ENSILING QUALITY OF PEARL MILLET FORTIFIED WITH GRADED LEVELS OF COWPEA FORAGE

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ABSTRACT
The experiment was conducted to investigate the effect of cowpea (Vigna unguiculata L. Walp) forage inclusion on the ensiling quality of Pearl millet (Pennisetum typhoides Burm.F). Pearl millet and cowpea forages were mixed at 100:00, 80:20, 60:40, and 40:60, respectively and ensiled for 3 weeks in the laboratory silos. After fermentation period, the silos were opened and contents scored for colour, aroma and pH. Proximate composition and fiber analysis was carried, dry matter intake, dry matter digestibility, metabolizable energy and reference feed value was also estimated. The result revealed that the silages were moderately acidic, very sweet and had yellowish colour. Cowpea forage inclusion for ensiling pearl millet improved the CP, ash, EE, ME, dry matter digestibility, dry matter intake and RFV with corresponding declined in DM and fiber fractions. Cowpea forage inclusion at 60% level is recommended for ensiling pearl millet grass. Further studies to determine voluntary feed intake and animal performance are recommended.
Key-words: pearl millet, cowpea, silage, proximate analysis

INTRODUCTION

The semi-arid zone of Nigeria is the home of ruminant animals of the country, hosting over 90% of bovine and 70% of sheep and goat. The importance of livestock in the economy of many Nigerians cannot be over stressed enough (Gefu, *et al.,* 1993). Their rearing is a common feature in most rural households and are important items in social, cultural and religious festivals. Many poorest populations depends on them for food and income as their main economic activities. According to Kolo *et al.* (2015), livestock industry contributes 9 – 10% of the Nigeria's GDP. However, the ruminant animal farmers in the zone experience a yearly shortages of forage feed both in quality and quantity to feed the animals for almost 8 – 9 month. The yearly situation forced pastoralists to move down to southern part of the country in search for abundant and quality forages to feed their animals which is nearly not feasible due to losses encounter by cattle rustlers and or farmers-herders clashes among other factors. The situation resulted in seasonal emaciation and weight loss, poor calving, lambing and kidding rate, retarded growth, poor performance and consequently death of most of the animals. These losses due to year round erratic feed supply will further down slide the already low animal protein intake among the populace. These suggest the need for the production of high yielding quality forages such as pearl millet and its preservation for used during the period of scarcity. The two principal forage conservation methods are silage and hay making. Ensilage is more viable option as it enable forage conservation during the wet humid condition which is practically impossible for hay making, ensiled forage is secured from combustion and rodent destruction and re-growth following harvesting will provide additional feed for *in situ* grazing and or hay making (Muhammad *et al.,* 2019). However, tropical grasses are not suitable silage materials due to poor nutrient content and low water soluble carbohydrate (WSC). Legume forages if incorporated to grasses during ensilage will improve national quality of the resultant silages (Baba *et al.,* 2016), reduce buffering and prevent proteolysis. Thus, the aims of the study was to determine the suitability of cowpea and its optimum inclusion level with pearl millet for ensilage. Thus, the objectives of the study was to examine the compatibility of cowpea forages and pearl millet for ensilage and to determine the optimum inclusion level of cowpea for quality silage production.

MATERIALS AND METHODS

Experimental site: The study was conducted at Teaching and Research Farm of Bayero University, Kano. Kano is situated between latitude 11° 59ˆN and longitude 8° 36ˆE at an altitude of 460m above sea level. The climate is characterized by a well-defined wet season (May to September) and dry season (October to April). The mean annual rainfall varies from 600 to 1000 mm (KNARDA, 2001).

Experimental pasture and silage preparation: The forage materials were separately planted on a well prepared seed beds following ploughing and harrowing. Pearl millet was sampled at full inflorescence while cowpea was sampled at flowering to early pod stages. Intact whole plants were separately chopped to 1 to 2 cm length and mixed at the following ratio: 100:0, 80:20, 60:40 and 40:60 pearl millet and cowpea respectively and designated as PM, PMC20, PMC40 and PMC60. Each of the treatment combination was ensiled in three replicates and kept in laboratory for 3 weeks incubation period. Thereafter, the silos were opened and contents were scored for colour and aroma on a scale of 1 – 4 (Table 1) and pH was determined using a digital pH meter. A sub sample from each replicates were taken and oven dried 60 °C for 48_hrs for chemical analysis.

Table 1: Description of colour and aroma rating used as indices of silage quality

Rating	Colour	Aroma
1	Dark or deep brown	Putrid or rancid
2	Light brown	Pleasant
3	Pale yellow	Sweet
4	Yellowish green	Very sweet

Source: Muhammad *et al*. (2009)

Chemical and statistical analysis

The dried silage samples were milled to 1mm using Tecator Cyclotec 1093 laboratory mill. Proximate analysis was carried out according to AOAC (1999), fiber fractions according to Van Soest *et. al.* (1991). Metabolizable energy (ME) was estimated as described by Pauzenga (1985). Total digestible nutrients (TDN), digestible dry matter (DDM), dry matter intake (DMI) and relative feed value (RFV) were estimated according to Jeranyama and Garcia (2004). Data collected were analyzed using General Linear Model of Statistical Analytical System (SAS, 1999-2000) package. Differences between the means were considered significant at 5% probability level.

RESULTS AND DISCUSSION

Silage characteristics: pH, aroma and colour of the resultant silages were presented in Table 2. Ensilage is a conventional forage conservation method which requires the use of high yielding forage species per unit area. Reports showed that mixtures of cereals and legumes are particularly suitable for silage making as the deficiency of protein in cereals and absence of fermentable carbohydrates in legumes are thus overcome. Nutritional value and physical characteristics are yard sticks for judging silage quality (Penn State Extension, 2014). The silages from this study were moderately acidic, pale yellow and averagely very sweet with a mean score of 3.5. The result showed that quality silages were produced as revealed from colour, aroma and pH values. The result were in agreements with the report of Baba *et al.* (2016), Ahmad *et al.* (2018) and Abdulrahaman *et al.* (2018).

Table 2: Effect of cowpea forage inclusion on pH, aroma and colour of pearl millet silage

Treatment	pH	Aroma score	Colour
PM	3.59	3	4
PMC20	3.39	4	4
PMC40	3.37	4	4
PMC60	3.20	3	4

Chemical Composition:

The chemical composition of mixed pearl millet-cowpea silage is presented in Table 3. The result showed that mixing of pearl millet with cowpea forage for silage production had significant ($p<0.05$) effects on the nutritional value of the resultant silage. Cowpea inclusion leads to a significant

($p<0.05$) increased in Ash, EE, CP and NFE with a corresponding declined in DM, CF and OM contents across the treatments regardless of inclusion level. Significant ($p<0.05$) higher Ash, CP, EE and NFE with corresponding lower DM, CF and OM concentrations was noticed in PMC60 treatment. On the other hands, PM treatment had the least Ash, CP, EE and NFE contents with corresponding higher DM, CF and OM values. The increasing trends observed in Ash, EE, CP and NFE with a corresponding decreased in DM, CF and OM were in agreement with previous findings (Egbunuogie and Bamikole, 2014; Ridwan *et. al.*, 2015; Abdulrahaman *et. al.,* 2018). The % CP of the resultant silages were above 7% minimum requirements for good rumen fermentation (Rego *et. al*., 2010).

Table 3: Proximate composition (%) of mixed pearl millet-cowpea silages

Treatment	PM	PMC20	PMC40	PMC60	SEM
DM	99.35^{a}	97.39^{ab}	93.58^{b}	93.27^{b}	5.00
ASH	8.75^{b}	7.50^{c}	9.04^{ab}	10.22^{a}	1.25
CP	10.94^{b}	12.13^{ab}	13.13^{a}	13.75^{a}	2.15
CF	28.37^{a}	26.35^{ab}	26.01^{bc}	24.01^{c}	2.01
EE	1.00^{b}	1.44^{ab}	1.18^{ab}	2.25^{a}	1.25
NFE	50.65^{ab}	52.58^{a}	50.90^{ab}	49.77^{b}	2.25
OM	90.31^{a}	89.89^{a}	84.80^{b}	83.05^{b}	5.05

Means with different letter superscripts within same row differ significantly ($p<0.05$).

Fiber fractions, digestible matter, dry matter intake, reference feed value and metabolizable energy:

Percent fiber fractions (ADF and NDF), total digestible nutrients (TDN), digestible dry matter (DDM), dry matter intake (DMI), reference feed value (RFV) and metabolizable energy (ME) ($MJkg^{-1}$) are presented in Table 4. Cowpea forage had significant ($p<0.05$) effects on the %NDF. The initial 58.77% NDF in PM treatment decreased to 50.31% in PMC60, the decreased observed could be due to hydrolysis of hemicelluloses to monosaccharide's that provides additional sugars for lactic acid production during ensiling (Muck, 1989). The result concurred with the report of Muhammad *et. al*. (2008). The DMI depends on physical and physiological factors. For a specific diet offered *ad-libitum*, current DMI is equivalent to the amount that meets the daily energy requirements or that completely fills the alimentary tract whichever is reached first. Never the less, DMI of growing goats can be reached when diet had ME value of 12.55 MJ/kg^{-1} DM. The DMI of the resultant silages were beyond requirement of growing goat (0.9 to 1.4%) and was higher than the report of Mart-inez-Marin *et. al* (2012). The RFV is a predictor of forage intake and energy value (Lithourgidis, 2006). Silage from treatment combinations of PMC40 and PMC60 were classified as good and PM and PMC20 treatments were fairly good silages (Kocer and Albayrak, 2012). Cowpea forage inclusion improved ME contents significantly from 9.51 – 10.25 $MJkg^{-1}$. The metabolizable energy of the silages satisfied daily requirement of cow at 6 – 8 months pregnancy (Moran, 2005) and maintenance requirement of 800_kg cow (Herdt, 2018).

Table 4: Fiber fractions, Digestible matter, RFV and ME of pearl millet-cowpea silages

Treatment	PM	PMC20	PMC40	PMC60	SEM
NDF	58.77^{a}	56.70^{ab}	54.12^{b}	50.31^{c}	3.00
ADF	39.09^{a}	37.70^{a}	35.35^{b}	33.8^{b}	2.10
TDN	50.88^{b}	52.68^{b}	55.71^{a}	57.71^{a}	2.15
DMI	2.04^{b}	2.12^{b}	2.22^{ab}	2.39^{a}	0.25
DDM	58.45^{c}	59.53^{bc}	61.36^{ab}	62.57^{a}	2.50
RFV	92.49^{b}	97.64^{b}	105.45^{a}	115.66^{a}	7.50
ME	9.51^{b}	10.13^{ab}	9.94^{ab}	10.24^{a}	0.70

Means with different letter superscripts within same row differ significantly ($p<0.05$).

CONCLUSION

The use of cowpea for ensiling pearl millet had beneficial advantages. Mixing pearl millet and cowpea forage at 40:60 level had higher nutritional contents, energy, dry matter intake and digestibility thus recommended for large scale production. Further studies are recommended determine mineral compositions and to ascertain voluntary intake the performance of animals fed on such silage.

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