Asian Journal of Chemistry Vol. 20, No. 5 (2008), 3919-3925

Mineral Content of Some Lucerne Cultivars for Livestock

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The purpose of this study was to assess the mineral contents of twelve lucerne cultivars on the highlands for livestock. Lucerne cultivars (Bilensoy, alfa-484, Resis, alfa-1312, Savas, Kayseri, alfa-1313, Planet, Seker, Daisy, Bilensoy-80, CW-3567) were collected from cultivated fields. In general, Ca, Fe and Mn contents of the lucerne cultivars were the highest in Bilensoy cultivar, N in Planet cultivar, K in Savas cultivar, P in Daisy cultivar, Mg in alfa-1313 cultivar and Zn and Cu in Bilensoy-80 cultivar. Bilensoy, Daisy and Seker cultivars especially had very high mineral contents. The determination of mineral contents of Lucerne cultivars has been a phase in the evaluation of impacts to animal feeding. Lucerne cultivars had a very high nutritional potential and their N, P, K, Ca, Mg, Na, Fe and Zn values were higher than those required for animal nutrition. Because of high digestion, taste, cheapness of Lucerne plant and provision of macro and micro mineral, it has very important raw material nutrition for animal nourishment.

Key Words: Lucerne, Animal feeding, Macro and Micro mineral content, Nutritional potential.

INTRODUCTION

Lucerne (*Medicago sativa*) is commonly cultivated throughout the world. Lucerne is important in the production of forage with a good quality for high-production animals[1]. It has high yield, superior forage quality. Lucerne is rich in protein, mineral[2] and vitamins[3-5]. Hanson *et al.*[6] reported that lucerne used in rations of cattles is a rich source of Ca, K and trace elements.

In sufficiency, nutritional elements cause breakdowns of the metabolism of animal and their additions reverting that condition are defined as essential elements[7]. The occurrence of nutritional elements is insufficient in cattle

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which graze in grasslands and can originate from the fact that the plant is not sufficent enough to meet the needs of cattle in terms of nutritive elements (esansiyel)[8] or the fact that the pasture may fail to meet the mineral needs of cattle in some seasons[9].

The mineral contents of pasture are influenced by several factors[10,11]. One of the basic factors effected the concentration of all minerals in crop and forage plants are the genus, species or strain (variety)[12]. With respect to some elements, there may be appreciable differences between varieties within a species[7]. The mineral differences within a species were reported by Oury *et al.*[13] *e.g.*, Mg and Zn among Bread Wheat, Kandemir *et al.*[14] reported the same view in most minerals among Barley cultivars, Sengül and Yolcu[15] reported the difference in N, P, K, Mg and Ca in Lucerne ecotypes, while Jawes *et al.*[16] showed in Mn and Zn among lucerne cultivars. In another study has showed the highest concentration of Na was approximately five times the lowest and the highest concentration of K was approximately twice times the lowest in six varieties of perennial ryegrass[17].

The aim of this study was to compare the composition of lucerne used in beef cattle diets and mineral composition of lucerne feedstuff commonly fed to dairy cattle issued by National Research Council[18,19] with the macro and micro mineral contents of twelve lucerne cultivars in the highlands.

EXPERIMENTAL

The study area was situated at an altitude between 1880 and 2030 m above sea level in the eastern part of Turkey. 12 Cultivars were collected on culture fields in the highlands. Lucerne cultivars were harvested at the beginning of flowering and at the heights of 5 cm. After harvesting, each sample was dried in a forced air drying oven at 68 ºC for 48 h and then they were ground for chemical analysis. Total nitrogen was determined using the micro-Kjeldahl method. K^+, Ca^{2+} and Mg^{2+} were determined after wet digestion of dried and ground sub-samples in a H_2SO_4-Se-salisilic acid mixture. In the diluted digests, P was measured in the indophenol-blue method with a spectrophotometer at 660 nm and after reaction with ascorbic acid. Potassium and Ca^{2+} were determined by flame photometry and Mg^{2+}, Fe, Mn, Zn and Cu analysis by atomic absorption spectrometry[20].

Soils used in this location were Entisol, Inceptisol, Mollisol and Aridisol according to the USA taxonomy[21]. Generally, the parent materials of soils in the location mostly consist of volcanic, marn and lacustrin residual and transported material.

RESULTS AND DISCUSSION

Mineral compositions of lucerne commonly used in beef cattle diets[18] and fed to dairy cattle[19] are presented in Table-1. The mineral contents of

12 lucerne cultivars in the highlands were shown in Table-2. The maximum ash content (9.98 g 100 g^{-1} Dw) was observed in Bilensoy while Kayseri had the minimum (7.06 g 100 g^{-1} Dw). These values were similar with 9.2 and 11.0 % values reported by National Research Council[18,19].

Nitrogen: Nitrogen content was the highest in Planet (5.12 g 100 g^{-1} Dw) and the lowest in Kayseri (3.87 g 100 g^{-1} Dw) cultivar (Table-2). That N is needed mainly for the synthesis of proteins and the dietary requirement is therefore greatest during periods of rapid growth, pregnancy and lactation periods[7] and was abundant in Planet cultivars. All of twelve cultivars had nitrogen contents over values issued in NRC[19] and cultivars reach the N levels required for animal nutrition (Tables 1 and 2). In another study, conducted at the same region, N contents of 13 different Lucerne ecotypes were determined[15] in range of 2.82-5.58 %.

Phosphorus: Phosphorus content among the various lucerne cultivars was fairly variable. Phosphorus is a structural component in the skeleton and teeth[22] was relatively abundant in Daisy cultivars. Daisy (0.35 g 100 g^{-1} Dw), Savas (0.33 g 100 g^{-1} Dw), Planet (0.30 g 100 g^{-1} Dw), Bilensoy-80 (0.29 g 100 g^{-1} Dw) and Resis (0.28 g 100 g^{-1} Dw) cultivars had adequate phosphorus level for dairy cattle[19]. Only the Alfa-484 cultivar had lower P content than those of lucerne feeds commonly used in beef cattle diets[18] (Tables 1 and 2).

Potassium: Potassium content was the highest in Savas (3.15 g 100 g^{-1} Dw) and the lowest in Bilensoy (1.52 g 100 g^{-1} Dw). Resis, Savas, Planet, Daisy and Bilensoy-80 cultivars had higher K values than that (2.37 g 100 g^{-1} Dw) of Lucerne feedstuff commonly fed to dairy cattle[19]. Savas, Bilensoy-80 and Daisy cultivars were better, with respect to K composition, than lucerne feeds commonly used in beef cattle diets[18] (Tables 1 and 2). Similar K contents were obtained from lucerne at the different cutting times[23].

Sodium: Sodium content showed a significant difference among the Lucerne cultivars. Potassium and sodium found mostly in body liquid and soft tissues[24] were significantly high in Savas and Resis cultivars, respectively. Na contents of all Lucerne cultivars reached over the Na levels in the mineral composition of lucerne used in beef and dairy cattle diets issued by National Research Council[18,19] (Tables 1 and 2).

TABLE-1
MINERAL COMPOSITION OF LUCERNE COMMONLY USED IN BEEF AND DAIRY CATTLE DIETS[18,19]

	(%)							(mg/kg)			
	Ash	N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
2000	9.20	–	0.21	2.56	1.63	0.34	0.15	227	36	30	12.7
2001	11.0	2.72	0.28	2.37	1.47	0.29	0.10	619	44	28	9.0

TABLE-2
MINERAL CONTENT OF LUCERNE CULTIVARS IN HIGHLANDS OF TURKEY

S. No.	Statis.	g 100 g^{-1} Dw						mg kg^{-1} Dw				
		Ash	N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
Bilensoy	Mean	9.98	4.75	0.2100	1.52	4.65	3.36	0.93	250.32	25.17	32.42	5.47
	SD	0.47	0.09	0.0064	0.06	0.25	0.04	0.08	14.19	2.72	4.86	0.23
	CV	4.74	1.88	3.0100	4.00	5.46	1.21	9.19	5.67	10.84	14.97	4.22
Alfa-484	Mean	7.29	4.08	0.1800	1.65	2.97	3.25	1.01	92.79	17.07	73.04	2.4
	SD	0.34	0.11	0.0048	0.05	0.11	0.11	0.05	4.26	3.93	72.60	0.99
	CV	4.76	2.69	2.7400	3.03	3.79	3.65	5.43	4.59	23.00	99.39	41.53
Resis	Mean	9.26	4.97	0.2800	2.48	3.04	2.82	1.08	144.16	18.69	66.69	5.10
	SD	0.55	0.19	0.0187	0.11	0.49	0.06	0.05	2.56	0.31	33.15	0.66
	CV	5.93	3.74	6.7400	4.49	16.18	2.19	4.81	1.77	1.70	49.71	13.01
Alfa-1312	Mean	9.48	4.83	0.2300	2.14	3.82	3.28	0.84	127.46	21.23	59.24	1.58
	SD	0.49	0.10	0.0084	0.08	0.73	0.56	0.04	15.83	1.14	36.37	0.31
	CV	5.21	2.17	3.5300	3.77	19.18	17.19	5.34	12.42	5.35	61.39	19.71
Savas	Mean	8.85	4.91	0.3300	3.15	2.25	2.33	0.95	104.85	16.45	65.57	3.81
	SD	0.21	0.24	0.0100	0.34	0.61	0.38	0.15	13.46	1.76	88.92	0.75
	CV	2.41	4.93	3.0600	10.78	26.79	16.37	15.57	12.84	10.71	135.62	19.94
Kayseri	Mean	7.06	3.87	0.2100	2.37	2.19	2.06	0.91	65.23	11.78	80.94	3.21
	SD	0.19	0.12	0.0059	0.07	0.88	0.10	0.09	6.87	1.25	35.72	0.66
	CV	2.63	3.21	2.8600	2.86	40.33	5.01	9.89	10.54	10.57	44.13	20.76

S. No.	Statis.	g 100 g^{-1} Dw						mg kg^{-1} Dw				
		Ash	N	P	K	Ca	Mg	Na	Fe	Mn	Zn	Cu
	Mean	7.46	4.54	0.2100	1.83	3.49	4.48	0.89	95.61	20.45	75.51	2.97
Alfa-1313	SD	0.11	0.32	0.0290	0.19	0.68	0.38	0.13	13.73	2.94	2.73	0.65
	CV	1.41	6.99	14.0500	10.59	19.69	8.56	14.78	14.37	14.38	3.61	22.14
	Mean	9.41	5.12	0.3000	2.54	3.21	3.17	0.91	140.92	22.13	53.28	3.61
Planet	SD	0.17	0.26	0.0110	0.10	0.16	0.13	0.09	10.13	0.85	18.48	0.09
	CV	1.84	5.05	3.6200	3.97	4.99	4.15	10.34	7.19	3.84	34.70	2.52
	Mean	7.85	4.73	0.2400	2.23	3.81	2.86	0.99	142.68	18.51	40.81	5.90
Seker	SD	0.31	0.24	0.0370	0.26	0.71	0.38	0.01	50.41	0.09	7.54	0.47
	CV	3.98	4.97	15.6200	11.98	18.64	13.48	0.58	35.33	0.48	18.47	8.07
	Mean	9.61	4.99	0.3500	2.64	2.34	2.84	0.95	104.89	21.49	33.74	2.65
Daisy	SD	0.31	0.24	0.0150	0.49	0.60	0.52	0.10	13.32	3.56	5.89	0.88
	CV	3.29	4.88	4.5400	18.73	25.74	18.60	10.47	12.69	16.61	17.47	33.17
	Mean	8.67	4.81	0.2900	2.68	3.06	2.27	0.94	90.11	15.67	94.38	5.97
Bilensoy-80	SD	0.47	0.33	0.0160	0.04	0.32	0.30	0.06	34.87	4.89	7.96	0.76
	CV	5.41	6.97	5.6100	3.25	10.68	10.07	6.98	38.70	31.25	8.43	12.73
	Mean	8.84	4.69	0.2200	2.12	2.64	2.19	0.83	80.60	14.10	7.69	4.94
CW-3567	SD	0.51	0.18	0.0089	0.22	0.50	0.07	0.06	12.39	0.93	1.96	0.71
	CV	5.77	3.91	4.0000	10.78	18.97	3.52	7.99	15.37	6.56	25.49	14.41

SD = Standard deviation; CV = Coefficient variance.

Calcium: Calcium values of cultivars ranged from 4.65 g 100 g^{-1} Dw in Bilensoy to 2.19 g 100 g^{-1} Dw in Kayseri. Calcium, which is important for providing a strong framework for supporting and protecting delicate organs and for movement and growth[12] was higher in Bilensoy cultivar than the other cultivars. All of the lucerne cultivars reached the Ca levels required for cattle feeding issued NRC[18,19].

Magnesium: The highest value was found in Alfa-1313 (4.48 g 100 g^{-1} Dw) and lowest in Kayseri (2.06 g 100 g^{-1} Dw). The Mg levels of lucerne cultivars were found over values required for cattle feeding issued NRC[18,19]. Magnesium, is found mostly in bone and teeth[24], was most abundant in Alfa-1313 cultivar.

Micro nutrients: The highest contents of Fe and Mn obtained from the lucerne cultivars were 250.32 and 25.17 mg kg^{-1} Dw in Bilensoy, respectively. The lowest Fe and Mn contents of cultivars were determined as 65.23 and 11.78 mg kg^{-1} Dw in Kayseri. These values were 227 mg kg^{-1} Dw Fe and 36 mg kg^{-1} Dw Mn in NRC[18], 619 mg kg^{-1} Dw Fe and 44 mg kg^{-1} Dw Mn in NRC[19]. Zinc is an integral component or activator of a number of enzymes that represent almost all enzymatic groups in plants[25]. The highest content of Zn (94.38 mg kg^{-1} Dw) and Cu (5.97 mg kg^{-1} Dw) were observed in Bilensoy-80. Copper has low mobility an increased transfer quotient[26]. The lowest Zn and Cu contents of the plant were observed as 7.69 and 1.58 g 100 g^{-1} Dw in CW-3567and Alfa-1312, respectively. These values were 30 mg kg^{-1} Dw Zn and 12.7 mg kg^{-1} Dw Cu in NRC[18], 28 mg kg^{-1} Dw Zn and 9 mg kg^{-1} Dw Cu in NRC[19].

Conclusion

The present study reveals that lucerne cultivars had a greater mineral content than that required for animal nutrition. Results obtained from lucerne cultivars show that they had abundant nutritional potential and mineral content, which are very important in cattle feeding. In general, Ca, Fe and Mn contents were the highest in Bilensoy cultivar, N in Planet cultivars, K in Savas cultivar, P in Daisy cultivar, Mg in alfa-1313 cultivar and Zn and Cu in Bilensoy-80 cultivar. Bilensoy, Daisy and Seker cultivars especially had very high mineral contents. Because of high digestion, taste, cheapness of Lucerne plant and its macro and micro mineral contents, it has a very important role in animal nutrition. In short, determination of mineral contents of Lucerne cultivars has been a phase in the evaluation of impacts to animal feeding. This study will light the way for work toward the betterment of ideal Lucerne cultivars for animal feeding.

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(*Received*: 22 October 2007; *Accepted*: 8 February 2008) AJC-6330