Environmental Resources Research
Vol. 3, No. 1, 2015

GUASNR

Assessment of new forage sources in saline areas of Iran

B. Rasouli[1], B. Amiri*[2]
[1]Animal Sciences department, Rasht Branch, Islamic Azad University, Rasht, Iran
[2]Natural Resources department, Firoozabad Branch, Islamic Azad University, Firoozabad, Iran

Received: September 2014 ; Accepted: December 2014

Abstract

Halophytes, as integral parts of many marine, coastal and terrestrial ecosystems, can play an important future role for biosaline agriculture, forage production and habitat restoration. There is currently a lack of public awareness and scientific documentation regarding nutritive value of halophytes. The aim of this research was to determine nutritive value of native halophytes of Iran. Seven saline indicator species of Iran including *Halocnemum strobilaceum, Halostachys caspica, Seidlitzia rosmarinus, Salicornia herbacea, Alhagi persarum, Salsola regida and Atriplex leucoclada* were sampled at three phenological stages (vegetative, flowering and seed ripening). Then, the plants were powdered and six quality traits, Crude Protein (CP), Acid detergent fiber (ADF), Moisture, Metabolizable Energy (ME), Ash and Dry mater digestibility (DMD) were determined. ANOVA results revealed that there were significant differences among all species and phenological stages. ME, DMD and CP decreased in all the species in three stages, but ADF changed significantly in seed ripening stages in *H. strabilaceum (20.63), S. rosmarinus (17.61 %)* and *H. caspica (17.4 %).* The difference was not significant in flowering (32.56%) and seed ripening (31.66 %) stages for *A. persarum*. Increasing of ash and moisture content in flowering stage in succulent halophytes helps them to tolerate salinity. Due to less fiber and more CP, ME and DMD, *S. regida* has the highest nutritive value and *A. leucoclada* has the lowest value. Also, late vegetative or early flowering stages are the best time of forage quality according to these traits.

Keywords: Nutritive value, phonological stage, Halophytes

*Corresponding author; bchamiri@gmail.com

1. Introduction

One of the greatest potential uses of halophytic plants probably rests in their utilization as forage and fodder (Weber *et al.*, 2006). This is particularly relevant for some countries such as Iran, with serious soil salinity problems, where growing halophytic forages offers the opportunity to reduce the national deficit substantially in forage for livestock. Examples of halophytes use as forage are found in many countries, e.g., *Haloxylon* and *Kochia* in Iran, *Atriplex* in Argentina and Australia, *Sporobolus, Alhagi, Salsola, Atriplex, Puccinella* and *Lptochloa* in Pakistan, *Alhagi* in Uzbekistan, *Tamarix* in Egypt, *Spartina* on the east coast and *Salicornia* on the west coast of USA. Planting halophytes is now a widely accepted option in low rainfall saline regions of Australia and many countries of North Africa to provide valuable fodder reserves when other supplies are exhausted (Khan and Ansari, 2008).

Plants nutritive value is affected by climatic factors, growth stages, soil and etc (Rasouli and Amiri, 2010; Arzani *et al.*, 2004; Van soest, 1991). Phenological stages are the most important factors determining forage quality for grazing livestock. Shinde *et al.* (2000) showed that seasonal variation and location of plant sites affect on quality and decreased CP, DMD and increased ADF with age. Malan & Rethman (2003) reported that differences in plant palatability are due to factors such as protein, chemical composition, and amount of fiber, growth form and stage. Therefore, this study was implemented to determine forage quality of 7 native halophytes of Iran in different growth stages. These plants are considered as important halophytes that can be used as forage in most areas in south and center of Iran.

2. Materials and methods

More than 100 native halophytes grow in Iran's saline areas. In this research we selected 7 dominant halophytes including *Seidlitzia rosmarinus*, *Salicornia herbacea*, *Atriplex leucoclada*, *Salsola rigida*, *Halostachys caspica*, *Halocnemum strobilaceum* and *Alhagi persarum.* Plant samples were completely randomized and collected at different growth stages as primary growth (March-May), flowering (July-September) and seed ripening (November-December) in different saline areas of Iran such as Qom Province (Salt Lake),Western Azerbaijan (Uremia Lake), Ahwaz (Shadegan), Mashhad (Shoor River) and Bushehr. Pooled vegetation samples (by transect) were dried in a 70°C forced air oven, and ground through a 1 mm screen. Samples were analyzed for ash (AOAC, 1990), ADF (ANKOM 200 fiber analyzer), Crude Protein (Kjeldal), water percentage (oven), Dry Matter Digestibility[1] (Oddy *et al.*, 1983) and Metabolism Energy[2] (standard equation of

1- DMD = 83.56 - 0.824 (%ADF) + 2.626 (%N)
2- ME (MJ / Kg) = %17 DMD-2

Standing Committee on Agriculture). Mean nutritive values were analyzed as a 3 phenological stages×7 dominant plant species factorial arrangement in a split-block design. Data were analyzed using SPSS. Following a significant preliminary F-test, the Duncan option was used to separate means.

3. Results and Discussion

Comparison of the halophytes species with alfalfa, brome and birds food trefoil showed that although, some of them have crude protein less than *medicago* and *lotus*, but, their ADF is lesser. Also, with the exception of *Atriplex*, DMD of other species is equal or more than common forages (Table 1). Thus, these species are valuable but, their anti nutritive traits should be studied.

Table 1. Comparison of the halophytes nutritive value with common forages

Seidlitzia rosmarinus	*Halostachys caspica*	*Halocnemum strabilaceum*	*Salicornia herbacea*	*Alhagi persarum*	*Atriplex leucoclada*	*Salsola rigida*	*Lotus corniculatus*	*Bromus tomentellus*	*Medicago Sativa*	species criteria
6.37	12.81	10.32	3.99	9.8	8.1	12.8	14.6	8.6	15.5	CP
14.2	17.1	18.2	22.56	33.06	47.85	19.54	29.1	41.8	29.4	ADF
74.51	74.86	72.92	66.6	60.47	47.56	72.85	65.6	52.8	65.8	DMD

ANOVA results revealed that there are significant difference among all species and phenological stages. There is a significant interaction between phenological stages and species (Table 2).

Table 2. Results of analysis of variances for 6 quality traits in 7 species in 3 phenological stages

Interaction			species			Phonological stage			
F	MS	df	F	MS	df	F	MS	df	quality traits
15.68**	60.85	12	327.52**	1270.4	6	72.92**	283.13	2	ADF %
6.48**	60.6	12	93.82**	95.86	6	77.99**	79.69	2	CP %
9.28**	121.23	12	64.67**	844.77	6	89.26**	1165.9	2	Moisture %
12.29**	99.9	12	65.36**	531.08	6	35.63**	289.5	2	ASH (gr)
13.21**	1.21	12	287.48**	26.37	6	97.74**	8.96	2	(MJ/Kg) ME
13.21**	41.94	12	287.48**	912.67	6	97.74**	310.29	2	DMD %

** = Means of squares are significant at 1 %.

Duncan test indicated that ADF and Ash decreased with increasing growth. However, crude protein, moisture content, DMD and ME increased (Figure 1). Holchek *et al.* (2001) and Arzani *et al.* (2004) explained that decreasing of forage quality with growing is related to change of leaf/stem ratio. Ash and moisture content did not differ significantly between vegetative and flowering stages in this research. It seems that the phenomenon is related to halophytes mechanism to tolerate salinity.

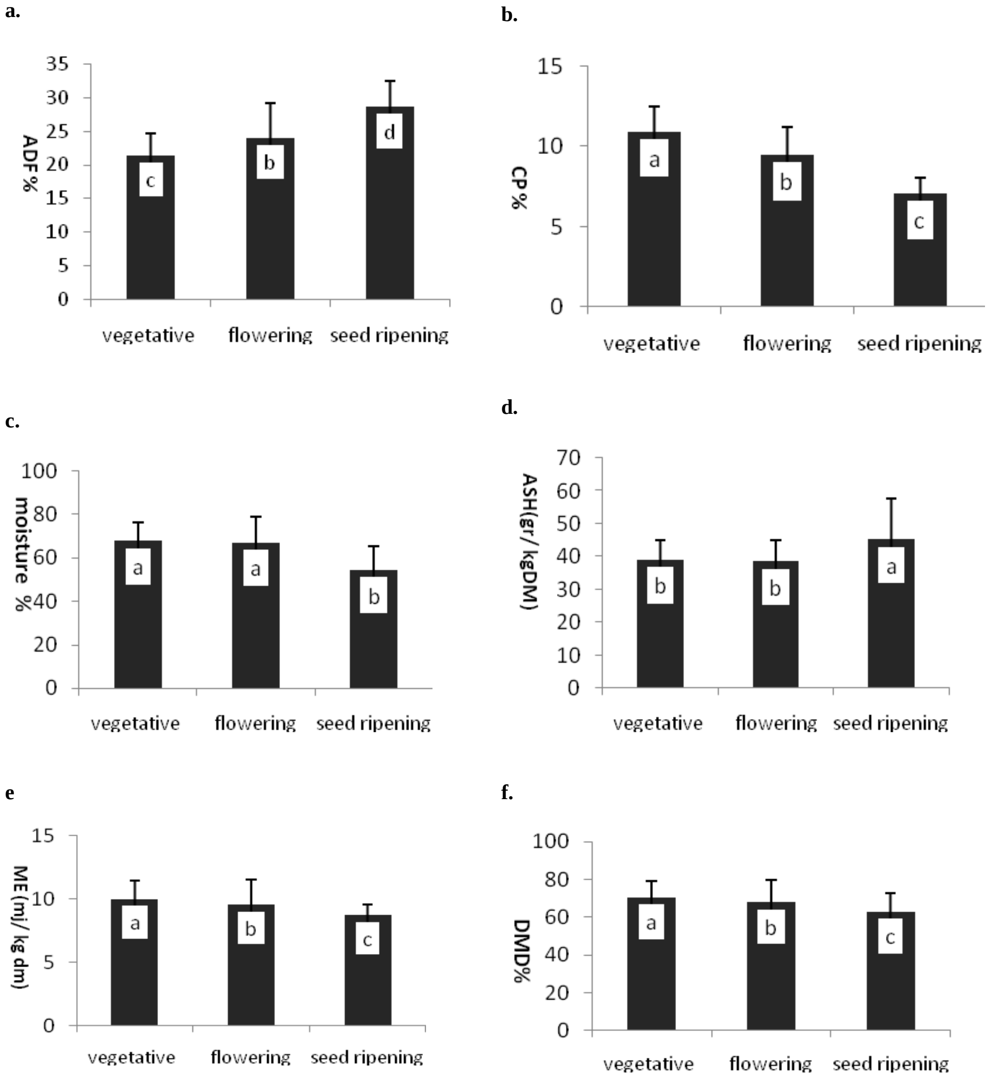
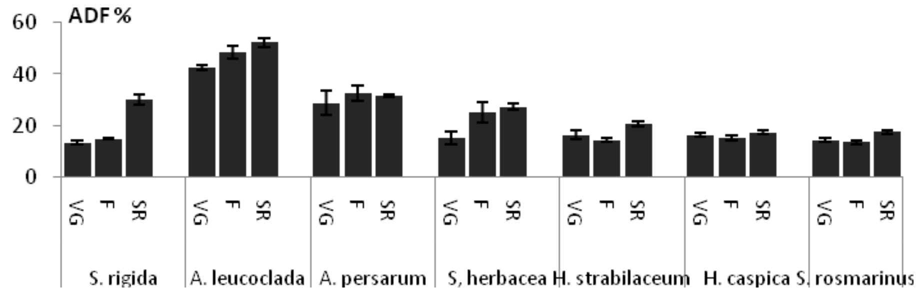
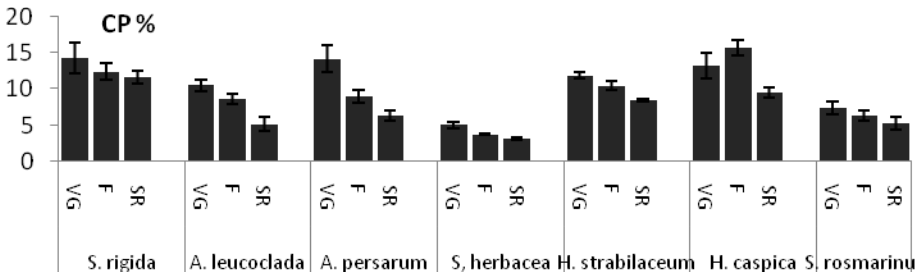


Figure 1. The effects of phenological stages on quality traits (1-a: ADF, 1-b: CP, 1-c: moisture, 1-d: ash, 1-e: ME, 1-f: DMD)

More investigation on the quality traits changes in each species denoted that ADF changes significantly in seed ripening stages in *S. rosmarinus* (17.61%), *H. strabilaceum* (20.63) and *H. caspica* (17.4%), but there is not a significant difference in flowering (32.56%) and seed ripening (31.66%) stages in *A. persarum* (Figure *2.a*). Increasing of moisture content in flowering stage (Figure 2.c) in succulent halophytes helps them to tolerate salinity (Khan and Ansari, 2008; Song and Feng, 2006). ME, DMD and CP decreased in all the species in the three stages (Figure 2).

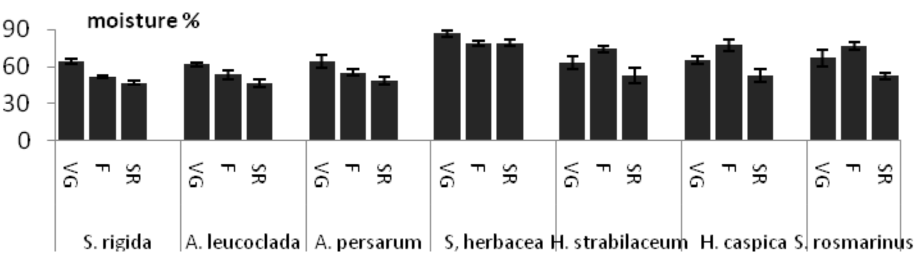


a.



b.

c.



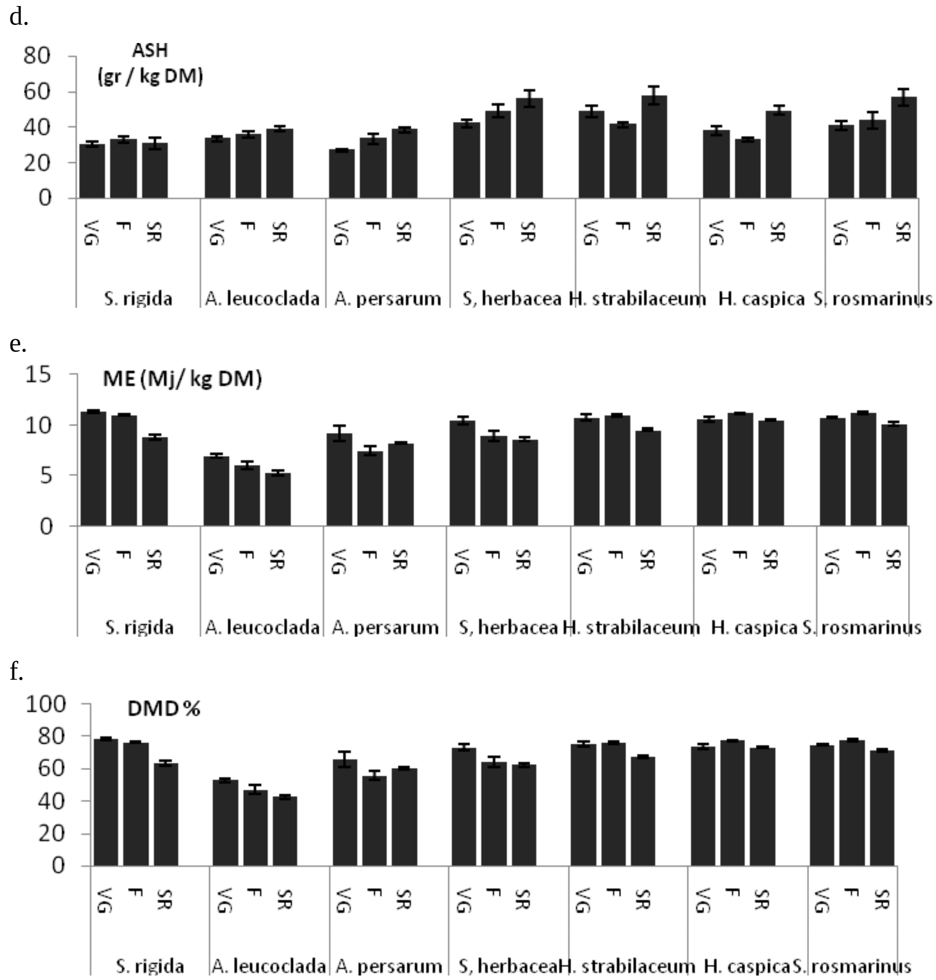


Figure 2. Comparison of means of *7* species for 6 quality traits in 3 phenological stages (VG: vegetative growth, F: flowering, SR: seed ripening)

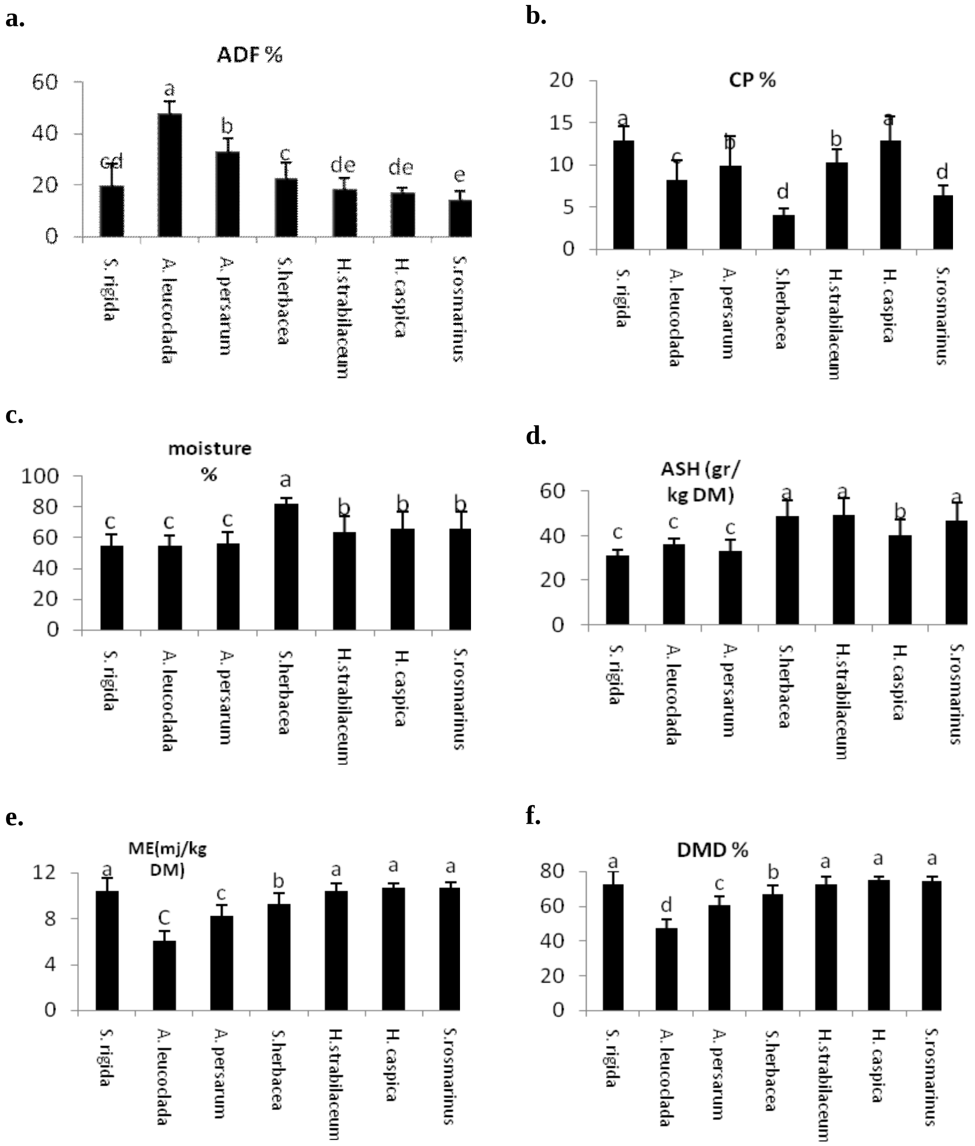


Figure 3. Comparisons of means of 7 species for 6 quality traits averaged over 3 phenological stages (3-a: ADF, 3-b: CP, 3-c: moisture, 3-d: ash, 3-e: ME, 3-f: DMD)

Within the plants, ME and DMD were greater and ADF was lesser ($P<0.01$) for *S.regida, H. caspica* and *H. strabilaceum.* Also, *A.leucoclada and A. persarum* had the least of ME and DMD and the most of ADF. In addition, CP was the most in *S. rigida* (12.8%) and *H. caspica* (12.83%) and the least in *S.herbacea* (3.9%). Our result confirmed that Ash and moisture content of the plants are more in *S. herbacea*, *H. caspica, H. strabilaceum and S. rosmarinus* (Figure 3). Welch (1987) stated that ash and moisture content of plants relate to soil salinity. Amiri *et al.* (2010) and Amiri *et al.* (2011) expressed that these plants can be seen near the salinity center.

In similar researches, such as that of Weber *et al.* (2006) on *S.rigida*, Amiri and Rasouli (2010) on *A. persarum* and *S.herbacea*, Khalil *et al.* (1986) and Malan and Rethman (2003) on *Atriplex*, Lu *et al.* (2009) on *Salicornia herbaceae*, Zhao and Feng (2001) on *H. caspica* and *H. strobilaceum* valuable quality of the studied plants were confirmed as fodder for sheep, goat and camel.

4. Conclusion

Due to lesser fiber and more CP, ME and DMD, *S. regida* has the highest nutritive value and *A. leucoclada* has the lowest value. Also, late vegetative or early flowering stages are the best times of forage quality according to these traits. However, care must be exercised in using the results of the current study, as still we are not aware of the studied plants nutritive and anti-nutritive values.

Acknowledgment

The authors are grateful to the Islamic Azad University, Firoozabad and Rasht Branch, Iran and Dr. M.H. Assareh.

References

Akhani, H., and Ghorbanli, M. 1993. A contribution to the halophytic vegetation and flora of Iran, in: H. Lieth and A. Al Masoom (Eds): Towards the rational use of high salinity tolerant plants. Journal of Plant physiology. 1: 35-44.

AOAC. 1990. Official Methods of Analysis (15th ed) Association of Official Analytical Chemists, Arlington, VA.

Arzani, H., Zohdi, M., Fish, E., Zahedi Amiri, G.H., Nikkhah, A. and Waster, D. 2004. Phenological effect on forage quality. Journal of Range Management: 57(6):624-629.

Amiri, B., Assareh, M. H., Jafari, M., Rasuoli, B., Arzani, H., and Jafari, A.A. 2010. Effect of salinity on growth, ion content and water status of glasswort (Salicornia herbacea L. Caspian Journal of Environmental Sciences. 8 (1): 79-87.

Amiri, B., Rasouli, B., Assareh, M.H., and Jafari, M. 2011. Effect of NaCl and Na2SO4 on osmotic potential, water relations and ions changes of Alhagi persarum L. 2011, Journal of Food, and Agriculture and Environment. 9(2): 253-256.

Amiri, C.B., and Rasouli, B. 2010. Investigation Nutritive Value of Halophyte Plants, Salicornia herbacea and Alhagi persarum, in Different Growth Stages, 9th International conference on halophillic microorganisms, Beijing, china.

Holechek, J.L., Herbel, C.H., and Pieper, R.D. 2001. Range management Principle and Practices. Prantice Hall Pub. USA. 4th Edition. 587p.

Khalil, J.K., Saxay, W.N., and Heyder, S.Z. 1986. Nutrient Composition of Atriplex leaves growing in Saudi Arabia. Journal of Range Management. 30: 204-217.

Kurkova, E.B., Kalinkina, G.O., Baburina, K., Myasoedov, N.A. and Naumova, T.G. 2002. Responses of Seidlitzia rosmarinus to Salt Stress. Biology Bulletin. 29 (3): 221-228.

Lu, D., Zhang, M., Wang, S. Cai, J., Zhou, X., and Zhu, C. 2009. Nutritional characterization and changes in quality of Salicornia bigelovii Torr. During storage, Food Science and Technology, In Press, Corrected Proof, Available online 26 September.

Malan, P.G., and Rethman, N.F.G. 2003. Selection Preference of Sheep Grazing Different Atriplex Species Proceeding of 7th International Rangeland Congress, Durban, 115-193.

Oddy, V.H., Sand, G.E., and Low, S.G. 1983. Prediction of in vivo dry matter digestibility from the fiber nitrogen content of a feed, In feed Information and Animal Production, G.E. Robards, and R.G. Pakham Commonwealth Agricultural Bureaux, Australia. 395-398.

Rasuoli, B., and Amiri, B. 2010. Investigation Nutritive Value of Halophyte Plant *Halocnemum strobilaceum* in three Different Growth Stages in three Different Sites, 9th International conference on halophillic microorganisms, Beijing, China.