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NUTRITIVE VALUE OF UNTREATED AND MOLASSES-UREA TREATED TYPHA (*Typha domingensis*) SILAGE

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ABSTRACT

The study evaluated the effect of ensiling without and with molasses-urea on the nutritive composition of Typha silages. *Typha domingensis* grass were collected from Hadeija Valley area, Jigawa State, Nigeria. Harvested Typha grasses were chopped manually using cutlass to 2-3 cm and wilted for 48 hours. Molasses and urea were sprinkled accordingly to improve the silage qualities. The mixture were then packed and compressed in a plastic containers of ten kg and sealed using cello tape for each treatments. The silage were left to ferment for 90 days. Four Typha silages were made; T1; 0.5m Typha grass, T2; 0.5m Typha grass + molasses-urea, T3; 1.5m Typha grass and T4; 1.5m Typha grass + molasses-urea laid in a completely randomized design with three replicates. Typha silages were analyzed for chemical composition, mineral contents and fibre fractions. Typha silages have pH values within the optimum range (3.8-4.2). The chemical composition and fibre fractions were significantly ($P<0.05$) different in all the treatments evaluated. Ensiling of Typha grass with or without molasses-urea improved its crude protein, nitrogen free extract, Metabolizable energy. The CP content increased from 5.26 to 8.68% and NFE increased from 23.19 to 34.37%. Similarly, the gross energy (GE) increased from 915.53 to 1060.21 Mcal/kg. Treatment of Typha grass with molasses-urea improved the nutritive value of the ensiled Typha. It is recommended that treated Typha with molasses and urea should be used for better silage qualities.

Keywords: Typha; Molasses; Urea; Silage; *Typha domingensis*

INTRODUCTION

The shortage of feed in terms of quality and quantity especially during dry season is one of the most serious problems faced by farmers in the semi-arid region of Nigeria. To overcome these challenge during dry season, by-products agriculture and agro allied industries are usually fed to sheep in the form of roughages or concentrates. Preserved surplus of various kinds of raw materials such as fresh grasses, leaves and crop residues are fed to sheep in the dry season and these include grasses such as Typha (Hassan *et al*., 2018). The scarcity of conventional livestock feed resources especially in the developing countries of the world has ever continued to constitute a challenge to livestock producers thereby necessitating the need to find alternative feed resources for livestock feeding (Badu *et al*., 2020). Typha also known as cattail or bulrush is a plant locally known as *Kachalla* in Hausa language Typha (*Typha domingensis)* is an invasive weed with rapid growth rate which could be utilized as a novel feed ingredient for feeding sheep during the dry season. The growth of Typha weed also called 'cattail' in water channels, rivers and agricultural lands of the irrigation schemes of northern Nigeria has been of great concern during the last decades and its control has become a priority to the Federal Government of Nigeria (Hassan *et al*., 2018). This problem is not yet solved and *Typha domingensis* has become a real agricultural and environmental challenge with important social implications to the local communities depending on agriculture and livestock production for livelihood (De Evan *et al*., 2019). Thus, the study was conducted with the aim of determining the nutritive value of treated and untreated Typha silage.

MATERIALS AND METHODS

The experiment was conducted at the Ruminant Unit of the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Federal University, Gashua, Yobe State, Nigeria. The area lies on Latitude 11^0 51'N and Longitude 15^0 10'E. The mean annual rainfall vary from 500-1000mm (Climatemp, 2020). The rainy season lasts from June to mid-September and provides an annual average of 420 mm rainfall (Climatemp, 2020).The location has about 4-8 months of dry season with maximum and minimum temperatures of 42.8^0C and 17^0C respectively. The temperature goes as low as 8^0C during harmattan and has an altitude of 339 m (Climatemp, 2020).

Boot stage Typha grass of about 0.5m and 1.5 m tall were harvested from Hadejia Valley Irrigation Scheme using sickle. The grasses were wilted to an approximate moisture content of 60–65% for 48 hours. Harvested Typha grasses were chopped to 2-3cm and sprinkled with 0.45 kg of molasses, 0.25kg of urea dissolved in 0.5 litres of water for T2 and T4 while 0.5 litres of water was sprinkled on T1 and T3 accordingly. The mixture were then packed and compressed to exclude air and packed in a plastic container of ten kg for each treatments. All silages were left to ferment for 90 days. The silages were opened and samples were taken for chemical analysis.

Experimental Layout is shown in Table 1 which consists four experimental treatments A, B, C and D. were made each of 10 kg of wilted Typha grass. Treatments A and B were about 0.5m height when harvested while C and D were about 1m height. Each treatments was replicated three times.

Table 1: Experimental Layout/Treatment

Ingredients	Treatments			
	T1	T2	T3	T4
Typha (kg)	9.50	8.80	9.50	8.80
Tap water (l)	0.50	0.50	0.50	0.50
Molasses (kg)	-	0.45	-	0.45
Urea (kg)	-	0.25	-	0.25
Total (kg)	10.0	10.0	10.0	10.0

Figure 1. Samples of Typha plant measuring 0.5 m (left picture) and 1.5 m (right picture).

The samples were oven dried at (45ºC for 48 h) to determine dry matter (DM) content. All samples were ground using (1 mm pore size) with a Wiley mill (*Model 3: Arthur H. Thomas Co. Philadelphia*) and stored in a container before analysis (Hassan *et al*., 2018). The pH of ensiled Typha grass with or without molasses-urea were measured using a handheld pH meter. The pH of each sample was determined in triplicate using 25 g wet ensilage that was mixed with 100 mL of distilled water. After hydration for 30 seconds using a blender, then were filtered through Whatman's filter paper (No. 1) to obtain the extracts. Immediately after extraction, the pH was measured using a pH meter (Mini Japan 1050) according to Filya (2001). The samples were also analysed for proximate composition comprising of nitrogen (N)for crude protein determination (N×6.25), crude fibre (CF), ether extract (EE), ash, and nitrogen free extract (NFE) as *outlined by AOAC* (2015) procedures. Fibre fractions were determined according to (Van Soest, 1994). The experimental samples were analyzed for phosphorus, calcium, Magnesium, Sodium, Potassium and Zinc using Atomic Absorption Spectrophotometry (Atomic Absorption Spectrophotometer; Analytical jend, contra 700, Germany) as outlined by (Larrauri *et al*., 1996). Data generated were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) of the Statistical Analysis System (SAS, 2015). Where significant differences existed between means, least significant difference (LSD) was used at 5% probability level to seperate means.

RESULTS

Chemical composition of untreated and molasses-urea treated Typha silage

Table 2 presents the pH and chemical composition of untreated and molasses-urea treated Typha silage. The pH ranges from 4.09 to 4.39 for all the treatments with the exception of T4. The optimum pH range of a good silage which is 3.8 to 4.2. There were significant (P<0.05) differences in the dry matter of untreated and molasses-urea treated Typha silage. The dry matter values were 25.66, 22.95, 27.78 and 26.88% for treatments T1, T2, T3 and T4 respectively. T3had significantly (P<0.05) higher dry matter than T1, T2 and T4respectively. Similarly, the dry matter of T2 was significantly (P<0.05) higher than all other Treatments in this experiment There were significant (P<0.05) differences in crude protein among all the treatments. The crude protein of T1 was significantly (P<0.05) higher T1, T2 and T4. T3 had the lowest crude protein among all the treatments. There were significant (P<0.05) differences in the ether extracts across all the treatments.T1 had the highest ether extract (0.35%) while T2 had significantly (P<0.5) higher ether extract than T2T4. T2 had significantly (P<0.05) lowest ether extract across all the treatments. There were significant (P<0.05) differences in the crude fibre content among all the treatments. The crude fibre were (23.20, 22.20, 28.24 and 30.09%) for the T1, T2, T3 and T4 respectively. T2 was significantly (P<0.05) higher than T1, T3 and T4. T2 had the lowest crude fibre. There were no significant (P<0.05) differences in the ash content among all the treatments. The values for ash were (11.25, 11.55, 11.40 and 11.95%) for T1, T2, T3 and T4 respectively. The nitrogen free extract (NFE) significantly (P<0.05) differed among all the treatments. The NFE values were (32.73, 34.37, 27.17 and 23.19%) for T1, T2, T3 and T4 respectively. Treated 0.5 m tall Typha had significantly (P<0.05) higher NFE than T1 and T3. T1 was significantly (P<0.05) different from T3 and T4. T2 had the lowest NFE value. There were no significant (P<0.05) differences in the organic matter among all the treatments. The organic matter values were (88.75, 88.45, 88.60 and 88.05%) for T1, T2, T3 and T4 respectively. The Gross energy (GE) significantly (P<0.05) differed among all the treatments. The GE values were (915.53, 1011.22, 984.29 and 1060.21kcal/kg) for T1, T2, T3 and T4 respectively. There were significant (P<0.05) differences in the fibre fractions among all the treatments. There were signifcant (P<0.05) differences in the neutral detergent fibre (NDF) among all the treatments. The NDF of T3 was significantly (P<0.05) higher than the T1, T2 and T4. T2 had the lowest NDF among all treatments. There were significant (P<0.05) differences in the acid detergent fibre (ADF) among all the treatments. T4 was significantly (P<0.05) higher in ADF than T1, T2 and T3. There were significant (P<0.05) difference in cellulose among all the treatments. T1 had similar (P<0.05) cellulose with T3 and T4. T2 had the lowest cellulose among all the treatments. There were significant (P<0.05) differences in hemicellulose among all the treatments. T3 had significantly (P<0.05) higher hemicellulose than T2, T3 and T4.

Table 2: Chemical composition of untreated and molasses-urea treated Typha silage in percentage unless otherwise stated.

Parameters (%)	Treatments T1	T2	T3	T4	SEM	P-Value
pH	4.09[d]	4.11[c]	4.18[b]	4.39[a]	0.128	0.002*
Dry matter	25.66[c]	22.95[d]	27.78[a]	26.88[b]	1.01	0.004*
Crude protein	7.26[c]	8.68[a]	5.26[d]	7.75[b]	1.19	0.002*
Ether extract	0.35[a]	0.25[b]	0.15[cd]	0.14[cd]	0.04	0.003*
Crude fibre	23.20[cd]	22.20[cd]	28.24[b]	30.09[a]	2.02	0.001*
Ash	11.25	11.55	11.40	11.95	0.90	0.083[ns]
Nitrogen free extract	32.73[a]	34.37[b]	27.17[c]	23.19[d]	2.05	0.001*
Organic matter	88.75	88.45	88.60	88.05	5.32	0.080[ns]
GE (Kcal/kg)	915.53[d]	1011.22[c]	984.29[b]	1060.21[a]	39.69	0.002*
Neutral detergent fibre	62.10[c]	60.15[d]	66.00[a]	65.45[b]	1.01	0.001*
Acid detergent fibre	53.81[ab]	49.70[c]	53.80[ab]	54.90[ab]	2.77	0.004*
Cellulose	41.70[abc]	37.69[d]	41.30[abc]	42.7[abc]	2.88	0.003*
Hemicellulose	8.30[d]	10.45[bc]	12.20[a]	10.55[bc]	1.15	0.002*

[abcd:] means separated by different superscripts are significantly (P<0.05) different.

SEM= Standard error of mean. T1= 0.5m tall Typha, T2=0.5m tall Typha+molasses+urea, T3=1.5m T4=1.5m Tall Typha +molasses+urea

Mineral composition of untreated and molasses-urea treated Typha silage

Table 3 presents the results for the mineral composition of untreated and molasses-urea treated Typha silage. The calcium values were (1.03, 1.32, 1.18 and 0.96 mg/kg) for T1, T2, T3 and T4 respectively. T2 had significantly (P<0.05) higher calcium than other treatments. T2 had significantly (P<0.05) higher calcium than other treatments. T4 had the lowest calcium. T2 had significantly (P<0.05) higher phosphorus than T1, T3 and T4. T1 had the lowest phosphorus. The magnesium values were (0.24, 0.19, 0.20 and 0.18 mg/kg)) for T1, T2, T3 and T4 respectively. Significant (P<0.05) differences were observed in the magnesium content of T1, T2, T3 and T4 respectively. The potassium values were (2.42, 1.95, 1.83 and 1.42 mg/kg)) for T1, T2, T3 and T4 respectively. Significant (P<0.05) difference was observed between the T1 and T4 but there were no significant (p<0.05) differences between the T1, T2 and T3. There were no significant (p<0.05) differences in sodium between the T1, T2, T3 and T4 respectively. There were no significant (p<0.05) differences in zinc between T1, T2, T3 and T4 respectively.

Table 3: Mineral Composition of untreated and molasses-urea treated Typha silage

Parameters (mg/kg)	Treatments T1	T2	T3	T4	SEM	P-Value
Calcium	1.03[cd]	1.32[a]	1.18[b]	0.96[cd]	0.13	0.002*
Phosphorus	0.07[cd]	0.09[a]	0.08[b]	0.07[cd]	0.01	0.001*
Magnesium	0.24[a]	0.19[cd]	0.20[b]	0.18[cd]	0.01	0.002*
Potassium	2.42[a]	1.95[bc]	1.83[bc]	1.42[d]	0.12	0.003*
Sodium	0.69	0.66	0.63	0.65	0.04	0.071[ns]
Zinc	31.75	37.60	25.03	29.50	9.22	0.082[ns]

[abcd:] means separated by different superscripts are significantly (p<0.05) different.

SEM= Standard error of mean. T1= 0.5m tall Typha, T2=0.5m tall Typha+molasses+urea, T3=1.5m T4=1.5m Tall Typha +molasses+urea

DISCUSSION

In the present study, there were significant ($P<0.05$) differences in the proximate composition for the untreated and molasses-urea treated Typha grass for both T1, T2, T3 and T4 respectively. Inclusion of molasses and urea increased the crude protein, nitrogen free extract and gross energy of both T1, T2, T3 and T4 respectively. There was a decrease in dry matter (DM) due to the addition of molasses and urea. This could be due to the fact that Typha is a wetland grass with high moisture content and therefore addition of molasses further increased the moisture content and lowered the dry matter content. The DM obtained in this study was lower than that reported by Hassan *et al*., (2018) who obtained a DM of (42.19%) for fresh Typha grass. Inclusion of molasses-urea increased the CP from 7.26 to 8. 68% for T1 and from 5.26 to 7.75% for T4. This agree with the findings of De evan *et al*., (2019) that microbial growth could be synchronized with ammonia released from urea hydrolysis, consequently increasing the CP content of ensiled forages . In terms of nutritional value, tropical grasses can be affected by their growth stage; therefore, maturity is considered the most important factor affecting the chemical composition and nutritional quality of forages (Shahabodin *et al*., 2014).

The nutritional value of forages linearly declines with increasing physiological maturity (De Evan *et al*., 2019). The increased DM and lower CP and ME with increasing age could be attributed to increased lignification and decreased content of leafy part of plant. Increased in pH was observed in both T1, T2, T3 and T4 and this agrees with the findings of (Makinde *et al*., 2020) who obtained higher pH values due to addition of urea and molasses to cattail silage. The decrease in pH with increasing heights of Typha grass is mainly due to the accumulation of lactic acid as a result of fermentation. The pre-requisite for the development of the lactic acid bacteria during the early stages of ensilage are the contents derived from the plant juices (water soluble carbohydrates) released by plasmolysis as a result of plan cell wall breakdown (McDonald, 1981). Treatment with molasses and urea decreased the ether extract of the Typha silage. The ether extract obtained in this study were lower than that reported by Hassan, *et al*., (2018) who reported ether extract of fresh Typha of 1.2% could be due to fermentation that might decrease the ether extract. The crude fibre content of Typha silage values was lower than (33.00 %) of ensiled water hyacinth with molasses and urea as reported by Kholif *et al*., (2018). The lower crude fibre could be due the treatment with molasses and urea hence lowering the crude fibre. Ash content of the silage was not increased by the inclusion of molasses and urea. The ash content of untreated and molasses-urea treated Typha silage were higher than that of urea treated Typha silage (10.80%) as reported by Musa *et al*., (2020). The ash content of the grass is an index of essential mineral components that are necessary for digestion, metabolism and growth. Nitrogen free extract increased for all the treatments.

The NFE obtained in this study is in consonance with that reported by Musa, *et al*., (2021) for the NFE of Typha silage of (36%). Treatment of Typha grass with molasses and urea increased the Metabolizable energy and this could be due to the soluble carbohydrates released as a result of ensiling and addition of molasses. The gross energy obtained in this study (915.53 – 1060.21 kcal/kg) were higher than that of fresh Typha grass (640 kcal/kg) as reported by Hassan *et al*., (2018). Typha grass treated with molasses and urea had higher calcium and phosphorus contents than that untreated. The calcium and phosphorus values obtained in this study were higher than that reported by Aboud, *et al*. (2005) for the calcium and phosphorus contents of ensiled water hyacinth. Higher calcium and phosphorus contents could be as a result of treatment of the Typha with molasses and urea which could increase the calcium and phosphorus level. Magnesium, Potassium, Sodium and zinc were similar to results of water hyacinth with magnesium (0.14), sodium (0.4) reported by Hussain *et al*., (2010). This revealed that the treatment influenced the mineral contents of both 0.5 m tall and 1.5 m tall Typha. The Typha silages had lower contents of calcium and this revealed that it does not meet the calcium requirement of sheep as reported by Robinson et al., (2018) that the calcium requirement of sheep and goat are 2.0g kg^{-1} and 3.5g kg^{-1} respectively. The Typha silages had lower contents of Magnesium, phosphorus and potassium than the recommended requirements reported by Robinson *et al*., (2018) that the requirements of these minerals are 20mg kg^{-1} 2.4 g kg^{-1} and 5g kg^{-1} respectively. The sodium contents obtained in this study were in consonance with the recommended level (0.8 g kg^{-1}) for sheep as reported by Robinson *et al*., (2018) while the zinc content obtained for Typha at 0.5 m tall treated with molasses-urea meet the zinc requirement for small ruminant of 33 mg kg^{-1} as reported by Robinson *et al*., (2018). This suggests that Typha silages had low calcium, phosphorus and not in the ratio of (2:1) and therefore, need mineral supplementation to meet the dietary requirement of ruminant as reported by Hassan *et al*., (2018). Neutral and acid detergent fibre decreased with the inclusion of molasses and urea.

This could be due to the fermentation process during ensiling of the Typha grass. The decreased NDF and ADF in silage from cereals with increasing maturity could also be due to the deposition of starch into seeds (Mertens, 1994). According to Van Soest, (1994), fibre degradation by rumen microorganisms is enhanced when animals are fed forages with high NDF digestibility. Rumen fill is the main factor inhibiting voluntary feed intake when high-fibre diets are fed or when animals are in high energy demand. Cellulose and hemicellulose were significantly ($P<0.05$) decreased by the inclusion of molasses and urea during ensiling. This agrees with the findings of Shahabodin *et al*. (2014) that ensiling of maize with molasses and urea decreased the cellulose and hemicellulose contents of sorghum Stover silage. Ensiling with molasses and urea had no effect on the lignin contents in this study. The lignin values observed in this study is within the range reported by Mustafa and Nura (2000) that ensiled Typha domingensis grass had a lignin value of 6.68 to 13.17.

CONCLUSION AND RECOMMENDATIONS

It was concluded that Typha harvested at 0.5 m tall treated with molasses-urea had better proximate and mineral contents. The CP content increased from 5.26 to 8.68% and NFE increased from 23.19 to 34.37%. Similarly, the gross energy (GE) increased from 915.53 to 1060.21 Mcal/kg. Typha silages have pH values within the optimum range (3.8-4.2).Therefore, nutritive and mineral compositions of the ensiled Typha treated with or without molasses-urea revealed that it could be included in the ration of small ruminants especially during the dry season.

The following recommendations are made;

1. Silage additives (urea and molasses) should be added to improve the nutritive value of Typha grass.
2. Further studies should be carried out to evaluate the performance of ruminant fed untreated and molasses-urea (1%urea and 4% molasses) treated Typha silage. .

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