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Effect of Cut and Irrigation Water Quality on Chemical Composition and *in situ* Rumen Degradability of Alfalfa

Research Article

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ABSTRACT

The objective of this study was to investigate the effects of cut and irrigation water quality on chemical composition and *in situ* dry matter (DM), crude protein (CP) and neutral detergent fiber (NDF) degradability of alfalfa. Three fistulated Zel sheep (approximately 2 years old) were used in a complete randomized design to evaluate the *in situ* rumen degradability. Ruminal incubation times consisted of 0, 3, 6, 9, 12, 24, 48, and 72 h. The results showed that increasing the cut of maturity and irrigation with saline water significantly cause to increase the components of cell wall (P=0.0011) and decrease the protein concentrations in alfalfa (P=0.0001). Except the quickly rumen degradability of DM that in first cut of alfalfa was higher, other parameters of ruminal degradability of DM were not different. Ruminal NDF degradability in second cut of alfalfa, that irrigated with saline water, was higher (P=0.0143). Degradation rate of NDF in first cut of alfalfa, and effective rumen degradation of NDF at different passage rate in alfalfa that irrigated with saline water were higher. Slowly ruminal CP degradability (P=0.001) and effective degradation at different passage rate of alfalfa, that irrigated with saline water, were higher. The cut did not effect on CP degradability of alfalfa. Our experiment indicates that increasing water salinity have not a negative effect on alfalfa forage quality.

KEY WORDS alfalfa, cut, NDF, protein degradability, water salinity.

INTRODUCTION

The gradual increase in the amount of land and water resources affected by salt in arid and semi-arid regions requires strategies to optimize the use of these marginal-quality resources (Diaz *et al.* 2018). An interest in salt tolerance has developed worldwide because crop irrigation promotes soil salinization (McKimmie and Dobrenz, 2007). The nutritional values, yield, and quality of forages are affected by growth stage, forage species, cultivar, fertilization, soil type, climate (e.g., rainfall, temperature), planting (e.g., row spacing, planting rate), and growing conditions (Cox *et al.* 1994). Vegetative forage production is basically a linear function of plant transpiration. Open stomata with lots of water vapor leaving the plant (transpiration) allows for maximum carbon dioxide uptake to build plant carbohydrates and biomass. Excessive salinity in the crop rootzone creates osmotic stress that reduces root uptake of water and crop transpiration. The added stress then reduces forage yield (Sanden and Sheesley, 2007).

The gradual reduction in the quantity and quality of conventional water resources for agricultural use in arid and semi-arid regions, representing 40% of the world's 270 million irrigated hectares, has necessitated the supplementation of new water resources obtained from the desalination of saline groundwater and seawater. Moreover, even if desalinized water of this type is considered high quality water by farmers, initial experiences with desalinated water have not proven totally positive. Biosaline agriculture (i.e. economically sustainable crop production using irrigation water and soils with a wide range of salinity levels) has gained popularity in recent years in arid and semiarid regions. Recent field and greenhouse experiments have demonstrated the potential of growing certain ‘pre-selected’ varieties of alfalfa in highly saline condition (Diaz *et al.* 2018).

Alfalfa (*Medicago sativa*) is the most important and a good quality forage for dairy cattle. Alfalfa possesses many of the attributes necessary for obtaining high, consistent levels of milk production, and for maintaining animal health. These include high nutrient levels, high overall digestibility, a unique proportion of structural to non-structural components, high protein content and digestibility compared to many other forages (Ferdinand and Jung, 2005). Alfalfa is a relatively drought tolerant, deep-rooted perennial crop, has the ability to survive long periods between irrigations but has relatively high water use requirement because it has a long growing season, and a dense mass of vegetation. Stress from dry soil, disease, and salinity can all add up to decrease the stomatal or leaf conductance of CO_2. Several studies show that this conductance and therefore yield decrease linearly starting around -10 bars plant water potential down to -25 bars where stomates shut down and growth stops. By comparison, almonds don’t experience serious stress until around -15 bars. The natural internal resistances to water flow in alfalfa are about -4 to -7 bars. Adding the resistances of water flow in a drying soil and any extra salinity can quickly put you above the -10 bar threshold. As a rule of thumb, for every 2 point increase in soil electrical conductivity (EC) above 2 d. Sm^{-1} you can expect about a 10% decrease in normal ET and tonnage. So the first best step in managing salinity in alfalfa is to review forage ET to understand the “normal year”, unstressed water requirement to be supplied by irrigation (Sanden and Sheesley, 2007).

Although alfalfa is moderately tolerant of salinity, the effects of salinity on nutrient composition and forage parameters are poorly understood; therefore, the objective of this study was to investigate the effect of cutting stage (maturity) of alfalfa and irrigation with two types of water on chemical composition, potential ruminal degradation characteristics of dry matter (DM), crude protein (CP) and neutral detergent fiber (NDF).

MATERIALS AND METHODS

The electricity conductivity (EC) of soil that irrigated with fresh and saline water and the EC of fresh and saline water were measured using one EC-meter (CDM210, MeterLab, Copenhagen). One varieties of alfalfa (*Medicago sativa*) grown at one field in Qom province (34.6456˚ N 50.8798˚ E) irrigated with saline (EC=12.18 d.Sm^{-1}) and fresh (EC=1.97 d.Sm^{-1}) water and was cut at two cuts at 15% early bloom. During 45 days with 15-day intervals, 3 times irrigations were carried out with saline and fresh water. The alfalfa was harvested at 15% flowering of fourth and fifth cutting. The alfalfa samples were oven dried at 55 ˚C for 24 h. All samples were ground through a 2 mm mesh screen. Samples were analyzed for DM, organic matter (OM), CP, ether extract (EE) (AOAC, 2005), NDF (using heat stable α-amylase but without the use of sodium sulfite), acid detergent fiber (ADF), lignin (Van Soest *et al.* 1991), and ash at 605 ˚C. The non-fiber carbohydrate (NFC) was calculated by 1000 - (CP (g/kg) + NDF (g/kg) + Ash (g/kg) + EE (g/kg)) (NRC, 2001).

Three fistulated Zel sheep (approximately 2 years old; body weight=34.43±1.31 kg) were used in a complete randomized design to evaluate the effects of cut and irrigation water quality on DM, protein, and NDF *in situ* degradability. Treatments including 1) first cut of alfalfa that irrigated with fresh water, 2) first cut of alfalfa that irrigated with saline water, 3) second cut of alfalfa that irrigated with fresh water and 4) second cut of alfalfa that irrigated with saline water.

The experiment carried out after 15-d of adaptation to ration, followed by rumen incubation. The sheep were housed in individual metabolic box and fed twice daily at 09:00 and 21:00 with alfalfa hay at maintenance level. Water and mineralized salt were available for all sheep over the experiment. The ruminal nutrients degradation was determined with *in situ* method.

About 3 g of dry matter equivalent were weighed in sealed nylon bags (7 cm×7 cm, polyamide, 26% porosity 40±10 µ pore size) that were closed using a heat sealer. Four bags were incubated in the rumen for each of the following periods 0, 1, 3, 6, 12, 24, 36, 48, and 72 h. All incubations started after the morning feeding. Bags were attached to a plastic tube (5- mm diameter) that was fixed to the outside of the fistula with a string. The bags and the tubes had free movement inside the rumen and reticulum. On removal, bags were washed using cold water until the effluent ran clear. The bags were dried in an oven at 55 ˚C for 48 h, and weighed. Samples were analyzed for N and NDF (Van Soest *et al.* 1991). All analyses were made on combined residues of the three bags. The analyses were run in duplicate and rerun when differences were greater than 3% and sufficient residue was available. The potentially degradable fraction was calculated as 100 minus the 0-h fraction. Kinetics of DM, CP, and NDF disappearance *in situ* was estimated by the nonlinear regression procedure of SAS (2002).

For each sample, the following model was fitted to the percentage of disappearance of DM, CP and NDF:

$Y = a + b(1 - \exp^{(-ct)})$

Where:
a: soluble fraction (percentage).
b: slowly degradable fraction (percentage).
c: fractional rate of disappearance (per hour).
t: time of incubation (hours).

The equation ED= [a + b × c / (c+*kp*)] was used to calculate effective degradability (ED). In this equation, *kp* represents the flow rate of particles out of the rumen that we theoretically consider equal to 0.02 (maintenance level), 0.04 and 0.06 %/h.

This experiment was designed as a complete randomized design with four treatments. Data were analyzed by using the generalized linear model (GLM) procedure of SAS (2002). Means were separated using Duncan's multiple range tests with an alpha level of 0.05.

$Y_{ij} = \mu + T_i + E_{ij}$

Where:
Y_{ij}: value of any measured data.
T_i: mean of the statistical society.
E_{ij}: experimental error.

RESULTS AND DISCUSSION

Chemical composition

The effects of fresh and saline water on chemical composition of alfalfa are shown in Table 1. The EC of soil that irrigated with fresh and saline water were 4.81 and 12.52 $d.Sm^{-1}$, respectively. In addition, the EC of fresh and saline water were 1.97 and 12.18 $d.Sm^{-1}$, respectively. Increasing the cut and irrigation with saline water significantly increased and decreased cell wall components (NDF, ADF, and lignin) and the protein concentrations in alfalfa, respectively.

The protein concentrations in alfalfa decreased in the second cut in comparison of first cut. The effects of salinity on nitrogen and protein concentrations in alfalfa were reported in some studies (Alikhani *et al.* 2007). Average values for alfalfa at different treatments were within the range of values reported elsewhere (NRC, 2001), with small differences that could be attributed to irrigation, varieties of forage, stage of maturity at harvest, weather conditions, soil type and management practices. Plant growth stage is the main factor affecting forage quality, but the interaction between environmental and agronomic factors with maturity will influence the quality of alfalfa, even if harvested at the same stage of development. Similarly, approaching harvest time, any stress that delays or accelerates alfalfa maturation affects the leaf-to-stem ratio and consequently forage quality. The stems contain mostly structural components and are low in N, while the leaves contain mainly photosynthetic components and are richer in nitrogen than the stems. As a result, alfalfa leaves have two or three times more CP than stems (Ferreira *et al.* 2015). Increased leaf N leads to increased leaf area, thus increasing the leaf/stem ratio, but this could also be accounted for by the reduced stem height caused by salinity. The leaf-to-stem ratio increase leads to decreases in both NDF and ADF. Decreased ADF and NDF and increased shoot N lead to higher shoot CP levels in alfalfa irrigated with saline water (Ferreira *et al.* 2015).

The use of saline water with EC (3.1, 7.2, 12.7, 18.4, 24.0 and 30.0 $dS.m^{-1}$), Ferreira *et al.* (2015) showed that alfalfa can tolerate moderate to high salinity while maintaining nutrient composition, antioxidant capacity, and slightly improved forage parameters, thus meeting the standards required for dairy cattle feed. Bekki *et al.* (2006) reported that with increasing salinity, the percentage of nitrogen in soybean and alfalfa plants decreased. As shown in Table 1, the DM, CP content decreased significantly with the maturing of alfalfa plants.

The value of protein concentrations was lower that the range of 21.7–30.0% given in the NRC (2000) for the alfalfa hay at vegetative stage. The protein levels may change day to day in the late bud stage as shown in the study of Pop *et al.* (2010). Besides, the factors such as the variety of alfalfa, irrigation, fertilization, drying, sampling, etc., may affect the protein level of the plant. Regarding the CP level at early bloom stage, we obtained a greater CP level (20.6%) than those reported by Yu *et al.* (2003); Yari *et al.* (2012a) and Yari *et al.* (2012b) or similar to those at feed tables in NRC (2000). Although Yu *et al.* (2003) reported a significant decline in CP after the transition from the bud to bloom stage; the same decline was insignificant in the present study. The EE content of alfalfa was similar between treatments. The ash content significantly increased by irrigation of saline water and were similar in treatments that irrigated with fresh water.

Ruminal degradability of dry matter

The ruminal DM degradability of alfalfa hay at the incubation times and degradation parameters are presented in Tables 2 and 3. There were no significant different between treatments at 0, 3, 9, 12, and 24 h rumen incubation. However, at 6, 48, and 72 h of ruminal incubation, the degradability of DM were different (Table 2). Except the quickly rumen degradability that in first cut of alfalfa was higher (P=0.0006), other parameters of ruminal degradability were not statistically significant (Table 3).

Table 1 Dry matter and chemical composition of alfalfa hay that irrigated with fresh and saline water

Items	Experimental treatments				SEM	P-value
	First cut of alfalfa hay irrigated with		Second cut of alfalfa hay irrigated with			
	Fresh water	Saline water	Fresh water	Saline water		
Dry matter (%)	93.75^{a}	92.74^{c}	93.24^{b}	92.52^{c}	0.012	0.0013
Chemical composition (% of dry matter)						
Neutral detergent fiber	43.53^{c}	45.17^{b}	43.83^{c}	46.17^{a}	0.055	0.0011
Acid detergent fiber	37.31^{c}	37.28^{c}	38.47^{b}	39.33^{a}	0.009	< 0.0001
Lignin	12.82^{d}	12.91^{c}	13.43^{b}	14.31^{a}	0.001	< 0.0001
Non fiber carbohydrate	32.68^{b}	31.80^{c}	33.58^{a}	31.12^{d}	0.059	0.0020
Crud protein	17.88^{a}	16.44^{b}	16.60^{b}	16.06^{c}	0.008	0.0001
Ether extract	1.60	1.77	1.66	1.72	0.006	0.3239
Ash	4.31^{b}	4.82^{a}	4.32^{b}	4.93^{a}	0.005	0.0017

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 2 Ruminal degradability of dry matter, neutral detergent fiber, and crud protein of first and second cut of alfalfa hay that irrigated with fresh and salt water, respectively

Incubation time (h)	Experimental treatments				SEM	P-value
	First cut of alfalfa that irrigated with		Second cut of alfalfa that irrigated with			
	Fresh water	Saline water	Fresh water	Saline water		
Ruminal degradability of dry matter						
0	20.00	21.33	21.33	19.67	0.111	0.4728
3	24.33	24.67	25.00	24.00	0.071	0.5122
6	28.29^{b}	32.35^{a}	30.81^{a}	28.96^{b}	0.072	0.0013
9	29.27	32.62	36.8	28.80	0.193	0.2836
12	38.61	44.27	43.67	39.74	0.210	0.6266
24	51.35	45.68	47.37	44.73	0.163	0.2438
48	59.33^{b}	54.34^{c}	62.00^{a}	54.33^{c}	0.104	0.0003
72	63.67^{b}	63.00^{b}	68.67^{a}	64.00^{b}	0.112	0.0164
Ruminal degradability of neutral detergent fiber						
0	3.67^{b}	6.00^{a}	4.50^{ab}	5.33^{ab}	0.801	0.0459
3	14.67	13.00	15.33	14.00	0.101	0.3606
6	23.00^{b}	26.67^{a}	24.00^{b}	26.00^{a}	0.812	0.0084
9	27.00^{bc}	31.33^{a}	26.33^{c}	28.33^{b}	0.807	0.0005
12	34.67^{bc}	38.00^{a}	33.00^{c}	37.55^{ab}	0.103	0.0145
24	36.00^{b}	43.33^{a}	35.33^{b}	42.00^{a}	0.103	0.0003
48	51.67^{b}	52.33^{ab}	52.67^{ab}	54.33^{a}	0.092	0.0019
72	57.67^{b}	59.67^{ab}	57.33^{b}	62.33^{a}	0.131	0.0268
Ruminal degradability of crud protein						
0	7.00	8.00	7.00	8.00	0.083	0.4411
3	12.00^{b}	12.67^{ab}	15.00^{a}	13.33^{ab}	0.091	0.0962
6	24.33^{a}	21.00^{b}	20.67^{b}	22.67^{ab}	0.092	0.0219
9	26.00	27·00	25.67	26.67	0.081	0.4602
12	35.33	35.00	34.67	35.67	0.101	0.8783
24	42.67^{ab}	45.00^{ab}	42.33^{b}	45.33^{a}	0.101	0.0650
48	53.33^{c}	57.67^{b}	54.33^{c}	59.67^{a}	0.081	0.0002
72	62·00	61.67	63.33	64.67	0.112	0.2114

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Generally, in alfalfa, as the cut increased, the a fraction decreased, but there were no effects on the potentially degradable fraction (b) as well as on K_d. Also, water quality is not effect on degradability of DM (Table 3).

In alfalfa, as the cut increased, a fraction decreased and the undegradable fraction increased (Yu *et al*. 2004).

In order to determine of nutritive value of alfalfa in different cuts with *in situ* technique, Taghizadeh *et al.* (2008) found that DM degradability's in first, second and third cuts of alfalfa at 96 h were 60.47, 64.71 and 64.36%, respectively.

Crude protein degradability's of mentioned cuts were 60.47, 63.08 and 58.07%, respectively. Balde *et al.* (1993) used four maturities of alfalfa (early bud, early, mid and full bloom) to test the effect of cut on *in situ* rumen DM and CP degradation. Corresponding changes in effective DM degradability with increasing cut declined from 72.9 to 61.9%.

Table 3 The parameters of ruminal degradability of dry matter of first and second cut of alfalfa hay that irrigated with fresh and salt water, respectively

Items	Experimental treatments				SEM	P-value
	First cut of alfalfa that irrigated with		Second cut of alfalfa that irrigated with			
	Fresh water	Saline water	Fresh water	Saline water		
Quickly rumen degradable= *a* (%)	18.73[a]	19.42[a]	9.69[b]	19.16[a]	0.110	0.0006
Slowly rumen degradable= *b* (%)	39.29[ab]	35.66[b]	46.46[a]	40.87[ab]	0.191	0.0767
Ruminal degradation dry matter= *a* + *b* (%)	58.02	55.08	56.15	60.03	0.211	0.7881
Ruminal undegradable dry matter= *c* (%)	41.98	44.92	43.85	39.97	0.212	0.7881
Rumen degradation rate= K_d (%/ h)	0.03	0.04	0.09	0.11	0.022	0.5258
Effective rumen degradation at different rumen passage rate for particulate matter						
0.02	41.17	42.99	47.21	46.52	0.201	0.5827
0.04	34.51	37.11	41.17	41.07	0.211	0.5599
0.06	30.9	33.61	36.83	37.93	0.222	0.5919

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

The most depression in rumen degradability of both CP and DM with increasing cut could be explained by increases in the indigestible fraction of the forage, as rates of digestion were not readily affected by stage of maturity. Cherney *et al*. (1997) found that *in vitro* digestion kinetic and quality of perennial grasses were negatively associated with forage maturity. Because ash content in forages was not highly affected by cultivar and stage of maturity (Yu *et al.* 2003), the pattern and changes of OM rumen degradation were similar to DM.

Ruminal degradability of NDF

The effect of stage of cut and irrigation on ruminal degradability of NDF and parameters of ruminal degradability of NDF are presented in Tables 2 and 4. Except at 3 h of incubation, ruminal degradability of NDF were different at 0, 6, 9, 12, 24, 48, and 72 h of rumen incubation (Table 2). Ruminal degradation of NDF in second cut of alfalfa that irrigated with saline water was higher; rumen degradation rate of NDF in first cut of alfalfa, and effective rumen degradation of NDF at different rumen passage rate (0.02, 0.04 and 0.06) in alfalfa that irrigated with saline water were higher (Table 4).

Despite the results of our experiment, Yu *et al.* (2004) showed that the stage of cut at cutting affected alfalfa; and the *in situ* effective rumen degradation of NDF fraction decreased from stage 1, 2, to 3 in alfalfa. Ruminants require adequate dietary fiber intake for normal rumen function and dairy animals, in particular, need fiber to maintain a normal milk fat content.

Primary factors in the conversion of forage to animal product are intake of DM or energy, digestibility, efficiency of converting digested energy to metabolizable energy and efficiency of converting metabolizable energy to net energy in animal product (Taghizadeh *et al*. 2008).

Diaz *et al*. (2018) found that although the yield of the alfalfa varieties (*Medicago sativa*, *vs*. SW8421S, PGI908S and WL656HQ) was reduced by an average of 7, 20, 31 and 46% as the salinity of the irrigation water increased from 0.4 d.Sm^{-1} to 2.5, 5.0, 7.5 and 10.0 d.Sm^{-1}, respectively, their relative salt tolerance, based on the average EC of the saturated soil extract (ECe), was much higher than those established in the literature. Based on their nutritional quality, all alfalfa varieties are categorized as 'supreme' quality, with metabolizable energy values in excess of 10 MJ kg^{-1}.

Ruminal degradability of crude protein

The effect of stage of cut and irrigation on ruminal degradability of CP and parameters of ruminal degradability of CP are presented in Tables 2 and 5. In addition, ruminal degradability of crude protein were different at 3, 6, 24, and 48 h of rumen incubation (Table 2). Slowly rumen degradable of CP, ruminal degradation of portion and effective rumen degradation of protein at different rumen passage rate (0.02, 0.04) in alfalfa that irrigated with saline water were higher (Table 5). The stage of cut did not effect on crude protein degradability of alfalfa.

Cutting frequency, or more precisely the maturity of the alfalfa when it is cut, has a more profound effect on forage quality and yield than perhaps any other single factor. Simply put yield and forage quality are usually inversely related.

As the alfalfa plant matures, yield increases but forage quality decreases (referred to as the Yield/Quality Tradeoff). This phenomenon is the scourge of the alfalfa producer and is a major source of frustration.

It is possible to achieve high yield or high forage quality, but ordinarily not both. The stage of cut at cutting had no impact on rumen degradation characteristics of CP in alfalfa (Yu *et al.* 2004).

Table 4 The parameters of ruminal degradability of neutral detergent fiber (NDF) of first and second cut of alfalfa hay that irrigated with fresh and salt water, respectively

Items	Experimental treatments				SEM	P-value
	First cut of alfalfa that irrigated with		Second cut of alfalfa that irrigated with			
	Fresh water	Saline water	Fresh water	Saline water		
Quickly rumen degradable= *a* (%)	1.85[b]	1.82[b]	3.76[a]	3.10[a]	0.06	0.0491
Slowly rumen degradable= *b* (%)	44.7[ab]	47.03[a]	44.20[ab]	48.20[a]	0.10	0.0291
Ruminal degradation dry matter= *a* + *b* (%)	46.55[c]	49.85[ab]	47.96[bc]	51.27[a]	0.10	0.0143
Ruminal undegradable NDF= *c* (%)	53.45[a]	50.15[bc]	52.04[ab]	48.73[c]	0.10	0.0143
Rumen degradation rate= K_d (%/h)	0.061[a]	0.060[a]	0.052[b]	0.051[a]	0.01	0.0253
Effective rumen degradation at different rumen passage rate for particulate matter						
0.02	34.97[b]	38.28[a]	34.04[b]	38.14[a]	0.07	0.0005
0.04	28.17[b]	31.29[a]	28.00[b]	30.64[a]	0.07	0.0006
0.06	23.69[b]	26.60[a]	23.56[b]	25.78[a]	0.07	0.0008

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Table 5 The parameters of ruminal degradability of crud protein of first and second cut of alfalfa hay that irrigated with fresh and salt water, respectively

Items	Experimental treatments				SEM	P-value
	First cut of alfalfa that irrigated with		Second cut of alfalfa that irrigated with			
	Fresh water	Saline water	Fresh water	Saline water		
Quickly rumen degradable= *a* (%)	4.96	6.36	5.73	6.79	0.08	0.2302
Slowly rumen degradable= *b* (%)	48.38[b]	56.10[a]	50.17[b]	58.86[a]	0.12	0.0010
Ruminal degradation dry matter= *a* + *b* (%)	53.30[b]	62.46[a]	55.90[b]	65.65[a]	0.14	0.0018
Ruminal undegradable NDF= *c* (%)	46.70[a]	37.54[b]	44.10[a]	34.35[b]	0.14	0.0018
Rumen degradation rate= K_d (%/h)	0.04[a]	0.03[b]	0.03[b]	0.03[b]	0.01	0.0121
Effective rumen degradation at different rumen passage rate for particulate matter						
0.02	37.50[c]	39.71[b]	37.65[c]	40.84[a]	0.06	0.0003
0.04	29.49[bc]	30.11[ab]	29.15[c]	30.80[a]	0.06	0.0126
0.06	24.64	24.80	24.23	25.35	0.06	0.0908

The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

Yu *et al.* (2003) investigate the effects of two varieties of alfalfa at three cuts on *in vitro* digestion. The varieties had minimal effects on nutritional value; however, the stage of cutting had a large impact on chemical composition, protein and carbohydrate fractions and *in vitro* rumen degradability. As plant maturity advanced from cut 1 to 3, CP was decreased, fibre was affected very little, the rapidly degradable protein fraction (PA) was reduced, the rapidly degradable fraction (PB1) increased the intermediate degradable fraction (PB2), the slowly degradable fraction (PB3) declined, and the unavailable fraction (PC) associated with the cell wall increased. The *in vitro* rumen degradability of DM (IVDMD) and NDF (IVNDFD) increased at cut 2 and then declined at cut 3.

The highest IVDMD and IVNDFD after a 48 h incubation were at cutting cut 2. In the *in situ* method, it was reported a greater *a* fraction and lower *b* fraction (Aufrere *et al.* 1994; Coblentz *et al.* 1999). In some of these studies (Aufrere *et al.* 1994; Coblentz *et al.* 1999), the *c* fraction was similar to our values and was consistent with our study. Using *in situ* method, Janicki and Stallings (1988) found values very close to our study (fraction a=29.4% and fraction b=61.6%).

The rumen degradable protein (RDP) was lower in this study than those reported by Coblentz *et al.* (1999) and NRC (2000). However, the RDP estimates were consistent with those of Yari *et al.* (2012a) and Yari *et al.* (2012b).

CONCLUSION

In semi-arid or arid locations, salinity can become a problem for farmers who irrigate crops; but research has shown that salt tolerant forages can grow well in drainage water reuse systems. Overall, alfalfa has varying levels of salt tolerance, being most sensitive to salt in soil in the seeding stage, but generally becoming more resistance to salt as the alfalfa plant matures. In our experiment, water salinity and stage of cut have an impact on alfalfa nutrients and degradation characteristics in the rumen. Increasing the cut in alfalfa and irrigation with saline water significantly increased cell wall components, while the protein concentrations decreased. In second cut of alfalfa, the quickly rumen degradable of DM were declined but water quality did not affect on DM degradability. The effective rumen degradation of NDF and CP in alfalfa that irrigated with saline water were higher and stage of cut is not effect. Our results indicate that increasing water salinity did not have a negative effect on alfalfa forage quality.

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