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Effect of Ensiling Graded Level of Poultry Litter with Desho Grass (Pennisetum pedicellatum) on Palatability and Nutritional Characteristics of Silage in Case of Bonga Sheep

Muluken Zeleke
Bonga Agricultural Research Centre, P.O. Box 101, Bonga, Ethiopia

Abstract
In tropical region inadequate quality and quantity of feed are major constraints to livestock production sector. Most of feed resources are low in nutrient content to meet nutrient requirement of maintenance, production and reproduction. Therefore this study was carried out to evaluate the effect of ensiling graded level of poultry litter with desho grass (Pennisetum pedicellatum) on intake, preference, fermentative and nutritional characteristics of silage in case of Bonga Sheep**.** Poultry litter (Pl) and desho grass (Dg) was ensiled by four treatments; T1 (100%Dg), T2(80%Dg+20%Pl), T3(70%Dg+30%Pl) and T4(60%Dg+40%Pl) in three replications for 30 days. Ten Bonga sheep were used to evaluate the free choice intake of silage in a cafeteria style. The experimental design was complete randomized design (CRD). Data obtained were subjected to analysis of variance and significant means. Ensiling with poultry litter significantly ($P<0.05$) increased the color quality in T3 (light brown) which is better than T2 (deep brown), T4(brown) and T4(Dark Brown). The smell of T4 (offensive) and T1 (poor) while T3 is very pleasant. The highest pH was recorded in control (6.2) with the least in T4 (4.4). In current study, the percent preference of sheep significantly varied ($P<0.05$) from 20.1 – 33.2 % and the order of preference was T3 > T2> T1 > T4. It is concluded that desho grass ensiled within 20% to 30% poultry litter improved Crude protein (CP) content and intake by Bonga sheep when compared with control and 40% poultry level.
Keywords: silage, poultry litter, desho grass, palatability trail, Bonga, sheep

INTRODUCTION

In many tropical regions, there is inadequate and inconsistent supply of good quality pasture and fodder to support maintenance, reproduction and production of ruminant livestock throughout the year [1]. A serious constraint of livestock production in this region is inadequate year-round supply of quality feeds [2]. Scarcity of forage during the dry season and low energy density of available forage are major factors limiting the productivity of these animals [3]. These challenges have a negative impact on the quality and amount of animal protein available for human consumption in this region.

The major available feed resources in Ethiopia are natural pasture, crop residues, aftermath grazing, and agro-industrial by-products [4]. The current report of CSA [5] revealed that 56, 30 and 1.2% of the total livestock feed supply of the country is derived from grazing on natural pasture, crop residues and agro industrial byproducts respectively[6]. Desho grass is one of the indigenous forage species which need a comprehensive research in Ethiopia which used as feed for ruminants [7]. According to desho grass can be used as basal diet for local sheep with best performance than natural pasture hay-based diet but feed resources that contain less than 7% CP do not support optimum rumen fermentation [8]. Supplementation of low quality feeds with concentrate, especially that composed of grains, may not be practical because grain is the major staple diet for human beings in developing countries and expensive to afford for smallholders.

The economic value of excreta as feed supplement in balanced diets for several classes of ruminants may be 3 to 10 times greater than their value as plant nutrients [9]. In both nutritional and economic terms, poultry excreta have the highest value [10]. Two serious obstacles to the feeding of poultry excreta to livestock are pathogenic organisms and medicinal drugs. Research by Jakhmola[11] showed that poultry waste can be rendered free of pathogens by autoclaving, fumigation and dry heat alone or in combination with formaldehyde. Furthermore, other methods of processing such as ensiling [12, 13]and deep stacking [14] have been proposed.

In order to efficiently exploit the genetic potential of animal under tropical environment, there is a need to look for biologically and economically sound supplementation. It has been argued recently that the challenges posed by global warming and resource depletion [15] can best be met by developing feeding systems that make better use of locally available feed resources [16].

Objective: This study was carried out to evaluate the effect of ensiling graded level of poultry litter with desho grass (*Pennisetum pedicellatum*) on intake, preference, fermentative and nutritional characteristics of silage in case of Bonga Sheep**.**

2. Methodology

2.1 Study Location

The study was conducted in Bonga Agricultural Research Center. Located in south-western Ethiopia , Keffa Zone of the Southern Nations, Nationalities and Peoples Region upon a hill in the upper Barta valley, it has a latitude and longitude of 7°16′N 36°14′E Coordinates: 7°16′N 36°14′E with an elevation of 1,714 meters above sea level [17].

2.2 Silage Preparation

Poultry litter was collected from Bonga poultry farm. Poultry litter was screened using a 20mm metal grid to remove caked material. The screened poultry litter was allowed to dry by sun. Desho grass at the flowering stage collected from Bonga Agricultural Research center forage site, then wilted and chopped in to 2-3cm size. In prepared pit mixed materials was pressed and covered using polyethylene sheet. A thin layer of soil (2-3 cm) was placed over the plastic sheet. Silage was opened after a fermentation period of 30 days.

2.3 Treatments and experimental design

The grass and poultry litter were mixed at different grade level. Poultry litter (Pl) and desho grass (Dg) was ensiled by four treatments in three replications. Treatments include T1 (100% Dg), T2 (80%Dg+20%Pl), T3 (70% Dg+30%Pl) and T4 (60%Dg+40%Pl). The experimental design was complete randomized design (CRD).

2.4 Silage Evolution

Samples of silage were taken from each pit after 30 days for physical characteristics, pH, chemical composition and coefficient of preference (CoP). The appearance, smell, texture and color were judged by a five (5) animal nutritional expert's panel that had experience with silage making and analyzing using 0-5 scale as follows in table 1.

Table 1: Silage physical characteristics evaluation scale

Parameter	0	1	2	3	4	5
Observation	Very bad	Bad	Going bad	Moderate	Good	Excellent
Color	Very dark	Dark	Dark brown	Deep Brown	Brown	Light Brown
Smell	Offensive	Poor	Almost pleasant	Fairly pleasant	Pleasant	Very pleasant
Texture	Slimy	Very soft	Soft	Moderate firm	Firm	Very firm
pH	>6.5	6.1-6.5	5.6-6.0	4.6-5.5	4.0-4.5	<4.0

2.5 Chemical analysis

Proximate composition of silage was determined following the general procedure of AOAC [18] while detergent fibers were determined by procedure of Van Soset*et* [19]. Dry matter concentration in the silage was determined using a forced draught oven at 60^0C and values obtained were corrected for loss of volatile compounds by multiplying with the correction factor of 1.056 [20].

2.6 Palatability study

Ten Bonga sheep were used to evaluate the free choice intake of silage in a cafeteria style. All the animals were pre-conditioned to the experimental diet for a period of 3 days after animals were offered 2kg each (wet basis) of experimental diets daily for the period of 10 days. Fresh water was also offered daily on a free choice basis. Intake of silage was measured 2 hours after it was offered by deducting remnants from the feed served and animals were allowed to graze for the rest of the day. The coefficient of preference (CoP) was calculated was the ratio of individual silage intake to average intake of all the silages while percentage of preference was calculated as the ratio of individual intake to total intake multiplied by 100. The silage was considered acceptable when the CoP is greater than one while ranking was based on percentage of preference.

2.7 Statistical analysis

The experimental design adopted for this study was the completely randomized design. Data obtained were subjected to analysis of variance and significant means were separated by Duncan's multiple range tests using the procedures of SAS 9.3(2005).

3. Result and Discussion

3.1 The physical characteristics and pH of the silage

The physical characteristics and pH of the silage was presented in Table 2. Ensiling with poultry litter significantly ($P<0.05$) increased the color quality in T3 (light brown) which is better than T2 (deep brown), T4(brown) and T4(Dark Brown). The smell of T4 (offensive) and T1 (poor) while T3 is very pleasant. The inclusion of poultry litter in 40% decreases the smelling quality and there was some mold/petrification was observed in T4. The texture of T1 which had no poultry litter was soft while others (T1, T2 and T3) with different level of poultry litter were firm to very firm, showing that addition of poultry litter to desho grass enhanced the texture of the silage. This was due to the high level of structural fibers and ash in which improved the general structure of the silage.

Table 2. Physical characteristics and pH of silage

Parameter	T1	T2	T3	T4
Color	Dark Brown	Deep brown	Light brown	Dark
Smell	poor	pleasant	Very pleasant	offensive
Texture	Soft	Moderately firm	Very firm	Firm
pH	6.2	5.0	4.4	5.9

T1=control(100% dg), T2= 80%Dg+20%Pl, T3= 70% Dg+30Pl and T4=60%Dg+40%.

Table 3. Silage score (0-5 scale*) based on physical characteristics and pH value

Parameter	T1	T2	T3	T4	SEM	*P*
Color	2.1^{c}	3.9^{b}	5.4^{a}	1.5^{d}	0.10	0.03
Smell	2.5^{d}	4.8^{b}	5.0^{a}	3.9^{c}	0.13	0.02
Texture	2.6^{d}	3.8^{c}	5.3^{a}	4.6^{b}	0.12	0.03
PH	1.5^{d}	3.6^{b}	4.2^{a}	2.1^{c}	0.14	0.03
Average score	2.4	4.2	5.1	4.0		

T1=control (100% dg), T2= 80%Dg+20%Pl, T3= 70% Dg+30Pl and T4=60%Dg+40%.

The pH value of silage was significantly decreased when PL amount increased. Ensiling desho grass with poultry litter increased the pH of the resultant silage. The highest pH was recorded in control (6.2) with the least in T4 (4.4). This agrees with the findings of Rasool [22] who reported an increase in pH of sudax grass ensiled with 30% Broiler litter and 6% molasses however, the pH values obtained were lower than the ones recorded in this study. Hadjipanayiotou [23] observed a similar trend with tomato pulp and poultry litter silage. The increase in silage pH observed might be due to buffering capacity as a result of ash and ammonia from uric acid hydrolysis. The pH levels of T2 (5.0) and T3 (4.4) were at the desired level for good quality silage (5.0) and the remained treatments were above the desired level [24]. This may indicate the lack of organic acids being generated by fermentation.

3.2 Chemical composition of silage

Chemical composition of silage was presented in table 4. According to the result dry matter of there is no significant difference (P>0.05) between T1 (42.29), T2 (44.07), T3 (46.71) and T4 (48.59). The finding of current study is agreed with Al-Rokayan [25] when poultry litter was ensiled with sorghum forage in the varying proportions. The liner DM value increment of this study is similar with Flachowsky and Hennig [26].

The addition of poultry litter in 40% significantly (P<0.05) increases the crude protein of the silage when compared with other treatment groups. Crude protein increased gradually from 4.49% in control (100% Dg) to 11.75 in T4. Ngele*et* [27] treated rice straw with poultry litter at different ratios and recorded highest crude protein in ratio 50:50. The crude protein of sorghum forages ensiled with broiler litter increased with increased proportion of poultry litter [25&26]. In this study the crude fiber (CF) content is significantly declining (P<0.05) from T1(27.63), T2(15.46), T3(12.08) to T4(11.95). Rasoot [22] observed a decline in NDF, hemicelluloses and cellulose (fiber component) in sudax fodder ensiled with broiler litter. In previous study [28 & 29] also observed a similar trend. The decline in crude fiber might be due to hydrolysis of uric acid in poultry litter to ammonia which can effectively break down the lignin bond in desho grass.

Ether extract (EE) of T1, T2, T3 and T4 are 1.91%, 1.74% 1.59% and 1.23% respectively. Ether extract content of the treatments were not significantly different (p>0.05) ensiling with poultry litter lowered the EE composition of silage save for treatment 60:40 observed to be higher (p>0.05) than control. The result of this study differs from that of [30]who observed increase in EE composition of sugarcane top ensiled with broiler litter and that of Ngele [27].

Table 3. Chemical composition of desho grass ensiled with graded level of poultry litter.

Parameter	Treatment					
(%)	T1	T2	T3	T4	P(0.05)	sig.
DM	42.29^{a}	44.07^{a}	46.7^{a}	48.59^{a}	0.26	ns
CP	4.49^{d}	8.31^{c}	10.04^{b}	11.75^{a}	0.02	s
CF	27.63^{a}	15.46^{a}	12.08^{b}	11.95^{b}	0.03	s
EE	1.91^{a}	1.74^{a}	1.59^{a}	1.23^{a}	0.76	ns
Ash	13.01^{d}	15.09^{c}	17.90^{b}	19.02^{a}	0.01	s
Lactic acid	13.89^{a}	14.07^{a}	14.28^{a}	14.60^{a}	0.08	ns

T1=control (100% dg), T2= 80%Dg+20%Pl, T3= 70% Dg+30Pl and T4=60%Dg+40%, p(0.05), s=significant and ns= non significant

The ash contents of all treatments T1 (3.11%), T2 (15.09%), T3 (17.90%) and T4 (19.02) were significantly different (P<0.05). Among the treatments, the ash content was observed to increase with increased proportion of poultry litter from 3.11% in treatment T1 to 19.02 in T2. This is similar with the findings of Al-Rokayan[25] and Flachowsky [26] who observed a linear increase in ash with increased proportion of broiler litter.

The lactic acid content of T1, T2, T3 and T4 are 13.89%, 14.07%, 14.28% and 14.60% respectively. All treatments had non-significant (p>0.05) lactic acid content, suggestive of the fact that addition of poultry litter had not effect on the lactic acid content of silage. Lactic acid content of the silage is under normal standard for good silage.

3.3 Palatability

According to table 4, intake of desho grass ensiled with poultry litter significantly different (P<0.05) between treatments T1(1.3), T2(1.56), T3(1.93) and T4(1.22). In this study, CoP of T1 (1.30) and T4 (1.22) was less than 1 while T2 (1.56) and T3 (1.93) had CoP greater than 1. The significant difference (P<0.05) implication of CoP is that sheep would accept desho grass ensiled within 20% to 30% and reject silage with no poultry litter or 40% of poultry litter. This might be due to poor and offensive smell in T1 and T4 respectively (table 2). In current study, the percent preference of sheep significantly varied (P<0.05) from 20.1 – 33.2 % and the order of preference was T3 > T2> T1 > T4. This may be related to the silage texture (mouth feel) and smell which was enhanced by the addition of poultry litter. At 40% inclusion of poultry litter, the silage may become too coarse and offensive smell which decreased palatability to the Bonga sheep.

Table 4: Preference of Bonga sheep fed desho grass ensiled with different levels of poultry litter

Parameter	T1	T2	T3	T4	SEM	*p*
Intake (kg, DM)	1.30^{c}	1.56^{b}	1.93^{a}	1.22^{c}	0.08	0.03
Coefficient of preference	0.89^{c}	1.64^{b}	1.89^{a}	0.84^{c}	0.04	0.02
% Preference	22.4^{c}	23.2^{b}	33.2^{a}	20.1^{d}	1.22	0.04
Preference ranking	3rd	2nd	1st	4th	-	-

a,b,c,d: means without common superscript are different at p<0.05 T1=control (100% dg), T2= 80%Dg+20%Pl, T3= 70% Dg+30Pl and T4=60%Dg+40%.

4. Conclusion

- Poultry litter (Pl) and desho grass (Dg) was ensiled by four treatments; T1 (100% Dg), T2 (80%Dg+20%Pl), T3(70% Dg+30%Pl) and T4(60%Dg+40%Pl) in three replications. The experimental design was complete randomized design (CRD). Data obtained were subjected to analysis of variance and significant means using the procedures of SAS 9.3 (2005).
- Ensiling desho grass with 20% and 30% of poultry litter has attractive smell and normal pH level than other groups. Addition of poultry litter in grass silage significantly increased CP and ash but statistically there is no significance difference (P>0.05) on DM, EE and lactic acid.
- Intake, CoP, and preference rank of desho grass ensiled with graded level of poultry litter in T2 and T3 are significantly different (P<0.05) from other treatments.
- It is concluded that desho grass ensiled within 20% to 30% poultry litter improved CP content and intake by Bonga sheep when compared with control and 40% poultry level.

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