of about 3 to 4 years old were used for the study. The study was laid out in a completely randomized design for preference, acceptability and dry matter intake: The feeding trial lasted for 14days including acclimatization period. The results of the feeding habit of the animals showed significant ($p<0.05$) differences amongst the crop residues in terms of number of bites, bites per visit, time spent feeding and dry matter intake. There was no outright rejection of any diet by the animals. The treatment of crop residues by chopping and mixing with salt licks (toka) influenced the increased dry matter intake. Numbers 1 to 6 were used to rank the crop residues in terms of preference and acceptability as number 1 been the most preferred while 6 the less preferred by the animals. Based on the coefficient of preference (COP) value obtained, cowpea husk was ranked the most preferred diet, followed by cowpea leaf, groundnut haulms, sorghum stover, maize stover and rice straw respectively. There were positive correlation between the feeding habits of the animals with the dry matter intake except for the time spent feeding. Likewise, the coefficient of preference (COP) had positive correlation with the feeding habit of the animals including time spent on the diets. It's therefore, advisable to treat crop residues with some mineral licks before feeding to enhance acceptability and dry matter intake. Thus, preference and acceptability is normally used as quality indicators when choosing the best diet to feed*

KEYWORDS: preference, acceptability, crop residues, salt licks (Toka), goats, Nigeria

INTRODUCTION

Crop residues are the by-products or fibrous secondary plant parts that remain mostly on the field after harvesting primary crop for human consumption (Adamu, Abbator, Abdul, Jokhtan &Yashim, 2010). Several tonnes of crop residues are generated yearly in rural communities of Nigeria including Adamawa State, but have not been put to good use as livestock feeds (Kalio & Ayuk, 2011).

Research has shown that, small ruminants, for example Red Sokoto goats are usually owned by resource-poor farmers in northern Nigeria and can achieve optimum productivity through these fibrous residues at cheaper rates (Vantsawa et al., 2007). Crop by-products from household wastes and crop residues could be used as feed stuffs after processing as they contain crude protein levels ranging from 1 - 23%, fiber of between 2 and 52% and metabolizable energy as high as 20 MJ/kg DM. Thus small ruminants fed these diets appear healthier and heavier (Onwuka et al., 1997). But feeding these crop residues untreated could affect preference, acceptability and animal performance. And having good knowledge of the quality and quantity of feeds in relation to the nutrient requirement of species/breed/class of animals could make these residues fulfil dietary requirement of ruminants at a cheaper rate. This could be achieved through processes such as milling and improvement programs such as mixing with molasses, minerals, nitrogen etc.

Indigenous salt licks, also known as “toka” in Hausa, is locally produced from ashes of crop residues and animal dung (Adamu & Kubkomawa, 2022). Salt licks generally provide bio-metals such as sodium, calcium, potassium, phosphorus and trace elements such as iron, zinc, etc. required for the development of bones, muscles, growth and functioning of other systems in livestock and wildlife (Black et al., 2011; Kubkomawa, 2017a, Adamu & Kubkomawa, 2022).

Conventional mineral licks used in livestock production in tropical Africa and Nigeria in particular, are usually imported and highly expensive and often beyond the reach of a common farmer (Kubkomawa, 2017b). The need for cheaper alternative mineral sources in the treatment of crop residues is therefore imperative to reduce the cost of raising animals in the study area. The objective of this study is to determine preference and acceptability of crop residues treated indigenous salt licks (toka) using Red Sokoto goats in Guinea Savana Zone of North-Eastern Nigeria.

MATERIALS AND METHODS

The Study Area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lays between latitudes 7^0 and 11^0 North of the Equator and between longitudes 11^0 and 14^0 East of the Greenwich Meridian

(Mohammed, 1999). It shares an international boundary with the Republic of Cameroon to the East and interstate boundaries with Borno to the North, Gombe to the North-West and Taraba to the South-West (Adebayo, 1999; ASMLS, 2010), as shown in Figure I.

Figure I: Map of Nigeria Showing Adamawa State

The state has minimum and maximum rainfall of 750 and 1050mm per annum and an average minimum and maximum temperature of 15^0C and 32^0C, respectively. The relative humidity ranges between 20 and 30% with four distinct seasons that include early dry season (EDS, October – December); late dry season (LDS, January – March); early rainy season, (ERS, April – June) and late rainy season (LRS, July – September), according to Adebayo (1999). The vegetation type is best referred to as guinea savannah (Adebayo & Tukur, 1997). The vegetation is made up of mainly grasses, aquatic weeds along river valleys and dry land weeds inter-spersed with shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugarcane, cowpea, benniseed, bambara nuts and tiger nuts, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The communities living on the banks of rivers engage in fishing, while the Fulani and other tribes who are not resident close to rivers are pastoralists who rear livestock such as cattle, sheep, goats, donkeys, few camels, horses and poultry for subsistence (Adebayo & Tukur, 1997; Adebayo, 1999).

The Study Site

Mubi is located at the northern part of old Sardauna Province, which now forms Adamawa North Senatorial District as defined by INEC (1996). The region lies between latitude 9^0 30´´ and 11^0 North

of the equator and longitude 13^0 and 13^0 45´´ East of Greenwitch Meridian. It has an altitude of 696 meters above sea level with an annual mean rainfall of 1,220mm and a mean temperature of 15.2^0C during hamattan periods from November to February and 39.7^0C in April (Adebayo,1999) as seen in Figure 2.

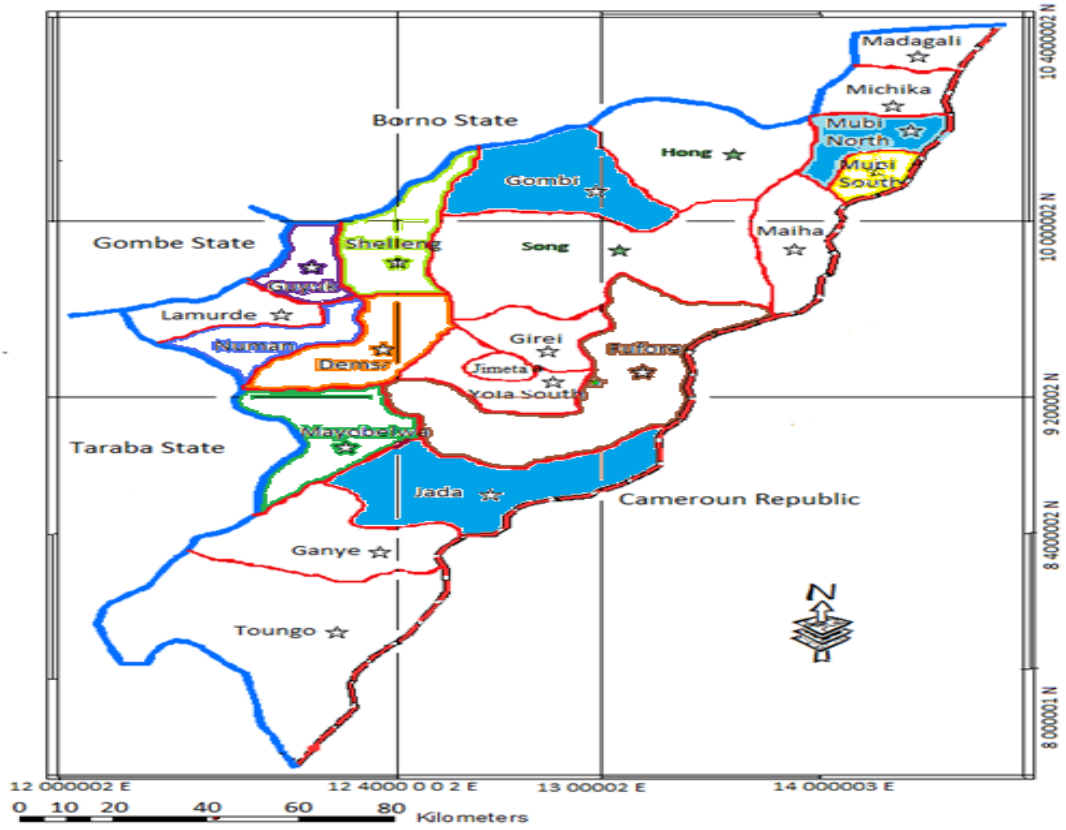

Figure 2: Map of Adamawa State Showing the Study Area in Blue Colour

COLLECTION AND PREPARATION OF SAMPLES

Source and Procedure of Handling Crop Residues

Sorghum stover, maize stover rice straw, cowpea leaves, cowpea husk and groundnut haulms were obtained from Mubi International Cattle Market which were already chopped into pieces, bagged and transported to the experimental site.

Collection of plant materials for the Production of Indigenous Salt Licks (Toka)

Crop residues for the production of salt licks (toka) were bought from farmers during the early dry season at about 10-23% moisture content. They were carefully packed to a floor or open field at the farm. The materials were then burnt to ashes under cool wind-free atmosphere and allowed to cool to

room or environmental temperature. The ashes were carefully and gently gathered using a broom and packed into a sack/bag. Fine grasses were obtained to serve as sieve which were put into clean iron pots with holes or perforated bottoms. The ashes were packed into the perforated pots filled to the brim and mounted on another clean containers without perforation but of the same sizes with the perforated ones. Water was sprinkled on the ashes gently and gradually until it was fully soaked and submerged. More water was added gradually and continually until the pots were filled. The system was allowed to stay overnight and the concentrated mineral solution filtered or leached down slowly into the clean containers serving as collection chambers. The concentrated mineral solution was then boiled while adding the dry ashes gradually and constantly stirring with a long cooking spoon for six to eight hours. The solution then formed paste-like product and solidified mineral lick. The product was then molded into blocks using small plastic containers polished with groundnut oil to prevent the mineral blocks sticking in them and to ease removal of blocks after sun-drying for 2 to 3 days. The process took 2 to 3 days to complete the production cycle as described by Adamu & Kubkomawa (2022).

Experimental Animals and Management

Twenty adult Red Sokoto goats comprising 10 males and 10 females of 3 to 4 years old were used for the study. The animals were bought from open livestock markets in the northern senatorial district. Early in the morning of each day during the experiment, the animals were moved out to a fenced run measuring 30 x 30m and later allowed to graze within the experimental location. The study was laid out in a completely randomized design for preference, acceptability and dry matter intake trial: The feeding of the Red Sokoto goats to determine preference and acceptability lasted 14days including acclimatization period.

Six plastic feeding troughs were used for the experiment. The six feeding troughs containing 50cm in diameter chopped crop residues treated indigenous salt lick (toka) were fed to the animals. The six feeding troughs used per feed sample were weighed and randomly placed at different locations within a fenced site. The animals were exposed to the feeds for four hours daily between 7:00 and 10:00am after which the leftover was weighed. The difference between feed offered and leftover gave an estimate of DMI in g/day per crop residue.

Water was provided ad libitum during periods of the trial. The order of placement of the experimental feeds within the open corridor were randomized daily to avoid “habit reflex” by the animals (Kaitho et al., 1996). Similarly, the animals’ feeding habits and DMI of the crop residues were determined as described by Mtenga et al. (1992).

The coefficient of preference (COP) of each crop residue was determined as the ratio between the individual intakes of each feed divided by the total intake on DM basis according to the procedure described by Karbo et al. (1996). A particular crop residue was considered to be most preferred by the animals when the calculated COP was more than unity. The results from this were used to rank the various crop residues. The number of visits, number of bites, bites per visit and time (sec) spent feeding were recorded by using a stop watch.

Data Analysis
Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) with 6 treatments (feeds) and 4 replications (SAS, 2002). Means were separated by using Duncan Multiple Range Test (Steel and Torrie, 1980). Correlation analysis between DMI and number of visits, number of bites, bites per visit and time spent feeding on crop residues were determined.

RESULTS AND DISCUSSION

Preference, Acceptability and Dry Matter Intake
The results of preference and acceptability of six crop residues by Red Sokoto goats is presented in table 1. The results of the feeding habits of Red Sokoto goats in terms of number of visits showed no significant ($p>0.05$) difference among the six crop residues offered. However, cowpea husk had the highest value followed by cowpea leaf, groundnut haulms, sorghum stover, rice straw and maize stover, respectively.

It was observed that, goats are intelligent animals and sensitive to their environment especially when feeding. They are not like sheep who are always head down and can move without looking back or rising their heads for hours. Sheep often move far distances away from their locality and even get lost in the process. But goats like to explore their environment by visiting all the feeding points which aid them to find out the content of the containers before settling on the most preferred feeds. The strongest among them also bullied the weaker ones by chasing them around, denying them access to some feeds.But on the contrary, results of the feeding habits of the animals showed significant ($p<0.05$) differences amongst the crop residues in terms of number of bites, bites per visit, time spent feeding and dry matter intake.

Table 1: Preference of crop residues treated indigenous salt licks (toka) by Red Sokoto goats

Crop residues	Number of visits	Number of bites	Bites per visit	Time spent feeding (sec)	Dry matter intake **(g)**	Coefficient of preference (COP)	Preference ranking (PR)
Sorghum stover	17.5	56.5 ^{d}	2.9 ^{d}	74.5 ^{d}	189.5 ^{d}	0.1	4
Maize stover	16.4	32.5 ^{f}	1.7 ^{f}	64.5 ^{f}	100.5 ^{e}	0.04	5
Rice straw	17.0	36.5 ^{e}	1.9 ^{e}	66.5 ^{e}	95.4 ^{f}	0.04	6
Cowpea leaf	18.5	180.0 ^{b}	8.9 ^{b}	194.5 ^{a}	505.9 ^{b}	0.2	2
Cowpea husk	19.5	270.5 ^{a}	13.6 ^{a}	162.5 ^{c}	906.5 ^{a}	0.4	1
Groundnut haulms	18.5	170.0 ^{c}	8.6 ^{c}	185.5 ^{b}	505.1 ^{c}	0.2	3
Mean	18	124.3	6.3	124.7	383.8	0.16	
SEM	0.08	0.57	0.07	0.70	0.09	0.03	0.19

a-f Means with different superscripts in the same column are significantly different ($P < 0.05$)

The results indicated that, cowpea husk had the highest number of bites, bites per visit and the dry matter intake. It was followed by cowpea leaves and groundnut haulms, respectively. The animals spent more time feeding on leguminous diets than grass sources. It was therefore, observed that roughages that displayed superior values in terms of the number of visits, number of bites, bites per visit and time spent feeding gave correspondent increase in feed intake and coefficient of preference (COP). This is also vital and essential since feed intake is one of the methods used in assessing preference and acceptability of diets as reported by Kalio et al. (2006).

The results again showed that, maize stover and rice straw had the least number of visit, number of bites, bites per visit, time spent feeding, dry matter intake and coefficient of preference. While sorghum stover had better values which may be attributed to the greenish nature of the feed as against the brownish maize stover and rice straw. Furthermore, studies have shown that animals show the tendency to desire forage especially sorghum stover because of its bulk which is needed for proper functioning of the rumen. This might have been the reason for the low preference of maize stover and rice straw (Schoenian, 2003).

Similarly, there were no significant ($p>0.05$) difference among the diets served to the animals in terms of coefficient of preference (COP). Nevertheless, cowpea husk had the highest COP followed by cowpea leaves and groundnut haulms. Based on the COP value obtained, cowpea husk was ranked the most preferred feed, followed by cowpea leaves, groundnut haulms, sorghum stover, maize stover and rice straw. The results agreed with Karbo et al. (1996) who reported similar observations in their studies for other forages. This was not surprising because the three crop residues that had the higher COP were legumes which contained lots of broken pods, seeds and leaves.

It is important to note that, there was no outright rejection of any diet by the animals in this experiment. The high quantity of feed intake observed could be linked to treatment of the crop residues by chopping in addition to mixing with salt licks (toka), hence influenced the increased dry matter intake. Furthermore, mixing of the crop residues with indigenous salt licks (toka) gave the diets additional improved quality and palatability which attracted the animals to consume more. The results contradicted that of Kalio, Ayuk & Etela (2012) who reported complete rejection of some diets with lower number of visits, number of bites, bites per visit, time spent feeding, dry matter intake and coefficient of preference in an untreated rice offal and groundnut haulms in their study of preference and acceptability as quality indicators of crop by-products used in feeding West African dwarf goats, Calabar Southern Nigeria.

The crop residues that had lower COP in this study which were from grass family may not be unconnected to the texture and roughness of the feeds that characterized high fibre, less palatable and low in nutrient contents. It was observed that, goats thrive better on free range especially during the dry season. They enjoy feeding on household and kitchen wastes, scavenge on dump sites and crop residues. They even dig and scratch fields for residues left on the farm lands. They hate to be confined and serve feeds and water no matter how nutritious the feeds may be. The

freedom of choice is paramount to them unlike cattle that always want to push taller grasses and graze on green forages even under confinement without any sign of discomfort.

The study therefore, is in agreement with the earlier reports of Coleman and Moore (2003) who stated that, voluntary feed intake is a major determinant of feed quality and is quite well accepted as an indicator of potential animal performance. In addition, the utilization of any diet is influenced by the preference and acceptability of the feed, which is related to the animal's feeding habit (Mtenga et al., 1992; Kalio et al., 2006). Likewise, the extent of preference and acceptability of a diet is one of the most fundamental things to note when determining the best feed to use (Ganskopp et al., 1997).

Correlation between Feeding Habit and Dry Matter Intake

The correlation between the feeding habits displayed by the Red Sokoto goats and their corresponding dry matter intake (DMI) were presented in table 2. There were significant relationship between DMI and the number of visits, number of bites and bites per visit. The results showed positive correlation between the feeding habits of the animals with the dry matter intake except for the time spent feeding. Furthermore, the coefficient of preference (COP) had positive correlation with the feeding habits of the animals including time spent on the diets. The findings agreed with Kalio et al. (2012) who reported similar feeding patterns of West African dwarf goats in Calabar Southern Nigeria. The results also corroborated that of Omokanye et al. (2001) who reported that, preference was in tandem with the time spent on feed intake in their study to assess preference and feed intake of eleven browse species by Yankasa sheep at Shika, Nigeria.

Table 2: Correlation ($p < 0.05$) between feeding habit and dry matter intake

parameters	Bites per visit	Coefficient of preference (COP)	Dry matter intake **(g)**	Number of bites	Number of visits
Coefficient of preference (COP)	0.97				
Dry matter intake **(g)**	0.99	0.99			
Number of bites	0.99	0.97	0.99		
Number of visits	0.97	0.96	0.96	0.97	
Time spent feeding (sec)	0.86	0.74		0.86	0.84

CONCLUSION

These crop residues constitute the bulk of available feed resources especially during the early dry season in northern Nigeria. Their utilization is growing geometrically because of the decrease in grazing reserves as well as increase in the cost of commercial feeds. The decision to utilize these fibrous residues is related to the need for roughage in times of lean feed resources especially during drought conditions. The techniques of feeding these diets ranges from traditional way of grazing harvested grain fields, to preparation of chopped residue mixes and ensilage that are made more palatable and nutritious by the addition of nutrient rich compounds. This is because most of the crop residues are poor in nutrition and high in fibre content. Feeding these crop residues untreated could reduce animal acceptance and performance. Therefore, having appropriate information on the quality and quantity of diets in relation to the nutrient requirement of animals could make these residues fulfil dietary requirement at cheaper rate. These are achieved by processes through milling and improvement programs such as mixing with molasses, minerals, nitrogen enrichment, etc.

RECOMMENDATIONS

Large quantities of fibrous crop residues are already in use as animal feed in many tropical countries of the world but much is still wasted for lack of storage facilities and other reasons. There are many regions where ruminant animals starved to death due to lack of feeds. This is because of inadequate knowledge of the economic value of these residues. New improvement technologies should be used to make these residues worthy of providing good nutrition across the needy communities of the world especially where animal products are marginal due to lack of enough feeds. There should be good methods on ground to handle the problems of storage, complete rationing with low cost available raw materials and the anti-nutritive factors associated with crop residues.

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