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Nutrient Value of Some Lucerne Cultivars Based on Chemical Composition for Livestock

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This study was carried out to determine of nutrient contents of twelve lucerne cultivars in the highlands of Turkey. There were significant differences ($p < 0.01$) among the cultivars for crude protein (CP), neutral-detergent fiber (NDF), acid-detergent fiber (ADF), digestible dry matter (DDM), dry matter intake (DMI), relative feed value (RFV), total digestible nutrients (TDN), net energy-lactation (NEl), net energy-maintenance (NEm) and net energy-gain (NEg). Although Planet cultivar had the highest protein content (32.00 %), Kayseri cultivar is one of the lowest protein content (24.17 %) among the all cultivars. Neutral detergent fiber in cultivars ranged from 33.41 % (Seker cultivars) to 50.39 % (Kayseri cultivars). Average acid detergent fiber content for all cultivars was 34.31 %. Relative feed value in cultivars ranged from 104.78 % (Bilensoy-80 cultivars) to 185.03 % (Seker cultivars). The average TDN content was 56.89 %. Evaluating for this respect contents were the most quality Seker, Bilensoy and Savas cultivars among lucerne cultivars. In conclusion, Seker, Bilensoy and Savas cultivars among lucerne cultivars had better nutrient content than other cultivars.

Key Words: Lucerne cultivars, Neutral detergent fiber, Acid detergent fiber, Relative feed value, Cattle feeding.

INTRODUCTION

Lucerne is one of the forage crops cultivated with the aim of producing forage in farms leaning animal production[1]. It is important in the production of forage with a good quality for high-production animals[2]. It has superior forage qualities and high yields that can be consumed by livestock readily[3].

It is important for good quality meat and milk production. Lucerne is rich in vitamins, minerals and protein and also the productivity of crude protein from the unit area is high[4]. Lucerne hay has significantly high digestibility coefficients for crude protein, crude fibre, organic matter and

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fat compared to grass[5]. It is consumed not only as hay, but it is also used as the raw material of concentrated food for livestock[6]. Lucerne is a protein-rich foodstuff that generally costs less than traditional protein supplements[7]. Lambs grazing the Lucerne sward had a higher herbage intake and live weight gain and required fewer days to slaughter than perennial rye grass sward[8].

The most crucial measurement of hay quality is to enhance the milk yield ability of dairy cows[9]. Hay quality is also important factor for meat production. Crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), relative feed value (RFV) and total digestible nutrients (TDN) are important criteria for determining hay quality.

The criteria values show very important differences among forage species. These differences are not only between species but also among cultivars and varieties within a species. Nutritional differences among cultivars or varieties within a species has been showed by studies of Sengül and Yolcu[10] in N among Lucerne ecotypes, Kamalak *et al.*[11] in CP between Lucerne varieties, Lema *et al.*[12] in CP among grain sorghum varieties silages, Lekgari *et al.*[13] in RFV among Triticale cultivars, Kim *et al.*[14] in TDN among rye varieties, Kim *et al.*[15] in TDN yield among oat varieties, Wang and Daun[16] in ADF and NDF between lentil varieties, Jefferson[17] in ADF and NDF of leaves between Timothy cultivars.

The aim of this study was to determine the nutritional value of some lucerne cultivars in the high altitude regions of Turkey and compare them with NRC[18,19] and the standards issued by Lucerne guidelines (for domestic livestock) Agriculture Marketing Service.

EXPERIMENTAL

The study was carried out in the Eastern part of Turkey. 12 Cultivars of lucerne were collected on culture fields in the highlands of Eastern Anatolia. Lucerne cultivars were harvested by hand-clipping at the beginning of the flowering time and at the height 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 by the aim of determine nutritive value. The crude protein content was determined[20] multiplied by 6.25 of total N. Acid detergent fiber and neutral detergent fiber analyses were determined by Van Soest[21]. Relative feed value was calculated from dry matter intake and digestibility dry matter[22].

DMI (% of body weight) = 120/ NDF%; DDM% = 88.9-(0.779x ADF%); RFV= (DDM% × DMI%)/1.29; Total digestible nutrients (TDN%) were calculated from ADF and net energy-lactation, net energy-maintenance and net energy-gain were calculated from TDN[22]. TDN% = 96.35-(ADF% × 1.15) NEl: Mcal/1b = (TDN% × 0.01114)-0.054; NEm: Mcal/1b = (TDN% × 0.01318)-0.132 NEg: Mcal/1b = (TDN% × 0.01318)-0.459.

The study site was situated at an average of 1880 and 2030 m altitude, annual temperature of 5.6 ºC and total annual precipitation of 394 mm for this region[23]. Soils used in this location were entisol, inceptisol, mollisol and aridisol according to the USA taxonomy[24]. Generally, the parent materials of soils in this location mostly consist of volcanic, marn and lacustrin residual and transported material.

A one-way analysis of variance (ANOVA) was carried out to compare[25] the crude protein (CP), neutral-detergent fiber (NDF), acid-detergent fiber (ADF), digestible dry matter (DDM), dry matter intake (DMI), relative feed value (RFV), total digestible nutrients (TDN), net energy-lactation (NEl), net energy-maintenance (NEm) and net energy-gain (NEg).

RESULTS AND DISCUSSION

Crude protein: Kayseri cultivars were found to have the lowest protein content (24.17 %) among the all cultivars. Planet cultivars had the highest protein content (32.00 %) (Table-2). The average crude protein content of all lucerne cultivars was 29.43 %. In another study, conducted in the same region, crude proteins of 13 different Lucerne ecotypes were determined[10] in the range of 17.6-34.9 %. The statistical analysis for crude protein content, among the lucerne cultivars, indicated that there were significant differences ($p < 0.01$) among the lucerne cultivars[25]. All Lucerne cultivars were supreme quality, in terms of crude protein, according to alfalfa guidelines quality standards (Table-1). Crude protein contents of cultivars were higher than those of lucerne commonly used in beef cattle[18] and dairy cattle diets[19].

TABLE-1
ALFALFA GUIDELINES (FOR DOMESTIC LIVESTOCK USE AND NOT MORE THAN 10 % GRASS)

Quality[a]	ADF	NDF	*RFV	**TDN 100%	**TDN 90%	CP
Supreme	<27	<34	>185	>62	>55.9	>22
Premium	27-29	34-36	170-185	60.5-62	54.5-55.9	20-22
Good	29-32	36-40	150-170	58-60	52.5-54.5	18-20
Fair	32-35	40-44	130-150	56-58	50.5-52.5	16-18
Utility	>35	>44	<130	<56	<50.5	<16

*RFV calculated using the Wis/Minn formula. **TDN calculated using the western formula. Values based on 100 % dry matter (TDN showing both 100 & 90%).
[a]Standard assigned by United States Department of Agriculture, Agricultural Marketing Service Livestock & Grain Market News 2005.

Acid detergent fiber: As the ADF content of forage increases, the forage becomes less digestible[26]. The statistical analysis for ADF content

showed that there were significant differences among cultivars (Table-2). Mean acid detergent fiber content for all cultivars was 34.31 %. The CW-3567 cultivar was found to have the highest ADF content (42.76 %), the lowest ADF content was in Bilensoy cultivar (25.79 %).

Bilensoy cultivars in terms of ADF were supreme quality according to alfalfa guidelines quality standards. Seker was premium and Savas Resis and alfa-1312 were good, Kayseri and Planet were fair, the others were utility quality (Tables 1 and 2). ADF contents of Bilensoy (25.79 %), Seker (28.82 %), Savas (29.06 %), Alfa-1312 (29.93 %), Resis (31.62 %) and Kayseri (32.47 %) cultivars were similar or superior quality according to the mean value (31.9 %) of lucerne commonly used in beef cattle diets[18]. These values were also similar with respect to ADF content (32.8 %) of some foodstuffs (Lucerne) commonly fed to dairy cattle[19].

TABLE-2
CRUDE PROTEIN, ACID DETERGENT FIBER, NEUTRAL DETERGENT FIBER, PREDICTED DRY MATTER DIGESTIBILITY, DRY MATTER INTAKE AND RELATIVE FEED VALUES OF VARIOUS LUCERNE CULTIVARS

Cultivars	CP (%)	ADF (%)	NDF (%)	DDM (%)	DMI (%)	RFV
Alfa-484	25.52C	41.09B	44.89C	56.89F	2.67FG	117.92G
Alfa-1312	30.23AB	29.93F	39.58F	65.59BC	3.03D	154.15C
Alfa-1313	28.42B	37.42C	44.80CD	59.75E	2.68FG	124.07F
Bilensoy	31.27A	25.79G	37.21G	68.81A	3.23C	172.04B
Bilensoy-80	29.67AB	42.22AB	49.73A	56.01F	2.41I	104.78H
CW-3567	29.34AB	42.76A	48.47B	55.59F	2.48H	106.69H
Daisy	31.19A	36.10C	45.03C	60.88E	2.66G	125.57F
Kayseri	24.17C	32.47E	50.39A	62.72D	2.38I	117.43G
Planet	32.00A	34.44D	44.12D	62.38D	2.72F	130.86E
Resis	31.08AB	31.62E	41.97E	64.27C	2.86E	142.45D
Savas	30.69AB	29.06F	36.18H	66.26B	3.32B	170.37B
Seker	29.56AB	28.82F	33.41I	66.45B	3.59A	185.03A
Average	29.43	34.31	42.98	62.13	2.84	137.61

Values inside columns with different letters differ significantly ($p < 0.01$).

Neutral detergent fiber: Neutral detergent fiber (NDF) concentration is the most reliable laboratory predictor of voluntary intake potential and genetic reductions in NDF lead to increases in dry matter digestibility[27]. There were significant differences ($p < 0.01$) among the studied cultivars for NDF contents. The mean NDF content was found to be 42.98 % (Table-2). Neutral detergent fiber in cultivars ranged from 33.41 % (Seker cultivars) to 50.39 % (Kayseri cultivars).

In terms of NDF values, Seker cultivar was of supreme quality according to alfalfa guidelines quality standards. Savas, Bilensoy and alfa-1312 were

good, Resis was fair and the others were utility quality (Tables 1 and 2). NDF contents of Seker (33.41 %), Savas (36.18 %), Bilensoy (37.21 %) and alfa-1312 (39.58 %) cultivars were similar or superior quality according to mean values (39.3 %) of Lucerne commonly used beef cattle diets[18]. These values were also similar in NDF content (41.6 %) of some food-stuffs (Lucerne) commonly fed to dairy cattle[19].

Relative feed value: Relative food value contents in cultivars ranged from 104.78 % (Bilensoy-80 cultivars) to 185.03 % (Seker cultivars). Seker cultivars with respect to relative food value were of supreme quality according to Lucerne guidelines quality standards. Savas and Bilensoy were premium, alfa-1312 was good, Planet and Resis were fair and the others were utility quality (Tables 1 and 2).

Total digestible nutrients: There were significant differences ($p < 0.01$) among the cultivars for TDN contents. The average TDN content of all cultivars was 56.89 % (Table-3). In terms of TDN contents Bilensoy, Seker and Savas cultivars were supreme quality according to alfalfa guidelines quality standards. Alfa-1312 was premium, Resis and Kayseri were good, Planet was fair and the other cultivars were utility quality (Tables 1 and 3). TDN contents of Bilensoy (66.69 %), Seker (63.21 %), Savas (62.93 %), Alfa-1312 (61.93 %), Resis (59.99 %) and Kayseri (59.01 %) cultivars were similar or superior quality according to the mean value (60 %) of lucerne commonly used in beef cattle diets[18]. This values were also similar quality with respect to TDN content (56.4 %) of some feedstuffs (Lucerne) commonly fed to dairy cattle[19].

TABLE-3
TOTAL DIGESTIBLE NUTRIENTS AND NET ENERGY VALUES OF SOME LUCERNE CULTIVARS

	%	Mcal/1b		
Cultivars	TDN	NEL	NEM	NEG
Alfa-484	49.10F	0.49F	0.52F	0.19F
Alfa-1312	61.93B	0.64B	0.68B	0.36B
Alfa-1313	53.32E	0.54E	0.57E	0.24E
Bilensoy	66.69A	0.69A	0.75A	0.42A
Bilensoy-80	47.80FG	0.48FG	0.50FG	0.17FG
CW-3567	47.18G	0.47G	0.49G	0.16G
Daisy	54.84E	0.56E	0.59E	0.26E
Kayseri	59.01C	0.60C	0.65C	0.32C
Planet	56.74D	0.58D	0.62D	0.29D
Resis	59.99C	0.61C	0.66C	0.33C
Savas	62.93B	0.65B	0.70B	0.37B
Seker	63.21B	0.65B	0.70B	0.37B
Average	56.89	0.58	0.62	0.29

Values inside columns with different letters differ significantly ($p < 0.01$).

When the other studied criteria have been took up, DDM and DMI in cultivars ranged from 68.81 % (Bilensoy cultivars) to 55.59 % (CW-3567 cultivars) and 3.59 % (Seker cultivars) to 2.38 % (Kayseri cultivars), respectively (Table-2). CW-3567 cultivar was found to have the lowest NEL, NEm and NEg content among the all cultivars; Bilensoy cultivar had the highest NEL, NEm and NEg content (Table-3).

Conclusion

The study results showed that crude protein, acid detergent fiber, neutral detergent fiber, relative feed value and total digestible nutrient contents of some Lucerne cultivars had significant differences ($p < 0.01$). Seker, Bilensoy and Savas cultivars had better nutrient content than other cultivars. Seker cultivars with respect to crude protein, NDF, RFV and TDN values, were supreme and in terms of ADF were good. Bilensoy cultivar, in terms of crude protein, ADF and TDN, were supreme and for RFV and NDF values were premium and good, respectively. Savas cultivar in terms of crude protein and TDN contents was supreme and for RFV contents was premium and for ADF and NDF values were good. The results indicated that lucerne cultivars had rich contents with respect to feeding value. The differences among Lucerne cultivars can be used to improve ideal lucerne cultivars for animal feeding.

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REFERENCES

1. M. Tan, Y. Serin and H. Yolcu, *J. Agric. Fac.*, **28**, 729 (1997).
2. J. Santrucek, M. Svobodova and D. Hlavickova, *Plant Soil Environ.*, **49**, 499 (2003).
3. S. Altinok and A. Karakaya, *Turk. J. Agric. For.*, **26**, 11 (2002).
4. Y. Serin and M. Tan, Ataturk University, Publication No. 190, Erzurum, Turkey, Ataturk University Press, p. 177 (2001).
5. A. Sommer, M. Vodnansky, P. Petrikoviç and R. Pozgaj, *Czech J. Anim. Sci.*, **50**, 74 (2005).
6. H. Yolcu, M. Tan and Y. Serin, *New Zealand Agric. Res.*, **49**, 201 (2006).
7. R.C. Cochran, D.C. Adams, P.O. Currie and B.W. Knapp, *J. Range Manag.*, **39**, 361 (1986).
8. M.D. Fraser, M.H.M. Speijers, V.J. Theobald, R. Fychan and R. Jones, *Grass Forage Sci.*, **59**, 345 (2004).
9. G. Alhadhrami and J.T. Huber, *Dairy Sci.*, **75**, 3091 (1992).
10. S. Sengül and H. Yolcu, *J. Agric. Fac. Atatürk Univ.*, **33**, 29 (2002).
11. A. Kamalak, O. Canbolat, Y. Gurbuz, A. Erol and O. Ozay, *Small Ruminant Res.*, **58**, 149 (2005).
12. M. Lema, A. Felix, S. Salako, E. Cebert and U. Bishnoi, *J. Appl. Anim. Res.*, **19**, 129 (2001).

13. A.L. Lekgari, S. Baenziger, K.K. Vogel and D.D. Baltensperger, The ASA-CSSA-SSSA International Annual Meetings, 12-16 November, Indianapolis (2006).
14. J.D. Kim, C.H. Kwon, C.N. Shin, C.H. Kim, D.A. Kim, *Asian-Australasian J. Anim. Sci.*, **18**, 997 (2005).
15. J.D. Kim, S.C. Kim, S.J. Abuel, C.H. Kwon, C.N. Shin, K.H. Ko and B.C. Park, *Asian-Australasian J. Anim. Sci.*, **19**, 970 (2006).
16. N. Wang and J.K. Daun, *Food Chem.*, **95**, 493 (2006).
17. P.G. Jefferson, *Can. J. Plant Sci.*, **85**, 377 (2005).
18. National Research Council, Update 2000, Seventh Revised Edition: National Academy Press, Washington, DC, p. 225 (1996).
19. National Research Council, National Academy Press, Washington, DC, p. 363 (2001).
20. D.I.H. Jones, The British Grassland Soc., pp. 243-265 (1981).
21. P.J. Van Soest, *J. Assoc. Off. Anal. Chem.*, **46**, 829 (1963).
22. J.W. Schroeder, North Dakota State University, Data (1994).
23. Anonymous, General Directorate of Government Meteorological Works, Ankara (2005).
24. Soil Survey Staff, SMSS Technical Monograph No. 19, Pocahontas Press Inc., Blacksburg (1992).
25. SPSS Inc., Base 13.0 Application Guide. Chicago, Illinois (2005).
26. C. Holland and W. Kesar, Pioneer Hi-Bred International, p. 55 (1990).
27. M.D. Casler and R.D. Hatfield, *J. Agric. Food Chem.*, **54**, 8206 (2006).

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