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Physiochemical qualities and digestibility of ensiled *Ficus lyrata* leaves with varying proportions of cowpea husks fed to Red Sokoto goats during the dry season

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ABSTRACT: This study was conducted to evaluate the physical properties, chemical compositions and digestibility of ensiled *Ficus lyrata* leaves with varying proportions of cowpea husks fed to Red Sokoto goats. The fresh leaves and soft stalks of *Ficus lyrata* were harvested around September and wilted for 12 hours before being chopped to 2-3cm particle size. The chopped forage were then mixed with cowpea husks at 0%, 20% 40% and 50%, and 50cl honey sludge for all treatments. The silages were ready on different days. T1 was ready on day 35 followed by T2 on day 42. T3 and T4 were completely fermented at day 56. All silages had pleasant smell, sweet vinegar taste, smooth texture and colour ranging from olive green to yellowish green. Temperature range obtained (32-36ºC) while pH range was between 4.1-4.6. DM contents were between 41.52- 45.35%. CP varied from 12.54-14.15% and increased with increased proportion of cowpea husks. CF ranged between 23.32-23.93% and increased as the cowpea proportion increased. EE varied among treatments (T_1, =3.78%, T_2=2.96%, T_3=3.07%, T_4=3.42%). Ash content (9.62-12.09%) increased as cowpea proportion increased. The NDF content of the silages ranged from 46.41-50.74%. Minerals investigated were Ca (1.93-33.22%), P (0.19-0.40%), K (1.00-1.41%), Na (0.84-1.10%), Mg (0.25-0.60%) and iron (32.1-35.8ppm). Digestibility parameters investigated included dry matter intake (298.36-300.51g/d), nitrogen balance (6.97-8.44g/d) and apparent digestibility (78.31-84.97).

Keywords: Cowpea husks, digestibility, *Ficus lyrata* leaves, physiochemical, silage.

INTRODUCTION

The dry season is a critical period that poses a serious threat to sustainable ruminant production (Lamidi and Ologbose, 2014) and the peaceful coexistence of pastoral nomads and host communities (Lamidi *et al*., 2021). Silage making is one of the important ways of conserving excess forages available during the wet season for ruminant utilization during the dry season (Lamidi *et al*., 2019). It serves as a feed bank for natural forages which are considered to be the main source of feed for ruminant livestock production in Nigeria, as most farmers can hardly afford to keep their animals on concentrate ration (Lamidi *et al.,* 2021). Ensiling forage offers a strategic solution to the off-season feeds for ruminants (Babayemi and Igbekoyi, 2008), especially for those browse forage trees that do not blossom but shed their leaves and lose most of their nutrients during the dry season (Mbatha and Bakare, 2018). During this period of the year, fodder trees such as fiddle leaf figs and shrubs play an important role in

ruminant nutrition, providing proteins, minerals, vitamins and energy (Sylva-Nyom *et al*., 2022). However, there is a dearth of information on the use of browse plants as silage (Ogunbosoye *et al*., 2016).

Ficus lyrata (fiddle leaf fig) is a common browse forage grown naturally and abundant in the wet lowlands of Nigeria especially in Taraba State; blossoms during the rainy season (Sylva-Nyom, 2023) but withers greatly in the harmattan (Sylva-Nyom *et al*., 2024). Its cousin, *Ficus polita* has been successfully used for silage production with maize residue (Ogunbosoye *et al*., 2016). *Ficus lyrata* leaves have 74.2% DM, 61% CF, 9.6% CP, 3.5% EE, 7.4% ash and 14.2% NDF (Sylva-Nyom *et al*., 2022).

The objective of this study is, therefore, to evaluate the physiochemical qualities of *Ficus lyrata* leaves-cowpea husk silage and its digestibility by Red Sokoto goats with the aim of curbing feed scarcity during the season.

MATERIALS AND METHODS

Location of the study

The study was carried out at the Livestock Teaching and Research Farm, Federal Polytechnic, Bali, Taraba State. Bali lies within the Guinea savanna zone and extends between latitude 8° 35‘ 00’’ North of the equator and 10° 46’ 00’’ East of the Greenwich Meridian (Taraba State Government, 2015). Rainfall varies between 1000 and 1500 mm per annum, with temperature ranges from 30 to 38°C depending on the season (Taraba State Government, 2015). Browse trees such as *Gmelina arborea, Daniella africana, Afzelia africana, Tamarindus indica, Parkia clappertoniana, Prosopis africana* and *Ficus spp* (Rimamchirka, 2019) such as *Ficus lyrata, Ficus sycamorus, Ficus thoningii, Ficus regiolisa* and *Ficus polita* (Sylva-Nyom, 2023) were found in the study area.

Sources and preparation of experimental materials, and treatments

Ficus lyrata leaves were harvested around September within the Bali B community and wilted for 12 hours before being chopped into 2-3 cm size. The forage were then mixed thoroughly with different proportions of cowpea husks as follows: 100% *Ficus lyrata* leaves and 0% cowpea husk (T_1), 80% *Ficus lyrata* leaves and 20% cowpea husks (T_2), 60% *Ficus lyrata* leaves and 40% cowpea husks (T_3), and 50% *Ficus lyrata* leaves and 50% cowpea husks (T_4). Each treatment samples were mixed thoroughly with 50 cl honey sludge as an additive and sweetener. The mixed forage samples were compactly packed into 70L drums used as silos and tightly sealed to avoid air penetration after which they were stored at room temperature of 32-37ºC for 30-56 days according to the procedure of Lamidi *et al*. (2021), Ogunbosoye *et al*. (2016) and Sylva-Nyom *et al*. (2024).

Evaluation of physical properties

As soon as the silages were ready, the silos were opened and physical characteristics such as aroma, taste, colour, texture, and wetness (Chiba *et al*., 2005; Lamidi *et al*., 2021) were assessed based on sensory evaluation while temperature and pH were determined using a thermometer and digital pH meter respectively. The colour was determined by comparing the colour of the silage samples to a colour chart, the aroma was perceived by sense of smell, and texture was done by pressing with fingers while wetness was done by pressing the silage with hands as described by (Lamidi *et al*., 2021). Afterwards, subsamples were collected from each silage sample and dried in an oven before being ground using a dry mill blender and taken for proximate, mineral and anti-nutrient analyses.

Proximate composition, mineral and anti-nutrient determination

Proximate compositions of silage samples were determined according to AOAC (2000). Neutral detergent fibre was determined according to Van Soest (1999). Minerals were determined using an atomic absorption spectrophotometer (AAS).

Digestibility

Twelve (12) male Red Sokoto goats, 3 in each treatment were fed the respective ensiled diets for 30 days. On days 21-30, faeces were collected from each animal and weighed fresh before being dried and bulked for each animal. A sub-sample from each animal was dried in a forced draft oven at 100-105°C for 48 hours and used for DM determination. Another sample was dried at 60°C for 48-72 hours for determination of proximate composition. Total urine from each animal was collected daily in the morning before feeding and watering which was trapped in a graduated transparent plastic container placed under each cage and to which 15 ml of 25% concentrated sulphuric acid had been added to curtail volatilization of ammonia from the urine as described by Ahamefule *et al*. (2006). The total volume of urine output per animal was measured and about 10% of the daily outputs were saved in numbered plastic bottles and stored in a deep freezer at -5°C. At the end of each 7-day collection, the collected samples were subjected to analysis after which nitrogen balance and digestibility were determined.

Table 1. Physical properties of ensiled *Ficus lyrata* leaves with varying proportions of cowpea husks.

Parameters	Treatments			
	T1	**T2**	**T3**	**T4**
DCF (days)	35	42	56	56
Aroma	Pleasant	Pleasant	Pleasant	Pleasant
Taste	Sweet vinegar	Sweet vinegar	Sweet vinegar	Sweet vinegar
Colour	Olive green	Olive green	Yellowish green	Yellowish green
Texture	Smooth	Smooth	Smooth	Smooth
Wetness	Moist/firm	Dry/firm	Dry/firm	Dry/firm
Temperature (ºC)	36	35	33	32
pH	4.6	4.1	4.4	4.3

DCF= day of complete fermentation.

RESULTS AND DISCUSSION

Table 1 shows the physical properties of silage made using *Ficus lyrata* leaves and varying proportions of cowpea husk. The silages were ready on different days. T1 was ready on day 35 followed by T2 on day 42. T3 and T4 were completely fermented at day 56. This might be due to the varying levels of inclusion of cowpea husks. The pleasant aromatic smell perceived for all the samples was a typical smell of lactic acid bacteria and also an indication that the ensiling materials were successfully ensiled. The vinegar tastes showed that the silage is good as also reported by Chiba *et al*. (2005). The vinegar taste was masked with sweetness as a result of the addition of honey sludge. The Olive green colour observed in T1 and T2 was due to the small proportion (20%) of cowpea and mixture with honey sludge in it. According to Babayemi and Igbekoyi (2008), good silage usually assumes the original colour of the ensiled materials. The yellowish-green colour observed was similar to the original colour of the *Ficus lyrata* leaves and cowpea mixtures before ensiling. Yellow colour in silage is the colour of good silage (Ogunbosoye *et al*., 2016). The textures were smooth and firm, not slimy when felt. When squeezed, none dripped off the water but could break easily. This is an indication of a good silage (Ogunbosoye *et al*., 2016). There was no moldiness observed among the samples. Silage temperatures were decreasing as cowpea proportion was increasing. The temperature range obtained (32-36ºC) was within the range (30-37ºC) obtained by Lamidi *et al*. (2021) when he ensiled *Panicum maximum* with different proportions of *Calopogonium mucunoides*. The pH range was between 4.1 and 4.6 within the range of good silage as reported by Meneses *et al*. (2007) even though they were higher than the pH (3.5 – 4.0) obtained by Lamidi *et al*. (2021) for ensiled *Panicum maximum* with different proportions of *Calopogonium mucunoides* but similar to pH (3 – 4.5) reported by Lamidi and Ingweye (2020) for ensiled fresh maize stover with groundnut haulm.

Table 2 shows the chemical compositions of silages produced from *Ficus lyrata* leaves with varying proportions of cowpea husks. CP varied from 12.54-14.15% and increased with increased proportion of cowpea husks. This is above the minimum required for growth (11.3 %) in ruminant animals according to ARC (1984). CF ranged between 23.32-23.93% and increased as the cowpea proportion increased. EE varied among treatments (T_1, =3.78%, T_2=2.96%, T_3=3.07%, T_4=3.42%). Ash content (9.62-12.09%) increased as cowpea proportion increased. The NDF content of the silages ranged from 46.41-50.74% which is below the acceptable levels of 60 to 65% recommended for optimum ruminant animal performance as outlined by Meissner *et al.* (1991). Minerals investigated were Ca (1.93-33.22%), P (0.19-0.40%), K (1.00-1.41%), Na (0.84-1.10%), Mg (0.25-0.60%) and iron (32.1-35.8ppm). The chemical composition of the silage is almost similar to that of the silage materials reported by Sylva-Nyom *et al*. (2022) except for NDF. Jianxin and Jun (2002) reported that the output of silage depends on the materials being ensiled. Similarly, Ogunbosoye *et al.* (2016) also observed a similar trend, adding that in silage making adequate attention must be drawn to the quality of materials to be ensiled to have good feeds for the animals. Anti-nutrients found were lignin, tannins, phytate and saponins. It was observed that anti-nutrients increased as cowpea husks increased. Anti-nutrient values in fermented *Ficus lyrata* leaves reduced as compared to the values of unfermented leaves recorded by Sylva-Nyom *et al*. (2022), agreeing with Jaybhaye and Srivastav (2015), and Handa *et al*. (2017) that fermentation reduces anti-nutrient contents.

Table 3 shows the dry matter intake, crude protein intake, nitrogen balance and apparent digestibility of the diets in Red Sokoto goats. There was no significant difference in the contribution of the diets for all the parameters studied except for nitrogen in faeces which was highest in T1. T2 showed the highest digestibility followed by T3. The high digestibility in T2 may be due to

Table 2. Proximate, mineral and anti-nutrient compositions of ensiled *Ficus lyrata* leaves with varying proportions of cowpea husks.

Parameters	Treatments			
	T_1 (0%)	T_2 (20%)	T_3 (40%)	T_4 (50%)
Dry Matter (DM)	41.52	42.51	44.45	45.35
Crude Protein (CP)	12.54	12.88	13.92	14.15
Crude Fibre (CF)	23.32	23.41	23.56	23.93
Ether Extract (EE)	3.78	2.96	3.07	3.42
Ash	9.62	10.36	11.86	12.09
Neutral Detergent Fibre (NDF)	50.74	50.39	47.57	46.41
Calcium (Ca)	1.93	2.30	3.05	3.22
Phosphorus (P)	0.26	0.19	0.23	0.40
Potassium (K)	1.00	1.20	1.41	1.32
Sodium (Na)	0.9	0.84	1.10	1.00
Magnesium (Mg)	0.3	0.25	0.40	0.60
Iron (in ppm)	33.0	32.1	35.0	35.8
Lignin	5.3	6.4	8.1	8.7
Tannins	2.8	3.3	3.8	3.9
Phytate	3.0	4.2	6.0	6.6
Saponins	1.8	2.1	4.6	4.9

ppm=part per ml.

Table 3. DM intake and nitrogen balance in RSG fed ensiled *F. lyrata* leaves with varying of cowpea husk.

Parameters	T1	T2	T3	T4	SEM
BW (g)	10500.00	10540.00	10560.00	10425.00	367.79
DMI (g/d)	300.19	300.20	300.51	298.36	10.52
DMI ($wkg^{0.75}$)	72.03	71.97	71.95	71.73	1.92
DM as %BW	3.00	3.00	3.00	3.00	0.00
CP-intake(g/d)	59.60	59.60	52.61	52.23	2.16
N-intake (g/d)	9.53	9.53	8.41	8.35	0.35
N-feaces (g/d)	2.04^{a}	1.40^{b}	1.67^{ab}	1.72^{ab}	0.10
N-urine (g/d)	0.25	0.22	0.36	0.44	0.06
N-bal (g/d)	7.74	8.34	7.11	6.97	0.37
N-bal ($wkg^{0.75}$)	4.63	4.90	4.32	4.28	0.17
Digestibility	79.37	84.97	78.26	78.31	1.47

Means on same row with different superscripts are significantly different at $p<0.05$; N= Nitrogen, DMI= dry matter intake, DM=dry matter, BW=body weight, CP= crude protein.

low levels of tannins in the diet which is in line with the report of Joye (2019) that tannins form complexes with proteins, which cause the inactivation of many digestive enzymes and decrease protein digestibility. The very little variations in the feed intake may be due to the fact that the animals were fed on the basis of live weight or metabolic weight.

Conclusion and Recommendation

The physical properties of all the silage are the qualities of a good silage. Proximate and mineral compositions were similar to the ensiling materials. Anti-nutritional factors were in reduced amounts compared to the materials used for the silage due to fermentation. Animals in T2 which had 80% *Ficus lyrata* leaves and 20% cowpea husks had the highest dry matter intake, crude protein intake and digestibility. Thus, 20% inclusion of cowpea husk is recommended to ensile *Ficus lyrata* leaves for better utilization and productivity in goats.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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