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PREDICTION OF NUTRITIVE VALUES FOR SOME ROUGHAGE FEEDS USING CHEMICAL COMPOSITION AND *IN SITU* DEGRADABILITY

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ABSTRACT

The rumen degradation characteristics and effective degradability (ED) of dry matter (DM) and crude protein (CP) of nine roughages were studied in four adult bulls fitted with rumen cannulaee using the nylon bag technique for rapid screening of some of the promising fodders and to develop a prediction equation for estimation of ED of DM and CP from chemical composition of different tested roughages. Roughages used are: 1- Berseem hay 3rd cut (BH); 2- Pea vine hay (PVH); 3- Peanut vine hay (PNVH); 4- Dried sugar beet tops (DSBT); 5- Elephant grass (EG); 6- Fodder millet (FM); 7- Fodder sorghum (FS), 8- Whole corn plant silage without additives (WCPS); 9- Corn stover silage prepared by addition 0.5% urea and 5% molasses at ensiling time (CSS). Samples from each roughage were incubated in the rumen of each animal for 0, 2, 4, 8, 16, 24 and 48 hrs, respectively. The disappearance rates of N or DM were used to calculate the rapidly soluble fraction ("a" value), potentially degradable fraction ("b" value) and the fractional degradation rate of "b" ("c" value) the effective degradability of N and DM was then estimated assuming a ruminal outflow rate of 0.02, 0.05 and 0.08/h ($P_{0.02}$, $P_{0.05}$ and $P_{0.08}$). The results indicated high positive relationships between CF content and its fractions (NDF and ADF). There were significant differences for immediately degradable fraction "a" among the different kinds of roughages. Moreover, effective degradability of DM decreased with increase in outflow rates. The degradability of N was consistently greater than DM. The data showed low relationship between N degradability rate and CF content and its fractions (ADF, NDF and ADL) for a variety of roughages. The results also indicated that, for prediction of the $P_{0.02}$, $P_{0.05}$ and $P_{0.08}$ of N using CP or NFE concentration as a predictor produced greater r^2 values than using ADF, NDF or ADL. The regression equation showed that OM, NDF, ADF and water soluble DM "a" were well correlated with *in sacoo* ED of DM while for ED of CP the best correlation was with NFE and the water soluble protein "a" fraction.

Keywords: roughages, chemical components, degradability, prediction equations.

INTRODUCTION

Many problems confront development of livestock, one of which is shortage of feedstuffs and the high cost of concentrate feed mixture. In Egypt, the gap between the availability and requirements of feed is wide and estimated as 3 million ton of TDN per year, it is covered by 4-6 million ton of concentrate feed mixture (El-Shinnawy, 1990). These necessitate using agricultural by-products in animal feeding to minimize the feed cost and improve the economical efficiency.

Nowadays, a great attention directed towards the utilization of agriculture by-products available as new sources of non traditional roughages for feeding farm animals. Recently about 150,767 feddans are dedicated to peanut production in Egypt (Ministray of Agriculture, March, 2002). Moreover, the total planted area of corn crop was about 1.65 million feddans, 1.49 million used for grain production and 160 thousand feddans were used as silage (National Campaign of Corn Crop Rising, 2003)

The adequate prediction of degree to which nutrients are made available in the rumen is the first step to establish the amounts of nutrients necessary for optimal microbial growth and animal response. The most accurate method for evaluation of feedstuffs is the *in vivo* procedures but it is very laborious, expensive and difficult to standardize.

The in sacco technique is often used to estimate the ruminal degradability of feedstuffs (Nocek, 1988; Michalet-Doreau and Ould-Bah, 1992) and most of the new feed evaluation systems are based on the degradability data in the rumen.

Crude fiber (CF) has been and remains relatively a good indicative for feedstuffs feeding value. Crude fiber and possibly ash content may explain the differences in their neutral detergent fiber (NDF); acid detergent fiber (ADF) and acid detergent lignin (ADL), (Van Soest, 1975 and Koller *et al*., 1978). It may be concluded that CP, CF, NDF and ADF can be used as good predictors for in vitro dry matter degradability.

In sacoo dry matter degradability (ISDMD) values were low for roughages contained high level of CF content. It also increased as their CF, NDF, ADF, ADL and silica contents decreased. Also, CP, CF, NDF, ADF and ash contents can be used as a good pre-indicator for ISDMD.

The objective of this study was to evaluate the degradability characteristics and effective degradability of the dry matter and crude protein contents of some common Egyptian roughages as a way of providing some information regarding their use in the strategic supplementation of ruminant diets.

MATERIALS AND METHODS

This study was carried out at the Department of Animal Production, Faculty of Agriculture, West-Hungarian University, Mosonmagyaróvár, Hungary and Department of Animal Production, Faculty of Agriculture, Kafr El-Sheikh University, Egypt.

1- Preparation of samples:-

Nine samples representing different roughages including legumes, non-legumes and its by-products as follow:- 1- Berseem hay 3rd cut (BH); 2- Pea vine hay (PVH); 3- Peanut vine hay (PNVH); 4- Dried sugar beet tops (DSBT); 5- Elephant grass (EG); 6- Fodder millet (FM); 7- Fodder sorghum (FS), 8- Whole corn plant silage without additives (WCPS); 9- Corn stover silage prepared by addition 0.5% urea and 5% molasses at ensiling time (CSS). All samples were collected from Kafr El-Sheikh Governorate. Five samples from each roughage were dried and then mixed together, blended and representative samples were taken for chemical analysis.

2- In sacoo procedure

Four adult Holstein bulls fitted with rumen cannulaee aged 6 years with an average body weight 550 kg were used to measure the rate of dry matter and protein degradability of the different tested roughages. The bulls were given 20 kg corn silage, 3.5 kg alfalfa hay, 6.0 kg ground corn and 1.2 kg soybean meal per head/day. Samples of the tested roughages were ground then 3.5 gm were weighted into 140 × 70 mm nylon bags with mean pore size 40 µm. The bags were tied near the end of 60 cm nylon cord anchored by a 70 gm steel weight and incubated in the rumen of bulls for different extends time (0, 2, 4, 8, 16, 24, and 48 hrs). Zero hour bags were washed to estimate the disappearance of DM and CP due to both solubility and washing procedure. The bags after incubation in the rumen were also washed. All bags then were dried at 60 °C for 48 hrs to determine DM and the residue was analyzed for CP according to AOAC (1990). The data of disappearance were fitted by the exponential equation derived by Ørskov and McDonald (1979) to describe the relation between disappearance and elapse time of incubation to predict the degradable potential of the tested material through an exponential equation: $P = a + b (1-e^{-ct})$, where "P" represent the percentage degradability at time T., "a" the readily soluble fraction which disappears irrespective to fermentation, "b" the fermentable fraction which disappears with the elapse time of incubation interval, "c" the rate of degradation of fraction b/h and t: time (h). The fractional outflow rate from the rumen (k) was considered as 0.02, 0.05 and 0.08/h according the equation developed by McDonald (1981) being: $ED = a+ (bc/c + K)$. The representative samples of the different tested roughages were chemically analysis according to AOAC (1990), while crude fiber and their fractions were adopted according to Goering and Van Soest (1970).

The data were statistically analyzed (one way ANOVA model) and regression analysis was used to established the relationship between chemical composition and in situ effective degradability of DM and CP using General Linear Models Procedure adapted by SPSS (1997), while appropriate means were separated using Duncan's (1955) Multiple Range test.

RESULTS AND DISCUSSIONS

1- Chemical composition:-

Chemical compositions of the different tested roughages are shown in Table 1. The results indicated that, legumes roughages such as BH, PVH and PNVH had higher CP content (15.57-18.08%) than non-legumes such as DSBT, EG, FM, FS, WCPS and CSS (7.14-14.78%). The results also showed that the non-legumes roughages had a higher NFE compared with legumes roughages especially for WCPS that may be due to its grain content. Similar trend was observed by many workers (Sawsan *et al*., 1990; De Boever *et al*., 1994; Saleh *et al*., 2000 and Eweedah *et al*., 2007). Chemical analysis could provide valuable information about the actual chemical constituents influencing digestion and *in vitro* methods (Van Soest, 1994). The actual nutrient contents for BH and other by-products of feedstuffs are differing, this may be due to variation in plant varieties and handling processing (De Peters *et al*., 1997). High concentrations of water-soluble carbohydrate in forages are positively related to efficient ruminant digestion (Beever *et al*., 1978) and are thus important in breeding high-quality grass for efficient animal production. Humphreys, (1989) noticed that water soluble carbohydrate concentration was negatively correlated with nitrogen content. Generally, chemical composition of different roughages or crop residues is depending on many factors such as plant age, species, climate, soil types, fertilizers, system of crop harvesting and others.

Table (1). Chemical composition of different tested roughages (on DM basis)

Feedstuffs*	DM	DM composition, %					
		OM	CP	CF	EE	NFE	ASH
1- BH	89.90	82.67	17.72	24.99	1.45	38.51	17.33
2- PVH	91.27	91.83	18.08	31.73	1.13	40.89	8.17
3- PNVH	91.25	88.25	15.57	27.01	2.52	43.15	11.75
4- DSBT	81.75	79.77	12.78	16.91	1.05	49.03	20.23
5- EG	19.25	89.03	11.16	33.62	3.80	40.45	10.97
6- FM	20.70	82.97	14.78	33.78	1.97	32.44	17.03
7- FS	20.80	88.72	12.21	34.09	1.77	40.65	11.28
8- WCPS	28.70	88.05	7.80	24.52	2.41	53.32	11.95
9- CSS	30.92	90.05	7.14	33.72	1.70	47.49	9.95

***1- Berseem hay 3rd cut (BH); 2- Pea hay (PVH); 3- Peanut vine hay (PNVH); 4- Dried sugar beet tops (DSBT); 5- Elephant grass (EG); 6- Fodder Millet (FM); 7- Fodder sorghum (FS), 8- Whole corn plant silage (WCPS); 9- Corn stover silage (CSS).**

2- Fiber fractions

As shown in Table 2, elephant grass, corn stover silage and fodder sorghum recorded the highest values of NDF, ADF, hemicellulose and cellulose. However, the other roughages recorded nearly similar values. The differences in the chemical composition of the tested material, especially ash and CF content may explain the differences in their NDF, ADF and ADL contents (Koller *et al*., 1978). Lignin restricts the degradation of polysacchrides by hydrolytic enzymes, thereby limiting the bioconversion of forages and fibrous crops into animal production, the enzymes degradation of cell walls in leaves and particularly stem of plant declines during maturation because of accumulation and progressive lignifications of primary and secondary cell wall of vascular and sclerenchyma tissues (Grabber, 2005). Forages digestibility is determined by structural fractions, such as degree of lignifications and also influenced by physical processing, level of intake, protein content and other associative effects within mixed diets (McDonald *et al*., 1995).

Table 2. Crude fiber fraction contents of different tested roughages.

Feedstuffs	Fiber fraction contents, % (DM basis)				
	ADF	NDF	ADL	Hemicellulose	Cellulose
1- BH	34.27	44.83	6.16	10.56	28.11
2- PVH	30.46	50.32	4.39	19.86	26.07
3- PNVH	32.27	47.19	5.82	14.92	26.45
4- DSBT	23.90	34.50	3.92	10.60	19.98
5- EG	38.54	64.98	4.02	26.44	34.91
6- FM	37.70	61.80	6.60	24.10	31.10
7- FS	38.40	63.20	5.90	24.80	32.50
8- WCPS	29.70	50.45	4.15	20.75	25.55
9- CSS	41.65	69.50	7.10	27.85	34.55

NDF: Neutral detergent fiber (Cellulose+ Hemicellulose+ Lignin).
ADF: Acid detergent fiber (Lignin+ Cellulose). ADL: Acid detergent lignin (Lignin).
Hemicellulose= NDF- ADF & Cellulose= ADF- ADL.

As presented in Table 3, there is a high significant (P<0.01) positive correlation was observed between fiber fractions (ADF and NDF) and crude fiber content. Values of r^{-2} were 0.71 and 0.82 for equations 1 and 2, respectively, this mean that about 71 and 82 % from variations in these fiber fractions are attributed to CF content, while 29 and 18%, respectively due to the other unknown factors. Meanwhile, effect of CF content on ADL was insignificant (Equ. No3). Based on the obtained results, it is possible to predict the NDF and ADF contents of tested roughages from their CF content. Such practice is of prime importance in practical and applied conditions as Van Soest assay is costly, time consuming and requires high technically-skilled personnel compared to the CF assay (Sawsan *et al*., 1990). Fiber and lignin assays should be continue to be important, due to their strong association with factors affecting animal performance (Cherney, 2000).

Table (3): Predicting equations of fiber fractions (NDF, ADF and ADL) from crude fiber content of the different roughage sources.

Independent variables (ŷ)	Equ. N0.	Predicting equations	± SE	r	r^2	r^{-2}	F value
NDF	1	Ŷ= 10.41 + 0.82*CF	3.18	0.92	0.85	0.82	38.51^{*}
ADF	2	Ŷ= 2.54 + 1.77*CF	2.49	0.86	0.75	0.71	20.54^{*}
ADL	3	Ŷ= 2.39 + 0.10*CF	5.55	0.48	0.23	0.12	2.05^{ns}

Ŷ: determined values of independent variables, r: correlation coefficient, r^2: coefficient of determination value, r^{-2} adjusted of r^2 value, SE: standard error.

3- Dry matter and crude protein degradability:-

As shown in Table (4) and Fig. (1), DSBT and PNVH had the highest values of DM degradability at all the incubation times. While, EG, CSS, WCPS and FS had the lowest DM degradability values. The BH, PVH and FM recorded the intermediate values. The relatively soluble DM value in DSBT and PNVH reveals the potential of their being good sources of more nutrients for microbial growth as indicated by Djouvinov and Todorov (1994), Clark *et al*. (1992) and Gomes *et al*. (1994) who reported a strong positive relationship between dry matter intake and microbial growth. The high potentially degradable fraction in the DSBT and PNVH is of interest for the fact that this parameter measures the proportion that is fermentable if this component does not bypass rumen. However, this did not translate into high effective degradability but, this may have resulted from high cell wall contents (Van Soest, 1988). The results also showed that DM disappearance increased with increasing NFE content. Contrary, the higher CF and its fraction contents were associated with the lower of these values. The DSBT recorded the highest DM disappearance value due to its lower CF content (16.91%) and slightly high NFE content (49.03%). These results support those found by Koller *et al*. (1978). Moreover, Stone (1994) reported that high concentration of NFE in the forages is positively related to efficient ruminant digestion which is important in breeding high-quality grasses for efficient animal production.

As shown in Table (5) there were significant differences for immediately degradable fraction "a" among the different kinds of roughages. The water soluble DM "a" is mostly derived from the cell wall content and in the

NDF method is represented by the detergent soluble fraction, the water soluble "a" fraction determined by the *in sacoo* method was comparable with NDF as predictors of whole tract digestibility of DM (R^2 of 0.30 and 0.32, respectively) as pointed out by Prakash *et al*. (2006). The DSBT had the highest value (43.90%) this may be due to its higher ash and lower CF content, while, EG recorded the lowest value (18.94%). Generally, effective degradability of tested roughages DM was decreased with increasing outflow rates. The insoluble but degradable DM fraction with time "b" was the lowest in BH (38.31%) and the highest in EG (79.18%). While, there were considerable variation at different outflow rates and were negatively related to ADF, NDF and ADL (P<0.05).

Table (4): Dry matter degradability (%) of different tested roughages

Feedstuffs	Incubation hours						
	0	2	4	8	16	24	48
1- BH	25.16^{c}	31.98^{c}	37.55^{c}	45.86^{b}	55.25^{b}	59.58^{c}	63.03^{e}
2- PVH	24.67^{cd}	28.67^{d}	32.39^{d}	39.08^{c}	49.93^{c}	58.13^{c}	72.60^{b}
3- PNVH	30.79^{b}	35.96^{b}	40.41^{b}	47.58^{b}	57.15^{b}	62.89^{b}	70.33^{bc}
4- DSBT	43.90^{a}	46.60^{a}	49.17^{a}	53.94^{a}	62.19^{a}	68.95^{a}	82.82^{a}
5- EG	18.94^{g}	20.68^{f}	22.43^{e}	25.82^{d}	32.17^{c}	37.97^{b}	52.56^{b}
6- FM	23.93^{d}	26.97^{e}	29.90^{e}	35.41^{d}	45.14^{d}	53.40^{d}	71.41^{b}
7- FS	22.14^{e}	24.86^{f}	27.46^{f}	32.34^{e}	40.96^{e}	48.26^{e}	64.17^{de}
8- WCPS	21.19^{ef}	23.99^{f}	26.70^{f}	31.83^{e}	41.03^{e}	48.99^{e}	66.96^{cd}
9- CSS	20.93^{f}	22.82^{g}	24.71^{g}	28.20^{f}	34.71^{f}	40.51^{f}	54.52^{f}
SEM	1.09	1.15	1.23	1.37	1.48	1.47	1.36

$^{a,b,c,...,g}$ **Means within a column with different superscripts are significantly different (P<0.05).**

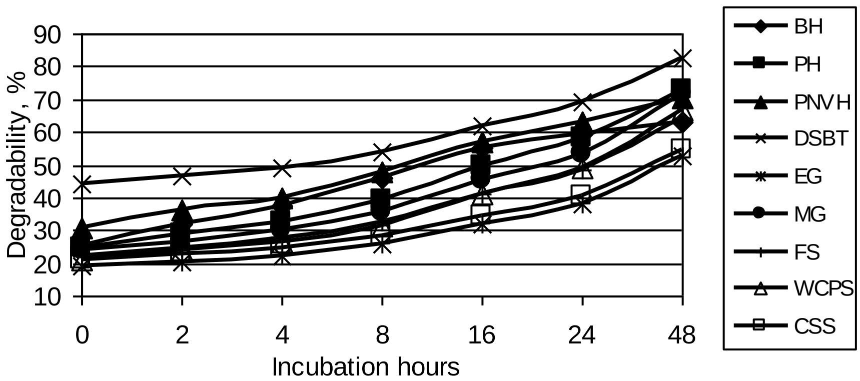

Fig. 1. Dry matter degradability of different experimental roughages.

Mean values of CP degradability for the different roughages samples at different incubation periods are shown in Table 6 and Fig. 2. In general, CP degradability increased as the period of incubation prolonged. The degradability of N was consistently greater than DM. The statistical analysis data showed low relationship between N degradability rate and CF content and its fractions (ADF, NDF and ADL) for a variety of roughages (r= 0.12, -0.39, -.115 and 0.256; r= 0.213, 0.123, 0.073 and -0.040; 0.313, 0.22, 0.185

and 0.116 for CF, ADF, NDF and ADL, respectively). The same trend was also reported by Nocek (1988)

Estimates of ruminal degradation constants (a b and c) fitted with rate of CP disappearance for different tested roughages is presented in Table 7. There were considerable variations in "a", "b" and "c" values and different out flow rates (K2, K5 and K8) of CP. The effective protein degradability at K=0.02/h were negatively related to ADF, NDF and ADL. These results are in agreement with those reported by Yan and Agnew (2004).

Nutrients degradability in the rumen can be decreased by decreasing the retention time of the digesta in the rumen when the same diet is offered. The effect of ruminal outflow rate on nutrient degradability is curvilinear and represented by equation suggested by Ørskov and McDonald (1979). This equation has been widely adopted across the world and was also used in the present experiment to calculate degradability of N and DM at ruminal outflow rates of 0.02, 0.05 and 0.08/h ($P_{0.02}$, $P_{0.05}$ and $P_{0.08}$). These ruminal outflow rates are recommended in AFRC (1993) for ruminant animals offered diets at approximately once, slightly below twice and over twice the maintenance feeding level, respectively. The ruminal outflow rates recommended in other systems differ. For example, for dairy cows, the ruminal outflow rate is suggested to be 0.06/h in the French feed-rationing system (INRA, 1989), 0.045/h for forages and 0.06/h for concentrates in the Dutch system (Tamminga *et al*., 1994) and 0.08/h in the Scandinavian system (Madsen, 1985). However, these recommended rates are based only on plane of nutrition and make no differentiation between liquid and solid phases of digesta. Therefore, the retention time of digesta in the rumen varies greatly with changes in the level of feeding and type of the diet.

Table (5): Effective degradability of dry matter (%) of tested roughages.

Feedstuffs	a %	b %	c %	Effective dry matter degradability		
				K = 0.02	K = 0.05	K = 0.08
1- BH	25.16^{c}	38.31^{e}	9.80^{a}	56.90^{c}	50.38^{c}	46.13^{c}
2- PVH	24.67^{cd}	54.18^{d}	3.5^{c}	62.53^{b}	49.00^{c}	42.63^{d}
3- PNVH	30.79^{b}	43.25^{e}	6.97^{b}	62.70^{b}	54.05^{b}	49.25^{b}
4- DSBT	43.90^{a}	54.10^{d}	2.47^{cd}	74.90^{a}	62.40^{a}	57.10^{a}
5- EG	18.94^{g}	79.18^{a}	1.13^{e}	47.70^{d}	33.70^{g}	28.90^{g}
6- MG	23.93^{d}	76.08^{ab}	2.05^{cd}	62.35^{b}	45.98^{d}	39.38^{e}
7- FS	22.14^{e}	68.24^{c}	2.06^{cd}	56.20^{c}	41.70^{e}	35.88^{f}
8- WCPS	21.19^{ef}	78.81^{a}	1.81^{cd}	58.63^{c}	42.15^{e}	35.25^{f}
9- CSS	20.93^{f}	69.60^{bc}	1.41^{cd}	49.20^{d}	35.96^{f}	31.16^{g}
SEM	1.09	2.57	0.29	1.32	1.44	1.46

[a,b,c,...,g] Means within a column with different superscripts are significantly different (P<0.05).
a) Immediately degradable dry matter fraction (g/100 g original dry matter).
b) Dry matter fraction that is slowly degraded (g/100 g original dry matter).
c) Rate of degradation of fraction b/h. k) Outflow rate from the rumen/h.

Table (6): Crude protein degradability (%) of different tested roughages

Feedstuffs	Incubation hours						
	0	2	4	8	16	24	48
1- BH	29.73[g]	33.25[f]	36.59[cd]	42.70[e]	53.40[c]	62.05[c]	79.49[b]
2- PVH	39.33[d]	42.70[c]	45.36[b]	51.61[b]	61.12[a]	68.49[a]	82.04[a]
3- PNVH	35.82[e]	39.71[d]	43.23[b]	49.31[c]	58.41[b]	64.49[b]	73.36[c]
4- DSBT	29.84[g]	32.57[f]	35.20[d]	40.20[f]	48.95[d]	56.45[d]	72.96[c]
5- EG	27.81[g]	29.03[g]	30.23[e]	32.57[g]	37.01[f]	41.15[g]	52.03[f]
6- MG	46.00[b]	48.20[b]	50.31[a]	54.25[a]	61.17[a]	66.98[a]	79.38[b]
7- FS	49.29[a]	50.40[a]	51.48[a]	53.51[ab]	57.14[b]	60.27[c]	67.82[d]
8- WCPS	41.27[c]	42.78[c]	43.73[b]	45.54[d]	48.82[d]	51.68[e]	58.27[e]
9- CSS	33.67[f]	36.06[e]	38.09[c]	41.31[ef]	45.34[e]	47.47[f]	49.51[g]
SEM	1.23	1.18	1.15	1.16	1.31	1.50	1.97

[a,b,c,...,g] **Means within a column with different superscripts are significantly different (P<0.05).**

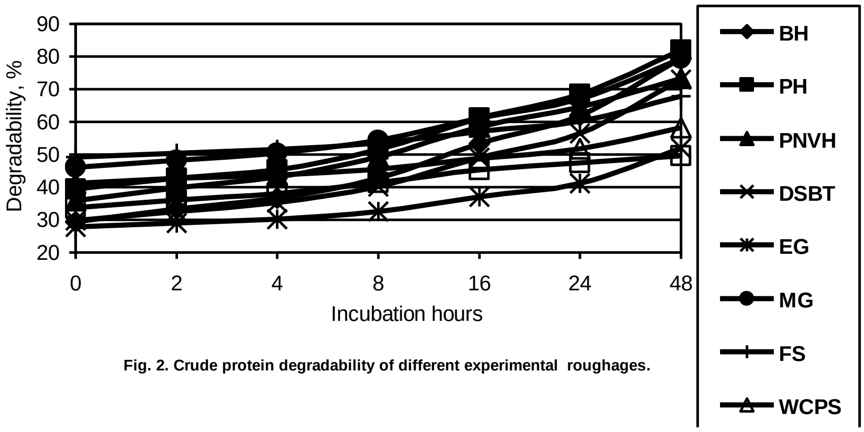

Fig. 2. Crude protein degradability of different experimental roughages.

Table (7): Effective degradability of crude protein (%) of different tested roughages.

Feedstuffs	*a* %	*b* %	*C* %	*Effective protein degradability*		
				K = 0.02	K = 0.05	K = 0.08
1- BH	29.48[g]	60.53[a]	2.57[d]	69.23[b]	53.76[c]	46.80[c]
2- PVH	39.33[d]	54.47[d]	3.19[c]	72.80[a]	60.60[a]	54.90[a]
3- PNVH	35.82[e]	41.41[f]	4.93[b]	65.30[c]	56.35[b]	51.60[b]
4- DSBT	29.84[g]	58.28[c]	1.99[f]	64.80[c]	49.80[d]	43.80[e]
5- EG	27.81[g]	59.89[b]	0.85[k]	49.38[e]	38.30[f]	34.80[f]
6- MG	46.00[b]	43.28[e]	2.19[e]	72.85[a]	61.65[a]	57.07[a]
7- FS	49.54[a]	30.34[g]	1.87[g]	64.00[c]	57.60[b]	55.00[a]
8- WCPS	41.79[c]	29.65[h]	1.69[h]	55.34[d]	49.30[d]	47.00[c]
9- CSS	33.67[f]	16.18[k]	7.97[a]	46.60[f]	42.60[e]	41.80[e]
SEM	1.24	2.56	0.35	1.56	1.29	1.18

[a,b,c,...,g] **Means within a column with different superscripts are significantly different (P<0.05).**
a) Immediately degradable protein fraction (g/100 g original protein).
b) Protein fraction that is slowly degraded (g/100 g original protein).
c) Rate of degradation of fraction b/h. k) Outflow rate from the rumen/h.

The linear and quadratic prediction equations for N and DM degradability using nutrient concentrations are presented in Table (8). Meanwhile, effect of some nutrient concentrations on the prediction value of DM and N degradability were insignificant, so excluded from the data presented in Table 8. However, for prediction of the $P_{0.02}$, $P_{0.05}$ and $P_{0.08}$ of N. using CP or NFE concentration (Eq. 16, 19 and 22 and Eq. 17, 20 and 23) as a predictor produced great r^2 values. These results are in agreement with those observed by Yan and Agnew (2004).

Table (8). Linear and quadratic prediction equations for DM and CP degradability at the ruminal outflow rates of 0.02, 0.05 and 0.08/h from chemical constituents.

	Equation and factors	r^2	r^{-2}	P	SE	Eq.No.
	Prediction of DM degradability					
$P_{0.02}$	Y= 131.29 – 0.84*OM	0.70	0.41	0.37	6.22	4
	Y= 90.85 -.093*ADF	0.64	0.33	0.06	6.65	5
	Y= 85.119 - 0.934*NDF	0.60	0.27	0.09	6.94	6
	Y= 34.86 + 0.94*"a" water soluble DM	0.68	0.74	0.002	4.11	7
$P_{0.05}$	Y= 112.69-0.776*OM	0.33	0.24	0.10	7.84	8
	Y= 77.55- 0.921*ADF	0.57	0.23	0.11	7.80	9
	Y= 67.99 - 0.405*NDF	0.51	0.16	0.16	8.27	10
	Y= 18.48+1.075*"a" water soluble DM	0.81	0.81	0.001	4.00	11
$P_{0.08}$	Y= 105.50 - 0.757*OM	0.56	0.21	0.12	8.06	12
	Y= 71.33 - 0.900*ADF	0.55	0.21	0.12	8.10	13
	Y= 61.75 - 0.391*NDF	0.49	0.13	0.18	8.47	14
	Y= 12.48 + 1.94*"a" water soluble DM	0.82	0.82	0.001	3.90	15
	Prediction of CP degradability					
$P_{0.02}$	Y= 47.33 + 1.15*CP	0.47	0.11	0.21	9.16	16
	Y= 95.77 – 782*NFE	0.50	0.15	0.17	8.94	17
	Y= 45.71 + 045*"a" water soluble CP	0.35	0.002	0.36	9.69	18
$P_{0.05}$	Y= 42.04 + 0.781*CP	0.39	0.03	0.31	7.86	19
	Y= 82.44 – 0.705*NFE	0.55	0.21	0.12	7.11	20
	Y= 26.72 + 0.689*"a" water soluble CP	0.66	0.35	0.05	6.43	21
$P_{0.08}$	Y= 40.99 +0.54*CP	0.29	-0.04	0.44	7.44	22
	Y= 75.11 - 0.63*NFE	0.54	0.19	0.13	6.55	23
	Y= 19.576 + 0.77*"a" water soluble CP	0.80	0.59	0.01	4.64	24

The "a" value for N and DM account a major part of N and a considerable part of DM. With increasing ruminal outflow rates, the "a" value of N or DM accounted for a greater proportion of degraded N or DM. This lead to greater accuracy for predicting the $P_{0.08}$ than $P_{0.02}$of N and DM using "a" value, with the r^2 value increasing from 0.68 (Eq. 7) to 0.82 (Eq.15) with DM or from 0.35 (Eq. 18) to 0.80 (Eq. 24) with N. The same trend was also reported by Prakash *et al*., (2006) who studied the rumen degradation characteristics and effective degradability of DM and CP of 18 different forest-based foliages. There were significant negative correlations between effective degradability of DM and cell wall content (NDF and ADF), the regression equation showed that NDF and water soluble DM "a" were well correlated with *in sacoo* effective degradability of DM while, for effective degradability of CP the best correlation was with the water soluble protein "a". The "a" value for N and DM account a major part of N and a considerable part of DM. With increasing ruminal outflow rates, the "a" value of N or DM accounted for a greater proportion of degraded N or DM. This lead to greater accuracy for predicting the $P_{0.08}$ than $P_{0.02}$of N and DM using "a" value, with the r^2 value increasing from 0.68 (Eq. 7) to 0.82 (Eq.15) with DM or from 0.35 (Eq. 18) to 0.80 (Eq. 24) with N. The same trend was also reported by Prakash *et al*., (2006) who studied the rumen degradation characteristics and effective degradability of DM and CP of 18 different forest-based foliages. There were significant negative correlations between effective degradability of DM and cell wall content (NDF and ADF), the regression equation showed that NDF and water soluble DM "a" were well correlated with *in sacoo* effective degradability of DM while, for effective degradability of CP the best correlation was with the water soluble protein "a".

CONCLUSION

From the foregoing present study, it could be concluded that the degradability of N of tested roughages was consistently greater than of DM. The effective degradability of DM decreased with increase in outflow rates. The data showed low relationship between N degradability rate and CF content and its fractions (ADF, NDF and ADL) for a variety of roughages. The regression equation showed that OM, NDF, ADF and water soluble DM "a" were well correlated with *in sacoo* ED of DM while for ED of CP the best correlation was with CP, NFE and the water soluble protein "a" fraction.

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التنبؤ بالقيمة الغذائية لبعض مواد العلف الخشنة باستخدام التركيب الكيميائي ودرجة التخمر الميكروبي فى الكرش

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أجرى هذا البحث لدراسة الصفات التخمرية فى الكرش وكفاءة التخمر الميكروبى للمادة الجافة والبروتين الخام لعدد تسعة من مواد العلف الخشنة بواسطة أربعة ثيران مزودة بفستيولاً بالكرش باستخدام طريقة الأكياس النايلون كطريقة سريعة وذلك للحصول على القيمة الغذائية لهذه الأعلاف وتطوير معادلات التنبؤ المستخدمة فى تقدير كفاءة التخمر الميكروبى للمادة الجافة والبروتين الخام من خلال التحليل الكيميائي للمواد الخشنة المستخدمة فى هذه الدراسة والمواد المختبرة هي:1- دريس البرسيم (حشة ثالثة). 2- دريس عرش اللوبيا. 3- دريس عرش الفول السوداني. 4- عرش البنجر المجفف. 5- علف الفيل. 6- علف الدخن. 7- الذرة السكرية. 8- سيلاج نباتات الذرة الكامل. 9- سيلاج عيدان الذرة المضاف إليه 0.5% يوريا + 5% مولاس وكان يتم تحضين من عينات من مواد العلف المختبرة فى الكرش لمدة صفر، 2، 4، 8، 16، 24، 48 ساعة. معدل اختفاء النيتروجين والمادة الجافة كان يستخدم لتقدبر الثوابت (a) الجزء المفقود نتيجة عملية الغسيل، (b) الجزء القابل للتخمر، (c) معدل مرور الجزء القابل للتخمر (b) فى الساعة وكفاءة التخمر (ED) عند مختلف معدلات المرور ($P_{0.02}$, $P_{0.05}$, $P_{0.08}$).

وقد أوضحت النتائج مايلى:-

1- هناك علاقة ارتباط موجبة بين محتوى مادة العلف من الألياف الخام ومكوناتها من الألياف المتعادلة (NDF) والألياف الحامضية (ADF).
2- كان هناك اختلافات معنوية (5%) بالنسبة للثابت (a) بين مواد العلف المختلفة كما ازدادت كفاءة تخمر المادة الجافة مع زيادة معدل المرور.
3- كانت درجة التخمر الميكروبى للنيتروجين بصفة عامة أعلى من مثيلتها بالنسبة للمادة الجافة.
4- انخفضت العلاقة بين معدل التخمر الميكروبى للنيتروجين ومحتوى مادة العلف من الالياف ومكوناتها بالنسبة لمواد العلف المختلفة.
5- كما أوضحت النتائج ان إستخدام البروتين الخام والمواد الكربوهيدراتية للتنبؤ لمعدلات المرور ($P_{0.02}$, $P_{0.05}$ and $P_{0.08}$) للنيتروجين اعطت قيم أعلى الأرتباط (r^2) بالمقارنة باستخدام كلا من ADF, NDF and ADL.

هذه الدراسة أوضحت أن هناك ارتباط جيد بين المادة العضوية،الألياف المتعادلة، والألياف الحامضية وأيضا الجزء الذائب من المادة الجافة "a" في مواد العلف المختلفة وكفاءة التخمر الميكروبي في الكرش للمادة الجافة. كما يوجد ارتباط قوي بين البروتين الخام والكربوهيدرات الذائبة وأيضا الجزء الذائب من البروتين "a" وكفاءة التخمر الميكروبي للبروتين مما سيكون له أهمية تطبيقية من حيث التنبأ بالقيمة الغذائية لمواد العلف من خلال معادلات الانحدار المستخرجة للمكونات الغذائية تحت الدراسة مما سيوفر الوقت والجهد مقارنة بالطرق التقليدية.