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Chemical composition and *in sacco* digestibility of Indian and Japanese barnyard millet stovers

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Abstract
Two genotypes of Indian barnyard millet (VL 181 and VL 207) and Japanese barnyard millet (PRJ 1 and PRB 903) and a local cultivar (Hawalbagh) were compared for chemical composition and digestibility attributes of *stovers*. Significant differences were observed among the genotypes for various *stover* quality attributes. Crude protein was highest in Hawalbagh local cultivar, while VL 207 had the highest crude fibre and ash contents. Nitrogen free extract was highest for PRJ 1. The mean *in sacco* digestibility of the barnyard millet genotypes on dry matter basis after 72 h was 61.3 per cent. *In sacco* digestibility of Hawalbagh local and PRJ 1 was at par and higher than the other genotypes. There were no species-specific differences between India and Japanese barnyard millet genotypes with respect to chemical composition and dry matter digestibility.

Keywords: Barnyard millet, Chemical composition, *In sacco* degradability, Stovers

Introduction
Barnyard millet (*Echinochloa* spp.) is one of the oldest domesticated millets in the semi-arid tropics of Asia. It is cultivated for dual purpose use- as grain and fodder. There is tremendous pressure of livestock on available total feeds and fodder as land available for fodder production has been decreasing (Hazra, 2014). A portion of the excess requirement can be met from under-exploited this dual purpose crop resource like barnyard millet. The crop thrives well even on marginal lands or under agricultural conditions where major cereals fail to give sustainable yields. In India, barnyard millet is grown from Himalayan region in the north to Deccan plateau in the south. It ranks second in production (87 thousand tonnes) and productivity (857 kg/ha) among the small millets after finger millet in India (Padulosi *et al*., 2009). The state of Uttarakhand with a total area and production of 63 thousand ha and 83.7 thousand mt, respectively (Anonymous, 2013), accounts for nearly two-third of total barnyard millet production in India, followed by Tamil Nadu. The species of barnyard millet cultivated in India is *Echinochloa frumentacea* (Indian barnyard millet), however, a new variety PRJ 1 belonging to *E. esculenta* species (Japanese barnyard millet) released in 2003 is also being cultivated by farmers mainly in the Garhwal region of the Uttarakhand (Yadav *et al.,* 2010).

Information on nutritional composition and digestibility attributes of *stovers* of the Japanese barnyard millet cultivars vis-à-vis the traditional and improved Indian barnyard millet cultivars would be of great value in facilitating adoption of the Japanese cultivars by hill farmers. The present study, therefore, was aimed at generating information on nutritional and digestibility attributes of *stovers* of the two important barnyard millets species.

Materials and Methods
Experimental materials: The genetic material comprised of five barnyard millet genotypes *viz*., VL 181, VL 207, PRJ 1, PRB 903 and Hawalbagh local were collected from Uttarakhand State Coordinated Barnyard Millet (Table 1). Evaluation trial was conducted at the Experimental Farm, Hawalbagh, Vivekananda Parvatiya Krishi Anusandhan Sansthan (ICAR), Almora during *kharif* 2012. The institute is situated at $29^0 36'$N, $79^0 40'$E and 1250 m above MSL. The average rainfall during the crop growing season was 684.7 mm. The experiment was conducted under organic mode with the application of FYM at 5 t/ha.

Chemical analysis and *in sacco* digestibility determination: Dried samples were ground in Willey mill using 2 mm sieve for chemical analysis and *in sacco* dry matter digestibility (DMD). Crude protein, crude fibre, crude fat (ether extract) and total ash were determined following AOAC (2000). The *in sacco* DMD was determine following ónylon bag techniqueô by incubating bags containing feed samples for 0, 12, 18, 24, 36, 48, 60, 72 hours in the rumen of male crossbred fistulated animal (Mehrez and Orskov, 1977) and degradability characteristics were worked out as per the equation given by Orskov and McDonald (1979). The data were analyzed statistically by following the method given by Snedecor and Cochran (1967).

Results and Discussion

The analysis of variance revealed significant differences among the genotypes for *stover* quality parameters viz., crude protein, crude fiber, crude fat, total ash and NFE (Table 2). Crude protein in the Indian local cultivar Hawalbagh (6.91) was significantly higher (P<0.05) than other genotypes, while the crude fiber content of Japanese cultivar PRJ 1 (27.90) was lowest and comparable to Indian cultivars Hawalbagh (29.80) and VL 181 (29.27). The crude fat content of Hawalbagh cultivar (1.98) and PRJ 1 (1.90) was comparable and significantly higher (P<0.05) than other genotypes. Total ash content was significantly higher in VL 207 (9.82) and VL 181 (9.58) as compared to other genotypes. The NFE of PRB 903 (53.40) and VL 181 (53.14) was at par and significantly higher (P<0.05) than VL 207, which recorded lowest NFE (50.78). Yadav and Yadav (2013) also reported higher crude protein, crude fat and acid insoluble ash in Japanese barnyard cultivar PRJ 1 in comparison to Indian cultivars VL 207 and VL 172.

In sacco dry matter digestibility (DMD) was found to increase progressively with the increase in duration of incubation period from 0h to 72h in all the five genotypes (Table 3). Dry matter digestibility at 0h was highest in Hawalbagh local (25.51) and was at par with that of PRJ 1 (24.55) and PRB 903 (23.95). DMD of VL 207 (20.71) and VL 181 (19.81) was significantly lower (P<0.05) than the aforementioned three genotypes.

The effective degradability (ED) calculated following Orskov and McDonald (1979) (Table 4) revealed that PRJ 1 and Hawalbagh local had higher effective degradability than VL 181 and VL 207, with PRB 903 falling in between. The soluble fraction (a), overall digestibility (a+b) and degradation rate (c) affected ED positively. Cherimiti *et al.* (1996) and Prakash *et al.* (2006) also reported that EDD was positively affected by soluble fraction (a) and degradation rate (c).

The analysis of association of chemical composition with dry matter digestibility revealed significantly positive correlation of crude protein with soluble fraction (a), overall digestibility (a+b) and effective digestibility (ED) of dry matter. Crude fat was also positively correlated with soluble fraction (a) and effective digestibility (ED). Significantly positive correlation was also observed between NFE and degradation rate (c). Crude fibre, however, was negatively correlated overall digestibility (a+b) of dry matter. Mohajer *et al.* (2013) also reported

Table 1. Details of genotypes used in the study

Name	Pedigree	Species	Status	Source/origin
VL 181	ECC 27 x VL 60	*E. frumentacea*	Improved variety	ICAR-VPKAS, Almora, India
VL 207	VL 172 x GECH 5202	*E. frumentacea*	Improved variety	ICAR-VPKAS, Almora, India
Hawalbagh Local	-	*E. frumentacea*	Traditional local cultivar	Almora, India
PRJ 1	Selection from IEC 542	*E. esculenta*	Improved variety	UUHF, Ranichauri, India
PRB 903	-	*E. esculenta*	Advance breeding line	UUHF, Ranichauri, India

Table 2. Chemical composition of *stover* of barnyard millet genotypes (on %DM basis)

Genotypes	Crude protein	Crude fibre	Crude fat	Total ash	NFE
VL 181	5.56	29.27	1.68	9.58	53.91
VL 207	5.03	32.82	1.55	9.82	50.78
Hawalbagh Local	6.91	29.80	1.98	8.17	53.14
PRJ 1	6.43	27.90	1.90	7.89	55.88
PRB 903	6.17	31.27	1.75	7.41	53.40
SEM	0.106	0.877	0.036	0.248	0.777
CD (P<0.05)	0.319	2.762	0.113	0.783	2.448

Table 3. *In sacco* dry matter digestibility (DMD) of barnyard millet genotypes at different hours (on % DM basis)

Genotypes	0 h	12 h	24 h	36 h	48 h	60 h	72 h
VL 181	19.81	27.09	32.19	38.24	44.33	51.67	60.82
VL 207	20.71	26.25	31.73	37.15	41.71	50.65	57.03
Hawalbagh local	25.51	30.56	38.82	43.05	48.38	56.31	63.33
PRJ 1	24.55	30.87	39.52	45.05	53.57	59.01	64.17
PRB 903	23.95	28.23	36.55	42.12	48.03	52.63	60.97
SEM	0.725	1.016	0.82	0.821	1.033	0.711	1.177
CD (P<0.05)	2.283	3.201	2.584	2.587	3.354	2.241	3.706

Table 4. *In sacco* degradation characteristics of dry matter of barnyard millet genotypes based on exponential equation and effective degradability of *stover* at the fractional rumen outflow rate of K=0.05/hr

Genotype	Constants				ED at K= 0.05/hr
	a	b	a+b	c	
VL 181	19.81	41.01	60.82	0.0146	29.08
VL 207	20.71	36.32	57.03	0.0132	28.30
Hawalbagh local	25.51	37.82	63.33	0.0149	34.15
PRJ 1	24.55	39.62	64.17	0.0172	34.70
PRB 903	23.95	37.02	60.97	0.0148	32.40

Table 5. Correlation coefficients between degradation characteristics and chemical composition

Degradation characteristic	Crude protein	Crude fibre	Crude fat	Total ash	NFE
a	0.915*	-0.348	0.875	-0.867	0.415
b	0.112	-0.817	0.217	0.126	0.708
a+b	0.900*	-0.879*	0.937*	-0.691	0.863
C	0.624	-0.875	0.687	-0.620	0.952*
ED	0.942*	-0.617	0.937*	-0.864	0.676

* Significant at 5% level of probability

that dry matter digestibility was positively correlated with soluble part and crude protein, and negatively correlated with fiber in nine superior varieties of three forage species, namely, sainfoin (*Onobrychis sativa*), proso millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*). Similar correlation pattern was also observed by Prakash *et al.* (2006) in forest-based fodders.

Conclusion

The results revealed that there was no species-specific difference between India and Japanese barnyard millet genotypes with respect to chemical composition and dry matter digestibility. Japanese barnyard millet is better suited for cultivation in higher hills compared to Indian barnyard millet. The present study, therefore, indicated that improved cultivars of the Indian and Japanese barnyard millets can be adopted in large scale by the farmers in the North West Himalayan hills for grain as well as fodder purposes.

References

Anonymous. 2013. *Uttarakhand at a Glance 2012-13*. Directorate of Economics and Statistics, Government of Uttarakhand, India. pp. 21.

AOAC. 2000. *Official Methods of Analysis*. Association of Official Analytical Chemists. 17th Edition. Washington, D. C, USA.

Cherimiti, A., A. Nefzaoui, E. Teller, M. Vanbelle, H. Ferchichi and N. Rakbani. 1996. Prediction of the voluntary intake of low quality roughages by sheep from chemical composition and ruminal degradation characteristics. *Animal Science* 62: 57-62.

Hazra, C. R. 2014. Feed and forage resources for sustainable livestock development. *Range Management and Agroforestry* 35: 1-14.

Mehrez, A. Z. and E. R. Orskov. 1977. A study of artificial fibre bag technique for determining the digestibility of feeds in the rumen. *Journal of Agricultural Science Cambridge* 88: 645-650.

Mohajer, S., R. M. Taha, A. Khorasani and E. E. Mubarak. 2013. Comparative studies of forage yield and quality traits among proso millet, foxtail millet and sainfoin varieties. *International Journal of Environmental Science and Development* 4: 456-469.

Orskov, E. R. and I. McDonald. 1979. The estimation of protein degradability in the rumen from incubation measurements weighed according to the rate of passage. *Journal of Agricultural Science Cambridge* 92: 499-503.

Padulosi, S., Bhagmal, J. Gowda, K. T. K. Gowda, G. Shanthakumar, N. Yenagi and M. Dutta. 2009. Food Security and Climate Change: Role of Plant Genetic Resources of Minor Millets. *Indian Journal of Plant Genetic Resources* 22: 1-16.

Prakash, B., M. Mondal, A. Rongsensusang, K. Hanna and C. Rajkhowa. 2006. Chemical composition and *in sacco* degradability of forest based fodders of Nagaland state of India in Mithun (*Bos frontalis*). http://www.lrrd.org/lrrd18/8/prak18119.htm (accessed on May 22, 2015)

Snedecor, G.W. and W. G. Cochran. 1967. *Statistical Methods*. Iowa State University Press. pp. 593.

Yadav, V. K. and R. Yadav. 2013. Comparative performance of Indian and Japanese barnyard millet cultivars under varied fertility conditions for dual use in Indian Central Himalaya. *Range Management and Agroforestry* 34: 175-178.

Yadav, V. K., B. Kumar, R. Yadav, N. Malik and J. Kumar. 2010. *All India Coordinated Small Millet Improvement Project*. G.B. Pant University of Agriculture and Technology, Hill Campus Ranichauri, Uttarakhand, India. pp. 79.