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**Estimating Nutritive Values of *Jasminum Fruticans* L. Plant Species in Northern
Rangelands of Golestan Province**

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ABSTRACT

Information on different rangeland plants' nutritive values in different parts of plant species and habitats are important in Rangelands Management. Effects of different plant parts (stems and leaves) of the *Jasminum fruticans* L. plant species on forage quality indicators were investigated in two regions in 2015. Plant samples were collected from Sharlogh Rangelands and cultivated in Research and Education Center of Agricultural and Natural Resources (RECANR) in Iran with completely randomized design with three replications in each plant sample. The plant leaves and stems' samples were oven-dried at 80°C for 24 hours, then analyzed for crude protein (CP), crude fiber (CF), dry matter (DM) Ether Extract (EE), Crude Ash (CA), Metabolizable Energy (ME), and mineral elements, including Calcium (Ca) and Phosphorus (P). Results showed that the forage quality indicators in different regions were statistically significant, except for the CA. Also, nutritive values differed significantly ($P<0.01$) between different plant parts, except ME parameter. Results also indicated that *J. fruticans* due to its high tissue CP content is a valuable source of forage for livestock.

Keywords: Nutrient value, Forage, *Jasminum fruticans*, Rangeland

INTRODUCTION

Range animal productivity and health of livestock depends on the nutritional value of forage available to grazing animals. Therefore, knowing the nutritional value of forage is necessary for the Range Managers to understand the nutritional dynamics of forage to sustain adequate growth and reproduction of animals (Ganskopp & Bohner, 2001; Richards and Caldwell, 1985), to balance the available forage and the animal's nutrition needs (Dehghani Bidgoli et al., 2012). Woody plants (Fodder trees and shrubs) constitute vital components in livestock productivity, especially in arid and semi-arid zones. The aim of this research is estimating nutritional value of different parts of the shrubby jasmine (*Jasminum fruticans* L.) plant species in different regions.

Several studies have assessed the nutritional values of forage in natural rangelands (Islam et al., 2003; Nasrullah et al., 2003). Different factors that affect forage nutritive values such as crude protein (CP), acid detergent fiber (ADF), metabolism energy (ME) have been studied by several investigators (Menke and Trlica, 1985; Moore and Biddingscomb, 1994; Orodho et al., 1990). On native rangelands, due to having more feeds to choose from, cattle can adjust their diets and select plants that may be more palatable and nutritious (Hendrickson et al., 1981).

Abusuwar and Ahmed (2010) stated the main feature of browse plants is their high CP and mineral contents. Generally, Calcium (Ca) content is higher than those of other minerals (Backlund and Belskog, 1991). The plants have CP (Holechek, et al., 1983), especially at leaf (Laredo and Minson, 1973; Poppi et al., 1981). Cook and Harris (1950) observed that CP and lignin of grasses on Utah summer range was about 6% and leaf CP material (~ 12%) was greater

than stem CP (~ 4%). The CP and lignin were 12.3 and 20.6 percent in leaf and stem, respectively. Weston et al. (2005) investigated nutritive value properties of Sagebrush-Grass. Their results showed that CP was generally greater for shrubs than grasses. Hussain and Durrani (2009) stated that grasses generally had more dry matter (DM), crude fiber (CF), carbohydrates, neutral detergent fiber (NDF), ADF and hemicelluloses than shrubs, while shrubs were generally high in crude ash (CA), CP, ether extract (EE), nitrogen (N), gross energy (GE), acid detergent lignin (ADL) contents than grasses. Generally DM, CF, NDF, ADF, ADL, carbohydrate and hemicellulose contents increased with the maturity of plants; while ash, CP, EE, N, and ME declined with plants maturity. The nutritive quality of forage decreased with the advancement of phenological growth stages in all analyzed plants. Dehghani Bidgoli and Ranjbarfordoei (2013) stated physiological changes in different plants at various phenological stages are different. The growth stage is effective on plant species quality. As Butler and Bialy (1973) reported the leaves contain high moisture, protein, mineral and low in fiber at early growth stage of forage plants. Quality of pasture affects fibrolytic activity of rumen micro-organisms which may be restricted when poor quality forage is fed (Fondevila et al., 1995). Forage with high digestibility is more intakes (Van Soest, 1994). The forbs and shrubs leaves are more digestible than grass (Short et al., 1974; Milchunas et al., 1978; Wofford and Holechek, 1982). Poor quality forage remains in the stomach of the animal about twice as long as does high quality one. According to Roy (1979) as the level of the roughages in the rations increased, the digestibility of the EE, DM, organic matter and N –free extract decreased and the CF digestibility increased.

The quality of forage differs at diverse regions. CP and phosphorus (P) amounts were reported 9 and 0.09 percent, respectively, in Utah shrub lands (Cook et al., 1959), 11 and 0.16 percent in

grass and desert rangeland of New Mexico (Nelson et al., 1970), 11 and 20 percent in short grassland of arid New Mexico range (Pieper et al., 1978; Cordova and Wallace, 1975), 19 and 0.17 percent in South of Texas (Varner et al., 1979), 8 and 27 percent in Belak Hilz, South of Dakota (Severson, 1982), overall average 11 and 0.17 percent. According to literature review, the amounts of CP and P are moderate in shrubs than forbs and grasses.

Several researchers studied nutrient values of forage plants for different range plant species. The research results of Ronald and Rex (1993) showed that the *Paspalum distichum* have more CP, *Sparganium erectum* have less CP, and *Aeluropus littoralis* have CP less than *Sparganium erectum* plant species. Heshmati et al. (2007) identified *Trifolium repens* as higher nutritive value with more CP and *Dactylis glomerata* as low nutritive value with less CP among 11 plant species in East of the Golestan Province. Result of research of Ayan et al., 2006 showed that *Rumex crispus*, *Convolvulus arvensis*, *Plantago lanceolata*, *Taraxacum officinale*, *Sanguisorba minor*, and *Malva neglecta* are the most important species for forage uses in the rangeland under this investigation considering the CP, CA, potassium (K), P, magnesium (Mg), and Ca contents. Jung et al. (1996) and Acar and Guncan (2002) stated that high variations were observed in the same species regarding the characters such as CP. Tan and Yolcu (2001) reported that similar weedy species were rich in P, CA, many kinds of minerals in a study on nine wild plant species. More recent researches have revealed that the forage nutritive value of some weed species may be comparable to that of cultivated forages (Tan and Yolcu, 2001; Acar and Guncan, 2002). Dutt et al. (1982) reported that there was no decrease in feeding value of alfalfa and digestibility of forage in the contamination of *Medicago sativa* and *Taraxacum officinale* Weber.

Overall, chemical composition of each plant part should be analyzed for identifying plant species with more forage quality. The introduced nutritive value is useful for planners to select plant species for cultivation and managing-conservation affords. Usually, plant species are selected with high CP, fat, vitamin, carbohydrates, minerals (Lindsey and Ohno, 1999; Al-Shorepy et al., 2001; Hyder and Sneva, 2003). According to the literature review, type of habitats, plant parts used have effect on quality of forage.

MATERIALS AND METHODS

Case Study

This study was conducted in Sharlogh Rangelands around national Golestan park and cultivated at Research and Education Center of Agricultural and Natural Resources (RECANR) Golestan province in northeast of Iran at September 2015. The Sharlogh Rangeland is located at 37° 53′ 06″ N latitude 55° 53′ 21″ E longitude. Mean annual precipitation and temperature are 400 millimeters and 11.5-17.5 °C, respectively. The climate is cold semi-arid with elevation 193 meters above sea level (Figure 1). The dominant vegetation is *Juniperus polycarpus*, *Artemisia sieberi*, *Astragalus* sp. and *Festuca ovina* (Avarseji, 1995). The RECANR is located at 36° 50′ 29″ N latitude 54° 27′ 28″ E longitude 41°21′ N latitude 36°15′ E longitude. Mean annual precipitation and temperature are 630 millimeters and 17.8 °C, respectively. The climate is moderate semi-moisture with elevation 146 meters above sea level.

Plant Materials and Sample Collections

The *J. fruticans* L. belong to Oleaceae family. This plant is a woody species (Figure 2). This plant is Phanerophytes Life form and Irano-Turanian, Mediterranean, Euro-Siberian Chorotype (Jankju Borzelabad et al., 2011).

Sampling data were collected from three replicated plots of plant parts in different regions. Therefore, 20 plants were harvested for plant parts during the flowering stage in two regions as treatments (Sharlogh and RECARN regions).

Analysis

The plant materials were dried in an oven at 70-105 °C for 24-72 hours. After cooling and weighing, the dried samples were ground. DM percent was calculated (Equation 1).

$$DM = ((A-B)/(C-B)) * 100 \quad \text{Equation [1]}$$

Where; DM: Dry matter, A: Dry weight, B: Dishes weight and C: Moisture weight.

Crude Protein (CP)

Measurement of the CP in this plant species was done by evaluation of the N content of the plants, assuming that all the proteins in the plants contained 6.25% nitrogen (6.25% N). The N was used for protein synthesis at 370-410 °C for 2-3 hours. CP was measured by the Kjeldahl

technique (AOAC, 1990). Then, the following equation was used to calculate the CP (Equation 2).

$$\text{CP (\%)} = (6.25 + \%N)/A. \quad \text{Equation [2]}$$

Where; CP: Crude protein, N: Nitrogen content percent, and A: Sample weight (0.5 g).

Ether Extract (EE)

The Ether Extract was measured by using 80 CC Eteria (Ethanol, 2-Ethyl-ethanol, 2-Ethyl-ether, Acetone and ect.). The following Equation was used to calculate the EE (Equation 3).

$$\text{EE (\%)} = (A-B)/C * 100. \quad \text{Equation [3]}$$

Where; EE: Ether Extract, A: Balloon weight with fat, B: Empty Balloon weight, and Sample weight (1 g).

Crude Ash (CA)

CA content was found ashing the plant samples at 550 °C for 2-3 hours (AOAC 1990) (Equation 4).

$$\text{CA (\%)} = (A-B)/C * 100. \quad \text{Equation [4]}$$

Where; CA Crude ash, A: Dishes weight with ash, B: Empty Dishes weight, and Sample weight (0.2-0.3 g).

Crude Fiber (CF)

To measure the CF content of the plants, 1 g of the ground sample was placed into the glass tubes in the Fibertec. Then, 100 ml ADS (Acid Detergent Solution) was added and boiled for 1 hour. For the preparation of the ADS, 20 g $\text{BrNH}_4(\text{CH}_3)_3$ (Three methyl bromide) was mixed with 10 milliliters H_2SO_4 (Sulfuric acid). Then, the samples were washed with distilled water and acetone in the cold extraction device and placed in the oven at 120 °C for 2 hours. Afterwards, the samples were put in an electric furnace at 500 °C for 3 hours. In the electric furnace, all of the samples' cellulose and lignin were burnt and only the minerals were remained. The CF was obtained using the following Equation (Equation 5).

$$\text{CF (\%)} = (\text{A}-\text{B})/\text{C} * 100. \quad \text{Equation [5]}$$

Where; CF: Crude Fiber, A: Initial sample weight, B: Samples weight after burning after weight Samples, and Sample weight (0.3 g).

Metabolisable Energy)ME)

After the DMD was found, the following formula was used to calculate the metabolisable energy. $\text{ME} = 0.17\text{DMD\%} - 2$ AOAC (1990).

Mineral Elements

Mineral elements, including Ca and P were measured. The most effective means of determining the type and concentration of specific minerals is to use atomic absorption. The sample to be

analyzed is normally ashed and then dissolved in an aqueous solution. This solution is placed in the instrument where it is heated to vaporize and atomize the minerals. A beam of radiation is passed through the atomized sample, and the absorption of radiation is measured at specific wavelengths corresponding to the mineral of interest. Information about the type and concentration of minerals present is obtained by measuring the location and intensity of the peaks in the absorption spectra.

Statistical Analysis

For the comparison of nutrient value plant species t-test was applied. Also the comparison of nutrient value between plant parts one-way analysis of variance (ANOVA), Duncan method was applied.

RESULTS AND DISCUSSION

The mean nutrient value parameters between at both regions are compared via t-test (Table 1). In this study, region has any significant difference at the nutrient value parameters. Results also showed differences ($P < 0.05$) between CA in regions.

The results of the one-way analysis of variance showed significant differences between plant parts of the species for all study parameters ($P < 0.01$) (Table 2). The mean values of DM and CF parameters of the stems were higher compared with the leaves. The CP, CA, Ca, P, and EE parameters of the leaves were higher compared to that of the stems. The Ca, P and CA

parameters of the leaves were similar to that of the total plants. These parameters were different for the stems at the $P < 0.01$ level.

Nutritional value varied ($P < 0.05$) among regions (Table 1). Results showed that the mean CA of *J. fruticans* was higher at Sharlogh rangelands (6.5 percent) than RECARN (5.75 percent). This difference is significant at 0.05 probability level. Different researchers have reported Ca ratios of different regions between 7.6 and 22.2% (Teutonica and Knorr, 1986; Tan and Yolcu, 2001; Ayan et al., 2006). Shortage of CA caused weakness and increasing mortality of livestock (Holecheck et al., 1983). Therefore, the *J. fruticans* is better at Sharlogh rangeland for increasing livestock function. Overall, both regions are good sources for providing forage for the livestock.

Ca/P contents of the plant species is near 1.95. The Ca/P ratios of *R. crispus* and *T. officinale*, were less than 2.00 that are similar to *J. fruticans* (Ayan et al., 2006). Some researchers (Jacobson et al. 1972, Reid and Jung 1974) have reported that when Ca/P ratio is over 2.00, milk fever may be observed in animals, or growing performance and effectiveness of the forage-animal product transformation may decrease. According to the results of Cohen (1975), the Ca/P ratio (upto 2) is not limiting factor for livestock production and function. Ruminants resistance for the Ca/P ratio higher than 2 is critical for ruminant production.

Ca contents of the species are 0.33% (at the Sharlogh rangeland) and 0.37% (at the RECARN). Ca contents in forages are recommended at least $3.1 \text{ g} \cdot \text{kg}^{-1}$ for ruminants (National Research Council (NRC), 1984). The values of examined two regions were less than the recommended ones; and those of other species were into the recommended limits (Tan and Yolcu 2001). P contents of the plant species were between 0.17% (at the Sharlogh rangeland) and 0.19% (at the RECARN). It is reported that forages for cattle should contain P between 0.17

and 0.39% (NRC, 1996) and forages for sheep should have P between 0.16-0.38 percent (NRC 1984). So, these plant species were not into the recommended limits.

The Ca, P, and CA contents of the leaves are greater than that of the stems. So, the plant leaves are providing needed minerals for the livestock. The mean values of DM, CF, EE, and CP are different between the plant parts for different species at 0.01 probability level. Greater DM and CF were estimated for the stems with 90.54 and 39.22%, respectively. The lowest of these parameters were estimated for the leaves with 34.03 and 17.88%, respectively. This result is similar to that of Hendrickson et al. (1981) that stated intake stem is less by livestock due to high CF and DM content. Dehghani Bidgoli et al. (2012) also stated ADF values in shrubs were higher than that in grass, followed by forbs. However, Ee and CP were greater in leaves (3.23 and 11.08 percent, respectively) than in stems (0.73 and 3.74 %, respectively). This result is in agreement with Cook and Harris (1950) and Holecheck et al. (1983) results. Cook and Harris (1950) observed that leaf CP content of grasses on Utah summer range (~ 12 percent) was greater than that of stem CP (~ 4 percent).

Overall, the leaves CP and ME contents of the plant species were greater, while for the stems, the CF was greater. This is due to the maintenance and the strength of the stem tissues. So, nutritive value of the leaf leave is more than stem. This result is similar to that of Ronald and Rex (1993) and Poppi et al. (1981). Plant materials are divided into fibrous and nonfibrous fractions. In ruminants, fiber fractions that provide energy are important as celluloses and hemicelluloses are easily digestible. The phenolic polymers like lignin are almost indigestible that may hinder carbohydrate digestion (Hussain and Durrani, 2009).

CP content of *J. fruticans* leaves were more than that of *D. glomerata*, and less than that of *Trifolium repens* (Heshmati et al., 2007). This appears to be due to climate factors and phenological stages. Changes in the chemical composition of these species showed that plant part of species is the most important factor affecting the forage quality. Therefore, according to these results, in order to improve the rangelands conditions and select a suitable grazing system, the following factor is essential: location of the food reserves in the rangelands' species. The forage quality indicators including all parameters were different in various plant species parts, except for DE. It seems that, the main constituents of the plant structure such as leaf to stem weight ratio, leaves' arrangement, stem length and growth rate determine the quality of the plants.

CONCLUSIONS

Results indicate that *J. fruticans* is a valuable source of forage for livestock due to high content of CP in tissues. The poor livestock productivity is partially due to insufficient amount of available good quality forage. In addition, this plant is resistance to fire and grazing intensity (this was observed in the Sharloogh rangeland- Figure 2) and has good growth in the city. This suggests that attention of the range managers is required to improve the habitat and livestock breeds by cultivating this plant. The managers can plan multiple usage, either development of urban green space or providing forage for the livestock.

Also, it is suggested to estimate the nutritive values of the plant species during the phenological stages in order to meet the nutritional needs of the animals and ensure the re-growth of the rangelands' plant species and determining the grazing time.

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FIGURE 1. The locations of the studied area in Iran (A) and Golestan Province (B)

FIGURE 2. The plant species of *Jasminum fruticans* L.

TABLE 1. Comparing of nutrient value parameters between region treatments

Treatment	Variables	Observation Degree				Probability		F	Probability level
		Average	SD	number of Free	Calculated tlevel	(2-tailed)			
DM	Sharlogh	61.28	24.65	9	16	0.279 ^{ns}	0.784	0.035 ^{ns}	0.855
	RECARN	58	25.11	9					
CP	Sharlogh	6.89	3.19	9	16	-0.653 ^{ns}	0.523	0.002 ^{ns}	0.926
	RECARN	7.88	3.19	9					
EE	Sharlogh	2.21	1.14	9	16	0.002 ^{ns}	0.998	0.003 ^{ns}	0.957
	RECARN	2.21	1.15	9					
CF	Sharlogh	29.16	9.21	9	16	0.524 ^{ns}	0.607	0.002 ^{ns}	0.966
	RECARN	26.26	9.41	9					
ME	Sharlogh	6.51	10731	9	16	0.970 ^{ns}	0.347	4.425 ^{ns}	0.052
	RECARN	3.04	559	9					
CA	Sharlogh	6.5	0.86	9	16	2.145[*]	0.048	1.81 ^{ns}	0.197
	RECARN	5.75	0.59	9					
Ca	Sharlogh	0.336	0.079	9	16	-0.926 ^{ns}	0.368	0.008 ^{ns}	0.928
	RECARN	0.372	0.083	9					
P	Sharlogh	0.17	0.05	9	16	-1.106 ^{ns}	0.285	0.413 ^{ns}	0.530
	RECARN	0.19	0.06	9					

* Significant difference at 5 percent level, ^{ns}: no significant difference

TABLE 2. Comparison of the nutritive value parameters between the plant parts

Parameter	Treatment	Degree of		MS	F	Sig	The average of parameters between plant parts		
		Free					Total	Leave	Stem
DM	Plant part	2	4917.17	605.05*	0.000		54.35	34.03	90.54
	Error Total	15	8.126				a	b	c
CP	Plant part	2	81	200*	0.000		7.35	11.08	3.74
	Error Total	15	0.405				a	b	c
EE	Plant part	2	10.39	815*	0.000		2.68	3.23	0.73
	Error Total	15	0.013				a	b	c
CF	Plant part	2	688.52	298.1*	0.000		26.94	17.88	39.22
	Error Total	15	2.31				a	b	c
ME	Plant part	2	7.31	1.319 ^{ns}	0.297		3286.93	8772.23	2285.52
	Error Total	15	5.54				a	a	a
CA	Plant part	2	3.56	13.26*	0.000		6.33	6.78	5.28
	Error Total	15	0.269				a	a	b
Ca	Plant part	2	0.05	68.98*	0.000		0.39	0.42	0.25
	Error Total	15	0.001				a	a	b
P	Plant part	2	0.02	34.53*	0.000		0.21	0.22	0.21
	Error Total	15	0.001				a	a	b

* Significant difference at 5 percent level, ^{ns}: no significant difference