Bang. J. Anim. Sci. 2010, 39(1&2) : 75 – 82 ISSN 0003-3588

COMPARATIVE STUDY OF THE NUTRITIVE VALUES OF THE DIFFERENT VARIETIES OF RICE STRAW

M. M. Rahman[1], M. R. Alam[2], M. R. Amin[2] and N. G. Das[3]

Abstract

This study was conducted to investigate the nutritional quality. The Dry matter (DM), Organic matter (OM), Crude protein (CP), Acid detergent fibre (ADF), Neutral detergent fibre (NDF), lignin, Ca and P contents of Pajam, Nijershail, Kablabadam, BR 11, BINA 5 and BRRI 29 varieties of rice straw varied from 92.21 to 93.05%, 81.21 to 86.24%, 3.49 to 5.10%, 41.38 to 46.32%, 72.16 to 77.57%, 4.3 to 6.97%, 0.10 to 0.245% and 0.046 to 0.146%, respectively. The OM content in Nijershail was significantly higher ($P<0.01$) than Kablabadam, BR 11, BRRI 29, Pajam and BINA 5, respectively. The variety BRRI 29 contained significantly higher ($P<0.01$) CP content (5.1%) than BINA 5, BR 11, Pajam, Nijershail and Kablabadam, respectively. Significantly ($P<0.01$) higher NDF content was found in BR 11 (77.57%) followed by Kablabadam, Nijershail, Pajam, BRRI 29 and BINA 5, respectively. Acid deter gut Fibre (ADF) content was significantly ($P<0.05$) higher in Nijershail (46.32%) than Kablabadam, BR 11, BINA 5, Pajam and BRRI 29, respectively. Significantly ($P<0.01$) higher lignin content was found in BRRI 29 (6.97%) compared to Kablabadam, BINA 5, Pajam, Nijershail and BR 11, respectively. The Ca content in Pajam and BR 11 was significantly ($P<0.01$) higher (0.245%) than Nijershail, BRRI 29, Kablabadam and BINA 5, respectively. BRRI 29 contained significantly ($P<0.01$) higher P content (0.146%) compared to BINA 5, Pajam, Nijershail, Kablabadam and BR 11, respectively. Organic Matter (OM) digestibility, and ME content in BRRI 29 was significantly ($P<0.01$) higher followed Nijershail, BINA 5, Pajam, Kablabadam and BR 11, respectively. Straw of BRRI 29 is expected to provide more nutrients, digestible organic nutrients and metabolizable energy to ruminants.

Key words: Rice straw, Chemical composition, Energy content, Digestibility

Introduction

Livestock are recognized as an integral component in cereal dominated cropping system of Bangladesh. Feed shortage is one of the main constraints in exploiting the genetic potential of indigenous livestock species. Due to inadequate availability and lack of scope of green grass production, rice straw has become a major feed resource for ruminant livestock. Tareque (1985) reported that rice straw alone contributes 81% of the total roughage available

[1] Senior Officer, Sonali Bank Limited, Bagha Branch, Rajshahi, Bangladesh
[2] Department of Animal Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[3] Bangladesh Livestock Research Institute, Savar, Dhaka-1341, Bangladesh

(Received: June 06, 2010)

for ruminants in Bangladesh. In some areas of the country rice straw constitutes over 90% of dry matter intake. Similarly, in many parts of the world straw makes up 60 to 90% of the bovine diet (Verma and Jackson, 1984). In the foreseeable future it is envisaged that if alternative feeds are not available farmers will continue to depend on local feed ingredients mostly straw for feeding of their livestock. So, there is a need for systematic study to assess the nutritive values of different varieties of rice straw to develop a feeding system for its efficient utilization. Therefore, the pre sent study was undertaken to determine the chemical composition and nutritive values of different varieties of rice straw.

Materials and Methods

The experiment was conducted in the Department of Animal science, Bangladesh Agricultural University, Mymensingh to study the nutrition value of different varities of rice straw. Different varieties of rice straw (Pajam, Nijershail, Kablabadam, BR 11, BINA 5 and BRRI 29) were collected from the village Darikathal of Trishal thana, Mymensingh. Straws were collected after harvesting of mature crops. Rice straws of Aman season were collected during the month of December, 2005 and that of Boro season were in May, 2006. the collected samples were chopped in to 3-4 cm size, dried in sun, ground in a grinding machine (CYCLOTC1 993, Sample Mill Tecator, Sweden) to 1.0 mm size and then kept in polyethylene bag for proximate analysis and in vitro digestibility.

Analytical methods

Proximate compositions of straw samples was estimated according to the methods of AOAC (2003). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin were estimated by the methods of Faichney and White (1983). Calcium (Ca) and Phosphorus (P) were determined by the method of Olsen and Sommers (1982). Digestibility and ME content of straws were determined according to *in vitro* gas production techniques described by Menke *et al.* (1979) and Menke and Steingass (1988) using following equations.

OM digestibility (%) = 14.88 + 0.889 × Gv (ml) + 0.45 × CP (%).
ME (MJ/kg DM) = 2.20 + 0.136 × Gv (ml) + 0.057 × CP (%).

Statistical analysis

Data were analyzed using Analysis of Variance (ANOVA) technique and the mean differences were tested by Duncan's Multiple Range Test (DMRT) described by Gomez and Gomez (1984) with the help of a computer based statistical package program, MSTAT.

Results

Chemical composition

The DM contents of different varieties of rice straw varied from 92.21 to 93.05% with an average of 92.75% and did not differ significantly (P>0.05) Table 1. The OM contents of

different varieties of rice straw were ranged from 81.21 to 86.24% with an average of 84.08%. The OM content in Nijershail is significantly higher (P<0.01) compared to Kablabadam, BR 11, BRRI 29, Pajam and BINA 5. Among the varieties BRRI 29, Kablabadam and BR 11 contain almost similar (P>0.05) OM. The OM content in Pajam differed significantly with BINA 5. The CP content of rice straw varied from 3.49 to 5.10% with an average of 4.29%. The variety BRRI 29 contained significantly higher (P<0.01) CP content (5.1%) compared to BINA 5, BR 11, Pajam, Nijershail and Kablabadam and the lowest CP content was found in Kablabadam (3.49%). The CP content of BR 11 did not differ significantly (P>0.05) with Pajam and BINA 5. There was no significant difference (P>0.05) between the variety of Kablabadam and Nijershail in CP content.

The NDF content of rice straws varied from 72.16 to 77.57% with an average NDF content of 74.39%. Significantly (P<0.01) higher NDF content was found in the variety of BR 11 (77.57%) compared to the variety Kablabadam, Nijershail, Pajam, BRRI 29 and BINA 5. The content of NDF in BINA 5 was found similar compared to BRRI 29 and Pajam. Insignificant differences (P>0.05) in the NDF content among the varieties of Nijershail, Kablabadam and Pajam were found. The ADF content was significantly (P<0.05) higher in Nijershail (46.32%) than Kablabadam, BR 11, BINA 5, Pajam and BRRI 29. There were no significant differences (P>0.05) in ADF contents among the varieties of Kablabadam, BR 11, BINA 5 and Pajam. The ADF content of Pajam was found similar to that of BRRI 29.

The variety BRRI 29 contained significantly (P<0.01) higher lignin content (6.97%) compared to Kablabadam, BINA 5, Pajam, Nijershail and BR 11. There was no significant difference (P>0.05) in lignin content among varieties of Pajam, Nijershail and BR 11. The variety Kablabadam differed significantly (P<0.01) compared to BINA 5 and BRRI 29.

The Ca content of Pajam was similar to the variety of BR 11, and that of these two varieties (0.245%) was significantly (P<0.01) higher compared to Nijershail, BRRI 29, Kablabadam and BINA 5. There was no significant difference (P>0.05) between the variety of Nijershail and BRRI 29. The Ca content in Kablabadam was significantly (P<0.01) lower compared to BINA 5. The P content of rice straw varied from 0.046 to 0.146% with an average of 0.079%. The variety of BRRI 29 contained significantly (P<0.01) higher P content (0.146%) compared to BINA 5, Pajam, Nijershail, Kablabadam and BR 11. Insignificant differences (P>0.05) in P content among the varieties of BINA 5, Pajam, Kablabadam and Nijershail were observed. The content of P in BR 11 was found to be similar to Kablabadam and Nijershail.

In vitro OM digestibility and ME content

The digestibility of OM significant difference (P<0.01) in OM digestibility was observed in BRRI 29 (44.58%) than Nijershail, BINA 5, Pajam, Kablabadam and BR 11 (Table 2). The variety of Kablabadam was statistically similar in OM digestibility compared to BR 11 and Pajam. There was no significant difference (P>0.05) between the varieties of Nijershail, BINA 5. It was observed from Table 2 that BRRI 29 (6.68 MJ/kg DM) contained significantly (P<0.01) higher ME content than Nijershail, BINA 5, Pajam, Kablabadam and

BR 11. The ME content in BR 11 was found similar to that of Kablabadam and Pajam. There was no significant difference (P>0.05) between the variety of BINA 5 and Nijershail in ME content.

Table 1. Chemical composition of different varieties of rice straw (±SE)

Varieties	DM (%)	OM (%)	CP (%)	NDF (%)	ADF (%)	Lignin (%)	Ca (%)	P (%)
BRRI 29	93.05 ± 0.25	84.49^{b} ± 0.37	5.1^{a} ± 0.03	72.53^{c} ± 0.15	41.38^{c} ± 0.13	6.97^{a} ± 0.05	0.165^{b} ± 0.004	0.146^{a} ± 0.003
BINA 5	92.81 ± 0.58	81.21^{d} ± 0.18	4.64^{b} ± 0.08	72.16^{c} ± 0.55	43.62^{b} ± 0.68	4.85^{c} ± 0.08	0.10^{d} ± 0.002	0.08^{b} ± 0.003
Pajam	92.84 ± 0.23	82.56^{c} ± 0.29	4.39^{c} ± 0.03	74.29^{bc} ± 0.49	42.83^{bc} ± 0.08	4.34^{d} ± 0.09	0.245^{a} ± 0.004	0.074^{b} ± 0.002
Kablabadam	92.73 ± 0.45	85.08^{ab} ± 0.44	3.49^{d} ± 0.05	74.95^{b} ± 0.68	44.22^{b} ± 0.34	5.94^{b} ± 0.04	0.14^{c} ± 0.006	0.06^{bc} ± 0.002
Nijershail	92.84 ± 0.06	86.24^{a} ± 0.29	3.61^{d} ± 0.08	74.86^{b} ± 0.63	46.32^{a} ± 0.13	4.3^{d} ± 0.05	0.175^{b} ± 0.003	0.068^{bc} ± 0.003
BR 11	92.21 ± 0.68	84.91^{ab} ± 0.15	4.52^{bc} ± 0.02	77.57^{a} ± 0.28	43.64^{b} ± 0.38	4.3^{d} ± 0.02	0.245^{a} ± 0.005	0.046^{c} ± 0.002

[a,b,c] Mean values with different superscripts in the same column within same parameters differ significantly either 5% or 1% level

Table 2. OM digestibility and ME content of Rice straw

Varieties	Digestibility of OM (%) ± SE	ME content (MJ/kg DM) ± SE
BRRI 29	44.58^{a} ± 0.565	6.68^{a} ± 0.021
Nijershail	39.94^{b} ± 0.047	5.99^{b} ± 0.031
BINA 5	39.87^{b} ± 0.243	5.97^{b} ± 0.070
Pajam	38.30^{c} ± 0.093	5.73^{c} ± 0.010
Kablabadam	37.67^{c} ± 0.055	5.65^{c} ± 0.015
BR 11	37.53^{c} ± 0.104	5.61^{c} ± 0.021

[a,b,c] Mean values with different superscripts in the same column within same parameters differ significantly either 5% or 1% level

Discussion

Chemical composition, alone, as measured by the proximate and elemental analysis system, is accepted as an inadequate indicator of nutritive values of feedstuffs. These measurements take no account of either the form of availability of nutrients and, at best, may provide information on potential nutrient contents. The values of DM content of Nijershail, Pajam

and BR 11 in this study were similar to the report of Saadullad *et al.* (1981) and Modak (1985). The DM content of different varieties of rice straw varied from 88-92% reported by Modak (1985).

Saadullad (1982) found OM contents of 83% with straw from the varieties Nijershail and Pajam, and 80% in the variety BR 11. The OM content in the variety of Nijershail was 84% and that of Pajam was 86% as reported by Modak (1985). Average OM contents of rice straw observer in this experiment are very close to the reports of Modak (1985) and McManus *et al.* (1976). The variety Nijershail was higher in OM content (86.24%) than other varieties in this pre sent study and this value is higher than the value of OM reported by Saadullah (1982). This variation might be due to the low content of silica and also less contamination of straw with soil and thus can be expected that this variety may have relatively more organic nutrients than other varieties of straw.

The average CP content of selected varieties of rice straw observed in this pre sent study was similar to the values reported by Modak (1985), NRC (1980); Saadullad *et al.* (1981) and Devendra (1982). The average CP content was 3.23% in rice straw reported by Ramanathan *et al.* (1979) and Sen *et al.* (2003) and their values were 22.09% lower than the average value of pre sent findings. The higher percentage of CP observed in this study compared to the values found by Biswas and Chowdhury (1981) and Ramanathan *et al.* (1979) might be due to application of higher nitrogen fertilizer in the soil.

Franzidis and Porteous (1981) found that NDF content of rice straw were 78.13% and Rao *et al.* (1987) found 79.74% NDF in rice straw. The NDF contents found in this study were slightly lower than the values reported by Franzidis and Porteous (1981) and Rao *et al.* (1987). This difference might be due to the variation in agro ecological zone, soil fertility, moisture content, season and other macro and micro environmental factors. Yadav and Yadav (1989) reported that NDF content in rice straw was 64.94% which is lower than the values of this study. This variation might be due to the fact that rice straw used in this experiment contained less soluble carbohydrate, cell content and higher lignocellulose content. High proportion of dietary NDF can suppress forage intake due to reduced rate of fiber digestion and passage through the rumen (Van Soest, 1994). The NDF components are at best low in digestibility and are entirely dependent on the microorganisms in the digestive tract. In the pre sent study BRRI 29 contained less NDF content hence its OM digestibility was higher and BR 11 contained highest NDF content which may have influenced to low OM digestibility.

The ADF content was 49.03, 55.33 and 59.72% in rice straw reported by Yadav and Yadav (1989), Franzidis and Porteous (1981) and Rao *et al.* (1987), respectively. The average ADF content of rice straw (43.67%) observed in this study was 10.89, 26.28 and 21.04% lower than the report of Yadav and Yadav (1989), Franzidis and Porteous (1981) and Rao *et al.* (1987), respectively. This difference might be due to the variation in soil fertility, moisture content, different agro ecological zone, season, crop association and other macro and micro environmental factors. Cell wall residues remaining after neutral detergent fiber extraction.

The lignin content of rice straw reported by different authors, particularly Franzidis and Porteous (1981), Yadav and Yadav (1989) was 15.00 and 9.17%, respectively and their findings were 65 and 44% higher, respectively than the average value found in pre sent study. Jackson (1977) found that lignin content of rice straw was 7% and this result was about 27% higher than the average value reported here. This variation might be due to different varieties, season, soil fertility and other macro and micro environmental factors. The lignin content of 5.79% in rice straw observed by Rao *et al.* (1987) and pre sent finding are in good agreement. Lignin is the single most limiting plant component in the digestion of cereal straw in rumen.

Sen *et al.* (2003) reported that Ca and P contents in straw were 0.14-0.7 and 0.05-0.3%, respectively. The Ca and P contents of different varieties of rice straw in the pre sent study are in agreement with the report of Sen *et al.* (2003) and Biswas and Chowdhury (1981). Presence of these materials are usually below the recommended level and absence of micro nutrients in straw limits the utilization of straw in the rumen since the micro nutrients enhance rumen ecosystem and hence increases straw digestibility.

In vitro OM digestibility and ME content

In vitro techniques for determination of rumen degradability of OM offer considerable advantage in terms of saving time and resources in routine feed analysis. There was a significant difference ($P<0.01$) in OM digestibility among the varieties of BRRI 29, Nijershail and Pajam in the pre sent study. *In vitro* OM digestibility of different varieties of rice straw recorded in this study is very close to the values obtained using *in vitro* techniques by Saadullah (1982). Balch (1977) reported that straw contained less than 7.5 MJME/kg DM. The pre sent findings are in agreement with the report of Balch (1977) and the ME content of this study was also supported by the report of NRC (1984). It appears from OM digestibility and ME content that BRRI 29 was superior to the varieties of Nijershail, BINA 5, Pajam, Kablabadam and BR 11, respectively.

Conclusion

It is revealed from this study that rice straw of BRRI 29 is better in CP, P, OM digestibility, and ME content compared to other varieties viz., Nijershail, BINA 5, Pajam, Kablabadam and BR 11, respectively. It may be concluded that rice straw of BRRI 29 would provide more digestible organic nutrients and metabolizable energy to ruminants. Further investigation is needed for *in vivo* assessment of these rice straws qualities in terms of protein and energy supply and utilization by ruminants for formulation of straw based balanced feeding system.

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