East African Scholars Journal of Agriculture and Life Sciences
Abbreviated Key Title: East African Scholars J Agri Life Sci
ISSN 2617-4472 (Print) | ISSN 2617-7277 (Online)
Published By East African Scholars Publisher, Kenya

Volume-4 | Issue-7 | Aug-2021| DOI:10.36349/easjals.2021.v04i07.002

OPEN ACCESS

Original Research Article

Feed Intake and Nutrient Digestibility of Sorghum (Sorghum Bicolor) Husk and Cowpea (*Vigna unguiculata*) Haulms Fed to Two Breed of Goat

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Article History
Received: 05.07.2021
Accepted: 10.08.2021
Published: 18.08.2021

Journal homepage:
http://www.easpublisher.com

Quick Response Code

Abstract: This study was conducted to determine feed intake and nutrient digestibility of sorghum husk (SH) and cowpea haulms (CH) fed to two breed of goat. A 2x2 factorial experiment involving two breeds of goats (Red Sokoto and Red Sokoto x Sahel). Eight goats with an average weight of 18-23 kg were arranged in completely randomized design. The animals were divided into four Treatments (T) groups replicated twice with one goat per replicate. Treatment one (1) comprises of Red Sokoto (RS) fed SH while T2, T3 and T4 were Red Sokoto x Sahel (RSxS) fed SH, RS fed CH and RS x S fed CH, respectively. The result of chemical composition showed that CH had significantly ($p<0.05$) higher Crude Protein (CP), Ether Extract (EE) and ash digestibility and significantly lower Non Fibre Carbohydrate (NFC), Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) than SH. RS goats had significantly ($p<0.05$) higher CP digestibility and significantly ($p<0.05$) lower digestibility of ash than RSxS goats. The digestibility of CH recorded significantly ($p<0.05$) higher digestibility in all the parameters than SH. It was concluded that CH have significantly higher CP and EE. Similarly, SH contains significantly higher NFC, NDF and ADF over the CH. RS is superior ($P<0.05$) in CP and CH had significantly better digestibility of all the parameters measure.

Keywords: Goat, breed, sorghum husk, cowpea haulms, nutrient digestibility.

1.0 INTRODUCTION

The population of goats in Nigeria is about 53.8 million and they serves as sources of meat and milk for local consumptions as well as hides for export earnings. Ruminant animals feed mainly on roughages such as crop residues and pastures obtained from rangelands (FAOSTAT, 2009; Anifowose *et al*., 2016). These roughages are scarce especially during drought period resulting to malnourishment and reduce productivity in ruminant animals. Sorghum and cowpea by-products have been used to evaluate the performance of ruminants in many part of the world. Basal diet of sorghum stover supplemented with sorghum bran 1 kg per milk met the requirements (450 kg, 5 kg milk/day) of nursing cow. A study with lambs suggested that digestibility of wet distillers without soluble was lower than that of dried sorghum distillers' grains with soluble. In a study with growing goats, a similar performance and cost effectiveness was observed between alfalfa pellets and maize-sorghum distillers' grain silage fed with concentrate (Lodge *et al*., 1997; Mahabile *et al*., 2000; Ankuo *et al*., 2001). Modu-Kagu *et al.,* (2018) observed low dry matter disappearance in sorghum husk possibly due to its low crude protein content during *in* sacco ruminant feed evaluation studies. Cowpea haulms is vital part of crop-livestock system in semi-arid part of the tropics due to its high dietary quality and hence, an important supplement when livestock animals are fed basal diet of cereal stovers of lower quality. The utilization of cowpea haulms could provide adequate nutrient supply for improved animal performance than using roughages low in quality (Ngwa and Tawah 2002; Baloyi *et al*., 2006; Baloyi *et al*., 2008; Grings *et al*., 2010). The dearth of information on effect of breed and roughage on the digestibility of sorghum husk and cowpea haulms necessitates a research with the aim of evaluating the feed intake and nutrient digestibility

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sorghum husk (SH) and cowpea haulms fed to two breed of goat. The objectives of this study were to determine proximate and fibre composition of the selected roughages (sorghum husk and cowpea haulms), and also to determine the effect of breed on the feed intake, apparent dry matter, organic matter and nutrient digestibility (*in vivo*) of the roughages.

2.0 MATERIALS AND METHODS

2.1 Location of the Study

The study was conducted at the Teaching and Research Farm and Laboratory of the Department of Animal Production, Federal University of Technology Minna. The city of Minna is located in the Southern Guinea Savanna zone on latitude and longitude 9^0 37 North and 6^0 32 East respectively, with temperature range of 38 – 40 degree centigrade, the range of annual rainfall from 1,200 – 1,300 mm, altitude of 1,475m above sea level and has two (2) seasons of wet from April to October and dry from November to March (Climatemp, 2019).

2.2 Sample Collection and Preparation

The samples of sorghum (*Sorghum bicolor* (L). Moench) husk (SH) and cowpea (*Vigna unguiculata*) haulms (CH) were collected from farms around the research farm of Federal University of Technology Minna, and cleaned from debris before feeding them to the animals for the apparent nutrient (*in vivo*) digestibility trial.

2.3 Experimental Animals and their Management

A total of eight (8) goats with an average weight of 18-23 kg and age of 1-2 years, from the Departmental farm were used for the experiment. Two breeds of goats [Red Sokoto (RS) and Red Sokoto x Sahel goats (RSxS)] having four (4) goats per breed were utilized. The pens were thoroughly washed and cleaned using disinfectant (Izol®) and allowed to dry for one week prior to the experiment. They were vaccinated against *pestes des petits ruminants* (PPR), using PPR vaccine and dewormed using albendazole suspension (Sambezole®) administered orally at about 1ml/10 kg bodyweight. Ecto-parasites were checked using Ivermectin® at 2ml/10kg body weight.

2.4 Experimental Designs

A 2x2 factorial arrangement involving two breeds of goats (RS and RSxS) and two roughages (Sorghum husk and Cowpea haulms) in a completely randomized design was use for the apparent nutrient digestibility studies. Each treatment had two goats with one goat per replicate. Treatment one (T_1) was Red Sokoto (RS) goats fed SH while T_2, T_3 and T_4 were Red Sokoto x Sahel (RSxS) goats fed SH, RS goats fed CH and RSxS goats fed CH respectively. The model for the experiment was;

$$Y_{ijk} = \mu + b_i + f_j + b_i f_j + \varepsilon_{ijk}$$

Where,

Y_{ijk} = dependent variable (feed intake and digestibility)
μ = general mean
b_i = effect of the breed (RS and RSxS)
f_j = effect of the roughage (SH and CH)
$b_i f_j$ = interaction effect of breed and roughage
ε_{ijk} = experimental error

2.5 Apparent Nutrient Digestibility (*In vivo*) Evaluation

The animals were introduced into metabolism crates for an eight (8) day digestibility trial. Three days was used for adaptation of the animals in the 50 x 20.6 m^2 metabolism crates and five days used for faecal samples collection. The value of feed intake was taken as the difference between feed given and feed consumed. The voided faeces were collected, labeled and taking to the laboratory. They were weighed and recorded and oven dried at 70 ^{0}C to achieve constant weight. After five (5) consecutive collection days, samples from each goat were pooled and Ten (10) percent of each were grinded and screened through a 1 mm sieve (Ajayi *et al*., 2005) and tightly kept in polythene bags for chemical analysis. Percentage of nutrient digestibility was estimated as;

$$\text{Nutrient Digestibility}(\%) = \frac{\text{nutrient in FC} - \text{nutrient voided in faeces}}{\text{nutrient in FC}} X100$$

Where; FC = feed consumed

NFC = 100 - (% Ash + % EE+ % CP % + NDF)

Where; NFC = Non-Fibre Carbohydrate; EE = Ether Extract; NDF = Neutral Detergent Fibre, % = percentage; CP = Crude Protein

While the procedure of Van Soest *et al*., (1991) was used to determined the Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF) components

2.6 Determination of Proximate Composition and Fibre Fractions

Ash content of roughage and faecal samples were obtained by burning the samples in a muffle furnace at 600 ^{0}C for 8 hours. Nitrogen (N) content of the roughages was obtained by the standard Kjeldahl method, also ether extract and moisture content from which dry matter was obtained were determined according to the methods of AOAC (2000). The values of Crude Protein (CP) obtained as (N x 6.25) and Non-fibre carbohydrate (NFC) taken as:

2.7 Data Analysis

The data collected on chemical analysis were subjected to student T. test while those from *in vivo*

studies were subjected to General linear model (GLM) procedure following SAS (2000). Where there was significant difference between individual means, Tukey's studentized (HSD) procedure of the same software package was used to separate the means.

3.0 RESULTS AND DISCUSSIONS

Table-1 revealed the proximate and fibre composition of sorghum husks and cowpea haulms fed to Red Sokoto and Red Sokoto x Sahel goats. The results shows significant (P<0.05) differences in all the parameters examined, except for Dry Matter (DM), organic matter and acid detergent fibre components of the roughages. Cowpea haulms had significantly (p<0.05) higher crude protein, ether extract and ash contents than sorghum husk. Meanwhile, the non fibre carbohydrates, neutral detergent fibre and acid detergent fibre contents of sorghum husk were significantly (p<0.05) higher than in cowpea haulms. The significantly higher crude protein, ash and ether extract content obtained from cowpea haulms (CH) than sorghum husk (SH) agrees with Modu-Kagu *et al*., (2018) who reported a higher crude protein (CP) content in crop residues of legume origin than that of cereal crops. The higher CP values of cowpea haulms emphasized the importance of cowpeas and cowpea by-products in ruminant diets as they are seen as sources of nitrogen and mineral needed for effective rumen degradation of roughages lower in quality by microbes (Leng *et al.*, 1992).

Table 1: Proximate and fibre composition of sorghum husk and cowpea haulms fed to Red Sokoto and Red Sokoto x Sahel goats

Parameters (%)	Sorghum husk	Cowpea haulms	SEM	LS
Dry matter	95.17	93.00	0.72	NS
Organic matter	89.50	84.83	0.69	NS
Crude protein	5.15[b]	21.30[a]	2.44	*
Ether extract	5.00[b]	8.83[a]	0.67	*
Ash	5.67[b]	8.17[a]	0.45	*
NFC	23.18[a]	18.04[b]	1.14	*
NDF	61.00[a]	43.67[b]	2.68	*
ADF	36.33[a]	33.00[b]	0.75	*
ab means on the same row having different superscripts differs significantly (P<0.05); SEM= standard error of means; LS= level of significance; * = significant (p<0.05); NS= not significantly different (P>0,05); NFC= non fibre carbohydrates; NDF= neutral detergent fibre; ADF= acid detergent fibre				

The results in Table-2 shows the main effect of breed and roughage on feed intake, dry and organic matter and apparent nutrient digestibility of sorghum husk and cowpea haulms fed to Red Sokoto and Red Sokoto x Sahel goats. There was significant (p<0.05) difference in digestibility values between RS and RSxS goats irrespective of the type of roughages in crude protein, Ash components of the roughages where RS goats recorded significantly (p<0.05) higher values of crude protein and a significantly (P<0.05) lower value for ash digestibilities than RSxS goats. The breed variation in feed intake and apparent nutrient digestibility of SH and CH in this study is similar to the works of Ayele *et al*., (2017) who reported on the effect of breed on digestibility of basal diet of hay containing two levels of concentrate as supplement fed to three (3) Ethiopian fat tail hair Sheep. In contrast, Abdullah *et al*., (2012) fed lactating Saanen and lactating Etawah crossbred (EC) goats with concentrate and *Indigofera zollingeriana* herbage; they discovered no variation in dry matter digestibility between the two breeds. Digestibility of roughages can be affected by animal's ability to digest and utilize their energy and protein content leading to differences digestibility values (Ayele *et al*., 2017).

The results on roughage revealed significantly (p<0.05) difference between the two roughages in favour of cowpea haulms on total feed intake and in all the digestibility values of the various components of the feeds. The variation recorded in apparent dry, organic and nutrient digestibility values of sorghum husk (SH) and cowpea haulms (CH) in this study is agrees to reports of Osafo *et al*., (2013) who recorded high digestibility in cowpea supplemented maize stover than the control diet of only maize to Rams. The resulting in digestibility difference may be related to the increased supply of readily fermentable nitrogen, enhancing ruminal fibre degradation and consequently, increasing content of ammonia in the rumen (Silva and Orskov, 1988).

Table 2: Main effect of breed and roughage on feed intake, dry and organic matter and apparent nutrient digestibility of sorghum husk and cowpea haulms fed to Red Sokoto and Red Sokoto x Sahel goats

Parameters	RS	RSxS	SEM	LS	Sorghum husk	Cowpea haulms	SEM	LS
Total feed intake(g)	3095.10	3076.48	205.80	NS	2747.16^{b}	3424.42^{a}	205.80	*
DMD(%)	82.29	85.36	1.20	NS	79.23^{b}	88.42^{a}	1.20	*
OMD(%)	84.40	86.46	1.04	NS	80.72^{b}	90.14^{a}	1.04	*
Crude protein(%)	87.20^{a}	78.72^{b}	0.98	*	72.75^{b}	93.18^{a}	0.98	*
Ether extract(%)	86.53	89.25	1.33	NS	82.80^{b}	92.97^{a}	1.33	*
Ash(%)	53.33^{b}	71.76^{a}	3.63	*	55.51^{b}	69.58^{a}	3.63	*
NFC(%)	86.68	88.29	1.07	NS	82.97^{b}	92.00^{a}	1.07	*
NDF(%)	82.87	85.98	1.12	NS	80.55^{b}	88.30^{a}	1.12	*
ADF(%)	82.32	83.94	1.22	NS	79.31^{b}	86.95^{a}	1.22	*

ab= means on the same row having different superscripts differs significantly(P<0.05); SEM= standard error of means; LS= level of significance; * = significant (p<0.05); NS= not significantly different (P>0,05); NFC= non fibre carbohydrates; NDF= neutral detergent fibre; ADF= acid detergent fibre; RS = Red Sokoto; RSxS = Red Sokoto x Sahel; DMD = dry matter digestibility; OMD = organic matter digestibility

The interaction effect of breed and roughage on total feed intake, dry and organic matter and apparent nutrient digestibility of sorghum husk and cowpea haulms is shown in Table-3. There was no significant (p>0.05) difference in total feed intake amongst the treatment groups. The values from Red Sokoto fed cowpea haulms and Red Sokoto x Sahel fed cowpea haulms differs significantly (p<0.05) from Red Sokoto fed sorghum husk and Red Sokoto x Sahel fed sorghum husk in DMD, OMD, CP, EE, NFC, ADF and digestibility. The lower feed intake and digestibility values recorded in animals fed SH roughage may be attributed to the presence high fibre content of the roughage. According to Olomu (1995) and D'Mello, (2000), sorghum husk contain antinutritional factors such as hydrogen cyanide which could depress its digestibility in animals. The observed higher CP digestibility of Red Sokoto fed SH than Red Sokoto x Sahel goats could be due to genotypic differences or adaptation to the environmental have earlier been reported by Tuah *et al*., (2005).

Table 3: Interaction effect of breed and roughage on feed intake, dry and organic matter and apparent nutrient digestibility of sorghum husk and cowpea haulms fed to Red Sokoto and Red Sokoto x Sahel goats

Parameters	T_1	T_2	T_3	T_4	SEM	LS
Total feed intake(g)	2696.42	2797.90	3493.78	3355.06	153.50	NS
DMD(%)	77.06^{b}	81.40^{b}	87.53^{a}	89.32^{a}	1.29	*
OMD(%)	79.40^{b}	82.03^{b}	89.39^{a}	90.89^{a}	1.47	*
Crude protein (%)	80.60^{b}	64.91^{c}	93.81^{a}	92.54^{a}	2.51	*
Ether extract (%)	81.00^{b}	84.61^{b}	92.06^{a}	93.89^{a}	1.41	*
Ash (%)	39.69^{b}	71.34^{a}	66.98^{a}	72.17^{a}	3.67	*
NFC (%)	80.57^{c}	85.38^{b}	92.79^{a}	91.21^{a}	1.24	*
NDF (%)	78.82^{c}	82.28^{bc}	86.91^{ab}	89.69^{a}	1.14	*
ADF (%)	78.24^{b}	80.37^{b}	86.39^{a}	87.51^{a}	1.15	*

abc means on the same row having different superscripts differs significantly(P<0.05); SEM= standard error of means; LS= level of significance; * = significant (p<0.05); NS= not significantly different (P>0,05); NFC= non fibre carbohydrates; NDF= neutral detergent fibre; ADF= acid detergent fibre; T_1=Red Sokoto fed on Sorghum husk; T_2=Red Sokoto x Sahel goat fed on sorghum husk; T_3=Red Sokoto fed on cowpea haulms and T_4=Red Sokoto x Sahel goat fed on cowpea haulms

4.0 CONCLUSIONS AND RECOMMENDATIONS

The results of this study showed that sorghum husks (SH) had significantly higher NFC, NDF, and ADF. While CH recorded significantly higher CP, EE and ash contents. It also showed that there was no significant difference between the breeds (Red Sokoto and Red Sokoto x sahel) in most of the apparent digestibility parameters except in crude protein digestibility where the values from Red Sokoto (87.20) differs significantly (p<0.05) from Red Sokoto x Sahel (78.72). However, cowpea haulms (CH) digestibility showed higher values in all the parameters measured compared to sorghum husk (SH).

Therefore, Red Sokoto goats are recommended for better *in vivo* digestibility of sorghum husk and cowpea haulms.

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Cite This Article: Baba, M. K *et al* (2021). Feed Intake and Nutrient Digestibility of Sorghum (Sorghum Bicolor) Husk and Cowpea (*Vigna unguiculata*) Haulms Fed to Two Breed of Goat. *East African Scholars J Agri Life Sci, 4*(7), 167-171.