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Determination of Digestibility and Nutritive Value of Iranian Alfalfa Varieties Using *In vivo* Technique in Sheep

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Abstract: The aim of this experiment was to determine the potential nutritive value of Hamedani (HAM) and Kareyonge (KAR) using the chemical composition, Dry Matter Digestibility (DMD), Organic Matter Digestibility (OMD) and Metabolizable Energy (ME) content. Each of the two alfalfa varieties were offered *ad libitum* to three Gezel rams. No significant difference found between Dry Matter (DM), Crude Protein (CP), Ash and Ether Extract (EE) contents of two alfalfa varieties, although the difference for Crude Fiber (CF), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were significant ($p<0.001$). Dry Matter Intake (DMI), Organic Matter Intake (OMI) and Crude Protein Intake (CPI) were similar in HAM and KAR hays ($p>0.05$). Dry Matter Digestibility (DMD) and organic matter digestibility in HAM hay were significantly ($p<0.01$) higher than that of KAR hay, whereas Crude Protein Digestibility (CPD) in HAM hay was similar than that KAR hay ($p>0.05$). Digestible Organic Matter in Dry Matter (DOMD) and ME intake in HAM were significantly ($p<0.01$) higher than that KAR hay. Calculations based on *in vivo* digestibility indicate that HAM alfalfa can have a higher inclusion than of KAR alfalfa in diets for ruminants because of lower cell wall (NDF and ADF) contents, greater DOMD and ME intake.

Key words: Nutritive value, digestibility, alfalfa, sheep

INTRODUCTION

Forages provide 83% of the protein requirements of beef cattle and 90% of the protein requirement of sheep (Griffith, 1978). Ruminants are the predominant forage utilizer among animals, because ruminant animals possess rumen microbes, which can digest cellulose and use NPN to produce high quality microbial protein (Wechsler, 1981). It is well known that forage has an important role in ruminant nutrition in terms of providing energy, protein and minerals (Chriyaa *et al*., 1997). Nutritive value of forages depends on their dry matter and digestibility and voluntary dry matter intake. Predictions of voluntary intake and digestibility of forages by ruminant animals have long been a research priority in animal nutrition (Kamalak *et al*., 2005a). Although the effect of maturity on the nutritive value of forage obtained from different plants is well established (Buxton, 1996; Kamalak *et al*., 2005b, c; Bal *et al*., 2006) there are little information about the nutritive value of Iranian hays especially common alfalfa varieties.

The aim of this experiment was to determine the potential nutritive value of KAR and HAM hays harvested at late maturity by using the chemical composition, *in vivo* method and ME content.

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MATERIALS AND METHODS

Sample Collection

Two alfalfa varieties (Hamedani and Kareyonge) used in this study were randomly sampled from ten alfalfa farms at near West Azerbaijan, Iran (located in the Uromia and Miandoab cities) in summer 2005. The samples were transported to the laboratories of Islamic Azad University-Shabestar Branch.

Both alfalfa, at harvested, were estimated to be at late maturity (both verities in mid to late bloom). Samples were collected, oven-dried at 60°C for 48 h, ground (5 mm screen) and prepared for chemical analysis.

Chemical Analysis

Dry Matter (DM) was determined by drying the samples at 105°C overnight and ash by igniting the samples in muffle furnace at 525°C for 8 h and Nitrogen (N) content was measured by the Kjeldahl method (AOAC, 1990). Crude Protein (CP) was calculated as N×6.25. Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent Lignin (ADL) were determined by procedures outlined by Goering and Van Soest (1970) with modifications described by Van Soest *et al*. (1991) sulfite was omitted from NDF analysis. Hemicellulose and cellulose were calculated as NDF-ADF and ADF-ADL-AIA, respectively (Andrighetto *et al*., 1993).

Estimation of Energy Value

Gross Energy (GE) was measured in an adiabatic bomb calorimeter. Metabolizable Energy (ME) values were estimated from *in vivo* DOMD values according to AFRC (1993).

Voluntary Feed Intake and Digestibility Trails

Each of the two alfalfa varieties were offered *ad libitum* to three Gezel rams (1.5 year old, avg initial BW 55 kg) kept in metabolism cages to enable accurate determination of feed intake and allow easy collection of faeces. The forages were fed twice daily at 08:30 and 16:30 h and fresh drinking water and mineral salt licks were freely available. The animals were adapted each forage for two weeks, followed by balance trails of seven days (total period of digestibility trials were 42 days), in which daily measurement of food intake and fecal excretion were made. Sub-sample of forages was taken and data on their daily intake (g DM kg^{-1} $LW^{0.75}$) and digestibility *in vivo* were obtained.

Statistical Analysis

All of the data were analyzed by using software of Statistical Analysis Systems (1985) and means of both varieties were separated by independent-samples t-test (Steel *et al*., 1980).

RESULTS AND DISCUSSION

There was considerable variation between forages in terms of chemical composition (Table 1). The CF content of KAR hay was higher than that HAM hay ($p<0.05$). On the other hand ADF and NDF contents ranged from 29.4±0.8 to 34.4±0.2 and 43.1±0.7 to 49±0.2 for HAM and KAR hays, respectively. The ADL content of both hays were similar (HAM: 6.3±0.7 and KAR: 7.3±0.1). The cell wall (ADF and NDF) and ADL contents of HAM hay were similar than those reported by Coblentz *et al*. (1998), lower than that reported by Torrent *et al*. (1994) and higher than that reported by Kamalak *et al*. (2005a). The different result reported by several researchers about alfalfa hay cell wall content may be due to differences in maturity (Coblentz *et al*., 1998; Gulsen *et al*., 2004; Kamalak *et al*., 2005b, c), variety, environmental conditions, agronomic factors (Wechsler, 1981; Buxton, 1996) and leaves to stem ratio (Coblentz *et al*., 1998). It is well established that the cell wall

Table 1: Chemical composition of KAR and HAM hays

Components (%)	HAM*	KAR*	Sig.
DM	92.93±0.23	93.46±0.23	NS
CP	15.80±2.40	12.50±0.44	NS
CF	29.20±1.40	34.00±0.40	**
EE	1.33±0.58	1.33±0.58	NS
Ash	10.33±0.57	10.33±0.57	NS
NDF	43.10±0.70	49.00±0.20	***
ADF	29.40±0.80	34.40±0.20	***
ADL	6.30±0.70	7.30±0.10	NS
GE (kcal kg^{-1})	4219.00±34.0	4250.00±89.0	NS

DM: Dry Matter; OM: Organic Matter; CP: Crude Protein; CF: Crude Fiber EE: Ether Extract; NDF: Neutral Detergent fiber; ADF: Acid Detergent Fiber; ADL: Acid-Detergent Lignin; GE: Gross Energy; *The data are mean value±standard deviation (SD) of three replicates; Sig. = Significant level; NS = Non-significant; **p<0.01; ***p<0.001

Table 2: A comparison of the DM, OM, CP and ME intake, apparent digestibility coefficients and digestible OM and CP contents in sheep

Items	KAR	HAM	Sig.
DMI			
kg day^{-1}	1.2±0.4	1.64±0.02	NS
g per $BW^{0.75}$	59.5	81.2	NS
OMI			
kg day^{-1}	1.1±0.3	1.5±0.04	NS
g per $BW^{0.75}$	54.4	74.2	NS
CPI			
kg day^{-1}	0.145±0.06	0.182±0.003	NS
g per $BW^{0.75}$	7.2	9	NS
Digestibility coefficient			
DM	56.8±2.2	65±2	**
OM	58.25±1.75	66.7±2.3	**
CP	56.4±5.6	64±2	NS
DOMD[a] (g kg^{-1} DM)	520±10.3	613.2±27	**
Predicted ME[b]			
(MJ kg^{-1} DM)	8.14±0.16	9.6±0.3	**
ME intake (MJ day^{-1})	9.81±0.0005	15.8±0.7	***

[a]: DOMD: Digestible organic matter in the dry matter; [b]: ME value predicted after AFRC (1993); Sig. = Significant level; NS : Non Significant; **: p<0.01; ***: p<0.001

content of forages increase with increasing maturity (Gulsen *et al*., 2004; Kamalak *et al*., 2005b, c). The GE content for HAM and KAR hays were similar and ranged from 4219±34 to 4250±89 kcal kg^{-1}, respectively. No significant differences were found between crude protein content of HAM and KAR. The CP content of HAM and KAR hays were lower than that reported by Coblentz *et al*. (1998) and Kamalak *et al*. (2005a) and similar with data of Abas *et al*. (2005). The ash content, which is an index of mineral contents, was similar (10.33±0.57) in HAM and KAR hays. The ash content of both hays consistent with that reported by Kamalak *et al*. (2005a).

DMI, OMI and CPI (kg per day and g kg^{-1} $W^{0.75}$) in HAM and KAR hays were similar (p>0.05) (Table 2). DMD and OMD (%) in HAM hay were significantly (p<0.01) higher than that KAR hay; but CPD (%) in KAR and HAM hays was similar (p>0.05). The reason why HAM hay had higher DMD and OMD than that of KAR probably is low cell wall content. Science there have a negative correlation between cell wall content and nutrient digestibility (Kamalak *et al*., 2005a). The DMD, OMD (%) and DMI (g kg^{-1} $W^{0.75}$) for KAR hay were similar with those values reported by Torrent *et al*. (1994), Kamalak et la (2005a) and Abas *et al*. (2005) in alfalfa, But lower than HAM hay. The DMD, DMI and CPI of HAM hay obtained in this study were consisted with those reported by Vanzant *et al*. (1998) and Martin *et al*. (2000). The DMD, DMI, CPD and CPI contents of HAM hay were lower than those obtained by Phillips *et al*. (2002). The DOMD, ME and ME intake of HAM hay were significantly (p<0.01) higher than that KAR hay. The calculated ME content of both alfalfa varieties were higher than that of reported Abas *et al*. (2005).

CONCLUSIONS

In conclusion, results obtained from the present study indicated that, the cell wall content of HAM hay was lower than that of KAR and DMD, OMD, ME content and ME intake of HAM higher than those of KAR. Overall it seems that nutritive value and digestibility of HAM were greater than those of KAR hay.

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