



Nutritive value of three fodder species at different stages of maturity

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Abstract

An experiment was conducted to compare the nutritive value of three fodder species: Para (*Brachiaria mutica* Stapf.), German (*Echinochloa crusgalli* L.) and Dhal (*Hymenachne pseudointerrupta* C. Muell) at three different stages of maturity. The grasses were cultivated in 9 plots arranged in completely randomized design having three replications for each fodder. The area of each unit plot was 6 m x 6 m. Number of cuttings were 16,000 /hectare, where plant to plant distance was 16 cm and row to row distance was 16 cm. Equal amount of organic and chemical fertilizer were applied in all stages of maturity. The fodders were first harvested after 60 d of planting, second and third harvests were done after successive 60 d of re-growth. There was highly significant ($p < 0.01$) variation on DM content among the three fodders in the first and third cuttings and significant ($p < 0.05$) difference was observed in the second cutting. There was also significant ($p < 0.01$) effect on Ash content in the first cutting. Significant difference at 1% and 5% level of probability was observed in NFE content in the third and second cutting, respectively. Crude fiber (CF) content was only significant ($p < 0.05$) in the third cutting. Among the three grasses German grass showed higher value in the proximate components except EE and CP (non-significant) than other grasses. Para, German and Dhal grasses were differed insignificantly ($p > 0.05$) in terms of IVOMD and ME content in all stages of maturity. The highest values (58.35, 59.97 and 61.92 %) of IVOMD were found in German grass compared to those of Para and Dhal grasses in all stages of maturity. The highest ME values (8.18 and 8.42 MJ/kg DM) were also found in German grass than other grasses in the second and third stages of maturity. From the above findings it may be concluded that among the three fodders, German grass showed the best result in respect of nutritive value.

Key words: Fodders, stages of maturity, comparison, nutritive value

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Introduction

Bangladesh has an area of 1, 47,570 sq. Km with net cropped area of 1.2 million hectares. There is 0.03 million hectares of cultivable land lying fallow and 0.29 million hectare is unavailable for cultivation. About 80% of the total cultivable land is used for cultivation of cereal crops and only 0.03% for cultivation of fodder crops and the rest for other crops (BBS 2009). Scarcity of animal feeds and fodder has been identified as a major constraint for the development of livestock in Bangladesh. In Bangladesh, cattle live mostly on straw based ration. So livestock development in Bangladesh is mainly depending upon the improvement of animal nutrition through improved feeding and availability of fodder. In this situation, it is of prime consideration to introduce suitable high yielding varieties of perennial fodder crops to the farmers (Ali et al. 1987). On a straw-based diet, supplementation of small amount of green grass is often

recommended for optimization of rumen environment (Preston and Leng, 1987) or even to meet the maintenance requirement of animal (Ranjhan and Singh 1993). Para, German, and Dhal grass are three important fodders suitable for production in the context of Bangladesh climate. The most significant feature of these three fodders is that, they can grow both high and low lands or in water logging condition (Khan et al. 2009). But no research work was undertaken on comparison between these fodders in respect of productivity, nutritive value etc. To meet up the increasing need of green fodder, it is essential to find out some potential fodder germplasm and recommend for extensive cultivation by the farmers for feeding their productive animals. The experiment was conducted to compare the nutritive of above three fodders at different stages of maturity.

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Materials and Methods

Location of experiment

The experiment was conducted at the Shahjalal Animal Nutrition Field Laboratory, Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh. The chemical analysis and the *in-vitro* organic matter digestibility of fodder samples were done in the Animal Nutrition Analytical Laboratory. The climate of the experimental site was characterized by scanty rain and higher temperature during the whole experimental period. The monthly climatological data were recorded. The experimental site was in the old Brahmaputra Flood Plain Agro-ecological zone having non-calcareous dark, gray flood plain. The soil was silt loam texture, neutral in reaction (pH 7.0) and contained 0.12% N, 0.07% P and 1.76% organic matter.

The experiment was laid out in a Completely Randomized Design (CRD) with three replications in each treatment. There were nine experimental plots each having an area of 36 m² with a distance of 0.16 m from plot to plot. The land was prepared by ploughing and cross ploughing four times with bullock-drawn country plough. German, Para and Dhal grass cuttings were collected from the experimental plots of the Department of Animal Nutrition, Bangladesh Agricultural University, Mymensingh. Length of cuttings was 16-18 cm and contained at least 3 nodes in its sheath. Cuttings of grasses were planted by line sowing keeping one node under the soil with 45 ° angle and maintaining a row and plant spacing of 16 cm with a cutting rate of 16,000 cuttings per hectare. At the time of land preparation 130 t/ha cow dung was applied. After 22 d of planting, cow dung was applied at the rate of 14.4 t/ha. After 30 d of first cutting, cow dung was again applied at the rate of 14.4 t/ha with 0.069 ton of urea/ha. Again after 30 d of 2nd cutting, 14.4 t/ha of cow dung and 0.097 ton of urea/ha were applied. Fertilizer doses were applied in broadcast method. Intercultural operations were done as and when necessary.

Harvesting of fodders

Fodders were harvested above the ground level (3-5 cm) after 60 d of planting. After 60 d of 1st cutting, the green fodder was harvested again. Then third time green fodder was harvested after 60 d of 2nd cutting and in every cutting, sample was taken for chemical analysis.

Collection and preparation of samples

The representative grass samples were collected from each treatment at the time of harvesting. Freshly harvesting plant samples were chopped into small pieces up to 1-2 cm, weighed and sun dried for 2-3 d. After proper sun drying the samples were kept in a drying oven at a temperature of 105°C for determination of dry matter. Then the dried samples were ground through 40 mesh sieve. After grinding, the samples were kept into polythene bag, labeled and stored for chemical analysis.

Chemical Analysis

Samples of each treatment were subjected to chemical analysis for determination of organic matter following the methods of AOAC (2004).

In-vitro organic matter digestibility and Metabolizable Energy

Approximately two hundred milligrams of air dried sample (Pass to 1 mm sieve) was weighed into 100 ml calibrated syringes and inoculated with rumen liquor according to Menke et al. (1979). Rumen liquor was collected from rumen cannulated cattle before offering feed and water in the morning and was collected through a cannula with the help of specially made glass fiber probe with a large number of pores drilled in them and covered with fine nylon cloth (pore size generally 50-60 µm). For representative samples of rumen liquor, probe was placed at five different sites in the rumen. Parallel incubation for measurement of gas production, without feed sample (blank), with 200 mg hay + starch mixture, with 200 mg hay, both as reference standards were also done. Incubations were continued for 24 hours. Gas production was recorded after 24 hours. By using chemical composition and net gas production (corrected for blank and the appropriate reference standards) at 24 hrs incubation (GP, ml), digestibility of organic matter (IVOMD) and metabolizable energy (ME, MJ/kg DM) were calculated using the following equations proposed by Menke and steingass (1988).

$$IVOMD = 16.49 + 0.9042GP + 0.0492CP + 0.0387TA$$

$$ME = 2.20 + 0.1357GP + 0.0057CP + 0.000286EE$$

where, IVOMD=*in-vitro* organic matter digestibility (%); ME=metabolizable energy (MJ/kg DM); GP=gas production is expressed in ml/200mg DM; CP=crude protein (g/kg DM); TA=total ash (g/kg DM); EE=ether extract (g/kg DM)

Nutritive value of fodder

Statistical analysis

The data were analyzed using the "MSTAT" statistical program in a Completely Randomized Design (CRD), and differences among the treatment means were determined by the Least Significant Difference (LSD) method (Gomez and Gomez, 1984).

Proximate components

The proximate composition (g/100g DM) of Para, German and Dhal grass cultivated in same level of cow dung and nitrogen fertilizer are presented in Table 1.

Results and Discussion

Dry matter (DM)

Dry matter content of Para, German and Dhal grasses are presented in Table 1, 2 and 3 at different stages of maturity. The dry matter content of fodders were highly significant ($p < 0.01$) in the first and second stages of maturity and significant ($p < 0.05$) in the third stage of maturity. The highest DM content was found in German grass in all stages of maturity. This may be due to rapid growth of plants as indicated from the rapid increase in different parts of the forage plant. According to Sen et al. (1978) dry matter (g/100 g fresh sample) of Napier grass and Para grass were 30.10 and 40.74 %, respectively which are higher than the present study. Jesmin (2009) reported that dry matter content of Para and German were 21.38 ± 0.40 and 23.14 ± 0.64 g/100g DM, respectively which are nearly close to this study.

Table 1. Chemical composition (g/100 g DM) of three fodders at first cutting

Fodders Name	DM fresh	CP	CF	EE	ASH	NFE
Para	18.4 ^c ± 1.1	8.9 ± 0.8	31.5 ± 1.8	2.10 ± 0.4	9.4 ^b ± 0.3	47.9 ± 1.9
German	19.2 ^a ± 0.8	9.1 ± 0.5	30.9 ± 2.3	2.23 ± 0.3	10.8 ^a ± 0.51	46.8 ± 2.8
Dhal	18.8 ^b ± 1.0	8.9 ± 0.4	30.2 ± 1.5	2.20 ± 0.5	10.4 ^a ± 0.3	48.2 ± 1.2
LS	**	NS	NS	NS	**	NS

Mean values with different superscripts differ significantly; LS, level of significance; NS, non significant; *, $p < 0.05$; **, $p < 0.01$

Table 2. Chemical composition (g/100 g DM) of three fodders at second cutting

Fodders Name	DM fresh	CP	CF	EE	ASH	NFE
Para	18.9 ^b ± 0.8	8.1 ± 0.5	36.0 ± 1.6	3.01 ± 0.7	10.3 ± 0.1	42.5 ^b ± 2.3
German	21.1 ^a ± 2.9	8.2 ± 0.3	34.4 ± 1.2	2.75 ± 0.2	10.8 ± 0.6	43.7 ^b ± 0.5
Dhal	19.6 ^b ± 1.9	7.9 ± 0.4	34.1 ± 1.7	2.58 ± 0.5	10.8 ± 0.6	44.4 ^a ± 2.6
LS	*	NS	NS	NS	NS	*

Mean values with different superscripts differ significantly; LS, level of significance; NS, non significant; *, $p < 0.05$

Table 3. Chemical composition (g/100 g DM) of three fodders at third cutting

Fodder Name	DM fresh	CP	CF	EE	ASH	NFE
Para	20.0 ^c ± 1.2	7.8 ± 0.4	40.9 ^a ± 1.6	3.6 ± 0.8	11 ± 0.4	36.7 ^b ± 1.5
German	21.6 ^a ± 1.5	7.5 ± 0.5	38.0 ^b ± 0.8	3.1 ± 0.1	11.1 ± 0.5	40.1 ^a ± 1.0
Dhal	20.5 ^b ± 1.1	7.6 ± 0.5	36.1 ^c ± 1.0	3.8 ± 0.1	11.3 ± 0.4	41.2 ^a ± 1.5
LS	**	NS	*	NS	NS	**

Mean values with different superscripts differ significantly; LS, level of significance; NS, non significant; *, $p < 0.05$; **, $p < 0.01$

Crude protein (CP)

The CP content of Para, German and Dhal grass were 8.93 ± 0.83 , 9.13 ± 0.49 , 8.89 ± 0.43 g/100g DM, 8.12 ± 0.54 , 8.2 ± 0.33 , 7.97 ± 0.42 g/100g DM and 7.83 ± 0.38 , 7.51 ± 0.49 , 7.55 ± 0.49 g/100 g DM in the first, second and third cuttings respectively. However, non significant differences in CP content between Para, German and Dhal grass were noted in all stages of maturity. But the highest CP content was found in German grass compared to the other grasses in first and second stages of maturity. And in third cutting CP content of all grasses nearly similar to each other. Verma and Singh (1987) reported that significant increase in CP content might be due to rapid synthesis of carbohydrates and their conversion to protein and protoplasm leaving relatively smaller portion for cell wall synthesis. Similar responses were also obtained in different fodder species by Targas and Urrea (1985), Tudsri et al. (1999), Lee et al (2000), Singh et al. (2000) and Johnson et al. (2001). Haque and Stem (1993) reported that CP content of Para and maize were 10.80 and 7.10% respectively which are nearly

similar to those of the present study. The present study also similar to the findings of Jesmin (2009) who found that CP content of Para and German grasses were 9.83 ± 0.67 and 10.79 ± 0.85 .

Crude fiber (CF)

Crude fiber content differs at 5% level of significance only in the third cutting among the three fodders. Crude fiber (CF) content of Para, German and Dhal grasses were statistically non significant in first and second stages of maturity. Similar results were also obtained by El-Hattab and Harb (1992) in hybrid Sorghum-Sudan grass. The results were also similar with the findings reported by Milked et al. (1994). Significantly ($p < 0.05$) higher CF content of Para grass was found in third cutting. This results were similar with the findings of Jesmin (2009) working with the different non legume fodder where Para grass was found to be higher CF content than German grass.

Ether extracts (EE)

The values of EE content of Para, German and Dhal grass at different stages of maturity are presented in Table 1. The values of EE content of three treatment grasses were statistically non significant. These values are in agreement with the findings of Jesmin (2009) who worked with Para and German grass and found EE value 2.68 ± 0.28 and 2.64 ± 0.18 . The results were also similar with the earlier investigation by Saha et al. (2001). Ether extract content of Para grass in second cutting (3.01%) is similar to 2.9% (Sen et al. 1978) and not similar to 2.34% (Haque and Stem 1993).

Ash

The average ash contents of Para, German and Dhal grass were 9.40 ± 0.25 , 10.78 ± 0.51 , 10.43 ± 0.32 g/100 g DM in the first cutting, 10.32 ± 0.17 , 10.81 ± 0.68 , 10.85 ± 0.65 g/100 g

DM in the second cutting and 11.01 ± 0.41 , 11.14 ± 0.57 , 11.32 ± 0.47 g/100 g DM in the third cutting respectively. Among all the grasses, German grass showed higher ash content than other grasses. The values of different grasses were significantly ($p < 0.01$) differed in the first cutting only. This result was nearly similar with the findings of Khanum et al. (2007) who found the total ash content of German grass was 13.40%. The result was also similar with Jesmin (2009) who worked with the seven non legume fodder and found significant ($p < 0.01$) difference in total ash content among them. Similar results were also found by Hannan (2004) and Malak (2005) both in German grass and Mondol (2008) in Dhal grass.

Nitrogen free extract

The values for NFE content of Para, German and Dhal grass were 47.99 ± 1.9 , 46.89 ± 2.89 , 48.22 ± 1.28 g/100 g DM in first cutting, 42.54 ± 2.32 , 43.77 ± 0.53 , 44.49 ± 2.6 g/100 g DM in second cutting and 36.71 ± 1.54 , 40.19 ± 1.07 , 41.2 ± 1.51 g/100 g DM in third cutting, respectively. Among the treatment no significant difference was observed in first cutting but in second cutting difference was significant at 5% level of significance and highly significant ($p < 0.01$) in the third stages of maturity. It was observed from the results that NFE content of these treatments successively decrease with stages of maturity of fodders. However the present findings are nearlly similar with the research conducted by Malak (2005) who worked with the German grass and found lower NFE content at different stages of maturity. Similar results also observed by Mohiuddin (2002) who worked with oat fodder.

In vitro organic matter digestibility (IVOMD)

In-vitro organic matter digestibility (IVOMD) of three fodders is presented in Table 4.

Table: 4. *In-vitro* organic matter digestibility (IVOMD) and Metabolizable energy (ME) content of three fodders

Fodders Name	First cutting		Second cutting		Third cutting	
	IVOMD (%)	ME (MJ/kg DM)	IVOMD (%)	ME (MJ/kg DM)	IVOMD (%)	ME (MJ/kg DM)
Para	57.18 ± 0.74	7.87 ± 0.36	58.58 ± 1.4	8.04 ± 0.31	58.65 ± 1.54	8.10 ± 0.29
German	58.35 ± 1.00	7.98 ± 0.35	59.97 ± 2.18	8.18 ± 0.32	60.00 ± 2.51	8.16 ± 0.37
Dhal	57.64 ± 2.20	8.02 ± 0.08	59.27 ± 0.90	8.11 ± 0.15	59.40 ± 0.61	8.08 ± 0.06
Level of sig.	NS	NS	NS	NS	NS	NS

IVOMD, in-vitro organic matter digestibility; ME, metabolizable energy; NS, non significant

Nutritive value of fodder

It has been observed from Table 4 that there was no significant ($p > 0.05$) difference among the treatments. However, increasing rate of IVOMD showed by all the treatment grasses. Out of three grasses German grass showed higher IVOMD in all stages of maturity. Similar results were also observed by Malak (2005) and Pervin (2004) worked with German grass. Johnson et al. (2001) reported that applying different doses of N fertilizer on Star grass and Bermuda grass linearly increased in IVOMD of both grasses. In this study, Para grass gave more IVOMD (57.88%) in the first stage of maturity than 42.89% (Khanum et al. 2007) in Pakistan. In this study, IVOMD of Dhal fodder (57.64%) is similar to the Napier fodder 57.6% (Khandaker and Uddin 2002). IVOMD of German fodder (59.97%) in the second stage of maturity is similar to 59.63% (Jesmin 2009).

Metabolizable energy

Metabolizable energy (ME) contents of three fodders are presented in Table 2. There was no significant difference in ME content between Para, German and Dhal grasses. But German fodder showed slightly higher ME content than other treatment grasses. This might be due to the higher response of German grass to the increasing level of nitrogen than other fodders. The present findings is in agreement with the results of Jesmin (2009) who worked with seven non legume fodder and found higher ME content of German grass (7.89 MJ/kg DM) than Para grass (7.68 MJ/kg DM).

Conclusion

The result concluded that the quality of three fodders were nearly similar. In respect of nutritive value, German grass showed best result. Therefore, it may be concluded that German, Para and Dhal fodder is suitable for animal production but German fodder is more suitable among the three fodders.

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