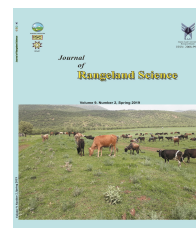


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### Research and Full Length Article:

## Forage Quality of *Salsola yazdiana* and *S. tomentosa* in Different Growth Stages in Saline Desert of Yazd Province, Iran

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**Abstract.** Information on forage quality could help rangeland managers to select suitable grazing method to achieve higher animal performance without damage to vegetation. The aim of this study was to determine and compare the forage quality of *S. yazdiana* and *S. tomentosa*, which are the most important species of saline rangelands in Ardakan in Yazd province, Iran. These two species are grazed by goats and camels. The edible biomass of both species was sampled in three phenological stages during 2015-2016. Forage quality indices such as Crude Protein (CP), Dry Matter Digestibility (DMD), Metabolizable Energy (ME), Acid Detergent Fiber (ADF), Crude Fiber (CF), and Water Soluble Carbohydrate (WSC) were measured using Near Infrared Spectroscopy (NIRS). Data were analyzed using a factorial experiment in a completely randomized design. Means comparison was conducted using Duncan's Multiple Range test. According to the results, phenological stages showed significant differences for DMD, CP, WSC, ASH, ADF ( $P < 0.01$ ) CF and ME ( $P < 0.05$ ). Moreover, results showed significant differences between species for DMD, WSC, ASH, ADF ( $P < 0.01$ ) and CP ( $P < 0.05$ ). However, interactions (species  $\times$  stage) showed significant differences only for DMD and ASH ( $P < 0.05$ ). In both species, forage quality based on positive indicators such as DMD (72.83, 63.91), CP (11.18, 10.12), and ME (7.7, 7.44) for both *S. yazdiana* and *S. tomentosa* had the highest values at the vegetative stage. By the progress of growth stages in both species, these indices were decreased. In comparison, *S. tomentosa* had higher forage quality than that of *S. yazdiana*. Although the grazing season for goat and camel in these rangelands is in fall and winter, the suitable time for grazing by these livestock is the late winter and early spring at the vegetative stage. Thus, by considering the grazing time of goat and camel from these species, supplementary feeding is required.

**Key words:** Animal nutrition, Forage quality, Halophytes, Saline rangelands, Chah-Afzal, NIRS

## Introduction

Saline and alkaline soils cover 204800 km<sup>2</sup> of Iran's area (Aghakhani and Ghorbanli, 1993). Regarding the extension of saline and alkaline soils and the importance of halophytes from the various aspects such as medicinal, industrial and forage, identifying and evaluation the changes of their nutritional value at different growth stages in different habitats can be helpful in planning livestock feed supply in the current critical circumstances. Halophytes and other salt-resistant plants can provide suitable and reasonable alternatives for forage supply in developing countries (Squires and Ayoub, 1994). These plants grow naturally or are planted in lands affected by salinity such as saline semi-arid areas, mangrove wetlands, swamps, degraded soils and coasts, and have the advantage to tolerate high levels of salinity in saline lands (Zahran, 1993). Many of plants growing in saline soils can produce high to moderate usable biomass (Zahran, 1986; Le Hou  rou, 1994; El-Shaer *et al.*, 2005). Therefore, vegetative production of halophytes and other salt tolerant species can be considered a significant potential especially as a source of livestock feed (Anon, 2009). Halophytes and salt tolerant plants could be a suitable livestock feed source in arid and semi-arid areas, through encouraging farmers to grow and produce plants resistant to salinity in the margins of saline lands (Le Hou  rou, 1993; Glenn *et al.*, 1999; El Shaer *et al.*, 2005).

Forage quality is one of the factors determining the nutritional requirements of livestock and subsequently the grazing capacity of rangelands. It also needs to be evaluated in line with introducing the halophytes as livestock forage regarding the vast distribution of saline lands and halophytes species in Iran. Halophytes are traditionally the forage of some livestock such as camel and goat in these regions (Ahmadi Beni *et al.*, 2014;

Kashki *et al.*, 2016). There are about 163 halophytes and salt tolerant species in Iran, of which 53% belong to Chenopodiaceae family (Jafari, 1994). These species play an important role as feed resources for livestock in saline marginal rangelands of central Iran such as Yazd province. Saline areas and marginal rangeland, covered with halophyte shrubs, have a great role in supplying forage for livestock as winter rangelands (Ahmadi *et al.*, 2015). Information on forage quality of halophytes in each phenological stage could help rangeland managers to select suitable plant species for rangeland restoration, and to determine suitable grazing time to achieve higher animal performance in these rangelands (Zandi Esfahan *et al.*, 2010; Ahmadi Beni *et al.*, 2014). Generally, halophytes with relatively high biomass production in saline rangelands are able to provide food supply or nutritional supplement, which helps to increase the productivity of livestock under arid and semiarid conditions (Kashki *et al.*, 2016). Moreover, knowledge on the nutritional value of plant species helps rangeland managers to balance between available food and livestock requirement to maximize livestock performance. Supplying livestock requirement is necessary in terms of energy, protein, minerals and vitamins and it is possible when forage quality is studied in terms of chemical and physical compounds (Arzani, 2009; Mirzaei Aghjeh Qeshlagh *et al.*, 2015). Halophyte species considerably vary in their nutritive value (Zandi Esfahan *et al.*, 2010). Forage quality differs depending on the species nutritional value and proportion of these factors (Arzani, 2009; Azizpour *et al.*, 2013; Ahmadi Beni *et al.*, 2014; Arzani *et al.*, 2015). CP, DMD and metabolizable energy (ME) are the most important factors of forage quality (Arzani, 2009). Plant nutritive value is affected by climatic and soil factors

(Vansoest *et al.*, 1991; Arzani *et al.*, 2004; Rasouli and Amiri, 2015). Moreover, phenological stages are also important factors in determining forage quality for grazing livestock (Arzani, 2009; Azizpour *et al.*, 2013; Kashki *et al.*, 2016). Near Infrared Reflectance Spectroscopy (NIRS) has been reported as a method for evaluating chemical composition of agriculture products, foods, and forages by several authors (Aiken *et al.*, 2005; Reeves, 2012; Arzani *et al.*, 2015; Jafari *et al.*, 2003). Contrary to most conventional analytical methods, NIRS is rapid and nondestructive and it does not use chemicals or generate chemical wastes requiring disposal while it is multi-parametric; it means that several parameters can be determined simultaneously in the same measurement process (Eldin, 2011). The advantages of NIRS over conventional assessments include the accurate and cost-effective analysis, non-destructive sampling, minimal amount of samples required for testing and an increase in number of samples analyzed per unit of time (Givens and Deaville, 1999; Deaville and Flinn, 2000; Andrés *et al.*, 2005; Arzani *et al.*, 2015). Several studies have evaluated NIRS to determine forage nutrients content such as N, CP, and ADF (Fassio *et al.*, 2009; Ward *et al.*, 2011; Arzani *et al.*, 2012; Arzani *et al.*, 2015). According to the little information about the nutritional value of halophytic species in central Iran (Kashki *et al.*, 2016), these plants are supplying forage of livestock (goat and camel) in this region. Moreover, according to the advantages of NIRS method to traditional chemical assessments of forage, this study was conducted to determine the forage quality of two native halophyte species of *Salsola yazdiana* and *S. tomentosa* from the center of Iran, Yazd province in different growth stages using NIRS.

## Materials and Methods

### Location of the study area and selected species

Plant species were collected from Chah Afzal, Ardakan desert as a saline habitat in Yazd province (53°10'34" to 54°15'34" E and 32°10'32" to 32°28'20" N) with about 70000 ha area (Baghestani, 2010). Elevation of the sampling area ranges from 850 to 1400 m a.s.l. The long-term annual average rainfall and temperature are 50 mm and 19°C, respectively. Climate is temperate extra dry with cold winter according to Domarten classification. Geology mainly consists of low level piedmont fan and valley terraces deposited and partly thick dolomite and limestone units, partly cherty with thick shale intercalations. Soil is saline and alkaline with sandy-clay-loamy and sandy-loamy texture. The sampling site is characterized by flat topography and halophytes and salt tolerant botanical composition. Four vegetation types including: 1) *Salsola yazdiana*-*Anabasis aphylla*, 2) *S. yazdiana*-*Artemisia sieberi*, 3) *S. yazdiana*-*Seidlitzia rosmarinus*, and 4) *Artemisia sieberi*-*S. tomentosa* are distributed on the study area (Baghestani, 2010). Thus, as the dominance of two halophyte species of *Salsola yazdiana* and *S. tomentosa* on 70000 ha in Chah Afzal, Ardakan desert in Yazd province, they were selected to study the forage quality traits. The other criteria for the selection of these species were the production, and their ability to tolerate a wide range of environmental conditions, particularly salinity according to the harsh environmental condition of the study area. These plants according to folk science are to be used by camel and goat in autumn and winter (about five months). The combinations of goats and camels are 85 and 15%, respectively.

The selected species both belong to Chenopodiaceae family with shrub life form. *Salsola yazdiana* Assadi is with 30 to 70 cm and rarely to 100 cm height

from the base with multiple branches. This species is endemic to Iran and distributed in Yazd, Kerman, Khorasan and Semnan provinces (Mozaffarian *et al.*, 2000; Assadi, 2001). *Salsola tomentosa* (Moq.) Spach. is with 10 to 25 cm in height from the base with multiple branches, which stem thickness is up to 15 mm and rule branched with standing wooden branches. This species is distributed in Caucasian, central Asia and Afghanistan, and in Iran, it is distributed in north, western north, western and central provinces such as Yazd (in counties such as Ardakan, Khranq, Meybod and Nadooshan) (Mozaffarian *et al.*, 2000; Assadi, 2001). These two species have the same phenological stage. Based on the field studies, the vegetative growth of these species starts from March and the flowering stage starts from August and continues to late September. At the same time, seeding stage starts at the end of September and lasted until late November when ripe seeds fall.

### Sampling and measuring forage quality

Two selected species were collected (harvested) at three phenological stages (vegetative, flowering and seed ripening stages) in 2015. Sampling was conducted in the key area of each vegetation type and for each sample, 10 bunches of each species were randomly harvested and collected for three stages. The samples were air dried for two to three weeks, and then placed in an oven for 24 hours at 70°C. Afterward, samples were powdered using an electric mill and passed through

a 1 mm sieve. Five quality traits (CP, CF, ADF, DMD and WSC) were measured using near infrared spectroscopy (NIR) INFRAMATIC8620 model (Jafari *et al.*, 2003), which is an advanced technique for forage quality assessment (Arzani *et al.*, 2015). In addition, ME was calculated by the following equation (AOAC, 1990):

$$ME = (0.17 \times DMD - 2) \quad (1)$$

### Data analyses

Data were analyzed in a factorial experiment based on a completely randomized design with three replications using SAS9.1 software to study the effects and interactions between species and phenological stages. Means comparison was performed by Duncan's multiple range test.

### Results

#### Analysis of variance of forage quality

Analysis of variance results for the factors affecting the forage quality of two selected halophyte species are presented in Table 1. Results showed that phenological stages had significant differences for DMD, CP, WSC, ASH, ADF ( $P < 0.01$ ) and CF and ME ( $P < 0.05$ ). Moreover, results showed significant differences between species for DMD, WSC, ASH, ADF ( $P < 0.01$ ) and CP ( $P < 0.05$ ). The species  $\times$  stage interactions effect was significant only for DMD and ASH ( $P < 0.05$ ) and no significant differences for other traits.

**Table 1.** Analysis of variance for forage quality indices values of *S. yazdiana* and *S. tomentosa*

Sources of variation	df	DMD (%)	CP (%)	CF (%)	WSC (%)	ASH (%)	ADF (%)	ME (Mj/kg)
Species	1	37.26**	9.04*	2.30 <sup>ns</sup>	113.23**	113.23**	10.28**	0.50 <sup>ns</sup>
Growth stage	2	50.17**	28.93**	5.62*	33.26**	100.81**	19.63**	3.06*
G. stage $\times$ Species	2	4.08*	0.06 <sup>ns</sup>	0.05 <sup>ns</sup>	2.57 <sup>ns</sup>	6.31*	1.15 <sup>ns</sup>	0.97 <sup>ns</sup>
CV		5.67	9.41	11.68	6.01	6.29	10.18	23.11

\*\* , \* : Significant at 1% and 5% probability level.

### Means comparison of species effects

Results for species comparison are presented in Table 2. Depending on the species and growth stages, there were significant differences between species for forage qualities ( $P < 0.01$ ). By considering Table 2, DMD, CP and WSC in *S. tomentosa* were higher as compared with *S. yazdiana*. Moreover, *S. tomentosa*

was also higher than the *S. yazdiana*. In contrast, the values of ASH, CF and ADF for *S. yazdiana* were higher than the *S. tomentosa*. Therefore, *S. tomentosa* had higher DMD, CP, WSC and ME and lower fiber content; thus, forage quality of this species is considerably higher than the *S. yazdiana*.

**Table 2.** Means comparison of forage quality traits between *S. yazdiana* and *S. tomentosa*

Species	DMD (%)	CP (%)	CF (%)	WSC (%)	ASH (%)	ADF (%)	ME (Mj/kg)
<i>S. yazdiana</i>	54.84 <sup>b</sup>	8.25 <sup>b</sup>	44.78 <sup>a</sup>	16.33 <sup>b</sup>	5.81 <sup>a</sup>	40.30 <sup>a</sup>	6.18 <sup>a</sup>
<i>S. tomentosa</i>	64.59 <sup>a</sup>	9.48 <sup>a</sup>	41.19 <sup>a</sup>	22.13 <sup>a</sup>	4.22 <sup>b</sup>	34.54 <sup>b</sup>	6.68 <sup>a</sup>

The values with different letters in the same column are significantly different ( $P < 0.01$ ).

### Means comparison of interaction (species × stage) effects

Results of means comparison of species × growth stage interaction effects performed by least squares method is presented in Table 3. According to the results depending on species and growth stage, there were significant differences among the forage quality traits ( $P < 0.01$ ). Accordingly, the highest value of DMD was recorded for *S. tomentosa* at vegetative growth stage (72.23%) and the lowest one was recorded for *S. yazdiana* at seeding stages (46.42%). In *S. yazdiana*, the highest and lowest values of CP were recorded as 10.12% and 6.29%, respectively at vegetative and seeding stages. In *S. tomentosa*, the highest and lowest values of CP were recorded as 11.18% and 7.67%, respectively at vegetative and seeding stages. The highest values of CF were recorded for *S. yazdiana* at seeding stage (48.91%) and the lowest one was for *S. tomentosa* at the vegetative stages (35.82%). Moreover, the highest value of

WSC was recorded for *S. tomentosa* at seeding stage (25.21%), and the lowest one was for *S. yazdiana* at flowering stages (17.34%). The highest values of ASH were recorded for *S. yazdiana* in the seeding stage (6.91%) while the lowest one is for *S. tomentosa* at vegetative stages (3.13%). The highest values of ADF were recorded for *S. yazdiana* (44.51%) and for *S. tomentosa* (42.33%) at vegetative growth stages while the lowest one was recorded for *S. tomentosa* (25.49%) at seeding stage. The highest values of ME were obtained for *S. tomentosa* as 7.70 Mj kg<sup>-1</sup> and for *S. yazdiana* as 7.44 mj kg<sup>-1</sup> at vegetative stages while the lowest value of ME was obtained for *S. yazdiana* as 5.20 mj kg<sup>-1</sup> at seeding stage. According to the obtained results, *S. tomentosa* with high levels of positive forage quality traits including DMD, CP and ME and lower values of negative forage quality traits such as CF showed a better forage quality in comparison with *S. yazdiana*.

**Table 3.** Means comparison of interaction effects of species and growth stage

Species	Growth stage	DMD (%)	CP (%)	CF (%)	WSC (%)	ASH (%)	ADF (%)	ME (Mj/kg)
<i>S. tomentosa</i>	Vegetative	72.23 <sup>a</sup>	11.18 <sup>a</sup>	35.82 <sup>c</sup>	19.89 <sup>bc</sup>	3.13 <sup>d</sup>	25.49 <sup>d</sup>	7.70 <sup>a</sup>
	Flowering	70.11 <sup>a</sup>	9.58 <sup>bc</sup>	43.43 <sup>abc</sup>	21.39 <sup>b</sup>	3.48 <sup>d</sup>	35.80 <sup>bc</sup>	6.56 <sup>a</sup>
	Seeding	51.44 <sup>cd</sup>	7.67 <sup>de</sup>	44.32 <sup>abc</sup>	25.21 <sup>a</sup>	6.07 <sup>b</sup>	42.33 <sup>ab</sup>	5.76 <sup>a</sup>
<i>S. yazdiana</i>	Vegetative	63.91 <sup>b</sup>	10.12 <sup>ab</sup>	39.10 <sup>bc</sup>	13.07 <sup>e</sup>	4.99 <sup>c</sup>	34.28 <sup>c</sup>	7.44 <sup>a</sup>
	Flowering	54.20 <sup>c</sup>	8.47 <sup>cd</sup>	46.33 <sup>ab</sup>	17.34 <sup>d</sup>	5.52 <sup>bc</sup>	42.11 <sup>ab</sup>	5.89 <sup>a</sup>
	Seeding	46.42 <sup>d</sup>	6.29 <sup>c</sup>	48.91 <sup>a</sup>	18.58 <sup>cd</sup>	6.91 <sup>a</sup>	44.51 <sup>a</sup>	5.20 <sup>a</sup>

The values with different letters in the same column are significantly different ( $P < 0.01$ ).

## Discussion

*S. tomentosa* and *S. yazdiana* are dominant species in Chah Afzal, Ardakan desert as a saline habitat in Yazd province, central Iran. This species provides an important part of forage requirements for livestock such as goats and camels. Thus, knowledge of forage quality of this species can assist range managers to determine forage requirement, stocking rates and grazing time to achieving maximum efficiency in this region. Results showed that forage quality of *S. tomentosa* and *S. yazdiana* declined as plants tended to mature that is in agreement with the studies carried out by (Arzani *et al.*, 2001); Ahmadi *et al.*, 2015) indicating that forage quality varied significantly according to the growth stage.

Most of the previous studies indicated that positive forage quality of species traits decreased with the advancement of phenological stages (from vegetative to seeding) (Arzani *et al.*, 2008; 2012; 2015; Ahmadi *et al.*, 2015). The results of our study showed that DMD of *S. tomentosa* and *S. yazdiana* in the vegetative stage was maximized and then decreased with a mild slope at flowering and seeding stages. (Arzani *et al.*, 2013a) also reported a direct relationship between forage quality and DMD as dry matter digestibility changes with the growth stage. Comment about the reason of these changes can be explained with phenological changes, the plant tissue becomes hard and fibrous, and DMD decreases until flowering and seeding stages. This result is in agreement with the report of (Arzani *et al.*, 2001; Sharifi Rad *et al.*, 2013; Ahmadi *et al.*, 2015).

The results of our study showed that CP for both species decreased by progressing growth stages. Seasonal changes of CP during different phenological stages were reported by (Arzani *et al.*, 2008). They found that when species became older, CP decreased. Although in the seed

maturation time we expect an increase in protein because of seed fall in both species, the CP decreased. This result is in agreement with the report of (Arzani *et al.*, 2008; Temel *et al.*, 2015). Thus, CP content was the highest one at active growth stage and then reduced with the emergence of dormancy. The CP content in flowering and maturity stages was higher than the minimum level of 7-8% DM required for optimum rumen function and feed intake in ruminant livestock (Van Soest, 1991). By considering our results, for *S. yazdiana*, the obtained results only for seeding stage was lower than 7%; thus, there is inefficiency in this regard. However, by distribution of *S. tomentosa* on the grazing areas by goat and camel, it seems that the requirement of ruminants will be covered, and there is no need to supplementary feeding by respect to CP. Overall, due to high content of CP in tissues of *S. tomentosa* and *S. yazdiana*, these plants are valuable source of CP for livestock feeding including goats and camels.

The cell solutions and the fiber content in two species showed an increasing trend until seeding stage. This showed that at vegetative stage, the content of lignin, cellulose and raw fibers are low but when plant gets elderly, CF and lignin content increase. This result is in agreement with those stated by (Arzani *et al.*, 2001; Arzani *et al.*, 2004).

The WSC content of two halophytes showed significant differences at phenological stages with an increasing trend. In addition, WSC in *S. tomentosa* is higher than the *S. yazdiana*. WSC percent increased with growth progression in both species in all locations as the highest WSC percent and the lowest one were measured in vegetative and seed ripening stages. In seed maturity stage, WSCs are converted to structural carbohydrates and as a result, both structural and nonstructural

carbohydrates are accumulated and increased.

Significant differences were found for ASH content between the study species at vegetative, flowering and seeding stages. In both species, the ASH content showed an increasing trend from vegetative to seeding stage in agreement with the findings of (Jafari *et al.*, 2008; Arzani *et al.*, 2013a). Halophytes regularly contain high levels of ASH and low energy. Thus, the value of halophytes is revealed when drought occurs in the rangelands and other food resources are scarce.

The results of ADF showed significant differences in phenological stages. Moreover, ADF showed an increasing trend during the development stages which is in accordance with (Heshmati *et al.*, 2006; Mahdavi and Saifi, 2016). Young plant cells have one external layer called a primary cell wall, but when they become mature, a secondary cell wall is also formed. Because of storage tissues in seeds, ADF content varied with seed maturity between phenological stages and species. (Arzani *et al.*, 2001) also reported that with the progress of plant growth, ratios of protector and firmness tissues which mostly consist of structural carbohydrates such as celluloses, hemicelluloses and lignin are increased. Therefore, maturity of plants and an increase in structural carbohydrates cause higher fiber amounts in forage in late growing season. High level of fiber content in some of the forage species could be explained partly by the environmental conditions prevailing in the studied area as low precipitations (compared with the native place of vetiver grass) tend to increase the cell wall fraction and to decrease the soluble contents of the plants. It is well accepted that forage degradation in the rumen is mainly affected by the cell wall content and its lignification as lignin is an indigestible fraction and acts as a barrier that limits the access of microbial

enzymes to the structural polysaccharides of the cell wall.

The change trend of ME is quite matching with DMD change trends. However, in these two species, ME at vegetative stage is upper than flowering and seeding stages. This result is in accordance with the findings of (Arzani *et al.*, 2004; Rasoli and Amiri, 2015; Azizpour *et al.*, 2013; Mahdavi and Saifi, 2016). These results clearly showed that these species in vegetative stage could provide the critical level of energy required by livestock. However, in *S. tomentosa*, the value of ME at vegetative stage is higher than the other stages and increased until flowering stage; then, it increased until seeding stage. The results of this study show that the value of ME of *S. tomentosa* and *S. yazdiana* in all the measured stages is lower than critical level (Arzani *et al.*, 2013b) of ME (8 MJ/Kg) for meeting daily needs of one animal unit in the maintenance mod.

To sum up, these two species provide livestock protein and ME, and are more suitable in the vegetative stage. In flowering stage and especially seeding stage, supplementary feeding is necessary for goats and camels. The grazing period of goats and camels is in the fall and winter; therefore, suitable time for gazing by these livestock is in the late winter and early spring at the vegetative stage. Thus, at present situation, grazing of goats and camels from *S. tomentosa* and *S. yazdiana* should be considered with complementary feeding.

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## کیفیت علوفه گونه‌های *Salsola tomentosa* و *Salsola yazdiana* در مراحل مختلف رشد در مراتع شور اردکان یزد

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**چکیده.** اطلاعات کیفیت علوفه در مراحل فنولوژی به مدیران مرتع کمک می‌کند تا روش چرای مناسب را برای رسیدن به حداکثر عملکرد دام بدون صدمه زدن به پوشش گیاهی انتخاب نمایند. هدف این مطالعه تعیین و مقایسه کیفیت علوفه دو گونه شورپسند *Salsola tomentosa* و *S. yazdiana* که از مهمترین گونه‌های مراتع شوره‌زار منطقه چاه افضل در شهرستان اردکان یزد می‌باشند، بوده است. این دو گونه توسط بز و شتر مورد چرا قرار می‌گیرند. زیست‌توده خوراکی هر دو گونه در سه مرحله رشد در سال‌های ۱۳۹۴ و ۱۳۹۵ نمونه‌برداری شد. شاخص‌های کیفیت علوفه مانند پروتئین خام (CP)، ماده خشک قابل هضم (DMD)، انرژی متابولیسمی (ME)، فیبرنامحلول در شوینده اسیدی (ADF)، فیبر خام (CF) و کربوهیدرات محلول در آب (WSC) با استفاده از روش NIR (طیف سنجی مادون قرمز نزدیک) اندازه‌گیری شد. داده‌ها با استفاده از آزمون فاکتوریل در قالب طرح کاملاً تصادفی تجزیه و تحلیل شد. مقایسه میانگین‌ها با استفاده از آزمون چند دامنه دانکن انجام شد. با توجه به نتایج، مراحل مختلف فنولوژیکی اختلاف معنی‌داری را برای DMD، CP، WSC، ASH، ADF و ME ( $P < 0.05$ ) نشان دادند. بعلاوه نتایج نشان داد اختلاف معنی‌داری از لحاظ DMD، WSC، ASH، ADF و ME ( $P < 0.01$ ) و CP ( $P < 0.05$ ) وجود دارد. اما اثر متقابل (گونه  $\times$  مرحله فنولوژی) تنها برای پارامترهای DMD و ASH اختلاف معنی‌داری را نشان داد. در هر دو گونه بر اساس شاخص‌های مثبت کیفیت علوفه مانند DMD (۷۲/۲۳ و ۶۳/۹۱)، CP (۱۱/۱۸ و ۱۰/۱۲) و ME (۷/۷ و ۷/۴۴) در مرحله رشد رویشی بالاترین مقدار را دارا بودند و با پیشرفت مراحل رشد گیاهان به تدریج کاهش یافت. در هر دو گونه با کامل شدن مراحل رویشی، این شاخص‌ها کاهش یافت. در مقایسه گونه *S. tomentosa* دارای کیفیت علوفه بهتری در مقایسه با گونه *S. yazdiana* می‌باشد. هر چند که فصل چرا برای بز و شتر در این مراتع در پاییز و زمستان می‌باشد، اما زمان مناسب چرا برای این دام‌ها اواخر فصل زمستان و اوایل بهار در مرحله رشد رویشی می‌باشد. بنابراین، با توجه به زمان چرای بز و شتر از این گیاهان، به غذای مکمل نیاز می‌باشد.

**کلمات کلیدی:** تغذیه دام، کیفیت علوفه، گیاهان نمک دوست، مراتع شور، چاه افضل، NIRS