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NUTRITIONAL PROPERTIES OF SAINFOIN (*ONOBRYCHIS VICIIFOLIA* SCOP.) AUTOCHTHONOUS POPULATIONS IN SERBIA AND B&H

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Abstratct:
Sainfoin (*Onobrychis viciifolia* Scop.) is the only species in the genus *Onobrychis*. Sainfoin is a Eurasian perennial herb that has purple flowers, curved pods and is naturalized in Europe, Asia and North America grasslands on calcareous soil. Sainfoin has been grown in parts of Europe and Asia for hundreds of years. Understanding the relationships among sainfoin ecogeographic, and chemical characteristics may provide insights for better utilizing exotic germplasm. Ten sainfoin populations, were sampled and determined in Serbia and B&H. Some chemical properties, such as crude protein, ash, fat, crude fibre, phosphorus, calcium, magnesium, potassium, K/(Ca+Mg) ratio, and sulfur. Serbia is an important gene origin center for most legume species. Considering the high values of their traits, some Serbian sainfoin populations could serve as a valuable breeding material. In comparison with populations from other parts of the world, Serbian populations are superior in chemical properties and nutritional quality values.
Key words: Sainfoin, populations, nutrition, chemical characteristics.

Introduction

Sainfoin (*Onobrychis viciifolia* Scop.) was widely grown in Europe, Asia and North America grasslands on calcareous soil. It was used as a source of very high quality hay. Distributed in parts of warm-temperate Europe and Asia, and on dryland, calcareous soils in western North America. Also cultivated in some Mediterranean environments, e.g. southern Italy. Performs best on well-drained calcareous soils. Sainfoin is one of the most commonly cultivated perennial legumes and due to its characteristics present the most important forage legumes from agronomic aspect. Erect growth habit, suited to infrequent cutting for conservation (hay or silage) rather than grazing. Nutritional qualities among sainfoin population grown in the research area show large variety due to different vegetations, soil types and long-term protection measures applied in experiment sites. There is a strong relationship between morphological structure and nutritional quality in forage crops (Korkmaz *et al.*, 1993). Soil has an important effect on mineral content of plants grown on it (Korkmaz *et al.*, 1993).
Protein (CP) is an important nutrient in animal production and is generally least expensive if supplied by forages. Protein is neccesary for muscle development, milk production and growth. Sainfoin has similar crude protein, and digestibility to lucerne. Cattle and horses require fiber (CF) in their diet to stimulate the microorganisms that assist in nutrient production through fiber fermentation. Mineral play an important role in animal development and growth. Mineral levels needed in the diet vary depending on the animals age and development stage. Different levels of dietary minerals create variations in animal growth performance, soundness, reproduction and longevity. These levels are important, as are the rations of certain minerals to each other (Jahns and Shipka, 2004). Over 70% of the total minerals in the body are calcium and phosphorus. Calcium and phosphorus are closely related elements and are laid down in bone in a ratio of 2.2 parts calcium to 1 part phosphorus. Largely determined by stage of growth at time of utilization since feeding value falls with increasing maturity and associated stemminess. Sainfoin I protein- and mineral-rich in

comparison with grasses but its Ca and Na concentrations are lower than in other major legumes (Spedding and Diekmahns, 1972).

Material and method

Ten autochthonous populations of sainfoin (*Onobrychis viciifolia Scop.*) colected in Serbia and Bosnia were investigated. Each population was represented by 50 plants. The research area has an irregular topography with elevations from 130 to about 900 meters, and clay and grey-brown podzolic and brown soils on hillside and upland positions (Zivkovic, 1999). The nutritional qualities of the sainfoin populations showed much variety due to different vegetations, soil types and long-term protection measures applied in experiment sites. An investigation was conducted at the Center for Agricultural and Technological Research, Zajecar and Faculty of Agriculture, Belgrade. Nutritional properties of sainfoin was assesed over three years of investigations. The sainfoin populations were sampled at the beginning of flowering.

Approximately 500-g samples were dried at 78°C for 24 h, to determine the dry matter content (DM). The crude protein (CP), crude fat (F), crude fiber (CF) and crude ash contents were determined using the official method (AOAC, 1980). Wet combustion in a 2:1 mixture of HNO_3 and $HClO_4$ was used for mineral elements analysis. Phosphorus (P) content was determined by the vanadomolybdate yellow color method. Calcium (Ca), magnesium (Mg); potassium (K) content was determined using a flame photometer.

Results and Discussion

Chemical Properties: Chemical properties of the sainfoin populations such as crude protein ratio, crude ash ratio, crude fat, crude fiber, P, Ca, Mg, K, K/(Ca+Mg) ratio, S are given in Tables 1.

Table 1. Chemical and mineral composition mean values of sainfoin populations

Population	CP	Ash	Fat	CF	K	P	Ca	Mg	K/(Ca +Mg)	S
					(g kg^{-1} DM)					
Pirot	130.4	99.6	33.6	245.7	17.51	2.00	14.32	1.96	1.075	2.6
Vranje	132.1	92.3	32.1	241.5	18.50	2.56	12.49	2.10	1.267	1.8
Nis	148.0	102.6	38.7	220.4	19.12	3.66	13.36	2.21	1.228	3.1
Knjazevac	136.4	89.4	31.4	237.0	19.03	2.69	13.47	1.98	1.231	1.5
Zajecar	132.3	99.3	31.1	240.6	16.17	2.14	12.95	2.04	1.078	1.9
Negotin	129.7	89.7	33.9	226.7	20.70	2.89	14.35	2.67	1.216	2.3
Paracin	147.8	98.0	42.0	213.8	19.61	3.45	13.42	2.26	1.250	2.6
Uzice	133.6	94.2	34.2	233.5	14.89	2.16	9.19	1.74	1.362	1.2
Sarajevo	148.3	99.3	39.5	215.9	15.83	2.94	10.42	1.49	1.329	2.4
Banja Luka	143.9	102.5	41.3	220.3	20.91	2.91	12.10	1.62	1.524	3.1

The crude protein ratio varied between 129.7 and 148.3 g kg^{-1} DM in populations Negotin and Sarajevo, respectively. Populations Banja Luka, Sarajevo, Paracin and Nis which were preferred by animals had high variability and crude protein ratios between 143.9 and 148.3 g kg^{-1} DM. The highest crude ash ratio was 102.6 g kg^{-1} DM in population Nis, the lowest 92.3 g kg^{-1} DM in population Vranje. Crude ash ratios and nutritional quality were higher in sainfoin populations grown under natural conditions than those under cultivation. However, populations Banja Luka, Nis, Pirot, Sarajevo and Zajecar were preferred. The highest crude fat ratio was 42.0 g kg^{-1} DM in population Paracin, the lowest 31.1 g kg^{-1} DM in population Zajecar. The content of crude fiber varied from 213.8 to 245.7 g kg^{-1} DM in population

Paracin and Pirot, respectively. All sainfoin populations had high K concentrations. The K concentration varied between 14.89 g kg^{-1} DM and 20.91 g kg^{-1} DM. These results were higher than 8.0 g kg^{-1} DM reported by Tajeda *et al.* (1985) and 6.5 g kg^{-1} DM reported by the NRC (1984). The 1989 NRC standards suggested that the total dry matter for high-producing cows should contain a minimum of 10.0 g potassium kg^{-1} DM. But, high K concentration may cause Mg deficiency (Loreda *et al.*, 1986). The P content in the sainfoin populations varied between 2.00 and 3.66 g kg^{-1} DM. Researchers recommend that dietary P be fed above 3.0 g kg^{-1} DM for low to medium producing cows (7,500–9,000 kg/lactation) and between 3.8–4.0 g kg^{-1} DM for high producing cows (>10,000 kg/lactation). Generally, fresh cows can be fed a diet containing as little as 3.0 g kg^{-1} DM P and still maintain good milk yield, but as they proceed into late lactation dietary P must be increased in order to maximize milk production (Calberry, 2003). Realistically, 3.5 g kg^{-1} DM to 3.8 g kg^{-1} DM P cover the requirements of most herds while maintaining a safety margin (Wu and Satter, 2000). The Ca contents in the sainfoin populations varied between 9.19 and 14.35 g kg^{-1} DM. Tajeda *et al.* (1989) reported that forage crops should contain at least 3.0 g kg^{-1} DM of Ca for ruminants. The American National Research Council (NRC, 1984) recommended that forage crops should contain 3.1 g kg^{-1} DM of Ca for beef cattle. The results for Ca concentration obtained in this study were higher than the recommended values. The Mg concentrations in the sainfoin populations was between 1.49 and 2.67 g kg^{-1} DM. Mg concentrations for forage crops are recommended as 2.0 g kg^{-1} DM for ruminants by Tajeda *et al.* (1985) and 1.0 g kg^{-1} DM for beef cattle by the NRC (1984). But, Loreda *et al.* (1986) reported that 1.8–2.0 g kg^{-1} DM of Mg in forage crops would not be adequate for ruminants if the K concentration in plants is 13.6-16.9 g kg^{-1} DM. K/(Ca+Mg) ratio in forage crops consumed by ruminants was recommended as less than 2.2 (Mayland *et al.*, 1979). More than 1.6 of K/(Ca+Mg) ratio indicates a potential risk of tetany (Ward, 1966). All sainfoin populations in this study had the K/(Ca+Mg) ratio lower than 1.1 as belonh to legume species. Therefore, increasing Mg content in legumes most probably causes a lower K/(Ca+Mg) ratio. The American National Research Council (NRC, 1988) recommended that forage crops should contain 1.5 g kg^{-1} DM of S for beef cattle. In ruminants, sulfur makes up about 1.5 g kg^{-1} DM of the body tissue and about 0.3 g kg^{-1} DM of milk. S concentrations in the sainfoin populations varied between 1.2 and 3.1 g kg^{-1} DM i.e. they were higher than the suggested values.

Conclusions

The ten autochthonous populations of sainfoin (*Onobrychis viciifolia Scop.*) collected in Serbia and B&H. Genotype effects were found for crude protein ratio, crude ash ratio, crude fat, crude fiber, P, Ca, Mg, K, K/(Ca+Mg) ratio, S.

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