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EFFECT OF RUMEN MICROFLORA OF BUFFALO AND CATTLE ON DIGESTION OF SOME ROUGHAGES

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ABSTRACT

This study was carried out to compare the effect of buffalo and cows rumen fluid on the digestibility of some common roughages. Ruminally fistulated bullocks (3 buffalo and 3 cattle) weighing 550 to 650 kg on the average were used as donors of rumen fluids and rumen bacteria. The animals were fed on (roughages) as berseem hay (BH), rice straw (RS) in addition to concentrate feed mixture (CFM) to cover maintenance allowances of the animals. *In situ* incubation was carried out for the experimental feedstuffs [berseem hay (BH) , wheat straw (WS), rice straw (RC), corn stover (CS), date seed (DS) and concentrate feed mixture (CFM)] in the rumen of buffaloes and cows. Pure cellulose, cotton fiber, filter paper, carboxymethyl cellulose (CMC) and xylan were also subjected to the same treatments. The results could be summarized as follows: The summative analysis of feedstuffs used in this study were within the normal ranges. Berseem hay is considered as high quality roughage, it has high CP (13.36%) and low CF (28.88%) contents, compared with other roughages tested. Date seeds are characterized by relatively high EE (7.98%) and NFE (63.97%) and low ash (3.08%) contents compared with other roughages.

The dry matter disappearances (DMD) as loss of weight and percentage of the synthetic polysaccharides (CMC and xylan), natural cellulosic materials and date seeds after incubation for 6 hours in buffalo and cattle rumen were significantly ($P < 0.01$) higher in buffalo than in cattle rumen. The DMD was, in general, significantly ($P < 0.01$) higher in case of synthetic materials than in natural cellulosic materials. The relative DMD of all feedstuffs tested was higher following incubation of samples in the buffaloes rumen compared with cattle rumen, and in both cases the magnitudes of DMD could be arranged according to the following descending order: CFM > BH > CS > DS > WS > RS >. The DMD % in all tested feedstuffs was significantly ($P < 0.05$) increased with increasing incubation period from 6 up to 96 hours in the rumen of both buffalo and cow. The same trend was observed in the case of OM>CP>EE>CF>NFE and ash disappearance. All CF fractions disappearance in all tested roughages were significantly ($P < 0.05$) higher when samples were incubated in buffalo rumen than in cattle rumen. All CF fractions disappearances except ADL in berseem hay were significantly ($P < 0.01$) higher compared with the other roughages in both buffalo and cattle rumen.

Rumen pH value in both buffalo and cattle was within the normal range (6.70-

7.57) without any significant differences among buffalo and cattle. The total number of bacteria was 1.5 x 10^9 and 1.48 x 10^9 cell/ml in rumen fluid of buffalo land cattle, respectively. Rumen microflora in buffalo proved to be more efficient in degradation of plant tissue than in cow and consequently, it can be possible to incorporate high levels of low quality roughage during formulation buffalo rations than that of cattle rations. Thus, the cost of feeding to produce one unit of production would be reduced in case of buffalo rather than for cow.

Keywords:*Nutrient disappearances. Rumen microflora, in situ technique.*

INTRODUCTION

Ruminants evolved the ability to utilize vegetative plant materials as their sole source of nutrients (Hofmann, 1989). Unlike seeds, vegetative tissues contain a large percentage (35 to 80%) of their organic matter in the walls that provide structural integrity to the plant (Jung and Allen, 1995). The rumen allows utilization of forages through a symbiotic relationship with microorganisms by anaerobically fermenting the polysaccharides in plant cell wall.

It should be pointed out that about 14 million tons of roughages and agricultural by-products are available annually in Egypt (El-Shinnawy, 1998), but unfortunately, they are not properly fully utilized. Roughages are mainly characterized by their high content of CF and low N content and to varying extents in minerals and vitamins. El-Ayouty (1991) reported that the poor quality roughages are divided into 2 categories: cereal straws and legumes. The cereals straws were higher in energy especially with stalks than legumes, but CF % of legumes were higher than cereal by-products. Legume cell walls have relatively larger amounts of cellulose compared to xylans than that observed for grasses. Esters of P-cumaric acid to lignin seem to be present in all forages with higher concentrations in grasses than legumes (Aman, 1993). Consequently, voluntary feed intake from each feed is very limited as a reflection of their low digestibility and their slow out flow rate from the rumen (increased gut fill), in other words their slow rate of fermentation in the rumen with subsequent low microbial protein synthesis.

This study was carried to investigate the effect of rumen fluid from buffaloes and cattle on the digestibility of some common roughages.

MATERIALS AND METHODS

The present work was carried out at the Department of Botany, Faculty of Science, Mansoura University, Sakha Anim. Prod. Res. laboratories and Ismailia Agric. Res. Station, Animal Prod. Res. Institute.

Six ruminally fistulated bullocks (3 buffalo and 3 cattle) weighting 550 to 650 kg were used to incubate experimental feedstuffs in their rumen. Rumen fluid and contents were taken from each animal through the fistula by suction pump for the liquid portion, and by hand grasp for the solid portion, and brought back to the laboratory in filled packed vessels (Masuda *et al.*, 1992 and Wanderley *et al.*, 1993).

Five feedstuffs were used in this investigation to represent the high quality roughages berseem hay (BH) and the low quality roughages wheat straw (WS), rice straw (RS), corn stover (CS) and date

seed (DS) which vary in the fiber content and its fractions, in addition to common concentrate feeds mixture (CFM). Also three natural cellulosic materials and two synthetic polysaccharides (pure cellulose, cotton fiber, filter paper, carboxymethyl cellulose-sodium salt (CMC-Na) and xylan), were used in this study.

During the experimental period all animals were individually fed similar ration and the level of feeding was at maintenance requirement according to NRC (1989) allowance. Ration contained concentrate feed mixture (CFM), rice straw (RS) and berseem hay (BH). Concentrate feed mixture was offered twice daily at 8.0 a.m. and 5.0 p.m., berseem hay once daily at 9.0 a.m., while rice straw was given from 10.0 a.m. to 4.0 p.m. Fresh water was offered to the animals three times daily.

The *in situ* technique was carried out as described by Cherney *et al.*, 1990; Hussein *et al.*, 1991 and Bowman and Firkins, 1993 to study the effect of rumen fluid on digestibility of cellulosic and hemicellulosic substances. A6-cm x 10-cm dacron polyester bags with an average pore size of 52 $\pm$ 16 µm were used. Samples of experimental feedstuffs and materials were ground using a mechanical grinder, screened through a 1-mm screen and 2.5 gm were weighed into each bag. Bags were tied to nylon lines and were weighed at one end. Bags were removed from the rumen 6, 12, 24, 48, 72 and 96 hr post-immersion, washed with water and squeezed until the runoff was clear. Bags were then dried and weighed. The *in situ* technique was conducted on two consecutive days to obtain triplicate measurements. After 3 weeks of feeding all animals ruminal fluid were collected for two successive days, at six different intervals (just before feeding: zero time) and at 1, 3, 6, 9 and 12 hours post feeding to determine ruminal pH using Orian 680 digital pH meter.

For isolation of bacteria, ruminal contents were taken 6 hours after feeding and total count of bacterial cells were determined by direct microscopic count using haemocytometer technique as described by Bryant and Burkey 1953 and Fluharty *et al.*, 1996.

Representative samples for tested feedstuffs were analysed for dry matter (DM), crude protein (CP), crude fibers (CF), ether extract (EE) and ash content, following the methods of AOAC (1980), while fiber fractions were determined according to the methods described by Goering and Van Soest, 1970), using Tecator Fibertic system.

All collected data were subjected to the statistical analysis as the usual technique of analysis of variance (ANOVA) as described by Steel and Torrie (1980) and was carried using IRRISTAT software version 3193 (Biometric Unit. International Rice Research Institute, Manila, Philippine).

RESULTS AND DISCUSSION

The summative analyses of the experimental roughages (Table 1) were within the normal published ranges (El-Ayouty, 1991, Abou El-Nor and Kholif, 1995; Maklad, 1996; Abdou 1996 and Ead, 1999). As shown in Table 1 Berseem hay is considered as a high quality roughage compared with other roughages tested it has high CP (13.36%) and low CF (28.88%) contents while it has suitable content of NFE (45.84%) and ash (10.80%). Date seeds are characterized by relatively high EE (7.98%), NFE (63.97%) and low ash (3.08%) contents compared with other roughages tested. The ash content of RS was higher (15.4%) than that of the other roughages. This could be a false

indication since it may be partly due to the possibility of its contamination with soil during storage or transportation. However, this inversely reflects on their organic matter (OM) contents.

The CP of corn stover was not adequate for ruminant microbial breakdown of ingested forage while the CF content as for other forages is high, being 39.01% on average that agree with Sundstϕl (1988).

Although DS showed the lowest content of CF (18.13%) compared with other roughages tested. It appeared to have the highest content of lignin (13.80%). The great hardiness of DS may be related to its high content of lignin, therefore, the date seeds are very hard to grind in an ordinary harmmer mill (El-Shazly *et al.*, 1963 and Barreveld, 1993).

Concerning CF fractions Table (1) cleared that BH contained the lowest value of NDF (73.30%), ADF (50.80%), hemicellulose (22.50)% ADL (5.95%) compared with other roughages tested. The content of NDF and ADF in the tested roughages ranged from 73.3 to 81.00% and 50.80 to 56.00% in BH and DS, respectively. While the content of cellulose and hemicellulose ranged from 42.20 to 47.98% in DS and WS and from 22.50% to 28.10% in BH and RS, respectively. Moreover, BH had the lowest content of acid detergent lignin (5.95%) while DS recorded the highest content (13.80%), while the other roughages had intermediate values. In general fiber fractions content of tested roughages in this investigation were within the normal published ranges (Leslie and Fahey 1994, Abdou, 1996 and Ead 1999).

Fiber fractions (i.e. NDF and ADF) are analytical products having nutritional characteristics that describe those forage components that have low solubility in specific solvent systems and are relatively less digestible than starch. Lignin has been considered to be the major component of the plant cell wall that limits the digestion of the cell wall polysaccharides in the rumen (Jung and Deetz, 1993). More recent work on several forage types indicated a negative correlation of lignin concentration with rate of NDF digestion. The effect of lignin on fiber digestibility has been shown to be greater in grasses than in legumes (Smith *et al.*, 1972 and Buxton & Russell, 1988).

As shown in Table (2) the DM disappearance (as percentage) of synthetic polysaccharides and natural cellulosic materials tested after incubation in buffaloes rumen were significantly ($P < 0.01$) higher than those incubated in cattle rumen. The DM disappearance (as percentage) was, generally, greater ($P < 0.01$) in synthetic polysaccharides (xylan and CMC) than in natural cellulosic materials (pure cellulose, cotton fiber, filter paper, date seed). Xylan and CMC recorded the highest values, which ranged from 97.10 to 97.20% and from 80.40 to 84.10% when incubated in both buffalo and cattle rumens, respectively. While the natural cellulosic materials (pure cellulose, cotton fiber, filter paper and date seed) showed the lowest values of DMD in both buffalo and cattle rumens which ranged from 14.10 to 48.30% and 12.20 to 40.70% after 6 hours of incubation, respectively, Prins (1977) and Kamra and Pathak (1996) reported the degradation of crystalline cellulose, was most difficult than the other materials. The DMD% of natural and synthetic materials could be arranged according to the following descending order, concerning their disappearance percentage: xylan > carboxymethyl cellulose > cellulose powder > filter paper > cotton fiber > date seed powder

Table (1) : Chemical composition of the experimental roughages.

Item	BH	WS	RS	CS	DS
DM %	**92.80**	**91.98**	**93.33**	**91.05**	**95.61**
Composition of DM %					
OM	89.80	89.97	84.60	90.31	96.92
CP	13.36	2.09	3.00	4.52	6.84
EE	1.72	0.71	0.87	1.76	7.98
CF	28.88	38.95	35.91	39.01	18.13
NFE	45.84	48.22	44.82	45.02	63.97
Ash	10.20	10.03	15.40	9.69	3.08
Crude fiber fractions %					
NDF	73.30	79.20	80.10	80.50	81.00
ADF	50.80	55.10	52.00	54.00	56.00
Cellulose	44.85	47.98	45.05	46.00	42.20
Hemicellulose	22.50	24.10	28.10	26.50	25.00
ADL	5.95	7.12	6.95	8.00	13.80

NDF: Neutral detergent fiber
ADF: Acid detergent fiber
ADL: Acid detergent lignin

Table (2) : Effect of rumen contents of buffalo and cattle on DMD % of some synthetic and natural cellulosic materials (*in situ* technique), after 6 hours of incubation.

Materials	Rumen content of		Sig.
	Buffalo DMD%	Cattle DMD %	
Xylan	97.20 [a]	84.10 [b]	**
Carboxymethyl cellulose	97.10 [a]	80.40 [b]	**
Pure cellulose	48.30 [c]	40.70 [d]	**
Filter paper	23.60 [c]	21.20 [d]	**
Cotton fiber	18.80 [e]	15.60 [e]	**
Date seed	14.0 [e]	12.20 [f]	**

** Significant at 1% (between buffalo and cattle).
Mean within the same column with different superscripts are significantly different ($P < 0.01$)

The different abilities of pure cultures (Hungate, 1957 and 1966; Ghose and King, 1963) and of mixed rumen bacteria (Baker *et al.*, 1959) to attack cellulose in natural materials indicate differences in the susceptibilities of various natural "cellulose's" to enzymatic attack.

Differences in hydrolysis of various "cellulose" preparations are party due to differences in the associated noncellulosic materials. Even defeated cotton fibers contain some non cellulosic materials. If the end of the long B-glucosidic chains in "native" cellulose are the point at which "encrusting" materials attach to cellulose, and if cellulose attack occurs only at a "free" end, a few non-B glucosidic linkages could be very effective inhibitors. Differences in abilities of celluloytic pure culture to attack "native" cellulose may depend on their capacity to split linkages other than the 1, 4-B-glucoside (Hungate, 1966).

The analysis of variance of the effect of interaction of feedstuffs x incubation period (6 to 96 hours) x animals on DM disappearance are presented in Table 3. The relative DM disappearance of all tested feedstuffs tested was higher as a consequence of their incubation in the buffalo rumen than in cattle rumen, and could be arranged according to the following descending order: CFM > BH > CS > DS > WS > RS. The DMD % in all feedstuffs tested was significantly ($P < 0.05$) increased with increasing incubation period from 6 up to 96 hours in the rumen of both buffalo and cattle CFM. Concentrate feed mixture recorded the highest DMD% (95.10 and 91.20%) after 96 hours of incubation in the rumen of buffalo and cow respectively, followed by BH (76.80 and 64.80%, respectively). The lowest DMD% were recorded with the low quality roughages (CS, DS, WS and RS). The same trend was observed in the case of OM, CP, EE, CF, NFE and ash disappearance (Table 4).

Table (5) shows the effect of rumen contents of buffalo and cows on the disappearance of CF fractions of the feedstuffs tested during *in situ* incubation for 12 hours. All CF fractions NDF, ADF, cellulose, hemicelullose and ADL disappearance in all roughages were significantly ($P < 0.05$) higher when samples were incubated in buffalo rumen than in cows rumen. All CF fractions disappearances except ADL in BH were significantly ($P > 0.05$) higher compared with other roughages in both buffalo and cattle rumen. Hemicellulose disappearance recorded the highest value in all roughages following incubation in both buffaloes and cows rumen. Cellulose disappearance came next, but ADL showed the lowest value, while the intermediate value was recorded with NDF and ADF disappearance. These results are in conformity with those obtained by Leslie and Fahey (1994) who reported that the disappearance values of legumes were higher and more rapid from 8 hr up to 24 hr of ruminal fermentation (limited energy) than cereal by-product which did not approach completion until 72 hr of fermentation. Moreover, Hussein *et al.* (1995) showed that forages and fibrous by-products are degraded by ruminal cellulosic bacteria to different extents depending on factors such as cell wall structure and degree of lignification and found that DMD % of alfalfa hay, orchard grass and wheat straw when incubated in the rumen for 24 hrs were 52.2, 49.6 and 32.9%, respectively.

Cellulose, hemicellulose and lignin are present in plants in a conjugated forms varying in complexity according to plant type, plant part and stage of maturity. The more the constituents are conjugated, the less rate they are attached by rumen microorganisms, (McAllister *et*

Table (3) : Effect of rumen contents of buffalo and cattle on DM of tested feedstuffs after in situ incubation for 6 to 96 hours.

Feedstuffs	6 hours		12 hours		24 hours		48 hours		72 hours		96 hours	
	DMD		DMD		DMD		DMD		DMD		DMD	
	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%
Buffalo rumen contents x incubation period x feedstuffs												
CFM	1.14^{f}	45.60^{f}	1.33^{e}	53.20^{e}	1.77^{d}	70.80^{d}	2.07^{c}	82.80^{c}	2.28^{b}	91.20^{b}	2.37^{a}	95.10^{a}
Berseem hay	0.68^{f}	27.20^{f}	1.06^{e}	42.40^{e}	1.52^{d}	60.80^{d}	1.62^{c}	64.80^{c}	1.75^{b}	70.00^{b}	1.92^{a}	76.80^{a}
Wheat straw	0.35^{f}	14.00^{f}	0.67^{e}	26.80^{e}	0.89^{d}	35.60^{d}	1.08^{c}	43.20^{c}	1.39^{b}	55.60^{b}	1.62^{a}	64.80^{a}
Rice straw	0.26^{f}	10.40^{f}	0.59^{e}	23.60^{e}	0.70^{d}	28.03^{d}	1.22^{c}	48.80^{c}	1.38^{b}	55.52^{b}	1.52^{a}	60.80^{a}
Corn stover	0.41^{f}	16.40^{f}	0.88^{e}	35.20^{e}	1.04^{d}	41.60^{d}	1.22^{c}	48.80^{c}	1.45^{b}	58.00^{b}	1.52^{a}	60.80^{a}
Date seed	0.36^{f}	14.40^{f}	0.72^{e}	28.80^{e}	0.91^{d}	36.40^{d}	1.09^{c}	43.60^{c}	1.24^{b}	49.60^{b}	1.53^{a}	61.20^{a}
Cattle rumen contents x incubation period x feedstuffs												
CFM	0.99^{f}	39.60^{f}	1.25^{e}	50.00^{e}	1.62^{d}	64.80^{d}	1.91^{c}	76.40^{c}	2.05^{b}	82.00^{b}	2.28^{a}	91.20^{a}
Berseem hay	0.67^{f}	26.80^{f}	0.86^{e}	34.40^{e}	1.15^{d}	46.03^{d}	1.33^{c}	53.20^{c}	1.47^{b}	58.80^{b}	1.62^{a}	64.80^{a}
Wheat straw	0.17^{f}	6.80^{f}	0.46^{e}	18.40^{e}	0.57^{d}	22.80^{c}	0.82^{c}	32.80^{c}	1.06^{b}	42.40^{b}	1.41^{a}	56.40^{a}
Rice straw	0.16^{f}	9.40^{f}	0.38^{e}	15.20^{e}	0.45^{d}	18.00^{d}	0.68^{c}	27.20^{c}	1.04^{b}	41.00^{b}	1.33^{a}	53.20^{a}
Corn stover	0.32^{f}	12.80^{f}	0.66^{e}	26.40^{e}	0.91^{d}	36.40^{d}	1.11^{c}	44.40^{c}	1.39^{b}	55.60^{b}	1.48^{a}	59.20^{a}
Date seed	0.35^{f}	14.00^{f}	0.59^{e}	23.60^{e}	0.84^{d}	33.60^{d}	0.91^{c}	36.40^{c}	1.08^{b}	43.20^{b}	1.34^{a}	53.60^{a}

Means with different superscripts within the same row are significantly different ($P < 0.05$).

Table (4) : Effect of rumen contents of buffalo and cattle on the nutrients disappearance of the experimental feedstuffs during *in situ* incubation period (12 hours).

Feedstuffs	Dry matter (DM)		Organic matter (OM)		Crude protein (CP)		Ether extract (EE)		Crude fiber (CF)		Nitrogen free extract (NFE)		Ash	
	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%
Feedstuffs x buffalo														
Berseem hay	1.137 [a]	49.00 [a]	1.156 [a]	51.60 [a]	0.160 [a]	48.50 [a]	0.010 [b]	24.1 [b]	0.320 [a]	44.88 [a]	0.66 [a]	57.50 [a]	0.038 [b]	15.10 [a]
Wheat straw	0.658 [d]	28.60 [d]	0.677 [b]	30.36 [b]	0.008 [d]	15.50 [a]	0.000 [d]	0.00 [d]	0.239 [c]	24.70 [c]	0.424 [b]	35.68 [b]	0.037 [e]	14.28 [a]
Rice straw	0.674 [d]	28.90 [a]	0.640 [b]	31.12 [b]	0.006 [e]	7.60 [c]	0.000 [d]	0.00 [d]	0.239 [b]	27.00 [b]	0.395 [b]	35.65 [b]	0.047 [e]	12.50 [b]
Corn stover	0.968 [b]	42.00 [b]	0.770 [b]	34.10 [b]	0.022 [b]	24.13 [b]	0.007 [c]	16.16 [c]	0.259 [b]	29.19 [b]	0.481 [b]	38.59 [b]	0.029 [e]	11.98 [b]
Date seeds	0.749 [c]	31.35 [c]	0.750 [b]	30.79 [b]	0.036 [c]	20.94 [c]	0.054 [a]	27.25 [a]	0.227 [b]	26.60 [b]	0.433 [b]	36.23 [b]	0.008 [b]	10.29 [c]
Feedstuffs x cattle														
Berseem hay	0.94 [a]	40.64 [a]	0.933 [a]	41.27 [a]	0.123 [a]	36.47 [a]	0.008 [b]	19.05 [b]	0.276 [a]	38.3 [d]	0.526 [a]	46.16 [a]	0.037 [a]	14.58 [a]
Wheat straw	0.49 [c]	21.49 [c]	0.485 [d]	21.68 [d]	0.005 [d]	10.51 [d]	0.00 [c]	0.00 [c]	0.159 [a]	16.29 [c]	0.321 [c]	26.96 [c]	0.031 [b]	11.97 [b]
Rice straw	0.45 [d]	19.67 [d]	0.404 [e]	18.99 [e]	0.001 [e]	1.87 [e]	0.00 [c]	0.00 [c]	0.148 [d]	16.20 [d]	0.255 [d]	23.30 [d]	0.040 [c]	10.52 [c]
Corn stover	0.63 [b]	27.76 [b]	.696 [b]	30.85 [b]	0.023 [b]	26.57 [b]	0.008 [b]	17.0 [b]	0.243 [b]	27.82 [b]	0.423 [b]	33.75 [b]	0.023 d	9.38 [c]
Date seeds	0.61 [b]	25.59 [b]	0.621 [c]	25.64 [c]	0.031 [c]	18.42 [c]	0.047 [a]	23.69 [a]	0.194 [c]	22.80 [c]	0.349 [c]	29.15 [c]	0.006 [d]	8.20 [d]

Means with different superscripts within the same column are significantly different ($P < 0.05$).

al., 1994 and Ead, 1999).

Any limitations to polysaccharide degradation in the rumen are generally a product of the nature of the substrate itself or its processing during feed preparation (Chesson and Forsberg, 1997). Moreover, the reasons for incomplete digestion are a product of both the anatomy of the ingested plant feed and its chemistry (Wilson, 1993). Yet, when some 20 chemical and anatomical measurements of cereal straws demonstrating a range of rumen degradabilities were analysed for their contribution to the variation in degradability, anatomical features such as sclernchyma wall thickness were found to account for more of the variation than the lignin content (Travis *et al.*, 1996).

Furthermore, McAllister *et al.* (1994) reported that most feeds contain surface layer that is resistant to microbial attachment and, therefore, to digestion. Much of the surface of plant particles entering the rumen may be protected by epicuticular waxes and the cuticle, both of which appear inert to the rumen flora. Invading microorganisms are dependent on broken edges of feed particles or naturally occurring opening such as stomata or lenticels to provide access to suitable substrates. Inevitably, walls of the deeper-lying cells remain protected from attack for longer periods than those of cells forming the more superficial layers. In addition, since cells in most tissue are closely packed and their walls congruent, the outer surface of the wall is rarely available and attack by invading organisms is restricted to the luminal surface (Cheng *et al.*, 1991).

Organisms are thus highly dependent on feed processing and, more importantly, mastication and rumination, to break open cells and expose the lumen. It has been argued (Engels and Schuurmans. 1992) that the region between two adjacent walls, the middle lamella, is inherently the more resistant to degradation. However, since attack is always from the two luminal surfaces, this region will always be the last to be attacked. Even where bacteria gain entry into the cell lumen, degradation of the wall may be limited by the presence of a warty layer, a layer lining the inner surface of lignified cell walls which appears resistant to attack and which may have to be mechanically disrupted to allow digestion by adherent bacteria to occur (Engels and Brice, 1985). The nature of the layer remains unclear but its position and staining reactions suggest that it may arise from plasmalemma of the primary cell which has become progressively suberized during secondary thickening and has adhered to the inner cell wall surface on the death of the cell (Chesson and Forsberg, 1997).

A consequence of limited porosity is that attack is restricted to the (inner) cell surface, and the chemistry of the surface layer is thus all-important in determining the availability of polysaccharides to rumen microorganisms and their enzymes (Chesson, 1993). Observations made by transmission electron microscopy of lignified cell walls undergoing degradation support this view and invariably show degradation to be a localized process occurring only in the outermost layer of the wall in closest proximity to the attacking organism (Chesson and Forsberg, 1997).

The results of DM, crude fiber fractions and all nutrients disappearance percentage of all feedstuffs tested in the rumen of buffalo and cattle through the *in sacco* artificial fiber bag technique indicated that, the ability of different cellulose-hydrolysing species in the buffalo rumen ecosystem to attach plant cell walls and hydrolyse the structural

Table (5) : Effect of rumen contents of buffalo and cattle on crude fiber fractions disappearance of the experimental roughages after *in situ* incubation for 12 hours.

Item	Crude fiber fractions									
	NDF		ADF		Cellulose		Hemicellulose		ADL	
	gm	%	gm	%	gm	%	gm	%	gm	%
Feedstuffs x buffaloes										
Berseem hay	0.862 ^{a}	47.03 ^{a}	0.466 a	36.69 ^{a}	0.454 ^{a}	40.39 ^{a}	0.396 ^{b}	70.33 ^{b}	0.012 ^{b}	8.05 ^{b}
Wheat straw	0.730 ^{d}	36.86 ^{d}	0.430 ^{b}	31.23 ^{b}	0.416 ^{b}	34.69 ^{b}	0.300 ^{d}	49.75 ^{d}	0.014 ^{b}	7.86 ^{b}
Rice straw	0.753 ^{c}	37.59 ^{c}	0.330 ^{d}	25.17 ^{d}	0.321 ^{d}	28.22 ^{d}	0.424 ^{a}	60.31 ^{a}	0.019 ^{ab}	10.92 ^{ab}
Corn stover	0.857 ^{a}	42.32 ^{a}	0.420 ^{b}	30.00 ^{b}	0.413 ^{b}	34.4 ^{b}	0.437 ^{a}	69.92 ^{a}	0.013 ^{b}	6.5 ^{b}
Date seeds	0.819 ^{b}	40.58 ^{b}	0.39 ^{c}	28.96 ^{c}	0.355 ^{c}	35.32 ^{c}	0.365 ^{c}	55.05 ^{c}	0.035 ^{a}	10.14 ^{a}
Feedstuffs x cattle										
Berseem hay	0.690 ^{b}	37.64 ^{b}	0.354 ^{b}	27.87 ^{b}	0.350 ^{a}	31.14 ^{a}	0.335 ^{c}	59.50 ^{c}	0.006 ^{b}	4.03 ^{b}
Wheat straw	0.520 ^{c}	26.26 ^{c}	0.326 ^{c}	23.67 ^{c}	0.316 ^{b}	26.35 ^{b}	0.190 e	31.51 e	0.010 ^{b}	5.62 ^{b}
Rice straw	0.475 ^{d}	23.71 ^{d}	0.198 e	15.11 e	0.197 ^{d}	17.33 ^{d}	0.278 ^{d}	39.54 ^{d}	0.009 ^{b}	5.17 ^{b}
Corn stover	0.790 ^{a}	39.01 ^{a}	0.376 ^{a}	26.85 ^{a}	0.363 ^{a}	30.25 ^{a}	0.414 ^{a}	66.24 ^{a}	0.012 ^{b}	6.0 ^{b}
Date seeds	0.677 ^{b}	33.63 ^{b}	0.306 ^{d}	22.66 ^{d}	0.273 ^{c}	27.16 ^{c}	0.371 ^{b}	55.95 ^{b}	0.033 ^{a}	9.56 ^{a}

Means with different superscripts within the same column are significantly different ($P < 0.05$).
NDF = Neutral detergent fiber ADF = Acid detergent fiber ADL = Acid detergent lignin.

Table (6) : Ruminal pH values in the rumen of buffalo and cattle at different intervals after feeding.

Time (hours)		pH in buffalo	pH in cattle	Sig.
Before feeding	**0.0**	7.57 ^{a}	7.57 ^{ab}	NS
After feeding	**1.0**	7.37 ^{ab}	7.47 ^{bc}	NS
	3.0	7.17 ^{b}	7.27 ^{c}	NS
	6.0	6.70 ^{c}	6.83 ^{d}	NS
	9.0	6.73 ^{c}	6.83 ^{d}	NS
	12.0	6.73 ^{c}	6.83 ^{d}	NS

NS Not significant
Mean within different superscripts within the same column are significantly different ($P < 0.05$)

Table (7): Total count of bacteria in rumen fluid of buffalo and cattle using haemocytometer technique.

Item	Total count of bacterial cells/ml
Buffalo rumen fluid	$(1.5 \pm 0.049) \times 10^{9}$
Cattle rumen fluid	$(1.48 \pm 0.016) \times 10^{9}$

polymers present more than in cattle rumen.

Differences between various ruminant species in the rate of fermentation of the same food per unit of rumen contents have been demonstrated by Hungate *et al.* (1960). Zebu cattle showed slightly greater digestibilities of African feedstuffs than did European breeds, but the differences were not statistically significant (French, 1940).

A statistically significantly greater digestibility of grass hay by Zebu cattle as compared to Herefords, correlated with a greater fermentation rate (Phillips, 1961).

Ruminal pH values of the experimental animals fed the same ration at different intervals after feeding are presented in Table (6). It is apparent that, the pH values in both buffalo and cattle are within the normal range (6.7 and 7.57) without any significant differences among buffaloes and cattle. Meanwhile, the pH values tend to decrease significantly ($P < 0.05$) by prolongation of time post-feeding; reaching lowest at 6 to 12 hrs. Post-feeding without any significant change. Bakr (1995) reported that the rumen pH values were between 6.39 and 7.57 at the different sampling time after feeding. such range is suitable for growth and activity of cellulolytic bacteria (Prasad *et al.*, 1972).The hourly decline observed in the rumen pH could be explained by the statement of Malestein *et al.* (1984) that the fermentation rate of sugar is higher than that of starch and is higher with starch than cell wall constituents as cellulose and hemicellulose.

The rumen bacteria change qualitatively and quantitatively in response to the changes in chemical composition of diet of the animals (Makled and Mohamed, 2001). The results in table (7) show that the total number of bacteria, as estimated by the haemocytometer technique was 1.5×10^9 and 1.48×10^9 cell/ml in rumen fluid of buffaloes and cows, respectively. In this connection, it may be mentioned that Kamara and Pathak (1996) stated that in a normal fed animal, the total number of bacteria may vary from one to ten billion cells/milliliter of rumen liquor. In the present study, rumen fluid of tested buffaloes contained larger number of bacterial cells than cow (amounted by 2 millions cells/ml), which means more activity for cellulose and hemicellulose digestion in buffalo than cattle.The results of this study revealed that, the rumen microflora of buffalo are more efficient in degradation of plant tissues than those of cattle. Consequently, it can be possible to incorporate higher levels of low quality roughages (by-products) during formulation of buffalo rations than in cattle rations. Thus, the cost of feeding for producing the same unit of production will be decrease in buffalo than in cattle.

REFERENCES

Abdou, A.M. (1996). Effect of ammonization on date seeds. Utilization in dairy rations. Ph.D. Thesis, Fac. Agric. , Cairo Univ., Egypt.

Abou El-Nor, S.A.H. and A.M. Kholif, (1995). Date seeds as a new component in diets for dairy animals. 2- *In vitro* and *in-vivo* digestibility studies by goats. Egypt. J. Dairy Sci., 23: 167.

A.O.A.C. (1980). Official Methods of Analysis (13th Ed.) Association of Official Analytical Chemists. Washington, D.C.

Aman, P. (1993). Composition and structure of cell wall polysaccharides in forages IN: H.G. Jung, D.R. Buxton, R.D. Hatfield and J. Ralph (Ed.) Forage cell wall structure and digestibility p. 183. ASA-CSSA, Madison, WI.

Baker, T.I.; G.V. Quicke; O.G. Bentley; R.R. Johnson and A.L. Moxon (1959). J. Animal Sci. 18, 655-662. Quoted from Hungate, R.E. (1966). The rumen and its microbes. Academic Press, New York and London.

Barreveld, W.H. (1993). Date palm products. FAO Agric Services, Bulletin ISSN, pp. 1010-1365.

Bowman, J.G.P. and J.L. Firkins (1993). Effects of forage species and particle size on bacterial cellulosic activity and colonization *in situ*. J. Anim. Sci. 71: 1623-33.

Bryant, M.P. and L.A. Burkey (1953). Numbers and some predominant groups of bacteria in the rumen of cow fed different rations. J. Dairy Sci., 36, 218-24.

Buxton, D.R. and J.R. Russell (1988). Lignin constituents and cell-wall digestibility of grass and legume stems. Crop. Sci. 28: 553.

Cheng, K.J.; H. Kudo; S.H. Duncan (1991). Prevention of fungal colonization and digestion of cellulose by the addition of methylcelullose. Can. J. Microbiol. 37, 484-7.

Cherney, D.J.; J.A. Patterson, and R.P. Lemenager (1990). Influence of *in situ* bag rinsing technique on determination of dry matter disappearance. . Dairy Sci. 73: 391.

Chesson, A. (1993). Mechanistic models of forage cell wall degradation. In Forage Cell Wall Structure and Digestibility. ed. H.G. Jung. D.R. Buxton, R.D. Hatfield and J. Ralph. American Society of Agronomy. Inc., Crop Science Society Of America. Inc. Soil Science Society of America. Inc. Madison. Wisconsin. pp. 347-76.

Chesson, A. and C.W. Forsberg (1997). Polysaccharide degradation by rumen microorganisms. In P.N. Hobson & C.S. Stewart (Ed.). The Rumen Microbila Ecosystem. Blackie & Professional, an imprint of Champan & Hall, London.

Ead, H.M. (1999). Studies on fermentation of feedstuffs in the rumen (influence of some nitrogen sources on fermentation and digestion of different poor quality roughages Ph.D. Thesis, Fac. Agric. Mansoura Univ., Egypt.

El-Ayouty, S.A. (1991). Response of several legume and cereal roughages to NH_3 treatment. Egypt. J. Anim. Prod. , 28(1): 59.

El-Shazly, K.; E.A. Ibrahim and H.A. Karam (1963). Nutritional value of date seeds for sheep. J. Animal Sci., 22: 894.

El-Shinnawy, M.M. (1998). Simple technologies of improving crop residues for feeding animal. 1st Int. Conf. on Animal & Health in Semi-Arid Areas, El-Arish, North Sinai, 1-3 Sept.

Engels, F.M. and J.L.L. Schuurmans (1992). Relationship between structural development of cell walls and degradation of tissues in maize stems. J. Sci. Food Agric. 59: 45-51.

Engels, F.M. and R.E. Brice (1985). A barrier covering lignified cell walls of barley straw that restricts access by rumen microorganism. Curr. Microbiol. 12, 217-24.

French, M.H. (1940). J. Agric. Sci. 30. 503-510. Quoted from Hungate, R.E. (1966). The rumen and its microbes. Academic Press, New York, and London.

Fluharty, F.L.; S.C. Loerdh, and B.A. Dehority (1996). Effect of feed and water deprivation on ruminal characteristics and microbial population of newly weaned and feedlot-adapted calves. J. Anim. Sci. 74: 465-474.

Ghose, S. and K.W. King (1963). Textile Res. T. 33, 392-398. Quoted from

Hungate, R.E. (1966). The rumen and its microbes. Academic Press, New York, and London.

Goering, K.K. and P.J. Van Soest (1970). Forage fiber Analysis Agric. Handbook, No. 379, USDA, Washington, D.C.

Hofmann, R.R. (1989). Evolution steps of ecophysiological adaptation and diversification of ruminants: A comparative view of their digestive system. Oecologia (Heidelb) 78: 443.

Hungate, R.E. (1957). Microorganisms in the rumen of cattle fed a constant ration. Can. J. Microbiol., 3: 289-311.

Hungate, R.E. (1966). The Rumen and its Microbes. Academic Press, New York and London.

Hungate, R.E.; G.D. Phillips; D.P. Hungate and A. MacGregor (1960). Quated from Hungate, R.E. (1966). The rumen and its microbes. Academic Press, New York, and London.

Hussein, H.S.; M.D. Stern and R.M. Jordan (1991). Influence of dietary protein and carbohydrate sources on nitrogen metabolism and carbohydrate fermentation by ruminal microbes in continuous culture. J. Anim. Sci. 69: 2129-2133.

Hussein, H.S.; M.R. Cameron; G.C. Fahey, Jr; Nr. Merchen and J.H. Chark (1995). Influence of altering ruminal degradation of soyabean meal protein on *In situ* ruminal fiber disappearance of forage and fibrous by-products. J. Anim. Sci. 73: 2428.

Jung, H.G. and D.A. Deetz (1993). Cell wall lignification and degradability. In: J.G. Jung, D.R. Buxton, R.D. Hatfield and J. Ralph (Ed.) Forage Cell Wall Structure and Digestibility. p. 315. ASA-CSSA-SSSA. Madison, WI.

Jung, H.G. and M.S. Allen (1995). Characteristics of plant cell walls affecting intake and digestibility of forages by walls affecting intake and digestibility of forages by ruminants. J. Anim. Sci. 73: 2774.

Kamra, D.N. and N.N. Pathak, (1996). Nutritional microbiology of farm animals. Vikas Publishing House PVT LTD. New Delhi.

Leslie, D.B. and G.C.Jr. Fahey (1994). Ruminal digestion and glycosyl linkage patterns of cell wall components from leaf and stem fractions of alfalfa, orchard grass and wheat straw. J. Anim. Sci., 72: 1362-1374.

Maklad, E.H.M. (1996). Use of untraditional feed ingredients in feeding animals. Ph.D. Thesis, Fac. Agric., Mansoura Univ., Egypt.

Maklad, E.H.M. and Bahira, K. Mohamed (2001). Comparison among the effects of clover hay and corn silages as feed ingredients on the nutritive value, bacterial strains and fermentation in the rumen of sheep. J. Agric. Sci. Mansoura Univ., 25(12): 7592-7597

Malestein, A.; A.Th. Vant Klooster; R.H. Prins and G.H.M. Counotte (1984). Concentrate feeding and ruminal fermentation. 3-Influence of concentrate ingredients on pH and DL. Lactic acid concentration in the rumen of dairy cows and on DM intake. Netherlands J. Agric. Sci. 32: 9-12.

Masuda, M.; K. Munekado and H. Kajikawa (1992). Comparison between *in vitro* methods using washed and unwashed rumen microbes for estimating forage digestion. J. Japan Soc. 38(2): 133-190.

McAllister, T.A.; H.D. Bae; G.A. Jones and K.J. Cheng (1994). Microbial attachement and feed digestion in the rumen. J. Anim. Sci., 72: 3004-3018.

National Research Council (NRC) (1989). Nutrient requirements of dairy cattle 6th Ed, Washington, DC. National Academic of Sci.

Phillips, G.D. (1961). Res. Vet. Sci. 202-208 Cited from Hungate, R.E. (1966). The rumen and its microbs. Academic Press, New York and London.

Prasad, J.; S.S. Ahluwalia and B.P. Joshi (1972). Clinico-Biochemical studies in digestion in cattle and buffaloes. In. J. Anim. Sci. 742: 911-919.

Prins, R.A. (1977). In: Microbial Ecology of the Gut. (Eds., R.J.J. Clarke and T. Bauchop) Acadimic Press. Lodnon.

Smith, L.W.; H.K. Goering and C.H. Gordon (1972). Relationships of forage composition with rates of cell wall digestion and indigestibility of cell walls. J. Dairy Sci., 55: 1140.

Steel, R.G.D. and J.H. Torrie (1980). Principles and Procedures of Statistics: A Biometrical Approach (2nd Ed.). McGraw-Hill Book Co., New York.

Sundstφl, F. (1988). Straw and other fibrous by-products. Livestock Production Sci., 19: 137-158.

Travis, A.J.; S.D. Murison; D. Hirst (1996). Comparison of the anatomy and degradability of straw from varieties of wheat and barley that differ in susceptibility to lodging. J. Agric. Sci. Camb. 127: 1-10.

Wanderley, R.C.; J.T. Huber; Z. Wu; M. Pessaraki and Jr. C. Fontes (1993). Influence of microbial colonization of feed particles on determination of nitrogen degradability by *in situ* incubation. J. Anim. Sci. 71: 3073-3077.

Wilson, J.R. (1993). Organisation of forage plant tissues. In Forage Cell Wall Structure and Digestibility, ed. H.G. Jung, D.R. Buxton, R.D. Hatfield and J. Ralph. American Society of Agronomy, Inc., Crop Science Society of America, Inc., Soil Science Society of America, Inc. Madison, Wisconsin, pp. 1-32.

تأثير ميكروفلورا كرش الجاموس والماشية على هضم بعض المواد الخشنة

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٥٥٠- استخدم فى هذه الدراسة ثلاثة من ذكور الجاموس وثلاثة من ذكور الماشية كان متوسط أوزانهم ٦٠٠ كجم. حيث تم تثبيت فستيولا بكرش كل حيوان ليتم التعامل من خلالها بسهولة مع محتويات كرش الحيوان وقد غذيت هذه الحيوانات على دريس البرسيم وقش الأرز والعلف المركز لتغطية الاحتياجات الحافظة لها.

تم دراسة تأثير سائل الكرش على هضم بعض المواد الخشنة (دريس البرسيم وتبن القمح وحطب الذره الطبيعية والمخلقة (سليلوز نقى وكربوكسي وقش الأرز ونوى البلح). وبعض المواد السليلوزية والهيميسليوزية ميثيل سليلولوز وألياف القطن وورق الترشيح والزيلان) عن طريق تقدير النسبة المئوية لاختفاء المادة الجافة بعد تحضين هذه المواد داخل الكرش فى أكياس خاصة من البولى إستر (الدكرون).

وجد أن تحضين هذه المواد فى كرش الجاموس والماشية صحبة اختفاء معنويا فى المادة الجافة ويكون معدل الاختفاء فى حالة المواد المخلقة أكبر منه فى حالة المواد الطبيعية كان ترتيب معدل اختفاء المادة الجافة تنازليا كان: الزيلان > الكربوكسي ميثيل سيليولوز > السليلوز النقى > ورق الترشيح > ألياف القطن > مطحون نوى البلح وأن معدلات اختفاء المادة الجافة فى حالة الجاموس أعلى منه فى حالة الماشية.

وجد أن معدلا الاختفاء فى محتويات المواد الخشنة من المركبات الغذائية يزداد بزيادة فترة التحضين داخل الكرش وأن أعلى معدل لاختفاء المادة الجافة والمركبات الغذائية (المادة العضوية ــ البروتين خام ــ الدهون ــ الألياف الخام ــ المستخلص الخال من الآزوت ــ الرماد) وكذلك مكونات الألياف الخام كان مع العلف المركز تلاه دريس البرسيم وأن أقل معدلات للاختفاء سجلت مع تبن القمح وقش الارز وحطب الانزة ومطحون نوى البلح وأن معدلات الاختفاء فى حالة الجاموس أعلى منه فى حالة الماشية كما سجل الهيميسليلوز أعلى معدل للاختفاء يليه السيليلوز كما سجل اللجنين أقل معدل للاختفاء.

ووجد أن قيم (pH)سجلت عينات سائل الكرش التى أخذت بعد ٦ ساعات من بداية التغذية أقل قيمة فى سائل كرش الجاموس أقل منها فى سائل كرش الماشية فى نفس الظروف القياسية.(pH)الاس الهيدروجينى وجد أن متوسط عدد الخلايا البكتيرية فى المليليتر ١,٥ × ١٠^{٩} فى سائل كرش الجاموس و ١,٤٨ × ١٠^{٩} فى سائل كرش الماشية باستخدام طريقة الهيموسيتومتر (العد الميكروبى المباشر).

أظهرت النتائج أن ميكروفلورا كرش الجاموس أعلى كفاءة على هضم الأعلاف الخشنة منها فى الماشية الامر الذى يشجع على استخدام المخلفات الزراعية والاعلاف الخشنة الفقيرة بكميات كبيرة عند تكوين علائق الجاموس مما يقلل تكاليف التغذية لإنتاج نفس الوحدة من الإنتاج فى الجاموس عنه فى الماشية.