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Determination of Relative Feed Value of Some Legume Hays Harvested at Flowering Stage

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ABSTRACT

The aim of this study was to determine the Relative Feed Value (RFV) and Metabolisable Energy (ME) content of some legume hays harvested at flowering stage. Chemical composition including Crude Protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Ether Extract (EE), ash, Dry Matter Digestibility (DMD), Relative Feed Value (RFV) and Metabolisable Energy (ME) were calculated. The CP content of hays ranged from 9.69 to 22.13%. The NDF and ADF contents ranged from 38.48 to 41.06% and 29.95 to 35.75%, respectively. The NDF content of *Trifolium repens* was significantly higher than those for *Vicia sativa* and *Trifolium incarnatium*. The ADF content of *Vicia sativa* was significantly ($p<0.001$) lower than that for *Trifolium incarnatium, Medicago lupulina* and *Lathyrus sativus*. The DMD of legume hays ranged from 60.54 to 65.56%. The DMD of *Vicia sativa* was significantly higher than that for *Trifolium* incarnatium. The DMI was ranged from 2.92 to 3.11% of body weight. The DMI of *Trifolium incarnatium* was significantly higher than those for the other legume hays. The RFV of legume hays ranged from 138.81 to 155.07. The RFV of *Vicia sativa* was significantly higher than those for *Trifolium repens, Medicago lupulina* and *Lathyrus sativus*. The ME contents of legume hays ranged from 2.346 to 2.522 Mcal kg^{-1}. The ME contents of *Vicia sativa* was significantly higher than that for *Trifolium incarnatium*. As a conclusion species had a significant ($p<0.001$) effect on the chemical composition, DMD, DMI, RFV and ME of legume hays.

Key words: Relative feed value, dry matter intake, digestibility, legume, hay, forage

INTRODUCTION

It is well known that forages have an important role in ruminant nutrition in terms of providing energy, protein and minerals as well as fibre for chewing and rumination. (Ahmad *et al*., 2000; Ranjbar, 2007; Kamalak and Canbolat, 2010). Although, the relationship used to develop prediction equations for animal performance from intake and digestibility are often less accurate than desired the digestibility and intake of forages has been used to form indices of forage quality (Coleman and Moore, 2003). In Mediterranean areas pastures represent the most important legume forage resource such as *Trifolium repens, Vicia sativa, Medicago sativa, Trifolium incarnatium, Medicago lupulina* and *Lathyrus sativa*. Nutritive value of forages depends on their dry matter digestibility and voluntary dry matter intake. The RFV is a widely accepted forage quality index in the marketing of hays in the United States of America. It was developed by the Hay Marketing Task Force of American Forage and Grassland Council (Rohweder *et al*., 1978). The RFV combines the estimates for forage digestibility and intake into a single number. The RFV is estimated from ADF and NDF content of forages (Caddel, 2005). Hay producers and purchasers also use RFV in price discovery, especially in hay auctions (Undersander, 2001).

Heydari *et al.* (2006) conducted the experiment to evaluate three wetland plant species including *Paspalum distichum*, *Sparganium erectum* and *Aeloropus litoralis* as a forage using the chemical composition, estimated relative feed value and dry matter digestibility and concluded that nutritive value of depends on the nutrients concentration, availability of these nutrients to animal, the effect of feed composition on the voluntary intake of the feed.

Hackmann *et al.* (2008) evaluated the relative feed value of grass and legume forages and suggested that relative feed value was significantly correlated with potentially digestible dry matter and crude protein for early cut alfalfa, potentially digestible dry matter for late cut alfalfa and potentially digestible dry matter and NDF and hemicellulose for grass-legume.

Canbolat and Karaman (2009) also conducted the experiment to evaluate the nutritive value of legume hays including *Medicago sativa*, *Medicago polymorha*, *Medicago orbicularis*, *Melilotus indicus*, *Mellilotus officinalis*, *Melilotus albus* Medicus, *Onobrychis sativa*, *Vicia villosa* and *Lotus corniculatus* using the chemical composition, *in vitro* gas production, organic matter digestibility, estimated relative feed value and concluded that there were significant differences among the legume hays with a different chemical composition in terms of nutritive value.

Although, RFV as forage quality has been determined for some plant spieces from different parts of world (Heydari *et al.*, 2006; Hackmann *et al.*, 2008; Canbolat and Karaman, 2009) the information about RFV for plants such as *Trifolium repens*, *Vicia sativa*, *Medicago sativa*, *Trifolium incarnatium*, *Medicago lupulina* and *Lathyrus sativa* was insufficient in Turkey. Therefore, the aim of this study was to determine the relative feed value of some legume hays harvested at flowering stage.

MATERIALS AND METHODS

Hay samples: In the current study, *Trifolium repens*, *Vicia sativa*, *Medicago sativa*, *Trifolium incarnatium*, *Medicago lupulina* and *Lathyrus sativa* were hand harvested from plots established in the experiment units of pasture at flowering stage in Kahramanmaras, Turkey in late May, 2010. The hay samples were shade-dried and milled to pass through a 1 mm sieve for subsequent analysis.

Chemical analysis: Dry matter content was determined by drying the samples at 105°C overnight and the ash by igniting the samples in a muffle furnace at 525°C for 8 h. Nitrogen (N) content was measured by the Kjeldahl method. The CP was calculated as N X 6.25. Ether extract was determined by the method of AOAC (1990). NDF and ADF contents were determined using ANKOM Fibre Analyzer (Van Soest *et al.*, 1991). All chemical analyses were carried out in duplicate.

Relative feed value: Relative feed value of hays is calculated from the estimates of dry matter digestibility (DDM) and Dry Matter Intake (DMI). Relative Feed Value (RFV) was developed by the Hay Marketing Task force of American Forage and Grassland Council (Rohweder *et al.*, 1978). Quality standards of legume hays are represented in Table 1.

Table 1: Legume, grass and legume-grass mixture quality standards

Quality standard[a]	CP	ADF % of DM	NDF% of DM	RFV [b]
Prime	>19	<31	<40	>151
1	17-19	31-40	40-46	151-125
2	14-16	36-40	47-53	124-103
3	11-13	41-42	54-60	102-87
4	8-10	43-45	61-65	86-75
5	<8	>45	>65	<75

[a]Standard assigned by Hay Market Task Force of American Forage and Grassland Council; [b]Relative Feed Value (RFV)- Reference hay of 100 RFV contains 41% ADF and 53% NDF

DMD% = 88.9 - (0.779×%ADF)
DMI% of BW = 120/%NDF
RFV = (%DDM×%DMI)/.29
DMD = Dry matter digestibility
ADF = Acid detergent fibre (% of DM)
NDF = Neutral detergent fibre (%)
DMI = Dry matter intake (% of BW)
RFV = Relative feed value

The DMD values were used to estimate digestible energy (DE) using the regression equation reported by Fonnesbeck *et al.* (1984): DE(Mcal kg^{-1}): 0.27+0.0428 x DMD (%), Then DE values were converted to metabolisable energy (ME) using the formula reported by Khalil *et al.* (1986):

$$ME(Mcal\ kg^{-1}) = 0.821 \times DE$$

Data on chemical composition, RFV, DMD and ME contents of legume hays were subjected to one way of ANOVA using GLM of SPSS for Windows (2002). Significance between individual means was identified using the Duncan test. Mean differences were considered significant at $p<0.05$. Standard errors of means were calculated from the residual mean square in the analysis of variance.

RESULTS AND DISCUSSION

The effect of species on the chemical composition of legume hays is given in Table 2, the species had a significant ($p<0.001$) effect on the chemical composition of hays. The CP content of hays ranged from 9.69 to 22.13%. The CP of *Lathyrus sativus* was significantly ($p<0.001$) higher than those for other hay samples. The NDF and ADF content ranged from 38.48 to 41.06% and 29.95 to 35.75%, respectively. The NDF content of *Trifolium repens* was significantly higher than those for *Vicia sativa* and *Trifolium incarnatium*. The ADF content of *Vicia sativa* was significantly ($p<0.001$) lower than that for *Trifolium incarnatium, Medicago lupulina* and *Lathyrus sativus*. The EE content of *Trifolium repens* was significantly ($p<0.001$) higher than those for the other hays. The ash content of *Trifolium incarnatium* was significantly ($p<0.001$) higher than those for the other hays. The CP, ash and ADF contents of *Trifolium repens* are consistent with findings of Karabulut *et al.* (2007) although the NDF content of *Trifolium repens* obtained in the current study was a little bit higher than that indicated by Karabulut *et al.* (2007) who found that the NDF content of *Trifolium repens* was 37.1%.

The NDF, ADF and CP contents of *Medicago sativa* were comparable with findings of Canbolat *et al.* (2006). On the other hand, NDF, ADF and CP contents of *Medicago sativa* hay was

Table 2: The chemical composition of legume hays harvested at flowering stage

	Legume hays							
Constituents	*Trifolium repens*	*Vicia sativa*	*Medicago sativa*	*Trifolium incarnatium*	*Medicago lupulina*	*Lathyrus sativus*	SEM	Sig.
DM	98.61^{c}	96.88^{e}	99.15^{a}	98.79^{b}	98.60^{c}	98.31^{d}	0.041	***
CP	15.08^{b}	9.69^{e}	20.20^{a}	16.74^{b}	21.09^{a}	22.13^{a}	1.294	***
NDF	41.06^{a}	39.34^{bc}	40.15^{ab}	38.48^{c}	40.92^{a}	40.92^{a}	0.450	***
ADF	33.15^{ab}	29.95^{b}	33.76^{ab}	36.40^{a}	34.76^{ab}	35.74^{a}	1.889	***
EE	3.29^{a}	2.49^{b}	2.58^{b}	1.95^{c}	2.51^{b}	2.50^{b}	0.144	***
Ash	9.77^{b}	8.69^{e}	8.58^{d}	10.69^{a}	9.76^{b}	8.16^{e}	0.030	***

Row means with common superscripts do not differ ($p>0.05$); SEM: Standard error mean; Sig: Significance level, ***$p<0.001$. DM: Dry matter %, CP: Crude Protein, NDF: Neutral Detergent Fiber %, ADF: Acid Detergent Fiber %, EE: Ether Extract %

considerably lower than those obtained by Yavuz (2005). The difference between these studies is possibly due to difference in harvesting stage of *Medicago sativa* hay. Canbolat *et al.* (2006) showed that NDF and ADF contents of *Medicago sativa* hay were increased with increasing maturity whereas CP content was decreased with increasing maturity.

The CP content of *Vicia sativa* was considerably lower than that reported by Tuna *et al.* (2004) who found that CP content of *Vicia sativa* was 14.24%. On the other hand The CP content of *Lathyrus sativus* was considerably higher than that reported by Tuna *et al.* (2004) who found that CP content of *Lathyrus sativus* was 16.35%. The NDF content of *Vicia sativa* was considerably lower than that reported by Tuna *et al.* (2004) who found that NDF content of *Vicia sativa* was 44.38% whereas The ADF content of *Vicia sativa* was considerably higher than that reported by Tuna *et al.* (2004) who found that ADF content of *Vicia sativa* was 27.69%. The difference between these studies is possibly due to difference in growing sites, climatic conditions and fertilization. On the other hand, NDF and ADF contents of *Lathyrus sativus* were comparable with those reported by Tuna *et al.* (2004) who found that NDF and ADF contents of *Lathyrus sativus* was 40.76 and 34.06%, respectively.

The effect of species on DMD, DMI and RFV of legume hays is given in Table 3, as can be seen from Table 3 the species had a significant ($p<0.001$) effect on DMD, DMI and RFV of legume hays. The DMD of legume hays ranged from 60.54 to 65.56%. The DMD of *Vicia sativa* was significantly ($p<0.001$) higher than that for *Trifolium incarnatium*. The DMI of legume hays was ranged from 2.92 to 3.11% of body weight. The DMI of *Trifolium incarnatium* was significantly ($p<0.001$) higher than those for the other legume hays. The RFV of legume hays ranged from 138.81 to 155.07. The RFV of *Vicia sativa* was significantly ($p<0.001$) higher than those for *Trifolium repens*, *Medicago lupulina* and *Lathyrus sativus*.

The ME value of legumes ranged from 2.346 to 2.522 Mcal kg^{-1}. The ME value of *Vicia sativa* was significantly higher than that of *Trifolium incarnatium*.

The DMD, DMI and RFV of *Medicago sativa* obtained in the current study were consistent with finding of Canbolat *et al.* (2006). On the other hand, The DMD, DMI and RFV of *Medicago sativa* obtained in the current study were considerable higher than those obtained by Yavuz (2005) who found that DMD, DMI and RFV of *Medicago sativa* were 59.7%, 2.56 and 118.8, respectively. The difference between these studies is possibly due to difference in harvesting stage of *Medicago sativa* hay. Canbolat *et al.* (2006) showed that DMD, DMI and RFV of *Medicago sativa* hay were decreased with increasing maturity.

Table 3: The dry matter digestibility, dry matter intake and relative feed value of legume hays harvested at flowering stage

	Legume hays							
Parameters	*Trifolium repens*	*Vicia sativa*	*Medicago sativa*	*Trifolium incarnatium*	*Medicago lupulina*	*Lathyrus sativus*	SEM	Sig.
DMD	63.07^{ab}	65.56^{a}	62.60^{ab}	60.54^{b}	61.82^{ab}	61.05b	1.470	***
DMI	2.92^{c}	3.05^{ab}	2.99b^{c}	3.11^{a}	2.93c	2.93c	0.034	***
RFV	142.90^{b}	155.07^{a}	145.04^{ab}	146.36^{ab}	140.55b	138.81b	4.119	***
ME	2.435^{ab}	2.522^{a}	2.418^{ab}	2.346^{b}	2.391^{ab}	2.364^{ab}	0.516	NS

Row means with common superscripts do not differ ($p>0.05$); SEM: Standard error mean; Sig. - significance level, ***$p<0.001$. DMD: Dry matter digestibility%, DMI: Dry matter intake, % of Body weight, RFV: Relative feed value. ME: Metabolisable energy (Mcal kg^{-1})

The ME content of *Medicago sativa* was considerable higher than that reported by Arzani *et al.* (2006) who found that ME content of Medicago sativa was 2.33 Mcal kg^{-1}. The high ME of *Medicago sativa* in the current experiment may be high DMD of *Medicago sativa*.

CONCLUSION

As a conclusion species had a significant effect on the chemical composition, dry matter digestibility, dry matter intake, relative feed value and metabolisable energy content of legume hays.

REFERENCES

Ahmad, Z., A. Ghafoor and A. Ali, 2000. Evaluation of three exotic legume species for fodder potential. Pak. J. Biol. Sci., 3: 2079-2081.

AOAC, 1990. Official Methods of Analysis. Association of Official Analytical Chemists, Washington, DC. USA., pp: 69-88.

Arzani, H. , M. Basiri, F. Khatibi and G. Ghorbani, 2006. Nutritive value of some zagros mountain rangeland species. Small Rumin. Res., 65: 128-135.

Caddel, J., 2005. Relative feed value. http://alfalfa.okstate.edu./webnews/quality2.htm.

Canbolat, O., A. Kamalak, C.O. Ozkan, A. Erol, M. Sahin, E. Karakas and E. Ozkose, 2006. Prediction of relative feed value of alfalfa hays harvested at different maturity stages using *in vitro* gas production. Livest. Res. Rural Dev.

Canbolat, O. and S. Karaman, 2009. Comparison of in vitro gas production, organic matter digestibility, relative feed value and metabolizable energy contents of some legume forages. J. Agric. Sci., 15: 188-195.

Coleman, S.W. and J.E. Moore, 2003. Feed quality animal performance. Field Crops Res., 84: 17-29.

Fonnesbeck, P.V., D.H. Clark, W.N. Garret and C.F. Speth, 1984. Predicting energy utilization from alfalfa hay from the western region. Proc. Am. Soc. Anim. Sci., 35: 305-308.

Hackmann, T.J., J.D. Sampson and J.N. Spain, 2008. Comparing relative feed value with degradation parameters of grass and legume forages. J. Anim. Sci., 86: 2344-2356.

Heydari, G., Y. Tempuras and H. Zali, 2006. Inspection on three plant species as animal forage souce in Mazandran Wetland. Pak. J. Nutr., 5: 382-386.

Kamalak, A. and O. Canbolat, 2010. Determination of nutritive value of wild narrow-leaved clover (*Trifolium angustifolium*) hay harvested at three maturity stages using chemical composition and *in vitro* gas production. Trop. Grasslands, 44: 128-133.

Karabulut, A., O. Canbolat, H. Kalkan, F. Gurbuzol, E. Sucu and I. Filya, 2007. Comparison of *in vitro* gas production, metabolizable energy, organic matter digestibility and microbial protein production of some legume hays. Asian-Aust. J. Anim. Sci., 20: 517-522.

Khalil, J.K., W.N. Sawaya and S.Z. Hyder, 1986. Nutrient composition of *Atriplex* leaves grown in Saudi Arabia. J. Range Manage., 39: 104-107.

Ranjbar, G.A., 2007. Forage and hay yield performance of different berseem clover (*Trifolium alexandinum* L.) genotypes in mazandaran conditions. Asian J. Plant Sci., 6: 1006-1011.

Rohweder, D.A., R F. Barnes and N. Jorgensen, 1978. Proposed hay grading standards based on laboratory analyses for evaluating quality. J. Anim. Sci., 47: 747-759.

Tuna, C., L. Coskuntuna and F. Koc, 2004. Determination of nutritional value of some legume and grasses. Pak. J. Biol. Sci., 7: 1750-1753.

Undersander, D., 2001. Does forage quality pay. Proceedings of the American Forage and Grassland Council. (AFGC'01), Springdale, AR., AFGC, Georgetown, TX., pp: 120-125.

Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and non starch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583-3597.

Yavuz, M., 2005. Determination of some ruminant feeds relative feed value and *in vitro* digestion values. GOU. Ziraat Fakultesi Dergisi, 22: 97-101.