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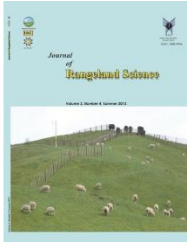

Full Length Article:

Chemical Composition and In Vitro Digestibility of Some Range Species in Rangelands of Chaharmahal and Bakhtiari Province, Iran

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Abstract. Five common range forage including *Agropyron intermedium*, *Bromus tomentellus*, *Hordeum bulbosum*, *Cousinia bakhtiarica* and *Scariolla orientalis*, were sampled during three phenological stages, from controlled rangeland stations over five locations in Chaharmahal and Bakhtiari province, Iran. All samples were chemically analyzed for Crude Protein (CP%), in vitro Dry Matter Digestibility (DMD), Organic Mater Digestibility (OMD), Ether Extract (EE), Crude Fiber (CF), total Ash, Neutral Detergent Fiber (NDF) and Acid Dtergent Fiber (ADF). Results for Crude Protein (CP%) showed significant differences between phenological stages in all of species. Maximum CP (15.2%) was found in vegetation stage of *Hordeum bulbosum* and the minimum (2.9%) was in seed ripening stage. The CF% was significantly different between phenological stages as well as the species. The minimum and maximum values of CF% were found in *Agropyron intermedium* in *Coosinia bakhtiarica*, respectively. Similarly, the minimum values of NDF and ADF were found in vegetative stage of *Scariolla orientalis* and *Agropyron intermedium* respectively, but the maximum values were obtained in seed ripening stage of *Hordeum bulbosum* and *Cousinia bakhtiarica*. The DMD and OMD% showed slightly reduction passing from vegetation to seed ripening stage in most of the species. The highest DMD and OMD% had been observed in vegetation stage of *Scariolla orientalis* and the lowest were in *Bromus tomentellus*. It can be concluded that in the early stage of growth, the quality of forage in range species is adequate for livestock production but during that stage, the greatest problem is its lower quantity. By progress of the vegetation stage toward the seed ripening stage, the nutritive value of all species decreased thus grazing animals oppose to nutrient deficiencies.

Key words: Range forage, Chemical composition, In vitro digestibility, Phenological stages, Chaharmahal, Bakhtiari province

Introduction

Shortage of feed resources often impose major constrains on the development of animal production in dry land areas such as majority of parts in Iran (Shakeri and Fazaeli, 2004).

Limitation of feed and natural resources, are the main problems faced with animal production in Iran and many developing countries as well (Rezvanfar and Shafiee, 2005). For maintaining sufficient growth and reproductive performance, animal producers need to compare the nutritional changes of range forage (Ramirez *et al.*, 2004). The principal factors limiting the performance of grazing animals are low protein content of grasses, low energy intake due to high fiber content and mineral deficiencies or imbalances (MC Dowell, 1985). The concept of matching small ruminant livestock production with available feed resources needs therefore intensified research into optimum use of local feed resources.

Chaharmahal & Bakhtiari province in the south west of Iran, has a long history of livestock grazing and nomadic system where most of the people depend on the livestock rangeland socio-economically system (Shaidaee and Niknam, 1970). The climate in these regions is semi-arid with annual precipitations of about 700 mm, which distributed from early autumn, to mid spring. A high majority of the sheep and goats population is managed under a migratory system, utilizing the ranges as the major source of feed. Furthermore, the feeds availability from natural grazing are limited and of low quality and periodic drought is also a constraint (Farid *et al.,* 1977; Shadnoush *et al.,* 2004). In this situation, optimum utilization of limited feed resources is based on available information about the locally feeds (Shakeri, and Fazaeli, 2004). Thus, development of forage production plans and improvement of balance nutrition system for livestock, need information of the nutrition value of range plants. However, there are few reports to quantify seasonal nutritional changes of the most important range, grasses and forage which consumed by range sheep and goats (Shadnoush, 2004; Shakeri and Fazaeli, 2004). The nutritive value of herbage depends not only on the growth or on maturity of the plants, but also on the seasonal variation and climatic conditions. The nutrient values are much different among plant species so as legumes and grasses. Additionally, the variation among the species of one family for nutrient values may be important (Shakeri and Fazaeli, 2004; Shadnoush, 2004).

In spring, the native graminaceous, herbaceous and brows species are growing and producing new foliage. During the end of summer and autumn most of the species showed reduction amount of nutrient, passing from vegetation to seed ripening stage, (Ramirez *et al.*, 2004). The nutritive value of a specific range plant may be affected by the variation among the soils, rainfall, temperature, and other ecological conditions. The nutritive value of forages can be determined by their chemical composition, digestibility, and palatability or by a combination of chemical constituents and *in vitro* techniques of digestibility (Ghoorchi, 1995; Pinkerton, 1996; Akbarinia and Koocheki, 1992; Arzani *et al.*, 2004). The aim of this study was to assess the chemical composition, and seasonal variations of five native dominant range plant species in semi- arid rangeland of Chaharmahal- Bakhtiari province in Iran.

Material and Methods

Study area

The study was carried out on five different controlled stations of Shahrekord, Borujen, Farsan, Lordegan and Ardal, which located between 31° 9' to 32° 48' N and 49° 30' to 51° 26' W. These areas almost account whole of medium condition rangeland in Chaharmahal-Bakhtiari province, Iran. The average altitude of area is 2000m. The climate of this region is considered semi- arid with annual mean temperature of 11.2°C and about 700 mm precipitation, which is with peak rainfalls in fall and winter. Precipitation is also very erratic and distributed 30, 52 and 18 percent in fall, winter and spring, respectively. However, 4-5 months of the year is dry (Reisian, 1998). This extreme year- to- year, rain and moisture variation is probably a greater constraint on ecological and agricultural systems than is the low annual amount of rainfall. Droughts are also common and frequently severe.

Plant sampling method

Five forage species *Agropyron intermedium*, *Bromus tomentellus*, *Hordeum bulbosum*, *Cousinia bakhtiarica* and *Scariolla orientalis*, which are common throughout the rangelands area, were collected from controlled station that were prohibited from grazing for ten years. The sampling was taken in three times at vegetative, blooming and seed ripening stages (May-Sep). As encountered on the ranges were hand harvested at 2-4 cm above ground level until adequate amounts of material were obtained, composite by species in each of sampling stage and area. Sampling was intended to simulate grazing by sheep (Ghadaki *et al.*, 1974). Samples were air-dried, and then they were ground pass through in a mill (1 mm) and stored in plastic containers for further analysis.

Chemical composition and in vitro digestibility analysis

Samples were analyzed for Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) and Gross Energy (GE) total Ash (AOAC, 1990). The cell walls constituents as Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were determined using (Van Soest *et al.*, 1991) method. The Dry Matter Digestibility (DMD) and Organic Matter Digestbility (OMD) were determined by using of in vitro two stages Tilly and Terry (1963) method.

Statistical analysis

Data were statistically analyzed, using factorial experiment based on complete randomized block design with four replications. The two factors were: five forage species and three phenological stage, by GLM of SAS (2001). Means and standard error of traits were compared using Duncan Multiple Range Test (DMRT) method.

Results and Discussion

Species chemical composition

Means of chemical compositions of five range species are shown in Table 1. The overall means of species for CP% was 8 (ranged 6.7-8.8), EE% mean was 3.1 (ranged 2.2- 4.1), CF% mean was 37.2 (ranged 31.5- 42), Total Ash% mean was 7.5 (ranged 6.7- 8.5) and GE mean was 4.2 Mcal kg^{-1} (ranged 4.1- 4.3). There were significant differences between species for nutrient, Because of the structural differences between the plants, such a variation among the species of range plants are expected (Ghadaki *et al.*, 1974; Topps, 1998; Arzani *et al.*, 2004; Ventaura *et al.*, 2004 and Ramirez *et al.*, 2004).

Crud protein

The minimum and maximum values of CP with average values of 6.7% and 8.8% were found in *Scariolla orientalis* and *Hordeum bulbosum*, respectively. There was also significant ($P<0.05$) variation among phenological stages for the CP (Table 1). The maximum values of CP was found in the vegetative stage and the minimum in seed ripening stage ($P<0.05$). All forage exhibited their higher CP values in vegetative stage, then slowly decrease in blooming stage and showed lowest content at seed ripening CP may have been induced by the precipitations seasonal variation (Promkot and Wanapat, 2004). The morphological and structural changes in the plants and variation of leaves to stem ratio are important factors, which affected CP content of the plants in phenological stages as well as the structural differences between the species. These results are in agreement with the suggestion of (Jerry *et al.*, 1989). Considering the plant species and sampling stages, the highest CP was found in *Hordeum bulbosum* (15.2%) at vegetative stage and the minimum in the same species (2.9%) at seed ripening stage (Table 2). Akbarinia and Koocheki (1992), Arzani *et al.* (1998) and Arzani *et al.* (2004), reported seasonal changes in CP of range plant during different phenological stages. They found that when plants became older, CP content was declined. The CP content was significant ($P<0.05$) different between the three phenological stages and at early stage of growth, range forage have higher CP than the later stages. Similar to this study Ghoorchi (1995) reported reduction of CP of forage when plants matured.

Crud fiber

Means of CF content for five native range species is shown in Table 1. Overall mean of CF were 37.2% (range 31.5-42%), the minimum amount was found in *Agropyron intermedium* 31.5% and the maximum was found in *Cousinia bakhtiarica* 42%, which was significant ($P<0.05$) differences between the two species. A negative correlation was found between the CF and CP content in all of species that was in accordance with the results reported by Ramirez *et al.*, (2004). Moreover species of *Agropyron intermedium, Bromus tomentellus* and *Hordeum bulbosum* had lowest, but stage. These phenological fluctuations in *Cousinia bakhtiarica* and *Scariolla orientalis* had highest of CF which belong to Graminae and Compositae family respectively. This finding is accorance to Ghoorchi (1995). The CF content was significantly different ($P<0.05$) between phenological stages for all species, except for *Agropyron intermedium*, *Hordeum bulbosum* and *Bromus tomentellus*, which were similar in blooming and seed ripening stages (Table 3). Regarding the species and phenological stages, *Agropyron intermedium* had significantly ($P<0.05$) the lowest 28.5% of CF in vegetative stage, but *Scariolla orientalis* had the highest values 45.6% in seed ripening stage. It seems that CF content in native range species were influenced by climatic conditions, thus fiber and lignin increase with maturity of plants, because mature stems contain more fibers compared with immature stems and leaves, which generally form from parenchyma tissues. Although from the primary growing until the stage of flowering, range species have a higher leaf to stem ratio when the structural portion as well as the CF is low in the plants but it will be changed by increasing the structural proportion toward the maturation. Other researcher (MC Donald *et al.*, 1995; Ghoorchi, 1995; Arzani *et al.*, 2004 and Ramirez *et al.*, 2004) for different species reported variations of CF concentration, during the phenological stages. They concluded that with progress of plants growth, when plants became older, CF content increased in structural carbohydrate, such as celluloses, hemicelluloses, and lignin when they are increased. In this study the CF content was significantly ($P<0.05$) different mostly where it was increased in accordance with progress of plant growth and between species.

Table 1. Means and standard error for chemical composition of five range species

Species Name	No	CP%	EE%	CF%	Ash%	GE (Mcal kg^{-1} DM)
Agropyron intermedium	56	8.3 ±0.4 ^{b}	3.1±0.2 ^{b}	31.5 ±0.7 ^{d}	8.5 ± 0.2 ^{a}	4.3±0.06
Bromus tomentellus	55	7.9 ±0.4 ^{b}	2.2±0.2 ^{c}	35.2 ±0.8 ^{c}	7.5 ± 0.2 ^{b}	4.2±0.06
Hordeum bulbosum	44	8.8 ±0.5 ^{a}	2.3±0.2 ^{c}	34.8 ±0.9 ^{c}	8.2 ±0.3 ^{a}	4.2±0.67
Cousinia bakhtiarica	60	8.0 ±0.4 ^{b}	3.8±0.2 ^{a}	42.0 ±0.7 ^{a}	6.8 ± 0.2 ^{c}	4.3±0.06
Scariolla orientalis	58	6.7 ±0.4 ^{c}	4.1±0.2 ^{a}	40.2 ± 0.7 ^{b}	6.7 ± 0.2 ^{c}	4.1±0.06
Overall mean	-	8.0 ±0.4	3.1 ±0.2	37.2 ± 0.75	7.5 ± 0.2	4.2±0.06

Means followed with different letters (a, b, c and d) in the same column of each species differ significantly (P<0.05)

Table 2. Means of CP% between species and among phenological stages of five range species

Species Name	Vegetative	Blooming	Ripening	Mean± SE
Agropyron intermedium	13.7 $^{a\,(B)}$	8.0 $^{b\,(A)}$	4.1 $^{c\,(AB)}$	8.3±0.39 $^{(A)}$
Bromus tomentellus	13.3 $^{a\,(B)}$	6.8 $^{b\,(B)}$	3.6 $^{c\,(BC)}$	7.9 ±0.4 $^{(A)}$
Hordeum bulbosum	15.2 $^{a\,(A)}$	8.4 $^{b\,(A)}$	2.9 $^{c\,(C)}$	8.8 ±0.5 $^{(A)}$
Cousinia bakhtiarica	13.5 $^{a\,(B)}$	5.8 $^{b\,(C)}$	4.8 $^{c\,(A)}$	8.0 ±0.4 $^{(A)}$
Scariolla orientalis	11.4 $^{a\,(C)}$	5.2 $^{b\,(C)}$	3.4 $^{c\,(BC)}$	6.7 ±0.4 $^{(B)}$

Means with in species and a phenological stage in a row followed by different lowercase letter (a, b, c) are significantly different (P<0.05)
Means of species for each phenological stage in a column followed by different uppercase letter (A, B, C, D, E) in parenthesis are significantly different (P<0.05)

Table 3. Means of CF% between species and among phenological stages of five range species

Species Name	Vegetative	Blooming	Ripening	Mean± SE
Agropyron intermedium	28.5 $^{b\,(C)}$	32.6 $^{a\,(D)}$	33.6 $^{a\,(D)}$	31.5±0.73 $^{(D)}$
Bromus tomentellus.	32.9 $^{c\,(B)}$	35.0 $^{b\,(C)}$	37.6 $^{a\,(C)}$	35.2 ±0.8 $^{(C)}$
Hordeum bulbosum	31.2 $^{b\,(B)}$	35.8 $^{a\,(C)}$	37.3 $^{a\,(C)}$	34.8 ±0.9 $^{(C)}$
Cousinia bakhtiarica	36.6 $^{b\,(A)}$	45.1 $^{a\,(A)}$	44.0 $^{a\,(B)}$	42.0 ±0.7 $^{(A)}$
Scariolla orientalis	33.6 $^{c\,(B)}$	41.3 $^{b\,(B)}$	45.6 $^{a\,(A)}$	40.2 ±0.7 $^{(B)}$

Means within species and a phenological stage in a row followed by different lowercase letter (a, b, c) are significantly different (P<0.05)
Means of species for each phenological stage in a column followed by different uppercase letter (A, B, C, D, E) in parenthesis are significantly different (P<0.05)

Cell wall content

The results of Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) are presented in Tables 4 and 5. As it is shown, NDF and ADF concentration were significantly (P<0.05) different between vegetation and blooming stages in most of the species, however the trend of variation were not similar for all the species. The species of *Agropyron intermedium*, *Bromus tomentellus* and *Hordeum bulbosum* had highest means of NDF and ADF, but *Cousinia bakhtiarica* and *Scariolla orientalis* showed the lowest (P<0.05).

The minimum NDF was found in vegetative stages of *Scariolla orientalis* (54.9%), but the maximum values was obtained in seed ripening stage of *Hordeum bulbosum* (78.3), whereas the minimum and maximum of ADF were found in vegetative stage of *Agropyron intermedium* (35.3%) and seed ripening stage of *Scariolla orientalis* (54.6%), respectively.

In general, during the summer and autumn seasons, NDF and ADF were higher than in the spring. As plant growth progressed, NDF and ADF in all species increased (Table 4 and 5). In species of *Bromus tomentellus*, *Hordeum bulbosum* and *Cousinia bakhtiarica*, the NDF was not significantly increased in seed ripening stage comparing to the blooming stage, because physical structure of these species were fully developed in blooming stage. 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 tissue in seeds, ADF and NDF contents varied from blooming to the seed ripening, however it depends on the species as well. Similar results were reported for NDF and ADF in some range species (Arzani *et al.*, 1998; Arzani *et al.*, 2004; Shakeri and Fazaeli, 2004 and Promkot and Wanapat, 2004), when they found that by progress of plant growth, ratio of protector and firmness tissues, which mostly consist of structural carbohydrates such as celluloses, hemicelluloses and lignin, are increased. Therefore, maturity of plant caused an increase in structural carbohydrates and causes higher ADF and NDF amount in plant species. Scarborough *et al.* (2001) when reported that sampling stage affected concentration of ADF and NDF in un-grazed and grazed Bermuda grass pasture, reported such a result.

Table 4. Means of NDF% between species and among phenological stages of five range species

Species Name	Vegetative	Blooming	Ripening	Mean± SE
Agropyron intermedium	62.8 $^{c\,(A)}$	68.1 $^{b\,(B)}$	74.5 $^{a\,(A)}$	68.4±1.9 $^{(A)}$
Bromus tomentellus	65.5 $^{b\,(A)}$	74.2 $^{a\,(A)}$	78.0 $^{a\,(A)}$	72.5±2.0 $^{(A)}$
Hordeum bulbosum	63.6 $^{b\,(A)}$	74.5 $^{a\,(A)}$	78.3 $^{a\,(A)}$	72.1±2.2 $^{(A)}$
Cousinia bakhtiarica	58.5 $^{b\,(B)}$	66.4 $^{a\,(B)}$	65.6 $^{a\,(B)}$	63.5 ±1.8 $^{(B)}$
Scariolla orientalis	54.9 $^{c\,(B)}$	61.1 $^{b\,(C)}$	66.3 $^{a\,(B)}$	60.7 ±1.9 $^{(B)}$

Means with in species and a phenological stage in a row followed by different lowercase letter (a, b, c) are significantly different (P<0.05)

Means of species for each phenological stage in a column followed by different uppercase letter (A, B, C, D, E) in parenthesis are significantly different (P<0.05)

Table 5. Means of ADF% between species and among phenological stages of five range species

Species Name	Vegetative	Blooming	Ripening	Mean± SE
Agropyron intermedium	35.3 $^{c\,(C)}$	40.5 $^{b\,(B)}$	46.1 $^{a\,(C)}$	40.6±1.2 $^{(B)}$
Bromus tomentellus	38.1 $^{c\,(C)}$	41.2 $^{b\,(B)}$	47.7 $^{a\,(C)}$	42.3 ±1.4 $^{(B)}$
Hordeum bulbosum	35.7 $^{c\,(C)}$	43.2 $^{b\,(B)}$	50.7 $^{a\,(B)}$	43.2 ±1.5 $^{(B)}$
Cousinia bakhtiarica	44.8 $^{b\,(A)}$	51.3 $^{a\,(A)}$	53.7 $^{a\,(A)}$	49.9 ±1.2 $^{(A)}$
Scariolla orientalis	41.5 $^{c\,(B}$	49.9 $^{b\,(A)}$	54.6 $^{a\,(A)}$	48.6 ±1.3 $^{(A)}$

Means with in species and a phenological stage in a row followed by different lowercase letter (a, b, c) are significantly different (P<0.05)

Means of species for each phenological stage in a column followed by different uppercase letter (A, B, C, D, E) in parenthesis are significantly different (P<0.05)

Digestibility

Dry matter digestibility (DMD) and organic matter digestibility (OMD) are shown in Table 6. The overall mean of in vitro DMD of studied range species was 48.4% (ranged 45.3-50.7%). The amount of DMD% showed slightly reduction, passing from vegetation stage in spring to seed ripening stage in summer and autumn in most of species. Except for the species of *Cousinia bakhtiarica* and *Scariolla orientalis* there were no significantly differences for DMD from vegetation to blooming and seed ripening stages. Among evaluated plant species, the highest amount of DMD had observed in vegetation stage of *Scariolla orientalis* (58.6%) and the lowest values was obtained in *Bromus tomentellus* (41.7%) at seed ripening. In this study the lower DMD observed in blooming and seed ripening stage was related to higher NDF contents, that is in accordance with the results of Arzani *et al.* (2004) which reported DMD mainly decreased by growth progress in range species.

Akbarinia and Koocheki (1992) reported that a reduction of DMD with maturity of plants is due to increasing of structural tissues in stems. They also stated that increasing or less changing of DMD in some grass species when seed are mature is due to relatively high amounts of digestible carbohydrates in seeds. It is well accepted that forage digestibility in the rumen is mainly affected by the cell wall content and its lignification. Lignin limits the access of microbial enzymes to the structural polysaccharides of the cell wall. Ammar (2002) reported that NDF, ADF, and lignin were significant and negatively correlated with digestibility. Pinkerton (1996) reported a close relationship between digestibility and cell wall characteristics. He showed that only cell contents could be 100% digestible and will not reduce even when the plant becomes mature. In contrast, the chemical structure of cell walls changed with plant growth. As plant growth continues, fiber content increases and digestibility decreased. In addition, some researcher (Kashki, 2001 and Erfanzadeh, 2001) reported reduction of digestibility in matured plants. Overall means of in vitro OMD of five range species was 58.8% (52-61.7%) (Table 7).

Similar to the DMD trend, in most of the range plants OMD showed slightly decreasing by progress of growth, specially passing blooming to seed ripening stage. Maximum OMD was found in vegetation stage of Scariola orientalis (71.7%) and minimum was 47.6% in seed ripening stage of *Bromus tomentellus*. It may be a reason why Scariolla orientalis usually had been considered as a good grazing plant by sheep and goats in vegetation stage but un-grazed in other stages. In general, during the summer and autumn seasons, as plant growth progressed, structural carbohydrates were developed, NDF and ADF increased, so OMD decreased from the vegetation to the blooming stages. Deinum *et al.* (1968) support these results, when they found that, temperature and maturity have great influence on digestibility and nutritive value of grasses. Also Ghadaki *et al.* (1974) reported that the differences in digestibility between grasses in arid-zone and temperate-zone could be explained by the differences in the amounts of precipitation in this area. Negative correlation between the amount of water and the digestibility reported before (Snaydon, 1972).

Table 6. Means of DMD% between species and among phenological stage of five range species

Species Name	Vegetative	Blooming	Ripening	Mean
Agropyron intermedium	50.6$^{a\,(B)}$	50.2$^{a\,(A)}$	46.4$^{a\,(A)}$	49.0±2.7 $^{(A)}$
Bromus tomentellus	49.1 $^{a\,(B)}$	45.3 $^{a\,(A)}$	41.7 $^{a\,(A)}$	45.3±2.8 $^{(C)}$
Hordeum bulbosum	54.6 $^{a\,(B)}$	49.9 $^{a\,(A)}$	45.6$^{a\,(A)}$	50.0±3.2 $^{(A)}$
Cousinia bakhtiarica	53.2 $^{a\,(B)}$	45.4 $^{b\,(A)}$	42.8$^{b\,(A)}$	47.1±2.6 $^{(B)}$
Scariolla orientalis	58.6 $^{a\,(A)}$	48.3 $^{b\,(A)}$	45.3 $^{b\,(A)}$	50.7 ±2.7$^{(A)}$

Means with in species and a phenological stage in a row followed by different lowercase letter (a, b, c) are significantly different (P<0.05)
Means of species for each phenological stage in a column followed by different uppercase letter (A, B, C, D, E) in parenthesis are significantly different (P<0.05)

Table 7. Means of OMD% between species and among phenological stage of five range species

Species Name	Vegetative	Blooming	Ripening	Mean± SE
Agropyron intermedium	59.9$^{a\,(B)}$	59.3$^{a\,(A)}$	56.2$^{b\,(A)}$	58.6 ±2.9 $^{(AB)}$
Bromus tomentellus	56.9$^{a\,(B)}$	51.9 $^{b\,(B)}$	47.6 $^{c\,(B)}$	52.0 ±3.0 $^{(C)}$
Hordeum bulbosum	63.7 $^{a\,(B)}$	56.5$^{b\,(AB)}$	52.2 $^{b\,(AB)}$	57.5 ±3.4 $^{(AB)}$
Cousinia bakhtiarica	62.2 $^{a\,(B)}$	50.3 $^{b\,(B)}$	50.9 $^{b\,(AB)}$	54.5 ±2.9 $^{(CB)}$
Scariolla orientalis	71.7 $^{a\,(A)}$	58.1 $^{b\,(A)}$	55.3 $^{b\,(A)}$	61.7 ±2.8 $^{(A)}$

Means with in species and a phenological stage in a row followed by different lowercase letter (a, b, c) are significantly different (P<0.05)
Means of species for each phenological stage in a column followed by different uppercase letter (A, B, C, D, E) in parenthesis are significantly different (P<0.05)

Conclusion

Based on the results obtained by five species sampled at different stages in the target area it was found that the forage quality changed by the phenological stages. With Iranian range, plants development, ADF and CF increased and DMD and OMD were decreased rapidly. At the vegetation stage, the forage quality is good because of low fiber, high cell contents, and digestibility but the quantity of the forage is very low at this stage. After plant maturity, even if the quantity is sufficient because the low nutrients and fewer digestibility, quality is low, therefore it is not possible to eat even the maintenance requirement of the livestock. That is an important reason why animals lose weight on summer in the area. Therefore, the range forage supply and its quality are adequate only for a limited time in the late spring and early summer each year in mostly rangeland of Iran.

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Literature Cited

Akbarinia, A., and Koocheki, A., 1992. Investigation on effects of different harvesting stages on growth, productivity and quality of some barley's varieties. *Jour. Pejouhesh and Sazandegi,* 15: 40-43. (In Persian).

Ammar, H., 2002. Composition chemical, digestibility kinetic of fermentation Ruminal in vitro of arbustos (abs). Ph.D thesis, Universidad de Leon, Spain.

AOAC, 1990. Official Methods of Analysis of the Association of Official Analytical Cheists. Edited by Kenneth. 15th edition. USA.

Arzani, H., Nikkhah, A., and Arzani, Z., 1998. Forage quality in three province of Semnan, Markazi and Lorestan rangelands, Final report, determining economic property size project. Tehran, Iran: College of natural resources University of Tehran, Iran. (In Persian).

Arzani, H., Zohdi, M., Fish, E., Zahedi Amiri, G. H., Nikkah, A., and Wester, D., 2004. Phenological effect on forage quality of five grass species. *Jour.* Range Manage. 57: 624-629.

Deinum, B., Van Es, A. J. H., and Van Soest, P. J., 1968. Effect of environment and quality of fiber on the nutritive value of crop residues. Netherlands *Jour. Agri. Sci.*16, 217-233.

Erfanzadeh, R., 2001. Investigation on quantitative indices changes of rangeland species during two-phenology stages. In: Proceeding of the 1st National Livestock and Rangeland Management Congress. Research Institute of Forests and Rangeland of Iran. 60 p. (In Persian).

Farid, A., Makarechian, M., and Setidbakht, N., 1977. Cross breeding of Iranian fat tailed sheep: lamb performance of karakul, Mehraban and Naeini breeds. *Jour. Anim. Sci.* 44: 542-548.

Ghadaki, M. B., Van Soest, P. J., MC Dowell, R. E., and Malekpour, B., 1974. Composition and in vitro digestibility of rangeland grasses, legumes, Forbs and shrub plant in Iran. Cornell University, Ithaca, NY, USA. 15 p.

Ghoorchi, T., 1995. Determination of chemical composition and dry matter digestibility of dominate species in Isfahan province (M.Sc thesis) technical university of Isfahan, Iran. 80 p. (In Persian).

Jerry, L., Holechek, P., Dcarlton, H., 1989. Comparative nutritive value of range forage. *Range manage. Princi. and practice.* 8: 274-276.

Kashki, V., 2001. Determination of chemical composition of 7 *Atriplex* species in Sabzevar Research Station. Proceeding of the 1st National Livestock and Rangelands Management Congress. Research Institute of Forests and Rangelands of Iran. 114 p. (In Persian).

MCDonald, P., Edvards, R. A., Greenhalgh, J. F. D., and Morgan, C. A., 1995. Animal nutrition. 5th Ed. New york, NY: Longman Scientific & Technical. 597 p.

MCDowell, L. R., 1985. Nutrition of grazing ruminant in warm climate 1st Ed. Academic press Inc. California, 443 p.

Pinkerton, B., 1996. Forage quality. Crop and Soil Environment Science Department, College of Agriculture, Forest and Life Science, Clemson University publication. 998 p.

Promkot, C., and Wanapat, M., 2004. Ruminal degradation and intestinal digestion of crude protein of tropical resources using nylon bag and three-step in vitro procedure in dairy Cattle. Proceedings of the Agri. Seminar, Anim. Sci. and Anim. Husbandry. 27-28 Jan.

Ramirez, R., Haenlein, G., Garcia G. F. W., Nunez, C. G., and Gonzalez, M. A., 2004. Protein, lignin and mineral contents and in situ dry matter digestibility of native Mexican grasses consumed by range goats. *Small Rumin. Res.* 52: 261-269.

Ramirez, R. G., 1990. Food habits and nutrition techniques of small ruminants: extensive management systems. *Small Rumin. Res.* 34: 215-220.

Reisian, R., 1998. National project of collection & evaluation of information for performance watershed of Chaharmahal–Bakhtiari province. Ministry of Jihad Agriculture. Agricultural Research and Education Organization. Research Center of Natural and Animal Science of Chaharmahal –Bakhtiari province. (In Persian).

Rezvanfar, A., and Shafiee, F., 2005. Role and function of agricultural extension on development of forages cultivation in modern paradigm in Proceedings of First National Forage Crops Congress of Iran, University of Teran. Karaj, Iran. pp 31-50. (In Persian).

SAS, 2001. Guide for personal computers. Ver. 6ed. SAS inst. Inc. Cary. NC. USA.

Scarbrough, D. A., Coblentz, W. K., Coffey, K. P., Turner, J. E., Davis, G. V., Kellogg, D. W., and Hellwing, D. H., 2001. Effects of calendar date and summer management on the in situ dry matter and fiber degradation of Stockpiled forage from Bermuda grass pastures. *Jour. Anim. Sci.* 79: 3158-3169.

Shadnoush, G. H., 2004. Macro mineral status of some permanent range plants for grazing sheep in Semi- aired area of Chaharmahal & Bakhtiari province, Iran. In: Proceeding of the Fourth International Iran & Russia Conference. University of Shahrekord, Iran. pp. 1031-1034.

Shadnoush, G. H., Ghorbani, G. R., and Edris, M. A., 2004. Effect of different energy levels in feed and slaughter weights on carcass and chemical composition of Lori-Bakhtiari ram lambs. Small Rumin. *Res.* 51: 243-249.

Shaidaee, G., and Niknam, F., 1970. Some information on the ranges of Iran. Forestry and Range Organization publication. No. 2. Ministry of Agriculture and Natural Resources, Iran. (In Persian).

Shakeri, P., Fazaeli, H., 2004. A survey of nutritive value of Gramineae range species in Kerman province, Iran. In: Proceeding of the Fourth International Iran & Russia Conference. University of Shahrekord, Iran, pp 1044-1047.

Snaydon, R. W., 1972. The effect of total water supply, and frequency of application, upon lucerne. II. Chemical composition Aust. *Jour. Agri. Res.* 23: 253-256.

Tilley, J. M. A., and Terry, R. A., 1963. A two-stage technique for the in vitro digestion of forage crops. *Jour. Br. Grass. Soc.* 18: 104-111.

Topps, J. H., 1998. Study of protein-rich forages for their nutritional and anti-nutritional Characteristics as supplementary feeds for ruminants in the semi- arid tropics. Summary Reports of European Commission Supported STD- 3 Projects (1992-1995) published by CTA.

Van Soest, P. J., Robertson, J. B., Lewis, B. A. 1991. Methods for dietary fiber. *Jour. Dairy Sci.* 74: 3583-3597.

Ventura, M. R., Castanon, J. I. R., Pieltain, M. C., and Flores, M. P., 2004. Nutritive value of forage shrubs: *Bituminaria bituminosa*, Rumex Lunaria, *Acacia Salicina*, *Cassia sturtii* and Adenocorpus foliosus Small Rumin. Res. 52: 13-18.

تعیین ترکیبات شیمیایی و قابلیت هضم آزمایشگاهی برخی از گونه‌های مرتعی در استان چهارمحال و بختیاری

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چکیده. به منظور بررسی ترکیبات شیمیایی و قابلیت هضم آزمایشگاهی پنج گونه علوفه مرتعی ***Agropyron intermedium*** ،***Bromus tomentellus*** ،***Hordeum bulbosum*** ،***Cousinia bakhtiarica*** و ***Scariolla orientalis*** در اقلیم‌های مختلف، مناطق قرق، مراحل سه گانه فنولوژی در استان چهارمحال و بختیاری نمونه‌گیری گردید. کلیه نمونه‌ها آنالیز شیمیایی گردید و قابلیت هضم آزمایشگاهی آن‌ها تعیین گردید. نتایج نشان داد که محتوی پروتئین خام گونه‌های مختلف در مراحل فنولوژیکی بطور معنی داری متفاوت بود. بیشترین و کمترین میزان پروتئین خام در مرحله رویشی و بذر دهی گونه ***Hordeum bulbosum*** و به ترتیب با مقادیر ۱۵/۲ و ۲/۹ درصد بود. درصد فیبرخام بین گونه‌های مختلف و مراحل فنولوژی به طور معنی‌داری متفاوت و کمترین و بیشترین مقدار آن به ترتیب در ***Agropyron intermedium*** و ***Cousinia bakhtiarica*** مشاهده شد. حداقل فیبر نامحلول در شوینده خنثی و اسیدی به ترتیب در مرحله رویشی گونه‌های ***Scariolla orientalis*** و ***Agropyron intermedium*** و حداکثر آن در مرحله بذردهی گونه‌های ***Hordeum bulbosum*** و ***Cousinia bakhtiarica*** مشاهده شد. درصد قابلیت هضم ماده خشک و ماده آلی در کلیه گونه‌ها با ادامه رشد از مرحله رویشی به طرف بذر دهی کاهش یافت. بیشترین و کمترین مقدار قابلیت هضم ماده خشک و ماده آلی در مرحله رویشی و به ترتیب در گونه‌های ***Scariolla orientalis*** و ***Bromus tomentellus*** دیده شد. در کل می‌توان گفت که در مراحل اولیه رشد کیفیت علوفه‌های گونه‌های مرتعی برای تولیدات دامی کافی است اما، در این ایام مهمترین مسئله میزان کم تولید در واحد سطح است. با پیشرفت مراحل رشد به طرف بذردهی، ارزش غذایی کلیه گونه‌ها کاهش می‌یابد بنابراین، حیوانات روی مرتع با کاهش مواد مغذی مواجه می‌شوند.

کلمات کلیدی: گیاهان مرتعی، ترکیبات شیمیایی، استان چهارمحال و بختیاری، ایران