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The Determination of Metabolizable Protein of Some Feedstuffs Used in Ruminant

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Abstract: In order to determine of metabolizable protein of corn grain (CG), cottonseed meal (CSM), barley grain (BG), alfalfa hay (three cut) (AH), beet pulp (BP), tomato pomace (TP), lupin by products (LBP) and fish meal (FM) using *in situ* method, this study was carried out. Three fistulatd Gizil whether was used. Data were analyzed using of NAWAY package. Metabolizable protein of CG, CSM, first cut AH, second cut AH, third cut AH, BP, TP, LBP and FM was 3.5098, 23.2197, 4.8509, 6.6067, 6.3770, 6.6207, 4.8044, 6.3005, 16.3847 and 39.6774 g kg^{-1} DM. The FM and CG had highest and lowest MP, respectively. The results showed that test feed with high crude fiber had low degradability. The degradability of CP of test feeds can be used in MP determination and diet formulation.

Key words: Nylon bags, rumen, sheep, metabolizable protein

INTRODUCTION

In ruminants due to ruminal microorganisms activity, the protein evaluation system is based on rumen degradable protein (RDP) and rumen undegradable protein (RUP). One of the proper methods for determining of disappearance of protein in the rumen is *in situ* method (Woods, 2002). This method is variable depends on the nylon bag characteristics, sample weight to nylon bag square ratio (mg cm^{-2}), sample size and microbial contamination (Vanzant *et al.*, 1998). Mehrdad *et al.* (2005) showed high degradability for third cut alfalfa compared to first and second cut. Mesgaran (2003) reported the DM degradability of (AH) about 44% and CP degradability about 55%.

Woods *et al.* (2003) studied the degradability of some feedstuffs and showed degradability parameters for CSM a, b, c about 31.5, 48.1% and 0.12 h^{-1}, respectively. Taghizadeh *et al.* (2006) found DM and CP degradability of BG at 96 h about 92%. Hadji Panayioton and Economids (2001) reported degradability characteristics of lupin (a, b and c) about 12.45, 84.41% and c = 0.1 h^{-1}.

Taghizadeh *et al.* (2006) showed the DM and CP degradabilities of FM at 12 h about 340 and 320 g kg^{-1} DM, respectively.

Tomatto pomace value depends on type of tomato, preservation, processing, drying type (Weis, 1997). The objective of this study was the determining of degradability characteristics and metabolizable protein (MP) of corn grain (CG), barley grain (BG), beet pulp (BP), lupin by products (LBP), cottonseed meal (CSM), first cut alfalfa (FCA), second cut alfalfa (SCA) and third cut alfalfa (TCA) and fish meal (FM) using *in situ* method.

MATERIALS AND METHODS

Sample collection: Ten test feeds were evaluated using *in situ* technique. All cuts of alfalfa were collected from at least 7 different areas within each field. All 7 samples were thoroughly mixed and a composite sample (100 g) was taken. Cereal grain (corn and barley), LBP, TP, CSM, BP and FM were collected from at least 10 different area within a bin. All samples were dried in an oven at 100°C until a constant weight was achieved. All feedstuffs were then ground to pass through a 2 mm screen in a Wiley mill before incubation.

Whethers and feeding: Three whethers were fitted with ruminal fistulas. All whether were fed a diet containing of 60% concentrate and 40% AH (NRC, 1989). The feed was fed in equal portion every 8 h to maintain a relatively rumen environment.

***In situ* rumen incubation of feeds:** Nylon bags (5.5×10 cm; 47 μm pore size) were filled with 5 g of dry, ground samples and were closed using glue. Each feed sample was incubated in 6 replicates (2 replicates for each whether) in the rumen. The incubation time for concentrates are 0, 4, 8, 12, 16, 24, 48 and for fiber samples are 0, 4, 8, 12, 16, 24, 48, 72 and 96 h. The incubation times were calculated according to Ørskov and McDonald (1979). Nylon bags were suspended in the rumen in a polyester mesh bag (25×40 cm; 3 mm pore size) and were removed from the rumen at the same time so that all bags could be washed simultaneously. The nylon bags were then removed from the mesh bag and washing until the

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rinse water remained clear. Samples were then dried in an oven at 55°C until a constant weight was achieved before determination of DM disappearance.

Chemical analyses: Determinations of N were conducted using the Kjel-dahl method an automated Kjelfoss apparatus. Neutral detergent fiber and ADF were measured according to the method of Goering and Van Soest (1970)

RESULTS AND DISCUSSION

Chemical composition: The DM, CP, NDF and ADF of test feeds are shown in Table 1. The CP content of CG and FM was lower and higher the other feeds.

The obtained chemical composition of test feeds are different compared to reports of NRC (2001), ARC (1992) and Taghizadeh *et al*. (2005). These differences may related to variance in environmental condition, variety, cut in forage and maturity, oil extract assay and other processing in meals.

***In situ* dry matter and Crude protein disappearance:** The disappearance of DM and CP at different times of incubation are shown in Table 2 and 3.

Regarding to obtained data at 0 h the DM disappearance of FM was lower than the other feeds ($p<0.05$). The CP disappearance of FM and second cut alfalfa hay was lower than the other feedstuffs ($p<0.05$). These differences can be resulted from differences in soluble fractions specially soluble CP. During incubation times obtained significant differences between ruminal CP degradation, whereas in 24 h CG and FM were higher and lower than the other test feeds CP, respectively ($p<0.05$). Concentrates had high degradability at 48 h except of FM. High degradability of CP in concentrates may be related to high rumen degradable protein fraction compared to roughage that have high ADIN. Low degradability of FM can be resulted from containing of its chitin resulting high ruminal escaped protein. There weren't significant differences among ruminal DM and CP degradation of alfalfa different cuts.

Table 1: The chemical composition of feedstuffs

Feed stuffs	DM[1] (%)	CP[2] (%)	NDF[3] (%)	ADF[4] (%)	ADIN[5] (%)
Lupin by products	94.00	24.89	19.13	8.88	0.214
Tomato pomace	91.64	22.21	54.26	45.87	1.902
Cottonseed meal	96.12	41.43	49.16	29.96	0.262
Beet pulp	95.25	9.34	33.18	20.04	0.179
First cut alfalfa	91.56	15.20	53.68	44.26	0.655
Second cut alfalfa	93.38	13.63	48.28	40.81	0.481
Third cut alfalfa	93.62	15.44	51.64	41.97	0.682
Fish meal	75.56	67.93	-	-	-
Corn grain	94.00	8.43	12.52	5.14	0.414
Barley grain	91.83	9.10	18.24	41.97	0.140

1: Dry Matter, 2: Crude Protein, 3: Neutral Detergent Fiber, 4: Acid Detergent Fiber, 5: Acid Detergent Insoluble Nitrogen

Table 2: *In situ* CP disappearance

	Incubation time (h)								
Feeds	0	4	8	12	16	24	48	72	96
LBP	15.29^{a}	25.13^{a}	29.61^{a}	37.15^{a}	38.63^{a}	42.02^{a}	57.25^{a}	-	-
TP	10.09^{bc}	16.34^{bc}	28.22^{a}	30.39^{a}	32.93^{b}	42.52^{a}	56.18^{a}	-	-
CSM	15.94^{a}	16.85^{bc}	22.24^{b}	26.60^{c}	32.57^{b}	35.97^{b}	46.46^{bc}	-	-
BP	12.31^{b}	18.88^{b}	24.64^{b}	25.71^{c}	30.58^{b}	32.68^{bc}	47.35^{bc}	-	-
AA C1	9.48^{cd}	9.82^{d}	16.43^{c}	18.87^{d}	32.46^{b}	32.69^{bc}	44.21^{c}	55.98^{a}	60.48^{a}
AA C2	5.02^{e}	6.32^{e}	10.92^{e}	16.08^{d}	25.64^{c}	29.83^{cd}	42.46^{c}	50.77^{a}	63.08^{a}
AA C3	8.21^{d}	10.36^{d}	13.76^{d}	16.90^{d}	27.30^{c}	31.69^{bc}	35.94^{d}	48.82^{a}	58.07^{a}
FM	5.63^{e}	14.44^{c}	16.72^{c}	18.15^{d}	24.54^{c}	25.32^{cd}	31.61^{d}	-	-
CG	10.59^{bc}	17.15^{bc}	27.73^{a}	35.81^{a}	40.50^{a}	45.91^{a}	53.91^{a}	-	-
BG	12.10^{b}	17.09^{bc}	22.02^{b}	24.80^{c}	31.14^{b}	36.27^{b}	51.91^{ab}	-	-
SEM	0.751	0.881	0.882	1.065	1.075	1.642	1.965	2.823	2.337

LBP = Lupine by Products, TP = Tomato Pomace, CSM = Cottonseed Meal, BP = Beet Pulp, AA C1 = alfalfa hay (first cut), AA C2 = alfalfa hay (second cut), AA C3 = alfalfa hay (third cut), FM = fish meal, CG = corn grain and BG = barley grain

Table 3: *In situ* DM disappearance

	Incubation time (h)								
Feeds	0	4	8	12	16	24	48	72	96
LBP	19.51^{b}	20.69^{def}	28.68^{cd}	35.98^{a}	37.40^{b}	42.70^{bc}	59.90^{b}	-	-
TP	6.37^{d}	18.61^{ef}	25.89^{d}	29.81^{c}	35.49^{b}	42.06^{bc}	48.63^{d}	-	-
CSM	17.09^{b}	17.91^{f}	20.67^{e}	24.72^{d}	30.27^{c}	33.43^{e}	43.19^{e}	-	-
BP	14.00^{c}	21.46^{cde}	33.36^{a}	34.38^{ab}	38.55^{b}	46.86^{b}	60.63b	-	-
AA C1	23.35^{a}	24.19^{bc}	29.61^{c}	31.42^{c}	35.36^{b}	38.65^{cd}	52.72^{cd}	55.57^{a}	60.47^{a}
AA C2	22.83^{a}	28.76^{a}	31.18^{abc}	35.58^{a}	37.12^{b}	41.17^{c}	55.57^{bc}	60.47^{a}	64.71^{a}
AA C3	22.54^{a}	23.42^{bcd}	25.62^{d}	28.83^{c}	31.08^{c}	39.27^{cd}	52.94^{cd}	58.73^{a}	64.36^{a}
FM	5.78^{d}	13.45^{g}	15.03^{g}	16.17^{e}	22.81^{d}	23.8^{f}	28.15^{f}	-	-
CG	18.13^{b}	18.48^{ef}	19.26^{e}	24.87^{d}	28.13^{c}	36.06^{de}	42.93^{e}	-	-
BG	24.64^{a}	24.90^{b}	32.08^{ab}	36.13^{a}	45.37^{a}	58.66^{a}	68.94^{a}	-	-
SEM	0.903	1.075	1.014	1.078	1.108	1.555	1.637	1.883	2.886

LBP = lupine by products, TP = tomato pomace, CSM = Cottonseed meal, BP = beet pulp, AA C1 = alfalfa hay (first cut), AA C2 = alfalfa hay (second cut), AA C3 = alfalfa hay (third cut), FM = fish meal, CG = corn grain and BG = barley grain

Table 4: The CP degradability characteristics of test feeds

	Parameters					
Feeds	a[1]	b[2]	c[3]	ERDP[4]	DUP[5]	MP[6]
LBP	16.9	45.81	0.0405	12.32	13.27	16.38
TP	10.38	54.43	0.0377	9.74	0.10	6.30
CSM	14.18	42.76	0.0298	15.30	20.98	23.21
BP	13.78	46.14	0.0260	3.46	4.04	4.80
AA C1	8.56	62.31	0.0186	5.60	4.71	6.60
AA C2	3.38	67.33	0.0196	4.90	5.05	6.37
AA C3	8.43	63.03	0.0148	5.18	5.16	6.62
FM	6.74	25.78	0.0610	89.94	45.14	39.67
CG	9.11	47.11	0.0647	3.64	1.83	3.50
BG	12.12	63.66	0.0204	3.80	3.77	4.85

LBP = lupine by products, TP = tomato pomace, CSM = Cottonseed meal, BP = beet pulp, AA C1 = alfalfa hay (first cut), AA C2 = alfalfa hay (second cut), AA C3 = alfalfa hay (third cut), FM = fish meal, CG = corn grain and BG = barley grain. 1-soluble fraction, 2-degradable fraction, 3- Undegradable Fraction, 4-Effective Rumen Degradable Protein, 5- Digestible Undegradable Protein and 6- Metabolizable Protein

The degradabilities parameter (a, b and c), ERDP, DUP and MP are shown in Table 4. There were differences between obtained results for CP, ERDP and DUP of test feed compared to AFRC (1992).

There can be resulted from variance in ruminal microbial yield, feeding level, type, variety, processing, harvest cut, soluble and insoluble protein. Fish meal showed high MP compared to other feed that can be resulted of high DUP (Table 4) resulting supply of high amino acids for ruminants. This finding is agreement with that reported by Taghizadeh *et al.* (2005), who showed that low ruminal degradability of FM CP, compensated for in the small intestine.

CONCLUSION

It is concluded that feed with high ADIN have low degradability. The different MP between test feeds can be related to differences in their ERDP and DUP.

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