Feeding Value of Poor Quality Feeds in Cattle and Buffalo

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Abstract

The principal feed resources for ruminant animals in tropical regions of the world are crop residues which are supplemented relatively with a small quantity of cultivated fodder, pasture and oil cakes. The concentrates which consist largely of agroindustrial by-products, forest and aquatic waste are fed to livestock in a very limited quantity. Ruminants, because of these feed resources of poor quality, are dependent upon nutrients resulting from fermentation in the rumen. Buffalo and cattle differ in their physiological characters, as well as rumen fermentative ability and microbial concentration. These two ruminant species are economically important for both milk and draught purposes in many countries. Their relative ability to utilize poor quality roughage is worth studying.

It has been observed that dry matter intake per metabolic body size by adult buffalo (74.8g) is generally lower than that of cattle (80.4g), while the digestibility of dry matter and crude fiber varies considerably betwen them depending on the source of roughage. The digestibility of other components of the feed does not vary significantly. The buffaloes are considered to utilize better feed energy, because of their lower feed intake (74.8 g versus 80.4g/$W^{0.75}$ kg) and lower basal metabolic rate (68 kcal versus 82 kcal/$W^{0.75}$ kg) compared to cattle for maintaining their liveweight.

The superiority of buffalo over cattle in terms of microbial population and ammonia concentration in the rumen has also been observed. The rumen protozoal ($x10^5$/ml) and bacterial ($x10^8$/ml) counts for cattle and buffalo are 1.15, 1.59 and 13.2, 16.2, respectively. The ammonia contents in the rumen are significantly higher in buffalo (12.8 mg/100ml) than in cattle (10.1 mg/100ml). However no differences were detected between these two species in other nitrogenous constituents and volatile fatty acids. The microbial enzymes such as cellulase and transaminases in the rumen have also been assayed in both cattle and buffalo.

Introduction

The principal feed resources for ruminant animals in most of the tropics are crop residues (Table 1) which are supplemented with a small quantity of cultivated fodder, pasture or aquatic and forest wastes. The concentrates which consist largely of agro-industrial by-products with a limited quantity of coarse grains and oil cakes or meals are fed to livestock in a very small amount. Ruminants, because of these poor quality feed resources, are primarily dependent upon nutrients resulting from their fermentation in the rumen. Therefore, the efficiency of utilization of these poor quality feeds and fodder by ruminants for maintenance and production purposes depends not only on the feed quality, but also on

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Table 1 Chemical composition of fibrous and proteinous feeds

Feeds	CP	NDF	ADF	CLSE	HCLSE	LGN	SLCA
Straw/Stover							
Wheat	3.7	75.9	54.4	34.8	21.5	10.9	10.0
Paddy	4.6	69.1	53.9	31.8	15.2	8.3	14.2
Gram	5.3	62.1	49.9	30.8	12.2	9.2	3.6
Pearl millet	2.1	76.9	54.3	37.7	22.6	7.9	7.3
Sorghum	2.4	75.1	47.1	37.9	28.0	4.6	4.6
Sugarcane bagasse	2.1	92.5	63.8	48.9	28.7	11.1	3.7
Oat	3.3	73.1	49.7	34.1	23.4	9.6	4.2
Berseem	16.1	61.7	50.6	38.0	11.1	11.6	1.2
Alfalfa	18.6	44.8	31.5	22.6	13.3	7.2	1.6
Cakes/Meals							
Cotton seed	22.0	64.3	40.4	36.2	23.9	3.9	–
Rape seed	35.0	50.3	20.0	14.3	30.3	3.7	–
Sesame seed	41.1	45.2	21.4	9.1	23.8	5.9	–
Cluster bean	40.4	39.2	17.7	7.8	21.5	7.4	2.7
Peanut	39.3	31.5	19.5	9.2	12.0	7.5	3.1

factors associated with the rumen ecosystem.

Ruminants have an inherent ability to subsist on cellulosic material and gainfully utilize microbes and other metabolic products of the rumen to meet their nutrient requirements. However, all the ruminants do not behave in the same way in utilizing the high fiber and low protein feeds. While it has been generally considered that buffalo is a better utilizer of dietary fiber components and nitrogen compared to cattle (Razdan *et al.*, 1971; Grant *et al.*, 1974: Krishna *et al.*, 1985; Sangwan *et al.*, 1987), some reports suggest that there is no such difference between these species (Balasubramanya and Raghavan, 1977; Gupta *et al.*, 1984). Cattle and buffalo are economically important for milk, meat and draught purposes in many countries. Therefore, their relative ability to utilize poor quality feeds and fodder is worth studying. This paper describes the current research findings on the feeding value of highly fibrous diets in cattle and buffalo based on a large number of experiments conducted in our laboratory.

In vitro and *in sacco* feed dry matter digestibility

The degradation of feeds normally available to large ruminants was studied *in vitro* and *in sacco* utilizing the rumen contents of fistulated adult cattle and buffaloes. The data are presented in Tables 2–4. Of the various feeds, berseem hay exhibited the highest IVDMD in cattle and buffalo (58, 60%), followed by wheat straw-alfalfa hay (57, 59%) and wheat straw-peanut meal (54, 52%). The digestion of other feeds varied from 15 to 51% in both species (Table 2), with the lowest value for sugarcane bagasse which may be attributed to its highly fibrous (92% NDF, 64% ADF and 11% lignin) nature (Table 1). Of the two abundantly available roughages, the IVDMD value seemed to be higher in wheat straw compared to paddy straw in both ruminant species. The overall IVDMD digestibility of feeds (43.1, 42.9%) did not exhibit any difference between cattle and buffalo, which is further demonstrated by the *in sacco* data (Tables 3 and 4). Irrespective of the supplementation of roughages or roughage-protein to the diets at various levels, the overall *in sacco* degradabilities of feeds in cattle and buffalo were similar (48.2, 49.3% and 54.8, 54.3%). These observations were contrary to the views expressed earlier by Ichhponani *et al.* (1962).

The degradability of paddy straw (59.0, 58.4%) was higher than that of wheat straw (51.7,

Table 2 ***In vitro*** **dry matter digestion of various feeds (%)**

Feeds	Cattle	Buffalo
Wheat straw	40.3 ±1.35	38.3±0.61
Paddy straw	29.0 ±2.18	27.8±1.52
Gram straw	51.7 ±1.60	48.4±2.33
Pearl millet stover	35.2 ±4.95	38.2±2.21
Sorghum stover	35.8 ±3.80	36.1±3.00
Sugarcane bagasse	15.2 ±1.31	16.3±2.60
Oat hay	38.9 ±3.36	36.5±4.55
Berseem hay	58.1 ±0.94	59.9±1.84
Wheat straw - Alfalfa hay	56.7 ±1.06	58.7±2.29
Wheat straw - Berseem hay	49.7 ±0.99	50.5±0.71
Wheat straw - Peanut meal	54.2 ±3.03	51.8±2.35
Wheat straw - Rapeseed meal	48.9 ±0.61	48.7±0.28
Wheat straw - Cotton seed	46.9 ±0.21	47.3±0.33
	43.12±3.36	42.9±3.37

Table 3 ***In sacco*** **feed dry matter disappearance (%, 48hr)**

Feeds	Cattle	Buffalo
Wheat straw	51.7±2.62	50.7±1.24
Paddy straw	59.0±1.02	58.4±1.43
Gram straw	55.7±1.09	55.7±1.88
Pearl millet stover	42.7±1.91	41.5±2.42
Sorghum stover	47.8±2.51	47.0±1.92
Sugarcane bagasse	28.1±2.04	29.4±0.76
Oat hay	37.5±2.30	46.1±4.82
Berseem hay	62.3±0.82	58.7±2.82
Wheat straw - Alfalfa hay	54.7±2.45	54.8±1.26
Wheat straw - Peanut meal	42.2±1.51	50.7±2.77
	48.2±1.51	49.3±2.77

Table 4 ***In sacco*** **seed dry matter disappearance (48 hr) in relation to level and source of proteins (%)**

Feeds (CP%)	Cattle	Buffalo
Wheat straw (4.7)	48.5±0.87	49.8±0.92
Paddy straw (4.4)	57.6±0.76	56.9±0.10
Sorghum stover (2.4)	49.2±2.70	46.1±2.74
Oat hay (4.1)	51.0±0.70	50.3±1.33
Wheat straw - Peanut meal (12.0)	56.4±0.97	55.7±1.13
Wheat straw - Peanut meal (16.0)	60.0±1.34	59.4±1.52
Wheat straw - Bean meal (12.0)	55.0±0.77	56.0±0.53
Wheat straw - Bean meal (16.0)	60.6±0.68	59.5±1.50
	54.8±1.68	54.3±1.76

50.7%) and the sugarcane bagasse showed the lowest degradability (28.1, 29.4%) in both ruminant species. The supplementation of protein meals to wheat straw improved the degradability of straw dry matter in cattle and buffalo without showing differences due to species (Table 4). The observations in *in vitro* and *in sacco* studies (Tables 2 and 3) are not comparable due to inherent differences during the process of feed digestion.

Feed consumption and digestion pattern

Adult cattle, when maintained on poor quality roughage (wheat or paddy straw) combined, either with cluster bean meal, or sesame meal invariably ate more ($P<0.01$) feed dry matter per unit body weight or body size compared to buffalo (Table 5). There were no variations among the diets. However, Prasad and Pradhan (1990) earlier reported a higher intake of feeds per unit body weight/size by buffalo compared to cattle which received wheat straw-concentrate or gram straw-concentrate diets in various proportions. The overall average feed dry matter intake and digestibility are presented in Table 6. It was revealed that buffalo ate a larger quantity of total feeds than cattle, but the feed consumption per unit body weight or metabolic body size was lower in buffalo (1.58%, 74.89g) compared to cattle (1.78%, 80.49g). Based on a number of feeding experiments it has been amply demonstrated that the dry matter intake per unit body weight or body size remained usually lower in

Table 5 Dry matter *ad lib* intake and nutrient digestibility of straw-protein meal diets

Feed parameters	WS-CM		WS-SM		PS-CM		PS-SM	
	C	B	C	B	C	B	C	B
DMI (kg/day)	8.7	9.0	8.0	6.9	9.4	8.6	9.1	7.5
DMI (% BW)	2.1	1.7	2.1	1.6	2.2	1.6	2.1	1.4
DMI ($g/W^{.75}$ kg)	95.0	81.0	95.0	80.0	101.0	77.0	98.0	65.0
Digestibility (%)								
DM	57.8	55.7	53.9	53.3	57.1	57.1	56.1	56.6
CP	71.6	75.2	71.9	72.6	72.1	73.4	72.8	72.5
NDF	56.8	55.5	52.4	52.0	54.9	55.3	56.2	58.0
ADF	49.6	49.4	47.0	46.9	48.7	49.9	47.7	51.8
Cellulose	52.9	47.9	49.4	49.1	54.1	57.1	55.4	57.5
Hemicellulose	74.2	70.7	67.3	66.5	69.1	74.7	66.8	71.5

Table 6 Dry matter intake and nutrient digestibility of roughage-protein meal diets (overall average)

Feed parameters	Cattle	Buffalo
DM intake (DMI)		
DMI (kg/day)	7.2 (6.5 - 8.9)	7.7 (5.2 - 8.6)
DMI (% BW)	1.78(1.65- 2.06)	1.58(1.37- 1.82)
DMI ($g/W^{0.75}$kg)	80.4 (73.4 -97.2)	74.8 (60.4 -84.6)
Digestibility (%)		
DM	54.5 (49.4 -56.6)	55.2 (49.4 -59.3)
CP	55.2 (39.9 -72.1)	59.9 (37.8 -73.5)
NDF	52.2 (47.0 -56.4)	53.5 (47.5 -57.4)
ADF	43.7 (39.7 -48.2)	44.9 (39.7 -49.5)
Cellulose	49.2 (38.0 -54.2)	49.7 (36.7 -49.5)
Hemicellulose	70.6 (67.3 -75.0)	69.2 (53.3 -74.7)

buffalo than in cattle. Similar observations have also been reported by Sebastian *et al.* (1970), Grant *et al.* (1974), Bhatia *et al.* (1979), Chopra and Kurar (1983) and Sangwan *et al.* (1987). However, Kennedy (1989) observed variable intake values in cattle and buffalo due to the nature of feeds. It has been reported that buffalo (68kcal) has a lower basal metabolic rate compared to cattle (82kcal/$W^{0.75}$ kg) for maintaining the liveweight (Khan *et al.*, 1990), resulting in a better feed energy utilization. The relative average dry matter and fiber digestibility values were not consistent between these two species when they were fed straws and supplemented protein sources (Table 6), though the trend remained slightly higher in favour of buffalo.

Rumen metabolic activities are influenced by the nature of the diets, the microorganisms in the rumen and the animals' physiological status. Using two sources of fiber and two sources of proteins, it has been shown that in buffalo the content of rumen ammonia nitrogen was relatively higher ($P<0.01$) than in cattle. The higher concentration of rumen ammonia due to peanut meal compared to cluster bean meal diets was observed in both ruminant species (Table 7). The higher concentration of rumen ammonia may reflect a higher activity of intracellular deaminases and/or high salivary recycling of urea in buffalo. The volatile fatty acid contents in the rumen were not affected by the ruminant species or dietary regimen.

Total ruminal nitrogen content was higher in buffalo than in cattle due to the diets ($P<0.05$) except in the wheat straw-peanut meal diet which showed a reverse trend. The overall average values of rumen metabolites presented in Table 8 revealed that the rumen nitrogen values tended to be higher in buffalo than in cattle. While the total volatile fatty acid content was apparently higher in buffalo (116.9 meq/l) than in cattle (109.4 meq/l), the proportions of acetic, propionic and butyric acids remained unchanged between these two ruminant species. Thus, no significant differences in the overall rumen nitrogen fractions except for ammonia N ($P<0.01$) and volatile fatty acids were detected between cattle and buffalo. These observations do not support the reported values of higher rumen protein contents (Mudgal, 1969) and total volatile fatty acids (Sebastian *et al.*, 1970) in buffalo compared to cattle.

Table 7 Rumen metabolites in cattle and buffalo fed straw-protein meal diets

Metabolites	OH-CM		OH-PM		WS-CM		WS-PM	
	C	B	C	B	C	B	C	B
Nitrogenous (mg/100ml)								
Total	90.2	100.0	95.2	100.2	67.0	75.6	66.4	62.7
Ammonia N	9.6	11.5	11.5	13.4	8.3	12.1	11.4	14.5
Protein N	23.7	34.5	33.6	32.0	28.6	29.2	22.6	27.4
VFA (meq/l)								
Total VFA	164.1	183.9	199.9	177.4	157.9	154.0	156.7	166.6
Acetate (%)	129.3 (78.8)	143.2 (77.8)	157.0 (78.5)	138.4 (78.0)	127.0 (80.4)	122.2 (79.2)	124.2 (79.2)	132.3 (79.2)
Propionate (%)	21.4 (13.0)	25.7 (14.0)	26.2 (13.1)	26.3 (14.8)	22.9 (14.5)	22.7 (14.7)	20.6 (13.2)	25.7 (15.4)
Butyrate (%)	9.8 (6.0)	12.1 (6.6)	12.5 (6.2)	12.2 (6.9)	6.8 (4.3)	7.0 (4.5)	7.1 (4.5)	7.4 (4.4)
Others (%)	3.6 (2.2)	2.9 (1.6)	4.2 (2.2)	0.5 (0.3)	1.2 (0.8)	2.5 (1.5)	4.8 (3.1)	1.2 (1.0)
Rumen pH	6.7	6.6	6.4	6.6	6.7	6.8	6.8	6.8

Table 8 Rumen metabolites in cattle and buffalo fed roughage-protein meal diets (overall average)

Metabolites	Cattle	Buffalo
Nitrogenous (mg/100 ml)		
Total	79.3(48.8-114.1)	82.9(55.0-109.8)
Ammonia N	9.8(6.1- 12.3)	12.1(6.8- 14.5)
Protein N	34.7(26.6- 48.4)	36.6(27.4- 42.4)
VFA (meq/l)		
Ttal VFA	109.4(75.7-199.9)	116.9(87.5-183.9)
Acetate	85.8(58.0-157.0)	91.3(67.3-143.2)
Propionate	13.9(9.6- 26.2)	14.9(9.5- 26.3)
Butyrate	5.7(3.9- 12.5)	6.0(4.7- 12.2)
Rumen pH	6.9(6.4- 7.1)	6.9(6.6- 7.1)

Eating pattern and rumen outflow rate

It has been stated earlier that irrespective of the nature of the diets, the daily feed intake per unit body weight was considerably lower in buffalo than in cattle (Table 6). The data in Table 9 further revealed that buffaloes, both young and adult, were slow eaters compared to cattle when maintained on a wheat straw-peanut meal diet. This pattern changed when berseem hay was fed to them. While growing buffalo exhibited a similar trend of eating pattern, adult buffalo ate berseem hay faster during the early hours of feeding compared to cattle. It is estimated that on an average 33.6 and 40.0% feed dry matter was consumed by buffalo and cattle, respectively up to the first 4 hours of feeding of wheat straw-peanut meal diet, reflecting subsequent ingestion of a larger portion of the diet. In contrast, adult buffaloes ate 78% of offered berseem hay in the first 4 hours of feeding which is considerably higher than what was observed in cattle (57%) during that period. These observations suggest that the eating behaviour of buffalo campared to cattle is different and requires further investigations.

Rumen volume and rumen outflow rate showed an inverse relationship ($P<0.05$) between cattle and buffalo maintained on wheat straw-berseem hay diet (Table 10). The outflow rate was slower in buffalo (46.5 l/day) than in cattle (51.8 l/day) which may probably result in an enhanced nutrient digestibility in the former species (Bhattacharya and Mullik, 1965).

Table 9 Eating pattern (% of feed consumed) in cattle and buffalo in relation to nature of diets

Diets	Feeding	Cattle		Buffalo	
		Adult	Growing	Adult	Growing
WS-PM	First 4 hrs.	46.0	37.2	33.6	34.0
	Subsequent hrs.	54.0	62.8	66.4	66.0
BM-HAY	First 4 hrs.	57.8	63.1	77.9	56.8
	Subsequent hrs.	42.2	36.9	22.1	43.2

Table 10 Rumen fluid outflow rate in cattle and buffalo fed wheat straw-berseem hay diets

	Cattle	Buffalo
Rumen volume		
Total (*l*)	24.5±6.3	33.7±0.99
% Body Wt.	6.1	6.8
Outflow to omasum		
l/hr	2.2±0.07	1.9±0.08
l/day	51.8±2.10	46.6±1.92
% Rumen volume	8.8±0.34	5.8±0.19

Rumen microbial enzymes

The relative activities of the ruminal ammonia assimilatory enzymes in the microbial fraction in cattle and buffalo under various dietary regimes were assayed and their specific activities are presented in Table 11. The ammonia in the rumen which is the end-product of the degradation of dietary proteins is assimilated through a microbial amination reaction involving glutamate dehydrogenase (GDH). The specific activities of GDH in the rumen microbes were apparently higher due to the administration of paddy straw diets versus wheat straw diet in both species. No differences in the species were detected. However, Bhatia *et al.* (1978) reported a higher activity ($P<0.05$) of GDH in cattle than in buffalo fed wheat straw-alfalfa hay concentrate diet. The occurrence of GDH activity in the rumen liquor of both ruminant species suggests the involvement of an amination reaction through microbes for the fixation of ammonia in α-ketoglutarate.

While the specific activities of microbial glutamate oxaloacetate transaminase (GOT) and glutamate pyruvate transaminase (GPT) did not differ among the diets, the GOT activities were higher in buffalo than in cattle ($P<0.01$) which is in contrast with the pattern of both transaminases of rumen microbes in these ruminants reported earlier by Bhatia *et al.* (1988), Pradhan *et al.* (1990) and Prasad and Pradhan (1990).

Table 11 Specific activities of rumen microbial enzymes

Feeds	Animals	Enzymes				
		GDH	GOT	GPT	AsS	GlS
WS-CM	Cattle	125.9	99.2	110.8	6.57	2.39
	Buffalo	97.6	122.4	126.6	5.79	1.90
WS-SM	Cattle	112.6	103.5	140.0	6.00	2.33
	Buffalo	115.2	115.8	135.9	5.70	2.08
PS-CM	Cattle	110.5	97.8	120.6	5.53	1.98
	Buffalo	131.0	112.7	123.5	5.67	2.13
PS-SM	Cattle	140.9	84.8	110.0	6.39	2.09
	Buffalo	159.3	118.2	134.2	7.09	2.64

Note : GDH - Glutamate dehydrogenase (Units/mg protein)
GOT - Glutamate oxaloacetate transaminase (μg Pyruvate/mg protein)
GPT - Glutamate pyruvate transaminase (μg Pyruvate/mg protein)
AsS - Asparagine synthetase (μM β-Aspartyl hydroxymate/mg protein)
GlS - Glutamine synthetase (μM γ-Glutary hydroxymate/mg protein)

The activities of glutamine synthetase and asparagine synthetase were found to be low and almost identical in cattle and buffalo (Table 11). The similarity mostly observed in the rumen protein level of cattle and buffalo (Table 8) may be attributed to the role of these enzymes in the protein synthesis in the rumen. It was observed that asparagine synthetase showed a higher specific activity than glutamine synthetase in both cattle and buffalo. These two intracellular microbial enzymes in the rumen which have not been extensively assayed, are reported to anabolize the ruminal ammonia at a considerably low concentration (Smith *et al.*, 1980). Since the amination and transamination reactions may be the major mechanisms

Table 12 Rumen microbial population in cattle and buffalo fed wheat straw-concentrate diet

Microbes	Cattle	Buffalo
Total protozoa ($\times 10^5$/ml)	1.15	1.59
Total viable bacteria ($\times 10^8$/ml)	13.2	16.2
Cellulolytic bacteria ($\times 10^8$/ml)	2.58	6.86
% of Viable bacteria	20.00	42.00
Proteolytic bacteria ($\times 10^8$/ml)	0.41	0.54
% of Viable bacteria	3.00	3.00
Amylolytic bacteria ($\times 10^8$/ml)	8.63	11.05
% of Viable bacteria	65.00	68.00

Source : Pradhan, 1991.

Table 13 Ruminal bacteria and protozoa population with their generic distribution (%) in relation to wheat straw-peanut meal diets

Microbiota	Cattle	Buffalo
Bacteria ($\times 10^8$/ml)		
Total viable	13.20	16.20
Cellulolytic	2.58	6.86
Proteolytic	0.41	0.54
Amylolytic	8.63	11.05
Protozoa ($\times 10^5$/ml)		
Total Ciliates	1.15	1.59
Holotrichs	13.84	10.81
Isotricha	5.64	4.24
Dasytricha	4.60	4.53
Charon	2.57	1.40
Blepharoprosthium	1.03	0.64
Entodiniomorphs	86.14	89.19
Entodinium	77.91	78.87
Diplodinium	1.61	2.45
D. crystagalli	Absent	0.64
Diploplastron	1.92	1.16
Ostracodinium	1.35	2.08
Ophryoscolex	1.10	Absent
Epidinium	0.84	1.06
E. ecaudatum	0.42	Absent
Eudiplodinium	0.20	0.95
Metadinium	0.15	1.22
Polyplastron	1.16	0.76

of ammonia assimilation in the rumen, it would be important to isolate microbial species exhibiting maximum enzyme profiles in terms of ruminal ammonia fixation and transamination process for application to the increase of microbial protein synthesis in the rumen.

Ruminal bacteria and protozoa

The rumen microbial pattern in cattle and buffalo was extensively studied by maintaining these animals on poor quality straw based diets (12–14% CP). The bacterial and protozoal populations in terms of most probable number (MPN) are presented in Table 12, which revealed the existence of higher rumen bacterial and ciliate protozoal populations ($P<0.05$) in buffalo (16.2, 1.59) than in cattle (13.2×10^8/ml, 1.15×10^5/ml). The distribution of the microbes according to physiological characteristics in bacteria (Table 12) or generic identification in protozoa (Table 13) was also higher in buffalo compared to cattle. Some of the ciliates were conspicuous by their absence in cattle and buffalo. In some studies it has been suggested that higher bacterial populations including cellulolytic ones caused an increase in the dry matter and cellulose digestibility in buffalo compared to cattle (Nath, 1976). In our studies these differences were not correlated with the dry matter or nutrient digestibility, thus, suggesting that factor(s) other than the microbial populations exert an influence on feed digestibility (Varel, 1987).

Summary

The principal feed resources for ruminant animals in most of the tropics are crop residues which are supplemented with a small quantity of cultivated fodder and pasture. The concentrates which consist largely of agro-industrial by-products with a limited quantity of coarse grain and oil cakes are fed to livestock in a very small amount. Therefore, the efficiency of utilization of these poor quality feeds and fodder by ruminants for maintenance and productive purposes is dependent upon the nutrients resulting from their fermentation in the rumen and also other factors associated with both feeds and animals.

The data based on a large number of feeding trials demonstrated that buffalo consumed a lower amount of poor quality feeds per unit body weight (1.58%) or metabolic body size (74.9g) compared to cattle (1.78%, 80.5g). The buffalo, irrespective of its physiological growth status, is a slow eater. Adult buffalo raised on good quality forage, however, eats faster than cattle. The feed dry matter digestibility values were largely diet-dependent. There were no significant differences in the digestibility of feeds between the two animal species. Likewise the trend in nutrient digestibility in cattle and buffalo was also inconsistent. The buffaloes are considered to utilize better feed energy, due to their lower feed intake (74.8g versus 80.5g/$W^{0.75}$kg) and lower basal metabolic rate (68 kcal versus 82kcal/$W^{0.75}$kg) as compared to cattle for maintaining their liveweight. Of all the rumen metabolites studies, a higher level of ruminal ammonia nitrogen was invariably observed in buffalo (12.1mg%) than in cattle (9.8mg%) suggesting a larger increase in the deaminase activities and/or a slow outflow rate of the rumen fluid in buffaloes.

While the rumen bacteria (16.2 versus 13.2×10^8/ml) and ciliate protozoa (1.59 versus 1.15×10^5/ml) counts including cellulolytic, proteolytic and amylolytic bacteria remained larger in buffalo, the microbial enzyme activities (GDH, GOT, GPT, asparagine synthetase and glutamine synthetase) generally showed no differences between cattle and buffalo.

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Discussion

Kudo, H. (Japan) : Have you compared the cellulase activities of pure cellulolytic bacteria isolated from buffalo and cattle?

Answer : Yes in a limited number of studies. We did not observe any difference between cattle and buffalo and we are pursuing studies in that area. We are struck by the fact that the energy utilization for maintenance is more efficient in buffaloes than in cattle.

Homma, H. (Japan) : Can you explain why the concentration of ruminal ammonia and microbial populations is higher in buffaloes though the DM intake is lower in buffaloes than in cattle?

Answer : We cannot explain this phenomenon based on the current information available. However the higher proteolytic activities of rumen microbes combined with the slower outflow rate of the rumen fluid from the reticulo-rumen to the omasum may contribute to the higher concentration of ammonia in the rumen of buffaloes compared to cattle.