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EFFECT OF STORAGE PERIOD ON CHEMICAL COMPOSITION OF SOME LOCALLY PRESERVED FORAGES IN THE SEMI-ARID ZONE OF SOKOTO STATE, NIGERIA

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ABSTRACT

The study was conducted in six (6) weeks to determine the chemical composition of four locally dried preserved forages and their chemical changes over time. The sourced forages were dried and replicated four (4) times and each preserved under local method of preservation. There were sixteen (16) replicates in all. The forages used were cowpea haulms, cowpea husk (Vigna unguiculata), groundnut haulms (Arachis hypogaea) and *Sorghum bicolor* panicles. Nutrient components of each was determined using proximate analysis. The data obtained were statistically analyzed using SPSS computer analytical package. The results showed that, there were significant differences ($P<0.05$) in their nutrient components. Cowpea haulms contained 6.7% moisture, 5% ash, 7.5% crude protein, 4.2% ether extract, 37.9% crude fibre and 45.5% nitrogen-free extract. Cowpea husk contained 7.3% moisture, 9.2% ash, 5.1% crude protein, 3% ether extract, 27.5% crude fibre and 55.2% nitrogen free extract. Groundnut haulms contained 6.3% moisture, 7.3 ash, 5.3% crude protein, 4.5% ether extract, 27.9% crude fibre and 54.9% nitrogen free extract. Sorghum panicle also, contained 6.9% moisture, 2.2% Ash, 4.3% crude protein, 2.6% ether extract, 12.7% crude fibre and 78.3% nitrogen free extract. The results also showed similar changes ($P<0.05$) in the nutrient contents of all the forage species within time of preservation.

Key words: Chemical composition, Cowpea, Forages, Groundnut, Sorghum, Preservation.

INTRODUCTION

Feeding high-quality forages increases a lactating dairy cow's efficiency and helps reduce feed costs associated with purchased ingredients, especially proteins (Schroeder, 2008; Salamone *et al.*, 2012). Intake of forages is influenced by many factors two of which are maturity and/or the preservation method of the forage (Salamone *et al*., 2012). The two most influential factors that affect forage quality and utilization are the forage species and forage maturity (Arthington and Brown, 2005).

The preservation method of forages affects the nutrient composition of the forage. Whether the forage is ensiled or made into hay, part of the protein is broken down due to the action of plant enzymes in the field after harvest (Verbic *et al*., 1999). Producing high quality forages in large quantities, is largely dependent on harvesting at optimum maturity while optimizing the storage/preservation conditions. Similarly, when forages are preserved as hay, lignification can increase in the cell walls of the plant during the wilting process (Salamone *et al*., 2012).

Most farmers in Nigeria sun-dry and conserve their forages locally throughout the dry season till needed for their animals without taking into cognizance nutrients deterioration. The protein content of the forages for ruminants in the tropics is within the range of 11- 14% of the dry matter, which is sufficient for modest livestock productivity (NRC, 1995). This could fall below the critical level of 7% required for ruminal function (ARC, 1980) especially in the dry season.

The nutrient quality of forages is one of the major prerequisites apart from availability for production of good quality feeds. Hence it becomes imperative to research into the nutrient composition of some of the locally available crop residues and forages that are preserved for use to supply the nutritional needs of animals in the dry season. The aim of this study is to analyze and provide some information on nutrient components, proportions and changes due to preservation over some period of time. The results generated from this study might help in decision making for the appropriate technic to use in preserving crop residues and/or forages that might help in maintaining their nutritive value. In other words this will assist in providing the animals with good forages capable of being digested in the rumen to release available nutrients to meet the animal requirements for both maintenance and production.

MATERIALS AND METHODS

Study area*:* the study was carried out in the Faculty of Agriculture Usman Danfodio University Sokoto. Sokoto State is located in the Sudan Sannavah zone in the extreme north western part of Nigeria, between longitude 48" E and 654"E, latitudes 12 N and 13 58"N (Anon., 2007). It shares common boarders with Niger Republic in the north, Kebbi State in the southwest and Zamfara State in the east. The humidity in January is less than 20% and between 20-40% in the southern areas. The mean annual rainfall is 750mm and potential evapotranspiration rates have been reported to be 162cm (Anon., 2007). The annual mean temperature is 34.9^{o}C with highest temperature (41.0^{o}C) recorded in April (41.0^{o}C) and the minimum temperature occurring in January (13.2^{o}C) (Anon., 2007).

Sample collection: Three (3) forage species comprising of two legumes i.e. cowpea haulms, cowpea husk (*Vigna unguiculata*) and groundnut haulms (*Arachis hypogaea*), and cereal crop of sorghum bicolor panicles were obtained from the University farm of the Faculty of Agriculture, Usman Danfodio University after harvesting. Four (4) replicates of each were made and stored in a room. Samples from each were randomly collected weekly and pounded into powder using local mortar and pestle. Chemical components were determined using proximate analysis at the Soil science laboratory of the Faculty of Agriculture, Usman Danfodiyo University Sokoto.

Statistical analysis: Data collected was subjected to Analysis of Variance (ANOVA) to test for significance while, means were compared by the Least Significance Difference (LSD) using SPSS (v.16) statistical package.

RESULT AND DISCUSSION

Table 1: Chemical Composition of the Forage Species

Forages	MC	Ash	CP	EE	CF	NFE
Cowpea haulms	6.72^{ab}	5.00^{c}	7.51^{a}	4.15^{a}	37.92^{a}	45.63^{c}
Cowpea husk	7.33^{a}	9.21^{a}	5.10^{b}	3.00^{b}	27.50^{b}	55.20^{b}
Groundnut haulms	6.25^{b}	7.27^{b}	5.34^{b}	4.54^{a}	27.92^{b}	54.93^{b}
Sorghum panicle	6.88^{ab}	2.19^{d}	4.27^{c}	2.59^{b}	12.71^{c}	78.29^{a}
S.E.M	0.243	0.343	0.212	0.182	0.938	0.890
LS	*	*	*	*	*	*

^{a,b,c,d} Means with different superscripts along the same column differ (P<0.05).

Note: MC= Moisture content, CP= Crude protein, EE= Ether extract, CF= Crude fibre and NFE= Nitrogen free extract. S.E.M. = significance Error Mean, LS = Level of Significance

The results from Table 1 show significant difference (P<0.05) in the chemical components of the forages. The moisture content of cowpea husk, cowpea haulms, sorghum panicle and groundnut haulms were 7.33, 6.72, 6.88 and 6.25% respectively. The variation in the moisture content might be due to differences in their dry matter contents. Significance difference (P<0.05) in the Ash content of cowpea husk, groundnut haulms, cowpea haulms and sorghum panicle were found to contain 9.21, 7.27, 5 and 2.19% ash, respectively. Mabile (2004) reported that groundnut haulms contained 9.5% Ash and Aduku (2004) reported ash content of cowpea haulms and sorghum panicle as 6.77 and 1.7% respectively. These differences might be due to differences in the minerals content and or harvesting period. Significant difference (P<0.05) in the Crude protein content were observed with no significant difference determined (P>0.05) between cowpea husk and groundnut haulms. Cowpea haulms content the highest value of 7.5% CP, groundnut haulms 5.3% CP, and cowpea husk 5.1% CP. Sorghum panicle has the lowest of 4.3% CP. The results are in consistence with the earlier work of Aduku (2004). However, Mabile (2004) reported that groundnut haulms contain 9.3% CP, which is not in agreement with the 5.3% CP was obtained from this study. This might be connected with the time at harvest, available soil nutrient and proportion of leaves per sample during sample collection which lead to sampling error.

Significance difference (P<0.05) were observed in the Ether extract (EE) content of the forage species with no significant difference (P>0.05) obtained between cowpea haulms and groundnut haulms, and between cowpea husk and sorghum panicle. The ether extract contained in groundnut haulms, cowpea haulms, cowpea husk and sorghum panicle was 4.54, 4.15, 3.00, and 2.59%, respectively. The information obtained for cowpea haulms and husk is not in agreement with the earlier results of Aduku (2004) who reported that cowpea hay, cowpea husk and sorghum contained 1.83, 0.6, and 2.6% ether extract, respectively. These differences might be due to differences in their genotype (Aduku, 2004).

Variation in the fibre content was significant (P<0.05) across the forage species with no significant difference (P>0.05) seen between cowpea husk and groundnut haulms. The fibre in cowpea haulms, groundnut haulms, cowpea husk and sorghum panicle was found to be 37.92, 27.92, 27.50 and 12.71% respectively. These results are not in line with the 27.39, 33.40 and 2.0% fibre content of cowpea hay, cowpea husk, and sorghum reported by Aduku (2004). This

might be due to some errors in sampling and some interference from residues from local mortar and pestle used during grinding process.

Significant (P<0.05) differences in the nitrogen-free extract of the forages was observed except for cowpea husk and groundnut haulms which were similar. The NFE content of sorghum panicle, cowpea husk, groundnut haulms and cowpea haulms was obtained to be 78.29, 55.20, 54.93 and 45.63% respectively. These results are closely related to the work of Aduku (2004), who reported 82.70, 52.98, and 45.11% NFE for sorghum, cowpea husk and cowpea hay respectively.

Table 2: Weekly variations in the chemical composition of cowpea haulms

Weeks	MC	Ash	CP	EE	CF	NFE
1	8.63^{a}	5.50^{b}	6.76^{d}	4.75^{ab}	40.00^{ab}	42.99^{bc}
2	8.00^{a}	8.00^{a}	7.49^{c}	4.00^{bc}	28.75^{c}	51.77^{a}
3.	6.50^{b}	5.38^{b}	7.44^{c}	3.00^{d}	35.00^{bc}	50.39^{a}
4	6.25^{b}	4.25^{c}	6.81^{d}	4.13^{bc}	38.75^{b}	46.07^{ab}
5	5.00^{c}	3.75^{cd}	7.97^{b}	3.63^{cd}	46.25^{a}	44.18^{bc}
6	5.88^{b}	3.13^{d}	8.58^{a}	5.38^{a}	38.75^{b}	44.18^{bc}
S.E.M	0.214	0.260	0.080	0.259	2.125	1.977
LS	*	*	*	*	*	*

$^{a, b, c, d}$ Means with different superscripts along the same column differ (P<0.05).

Note: MC= Moisture content, CP= Crude protein, EE= Ether extract, CF= Crude fibre and NFE= Nitrogen free extract, S.EM. = Significance Error Mean, LS = Level of Significance

The results in Table 2 shows significant differences (P<0.05) in some of the chemical components of cowpea haulms within the study period, no significant differences (P>0.05) was observed from week 1 to 2, and from week 3, 4 and 6 in terms of moisture content. Differences between week 5 and 6 might be due to change in weather with increased humidity in week 6 than in week 5. Thus, moisture content showed a declining trend from week 1 to week 5 and only rises in week 6 due to reason stated above.

Ash content of cowpea haulms was significantly (P<0.05) different across the weeks with no significant difference (P>0.05) seen from week 1 to 3. There was no significant differences (P>0.005) between weeks 2 and 3, and weeks 1 and 4 for crude protein content of cowpea haulms. Ether extract significantly differed (P<0.05) in week 1 and 6, between week 1, 2, and 4, and from week 2, 4 and 5. There was also no significant (P>0.05) variation in crude fibre, between week 1 and 5, from week 1, 3, 4 and 6, and between week 2 and 3. no significant difference (P>0.05) observed in the Nitrogen-free extract from weeks 2, 3 and 4, between weeks 1, 4 and 6, and in weeks 1, 5 and 6. Difference in ash content of the forages might be due to error in sampling as the samples collected from two different weeks might contain varying proportions of leaves to stem ratios or due to the time taken to ignite the two different samples. This mean errors might occur at sampling or during ignition process.

Table 3: Weekly variations in the nutrient components of cowpea husk

Weeks	MC	Ash	CP	EE	CF	NFE
1	8.50[a]	8.88[c]	6.85[a]	3.63a[b]	26.25[a]	54.40[ab]
2	7.88[b]	7.13[d]	4.73[d]	4.00[a]	25.00a	59.15[a]
3	7.63[b]	11.88[a]	4.25[e]	3.50[ab]	28.75[a]	51.63[b]
4	8.50[a]	9.25[c]	4.03[f]	2.50[c]	28.75[a]	55.47[ab]
5	5.13[d]	7.13[d]	4.95[c]	1.25[d]	30.00[a]	56.68[ab]
6	6.38[c]	11.00[b]	5.78[b]	3.13[b]	26.75[a]	53.85[ab]
S.E.M	0.156	0.250	0.059	0.208	2.125	2.106
LS	*	*	*	*	*	*

[a, b, c, d, e, f]Means with different superscript along the same column differ significantly (P<0.05).

Note: MC= Moisture content, CP= Crude protein, EE= Ether extract, CF= Crude fibre and NFE= Nitrogen free extract. S.EM. = Significance Error Mean, LS = Level of Significance

The information from Table 3 shows a significant (P<0.05) difference in moisture content, ash, and crude protein and ether extract of cowpea husk from week 1 to 6 and with no significant differences (P>0.05) in crude fibre and nitrogen-free extract from week 1 to 6, except in weeks 2 and 3. It also shows no significant differences (P>0.05) between week 1 and 4, and from week 2 and 3 in moisture content; in week 1 and 4, and between week 2 and 5 in ash content; from week 1, 2 and 3, and along week 1, 2 and 6 in ether extract, from week 1, 2,3,4,5 and 6 in crude fibre and between week 1,3,4,5 and 6 in nitrogen-free extract of cowpea husks. These weekly fluctuations in moisture, ash and crude protein contents might be affected by same reasons mentioned above.

Table 4: Weekly variations in the nutrient components of groundnut haulms

Weeks	MC	Ash	CP	EE	CF	NFE
1	8.00[a]	11.88[a]	7.20[a]	5.13[a]	25.00[b]	50.81[b]
2	6.63[c]	6.50[b]	3.22[c]	5.13[a]	31.25[a]	53.91[ab]
3	7.13[b]	6.00[b]	5.36[c]	5.38[a]	26.25[b]	57.02[a]
4	5.13[d]	6.50[b]	4.40[d]	4.25[b]	27.50[ab]	57.35[a]
5	5.50[d]	6.00[b]	5.41[c]	3.00[c]	28.75[ab]	56.85[a]
6	5.13[d]	6.75[b]	6.46[b]	4.38[b]	28.75[ab]	53.67[ab]
SEM	0.15	0.234	0.068	0.167	1.443	1.428

[a, b, c, d,]Means with different superscript along the same column differ (p<0.05).

Note: MC= Moisture content, CP= Crude protein, EE= Ether extract, CF= Crude fibre and NFE= Nitrogen free extract. S.EM. = Significance Error Mean

Table 4 shows significant (P<0.05) differences in moisture content, ash, crude protein and ether extract contents of the groundnut haulms. No significant differences (P>0.05) was observed in crude fibre and nitrogen- free extract of groundnut haulms across the weeks. No significant differences (P>0.05) were also seen from week 4,5 and 6 in moisture content, along week 2, 3,4,5 and 6 in ash content, between week 3 and 5 in crude protein, from week 1, 2, and 3, and between week 4 and 6 in ether extract. Similarly no significant difference seen in week 2, 4, 5

and 6, and week 1,3,4,5, and 6 in the crude fibre content. As well as week 2,3,4,5 and 6 and from week 1, 2, and 6 in nitrogen-free extract of groundnut haulms.

Table 4.5: Weekly variation in the nutrient components of sorghum panicle

Weeks	MC	Ash	CP	EE	CF	NFE
1	8.00^{a}	2.75^{a}	2.19^{e}	3.00^{a}	18.75^{a}	73.31^{b}
2	$7.50a^{b}$	2.50^{ab}	4.53^{c}	2.88^{a}	11.25^{b}	78.85^{a}
3	7.00^{bc}	2.00^{b}	4.09^{d}	3.00^{a}	11.25^{b}	79.66^{a}
4	7.13^{b}	2.00^{b}	4.73^{b}	3.25^{a}	11.25^{b}	78.77^{a}
5	5.13^{d}	200^{b}	5.54^{a}	1.63^{b}	11.25^{b}	79.59^{a}
6	6.50^{c}	1.88^{b}	5.57^{bc}	1.50^{b}	12.50^{b}	79.59^{a}
S.E.M	0.182	0.219	0.059	0.177	1.284	1.322

a, b, c, d, e—— Means with different superscript along the same column differ ($p<0.05$).

Note: MC= Moisture content, CP= Crude protein, EE= Ether extract, CF= Crude fibre and NFE= Nitrogen free extract. S.EM. = Significance Error Mean

Table 4.5 shows the significant changes ($p<0.05$) in chemical components of sorghum panicle with time. There is no significance ($p>0.05$) decrease in the ash content, ether extract and crude fibre contents, with significant decrease in moisture content of the sorghum panicle. There is no significance changes in the nitrogen-free extract content of the sorghum panicle throughout the six weeks period. No significant differences ($p>0.05$) shown between week 1 and 2, from week 2, 3 and 4, and between week 3 and 6 in moisture content. There were significance ($p<0.05$) difference between week 1 and 2, and no significant differences between from 2, 3, 4, 5, 6 in ash content, and in week 4 and 6, and between week 2 and 6 in crude protein content. No significant ($p<0.05$) changes observed from week 1, 2, 3, and 4 and between week 5 and 6 in ether extract and from week 2, 3, 4, 5, and 6 in crude fibre content. There was no significance difference in Nitrogen free extract seen from week 2, 3, 4, 5 and 6.

CONCLUSION

The proximate components of each forage species significantly varies ($p<0.05$) over period of six-weeks of storage and no significant changes ($p>0.05$) were observed in ether extract, crude fibre and nitrogen-free extract of cowpea haulms and cowpea husk. There were no significant difference that were determine in the crude fiber content and nitrogen-free extract of the groundnut haulms during the study period.

RECOMMENDATION

Appropriate preservation techniques should always be employed in order to minimize deleterious effects in nutritive components as a result of climatic factors, such as temperature, humidity and other factors that might affect nutritive value of forages. Farmers should be accustomed to right stage and time at which the forage should be cut off for hay making. Early harvesting might improve the forage quality.

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