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Research Article

Prediction of the Voluntary Intake and Digestibility of Forage-Based Diets from Chemical Composition and Ruminal Degradation Characteristics

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Abstract: Two digestion experiments and an *in situ* nylon bag experiment were conducted to determine the correlations between chemical composition, ruminal *in situ* degradation kinetics and OMI, and OM and CP digestibilities of diets in wethers fed forages of varying nutritive value without and with protein supplementation. Wethers were fed ground corn crop residues, oat-berseem clover or alfalfa hay in the first experiment, ground corn crop residues with or without alfalfa or oat-berseem clover hay supplemented with SBM and grain corn mixture to meet the DIP requirement, by using level 1 of the Nutrient Requirements of Beef Cattle computer program at *ad libitum* intake. To determine the kinetics of N and OM degradation in the rumen, a composite sample of each feed was prepared. Duplicate bags of each forage were attached to weighted rings, placed in the rumens of two fistulated steers grazing smooth bromegrass, and allowed to incubate for 0, 3, 6, 12, 24, 48 and 72 h. While the concentrations of NDF and ADF and the percentage of potentially digestible organic matter fraction and indigestible organic matter fraction were greater, the percentage of water soluble organic matter fraction was lower in corn crop residue compared with alfalfa hay or oat/berseem clover ($P<0.05$). Addition of alfalfa or oat-berseem clover hay supplemented with SBM and grain corn mixture to corn crop residues linearly decreased the concentrations of NDF and ADF, and the percentage of the indigestible organic matter fraction, but increased the percentage of potentially digestible and water soluble organic matter fractions. Organic matter intake, organic matter and crude protein digestibilities were significantly lower ($P<0.05$) in wethers fed corn crop residues alone compared with wethers fed alfalfa or oat/berseem clover hays. Addition of protein supplement and addition of increasing levels of oat/berseem clover or alfalfa hays to corn crop residues linearly increased organic matter intake, organic matter and crude protein digestibilities of diets in wethers. The highest correlations were observed between water soluble organic matter fraction and organic matter intake (r^2 =.80), ADF and apparent total track OM digestibility (r^2=.94), and indigestible CP fraction and true ruminal CP digestibility (r^2=.82). It was concluded that chemical composition with ruminal degradation characteristics can provide a reliable prediction of the intake and digestibility of forage-based diets.

Key Words: Intake, Digestibility, Nylon Bag Technique, Forage

Kaba Yemlere Dayalı Rasyonların Kimyasal Kompozisyonu ve Rumen Yıkılım Özelliklerinden Yararlanılarak Sindirebilirlilik ve Yem Tüketimlerinin Tahmini

Özet: Bu çalışmada, değişik besleyici değere sahip kaba yemleri tüketen koyunlarda, yem tüketimi, OM ve HP sindirile bilirlikleri ile yemlerin besin içerikleri ve rumen yıkılım özellikleri arasındaki ilişki incelenmiştir. Bu amaçla, iki sindirim ve bir naylon kese yıkılım denemesi yapılmıştır. Birinci sindirim denemesinde, kastre edilmiş toklulara mısır samanı, yulaf otu-iskenderiye üçgülü karışımı yada yonca; ikinci sindirim denemesinde ise, mısır samanına ilave olarak, hayvanların DIP ihtiyaçlarını karşılamak amacıyla, soya küspesi ve dane mısırdan oluşan suplementasyon, yine mısır samanına ilave olarak bu suplementasyon ile birlikte iki değişik düzeyde yonca kuru otu yada yulaf otu-iskenderiye üçgülü karışımı verilmiştir. Böylece birinci sindirim denemesi için 3, ikinci sindirim denemesi için ise 5 yem karışımı hazırlanmıştır. Hazırlanan bu karmalar ayrıca rumende N ve OM yıkılım kinetiğinin belirlenmesi için, kılçıksız brom tüketen iki adet fistüllü öküzün rumeninde 0, 3, 6, 12, 24, 48 ve 72 saat süreyle inkube edilmiştir. Mısır samanın NDF ve ADF içerikleri, potansiyel olarak rumende yıkımlanabilen ve yıkılamayan OM oranları, yonca kuru otu ve yulaf otu-iskenderiye üçgülü karışımına oranla yüksek, suda kolay eriyen OM oranı ise daha düşük bulunmuştur ($P<0.05$). Mısır samanına suplementle birlikte yonca kuru otu veya yulaf otu-iskenderiye üçgülü karışımı ilavesi, rasyonların NDF, ADF içerikleri ve rumende yıkılamayan OM oranını lineer olarak düşürürken, suda kolay eriyen ve potansiyel olarak rumende yıkımlanabilen OM oranlarını artırmıştır. Hayvanların OM tüketimi ile OM ve HP sindirm değerleri mısır samanı tüketen hayvanlarda yonca kuru otu yada yulaf otu-iskenderiye üçgülü karışımını tüketen hayvanlara oranla önemli derecede düşük bulunmuştur ($P<0.05$). Mısır samanına suplementle birlikte yonca kuru otu yada yulaf otu-iskenderiye üçgülü karışımı ilavesi, hayvanların OM tüketimi ile OM ve HP sindirim değerlerini lineer olarak artırmıştır. En yüksek korelasyonlar suda kolay eriyen OM miktarı ile OM tüketimi (r^2 =.80), ADF ile toplam sindirilebilirlilik (r^2 =.94) ve rumende yıkımlanamayan HP ile rumende gerçek HP sidilebilirliliği (r^2 =.82) arasında bulunmuştur.

Bu çalışmada, kaba yeme dayalı rasyonların besin madde içerikleri ile birlikte rumen yıkılım özelliklerinin bilinmesi, bu rasyonların sindirilebilirliklerinin ve hayvanların yem tüketimlerinin tahmininde güvenilir sonuçlar verebileceği sonucuna varılmıştır.

Anahtar Sözcükler: Yem Tüketimi, Sindirim, Naylon Kese Tekniği, Kaba yem

Introduction

Most beef production in the world is associated with cow-calf enterprises in which the majority of feed consumed is forages. To accurately develop balanced supplementation programs, precise prediction of forage intake is necessary because forage intake is responsible for about two-thirds of the variation associated with the production performance of cow fed forage (1). Another factor determining animal performance is the digestibility of forage (2).

The determination of forage intake and digestibility by using *in vivo* methods is time-consuming, laborious and expensive and requires a large quantity of forage. It is also unsuitable for large-scale feed evaluation laboratories. Thus, many scientists have attempted to develop regression equations to predict forage intake and digestibilities by using chemical compositions of forages and biological methods to estimate forage digestibility (3,4).

Because of its gut-filling effect, forage neutral detergent fiber (NDF) concentration has been used to predict forage intake (5). In addition to acid detergent fiber (ADF) concentration (6), the digestibility of forage can be estimated by biological methods. These methods include *in vitro* (either using rumen fluid or enzyme) and *in situ* nylon bag methods. The technique of Tilley and Terry (7) is now widely used in many forage evaluation laboratories because of its convenience. The nylon bag technique has been used for many years to provide a useful means for estimating rates of disappearance and potential degradability of feedstuffs (3). This technique also provides an opportunity to fractionate feedstuffs into water soluble, potentially degradable, and indigestible fractions, which gives some idea about the extent of degradation of feedstuffs in the rumen (3). These fractions may provide an opportunity to develop better regression equations for predicting forage intake and digestibility.

Therefore, the objective of this study was to evaluate the use of chemical composition and fractions obtained from ruminal degradation kinetics of forage to predict the intake and digestibilities of nutrients.

Materials and Methods

Animals and diets used in *in vivo* digestion study

Two digestion experiments were conducted to determine apparent and true organic matter (OM) and crude protein (CP) digestibilities in wethers fed forages of varying nutritive value without and with protein supplementation in order to obtain variations in feed intake and digestibilities. Six and five wethers, fitted with cannulae in the rumen and proximal duodenum, were utilized in a 6 x 6 and 5 x 5 Latin Square metabolism trail in the first and second experiments, respectively. Each period lasted 22 d: 12-d adaptation and 10-d collection phases. During the experiment, animals were housed in individual pens in a room with a constant temperature of 25ºC.

Wethers were fed ground corn crop residues, oat/berseem clover or alfalfa hay at two levels of intake in the first experiment. However, only data obtained at *ad libitum* intake levels were used in this study. In the second experiment, ground corn crop residues with or without alfalfa or oat/berseem clover hay supplemented with soybean meal (SBM) and grain corn mixture to meet (degradable intake protein) the DIP requirement, by using level 1 of the Nutrient Requirements of Beef Cattle computer program (8), were fed to wethers at *ad libitum*

Table 1. The botanical composition of diets.

	Diets*							
Corn stalk Item	Oat/Berseem (CS)	Alfalfa Clover(O/Br)	CS+ hay(Alf)	CS/BrL+ Suppl	CS/BrH+ Suppl	CS/AlfL+ Suppl	CS/AlfH+ Suppl	Suppl
				of total diet , % of DM				
Corn stalk	100	-	-	79	69	45	69	45
Oat/Berseem clover	-	100	-	-	10.3	35	-	-
Alfalfa hay	-	-	100	-	-	-	10.3	35
Corn grain	-	-	-	5	8.3	15	10.3	20
SBM-44 % CP	-	-	-	16	12.4	5	10.3	-

* BrL= berseem clover at low level (10.3% of diet), BrH= berseem clover at high level (35% of diet), AlfL= alfalfa at low level (10.3% of diet), AlfH= alfalfa at high level (35% of diet).
Suppl (Supplement)= a mixture of soybean meal and grain corn used to meet DIP requirements of animals by using 1996-NRC computer program.

intake (Table 1). Diets were given twice daily at 0800 and 2000 h. Wethers had continuous access to clean water and a trace mineralized salt block during the experiment. To determine duodenal and fecal dry matter (DM) flow, 1.5 g chromium (Cr)-mordanted fiber containing approximately 2% Cr (9) was inserted through the ruminal cannula of each sheep at 0800 and 2000 h from d 5 to 16 of each period.

Sampling for Determination of Nutrient Digestion and Microbial Protein Synthesis

Feed and ort samples were collected on d 12 to 16 of each period and composited. On d 14, 15, and 16 of each period, duodenal digesta (200 ml) and rectal fecal samples (approximately 15 g wet-basis) were collected four times daily. Sampling times were advanced 2 h each day so that samples collected over the 3 d represented each 2 h of a 24-h cycle. Samples were frozen for later analysis. Approximately 1500 ml of ruminal fluid was collected from the ventral sac of the rumen and used for isolation of ruminal microbes by differential centrifugation (10).

in situ nylon bag study

To determine the kinetics of nitrogen (N) and OM degradation in the rumen, a composite sample of each feed was prepared. Twenty-eight 3 g samples of each feed were placed in 10 x12-cm nylon bags with a mean pore size of 50 mm. Duplicate bags of each forage were attached to weighted rings, placed in the rumens of two fistulated steers grazing smooth bromegrass, and allowed to incubate for 0, 3, 6, 12, 24, 48 and 72 h. Bags were placed in the rumen at staggered times to allow all bags to be withdrawn simultaneously. Bags were washed in cold water until rinsates were clear, and dried at 60ºC for 48 h. Remaining residues were analyzed for OM and N concentrations.

Organic matter and N were divided into three fractions as follows: 1) the soluble OM or N fraction (fraction a) determined as OM or N loss during the washing process, 2) the potentially digestible OM or N fraction (fraction b) determined as the differences between initial OM or N content after washing and the amounts of OM and N recovered after a 72-h incubation, 3) the indigestible fraction (fraction c) determined as the amount of OM or N residue recovered after a 72-h incubation (11).

Chemical Analysis

Dry matter concentrations of feed, orts and feces were determined by drying in a forced-air oven at 60ºC for 48 h (12). Duodenal digesta samples and the bacterial pellets from differential centrifugation of rumen fluid were freeze-dried. Dried feed, duodenal digesta and feces were ground through a 1-mm screen. Dry duodenal digesta and fecal samples were composited on an equal dry weight basis for each animal in each period. Organic matter concentrations of dried feed, orts, duodenal digesta and fecal samples were determined as the weight loss during combustion at 600ºC for 2 h in a muffle furnace (12). Concentrations of NDF and ADF in dry feed, orts, duodenal digesta and fecal samples were determined by the sequential procedure of Van Soest and Robertson (13). Nitrogen concentration of dried feed, orts, duodenal digesta, and fecal and bacterial samples were analyzed by the Kjeldahl procedure (12) using selenium as a catalyst. Purine concentrations of duodenal digesta samples and the ruminal bacterial pellet were determined using the procedure of Zinn and Owens (14). To determine Cr concentrations of the Cr-mordanted fiber, the dried duodenal digesta and fecal samples were dried at 60°C for 48 h, ground through a 1-mm screen, and ashed at 600ºC for 2 h in a muffle furnace. Chromium was extracted from the remaining ash with a phosphoric acid-manganese sulfate-potassium bromate solution and analyzed by atomic absorbtion spectrophotometry (15).

The amounts of nitrogen and OM truly digested in the rumen were calculated by correcting the amounts of nitrogen and OM apparently digested in the rumen for microbial nitrogen and OM as determined by the ratio of the two components with purines in the rumen bacterial pellet.

Statistics

All of the data were analyzed by using ANOVA of Statistical Analysis Systems (16) and means were separated by Duncan`s t-test (17).

Results and Discussion

As expected, the concentrations of neutral detergent fiber and acid detergent fiber were significantly lower ($P<0.05$) in alfalfa hay than-oat/berseem clover hay or corn crop residues (Table 2). The concentrations of NDF and ADF for corn crop residues, alfalfa and oat/berseem

Table 2. Chemical composition and fractions based on ruminal degradation kinetics of forage-based diets fed to sheep.

	Diets*								
Item	Corn stalk (CS)	Oat/Berseem Clover(O/Br)	Alfalfa hay(Alf)	CS+ Suppl	CS/BrL+ Suppl	CS/BrH+ Suppl	CS/AlfL+ Suppl	CS/AlfH+ Suppl	SEM[1]
				Chemical Composition of Diets, % of DM					
NDF	75.7 ^{a}	62.2 ^{c}	42.0 ^{f}	65.9 ^{b}	64.5 ^{b}	61.0 ^{d}	62.8 ^{c}	55.4 ^{e}	0.70
ADF	43.3 ^{a}	37.4 ^{b}	28.4 ^{f}	36.9 ^{b}	35.9 ^{bc}	33.9 ^{d}	35.6 ^{c}	31.5 ^{e}	0.64
Fractions of Organic Matter, % of OM									
a	14.5 ^{g}	24.4 ^{b}	28.4 ^{a}	18.5 ^{f}	19.4 ^{e}	21.6 ^{d}	19.4 ^{e}	23.0 ^{c}	0.41
b	48.5 ^{b}	45.4 ^{c}	43.3 ^{d}	51.3 ^{a}	51.1 ^{a}	50.5 ^{a}	51.1 ^{a}	49.8 ^{a}	0.71
c	37.9 ^{a}	30.3 ^{b}	28.3 ^{c}	30.2 ^{b}	29.4 ^{bc}	27.8 ^{c}	29.5 ^{bc}	27.2 ^{c}	0.42
Fractions of Crude Protein, % of CP									
a	15.0 ^{g}	41.9 ^{b}	47.6 ^{a}	18.6 ^{f}	21.4 ^{e}	27.9 ^{c}	22.0 ^{d}	29.8 ^{b}	1.21
b	41.0 ^{c}	36.1 ^{d}	41.8 ^{c}	46.5 ^{a}	45.8 ^{a}	44.4 ^{b}	46.3 ^{a}	46.3 ^{a}	0.65
c	44.0 ^{a}	22.0 ^{e}	10.6 ^{f}	34.9 ^{b}	32.8 ^{c}	27.6 ^{d}	31.7 ^{c}	23.9 ^{e}	0.88
Organic Matter Intake,% of BW2	1.56 ^{ef}	3.11 ^{b}	4.52 ^{a}	1.60 ^{e}	1.64 ^{e}	2.05 ^{c}	1.77 ^{d}	2.04 ^{c}	0.06
Organic Matter Digestibilities, %									
Apparent Ruminal,	31.3 ^{e}	34.1 ^{d}	49.7 ^{a}	45.0 ^{b}	42.3 ^{c}	43.9 ^{bc}	43.4 ^{c}	45.6 ^{b}	0.81
True Ruminal,	45.4 ^{e}	51.9 ^{d}	70.5 ^{a}	65.5 ^{c}	64.7 ^{c}	67.0 ^{b}	64.5 ^{c}	65.7 ^{c}	0.72
Apparent total tract,	45.6 ^{d}	57.6 ^{c}	65.8 ^{a}	56.3 ^{c}	56.4 ^{c}	61.2 ^{b}	57.4 ^{c}	61.4 ^{b}	1.33
Crude Protein Digestibilities, %									
True Ruminal,	43.9 ^{g}	65.5 ^{d}	82.2 ^{a}	59.8 ^{f}	68.9 ^{b}	62.9 ^{e}	62.5 ^{e}	67.5 ^{c}	0.68
Apparent total tract,	25.8 ^{e}	64.2 ^{b}	75.1 ^{a}	56.3 ^{d}	59.0 ^{c}	56.2 ^{d}	57.8 ^{cd}	60.2 ^{c}	1.32

*Supplement= a mixture of soybean meal and grain corn used to meet DIP requirements of animals by using 1996-NRC computer program.

BrL= berseem clover at low level (10.3% of diet), BrH= berseem clover at high level (35% of diet), AlfL= alfalfa at low level (10.3% of diet), AlfH= alfalfa at high level (35% of diet).

^{a}=the soluble fraction, ^{b}= the potentially digestible fraction, ^{c}= the indigestible fraction.

^{abcdefg} Means in rows with different superscripts differ significantly ($P < .05$).

[1]SEM= Standard error of means, [2]of BW=Percentage of body weight.

were in agreement with the results of Karsli et al. (18) at a comparable maturity. Addition of supplement to corn crop residue decreased the concentrations of neutral detergent fiber and acid detergent fiber and, in addition to supplement, addition of alfalfa or oat/berseem clover hay to corn crop residue further decreased the concentrations of neutral detergent fiber and acid detergent fiber in these diets.

Similarly, while the percentage of water soluble organic matter fraction (fraction a) was lower, the potentially digestible organic mater fraction (fraction b) and indigestible organic matter fraction (fraction c) were greater in corn crop residue compared with alfalfa hay or oat/berseem clover ($P<0.05$) (Table 2). Addition of supplement and increasing levels of hays linearly increased fraction a of organic matter, but decreased fractions b and c of organic matter. While the percentage of water soluble protein fraction (fraction a) was significantly lower, the indigestible protein fraction (fraction c) was significantly greater in corn crop residue compared with alfalfa hay or oat/berseem clover. Percentage of potentially digestible protein fraction (fraction b) was similar in corn crop residue and alfalfa hay, but significantly lower in oat/berseem clover compared with corn crop residue or alfalfa hay ($P<0.05$). Similar to organic matter, addition of supplement and increasing levels of hays linearly increased fractions a and b of crude protein, but decreased fraction c of crude protein in diets. The differences in OM and CP fractions among forages have been reported by Chermiti et al. (4) and Blümmel and Orskov (19).

Wethers fed alfalfa or oat/berseem clover hays consumed significantly greater (P<0.05) quantities of organic matter than wethers fed corn crop residues alone (Table 2). Addition of protein supplement and addition of increasing levels of oat/berseem clover or alfalfa hays to corn crop residues linearly increased the organic matter intake of wethers, which is in agreement with the findings of Karsli et al. (18).

Similarly, apparent, true ruminal and total tract organic matter and crude protein digestibilities were significantly lower in wethers fed corn crop residues alone compared with wethers fed legumes (P<0.05) (Table 2). Again, addition of protein supplement and increasing levels of oat/berseem clover or alfalfa hays to corn crop residues linearly increased organic matter and crude protein digestibilities of diets. The digestibilities of OM and CP observed in the current study were similar to those of Karsli et al. (18) with similar diets.

Regression equations predicting dietary organic matter intake (OMI), expressed as a percentage of body weight, from chemical composition or organic matter fractions of forage based-diets was most highly significant for fraction a (r^2=.80), the water soluble fraction, of organic matter (Table 3). There was very little correlation between organic matter intake and fractions a+b or c of organic matter (r^2=.10). Organic matter intake was also significantly correlated with the chemical composition of the diets. The highest correlation between organic matter fractions and organic matter intake was obtained with NDF concentrations (r^2=.69).

Because NDF has a gut-filling effect (5), it limits organic matter intake. Thus, as NDF concentrations increase, organic matter intake linearly decreases. However, because water soluble fraction is assumed to rapidly disappear in the rumen fluid without occupying a great volume, rumen retention time of diets decreases with increasing percentage of fraction a in diets (4). Therefore, organic matter intake increases with increasing percentage of fraction a in diets because of the increased rate of passage of solid matter from the rumen. Significant correlations between the chemical compositions (NDF and ADF) of forage-based diets have been reported by many researchers (3,4,19). In addition to the chemical composition of forage-based diets, addition of OM fractions, especially fraction a, into the equation has improved the correlation with dry matter intake (DMI) (3,4), which confirmed the results of the current study.

Apparent ruminal, true ruminal, and apparent total tract OM digestibilities were most highly related to ADF and fraction c, which is the indigestible fraction of OM. Apparent ruminal, true ruminal, and apparent total tract OM digestibilities were also significantly correlated with NDF, fraction a and fraction a+b. However, the correlation between OM digestibilities and fraction a was the lowest (Tables 4-6).

It seems that OM digestibilities were mostly related to compounds that are related to indigestibility. While amounts of NDF digested varied greatly, amounts of ADF digested were less variable compared with amounts of NDF digested in animals fed forage-based diets. Because fraction c determined by the *in situ* technique gives the indigestible fraction of OM in the rumen, the indigestible fraction of OM also indicates the digestibility of OM because the majority of OM digestion occurs in the rumen of ruminant animals. Thus, OM digestibilities were highly related to ADF or fraction a of OM.

Table 3. Regression predicting forage intake from chemical compositions and fractions of OM.

Independent Variables	Equations	r^2
NDF	Y = -7.72 x + 78.85	.69
ADF	Y = -2.69 x + 41.52	.40
a	Y = 3.63 x + 12.85	.80
a+b	Y = 1.04 x + 67.55	.10
c	Y = - 1.05 x + 32.45	.10

Where Y= independent variables, x = dependent variables.
a=the soluble OM fraction, b= the potentially digestible OM fraction, c= the indigestible OM fraction.

Table 4. Regression predicting apparent ruminal OM digestibility from chemical compositions and fractions of OM.

Independent Variables	Equations	r^2
NDF	Y = - 1.19 x + 111.2	.58
ADF	Y = - 0.63 x + 61.78	.77
a	Y = 0.43 x + 3.47	.36
a+b	Y = 0.45 x + 51.1	.61
c	Y = - 0.45 x + 48.84	.66

Where Y= independent variables, x = dependent variables.
a=the soluble OM fraction, b= the potentially digestible OM fraction, c= the indigestible OM fraction.

Table 5. Regression predicting true ruminal OM digestibility from chemical compositions and fractions of OM.

Independent Variables	Equations	r^2
NDF	Y = - 0.79 x + 110.2	.50
ADF	Y = - 0.44 x + 62.5	.73
a	Y = 0.28 x + 3.94	.31
a+b	Y = 0.33 x + 49.32	.67
c	Y = - 0.33 x + 50.77	.73

Where Y= independent variables, x = dependent variables.
a=the soluble OM fraction, b= the potentially digestible OM fraction, c= the indigestible OM fraction.

Table 6. Regression predicting apparent total tract OM digestibility from chemical compositions and fractions of OM.

Independent Variables	Equations	r^2
NDF	Y = - 1.51 x + 148.2	.85
ADF	Y = - 0.72 x + 77.1	.94
a	Y = 0.68 x - 17.82	.83
a+b	Y = 0.54 x + 38.59	.85
c	Y = - 0.52 x + 60.3	.85

Where Y= independent variables, x = dependent variables.
a=the soluble OM fraction, b= the potentially digestible OM fraction, c= the indigestible OM fraction.

Similar to OM digestibilities, true ruminal (r^2=.82) and apparent total tract CP (r^2=.78) digestibilities were highly related to fraction c or combination of fraction a + b. The correlation between CP digestibilities and fraction a was the lowest (Table 7).

Table 7. Regression predicting true ruminal and apparent total tract CP digestibility from fractions of CP.

Independent Variables	Equations	r^2
True ruminal CP digestibility,		
a	Y = 0.83 x - 25.35	.60
a+b	Y = 0.84 x + 17.39	.82
c	Y = - 0.84 x + 82.61	.82
Apparent total tract CP digestibility,		
a	Y = 0.62 x - 7.48	.58
a+b	Y = 0.63 x + 35.83	.78
c	Y = - 0.63 x + 64.17	.78

Where Y= independent variables, x = dependent variables.
a=the soluble CP fraction, b= the potentially digestible CP fraction, c= the indigestible CP fraction.

Conclusion

The highest correlations were observed between the water soluble organic matter fraction and organic matter intake (r^2 =.80), ADF and apparent total track OM digestibility (r^2=.94), and indigestible CP fraction and true ruminal CP digestibility (r^2=.82). It was concluded that chemical composition with ruminal degradation characteristics can provide reliable prediction of intake and digestibility of forage-based diets.

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