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EFFECT OF STAGE OF GROWTH AND ADDITIVES ON DIGESTIBILITY AND PALATABILITY OF GUINEA (*PANICUM MAXIMUM*, JACQ) GRASS SILAGE

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Abstract: Experiments were conducted to investigate the digestibility and palatability of Guinea-'A' (*Panicum maximum*, Jacq) grass silage by sheep. One month growth of Guinea was harvested and ensiled directly whereas, mature Guinea (8 weeks) was chopped into half and ensiled alone or with 5% coconut (*Cocos nucifera*, L) meal, wet basis or with 5% rice (*Oryza sativa*) bran, wet basis in 210 litre metal drums. Animals with an initial weight of 16.4 ± 2.5Kg were used and faeces were collected by means of light harness and canvas bag. Addition of coconut meal at the time of ensiling increased ($P < 0.05$) crude protein content of silage compared to mature silage without additives. Digestibility of dry matter, organic matter and crude protein were higher ($P < 0.05$) for one month old Guinea grass silage and silage prepared with the addition of coconut meal compared to other two treatments. Addition of coconut meal at the time of ensiling also increased ($P < 0.05$) the dry matter and organic matter intake of silage by sheep. The data indicate that the nutritive value and intake of silage prepared from mature, chopped Guinea grass with 5% coconut meal, wet basis was similar to that of silage prepared from 1 month old Guinea grass.

Key words : Guinea grass, silage, additives, digestibility, palatability, growth stage.

INTRODUCTION

Silage making is not a common practice in tropical countries. However, silage has been made with varying success and with varying capital outlay in towers, clamps, pits and trenches in Government Agricultural Stations. Several research workers have reported the characteristic features of silage made from tropical herbage plants .[1-4] According to these workers, the factors eg. lactic acid, pH, concentration of NH_3 and butyric acid that may be responsible for preserving of tropical silage have not been established. However, they have concluded that this process is not related with the production of high concentration of lactic acid.[1-4]

It is common knowledge that the digestibility of forage decreases with the maturity in tropical forages. It is also interesting to note that the chopping increased the digestibility and voluntary feed intake of temperate forage silage by sheep.[5-9] Published information on the effect of stage of growth and additives on digestibility and palatability of tropical grass silage is lacking. The objective of this study was to investigate the effect of stage of growth and additives on digestibility and palatability of Guinea - 'A' grass (*Panicum maximum*, Jacq) silage to sheep.

METHODS AND MATERIALS

Preparation of Silage

An established stand of Guinea 'A' grass from the Veterinary Research Institute, Gannoruwa, longitude 80^0 29'E, latitude 7^0 13'N, elevation 485 m was used. The forage was harvested at two periods *viz.*, 1 month after foliage regrowth and after flowering (8 weeks). The herbage was handcut to 12.5 cm above ground level. The forage harvested at 1 month after foliage regrowth (about 30 cm in length) was ensiled alone (Treatment 1) whereas forage harvested after flowering was chopped into half (about 45 cm in length) and divided into 3 equal portions. One portion of the material was ensiled alone (Treatment 2) and the other two portions were ensiled either with 5% coconut (*Cocos nucifera*, L) meal, wet basis (Treatment 3) or with 5% rice (*Oryza sativa*) bran, wet basis (Treatment 4). Several samples of the grass were taken while filling each silo for subsequent analysis. The grass for ensiling was firmly packed into 210 litre steel drums double lined with 0.08mm (1000 gauge) polyethylene bags. An attempt was made to remove as much air above the ensiled mass as possible before each polyethylene bag was sealed. The bags were sealed with plastic coated wire and the drums were stored upright in an open barn from harvest until the initiation of sheep feeding trials (about 2 months).

Digestibility Studies

An experiment was conducted with ten sheep (about 4-5 months of age) with an initial weight of 16.4 ± 2.5 Kg. The experiment consisted of two periods, at each period the sheep were placed in three blocks by weight. Sheep within each block were allocated at random to the silages with restriction that no animal would receive the same silage in both periods. The allocation was in a such way that in period 1, treatment's 1 and 2 had three animals each and treatment's 3 and 4 had two animals each. In period 2, treatment's 1 and 2 had two animals each and treatment's 3 and 4 had three animals each. As such, at the end of two periods, five individual animal data were obtained for each treatment. The design used was an incomplete randomized block design.

All sheep were treated for internal parasites with 'Nilworm'. The sheep were fed the silages and 55g of mineral-vitamin mixture twice daily (6 and 18 h) in equal amounts. Silages and water were provided *ad-libitum*. The sheep were housed in individual 1.22 x 1.07 m stalls in a semi-closed barn. Each period consisted of a 14 day preliminary followed by a 7 day measurement period. Canvas bags held by harnesses as described by Fontenot and Hopkins[10] were used to collect faeces. Beginning 2 days before the start until 2 days prior to the end of the 7 days collection period, the silages were sampled at each feeding. The silage samples were frozen daily in doubled plastic bags and composited at the end of the period. Refusals and faeces were collected twice daily and dried at 55^0C to a constant weight for dry matter determination, allowed to air equilibrate, then ground to pass through a 1 mm screen. Kjeldhal nitrogen was determined on faeces, refusals and silage samples.[11] All samples were analysed for dry matter (DM), neutral detergent fibre (NDF),[12] acid detergent fibre (ADF),[13] lignin

and cellulose.[14] All animals were weighed before and after the period. The average of the initial and final weights was used to determine metabolic size ($W^{0.75}$ kg) on which dry matter intake was calculated.

Statistical Analysis

Statistical analysis were performed using the analysis of variance procedure for an incomplete randomized block design[15] and treatments were compared using least significant difference values.

RESULTS

Table 1 presents the composition of Guinea grass, coconut meal and rice bran used in the preparation of silage. Crude protein and water soluble carbohydrate content of coconut meal were very much higher whereas, NDF, ADF, lignin and silica were lower compared to grasses and rice bran used in the preparation of silages. Crude protein content of 1 month Guinea grass was much higher whereas cell wall fractions were lower compared to 2 month Guinea grass. The composition of silage fed in sheep digestibility experiment is shown in Table 2. Addition of coconut meal at the time of ensiling increased ($P < 0.05$) the crude protein content of silage when compared with the mature silage without additives (8.2% vs 6.2%). However, there was no significant difference between the 1 month old Guinea grass silage and silage prepared with the addition of coconut meal.

Table 1: Composition of Guinea grass, coconut meal and rice bran (% of dry matter) used in the preparation of silage.

Component	Guinea grass		Coconut meal	Rice bran
	1-month	2-months		
Dry matter	91.5	93.0	86.0	87.4
Crude protein	14.1	7.8	23.1	9.5
Ether extract	2.3	2.3	10.9	1.5
Cell wall fractions :				
NDF	74.7	80.8	48.9	56.2
ADF	48.4	52.6	29.9	47.4
Cellulose	34.4	41.2	24.7	23.1
Hemicellulose	26.3	28.2	19.0	8.8
Lignin	10.1	11.5	4.9	11.5
Ash	10.1	9.8	7.2	21.5
Silica	3.8	4.7	0.9	10.8
Water soluble carbohydrates	4.9	6.1	12.7	7.0

NDF - neutral detergent fibre
ADF - acid detergent fibre

Table 2: Composition and cell wall fractions of silage fed in sheep digestibility and palatability trials (% of dry matter)[a].

Component	Growth period			
	1-month	2-months		
	No additives	No additives	With coconut meal	With rice bran
Dry matter	92.7[b]	94.9[c]	95.9[c]	94.4[c]
Crude protein	8.9[d]	6.2[b]	8.2[c,d]	7.6[c]
Cell wall fractions				
NDF	67.5[b]	71.9[c]	68.0[b]	66.8[b]
ADF	52.0	54.4	50.7	51.5
Cellulose	36.8[c,d]	37.8[d]	35.9[b,c]	34.9[b]
Hemicellulose	15.5	17.5	18.8	15.3
Lignin	10.5	11.0	8.9	10.0

[a] Dry basis
Different superscripts in a row are significantly different ($P < 0.05$).

Dry matter and organic matter intake of silage per metabolic body weight of sheep were much higher ($P < 0.05$) for silage prepared with coconut meal compared to other three treatments (Table 3). Table 4 presents the digestibility of Guinea - 'A' silage by sheep. Digestibility of dry matter, organic matter and crude protein were higher ($P < 0.05$) for 1 month old Guinea grass silage compared to mature grass silage without additives. Furthermore, digestibility of dry matter, organic matter and crude protein were higher ($P < 0.05$) for 1 month old grass silage and silage prepared with the addition of coconut meal compared to other two treatments (2 month old grass silage control and 2 month old grass silage with rice bran). Addition of coconut meal at the time of ensiling increased ($P < 0.05$) the organic matter digestibility of the ensiled product by 4.5 digestibility units compared to mature silage without additives. However, addition of coconut meal at the time of ensiling increased ($P < 0.05$) the crude protein digestibility of the ensiled product by 9.7 digestibility units compared to the mature grass silage without additives. Addition of rice bran at the time of ensiling decreased ($P < 0.05$) the dry matter and organic matter digestibility of silage compared with mature grass silage without additives (Table 4). Addition of rice bran at the time of ensiling also decreased ($P < 0.05$) the digestibility of cell wall fractions.

Table 3: Dry matter and organic matter intake of sheep fed Guinea - 'A' silage.[a]

Component	Growth period			
	1-month	2-months		
	No additives	No additives	With coconut meal	With rice bran
Dry matter intake				
g/day	497^{b}	516^{b,c}	602^{d}	571^{c,d}
g/W$^{0.75}$ kg/day	60^{b}	61^{b}	68^{c}	66^{b,c}
Organic matter intake				
g/day	437	450	527	492
g/W$^{0.75}$ kg/day	53^{b}	53^{b}	59^{c}	57^{b,c}

[a] Mean of five animals.
Different superscripts in a row are significantly different ($P < 0.05$).

Table 4: Digestibility co-efficients of Guinea - 'A' silage (%)[a].

Component	Growth period			
	1-month	2-months		
	No additives	No additives	With coconut meal	With rice bran
Dry matter	51.5^{d}	45.2^{c}	50.8^{d}	42.3^{b}
Organic matter	55.7^{d}	51.3^{c}	55.8^{d}	48.2^{b}
DOMD('D' value)	48.9^{d}	44.7^{c}	48.8^{d}	41.5^{b}
Crude protein	52.8^{d}	44.5^{b}	54.2^{c}	45.1^{b}
Cell wall fractions:				
NDF	50.3^{d}	45.4^{c}	47.5^{c,d}	34.7^{b}
ADF	48.3^{d}	40.4^{c}	48.3^{d}	26.3^{b}
Cellulose	60.0^{c,d}	57.0^{c}	63.2^{d}	49.2^{b}
Hemicellulose	65.7^{c}	58.9^{b}	64.3^{c}	57.1^{b}

[a] Mean of five animals
Different superscripts in a row are significantly different ($P < 0.05$).

DISCUSSION

Addition of coconut meal and rice bran at the time of ensiling increased the crude protein content of silage compared with mature silage without additives. This increase in crude protein content is associated with the higher crude protein content of these additives (Table 1). Dry matter and organic matter intake of silage with coconut meal was higher compared to 1 month and 2 month grass silage without additives (Table 3). However, there was no difference in intake between silages with coconut meal and rice bran. This may be due to the better fermentation improving the palatability of these silages. The intake of mature forage silage without additives was almost similar to that of unchopped

1 month old silage. This seems surprising in view of the effect of stage of maturity on the fermentation quality of silage. However, Anderson[5] has shown that there was no significant effect of stage of maturity on silage intake by sheep. According to Table 4, digestibility of dry matter, organic matter, crude protein and cell wall fractions were higher for 1 month old Guinea grass silage compared to mature grass silage without additives. It is generally accepted that the digestibility of forage decreases with increased maturity.[2,16,17] Digestibility of dry matter, organic matter and crude protein were higher for 1 month old grass silage and silage prepared with the addition of coconut meal compared to other two treatments (2 month old grass silage control and 2 month old grass silage with rice bran). The increased digestibility after adding coconut meal during ensiling may be due to improved fermentation. The crude protein content of coconut meal may also increase nitrogen available for microbial growth that in turn may improve the digestibility.

In conclusion, the results presented here indicate that the stage of maturity of the forage significantly affect the digestibility of silage but had no effect on the voluntary feed intake. Furthermore, addition of coconut meal at the time of ensiling increased the digestibility of silage. The data indicate that the nutritive value and intake of silage of mature, chopped Guinea grass with 5% coconut meal, wet basis, was similar to that of silage prepared from 1 month old unchopped Guinea grass.

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