Determination of Nutritional Value and Digestibility and Degradability of Twigs in Four Tree Species through Chemical and in Situ (Nylon Bags) Techniques

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Abstract: This study has been conducted in order to determine nutritional value and digestibility and degradability of twigs in four tree species including Zelkova carpinifolia, Gleditchia Caspica, Populus deltoids and Quercus castanaefolia through chemical and in situ techniques using 3 fistulated sheep in National Research Institute for Animal Science, IRAN. The experiment conducted based on Randomized Complete Block Design and obtained data were analyzed by software SAS and Neway. Chemical compounds (crude protein (CP), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), Ether Extract (EE), Ash, Crude Fiber (CF), NFC(Non Fiber Carbohydrate), Nitrogen Free Extract (NFE) and organic material (OM)) and degradation (dry matter and protein) were determined. Amount of crude protein for 4 species are as follow Z. carpinifolia (11%), G. caspica (15.4%), P. deltoids (10.3%) and Q. castanaefolia (9.5%), also amount of crude fiber in these trees are respectively 32.7, 18.6, 13.9 and 22.9%. Survey conducted on species’ degradation and on amounts of dry matter and protein which disappear after 0, 4, 8, 16, 24, 48, 72 and 96 hours. Results of degradation in dry matter and protein showed that extent of degradation has been an uptrend over time of incubation and it follows a similar trend at all times. The most degradation of dry matter (80.6%) and protein (91.6%) are related to G. caspica and the least degradation of dry matter (36%) and protein (38.4%) are related to Q. castanaefolia. Results showed that as a replacement or a complementary for alfalfa, the four considered tree species can provide some parts of food requirements by livestock through a correct programming.

Keywords: Chemical, digestibility, in situ (Nylon Bags), nutritional value, tree, twigs

INTRODUCTION

Today, shortage of forage especially in developing country is as the most important limiting factor in livestock development (FAO and World Food Summit, 1996). Increasing need for animal protein in Iran has increased environmental hazards and rate of vegetation destruction in pastures and forests so that livestock of Department of Livestock (2002) are 4 times more than the capacity of pastures. Therefore, identifying and exploiting new forage resources is very important. One of these resources are tree twigs. Most of researchers state that tree twigs have high nutritional value and they could compensate a considerable part of shortage in forage resources and they should be in priority of culture as a key of protein resources for farm animals along a year (Eyog-Matig and Obel-Lawson, 2002; Larbi et al., 2005; Petit and Mallet, 2001).

Ruminants simply utilize foods such as tree twigs which include Cellulose, Hemicellulose and wooden materials due to existing microorganisms in their rumen (Church and Pond, 1992; Ensiminger and Parker, 1986). Marker and Singh (1991) reported that leaves of different species of Q. castanaefolia are parts of dry matter intake by ruminants in winter in areas of Himalaya, India, Nepal, China and some other countries. In Iran, especially in winter and when there is shortage in forage, local ranchers use leaves and twigs of species of Z. carpinifolia, G. caspica, P. deltoids and Q. castanaefolia for their livestock due to palatability, having high starch and necessary nutritional materials such as phosphor, Calcium and organic matter and high percentage of digestibility in livestock (Khalatbari et al., 1997). On the other hand, more than 80% of non-forest arboriculture (150,000 hectares) is related to P. deltoids (Modir, 2008) which has been traditionally consumed by livestock and extent of crude protein is 7.9 to 10.5%, extent of crude fibers is 15.2 to 19.8%, extent of NDF is 30.9 to 35% and extent of ADF is 22.2 to 25% for its varieties (Kelagry et al., 2008). Kamlak et al. (2005) reported that chemical compounds of leaves of P. deltoids’ five species are as follow: Protein between 26 to 28 g/kgDM, Crude fiber between 509.5 to 205.9 g/kgDM, Lamers and Khamzina (2010), Szekai et al. (1998) and Ayers et al. (1996) reported that P. deltoids’ leaves have good quality so that its crude protein is between 12.7 to 15.6 percent and its crude fibers is between 18.9 to 25.6 percent. Ben salem et al. (2003), Singh and Doel (1985) and Matinzaeh
et al. (2006) reported that nutritional value of *P. deltoids'* fruit and twig is relatively high. Regarding that the four considered species are cultured widely in regions of Iran and they are used by ranchers, therefore, this research conducted in order to determine nutritional value and digestibility of these species for better and more proper programming.

**MATERIALS AND METHODS**

*Gleditchia caspica* is family of *Laguminosae*, compound leaves with 15 to 25 cm long along and large elongated maroon fruit. Stems have large thorns with relatively 15 cm in length.

*Zelkova carpinifoli* is a tree growing to 20 to 35 meters tall; its leaves are 4 to 10 cm long and 5.2 to 6 cm wide which are rough, alternative, deciduous, dentate and pulpy.

*Populus deltoids* is family of *Salicaceae* and grows fast, culture is known as wood farming, mostly it needs light and deep soil and water.

*Quercus castanaefolia* is family of *Fagaceae* and just grows in lands with deep and heavy soil which has suitable moisture (Sabeti, 2003).

Sampling were completely conducted randomly from twigs of the four species with three replications (each replication were a compound of 5 samples of each species) in north of Iran. Plant samples were dried in oven with 70ºC for 72 h and then they were milled. In this research 3 adult castrated sheep with similar weight (Average weight of 65±2.6) were used which were Talyshiyan species and they were fistulated. this research was done in the Research Institute of Animal Science of Iran (April, 2011). In order to have a proper growth and concentration of microbial population and also to make a habit in animals, two weeks before each test (daily at 8 a.m and 15 p.m), forage including 60% of tree twigs and 40% concentrate were given to animals to the extent of their appetite and they were allowed to have rock salt and water as much as they want (Orskov and McDonald, 1979). The experiment conducted based on Randomized Complete Design and data were analysed by software SAS and Neway.

Chemical compounds including dry matter, crude protein (Kjeldahl), crude ash (furnace), Fibre (Fibrotic), Ether Extract (Soxhlet extractor) amount of cell wall without hemicellulose (ADF) and cell wall (NDF) determined based on common method of Van Soest et al. (1991) and AOAC (2005).

Nylon-bags: Measuring dry matter, protein, cell wall without hemicellulose (ADF) disappeared, were conducted through suggestive method by Orskov and McDonald (1979). In Nylon-bag technique (in situ), 5-10 gr samples were put in bags made of artificial polyester which are indigestible and resistant against microbial decomposition in rumen with holes of 50 micrometres and dimensions 12×18 cm. Head of bags were blocked by string. Times of incubation were 0, 4, 8, 16, 24, 48, 72 and 96 h and 3 replications were provided per hour for each treatment. After times of incubation finished, the bags were out, washed and completely cleared under cold water flow. Then, bags were put in temperature of 65ºC for 24 h. In order to determine its dry matter, they were put in oven with 10ºC for 24 h and percentage of disappeared dry matter and protein computed through following formulas:

\[
\text{Disappeared dry matter(\%)} = \frac{\text{Bag’s weight-Sample or bag’s weight after incubation)}-(\text{Bag’s weight-Sample or bag’s weight})\times100}{\text{Initial weight of food } \times \text{ protein (\%)}}
\]

\[
\text{Disappeared protein (\%)} = \frac{(\text{remained protein after incubation (\%)} \times \text{Remained weight after incubation})-(\text{protein (\%)} \times \text{Initial weight of food})}{(\text{Initial weights of food} \times \text{protein(\%)}}
\]

\[
\text{Degradation (\%)} = \frac{(\text{Nutrient after incubation}) - (\text{Initial nutrients})}{100}
\]

It was computed by software Neway and potential degradation through model \( P = a+b(1-e^{-ct}) \) (Orskov and McDonald, 1979)

\( P \): (Percentage of disappeared materials in time t);

\( a \): The part which is solved quickly (soluble part in time zero);

\( b \): sample amount is degraded in time t (Degradable potential part);

\( C \): Speed of b part’s degradation per hour (fixed rate of degradability along time);

\( e \): 2/7182(log neper)

Data obtained from degradability per hour incubation surveyed through SAS software and based on Randomized Complete Design in 3 replications. Statistical model of the design is as:

\[ Y_{ij} = \mu + T_i + e_{ij} \]

\( Y_{ij} \) (amount per observation), \( \mu \) (Total average), \( T_i \) (effect of treatment) and \( e_{ij} \) (Experimental error)

**RESULTS**

Results of survey about chemical compounds of four species show that the most amount of protein is in *G. caspica* and the least amount of it is in *Q. castanaefolia* but it is vice versa about structural hydrocarbons, it means that *G. caspica* has the least amount and *Q. castanaefolia* has the most amount of it (Table 1).
Table 1: Comparing chemical compound of species through chemical analysis (based on DM)

<table>
<thead>
<tr>
<th>Species</th>
<th>%OM</th>
<th>%NFE</th>
<th>%NFC</th>
<th>%NDF</th>
<th>%ADF</th>
<th>%Ash</th>
<th>%CF</th>
<th>%EE</th>
<th>%CP</th>
<th>%DM</th>
<th>Hemi</th>
<th>%WSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z. carpinifolia</td>
<td>82.9c</td>
<td>48.7b</td>
<td>27.5c</td>
<td>36.4b</td>
<td>32.7a</td>
<td>17.1a</td>
<td>15.3b</td>
<td>8.0a</td>
<td>11.0b</td>
<td>93.5a</td>
<td>3.7c</td>
<td>19.1c</td>
</tr>
<tr>
<td>G. caspica</td>
<td>90.1b</td>
<td>54.0a</td>
<td>39.0a</td>
<td>27.4c</td>
<td>18.6c</td>
<td>9.9b</td>
<td>12.4a</td>
<td>8.4a</td>
<td>15.4a</td>
<td>93.3a</td>
<td>8.8b</td>
<td>27.4b</td>
</tr>
<tr>
<td>P. deltoids</td>
<td>87.1b</td>
<td>56.7a</td>
<td>37.3a</td>
<td>33.3b</td>
<td>24.6b</td>
<td>12.9b</td>
<td>13.9ab</td>
<td>6.2b</td>
<td>10.3b</td>
<td>93.2a</td>
<td>8.7b</td>
<td>26.1b</td>
</tr>
<tr>
<td>Q. castanaefolia</td>
<td>96.3a</td>
<td>55.1a</td>
<td>34.5b</td>
<td>43.4a</td>
<td>31.7a</td>
<td>3.7c</td>
<td>22.9a</td>
<td>8.8a</td>
<td>22.9a</td>
<td>92.1a</td>
<td>11.7a</td>
<td>29.2a</td>
</tr>
</tbody>
</table>

SEM 0.42 0.43 1.13 0.91 0.00 0.22 0.27 0.39 0.22 0.58 0.89 0.55

Differences in each column show significant differences. *, ** is significant respectively in levels of 1% and 5%.

Table 2: Average of dry matter degradability of species over incubation time 96 h in “in situ” technique (percentage of dry matter), characteristics of degradability for nylon bags after 0, 4, 8, 16, 24, 48, 72 and 96 h incubation and effective degradability of dry matter (ED)

<table>
<thead>
<tr>
<th>Incubation time (h)</th>
<th>exponential equation</th>
<th>Effective degradability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>a+b+c</td>
<td>K=2%  K=5%  K=8%</td>
</tr>
<tr>
<td>Z. carpinifolia</td>
<td>18.9b 23.5c 29.6c 33.6c 37.6c 39.6c 40.7c 19.1b 20.5c 39.5c 0.08a 35.2c 31.3c 28.9c</td>
<td></td>
</tr>
<tr>
<td>G. caspica</td>
<td>34.2a 47.6a 63.4a 74.3a 78.2a 80.3a 80.8a 33.1a 47.8a 80.9a 0.12a 70.9a 66.5a 61.4a</td>
<td></td>
</tr>
<tr>
<td>P. deltoids</td>
<td>33.3a 39.6b 42.8b 54.9b 60.8b 68.3b 69.5b 70.1b 32.2a 38.5b 70.8b 0.05a 60.2b 52.1b 47.5b</td>
<td></td>
</tr>
<tr>
<td>Q. castanaefolia</td>
<td>19.4b 23.6c 26.8c 28.9d 31.3d 32.7d 36.1d 36.9d 20.4b 15.7d 36.1d 0.05a 31.6d 28.2d 26.4d</td>
<td></td>
</tr>
</tbody>
</table>

SEM 0.53 0.49 0.68 0.81 0.39 0.41 0.23 0.33 0.44 0.51 0.16 0.01 0.31 0.37 0.38

a (soluble substances in time 0), b (Fermentable substances) and c (Fixed rate of degradability of part b in time t),

Different letters in each column show significant differences. *, **: significant respectively in levels of 1% and 5%. Passing rate in speeds of K = 2%, K = 5%, K = 8% is respectively for conditions of treatment, fattening and lactation.

Fig. 1: dry matter degradability of four species over incubation time in “in situ”

Fig. 2: effective degradability of dry matter of the tree species

Results of degradability of dry matter in nylon bags showed that the process of degradability has been an up trend over time of incubation and species have statistically significant differences (p<0.05). Also, G. caspica has the most and Q. castanaefolia has the least degradability of dry matter (Table 2 and Fig. 2). Results of dry matter degradability coefficients showed that G. caspica has the most soluble and free substances and Q. castanaefolia has the least of it (Table 2). Effective Degradability of dry matter (ED) of four species has significant differences in conditions of treatment, fattening and lactation (p<0.5) (Table 2, Fig. 3).

Results of protein degradation in nylon-bag showed that process of degradation has been an up trend over time of incubation and species have statistically significant differences (p<0.05). Also, G. caspica has the most protein degradability and Q. castanaefolia has the least protein degradability (Table 3, Fig. 3). Results of protein degradability coefficients showed that amount of soluble substances and fermentable material among considered species is significant statistical differences (p<0.05) (Table 3). Effective Degradation of protein (ED) in four species in conditions of treatment, fattening and lactation has significant differences (p<0.05) (Table 3, Fig. 4).

DISCUSSION AND CONCLUSION

Conclusions showed that the most amount of protein belongs to G. caspica (15.4%) and the least amount of it belongs to Q. castanaefolia (9.5%). Amount of protein in P. deltoids is 10.3% and in Z. carpinifolia is 11%. It considers that high protein in G. caspica in compare with other species is due to higher weight of leaves to stems in considered species as leaves occupy a greater part of the plant’s weight. This species has compound leaves which own greater part of it. However, in Z. carpinifolia sp.
Table 3: Average of protein degradability of species over incubation time 96 h of in situ technique (percentage of dry matter), characteristics of protein degradability for nylon bags after 0, 4, 8, 16, 24, 48, 72 and 96 h incubation and effective degradability of protein (ED)

<table>
<thead>
<tr>
<th>Incubation time (h)</th>
<th>a</th>
<th>b</th>
<th>a+b</th>
<th>c</th>
<th>K=2%</th>
<th>K=5%</th>
<th>K=8%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z. carpinifolia</td>
<td>9.4b</td>
<td>24.5b</td>
<td>32.3b</td>
<td>36.4b</td>
<td>38.1c</td>
<td>42.7c</td>
<td>43.1c</td>
</tr>
<tr>
<td>G. caspica</td>
<td>32.3a</td>
<td>45.8a</td>
<td>64.1a</td>
<td>83.1a</td>
<td>85.7a</td>
<td>88.5a</td>
<td>91.2a</td>
</tr>
<tr>
<td>P. deltoids</td>
<td>1.6d</td>
<td>15.3c</td>
<td>22.9c</td>
<td>50.1b</td>
<td>55.8b</td>
<td>59.5b</td>
<td>64.6b</td>
</tr>
<tr>
<td>Q. castanaefolia</td>
<td>6.4c</td>
<td>12.1c</td>
<td>16.9d</td>
<td>25.1d</td>
<td>35.2d</td>
<td>37.1d</td>
<td>38.4d</td>
</tr>
<tr>
<td>SEM</td>
<td>0.22</td>
<td>0.85</td>
<td>0.96</td>
<td>0.92</td>
<td>0.51</td>
<td>0.6</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Different letters in each column show significant differences. *, **: ss significant respectively in levels of 1% and 5%. Passing rate in speeds of K = 2%, K = 5%, K = 8% is respectively for conditions of treatment, fattening and lactation.

P. deltoid has 24.7% ADF and 33.4% NDF. Conclusions obtained about P. deltoid are consistent with conclusions obtained by Kelagry et al. (2008) and Szekai et al. (1998) who reported that crude protein in P. deltoid is 7.9% to 13.5% and its crude fiber is 15.2 to 19.8%. But Ayers et al. (1996), reported that amounts of crude protein, NDF and ADF in leaves of P. deltoid are respectively 14.8%, 42.1 and 29.3%. Ben salem et al. (2003), Tabatabaei et al. (1992), Singh and Doel (1985) and Matinzaeh et al. (2006), reported that nutritional value of P. deltoid’s fruit and twigs are relatively good which is consistent with conclusions of this research. However, indexes of ADF and NDF show extent of cellulose and lignin and these structural carbohydrates are mostly observed in plant cells (Arzani, 2009). Regarding obtain results, G. caspica’s twigs have higher nutritional values than P. deltoid, Z. carpinifolia and Q. castanaefolia respectively. Results of the present study show that G. caspica (15.4%) provides 80% and three other species provide 70% of crude protein of Alfalfa for livestock. Also, According to the results amount of ADF in Z. carpinifolia, Q. castanaefolia, P. deltoids and G. caspica are respectively, 32, 31.7, 24 and 18.6%. As it could be observed, Z. carpinifolia and Q. castanaefolia have almost equal ADF and ADF in G. caspica is half of ADF in Alfalfa which shows higher quality and digestibility of G. caspica to Alfalfa. These results show that, generally, considered species could be up to 70% replaced (G. caspica and a part of three other species) for ration and provide some parts of it. Gautier et al. (2005), also, stated that numbers of livestock could be increased or considerable parts of shortage in forage could be compensated through tree and shrub’s twigs in north of Cameroon. Of course, it should be considered that probably problems caused by G. caspica’s seeds overusing such as emphysema and diarrhea are not caused by using its twigs. Rip pods of G. caspica fall down and absorb rainwater. When these watery pods included seeds are eaten by livestock, they find a proper condition for growth in rumen. Therefore, they, gradually, begin to sprout in animal’s stomach and as they secrete toxin while sprouting and growing, they are not digestible but they become like a ball and they could not be

leaves are smaller and rougher and weight of leaves is less than stems. Also there is higher weight of stem to leaves in Q. castanaefolia and P. deltoids (Sabeti, 2003). Conclusions showed that there is an inverse relation between amounts of structural hydrocarbons and protein in considered species so that Q. castanaefoli has the most amount (ADF = 31.7% and NDF = 43.4%) and G. caspica has the least amount (ADF = 18.6% and NDF = 27.4%). Also, Z. carpinifolia has 32.7% ADF and 36.4% NDF and
excreted. Therefore, stomach’s mechanical movement could not be performed and serious disorders cause in livestock’s digestive system. It has been observed that in some advanced issues, all attempts by the animal to excrete this balls of seeds is useless and finally it removes after 2 to 3 months with lots of suffering (Khalatbari et al., 1997), while this problem has not observed when animals feed by twigs and it is another positive factor of using tree twigs which should be considered.

Results of twigs degradation in four species showed that degradation is on an uptrend over time of incubation and it follows a similar process at all the times. Average of dry matter disappearance on study species could be seen in Table 1-3 Existing differences in disappearance of dry matter of all tree species in times 0, 4, 8, 16, 24, 48, 72 and 96 h are statistically significant. Something which should be considered in this part of results is that in both species degradation is always on an uptrend and its slope is more in the first h before 24 h incubation but after this time, this process slows down in species. So that degradation in G. caspica in the first 24 h goes to 78% and it reaches 80% from 24 to 96 h. In Z. carpinifolia degradation goes to 35% in the first 24 h and it increases to 40% from 24 to 96 h. In P. deltoids it goes to 60% in the first 24 h and it reaches 70% from 24 to 96 h and in Q. castanaefolia degradation goes to 31% in the first 24 h and it becomes 36% from 24 to 96 h. As the most part of degradation is related to protein and decrease in degradation is related ADF and Cellulose structure, therefore, results of chemical part completely represent these conditions in nylon bag. Regarding that protein in G. caspica, Q. castanaefolia, P. deltoids and Z. carpinifolia is 15.4, 9.5, 10.3 and 11%, respectively and as ADF and NDF in cellules part are respectively 18.6 and 27.4% in G. caspica, 31.7 and 43.4% in Q. castanaefolia, 24.7 and 33.4% in P. deltoids and 32.7 and 36.4% in Z. carpinifolia, therefore, degradation of G. caspica is more than degradation of P. deltoids and it is more in P. deltoids than Z. carpinifolia and degradation in Z. carpinifolia is more than degradation in Q. castanaefolia. These results are consistent with results obtained by Ben salem et al. (2003) who reported that leaves of Q. castanaefolia have low digestibility and high Lignin and Tannin.

Mansouri et al. (2003) reported that degradation of dry matter in alfalfa through in situ technique was 55.9% during 96 h incubation. According to results of the present research, degradation of G. caspica (80.8%) and P. deltoids (70%) is more than alfalfa and degradation in Z. carpinifolia (40.7%) and Q. castanaefolia is less than alfalfa at the time of 96 h. Taghizadeh and Farhoomand (2007) reported that degradation of dry matter and crude protein in alfalfa through in situ technique is 64% and it is 63.3% after 96 h incubation which follows again the above process. Considering that cell wall of plant species is firstly fed, therefore, degradability of cell wall has an effective role in degradation of contents and other nutritional materials because high concentration of cell wall prevent cell wall to be break down and decreases microbial penetration.

Degradability of protein shows that protein degradation is on an uptrend process and it increase while time of incubation increase in all 4 species. This phenomenon is justified due to changing microorganism population in rumen after feeding and effect of the food (Najaf, 2006). Protein degradation also has steeper slope at the first hours (16 to 24 h) so that in Z. carpinifolia, G. caspica and Q. castanaefolia the process has a steeper slope and after 16 h it slows down but in P. deltoids this process moves steadily and it has uniform slope at all h. In G. caspica, degradability reaches to 83% at the first 16 h and it increase to 91% from 16 to 96 h. In Z. carpinifolia degradation goes to 36% in the first 16 h and it increases to 44% from 16 to 96 h. In P. deltoids it goes to 50.1% in the first 24 h and it reaches 64% from 24 to 96 h. Also, in Q. castanaefolia degradation reaches to 25.1% in the first 24 h and it becomes 38% from 24 to 96 h.

Considering that the most protein is degraded at the first hours, this process has steep slope and amount of protein decreases along passing time and EDF and cellulose structure increase which this issue decreases speed and slope of protein degradation. This process is obviously justified due to amount of protein in G. caspica (15.4%), Q. castanaefolia (9.5), P. deltoids (10.3%) and Z. carpinifolia (11%). Mansouri et al. (2003) reported that protein degradability in crude alfalfa through in situ technique and after 96 hours incubation are respectively 71 and 87%. According to the present research, protein degradability in G. caspica is more than alfalfa and degradability of the three other species is less than alfalfa. Less ADF and more protein in G. caspica cause such a condition. Some of researchers believe that even an edible material is rich in protein, its digestibility is better. But some others believe that a balanced rate between proteins and nitrogen-free materials is a better condition (Jameei, 1997). Regarding to effective degradation, the results is consistent with digestion experiments so that effective degradation in conditions of treatment, fattening and lactation has its most amount in G. caspica and its least amount in Q. castanaefolia. Regarding to the speed change of passing materials, if materials stop less in rumen and their passing speed is higher, degradation will be less. So that in passing speed of 8, 5 and 2% degradation for the study species are respectively as follow: Z. carpinifolia (28.9, 31.3 and 35.2), G. caspica (61.4, 66.5 and 73.9), P. deltoids (26.9, 28.3 and 31.2) and Q. castanaefolia (47.4, 52.5 and 60.9). Regarding cell structure and more combination of cellulose and lignin in Q. castanaefolia and Z. carpinifolia in compare with P.
Petit and Mallet (2001) and Gautier (2007) effective and it should be considered in food planning. This event providing 70% of nutrients of alfalfa is cost-effective and it should be considered in food planning. Of course it should be mentioned that, as this food resources would be free, effective degradability of dry matter and protein degradability were high and the slope became more balanced when time passed. As it could be observed, degradability of protein and dry matter is depended on the time duration when the sample remains in rumen and even passing speed is more, effective degradability will decrease due to less effectiveness and compatibility of rumen’s microorganism (Gosselink et al., 2004). Finally it could be stated that among the study species, G. caspica has the possibility to be replaced by alfalfa and the other three species could provide at least 70% of nutrients of alfalfa. Of course it should be mentioned that, as this food resources would be free, event providing 70% of nutrients of alfalfa is cost-effective and it should be considered in food planning. Petit and Mallet (2001) and Gautier et al. (2005) stated that by using tree and shrub twigs it would be possible to increase livestock or compensate a considerable shortage of forage resources so that they should be in priority of cultivation.

REFERENCES


