The Evaluation of Chemical Composition and Dry Matter Degradability of Prosopis farcta Fruit using in situ Nylon Bag Technique

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ABSTRACT: The evaluation of foodstuffs provides the animal nutritionists with necessary information to adjust the diet from a physiological and economic point of view, so that the animal performance be desirable. Nowadays, there are various methods for evaluating ruminant feed intake. One of the most important methods is in situ nylon bag technique. Prosopis farcta is one of plants which is used as forage for livestock feed in Sistan-Baluchistan province. The objective of the present study was to evaluate the nutritive value of Prosopis farcta fruit using in situ nylon bag technique. In the present experiment, the dry matter degradability (DMD), organic matter degradability (OMD), crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF) of the Prosopis farcta fruit were measured using in situ nylon bag technique on two native Sistani rumen fistulated male cattle dry matter degradability was measured using at incubation times of 0, 6, 12, 24, 48, 72 and 96 h. The results showed that the crude protein, organic matter, crude fat, NDF and ADF was 9.97, 94.29, 1.84, 40.37 and 34.37 percent, respectively. The dry matter degradability (DMD), fast degradation (a), digestible particles over the time (b), potential degradability (a + b) and effective degradability (ED) were measured at 57.05, 18.62, 38.63, 57.26 and 38.85 percent, respectively at incubation time of 96 h. The results showed that Prosopis farcta fruit has a desirable nutritive value and can be considered as a part of the forage needs in ruminant nutrition.

Keywords: Prosopis farcta, Chemical Composition, Dry matter Degradability

INTRODUCTION

The forages indirectly enter the food chain to humans. The proper use of these food resources reduces the protein and energy costs per livestock product unit. To reach this goal, determination of nutritive value and different parameters including dry matter degradability and cell wall composition in the rumen is very important. The nutritive value of foodstuffs is usually expressed based on chemical composition, digestibility and nutrient consumption rate (NRC., 1981). The energy value of the forage is the most important factor in predicting animal performance and forage quality evaluation systems. Previous studies used applied equations based on neutral detergent fiber (NDF) to predict the energy value of forages (Mertens., 1993). Nowadays, some other equations have been suggested to predict the energy value of forages based on the amount and digestion rate of crude protein (CP), NDF, fat and unstructural carbohydrates (Weiss., 1993).

Several factors including climate, plant species, growth stage and soil condition affect the nutritive value of the crops and forage (AOAC., 1990). Therefore, it is necessary to determine the nutritive value of forages in each region to use these foodstuffs effectively. The determination of the degradability of dry matter (DMD), organic matter and cell wall components is very important to effective use of foodstuffs (NRC., 1981). Moreover, due to the effect of the cell wall content on rumen fullness and the amount of consumed feed in different models (Madsen et al., 1994 & Madsen et al., 1994), the NDF degradability parameters have been used to determine the feed consumption capacity of the animal. Therefore, it is necessary to determine the degradability of the NDF compounds of pasture forages. The objective of the present study is to determine the
chemical composition and dry matter degradability (DMD) of the cell wall of Prosopis farcta fruit in native Sistani male cattle using in situ nylon bag technique.

MATERIALS AND METHODS

This study was carried out to investigate the chemical composition and degradability of dry matter of (Prosopis farcta). After collecting the plant samples, the samples were dried, milled and sieved using a sieve with a pore diameter of 2.5 mm. After that, the chemical composition was measured. The crude fat, crude protein and ash were measured using AOAC method (AOAC., 1990). The Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were measured using Van Soest method (Van Soest et al., 1991).

To measure the dry matter degradability (DMD) of the plant samples using in situ nylon bag technique, the experiments were carried out on two rumen fistulaed Sistani male cattle in the Sistan Dam farm of the Faculty of Agriculture. 5 g of dry pasture forage (particle size: 3 mm) was incubated in the rumen of cattle for 3, 6, 12, 24, 48, 72 and 96 h with four replicates (4 bags) for each time. The bags were 12×6.5cm polyester bags with a pore diameter of 45 μm according to the standard recommended by Hopeland and Weisberg (2000). After incubation, the bags containing samples were removed from the rumen. The samples were washed with cold water for 30 min and then dried in an oven in 65°C for 48 h. The bags were weighed and the amount of dry matter and organic matter in the samples were determined according to AOAC method (AOAC., 1990).

Similarly, the bags were washed and dried. Thus, the disappearance (degradability) of the dry matter can be determined using in situ method during incubation period. In this technique, the disappearance of the material is measured. It is assumed that the disappearance of the sample is equal to degradability. The various parameters including dry matter degradability and the effective degradability were calculated using the nonlinear relationship of Ørskov and McDonald (1979):

$$P = a + b \left(1 - e^{-ct}\right)$$

where:

- P: the degradability at time t (%)
- a: rapid degradation
- b: slow degradation
- (a + b): potential degradability
- c: degradation rate
- t: degradation time
- e: Naperian number (2.718)

The effective rumen degradability of the forage compounds is calculated as follows:

$$ED = \frac{a + \left(b \times c\right)}{c + k}$$

where:

- ED: effective rumen degradability
- a: rapid degradation
- b: slow degradation
- c: passage rate constant
- k: rumen material flow rate

The residence time of the foodstuff in the rumen was estimated based on levels of feed intake by the cattle. The residence time for the three levels of maintenance, twice and more than twice is equal to 0.02, 0.05 and 0.08, respectively. The degradability coefficients of a, b, c. and the standard deviations were calculated using Neway software. The results were analyzed using SAS software (SAS., 2003). Graphs were plotted using Microsoft Excel.

RESULTS

Table 1 shows the chemical composition of Prosopis farcta fruit. Table 2 represents the results of the analysis of in situ dry matter degradability at incubation times of 3, 6, 12, 24, 48, 72 and 96 h. The dry matter disappearance from the bags incubated in the rumen increased with increasing the incubation time. The degradability parameters have been shown in Table 3. The fast degradability (a), the insoluble but potentially degradable (b), the degradability rate (c) (which represents the degradation rate of b (hr.%) is equal to 18.62%, 38.63% and 0.055%, respectively. The degradation rate of a + b (potential degradability) is equal to 57.26. The average effective degradability of dry matter per hour for a passage rate of 0.02, 0.05 and 0.08 was equal to 46.92, 38.85 and 34.38, respectively (Figure 1).
The objective of the present study is to determine the nutritive value, chemical composition and digestibility of the Prosopis farcta fruit. Given the results of chemical composition, the protein content of this plant species in fruiting stage was 9.97%. Typically, the crude protein level of 7.5% is considered as the suitable qualitative threshold of forages, since this range has been suggested for goats maintenance (NRC, 1981). Batroret (1985) also mentioned a minimum required crude protein of 7% to maintain the digestion status of the ruminant. The results of the nylon bag technique show a significant correlation between chemical composition (CP, ADF and NDF), so that increasing the protein content and reduction of ADF and NDF led to the best degradability of the plants. In this case, the results showed that the NDF (40.37%) and ADF (34.37%) content were high. This reduced the degradability of dry matter in various stages of incubation.

Another reason for the reduced digestibility of Prosopis farcta fruit is likely the presence of secondary plant materials including high levels of lignin, tannin and saponin. The low content of tannin may be beneficial for the ruminants because of reducing protein degradation during rumen microbial digestion process. This amount of protein is degraded in the organs after the rumen (Bary, 1989). Ramirez (2009) showed that the effective degradability of dry matter in all plant species was in range of 0.33 to 0.62. It seems that the increase in crude protein of the plant has a positive impact on dry matter disappearance in the rumen, because the effective degradability of dry matter increased by increasing the protein content of plant species. Furthermore, the increase of lignin in plant species reduced the effective degradability of dry matter. Riasi et al (2008) attributed the reduced dry matter degradability of the foodstuffs to factors such as low ash and high NDF content. Tekasy et al (2007) showed that the in vitro dry matter digestibility of haloxylon is less than alfalfa (41.93 vs. 59.4) because of higher NDF and ADF in haloxylon samples. NDF and ADF along with lignin show more resistance against the activity of fiber degrading microorganisms in the rumen. The mean degradability of alfalfa and haloxylon after 96 h of incubation was 47.5 and 41.7%, respectively. The mean coefficient of dry matter degradability of haloxylon in all samples after 96 h of incubation in the rumen was 44.93 ± 4.66. This was due to the high lignin content in haloxylon and reduced degradable matter. Larbi et al (1998) showed that the estimated parameters in the nylon bag technique (c, b and ED), except a, significantly correlated with the NDF. Previous studies indicated that NDF and lignin have negative impacts on the digestibility of forages. Therefore, it is recommended to measure the lignin, tannin and saponin content of the Prosopis farcta fruit. Given the special climatic conditions, low rainfall and saline soils in Sistan region, and the lack of forage to meet the nutritional requirements of livestock, if further studies are carried out on Prosopis farcta, the use of fruit and bush of this plant could be recommended as part of the livestock foodstuffs.

**CONCLUSION**

The data obtained in this study can be used to formulate the diets of livestock feed in the pastures and realization of the diet-formulation to balance the cattle in the pasture to keep the pastures. The degradability parameters should be considered for adjusting the diet of ruminants.
Table 1. Chemical composition of *Prosopis farcta*

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Amount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>97.45</td>
</tr>
<tr>
<td>Ash</td>
<td>3.15</td>
</tr>
<tr>
<td>Crude protein</td>
<td>9.97</td>
</tr>
<tr>
<td>Neutral detergent fiber</td>
<td>40.37</td>
</tr>
<tr>
<td>Acid detergent fiber</td>
<td>34.37</td>
</tr>
<tr>
<td>Crude fat</td>
<td>1.83</td>
</tr>
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</table>

Table 2. The Percent of degradability in Different Incubation time

<table>
<thead>
<tr>
<th>Incubation time (h)</th>
<th>Prosopis farcta</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>24.51</td>
</tr>
<tr>
<td>6</td>
<td>29.5</td>
</tr>
<tr>
<td>12</td>
<td>37.3</td>
</tr>
<tr>
<td>24</td>
<td>46.92</td>
</tr>
<tr>
<td>48</td>
<td>54.47</td>
</tr>
<tr>
<td>72</td>
<td>56.49</td>
</tr>
<tr>
<td>96</td>
<td>57.05</td>
</tr>
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</table>

Table 3. NDF degradability Dry Matter

<table>
<thead>
<tr>
<th>NDF degradability</th>
<th>Prosopis farcta</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18.62</td>
</tr>
<tr>
<td>B</td>
<td>38.63</td>
</tr>
<tr>
<td>a+b</td>
<td>57.26</td>
</tr>
<tr>
<td>C</td>
<td>0.055</td>
</tr>
<tr>
<td>0.02</td>
<td>46.92</td>
</tr>
<tr>
<td>0.05</td>
<td>38.85</td>
</tr>
<tr>
<td>0.08</td>
<td>34.38</td>
</tr>
</tbody>
</table>

REFERENCES


