Journal of AgriSearch, 6(Special Issue):135-138
An Open Access International Peer Reviewed Quarterly
ISSN : 2348-8808 (Print), 2348-8867 (Online)

Evaluation of Chemical Composition of fifteen commonly used Ruminants Feed Ingredients locally available in Murshidabad District, West Bengal

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ARTICLE INFO

Received on	:	03-05-2019
Accepted on	:	26-06-2019
Published online	:	09-07-2019

ABSTRACT

Fifteen feed ingredients (five non-leguminous, two leguminous, four agricultural by-products, two oil cakes and two grains) were analyzed for their proximate principles (CP- crude protein, EE- ether extract and total ash) and fiber fractions (NDF- neutral detergent fiber, ADF-acid detergent fiber, hemicelluloses, cellulose and lignin) on dry matter (DM) basis. CP value was highest (43.12%) in ground nut cake (GNC) and lowest in wheat straw (2.81%) among fifteen feed ingredients. Fiber components especially NDF content was highest (79.03%) in wheat straw of agricultural by-product and lowest (19.71%) in wheat grains. Ether extract (EE) contents lowest (0.96%) in wheat straw and highest (9.22%) in mustard oil cakes (MOC) whereas total ash (TA) content were 19.28% (maximum) and 1.51% (minimum) in paddy straw and maize grain respectively. Similarly fiber (neutral detergent fiber; NDF and acid detergent fiber; ADF) content of wheat straw and wheat grain were 79.03% & 50.07% and 19.71% & 5.44%, respectively. Basing on higher CP and lower NDF content, oil cakes were found to be superior in terms of nutritional quality for ruminants. Evaluation of various feeds ingredients is helpful in balanced ration formulation for field ruminants and under farm conditions for better utilization of these commonly available feed resources.

KEYWORD

Chemical compositions, feed ingredients, ruminants

INTRODUCTION

The shortage and high cost of animal feed in semi-arid countries are the major problems in animal husbandry. India has a very large population of livestock both of productive and unproductive animals. Ruminants are mainly dependent on low-quality forages, which are poor in protein, energy, minerals, and vitamin contents. To get more production from these ruminants it is necessary to enhance the utilization of these low quality forages. Incorporation of cereal and leguminous fodder in ruminant diets can improve the utilization of low-quality forages mainly through the supply of N to rumen microbes. The ruminants can make efficient use of mill by-products, crop residues, and other non-conventional feed sources being prepared with rumen microbial ecosystem. The majority of livestock is fed a very small quantity of concentrates and productive animals are fed either balanced concentrate or raw ingredients, which are traditionally mixed on farms and which do not meet the sufficient nutrient requirements of livestock and hence can be called unbalanced (Sagar *et al.*, 2013). In spite of a large cattle population, milk production is low owing to poor individual cow productivity, which is attributed to malnourishment and mineral deficiency (Sharma *et al.*, 2003). Hence, knowledge regarding the nutrient composition of different feed ingredients helps in preparation of balanced rations for ruminants. Database on nutritive values, access, and use of such information will have a significant impact on improved animal performance and productivity also (Devendra and Leng 2011).

The nutritive value of ruminant feed is determined by the concentration of its chemical compositions. The ultimate goal of feed analysis is to expect the productive response of animals when they are fed rations of a given composition. This is the real reason for the necessity of information on feed ingredients composition. Therefore, the objective of this study was to generate information on nutritional quality of locally available feeds or introduced fodders, so that a data bank could be established which would be helpful in balanced ration formulation for enhancing ruminant productivity. Thus, the feeds ingredients available in and around Murshidabad District of West Bengal were evaluated for various nutritional aspects in terms of chemical compositions.

MATERIALS AND METHODS

Experimental work plan

A series of laboratory experiments were conducted to characterize selected non-leguminous fodders like maize (*Zea mays*), sorghum (*Sorghum bicolor*), oat (*Avena sativa*), para grass (*Brachiaria mutica)* and napier grass (*Pennisetum purpureum*); leguminous fodders like cowpea (*Vigna unguiculata*) and rice bean (*Vigna umbellate*); agricultural by-products such as deoiled rice bran, paddy straw, wheat bran and wheat straw; oil cakes like mustard oil cake (MOC) (*Brassica juncea*), ground nut cake (GNC) (*Arachis hypogaea*) and grains like maize and wheat (*Triticum aestivum*) for their chemical composition.

Sample collection

Representative sample of cowpea (Variety: Bundel-1) was collected from Regional

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Fodder Station, Kalyani, W.B. Whereas rest of the samples were collected from Murshidabad Krishi Vigyan Kendra's Farm, W.B. The samples were dried at 60°C in an oven and ground through a 1 mm sieve and stored for the determination of different chemical components as described in the following sections.

Chemical analyses

All feed samples were analyzed in triplicate for DM, Toatl ash and ether extract (EE) by using methods of AOAC (1990). All these samples were analyzed for EE with the help of soxhlet apparatus. The CP content was calculated indirectly by multiplying a factor of 6.25 to the estimated Nitrogen (N) content (N × 6.25). The cell wall constituents (neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin, cellulose, and hemicellulose of feeds were determined by the methods of Van Soest *et al*., (1991) and Goering and Van Soest (1970).

RESULTS AND DISCUSSION

The chemical composition of various feeds ingredients has been presented in Table 1. The cultivated fodders included those, which are grown locally like leguminous and non-leguminous fodders. Generally, wide variations existed in the chemical composition of the investigated feed ingredients. These variations could be a result of agronomic factors such as application of various levels of N fertilizers, time of harvest, ensiling, field drying, and storage. The CP content of non-leguminous fodders varied from 7.16% (sorghum) to 14.74% (para grass), but leguminous fodders have variation in CP (16.61% in rice bean and 24.02% in cowpea). Agza *et al*., (2012) evaluated seven cultivars of cowpea fodder and found a mean CP content of 23.9% which is in agreement with our findings. Similarly, Akinlade *et al*., (2005) observed CP range of 13.8-11.5% in cowpea varieties which were also very much lower from present results.

Generally CP content in forages serves as a reliable measure of their nutritional quality; however it significantly varies during various seasons and among different species also (Ramirez *et al*., 2009). If 8% of protein content is considered as adequate for maintenance of cattle as suggested by NRC (2001), then in this study except sorghum, paddy and wheat straw, all other group of forages can be considered to be of high nutritional quality for grazing ruminants. Oilseed cakes had high CP and EE than other feeds ingredients. Amongst grains, CP content ranged from 9.40% for maize to 11.71% for wheat and EE content ranged from 3.82% for maize to 2.10% for wheat. The chemical composition of concentrate feeds observed is in accordance with that of NRC (2001) and Mandal *et al*., (2003). All grains had similar CP values. All agricultural by-products had higher CP content except paddy and wheat straw, which recorded minimum CP content (2.81%) among all estimated feeds ingredients. These results of chemical composition of straws corroborate the earlier reports of NRC (1982), Ranjhan (1998), Mandal *et al*., (2003) and Kumarmath *et*

Table 1: Proximate composition of feed ingredients (% DM)

Feed	DM	TA	CP	EE
		Non-leguminous green fodders		
Maize	16.13±0.43	11.41±0.10	9.41±0.20	1.46±0.20
Sorghum	18.81±0.45	11.77±0.24	7.16±0.35	1.94±0.35
Oat	11.38±0.15	11.97±0.23	8.85±0.15	2.76±0.21
Para grass	18.02±0.22	13.24±0.37	14.74±0.25	3.14±0.24
Napier grass	22.69±0.23	12.55±0.15	13.52±0.33	2.57±0.30
		Leguminous green fodders		
Cowpea	21.37±0.18	9.42±0.37	24.02±0.36	2.43±0.40
Rice bean	18.84±0.24	10.65±0.32	16.61±0.22	1.96±0.29
		Agricultural by-products		
Deoiled Rice bran	92.27±0.20	13.26±0.32	15.16±0.19	0.50±0.19
Paddy straw	91.03±0.28	19.28±0.32	3.58±0.19	1.61±0.19
Wheat bran	94.09±0.17	5.97±0.21	16.99±0.20	3.48±0.14
Wheat straw	92.84±0.17	10.36±0.16	2.81±0.19	0.96±0.11
		Oil cakes		
MOC	94.10±0.23	7.99±0.19	36.18±0.36	9.22±0.20
GNC	91.82±0.22	6.67±0.40	43.12±0.22	6.30±0.15
Grains				
Maize	92.10±0.22	1.51±0.28	9.40±0.25	3.82±0.40
Wheat	91.80±0.37	2.20±0.26	11.71±0.23	2.10±0.29

DM=Dry matter, TA=Total ash, CP=Crude protein, EE=Ether extract, GNC=Groundnut cake, MOC=Mustard oil cake

al., (2004). Total ash content maximum in case of mustard oil cakes (9.22%) and minimum in case of deoiled rice bran (0.50%) among all investigated feed ingredients. Napier grass is one of the most important and well recognized fodder grass for dairy animals in our country with an average of 5-7% protein content (Mali *et al*., 2014), which is lower to the findings of this study. Khanum *et al*., (2007) reported the values for para and napier grass were slightly less than present findings.

Cell wall composition of feeds ingredients is shown in the Table 2. There are wide variations in the cell wall composition of all feed ingredients. Lowest neutral detergent fiber (NDF) and acid detergent fiber (ADF) were observed in wheat grain whereas, highest in wheat straw. Wheat straw contained highest NDF and napier grass contained highest ADF among all feeds. Higher fiber and lower protein content of paddy and wheat straw demonstrated its poor nutritional quality. Leguminous fodders showed comparatively lower NDF contents than that of non-leguminous fodders. Together with higher protein content, leguminous fodders were found to be of better feeding value for ruminants. Grains and oil cakes contained lower NDF values. Among non-leguminous fodder napier contained highest cellulose (45.56%) and oats contained lowest. Lignin content was found to be higher in feeds like paddy straw and wheat straw. Higher lignin content of feeds usually interferes with fiber availability to ruminants.

Table 2: Cell wall constituents of feed ingredients (% DM)

Feed	NDF	ADF	HC	Lignin	Cellulose
green fodders		Non-leguminous			
Maize	66.69±0.06	39.55±0.06	27.08±0.15	5.53±0.16	32.56±0.16
Sorghum	70.11±0.18	41.99±0.15	27.81±0.34	4.42±0.29	35.79±0.15
Oat	53.22±0.16	27.22±0.10	25.81±0.14	6.72±0.11	20.24±0.13
Para grass	68.90±0.11	47.60±0.10	24.34±0.22	5.28±0.20	42.11±0.14
Napier grass	72.50±0.13	50.02±0.06	30.02±0.24	6.50±0.37	45.56±0.28
fodders		Leguminous green			
Cowpea	47.12±0.24	33.43±0.12	15.51±0.20	8.86±0.18	19.94±0.29
Rice bean	51.61±0.35	31.95±0.18	19.03±0.22	9.02±0.12	22.79±0.18
		Agricultural by-products			
Deoiled Rice bran	47.16±0.17	16.85±0.07	30.17±0.12	5.42±0.11	10.29±0.24
Paddy straw	67.60±0.19	47.82±0.15	26.30±0.17	15.25±0.20	32.65±0.22
Wheat bran	41.16±0.10	12.38±0.10	28.57±0.14	2.79±0.25	9.09±0.30
Wheat straw	79.03±0.29	50.07±0.10	25.30±0.13	13.08±0.19	36.52±0.15
		Oil cakes			
MOC	23.33±0.10	17.48±0.13	5.55±0.15	3.12±0.20	13.70±0.23
GNC	24.17±0.16	18.05±0.21	5.72±0.34	3.72±0.19	13.61±0.08
Grains					
Maize	26.15±0.38	6.47±0.10	19.55±0.14	1.50±0.17	4.98±0.23
Wheat	19.71±0.19	5.44±0.19	13.98±0.17	1.70±0.15	3.59±0.08

NDF=Neutral detergent fiber , ADF=Acid detergent fiber, HC=Hemicellulose, DM=Dry matter, GNC=Groundnut cake, MOC=Mustard oil cake

The cell wall constituents of green roughages were in the range reported earlier by other workers (Ranjhan 1998, Kumarmath *et al*., 2004, Datt *et al*., 2009). Structural components such as NDF and ADF were higher in non leguminous and straws (paddy and wheat) than other groups, which are well supported by the studies of Sultan *et al*., (2008). In general structural components in plants increase with gradual increase in their maturity. Wadhwa *et al*., (2010a) reported slightly less NDF content for maize and sorghum fodder than our findings. Singh *et al*. (2013) evaluated three new sorghum varieties and found almost comparable NDF content which might be due to the hybrid nature of the varieties. Wadhwa *et al*., (2010b) evaluated two varieties of oat fodder to find out similar NDF contents with our present findings. However, Islam *et al*., (2010) reported similar NDF value in oat fodder which might possibly due to higher stage of maturity during the time of study.

CONCLUSION

It appears that oil cakes *i.e.* ground nut cake and mustard oil cake had highest CP and EE values respectively among all feeds. Based on this study, low fiber containing feeds among the different groups for use in ruminant feeding ranked from the lowest to the highest were; wheat grains, MOC, wheat bran, cowpea, oats respectively. Our study revealed that all the feeds ingredients have wide variability in their nutritional quality and composition. The major factors that might have

affected the nutritive value of such feeds are seasonality, species specificity, site of growth, soil characteristics etc. which are well supported by studies of Arzani *et al*., (2008), Mahala *et al*., (2009), Subhalakshmi *et al*., (2011) and Teka *et al*., (2012). Evaluation of various feeds ingredients is helpful in balanced ration formulation for field ruminants and under farm conditions for better utilization of these commonly available feed resources.

ACKNOWLEDGMENTS

The authors are thankful to the Programme Coordinator, Murshidabad Krishi Vigyan Kendra, West Bengal for providing facilities and infrastructural support for carrying out the study. Financial assistance provided by the office of ICAR- Agricultural Technology Application Research Institute, Kolkata (Zone-V) for undertaking this study, is gratefully acknowledged

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