

Nutritive Values of Forages Evaluated Using a Mixed Bacteria Isolated From the Rumen Liquor of Buffalo

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Abstract

*Fresh rumen liquor (FRL) is commonly used in in vitro studies to evaluate the nutritive values of feed for ruminants. However, the type and activity of microbes in the FRL vary with feed and time. To reduce the variation of results, a mixed bacterial isolates (MBI) may be used as an alternative to replace the FRL. This study was aimed at evaluating the nutritive value of forages using MBI and FRL. Sampels of *Penisetum sp.*, *Panicum sp.*, *Brachiaria sp.*, *Setaria sp.*, *Paspalum sp.*, *Calliandra sp.*, *Leucaena sp.*, *Indigofera sp.* and *Gliricidia sp.* were fermented in vitro using either MBI or FRL for 3 and 48 hours to determine NH_3 , total volatile fatty acids (VFA), dry matter (DMD) and organic matter digestibility (OMD) based on two steps digestibility method. Paired t-Test was applied to compare the results of using MBI and FRL. Dry matter and organic matter digestibility of the forages were lower when they were determined using MBI than those determined using FRL. The forages DMD and OMD determined using MBI and FRL had significant correlation. Digestibility of dry matter and organic matter were affected by fiber and protein content of the forages. The results suggested that to determine the nutritive values of the forages, in in vitro studies, the MBI could be used to replace FRL with an adjustment to the result.*

Keywords: buffalo, forage, isolation, liquor, mixed bacteria

Introduction

Fresh rumen liquor is commonly used in *in vitro* studies to evaluate the nutritive values of feed for ruminants (Dhanoa *et al.*, 2004). However the type and activity of microbes in the rumen liquor varies with feed and time after feeding (Yanhong Chen *et al.* 2011). This study aimed at evaluating the possibility of using a mixed bacteria isolated from rumen buffalo to determine the nutritive value of forages.

Materials and Methods

Fresh rumen liquor (FRL) of cattle obtained from a slaughter house and a mixed of six types of bacteria isolated from buffalo rumen (MBI) were used as treatments of microbial sources in an *in vitro* study. Sampel of *Penisetum sp.*, *Panicum sp.*, *Brachiaria sp.*, *Setaria sp.*, *Paspalum sp.*, *Calliandra sp.*, *Leucaena sp.*, *Indigofera sp.* and *Gliricidia sp.* were fermented *in vitro* for 3 hours to determine NH₃ and VFA, and for 48 hours to determine dry matter and organic matter digestibility based on two steps disgetibility method (Tilley and Terry, 1963) using either FRL or MBI. Proximate analysis was applied to determine the nutrient content of forages. Concentration of NH₃ and VFA in the fermentation media were determined accoding to microdifusion Conway method and steam distillation method, respectively. Paired t-Test was applied to compare the different effect of two treatments. Correlation between nutrient content of forages on their fermentative characteristic was evaluated (Steel and Torrie, 1980).

Results and Discussion

Nutrient content of forages are shown in Table 1. Forages varied in their nutritive content. Ash and crude fiber content of grasses were higher than those of leguminous forages, but the leguminous had higher protein content. Crude fiber is the

Table 1. Nutrient Content of Various Grass and Leguminous Forages Used in an *In Vitro* Digestibility Study Using Fresh Rumen Liquor (FRL) and Mixed Bacterial Isolates (MBI).

Forages	Dry Matter	Ash	Crude Protein	Crude Fiber	Ether Extract	NFE
<i>Penisetum purpureum</i>	26.58	7.37	9.43	34.10	2.07	47.03
<i>Panicum maximum</i>	23.67	9.69	9.71	39.58	0.95	40.07
<i>Brachiaria humidicola</i>	23.73	4.96	9.24	38.88	1.47	45.45
<i>Setaria splendida</i>	10.42	9.25	14.48	44.89	1.78	29.60
<i>Paspalum notatum</i>	25.84	6.42	9.96	36.52	2.14	44.96
<i>Leucaena leucocephala</i>	27.05	0.32	24.29	27.19	3.32	44.88
<i>Calliandra calothyrsus</i>	28.42	0.22	19.53	27.48	1.52	51.25
<i>Indigofera sp.</i>	25.56	0.31	25.87	18.72	3.79	51.31
<i>Gliricidia sepium</i>	18.26	0.34	22.11	22.02	2.25	53.28
Mean	23.28	4.32	16.07	32.15	2.14	45.31
Standard deviation	5.64	4.06	6.92	8.77	0.90	7.18

most limiting factor determining the digestibility of dry and organic matter of feeds. Crude fiber of the forages varied from 18.72% to 44.89% indicating that coefficient digestibility might represent the ability of bacteria in both the mixed bacterial isolates and fresh rumen liquor in degrading the fiber component of the forages.

Table 2. Coefficient Digestibility of Dry and Organic Matter of Grasses and Leguminous Forages in an *In Vitro* Study Using Fresh Rumen Liquor (FRL) and Mixed Bacterial Isolates (MBI)

Forages	% CDDM		% CDOM	
	FRL	MBI	FRL	MBI
<i>Penisetum purpureum</i>	47.64	19.37	46.19	16.66
<i>Panicum maximum</i>	37.09	20.20	34.33	15.72
<i>Brachiaria humidicola</i>	38.14	21.60	36.81	21.41
<i>Setaria splendid</i>	42.09	22.56	39.70	18.78
<i>Paspalum notatum</i>	33.93	20.19	32.01	17.71
<i>Leucaena leucocephala</i>	54.28	53.13	50.58	49.23
<i>Calliandra calothyrsus</i>	37.24	33.87	35.12	30.36
<i>Indigofera sp.</i>	67.18	67.47	65.05	63.55
<i>Gliricidia sepium</i>	56.19	46.54	51.16	40.23
Mean	45.98 ^a	33.88 ^b	43.44 ^A	30.41 ^B
Standard Deviation	11.19	17.76	10.76	17.07

Note: Means with different superscripts differ (P<0.01)

Concentration of N-NH₃ and VFA in the filtrate of fermentation media contained grasses and leguminous forages are indicated in Tabel 3. MBI as a source of bacteria produced more N-NH₃ than FRL did. High concentration of N-NH₃ in MBI treatment indicated that bacteria in the media had less ability to convert the N-NH₃ into microbial protein.

Coefficient digestibility of DM and OM of forages determined using MBI and FRL had significant correlation (Table 4). Bacteria from MBI and FRL degraded the forages components in the different extent, resulted in different values of the coefficient digestibility of DM and OM. Dry and organic matter digestibility in MBI treatment was reduced by increasing content of N-NH₃ in the media. Coefficient digestibility of DM and OM were reduced by the increase of ash and crude fiber of the forages, but they were stimulated by the crude protein and ether extract of the forages. Ash content might represent undegradable lignin in fiber component.

Table 3. Concentration of NH₃ and VFA in the Filtrate of Fermentation Media Composed of Grasses and Leguminous Forages in an *In Vitro* Study Using Fresh Rumen Liquor (FRL) and Mixed Bacterial Isolates (MBI)

Foarges	N-NH ₃ (mM)		VFA (mM)	
	FRL	MBI	FRL	MBI
<i>Penisetum purpureum</i>	4.43	23.33	168.36	148.25
<i>Panicum maximum</i>	5.94	21.48	185.29	146.52
<i>Brachiaria humidicola</i>	3.69	22.82	214.77	178.86
<i>Setaria splendid</i>	10.40	24.02	165.35	150.46
<i>Paspalum notatum</i>	3.96	21.40	102.04	245.41
<i>Leucaena leucocephala</i>	6.63	11.60	167.00	177.00
<i>Calliandra calothyrsus</i>	4.56	9.92	199.00	152.00
<i>Indigofera sp.</i>	9.84	13.29	190.00	174.00
<i>Gliricidia sepium</i>	8.82	12.38	216.00	201.00
Mean	6.47 ^b	17.80 ^a	178.65	174.83
Standard Deviation	2.61	5.82	34.59	32.23

Note: Means with different superscripts differ (P<0.01)

Table 4. Correlations Between the Coefficient Digestibility (CD) of Dry Matter (DM), Organic Matter (OM), N-NH₃ Concentration in Fermentation Media, Ash, Crude Protein (CP), Crude Fiber (CF), and Ether Extract (EE) Content of Forages

	CD-DM-FRL	CD-DM-MBI	CD-OM-FRL	CD-OM-MBI
CD-DM-MBI	0.883 (0.002)			
CD-OM-FRL	0.995 (0.000)	0.868 (0.002)		
CD-OM-MBI	0.874 (0.002)	0.996 (0.000)	0.865 (0.003)	
N-NH ₃ -FRL	0.648 (0.059)	0.558 (0.118)	0.622 (0.074)	0.519 (0.152)
N-NH ₃ -MBI	-0.506 (0.164)	-0.787 (0.012)	-0.467 (0.205)	-0.770 (0.015)
Ash	-0.592 (0.093)	-0.818 (0.007)	-0.569 (0.110)	-0.825 (0.006)
CP	0.785 (0.012)	0.949 (0.000)	0.754 (0.019)	0.932 (0.000)
CF	-0.772 (0.015)	-0.876 (0.002)	-0.755 (0.019)	-0.867 (0.002)
EE	0.847 (0.004)	0.851 (0.004)	0.857 (0.003)	0.866 (0.003)

Note: Pearson correlation (P-Value). Fresh Rumen Liquor (FRL). Mixed Bacterial Isolates (MBI).

Conclusion

Dry matter and organic matter digestibility determined using MBI indicated the nutritive value of the forages. Therefore, MBI was possible to replace FRL in *in vitro* studies to evaluate the nutritive values of forages.

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