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Title: Evaluation of Nutritional Composition of Small Ruminants' Feed stuffs widely grown in Khulna Region of Bangladesh

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ABSTRACT

Feed stuffs availability is one of the extreme obstacles to small ruminant production, particularly during the dry season. In Khulna region, there are several feed stuffs, fodders, grasses and weeds, but their potential has not yet been completely realized due to a lack of understanding of their nutritional value. Therefore, the research was carried out to determine the nutritional value of available feed stuffs for small ruminants in the Khulna region. Roughage and concentrate samples were collected from different areas of Khulna region. All of the samples were taken in triplicates and analyzed accordingly. The results revealed that among the grass species, the Gitlaghash contains the highest amount of DM content (39.74%) and lowest in Kalmilata (13.90%). The crude protein contents in grass species ranged from 6.5% to 25.65% being highest in Helencha and lowest in Para. Highest EE (ether extract) content was found in German lata (7.05%), followed by Kakpaya (6.72%). The CF content varied between 9.39% in Chanchi to 40.05% in Para. Kakpaya contains the highest ash (17.45%), while Pakchong the lowest (8.68%).Mustard oil cake contains the highest amount of DM (94.77%) among the concentrates, whereas red wheat contains the lowest (89.85%). Crude protein (CP) contents of concentrate feed stuffs ranged from 5.35% in gram bran to 50.75% in soybean meal. Rice polish (21.12%) showed the highest EE concentration and it was lowest in motor bran (2.50%). The maximum concentration of CF was found in Khesari bran (27.17%), while the lowest was in maize (1.82%). It could be concluded that evaluated concentrate feeds and grass species could serve as prospective livestock feeds in southwest Bangladesh.

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INTRODUCTION

Bangladesh is an agricultural country and livestock has become one of the most important sub-sectors of agriculture, contributing significantly to the country's national economy (Sharma et al., 2014). Livestock production serves various purposes including providing food, providing a source of income and generating foreign exchange. According to statistics, it contributed 1.47% to the national GDP in 2018-2019 (BBS, 2019). The production of animal-source protein requires numerous resources. Among these, feed plays an important role in livestock sustainability and profitability. Animal feed in Bangladesh is generally derived from grasses, crop residues and plant leaves as roughage and cereal by-products and very small amounts of grains as concentrates. Availability of these feed resources in lower quality and quantity results in poor animal performance. Profitable and sustainable livestock production requires low-cost, nutrient-dense feed rather than expensive feed. For feed formulation, it is necessary to use locally available feed ingredients to reduce livestock feed costs. Locally available feed ingredients need to be characterized according to their nutritional value to meet protein requirements, improve food security and reduce poverty levels in developing countries like Bangladesh. The future development of small-scale livestock production systems depends on locally available feed ingredients that would potentially ill reduce feed costs (Bhuyain et al., 2018). Because of the obvious seasonal variation in plant growth, forage from natural pastures is distinguished by seasonal fluctuations in total nutrient quality and dry matter production in proportion to annual rainfall (Sarker et al., 2016). Thus, livestock development in Bangladesh largely depends on improving animal nutrition through the availability of improved feed and fodder (Kanak et al., 2013). The productivity of sheep can be improved by improving the nutrition either concentrate feeding or provision of additional forage.

Despite the abundance of potential fodder crops, their nutritional attributes have not yet been fully explored and thus these fodder and crop residues are not being utilized as fodder for livestock. Research gap was insufficient information regarding nutrient composition of available feed ingredients. In order to gain knowledge about the chemical composition of various feed stuffs available in Khulna region of Bangladesh, the study was conducted to determine the proximate composition of the selected feed ingredients. Since these grasses are less expensive, it can be replaced high-priced livestock feed of small ruminants.

MATERIAL AND METHODS

Collection of roughage samples and preparation for proximate analysis:

Roughage samples were collected from different areas in the Khulna region. Triplicate samples were collected for each grass species from the same place but at different times. Twelve species of grasses viz. Helencha (*Enhydra fluctuans* Lour), Malancha (*Alternanthera philoxeroides*), Arail (*Leersia hexandra),* German lata (*Mikania cordata*), Durba (*Cynodon dactylon*), Gitlaghash (*paspalum distichum),* Para ghash (*Brachiaria mutica*), Napier (*Pennisetum purpureum*), Kalmilata (*Ipomoea aquatica*), Chanchi (*Alternanthera sessilis*), Kakpayaghash (*Dactyloctenium aegyptium*), Pakchong (*Pennisetum purpureum cv. Pakchong 1*) were collected for the study. The collected grass samples were chopped into small pieces up to 1-2 cm, weighed, and sundried for 2-3 days. Fresh samples were kept in the oven at a temperature of 105ºC for 24 hours to determine the dry matter. The sundried samples were grounded by using an electrical grinder into small particle sizes and were stored in dry and well-covered containers until analysis.

Collection of concentrate samples and preparation for proximate analysis:

Thirteen concentrates feed ingredients viz. Coconut oil cake (*Cocos nucifera*), Rice bran (*Oryza sativa*), Mustard oil cake (*Brassica spp*.), Khesari bran (*Lathyrus sativus*), Wheat bran (*Triticum vulgare*), Motor bran (*Pisum sativum*), Wheat (white and red) (*Triticum vulgare*), Gram bran, Maize (*Zea mays*), Soyabean meal (*Glycine max*), Poultry meal and Rice polish (*Oryza sativa*) were collected from local markets of Khulna for chemical analysis. The collected samples were grounded by using an electrical grinder into small particle sizes. Then, the samples were kept in the oven for drying at a temperature of 105ºC for 24 hours to determine the dry matter. The rest of the samples were stored in dry and well-covered containers until analysis.

Proximate analysis:

Determination of proximate composition was conducted at Animal Husbandry Laboratory of Agrotechnology Discipline, Khulna University, Khulna. Samples of green grasses and concentrate feeds were subjected to chemical analyses for the determination of dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and total ash (TA) following the method of AOAC (1990). On each chemical analysis, a triplicate determination was carried out and their average was recorded for statistical analysis.

Data analyses:

Data was edited using Excel 2013. Data were tabulated and analyzed with a descriptive statistical method to fulfill the objectives of the research. Descriptive statistical tools such as mean and standard error were identified. Tabular technique was applied for analysis through General Linear Model (GLM) procedure (F-value, P-value and Duncan's multiple range test) of SAS version 9.1.3 (SAS, 2009).

RESULTS AND DISCUSSION

Chemical composition of roughage samples:

Chemical analysis except for dry matter (DM) of roughages was carried out on a dry basis. Table-1 showed that among 12 grass species, the average DM content percentage was almost 3-times higher in Gitla (39.74± 2.00) while the lowest content in Kalmilata (13.90± 1.61). Crude protein (CP) contents percentage of roughage samples were highest in Helencha (25.65±1.49) followed by Kalmilata (20.99±0.33), German lata (19.44±0.53), Arail (15.50± 3.00), Kakpaya (15.13±0.31), Malancha (14.94±0.30), Pakchong (14.89± 0.47), Gitla (13.61±1.56), Napier (12.94± 0.48), Chanchi (12.29± 0.66), Durba (11.30± 0.34) and Para (6.50±1.37) and all the difference were statistically significant at $p<0.001$ level. The Highest EE content percentage was found in German lata (7.05± 0.34) and lowest in Arail (2.40± 0.10). The crude fiber content percentage of the roughage samples was ranged between 9.39 and 40.05 which was lowest in Chanchi (9.39 ±0.59) and highest in Para (40.05 ± 3.60). The ash contents percentage of roughages ranged from 8.68±0.39 in Pakchong to 17.45±0.47 in Kakpaya (Table 1).

Satter et al. (2016) reported that lower DM content percentage of Helencha (12.40) and Kalmilata (9.88) which is comparable with the findings of the present study. Anonymous (2010) reported that dry matter content percentage of Arail (35.2) was higher than the present study (22.02). Mohd et al. (2018) observed the DM content percentage of German lata to be 13.67 which was lower than that of the present findings. Anonymous (2010) reported DM content percentage of Durba to be 31.3 which is pretty close to the present finding. Manzoor et al. (2013) reported lower DM content percentage in Durba (28.36) than the present findings. Lower DM content percentage in Durba (23.22) was also recorded by Oke et al. (2016). Higher amount of DM content percentage of Para (48.00) was reported by Alam et al. (2015) than the present findings. The crude protein content percentage of Durba (11.30) in the present study is almost similar to the findings of Manzoor et al. (2013) (11.30). Oke et al. (2016) reported lower CP content percentage in Durba (8.60) than the present findings. Lower CP content percentage of Para (3.30) was reported by Alam et al. (2015). But higher CP content percentage of Para was reported by Kanak et al. (2013) (8.9) than the present findings. CP content percentage of Napier (12.94) in the present study is in closer agreement with the findings of Talukder et al. (2019). Sree and Vijayalakshmi (2018) reported much higher CP content percentage of Chanchi (36.16). However, lower CP content percentage of Chanchi (4.5) was reported by Kumar et al. (2016) than the present findings. Much lower CP content percentage of Pakchong (6.4) was observed by Turano et al. (2016). The result differed due to excessive salinity of the soil in Khulna region.

Alam et al. (2015) and Kanak et al. (2013) both reported the EE content of Para to be 2.65% and 2.10%, respectively which are lower than the present findings. Lower EE content of Napier (1.90%) was reported by

Talukder et al. (2019). Similar EE content of Chanchi (3.87%) and lower EE content of Chanchi (2.9%) were reported by Sree and Vijayalakshmi (2018) and Kumar et al. (2016). Lower CF content of Helencha (11.95%) and Kalmi (9.26%) were reported by Satter et al. (2016). Mohd et al. (2018) and Talukder et al. (2019) reported the CF content of German lata to be 2.16% and Napier as 12%which are lower than the present findings. Lower CF content of Durba (21.01%) was found by Oke et al. (2016). Similarly, Sree and Vijayalakshmi (2018) and Kumar et al. (2016) reported lower CF content percentage of Chanchi than the present findings. Lower ash content of Helencha (12.46%) and Kalmi (9.11%) than the present findings was reported by Satter et al. (2016). Anonymous (2010) reported higher ash content of Arail (12.8%) than the present study. Mohd et al. (2018) reported the ash content of German lata to be 14.73% which is in closer agreement with the present findings. Manzoor et al. (2013) reported higher ash content of Durba (11.56%) but lower ash content of Durba (1.18%) was reported by Oke et al. (2016) than the present findings. Alam et al. (2015) and Kanak et al. (2013) reported the ash content of Para 4.73% and 9.4%, respectively in which the data was lower than the present findings. Lower ash content of Napier (6.00%) was reported by Talukder et al. (2019) than the present findings. Similar ash content of Pakchong (8.9%) was reported by Turano et al. (2016) which is comparable with the findings from the present study. Saline water has reduced grass cultivation in Khulna. The result differed due to excessive salinity of the soil in Khulna region than another region.

Chemical compositions of concentrate feed samples:

Table 2 reveals that the highest DM content percentage was in Mustard oil cake (94.77±1.81) and lowest in Wheat (red) (89.85± 0.37). Ether extract (EE) contents percentage of concentrate feeds varied between 2.50± 0.76 in Motor bran and 21.12±1.87 in Rice polish. Highest ash content percentage was found in Poultry meal (19.34±6.73) and lowest in Maize (0.50±0.00). Bhuyain et al. (2018) reported higher ash contents percentage of rice bran (20.09), mustard oil cake (9.90), wheat bran (18.02) and maize (1.78) than the present findings. Talukder et al. (2019) reported higher ash contents percentage of wheat bran (3.08) and maize (1.780).

Qi et al. (2015) observed the DM content of rice bran (92.06%) which is lower than the present findings. Bhuyain et al. (2018) reported lower DM contents of rice bran (88.26%), mustard oil cake (86.69%), wheat bran (85.87%), maize (87.21%), wheat (87.30%) and soybean meal (87.33%) than the present findings. Lower DM content of khesari bran (86.75%), wheat bran (87.44%), maize (87.01%) and soybean meal (89.85%) were also reported by Talukder et al. (2019). Moorthy and Viswanathan, (2009) observed CP content of coconut oil cake to be 22.75% which was lower than the present findings. Bhuyain et al. (2018) recorded lower CP contents of mustard oil cake (33.04%), wheat bran (12.37%), wheat (11.83%) and higher CP contents in rice bran (8.49%) than the present findings. Lower CP contents of khesari bran (15.13%), wheat bran (15.36%) and soybean meal (43.84%) than the present findings were reported by Talukder et al. (2019). Moorthy and Viswanathan (2009) reported EE contents of coconut oil cake to be 2.89% which were lower than the present findings. Lower EE contents of rice bran (2.53%), mustard oil cake (3.75%), wheat (1.62%), soybean meal (1.05%) than the present findings were reported by Bhuyain et al. (2018). Talukder et al. (2019) reported lower EE contents of khesari bran (2.58%), wheat bran (1.36%) and soybean meal (3.12%) than the present findings. Lower CF contents of coconut oil cake than that of present study were reported by Moorthy and Viswanathan (2009) (12.11%).

Table 1. Proximate composition percentages (Mean ± SE) of roughage feed samples for ruminants in the Khulna region of Bangladesh

Feed stuffs	Dry matter (%)	Crude protein (%)	Ether extract (%)	Crude Fiber (%)	Ash (%)
Helencha (*Enhydra fluctuans* Lour)	$15.36^{g}\pm 1.01$	$25.65^{c}\pm1.49$	$3.71^{ghi}\pm0.96$	$13.44^{gh}\pm1.30$	$15.20^{abcd}\pm0.18$
Malancha (*Alternanthera philoxeroides*)	$18.20^{fg}\pm0.76$	$14.94^{fgh}\pm0.30$	$3.78^{ghi}\pm0.23$	$17.08^{fg}\pm1.25$	$9.76^{efgh}\pm0.78$
Arail (*Leersia hexandra*)	$22.02^{efg}\pm1.09$	$15.50^{fgh}\pm3.00$	$2.40^{i}\pm0.10$	$30.19^{cd}\pm0.51$	$10.45^{efgh}\pm0.35$
German lata (*Mikania cordata*)	$19.48^{fg}\pm4.82$	$19.44^{de}\pm0.53$	$7.05^{defg}\pm0.34$	$27.27^{d}\pm1.39$	$15.83^{abc}\pm0.21$
Durba (*Cynodon dactylon)*	$38.42^{bc}\pm1.87$	$11.30^{ij}\pm0.34$	$2.86^{i}\pm0.48$	$31.52^{bc}\pm0.31$	$10.14^{efgh}\pm0.81$
Gitla (*Paspalum distichum*)	$39.74^{b}\pm2.00$	$13.61^{ghi}\pm1.56$	$2.62^{i}\pm0.89$	$35.65^{b}\pm1.41$	$11.80^{cdefg}\pm0.55$
Para (*Brachiaria mutica)*	$32.21^{cbd}\pm2.03$	$6.50^{k}\pm1.37$	$3.77^{ghi}\pm0.18$	$40.05^{a}\pm3.60$	$12.52^{cdef}\pm0.31$
Napier (*Pennisetum purpureum*)	$25.39^{efd}\pm2.79$	$12.94^{hi}\pm0.48$	$5.74^{fghi}\pm0.58$	$30.53^{cd}\pm0.26$	$11.03^{defgh}\pm0.49$
Kalmilata (*Ipomoea aquatica*)	$13.90^{g}\pm1.61$	$20.99^{d}\pm0.33$	$4.75^{ghi}\pm0.78$	$17.48^{f}\pm0.10$	$13.02^{cdef}\pm0.71$
Chanchi (*Alternanthera sessilis*)	$36.76^{bc}\pm6.67$	$12.29^{hi}\pm0.66$	$3.99^{ghi}\pm0.66$	$9.39^{ij}\pm0.59$	$14.11^{bcde}\pm0.64$
Kakpaya (*Dactyloctenium aegyptium*)	$21.21^{efg}\pm3.48$	$15.13^{fgh}\pm0.31$	$6.72^{efgh}\pm1.43$	$32.23^{bc}\pm1.51$	$17.54^{ab}\pm0.47$
Pakchong (*Pennisetum purpureum cv. Pakchong 1*)	$29.58^{cde}\pm4.42$	$14.89^{fgh}\pm0.47$	$2.43^{i}\pm0.17$	$34.72^{b}\pm0.52$	$8.68^{fghi}\pm0.39$

Table 2. Proximate composition percentages (Mean ± SE) of concentrate feed samples for ruminants in the Khulna region of Bangladesh

Feed stuffs	Dry matter (%)	Crude protein (%)	Ether extract (%)	Crude Fiber (%)	Ash (%)
Coconut oil cake	$91.82^{a}\pm2.63$	$24.74^{c}\pm1.81$	$13.84^{b}\pm1.75$	$21.60^{e}\pm2.33$	$7.16^{ghij}\pm0.17$
Rice bran	$93.81^{a}\pm1.91$	$6.93^{k}\pm0.33$	$8.64^{def}\pm0.59$	$18.04^{ef}\pm2.27$	$11.47^{cdefg}\pm0.29$
Mustard oil cake	$94.77^{a}\pm1.81$	$41.57^{b}\pm0.19$	$12.55^{bc}\pm2.89$	$11.08^{hi}\pm1.04$	$8.81^{fghi}\pm1.02$
Khesari bran	$93.24^{a}\pm3.14$	$19.17^{de}\pm0.63$	$3.93^{ghi}\pm1.06$	$27.17^{d}\pm2.70$	$6.48^{hijk}\pm0.50$
Wheat bran	$91.50^{a}\pm3.26$	$17.08^{efg}\pm0.64$	$2.69^{i}\pm0.65$	$5.30^{jklm}\pm0.60$	$2.50^{kl}\pm0.29$
Motor bran	$92.66^{a}\pm2.63$	$10.85^{ij}\pm2.43$	$2.50^{i}\pm0.76$	$3.27^{lm}\pm0.42$	$3.16^{jkl}\pm0.17$
Wheat white	$92.98^{a}\pm3.26$	$14.99^{fgh}\pm0.13$	$4.63^{ghi}\pm0.38$	$2.92^{lm}\pm0.53$	$2.00^{kl}\pm0.003$
Gram bran	$91.47^{a}\pm3.10$	$5.35^{k}\pm0.65$	$3.30^{hi}\pm0.48$	$3.72^{lm}\pm0.12$	$4.32^{ijkl}\pm0.33$
Wheat red	$89.85^{a}\pm0.37$	$16.64^{efg}\pm0.41$	$3.15^{i}\pm0.33$	$3.02^{lm}\pm0.25$	$1.67^{l}\pm0.17$
Maize	$91.11^{a}\pm3.70$	$8.27^{jk}\pm0.07$	$2.88^{i}\pm0.33$	$1.82^{m}\pm0.33$	$0.50^{l}\pm0.00$
Soyabean meal	$92.53^{a}\pm3.20$	$50.75^{a}\pm0.75$	$9.26^{de}\pm1.03$	$8.33^{ijk}\pm1.18$	$6.40^{hijk}\pm0.22$
Poultry meal	$90.78^{a}\pm0.40$	$25.53^{c}\pm1.37$	$10.01^{cd}\pm1.55$	$4.95^{klm}\pm0.55$	$19.34^{a}\pm6.73$
Rice polish	$90.65^{a}\pm1.02$	$18.12^{def}\pm0.93$	$21.12^{a}\pm1.87$	$6.97^{ijkl}\pm0.72$	$7.53^{ghij}\pm0.91$
F-value (Overall)	139.07	84.30	18.85	86.00	12.97
P-value (Overall)	0.0001	0.0001	0.0001	0.0001	0.0001

Means followed by same letters are statistically similar within each parameter. Data are mean ± standard error of three replications.

Bhuyain et al. (2018) observed lower CF contents of rice bran (11.72%), mustard oil cake (9.36%), wheat (1.89%), soybean meal (6.12%) and higher CF contents of wheat bran (10.13%) and maize (2.49%) than the present findings. Lower CF contents of khesari bran (24.78%) and soybean meal (6.41%) were reported by Talukder et al. (2019). Talukder et al. (2019) reported lower ash contents percentage of khesari bran than the present findings.

Moorthy and Viswanathan (2009) reported similar DM content of coconut oil cake (91.5%) to that of the present findings. Bhuyain et al. (2018) and Talukder et al. (2019) determined the CP contents of maize as 8.95% and 8.44%, respectively which were similar to the present findings. Similar EE contents of wheat bran (2.21%) and maize (2.84%) with the present findings were reported by Bhuyain et al. (2018). Ether extract content of maize (2.82%) in the present study is similar to the findings of Talukder et al. (2019). Qi et al. (2015) reported similar CF contents of rice bran (18.09%) with the present findings. Bhuyain et al. (2018) reported almost similar ash contents of wheat (1.43%) and soybean meal (6.80%) with the present findings. Similar ash content of soybean meal (6.18%) with the present findings was also reported by Talukder et al. (2019). Due to climate change, the Khulna region is more prone to flooding and salinity for which the result varies sometimes.

CONCLUSION

Among the roughage samples, Helencha, Kalmilata and German lata are good sources of crude protein whereas among concentrate samples, soybean meal, mustard oil cake and poultry meal are rich sources of crude protein. It is evident that some feed ingredients have good potential as diets for small ruminants like sheep and goats. High-cost feed can be replaced by locally available feeds which are rich in sufficient nutrients and could be used to alleviate feed shortages for livestock industry. Thus, by using locally available feeds, livestock production could be increased and thereby animal protein deficiency would be minimized.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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