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THE QUALITY INDICES OF WILD GROWING SAINFOIN SPECIES (*ONOBRYCHIS MILL.)* OF ARMENIA*

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Irrational use of mountain ecosystems of Armenia resulted in an acute reduction of the proportion of legume forages which are distinguished with high feed quality. That is why the investigation of this systematic group of plants, apart from the ecological, has also important agronomical meaning. In the paper the results of studies on biochemical composition and some macro- and microelements of 10 wild growing sainfoin species of the country are presented. It has been shown that some wild growing species exceed significantly the cultivated ecotype by the content of crude protein, crude fat, phosphorus and calcium. The studied sainfoin species substantially differ from each other by absorption capacity of microelements, which is evident from obtained data on coefficients of biological absorption.

INTRODUCTION

Flora of Armenia is distinguished with a great diversity of legume plants including wild-growing sainfoin (*Onobrychis Mill.*), which according to recent investigations in our Republic are presented by 3 sections (*Onobrychis Mill., Hymenobrychis DC.*, *Heliobrychis Bunge*) and 16 species [1]. Some species of sainfoin are widely distributed throughout Armenia (about 800-2400 m a.s.l.) and are the important components of semi-desert, upland-xerophytes, steppe and meadow vegetation [2].

The wild-growing sainfoins are nutritionally rich fodder plants and are excellently grazed by cattle before fruiting stage. The investigation of wild-growing forms of sainfoin in Armenia is essential, firstly because of substantial reduction of the proportion of legumes and feed quality in natural grasslands caused by over-grazing and strengthening the erosion-succession processes [3]. Therefore, the exploration of high quality wild forms, which are well adapted to unfavorable environment is needed for the development of measures on the restoration of vegetation cover of the degraded grasslands at different vertical belts. Taking this into account, since 2007 we have carried out investigations on bioecological indices of wild-growing sainfoin species throughout the republic, in addition, a part of the obtained data is summarized in our previous papers [4.5]. In this work are presented the experimental data on feed quality and the content of some chemical elements in biomass and soils of root-inhabited layers of 10 plant species are presented.

*The work was done under the supervision of Dr. agric. sci. B.Kh. Mezhunts

OBJECTIVES AND METHODS

The investigations were carried out in mountain-forest, semi-desert, steppe and meadow steppe vertical belts, where are distributed brown-forest, semi-desert sandy, mountain-chestnut and mountain-black soils [6]. The objects of this study were the following wild-growing sainfoin species: *O. altissima Grossh., O.aragatzi Arev.,O. atropatana Boiss., O. bungei Boiss., O. cyri Grossh., O.hajastana Grossh., O. michauxii DC. O. oxytropoides Bungei ex Boiss, O. petrea (M. Bieb. ex Willd) Fisch.*, *O. radiata (Desf.) M. Bieb., O.subacaulis Boiss., O. takhtajanii Sytin* and *O. transcaucasica Grossh,* as well as cultivated ecotype, collected from the sown area of v. Dzorap of Aragatsotn Marz. Sampling of above ground biomass and soils (on depth 40 cm) was implemented in flowering stage from the 12 points of Aragatsotn, Ararat, Gegharkunik, Vayotsdzor, Kotayk, Lory and Syunik Marzes using Random method. In the laboratory plant and soil samples were preliminary processed to carry out the designed analysis. The content of crude protein, phosphorus and calcium was measured from the same batch of samples [7], crude cellulose was measured according to Genneberg and Shtoman, crude fat – Sockslet apparature [8] and micro-elements in soils and plants - atomic-absorbtion method (AAS-1N).

RESULTS AND ANALYSIS

Before presentation of the results of our investigations it is noteworthy to mark that feed quality of wild-growing sainfoin in whole is weakly investigated and elucidated in scientific literature. The available data obtained in Armenia relate only to the following 3 species - *O. transcaucasica*, *O. altissima*, *O. oxytropoides* [9,10], which are valuable meadow plants and are distinguishing with high content of crude protein (more than 18%).

Table 1. *Feed quality of wild-growing sainfoin species, % of dry substances*

Species/habitat	Crude protein	Crude fat	Crude cellulose	NFES	Crude ash	P	Ca
O. altissima (v. Lchashen 1, 1950 m)	16.8	2.46	22.9	54.2	3.60	0.42	2.20
O.atropatana (Jrvezh, 1650 m)	17.5	3.00	26.6	48.6	4.30	0.43	1.74
O. bungei (v. Lchashen 2, 2040 m)	15.7	2.72	20.1	55.0	5.46	0.55	1.90
O. cyri (v. Yenokavan, 800 m)	14.6	3.54	25.1	52.4	4.45	0.48	1,74
O.hajastana (Jrvezh, 1650 m)	20.2	3.50	33.7	38.1	4,51	0.60	2.40

O. michauxii (Garni, 1380 m)	17.3	2.55	35.1	40.5	4.55	0.45	3.05
O. oxytropoides (v. Blagodarnoe, 2020 m)	17.5	2.69	27.1	47.5	5.18	0.40	2.18
O. radiata (v. Agitu, 1740 m)	17.3	2.80	32.0	44.4	3.60	0.50	1.94
O.subacaulis (v. Goravan, 920 m)	15.8	2.69	32.0	43.0	6.52	0.35	2.07
O.transcaucasica (v. Lchashen 1, 1940 m)	16.9	2.27	25.4	51.5	3.96	0.50	3.05
Cultivated ecotype, (v. Dzorap, 1360 m)	17.3	2.42	21.4	54.4	4.50	0.45	2.38

The results of our investigations show (Table 1) that the content of crude protein in dry biomass of studied species varied from 14.6 (*O. cyri*) to 20.2% (*O. hajastana*), i.e. the difference observed between the species was quite significant (5.6%). The protein content in cultivated ecotype was 17.3% and about the same indices were revealed for 6 wild-growing forms, 3 of which belong to the section *Onobrychis* (*O. altissima, O. oxytropoides* and *O. transcaucasica*), 2 – *Hymenobrychis* (*O. radiata* and *O. michauxii*) and 1 – *Heliobrychis* (*O. atropatana*).

The content of crude fat in aboveground biomass of wild-growing sainfoin varied within 2.3-3.5%, meanwhile the indices higher than 3.0% were observed in biomass of the following species: *O.cyri, O.hajastana, O.atropatana*, which exceeded the same index obtained for the cultivated ecotype by 1.24-1.46 times and as for other species it was 2.3-2.7%. In our study the content of crude cellulose varied from 20 to 35% and the high indices were revealed for *O.hajastana* and for the representatives of *Helio*- and *Hymenobrychis* sections, which probably is connected with the presence of strong pubescence and high proportion of stems in plant biomass. We calculated also the quantity of nitrogen free extractive substances (NFES), which fluctuated within 40-55% with minimal indices for the species, are distinguishing with high content of crude cellulose. It is notable to mark that the obtained results on crude fat, crude cellulose and NFES in whole are comparable with the similar data received by other authors [9,10].

The data presented in Table 1 indicate that the content of ash in wild-growing species amounted to 3.6-6.5% (4.5% for cultivated ecotype) and the maximum value was observed for *O. subacaulis* and minimum one - for *O. altissima* and *O. radiata*. It is notable that in the investigations of A.K. Maghakyan [10] the content of ash in biomass of the same species varied from 4.5 to 8.4%, moreover, its quantity in leaves was higher than in stems by 2.5 times. We also determined the content of phosphorus and calcium, which are the important components of daily ration of ruminant animals. From the data of Table 2 is evident that the content of phosphorus changed in the range of 0.35-0.60% (the minimum index was observed for *O.subacaulis* and maximum for *O. hajastana*) and calcium concentration – from 1.74 (*O. atropatana* and *O. cyri*) to 3.05% (*O.michauxii* and *O.transcaucasica*). The cultivated ecotype held middle position by the content of indicated macro-elements, which approximately corresponds to the data received by G.B. Babayan [11] for the same plants have grown in mountain-chestnut and black soils.

The investigation of the composition of micro-elements of fodder plants has important biological and ecological sense as some of them belong to biophilus elements (in our investigation they are Mn, Cu, Mo, Zn), which supported the vital activities of animals and other elements (Pb, Ni) are of

toxic nature and their quantity higher than maximum permissible concentration (MPC) reduces the ecological soundness of feeds.

It's well known that the soils serve as the principal source of micro-elements for plants; meanwhile their total content mainly depends on environmental conditions, including also pH and humus indices of soil etc., these indices in whole are characterizing the type of soils. The results of analyses of the investigated soils have shown (Table 2) that according the average value of micro elements they form the following descending rows: for Mn – chestnut > black > brown forest; Ni, Mo and Zn – chestnut > brown forest > black; Cu and Pb – brown forest > chestnut > black, i.e. the maximum accumulation of Mn, Ni, Mo and Zn was observed in chestnut and for Cu and Pb – in brown forest, whereas in black soils with the exception of Mn was observed the minimum content of the remain microelements. The concentration higher than Clark was revealed for Mn in chestnut and black soils and for Mo and Zn – in chestnut and brown forest soils and for Ni, Cu and Pb in all investigated types of soil.

The investigated forms of sainfoin differ significantly according to the content of micro-elements in aboveground biomass (Table 2): the concentration of Mn varied within 200-270, Ni – 1.75-3.25, Cu – 30-50, Mo – 0.8-1.1, Pb – 1.8-2.8, Zn – 52-71.5 mg/kg. In addition, the

Table 2. *The content of microelements in soils and ash of plants, mg/kg*

Plant species and sampling points	Object of investigation	Mn	Ni	Cu	Mo	Pb	Zn
O. cyri (v. Yenokavan, 800 m)	plant	220	1.75	30.0	1.0	2.3	65.0
	soil	850	56.3	35	3.0	15.8	65.0
	CBA*	0.26	0.03	0.86	0.34	0.14	1.00
O. radiata (v. Lernapat,1470 m)	plant	270	3.25	50.0	0.90	1.8	52.0
	soil	1200	38.8	21.5	2.8	11.7	55.0
	CBA	0.23	0.08	2.33	0.33	0.15	0.95
O. petrea (v. Agarakadzor,1720 m)	plant	200	2.50	33.0	1.1	2.3	71.5
	soil	1100	56.3	33.5	4.3.	15.0	70.0
	CBA	0.18	0.04	0.99	0.25	0.15	1.02
O. takhtajanii (v. Agarakadzor,1720 m)	plant	220	3.25	35.0	0.90	1.8	58.5
	soil	1080	75.0	35.0	2.0	13.3	80.0
	CBA	0.20	0.04	1.00	0.45	0.13	0.73
O. altissima (v. Lchashen 1, 1950 m)	plant	250	3.00	33.0	0.90	2.8	58.5
	soil	930	62.5	30.0	2.0	15.0	60.0
	CBA	0.27	0.05	1.10	0.45	0.18	0.98

O. bungei (v. Lchashen 2, 2040 m)	plant	270	2.25	45.0	0.80	2.3	58.5
	soil	900	32.5	25.0	2.0	10.0	50.0
	CBA	0.30	0.07	1.80	0.42	0.23	1.17
O.aragatzi (met./st.Hamberd, 2000 m)	plant	200	2.25	35.0	1.1	2.8	71.5
	soil	1050	32.5	20.0	2.0	10.0	40.0
	CBA	0.19	0.07	1.75	0.54	0.28	1.79
Clarкs of element	plant	240	2.00	16.0	0.60	2.5	50.0
	soil	850	40.0	20.0	2.0	10.0	50.0

** The coefficient of biological absorption*

content of Mn in biomass of 3 species (*O. radiata*, *O. bungei* and *O. altissima*) was slightly higher and in all other species vise verse lower than Clark. The content of Ni, with the exception of *O. cyri,* exceeded the Clark by 1.1-1.6 times and as for Pb except for *O. altissima* and *O. aragatzi* was somewhat lower and the content of other 3 elements in all species was higher compared with the Clark.

On the basis of the data regarding to the content of micro-elements in soils and plants we calculated the coefficient of their biological absorption (CBA), which reflects the ratio of the contents of micro elements revealed in plants and soils (Table 2). The presented data show that CBA of micro-elements studied varied in quite wide range: Mn from 0.18 to 0.30; Ni – 0.04-0.08; Cu – 0.90-2.33; Mo – 0.33-0.54; Pb – 0.13-0.28 and Zn – 0.73-1.79. The maximum index of CBA of Mn was revealed for *O. cyri*, Ni and Cu – *O. radiata*, Mo and Zn – *O.aragatzi*, Pb – *O. altissima*, i.e. it was observed a certain selectivity of studied species in the absorption of different micro-elements. For example, the species *O. radiata* grown in chestnut soils with the concentration of Ni equals to 39 mg/kg, has accumulated the same quantity of the element (3,25 mg/kg) as the species *O. takhtajanii* grown in the similar type of soil, but with twofold more concentration of indicated element. The same species *O. radiata* displayed even more activity in absorption of the Cu, the content of which was 1.5 times higher than in plants of *O.petrea*, despite of the concentration of this element in root-inhabited layer was 1.5 times higher; the similar examples may be presented for the other species studied (Table 2). It is noteworthy to say that, with the exception of Ni, the data obtained in our study fully correspond to the scale was developed by A.I. Perelman [12] and according to this scale Zn belongs to the group of elements are distinguished with the strong biological accumulation and the other 4 micro-elements – to medium biological capture (CBA=n-0.0n).

CONCLUSION

1. The majority of wild-growing as infoin species in Armenia are distinguished with high content of crude protein and fat, which varied correspondingly within 14.6-20.2 and 2.3-3.5%. For the comparison, it is notable to state that cultivated ecotype consisted crude protein and fat correspondingly 17.3 and 2.42%.

2. The high content of crude cellulose was generally inherent to the representatives of *Heliobrychis* and *Hymenobrychis* sections, which obviously is connected with the strong pubescence of plants and high proportion of stems in total biomass.

3. The phosphorus content in wild-growing plants was equal to 0.35-0.60%, calcium content – 1.74-3.05%. In the cultivated ecotype was observed the average values of the studied macro- elements.

4. The studied sainfoin species differed significantly according to the content of micro-elements and the coefficient of biological absorption, in addition, the values of these parameters very often didn't agree with the concentration of elements in the soils they were growing.

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КАЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ ДИКОРАСТУЩИХ ВИДОВ ЭСПАРЦЕТА (*ONOBRYCHIS MILL.)* АРМЕНИИ

М.А.Навасардян

Нерациональное использование горных экосистем Армении привело к резкому сокращению доли бобовых форм, которые отличаются высоким кормовым качеством. Поэтому, исследование этой систематической группы растений, кроме экологического, имеет также важное сельскохозяйственное значение. В статье приведены результаты определений биохимического состава и содержания некоторых макро- и микроэлементов 10 дикорастущих видов эспарцета республики. Показано, что некоторые виды, по содержанию сырого протеина, сырого жира, фосфора и кальция значительно превосходят культивируемый экотип. Исследуемые формы эспарцета существенно различаются друг от друга по поглотительной способности микроэлементов, что очевидно из полученных коэффициентов биологического поглощения.