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EFFECTS OF GROWTH STAGES ON THE NUTRITIVE VALUE OF SPECIFIC HALOPHYTE SPECIES IN SALINE GRASSLANDS

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ABSTRACT

Halophytes adapting to extreme environmental factors provide an important part of forage requirements for livestock grazing in early spring, summer and especially in late autumn. But many wild halophyte species are undervalued mainly because of insufficient knowledge about their potential feeding value and yields. Information on nutritive values and forage yields of species in different phenological stages is important in terms of grazing management. Thus dry hay yield per plant, and crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), dry matter digestibility (DMD), digestible energy (DE) and metabolizable energy (ME) of *Salicornia europaea*, *Salsola dendroides, Salsola nitraria, Salsola oppositifolia, Suaeda microphylla, Suaeda altissima, Petrosimonia brachiata* and *Alhagi pseudalhagi* in early vegetative and seed maturity stage were investigated in this study. Research was conducted in a factorial arrangement of a completely randomized block design with three replications in saline rangelands of Turkey's Igdir Plain. Results showed that phonological stages and species had a significant effect on all traits (P<0.01). While the highest yields per plant were produced in *Salsola dendroides*, the highest nutritional values were obtained from *Suaeda microphylla* and *Salicornia europaea*. It was determined that CP, DMD, DE and ME contents decreased with the maturation of plants while yields per plant as well as NDF, ADF and ADL increased. As a result, it was found both phenological stages were suitable for grazing in terms of nutritional value, and all species could be supplied a considerable amount and quality of forage compared to conventional fodder resources.

Keywors: Forage quality and yield, growth stage, livestock feeding, saline grazing lands.

INTRODUCTION

Many of grazing lands located in arid and semi-arid regions fail to provide enough quantity and quality nutrition resources for livestocks, and are spoilt because of unproper utilization and extreme enviromental conditions (Kazemi and Eskandari 2011). Whereas, the less and unpalatable halophytic species adapt better to the saline soils and are less affected from the grazing pressure. It is known that a lot of halophyte species in arid areas of the world naturally grow on saline grazing lands where other forage crops are difficult to grow, and these species have provided forage resource for livestocks in grazing systems (Arzani *et al.* 2010; Ben Salem *et al.* 2010; Rad *et al.* 2013; Oktay and Temel 2015). For example, *Atriplex* species are commonly used to fill the summer and autumn feed gap in many countries of the world (Osman *et al.* 2006; Papanastasis *et al.* 2008). Concerning this issue, Swingle *et al.* (1996) stated that *Salicornia bigelovii* and *Suaeda esteroa* have been intensely used as an alternative forage resource and for forage production in saline ecosystems. Norman *et al.* (2004) also reported that the chenopods had higher CP than halophytic grasses growing in the same environment. Thus, nonconventional fodder sources growing naturally in the marginal areas are considered as an opportunity in terms of providing livestocks roughage need in early spring, summer and especially in late autumn.

Animals' grazing performance on rangelands is directly related to the the amount of forage and the nutritient value of the available forage grazed (Asaadi and Dadkhah 2010; Schut *et al.* 2010). Biomass yield and forage quality are influenced by various factors such as enviromental conditions, soil agents, species, stage of growth, leaf to stem ratio, diseases and pests (Harrocks and Valentine 1999; Arzani *et al.* 2001; Temel and Tan 2011a, b), and among these factors, stage of growth (phenological stage) and plant composition are the most important factors affecting yield quantity and quality (Arzani *et al.* 2004; Martiniello and Teixeira da Silva 2011). On the other hand, knowing the nutritional contents of forages (fiber, minerals, energy and protein) is important for an effective livestock production (Schut *et al.* 2010). With this purpose, CP, DMD, ME, NDF and ADF contents are often used as indicators of forage quality (Aydin *et al.* 2007: Karabulut *et al.* 2007; Arzani *et al.* 2010). Previous research showed that the palatability and the chemical composition contents of halophytic species varied depending on the phenological stages and species (Zandi Esfahan *et al.* 2010; Panahi *et* *al.* 2012; Valipoor Dastenai *et al.* 2012; Rad *et al.* 2013; Oktay and Temel 2015). Regarding this issue, Asaadi and Daadkhah (2010) reported that nutritional contents were significantly different between species and the phenological stages, and also the percentages of CP, ME and DMD decreased when plants matured; however, ADF and NDF increased. El Shaer (1996) and Mohajer *et al.* (2013) also indicated that biomass yields of natural range and grazing lands were significantly different based on the development stages, enviromental factors, regions and seasons. Thus, it is necessary to consider temporal variation of forage quantity and quality to obtain maximum utilization of rangeland and grazing areas.

Knowledge on forage yield and quality of wild browse species adapted to halomorfic soils in different developmental stage is important not only in determining grazing capacity and season but also in recognising probable deficiencies in the nutrition of livestock grazing in rangeland (Hussain and Durrani 2009; Lazzarini *et al.* 2009; Asaadi and Dadkhah 2010; Schut *et al.* 2010). But many wild halophytes browse species growing on natural grazing lands with salinity are undervalued mostly due to insufficient knowledge about their potential forage value and yields.

The trial was conducted in Igdir Plain that is one of the most arid regions in Turkey (annual precipitation amount is low, evaporation rate is high). In addition, the plain is surrounded by high mountains and the ground water level is high. Therefore, the salinization rate is high in region, and more than 1/3 of the total available land is affected by salinization (Ozkutlu and Ince 1999). Despite these edaphic shortcomings, the most important sources of livelihood in the region are vegetable production and livestock in the nomadic form. An important component of income in the region is gathered through grazing animals on saline grasslands having low altitude particularly in the beginning of spring period and the end of autumn period. The reason is that a great majority of herbaceous plants in vegetation is dormant in these periods of the year (early spring and late autumn), and they cannot produce sufficient hay. Whereas, many of halophyte species growing in saline grasslands have already grown in grazing maturity, and they are good forage sources for the grazing livestocks. Undoubtedly, yields of species (dry matter contents) are higher in late development stages compared with early growth stages. But due to the reasons above, this study was planned to determine whether or not the halophyte species are adequate for ruminants' demands in early spring and late autumn periods, and to reveal the potential forage value of the material grazed by animal.

MATERIALS AND METHODS

Climate and soil characteristics of trial area: The study was conducted on the saline grazing lands of the Igdir Plain with arid climate, located in eastern Turkey in 2013. Based on the average from many years, the mean relative humidity was 51.2%, average annual temperature was 12.5ºC, and annual rainfall was 264.0 mm (Anonymous 2014). In 2013, when the trial was conducted, annual average precipitation, temperature and relative humidity were calculated as 226.9 mm, 14.1ºC and 51.4%, respectively. In 2013, average annual total precipitation amount was found relatively lower than long-term average annual precipitation, but the temperature higher. Average elevation was 825 m above sea level. Soil (0-30 cm) samples belonging to the site were taken by a hole digger and some chemical and physical characteristics of the soil were determined according to the following methods (Table 1).

Table 1. Some physical and chemical soil characteristics of the experimental area

Texture	EC	pH	OM	P	Ca	Mg	Na	K	B	ESP
	dS/m	½. 5	%	ppm		me/100g			ppm	%
Clayed	10.50	8.98	0.31	50.36	22.30	3.39	11.40	3.71	10.67	50.16

ESP: exchangeable sodium percentage

According to these results, the soils of trial are excessive saline-alkaline, and involve slow organic matter and high boron contents were to have. Texture analysis of the soil was determined by Bouyoucos Hydrometer method (Gee and Hortage 1986). Soil pH was measured by using ''Glass Electrode'' pH meter (Watson and Brown 1998). The organic matter (OM) of the soil was performed by using the Smith-Weldon method; Available phosphorus (P) content was determined by sodium bicarbonate (NaHCO3) extraction and subsequent spectrophotometry. Available potassium (K), sodium (Na), calcium (Ca) and magnesium (Mg) were determined using an ammonium acetate extraction followed by the Atomic Absorption Method (Nelson and Sommers 1982). Boron (B) analysis was determined as described by John *et al.* (1975) and electrical conductivity (EC) according to Demiralay (1993).

Experimental design: Research was conducted on a total of one hectare area where all the species were homogen, and located intensively. Location that was chosen as testing site was being grazed. However, the quantity generated should not be grazed in order to estimate the yield and quality differences accurately according to the development stages of species. For this reason, the trial area was surrounded by wire fence. Hand-samples of the different species were taken in different growth stages in an experimental plot. A plot area of two square meters where the available halophytic species had intensively grown was chosen. Research was conducted in a factorial arrangement of an 8x2 completely randomized block design with three replications. Eight halophyte species to both blocks (*Salicornia europaea* L., *Salsola dendroides* Pall, *Salsola nitraria* Pall, *Salsola oppositifolia* Desf., *Suaeda microphylla* Pall, *Suaeda altissima* (L.) Pall, *Petrosimonia brachiata* (Pall.) Bunge, *Alhagi pseudalhagi* (Bieb.) Desv.) were selected for study, and five plants were randomly selected for each species. These species belong to the family of Chenopodiaceae, but *Alhagi pseudalhagi* (Bieb.) Desv. belongs to the family of Fabaceae. *S. europaea*, *S. dendroides*, *S. microphylla* and *A. pseudalhagi* were perennial semi-shrub forming while *P. brachiata*, *S. nitraria*, *S. oppositifolia* and *S. altissima* were the annual herbaceous plants.

Data collection: Forage samples were cut in two phenological stages (early vegetative stage and seed maturity stage). In general, all the examined halophyte species generate just leaf and a few of shoots at the first period (vegetative stage) corresponding to the beginning of spring. Few or no floral bud appears. Second period corresponding to autumn months is the pre-winter period. In this period, plants completed flowering and were in the seed setting period. Generally, plants had the yellow and green images. The growth of the plants was completed. The 1st and the 2nd cuttings were performed on 15th April 2013 and 15th October 2013, respectively. All the species were cut 10 cm above ground and the fresh hay weight per plant was determined immediately. Later, a representative sub-sample (0.5 kg) of the cut material was dried at 70 ^{o}C in a oven for 48 h and hay yields per plant were weighed, then ground with a Wiley mill to pass a 1 mm screen and analyzed for quality components. All analyses were carried out on duplicate samples. The Nitrogen content of the forage was measured by the Kjeldahl Method (AOAC 1997) and crude protein of plant samples were calculated by multiplying N with 6.25. NDF, ADF and ADL were measured using the procedure described by Van Soest *et al.* 1991. As suggested by Weiss (1994), accurate data on the digestibility of forage would greatly assist diet formulation and the economic valuation of different collection periods. Although the value of accurate digestibility data is unequivocal, collecting actual data is a time consuming and expensive process that requires large amounts of forage samples and was therefore not feasible in this study. For this purpose, many researchers have estimated the DMD, DE and ME contents of the forages using the allometric equations, and compared the nutritional values of forages by evaluating these data (Parlak *et al.* 2011; Rad *et al.* 2013; Oktay and Temel 2015). Dry matter digestibility of plants was estimated using by Sheaffer *et al.* (1995) by using ADF results: DMD% = 88.9- (0.779 x ADF%). Dry matter digestibility values were used to estimate digestible energy using the regression equation reported by Fonnesbeck *et al.* (1984): DE (Mcal/kg) = 0.27 + 0.0428 x DMD%. Then DE values were converted to ME using the formula reported by Khalil *et al.* (1986): ME (Mcal/kg) = 0.821 x DE (Mcal/kg).

Statistical analysis: The data were analyzed using general linear models with SPSS (version 20). The measurements of the treatments were compared and grouped using Duncan's multiple range tests at a 5% level of significance.

RESULTS

Dry hay yield per plant: The variance analysis results showed that dry hay yield per plant (dry matter) was significantly different (P<0.01) among the phenological growth stages and species (Table 2).

Table 2. Results of analysis of variance for forage yield and quality in eight halophyte species in two phenological stages

Sources of variation	Plants	Stages	Plant x Stage
Dry hay yield per plant	264.92**	1413.58**	155.50**
CP	41.31**	608.11**	19.92**
NDF	85.66**	1235.96**	121.19**
ADF	168.94**	629.17**	44.72**
ADL	250.80**	767.17**	28.14**
DMD	168.94**	629.17**	44.72**
DE	168.94**	629.17**	44.72**
ME	168.94**	629.17**	44.72**

** = Significant at P<0.01. CP = crude protein; NDF = neutral detergent fibre; ADF = acid detergent fibre; ADL = acid detergent lignin; DMD = dry matter digestibility; DE = digestible energy; ME = metabolizable energy.

The highest hay yields (0.357 kg/plant) per plant were obtained from *Salsola dendroides*, the lowest yields were determined in *Alhagi pseudalhagi* (Table 3). Based on the stages, maximum hay yield per plant (0.251 kg/plant) was obtained in seed maturity stage, but minimum yield was realized in early vegetative growth stage (Table 3). With the advence of growth, the average hay yield per plant of all species increased 95% and 132%, respectively.

Table 3. Dry hay yield (kg/plant) and CP (%) of eight halofit browse species in two phenological stages

Plants	Dry hay yield (kg/plant)			CP (%)		
	EVS	SMS	Mean	EVS	SMS	Mean
Salicornia europaea	0.134	0.286	0.209c	19.91	14.19	17.05a
Salsola dendroides	0.135	0.579	0.357a	18.25	10.59	14.42cd
Salsola nitraria	0.135	0.348	0.241b	15.09	12.10	13.60d
Salsola oppositifolia	0.092	0.140	0.116f	17.75	12.39	15.07bc
Suaeda microphylla	0.119	0.215	0.167d	22.54	12.05	17.29a
Suaeda altissima	0.093	0.181	0.137e	20.54	11.28	15.91b
Petrosimonia brachiata	0.080	0.128	0.108fg	13.50	9.66	11.58e
Alhagi pseudalhagi	0.066	0.132	0.099g	12.77	10.81	11.79e
Mean	0.108b	0.251a	0.179	17.55a	11.64b	14.59

a,b,c: The values with different letters in the same column and rows are significantly different at P<0.01. EVS = early vegetative stage; SMS = seed maturity stage; CP = crude protein.

In peresent study, all yield and quality parameters were found very significant (P<0.01) with respect to species x location (Table 2). The highest dry hay yields (0.579 kg/plant) were obtained from *Salsola dendroides* harvested at the seed maturity stage (Fig. 1). Wheras in the early vegetative stage, the optimum dry hay yield per plant was determined in *Salsola nitraria* and *Salsola oppositifolia*, respectively (Fig. 1).

Nutritional contents: The statistical analysis showed that species and phenological stages had a significant effect (P<0.01) on all forage quality parameters studied here. While the highest CP was determined on *Suaeda microphylla* and *Salicornia europaea* (Table 3), the highest ADF, NDF and ADL were obtained from *Alhagi pseudalhagi* (Table 4) and DMD, DE and ME from *Salicornia europaea* (Table 5).

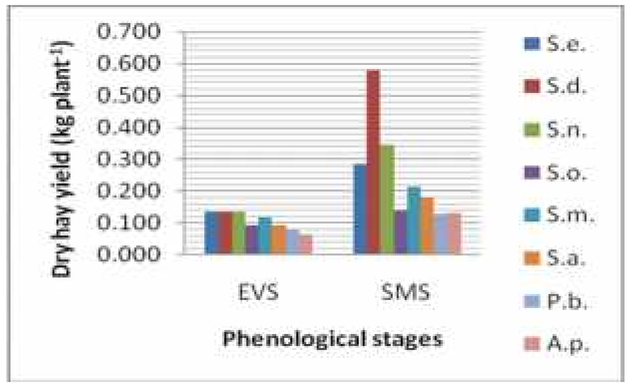


Figure 1.Dry hay yield per plant of halophytic species (S.e. = *Salicornia europaea*, S.d. = *Salsola dendroides*, S.n. = *Salsola nitraria*, S.o. = *Salsola oppositifolia*, S.m. = *Suaeda microphylla*, S.a. = *Suaeda altissima*, P.b. = *Petrosimonia brachiata* and A.p. = *Alhagi pseudalhagi*) at early vegetative stage and seed maturity stage.

Table 4. NDF (%), ADF (%) and ADL (%) contents of eight halofit browse species in two phenological stages

Plants	NDF (%)			ADF (%)			ADL (%)		
	EVS	SMS	Mean	EVS	SMS	Mean	EVS	SMS	Mean
Salicornia europaea	30.47	32.93	31.70e	14.42	17.14	15.78e	2.44	3.72	3.08d
Salsola dendroides	35.25	37.15	36.20d	17.50	19.00	18.25d	1.32	3.82	2.57e
Salsola nitraria	18.05	39.59	28.82f	12.23	24.40	18.31d	1.45	5.81	3.63c
Salsola oppositifolia	30.41	44.78	37.59c	12.45	20.78	16.61e	1.73	3.24	2.49ef
Suaeda microphylla	37.09	39.13	38.11c	18.08	21.89	19.98c	1.38	5.41	3.39cd
Suaeda altissima	31.51	42.17	36.84cd	16.25	28.82	22.53b	1.40	6.83	4.12b
Petrosimonia brachiata	25.31	54.00	39.65b	19.56	25.43	22.49b	1.43	2.81	2.12f
Alhagi pseudalhagi	37.72	45.30	41.51a	28.87	30.15	29.51a	8.12	10.61	9.31a
Mean	30.73b	41.88a	36.30	17.42b	23.45a	20.44	2.41b	5.28a	3.85

a,b,c: The values with different letters in the same column and rows are significantly different at P<0.01. EVS = early vegetative stage; SMS = seed maturity stage; NDF = neutral detergent fibre; ADF = acid detergent fibre; ADL = acid detergent lignin.

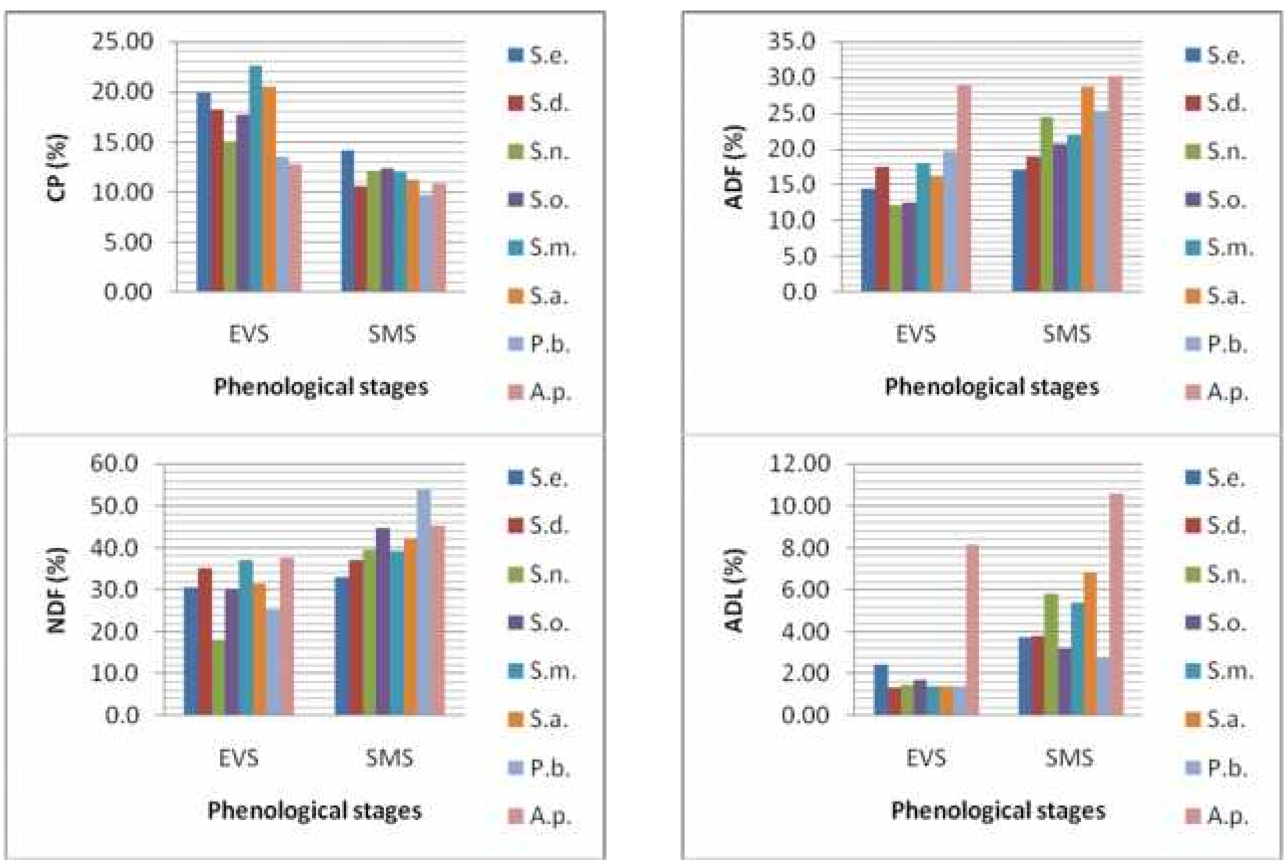
However, the lowest quality parameters were found in *Alhagi pseudalhagi.* Between phenological stages, the amounts of maximum CP, DMD, DE and ME were determined at early growth stage (Table 3 and Table 5), but the percentages of NDF, ADF and ADL were obtained at the latter one (Table 4). According to this, the nutritive value of hays harvested at vegetative growing stage was found higher than that in the seed maturity stage.

With respect to species x location, the lowest NDF and ADF, and the highest CP, DMD, DE and ME contents except for ADL (in *Petrosimonia brachiata*) were obtained from *Salicornia europaea* in the seed maturity stage, but the best forage quality except for CP value (in *Suaeda microphylla*) was procured from *Salsola nitraria* in early vegetative stage (Fig. 2). With respect to all examined quality parameters, plant having the lowest forage quality was *Alhagi pseudalhagi* in both phenological stages.

Table 5. DMD (%), DE (Mcal/kg) and ME (Mcal/kg) contents of eight halofit browse species in two phenological stages

Plants	DMD (%)			DE (Mcal/kg)			ME (Mcal/kg)		
	EVS	SMS	Mean	EVS	SMS	Mean	EVS	SMS	Mean
Salicornia europaea	77.66	75.54	76.60a	3.59	3.50	3.55a	2.95	2.88	2.91a
Salsola dendroides	75.26	74.09	74.68b	3.49	3.44	3.46b	2.87	2.82	2.84b
Salsola nitraria	79.37	69.89	74.63b	3.67	3.26	3.46b	3.01	2.68	2.84b
Salsola oppositifolia	79.19	72.71	75.95a	3.66	3.38	3.52a	3.00	2.78	2.89a
Suaeda microphylla	74.82	71.85	73.33c	3.47	3.34	3.41c	2.85	2.74	2.80c
Suaeda altissima	76.24	66.44	71.34d	3.53	3.11	3.32d	2.90	2.56	2.73d
Petrosimonia brachiata	73.66	69.09	71.37d	3.42	3.22	3.32d	2.81	2.65	2.73d
Alhagi pseudalhagi	66.41	65.41	65.91e	3.11	3.07	3.09e	2.55	2.52	2.54e
Mean	75.33a	70.63b	72.98	3.49a	3.29b	3.39	2.87a	2.70b	2.79

a,b,c: The values with different letters in the same column and rows are significantly different at $P<0.01$. EVS = early vegetative stage; SMS = seed maturity stage; DMD = dry matter digestibility; DE = digestible energy; ME = metabolizable energy.



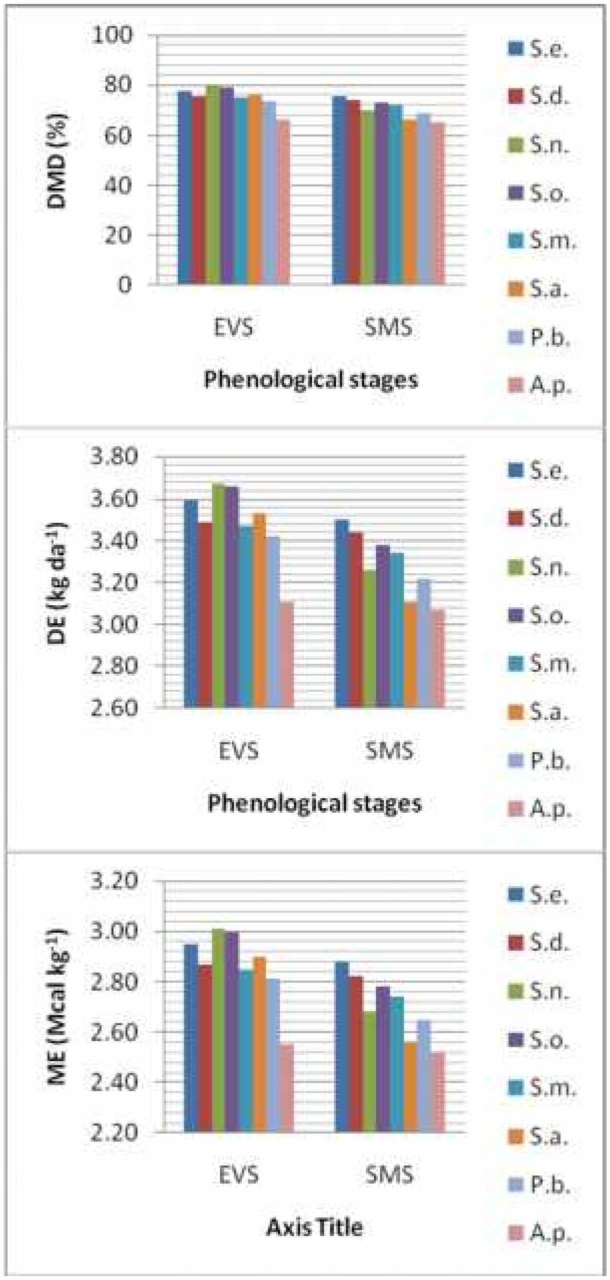


Figure 2. The CP, NDF, ADF, ADL, DMD, DE and ME contents of halophytic species (S.e. = *Salicornia europaea*, S.d. = *Salsola dendroides*, S.n. = *Salsola nitraria*, S.o. = *Salsola oppositifolia*, S.m. = *Suaeda microphylla*, S.a. = *Suaeda altissima*, P.b. = *Petrosimonia brachiata* and A.p. = *Alhagi pseudalhagi*) at early vegetative stage and seed maturity stage.

DISCUSSION

Dry hay yield per plant: In the study, dry hay yields per plant were significantly different among species. The differences could be due to the the genetic structures, genotype or species since each halophytic species has different physiological and biological properties, root structure, habitat. Quadir *et al.* (2008) and Mohajer *et al.* (2013) indicated that the plant yield growing in arid and saline ecosystems differ greatly among species, and even in the same species. The difference in the degree of salt tolerance of the present halophytes could have led the variations. The conducted studies showed that the degrees of salt tolerance of the species were different (Masters *et al.* 2007), and the forage productions were significiantly affected by abiotic stress factors (Jenkins *et al.* 2010).

Based on the yields, the seed maturity stage produced statistically higher dry hay per plant than that at the early vegetative stage (Table 3). This can be explained with growth kinetics depending on the physiology of plants. Altin *et al.* (2011), expressed that the growth kinetic in plants depends on substitute nutrition material and that this varies according to plant development stages. As known, the repeated shoot of plants in initial development period depends mostly on the amount of the reserve nutrition material. Besides, as plants have insufficient photosynthesis tissue in this period, they demonstrate slow growth and their organic material production remain low. However, as total carbohydrate production will increase due to increasing photosynthesis production together with growth stage plants form more biomass. Therefore, in seed maturation period the dry hay yields of species per plant were found to be higher than early vegetative stage.

Nutritional contents: In present study, the forage quality was significiantly different among halophytic species. This can stem from the difference of the chemical composition contents, the tissue morphology and their genetic structures of the examined plants. Similar results were obtained by different researchers, and they reported that the nutritional values and forage quality of halophytic species varied according to maturity stages, species and cultivars depending on their genetic structures (Mountousis *et al*. 2008; Asaadi and Daadkhah 2010; Atasoglu *et al.* 2010). Cook and Stubbendieck (1986) also stated that the chemical content of plant species may differ because of their abilities to withdraw certain nutrients from the soil and to concentrate them in tissues. Another reason that the nutrient content is different among species may result from the difference of leaf to stem ratio at which the species harvested. Generally, plants can produce different proportions of leaves, stems, and generative stalks at various stages of maturity or because of previous grazing treatments (Ghodsi Rasi and Arzani 1997; Arzani *et al.* 2004).

The nutritient values of the forage on range and grazing areas are extremely related plant composition and stage of growth. Previous studies have indicated that the nutritional contents of halophytic species varied depending on the growth stages and, as plants became older, the forage quality decreased (Zandi Esfahan *et al.* 2010; Asaadi and Yazdi 2011; Arzani *et al.* 2012; Mohajer *et al.* 2012; Panahi *et al.* 2012; Valipoor Dastenai *et al.* 2012; Rad *et al.* 2013; Khan *et al.* 2014; Oktay and Temel 2015). Regarding this issue, Dianati Tilaki *et al*. (2012) emphasized that forage quality was significantly different between the phenological stages, and the highest nutritive values were achieved in the vegetative stages in *Salsola arbuscula* and *Salsola richteri*. In our present study, it has also been determined that the amounts of CP, DMD, DE and ME decreased, NDF, ADF and ADL increased with advancing maturity. With maturity of plants, a decrease in leaf to stem ratio, and an increase in fibrous composites especially in stems and in leaf can cause these differences. Young plants are known to have younger cells, thin and elegant cellular walls and also higher amounts of intracellular soluble nonstructural carbonhydrates (Fahey 1994). Wheras cellular walls become thicker and the percentages of structural carbonhydrates such as celluloses, hemicellulose, and lignin increase with the increased maturity (Arzani *et al.* 2001; Arzani *et al.* 2010; Asaadi and Daadkhah 2010; Asaadi and Yazdi 2011; Martiniello and Teixeira da Silva 2011). For this reasons, it was determined that with maturity of halophytic species, the desired nutritional contents decreased and the undesired quality parameters increased. Nevertheless, decrease in CP, DMD, SE and ME contents by the advancement of the growing stage of the examined halophytic species occured in a lower ratio (34%, 6%, 5% and 6%, respectively) compared to many rangeland species grazed. This may derive from the halophytic species having a more succulent structure and its hay growing old slower. This is in agreement with results obtained by Oktay and Temel (2015), and they reported that decrease in the forage quality was low with development at the maturity stage of *Calligonum polygonoides*, which is a halophytic plant.

According to NRC (2007) records, for an addition of 150 g live weight gain in addition to maintenance of ovine animals with 50 kg weight 11.7% CP, for 100 g live weight increase 3.22 Mcal/kg DE and 2.99 Mcal/kg ME requirement was reported. Besides, it was expressed that sufficient DMD content for maintenance of animals is 50% (Victor 1981). As known, the CP, DE, ME and DMD contents of feed are important factors determining nutrition values and these nutrition contents should be provided for obtaining maximum performance from grazing animals. In our present study, the mean CP, DE, ME and DMD ratios of halophytic species were determined as 14.59%, 3.39 Mcal/kg, 2.79 Mcal/kg and 72.98%, respectively, and these values were obtained from the highest *Salicornia europaea* and the lowest *Alhagi pseudalhagi*. Between the phenological stages, while the highest CP (17.55%), DE (3.49 Mcal/kg), ME (2,87 Mcal/kg) and DMD (75.33%) contents were measured in the early vegetative stage, the minimum CP (11.64%), DE (3.29 Mcal/kg), ME (2.70 Mcal/kg) and DMD (70.63%) ratios were determined at the seed ripening stage. According to these results, it was observed that for both phenological periods and all examined species, grazing ovine animals fulfilled their CP requirements for daily 150 g live weight increase and DM, ME and DMD requirements easily and no additional feeding was required. Similar results were also determined for *Calligonum polygonoides* plant which is a halophytic shrub (Oktay and Temel 2015).

The results of this research showed that there were significant differences between the phonological stages and the species evaluated. When forage quantity is considered, it was determined that the seed maturity stage was the most suitable stage for grazing livestocks. With respect to forage quality, early vegetative stage produced forage with higher nutritive value when compared to seed maturity stage. However as quality losses are very little in halophytic species due to maturation, it was stated that both growth stages are suitable for grazing in means of fulfilling the nutrition requirements of grazing animals. All the halophytic species naturally growing in these areas could also supply a considerable amount of forage with quality compared to conventional fodder resources. As a result, these species can play an important role as an alternative forage resource in recovered of the grazing lands losing the production potential due to unconscious utilization and salinity.

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