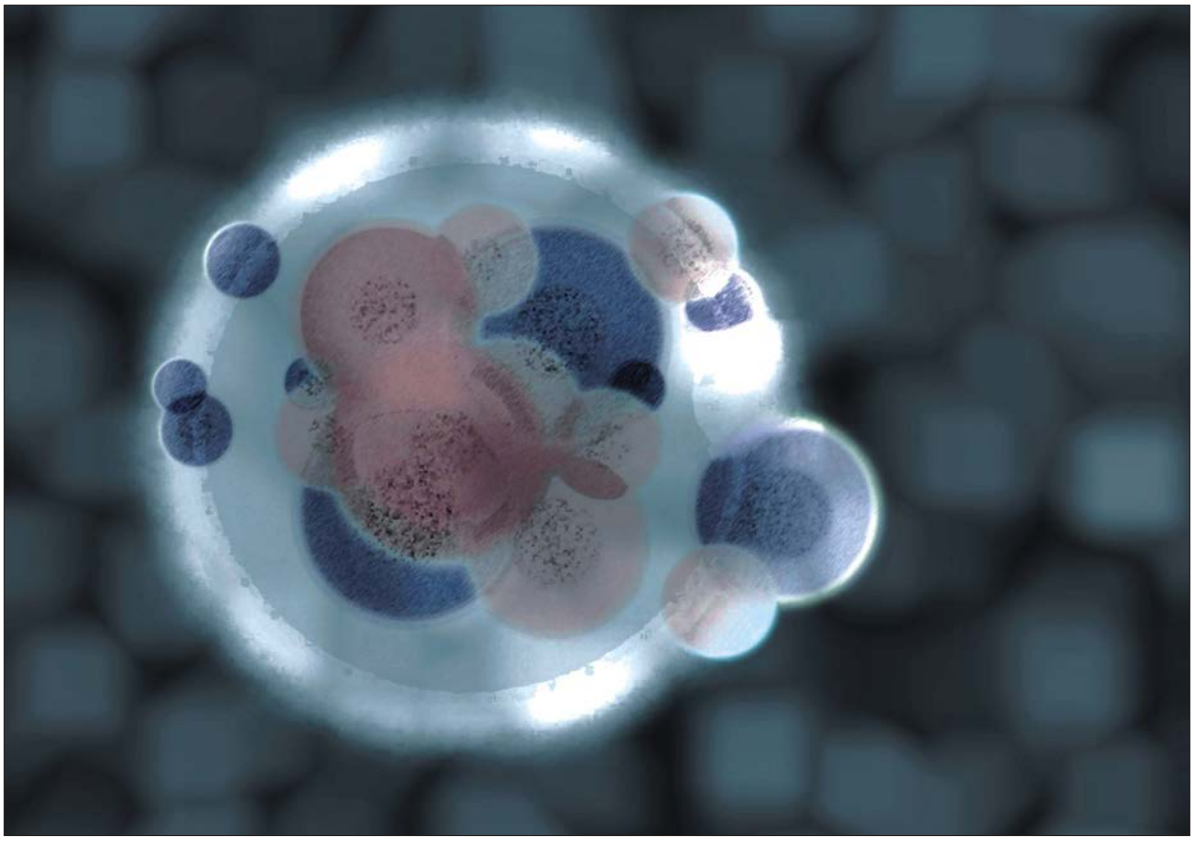

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Degradation Characteristics of Crude Protein and Crude Fibre of Jumbo Grass Grown in Different Nitrogen Fertilizer Doses

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Abstract: The study was conducted in the Department of Animal Nutrition, Bangladesh Agricultural University with an aim to assess the degradability of crude protein (CP) and crude fibre (CF) of Jumbo grass grown in four different doses of nitrogen (N) fertilizer. The four doses of N fertilizer were 0, 50, 100 and 150 kg urea ha^{-1} in a Completely Randomized Design having four replications in each treatment. The unit plot size of each replicate was 4×4 m^2. The fodder was harvested at the pre flowering stage at 68 days after sowing for first cutting. Four adult male cattle of about 170 kg live weight and about four years of age, fitted with permanent rumen canula, were used for the experiment. Approximately 3 g of each ground sample was placed in nylon bag separately for ruminal incubation. The size of the bag was 7×5 cm^2 with pore size of 60 μm. The bags with samples were incubated for the period of 2, 6, 12, 24, 48 and 72 h in the rumen. The bags with contents were removed from rumen and dried in an oven at 100°C for complete removal of moisture. The residues were analyzed for crude protein (CP) and crude fibre (CF) estimation. The disappearance values were obtained by difference in weight of the sample before and after incubation. From the percentage of disappearance data, the degradation characteristics were calculated by using the NAWAY computer programme. The results of the study showed that the effective degradability of crude protein (EDCP) of the fodder increased by increasing the N fertilizer doses while effective degradability of crude fibre (EDCF) remain unchanged. Due to fertilization the values of potential degradable fractions '(a+b)' decreases for CF and this value remain unchanged for CP. Rate constant (c value) was increased due to N fertilizer for both CP and CF.

Key words: Degradation, crude protein, crude fibre, grass

INTRODUCTION

Effective degradability, rate and extent of digestion in the rumen are important characteristics of forage digestion in ruminants. Such characteristics can be used to predict the nutritive value more accurately and compare the utility of forages in the diets for ruminants[1]. It is therefore, very important to determine the degradability and digestion of different feed ingredients, which are grown and used in different locations. Ørskov *et al.*[2] observed that the nylon bag technique was not only a powerful tool for indexing the relative degradabilities of feedstuffs, but that it may also be used to study rumen processes, as it is possible to vary the factors within the bag, or within the rumen.

Jumbo grass is a hybrid of sorghum (*Sorghum bicolor*) that is a perennial grass. Depending on soil fertility and application of fertilizer, dry matter, crude protein and crude fibre yields vary. Incubation of feeds in nylon bags in the rumen of fistulated ruminants has been used to determine the extent to which the protein fraction of feeds is degraded in the rumen[3,4]. However, there is limited information available on characteristics of crude protein and crude fibre degradation of Jumbo grass in the rumen with special reference to Bangladesh. Therefore, the present study was undertaken to assess the degradation characteristics of crude protein and crude fibre of Jumbo grass grown in different doses of nitrogen fertilizer.

MATERIALS AND METHODS

Cultivation of jumbo fodder: The experiment was conducted at the field laboratory, Department of Animal Nutrition, Bangladesh Agricultural University,

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Mymensingh during the period from May 1999 to September 1999. The experiment was conducted in Completely Randomized Design comprised of 4 nitrogen (N) levels viz., 0, 50, 100 and 150 kg urea ha^{-1}. Each treatment was replicated four times. Size of each experimental plot was 4×4 m^2. Phosphorus fertilizer (P_2O_5) in form of triple super phosphate (TSP) and murate of potash (MP) was applied at a rate of 50 kg ha^{-1} during land preparation. Fifty percent of the required N fertilizer of different doses was applied before sowing in the form of urea and remaining 50% was applied after 5 weeks of sowing as top dressing. All the plots received a basal dose of 20 q ha^{-1} of cowdung. The seeds were sown in rows by line sowing method maintaining the distance of 25 and 5 cm for row-to-row and plant-to-plant, respectively. The seed rate was 50 kg ha^{-1}. Weeding was done once during the experimental period. No irrigation and insecticides were used. Jumbo grass in each plot was harvested at the pre flowering stage (68 days after sowing) and green fodder yield was recorded.

Samples collection and chemical analysis: During harvesting, the representative samples of Jumbo grass were collected at random from each treatment plot. Samples of the whole plant of Jumbo grass for different treatments were subjected to chemical analysis for the determination of crude protein (CP) and crude fibre (CF) contents following the methods of AOAC[5]. The incubated feeds were also subjected to chemical analysis for determination of CP and CF.

***In situ* degradability study:** Four adult male cattle of about 170 kg live weight and about four years of age, fitted with permanent rumen canula, were used for the experiment. The animals were kept in individual pen under close observation and under appropriate hygienic condition. The degradability of Jumbo grass from different fertilizer treatments were determined according to the method of Mehrez and Ørskov[6]. Approximately 3 g of each ground sample was placed in nylon bag separately for ruminal incubation. The size of the bag was 7×5 cm^2 with pore size of 60 μm. After placing the samples in the bags, the neck of each bag was tied tightly with the help of string and then they were again tied closely with a piece of plastic tubing one after another in such an arrangement that the bag to be removed after 72 h incubation were tied at the lower most end and thereafter those for 48, 24, 12, 6 and 2 h sequentially towards the upper direction of the tubing. This was done in order to make easy withdrawal of bags at different time intervals with minimum disturbance of fermentation. The bags were placed into the rumen through the rumen canula and the upper end of the nylon string was kept outside. The bags with samples were incubated for the period of 2, 6, 12, 24, 48 and 72 h in the rumen. After the assigned incubation period bags were removed form the rumen one after another through the rumen canula and then transferred to the laboratory. Bags were washed under gentle stream of tap water until the dirt and rumen stuff sticking with the bags were clear. The bags with contents were then dried in an oven at 100°C for complete removal of moisture. The residues were analyzed for determination of crude protein (CP) and crude fibre (CF) content. The disappearance values were obtained by difference in weight of the sample before and after incubation.

Calculations: From the percentage of disappearance data, the degradation characteristics were calculated by using the NAWAY computer programme developed by McDonald[7] with the following exponential model:

$$P = a+b\ (1-e^{-ct})$$

Where:
P = Rumen degradation of time t
a = Rapidly soluble fraction
b = Slowly degradable fraction
c = Fractional rate constant at which b will be degraded
t = Incubation time
In addition, (a+b) shows the value of rumen potential degradability.

The effective degradability of crude protein and crude fibre were calculated from the rumen outflow rate (k) and the constants 'a', 'b' and 'c' from the above model[8]. K was calculated on 0.02 h^{-1} using the equation:

$$P = a+b*c/\ (c+k\ *\ Exp\ (-\ (c+k)\ *\ T)$$

Where, k is the estimated rate of outflow from the rumen and T is the time.

Statistical analysis: Data were analyzed using MSTAT-C statistical programme for a completely randomized design and differences among the treatment means were determined by the least significant difference method[8].

RESULTS AND DISCUSSION

Crude protein degradability: Present data showed that fodder grown in 150 kg urea ha^{-1} gave the highest and 50 kg urea ha^{-1} gave the lowest CP disappearance rate among the different fertilizer treatments at 2 h of incubation and this pattern remained unchanged up

Table 1: Degradation characteristics of crude protein (CP) of Jumbo grass grown in different nitrogen fertilizer doses

	Treatments (urea ha^{-1})				
Parameters	0 kg	50 kg	100 kg	150 kg	Level of significance
a	12.37±2.02	9.37±2.99	10.17±4.78	6.49±0.11	NS
b	43.97±3.44	42.60±3.07	42.11±6.07	45.77±1.14	NS
c	0.05±0.02^{c}	0.07±0.00^{ab}	0.09±0.02^{b}	0.13±0.00^{a}	**
(a+b)	56.34±5.47	51.97±5.99	52.28±6.79	52.26±1.28	NS
EDCP	42.25±0.15^{b}	43.30±0.50	44.65±1.85	46.35±1.15	**

Table 2: Degradation characteristics of cmde fibre (CF) of Jumbo grass grown in different nitrogen fertilizer doses

	Treatments (urea ha^{-1})				
Parameters	0 kg	50 kg	100 kg	150 kg	Level of significance
a	2.72±0.96	3.48±0.91	2.97±0.79	2.35±0.18	NS
b	52.01±5.08^{a}	50.92±0.18^{ab}	45.50±1.98^{b}	44.75±1.98^{b}	**
c	0.022±0.00^{b}	0.03±0.00^{b}	0.208±0.00^{a}	0.033±0.00^{b}	**
(a+b)	54.73±5.29^{a}	53.40±1.38^{ab}	47.47±2.78^{b}	46.10±2.28^{b}	**
EDCF	21.35±20.95	42.30±0.10	40.25±0.45	40.05±1.05	NS

a=Rapidly soluble fraction, b=slowly degradable fraction, c=rate constant, (a+b)=potential degradability, EDCP=Effective degradability at k_p=0.02 h^{-1}
^{abc}Mean values with different superscripts in the same row differ significantly (P<0.05), NS=Non-significant

to 48 h of incubation thereafter at 72 h they gave almost similar results. The CP disappearance rates of 100 kg urea ha^{-1} treatment at 2 h of incubation was lower and this pattern continued up to 24 h of incubation and at 48 h they gave almost similar results (Table 1).

Results of CP degradation characteristics indicated that there was no significant difference among the fodder sample grown at different fertilizer doses in regards to rapidly soluble fraction 'a', slowly degradable fraction 'b' and potential degradable fraction '(a+b)' (Table 1). The rapidly degradable fraction 'a' and potential degradable fraction '(a+b)' of CP tended to be higher in treatment using no urea. In contrast, the slowly degradable fraction 'b' was the lowest (42.11) in treatment with 100 kg urea ha^{-1} and the highest (45.77) in 150 kg urea ha^{-1} treatment. The rate at which 'b' fraction was degraded (c value) differs significantly (P<0.05) among the different doses of N fertilizer treatments. The rate constant 'c' was lowest (0.05) in the treatment with 0 kg urea ha^{-1} followed by 0.07, 0.09 and 0.13 obtained from the treatments 50, 100, 150 kg urea ha^{-1}, respectively. These results indicated that the increasing level of N fertilizer increases the rumen degradability of the CP of the fodder and it will not be good source of undegradable protein (UDP). Effective degradability of crude protein (EDCP) was significantly (P<0.01) higher for 150 kg urea ha^{-1} treatments (46.35%) than that of 0 kg urea ha^{-} (42.25%). However, there was no significant difference for this parameter between 0 and 50, 50 and 100, 100 and 150 kg urea ha^{-1} treatments but trend was increasing. Thus effective degradability of crude protein (EDCP) increases by increasing the N fertilizer doses (Table 1).

Wide variations of protein degradability at different time and from different sources of feedstuffs were noted by Gangadhar *et al.*[9]. It was reported that protein fraction present in each feed stuff was important factors influencing crude protein degradability[10,11]. In the present experiment, the rate constant of Jumbo grass was in agreement with the findings of other workers, the rate constant (c value) of Jumbo grass (0.05 for treatment 0 kg urea ha^{-1}, 0.07 for treatment 50 kg urea ha^{-1} and 0.09 for treatment 100 kg urea ha^{-1}) were agreeing with Khandaker[12] who found 0.05, 0.06 and 0.08 for Napier grass, Dhal grass and green maize, respectively. Rapidly soluble fraction (a) of Jumbo grass (12.37) in the present study was much lower than other grasses observed by Khandaker[12], who found 'a' value, 38.8, 28.8 and 20.7 for Napier grass, Dhal grass and maize, respectively. On the other hand 'b' fraction in Jumbo grass in the present study (43.97) was somewhat higher than that of Napier grass (36.1) as described by Khandaker[12]. Lower 'a' fraction and a large 'b' fraction of Jumbo grass indicated most slowly degradable fractions of CP in the rumen.

Crude fibre degradability: The rate of CF disappearance of all treatments was slower from 2-12 h of incubation. After 12 h of incubation this disappearance rate became very faster and this faster rate continued up to 48 h of incubation. There were no remarkable variations among the four different fertilizer treatments in respect of CF disappearance rate of other fodder. Table 2 revealed that [1]there was no significant difference among the different fertilizer doses for rapidly soluble fraction'a' of crude fibre (CF) degradation. The slowly degradable fraction 'b', rate constant 'c' and potential degradable fraction '(a+b)' of CF differ significantly among the treatments. The slowly degradable fraction 'b' and potential degradable fraction '(a+b)' of CF tended to be significantly higher in the treatments with 0 kg urea ha^{-1} than those recorded in the treatments with 50, 100 and 150 kg urea ha^{-1} and lowest

value was found in the treatment with 150 kg urea ha^{-1} (Table 2). Highest value for the rate at which 'b' fraction was degraded (c value) was found in 150 kg urea ha^{-1} treatment and lowest was found in 0 kg urea ha^{-1} treatment. The effective degradability of crude fibre (EDCF) at an assumed outflow rate (k_p = 0.02 h) did not changed significantly due to the application of different levels of nitrogen fertilizer doses in Jumbo grass.

Effective degradability of crude protein (EDCP) of the fodder increases by increasing the nitrogen fertilizer while effective degradability of CF (EDCF) remains unchanged. Due to fertilization the values of potential degradable fraction '(a+b)' decreases for crude fibre (CF) and this value remain unchanged for crude protein. Rate constant (c value) was increased due to nitrogen fertilization for crude fibre.

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