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STUDY ON THE CHEMICAL COMPOSITION AND NUTRITIONAL VALUE OF THE *GALEGA ORIENTALIS* LAM. AND THE PROSPECTS OF ITS VALORIFICATION IN THE REPUBLIC OF MOLDOVA

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Abstract

The results of the research on biological features, productivity, chemical composition and forage value of Galega orientalis Lam., variety Speranţa, are presented in this paper. The research was focused on the chemical composition and the nutritional value of Galega orientalis Lam., which is a non-traditional fodder plant for the Republic of Moldova, and on the fodder obtained from it. The dry matter of this plant contains 15-20% crude protein, 2.7-3.9% crude fat, 32.2-37.8% crude fibre, 7.3-8.8% ash and 30.6-39.5% nitrogen-free extract. The possibility of producing high quality hay and haylage of this plant under laboratory, semi-production and production conditions has been demonstrated.

Key words: *chemical composition, Galega orientalis, hay, haylage, nutritional value.*

INTRODUCTION

Forages play a significant role in livestock nutrition and approximately 85% of all feed units are from forages. In recent years, in many countries, more non-traditional fodder crops are cultivated and used as sources of protein, essential amino acids, biologically active substances, to provide a balanced diet for animals, increasing their productivity, as well as to improve soil fertility, to restore degraded soils etc. (Uteush, 1990; Kshnikatkina et al., 2005;).

Broadening the range of fodder plants is necessary because, in the Republic of Moldova, only a few basic fodder crops are traditionally used: alfalfa, sainfoin and soybean – as sources of protein and corn – as a source of energy. These fodder crops are highly effective and well studied, but in some years, have a poor harvest because of natural hazards (drought, heat waves). Therefore, it is necessary to diversify the sources of fodder by studying the chemical composition and the nutritional value of new and non-traditional crops (Bahcivanji et al., 2012; Teleuţă and Ţîţei , 2012; Coşman, 2014).

The introduction, acclimatization and implementation, in Moldova, of fodder plants from other floristic regions of Earth, rich in nutrients and biologically active substances, is one of the possibilities to broaden the range of fodder sources, to diversify animal nutrition, to enhance the quality of animal feed, to increase the productivity and the quality of animal products. The species *Galega orientalis* Lam., family *Fabaceae* Lindl., is distinguished by high and stable yields over several years, accumulating biomass with a high content of protein and essential amino acids (lysine, methionine).

Galega orientalis, eastern galega, fodder galega, is an herbaceous perennial, native to the Caucasus. It forms a solid shrub of 10 to 18 leafy stems, 0.8-2.0 m tall; has alternate, odd-pinnate, 15-30 cm long leaves, which have a good feature to remain undamaged while drying hay. The tap-root system is

composed of combined lateral rhizomes; at a depth of 7 cm, the main roots produce 2–18 lateral offspring – rhizomes; they grow horizontally over 30 cm in length and form buds, which sprout shoots. It has been introduced to many other regions for use in agriculture (Uteush, 1990; Nommsalu, 1994; Stjepanović et al., 2007; Darmohray, 2009; Pikun, 2011).

MATERIALS AND METHODS

The local cultivar *Speranta* of fodder galega *Galega orientalis* (Photos 1, 2) created in the Botanical Garden (Institute) of the ASM, registered in the in the Catalogue of plant varieties of the Republic Moldova, served as subject of study, the traditional leguminous fodder crop *Medicago sativa* – as control variant. The samples, necessary for determining the chemical composition of *Galega orientalis*, were taken at the first mowing, in the budding (27.04.2016), early flowering (03.05.2016) and flowering periods (18.05.2016), and the samples of *Medicago sativa* – in the budding period (18.05.2016).

Photo 1. *Galega orientalis* in budding period

Photo 2. *Galega orientalis* in flowering period

The analyses were performed in the Laboratory of Nutrition and Feed Technology of the Institute of Biotechnology in Animal Husbandry and Veterinary Medicine and included the determination if the following indices: initial and hygroscopic moisture content, nitrogen, crude protein, crude fat, crude fibre, ash, nitrogen-free extract (NFE) and carotene.

Haylage and hay were prepared from the green mass harvested in the flowering period. The haylage was prepared from wilted green mass (2 days after mowing). In the obtained haylage, the chemical composition was determined according to the above-mentioned indices and the following indices: pH index, concentration of organic acids in free and fixed state (lactic, acetic and butyric) and the organoleptic characteristics (smell, colour and consistency) were assessed. The content of neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and matter digestibility were evaluated using the near infrared spectroscopy (NIRS) technique in the Laboratory for Determining Feed Quality of the Research-Development Institute for Grassland Brasov, Romania.

RESULTS AND DISCUSSIONS

Studies were conducted on the evolution of the content of nutrients in *Galega orientalis*, depending on the development stage. The data are presented in Table 1. The obtained results demonstrate that *Galega orientalis* is primarily characterized by high moisture content, 87.48% in the budding period, 86.43% in the early flowering period, gradually decreasing to 81.93% in the flowering period. Yet, the dry matter content increased gradually from 12.52% in the budding period, up to 18.07% in the flowering period. As compared with alfalfa, the moisture content of *Galega orientalis* was with 6.79% higher in the budding stage. The crude protein content was also quite high and constituted 20.56% dry matter in the budding period, decreasing gradually to 15.13% in the flowering period, that was, over 5%. These data are particularly important when determining the best harvest time for *Galega orientalis*. The data on the crude protein content of *Galega orientalis* in the budding stage were comparable with the

data on alfalfa in the same phenological stage, which contained 20.44% crude protein.

The crude fat content in the dry matter of *Galega orientalis* varied from 3.51% in the budding period to 3.01% in the flowering period and was somewhat lower than in alfalfa (4.4%). The amount of ash was also higher in alfalfa – 9.7% as compared with 7.02-7.98% in *Galega orientalis*. No substantial differences were found in the content of nitrogen-free extract (NFE), this index varied from 29.98% to 35.13% in *Galega orientalis* and 32.92% in alfalfa. These two plant species were also comparable in the crude fibre content, which reached 29.01% in *Galega orientalis* and 25.34% in alfalfa, in the budding period. It was found that the amount of crude fibre in *Galega orientalis* increased and reached 34.45% in the flowering period.

Fibre refers to the cell wall constituents – hemicellulose, cellulose and lignin. The data on the constituents of cell walls demonstrated that, as the plants aged, from the budding period until the flowering period, the amount of indigestible fractions, such as ADL, increased from 3.9% to 6.3%, or, 1.6 times. The fractions of ADF and NDF also increased, ADF – from 28.8%, in the first stage, to 37.7%, in the last stage, or with 8.9%, and NDF – from 46.5% to 57.9%, or with 11.4 %, respectively. The hemicellulose content gradually changed from 17.7%, in the budding period, to 20.5%, in the early flowering period, and decreased to 20.2%, in the flowering period, while the cellulose content increased essentially from 24.9% to 31.4%.

Table 1. Dynamics of the chemical composition of *Galega orientalis* depending on the harvest time

Indices		*Galega orientalis*			*Medicago sativa*
		Budding period	Early flowering period	Flowering period	Budding period
Moisture content,%	initial	86.1	85.3	80.67	79,19
	hygroscopic	9.96	7.70	6.51	7,2
	totals	87.48	86.43	81.93	80,69
Absolutely dry matter, %		12,52	13.57	18.07	19.31
Nitrogen ,%	dry matter	3.29	2.80	2.42	3.27
	abs. dry matter	3.65	3.03	2.59	3.52
	natural forage	0.46	0.41	0.47	0.68
Crude protein , %	dry matter	20.56	17.50	15.13	20.44
	abs. dry matter	22.84	18.96	16.18	22.02
	natural forage	2.86	2.57	2.92	4.25
Crude fat ,%	dry matter	3.51	3.01	3.19	4.40
	abs. dry matter	3.90	3.26	3.41	4.74
	natural forage	0.49	0.44	0.62	0.92
Crude fibre , %	dry matter	29.01	29.49	34.45	25.34
	abs. dry matter	32.22	31.95	36.85	27.31
	natural forage	4.04	4.33	6.66	5.27
Acid Detergent Fibre, %		28,8	32.6	37.7	-
Neutral Detergent Fibre, %		46,5	53.1	57.9	-
Acid Detergent Lignin,%		3,9	5.0	6.3	-
Ash ,%	dry matter	7.98	7.17	7.02	9.70
	abs. dry matter	8.86	7.77	7.51	10.45
	natural forage	1.11	1.05	1.36	2.02
NFE ,%	dry matter	29.98	35.13	33.71	32.92
	abs. dry matter	32.18	38.06	36.05	35.48
	natural forage	4.03	5.16	6.52	6.85
Dry matter digestibility		82.0	72.2	64.0	-
Organic matter digestibility		77.9	69.9	58.2	-
Relative Feed Value		133	112	97	

Digestibility is an important factor of the nutritive value of feed. Digestibility determines the relation between the content of nutrients and the energy that is available to ruminants. Thus, the organic matter digestibility (OMD) from the plants harvested in the budding period was 77.9%, a very high index, in the early flowering period – 69.9% and in the full flowering period this index decreased to 58.9%. The dry matter digestibility changed similarly: from 82.0% to 72.2% and 57.9%., according to the phenological stage.

The most widely accepted measure of the quality is Relative Feed Value. It was found that Relative Feed Value *Galega orientalis* decreased from 133 to 97.

The obtained data show that *Galega orientalis* needs to be collected in the early stages of development. In this period, it is more valuable as a fodder crop with a high level of crude protein and high digestibility of organic matter and, because of this, it can help solving some problems in the livestock sector by providing a balanced diet for animals with an appropriate amount of protein and fibre.

As for the organoleptic properties, the haylage prepared from *Galega orientalis* is green-brown leaves and yellowish-green stems; has a pleasant smell of fruits and pickled vegetables; the texture of the plants stored as haylage was preserved well, without mould and mucus (Photo 3). Thus, by the organoleptic characteristics, the haylage made from the non-traditional fodder plant *Galega orientalis* belongs to Class I, according to the Moldovan quality standards.

The data from table 2, indicate that the total moisture content in the freshly mowed green mass of *Galega orientalis* constituted 81.93%, in the green mass wilted for two days – 64.73%, in the prepared haylage – 61.53% and in hay – 12.75%. The content of absolutely dry matter constituted: in freshly mowed plants – 18.07%, in the wilted plants – 35.27%, in haylage – 47.81% and in hay – 87.25% respectively.

The dry matter of the freshly mowed plants for making haylage contained 2.59% of nitrogen,

Photo 3. Haylage of *Galega orientalis*

after two days of wilting – 2.62%, the haylage – 2.65% and the hay – 2.76%. The crude protein content was at almost the same level in the green mass, wilted mass, haylage and hay of *Galega orientalis*, and ranged from 16.18 to 17.23%. In the dry matter of freshly mowed plants, there was 3.41% crude fat, in the wilted plants 2.68%, in haylage 3.22% and only 1.49% - in the hay produced from the non-traditional fodder crop.

We assume that in the process of dehydration of the initial mass to 12.75% of moisture in hay, the fat content suffered considerable loss.

The crude fibre in the dry matter of fresh plants constituted 36.85%, in wilted plants – 37.85%, in haylage – 40.61% and in hay – 39.85%. The ash content in dry matter was of 7.51% in freshly mowed plants, 8.57% in wilted plants, 8.54 % in haylage and 7.41% in hay.

The nitrogen-free extract in freshly cut plants constituted 36.05% of the dry matter, in wilted plants – 34.51%, in haylage – 31.29% and in the hay of *Galega orientalis* – 34.03%.

Table 2. The content of nutrients in the freshly mowed and wilted plants, haylage and hay of *Galega orientalis*

Indices		Green mass	Wilted green mass	Haylage	Hay
Moisture content,%	initial	80.67	62.7	58.23	8.22
	hygroscopic	6.51	5.45	7.90	4.94
	totals	81.93	64.73	61.53	12.75
Abs. dry matter,%		18.07	35.27		38.47
Nitrogen ,%	dry matter	2.42	2.48	2.44	2.62
	abs. dry matter	2.59	2.62	2.65	2.76
	natural forage	0.47	0.93	1.02	2.40
Crude protein ,%	dry matter	15.13	15.50	15.25	16.38
	abs. dry matter	16.18	16.39	16.56	17.23
	natural forage	2.92	5.78	6.37	15.03
Crude fat ,%	dry matter	3.19	2.53	3.43	1.42
	abs. dry matter	3.41	2.68	3.72	1.49
	natural forage	0.62	0.94	1.43	1.30
Crude fibre ,%	dry matter	34.45	35.79	37.40	37,88
	abs. dry matter	36.85	37.85	40.61	39.85
	natural forage	6.66	13.35	15.62	34.77
Ash ,%	dry matter	7.02	8.10	8.73	7.04
	abs. dry matter	7.51	8.57	9.48	7.41
	natural forage	1.36	3.02	3.65	6,46
NFE ,%	dry matter	33.71	32.63	27.29	32.35
	abs. dry matter	36.05	34.51	29.63	34.03
	natural forage	6.52	12.17	11.40	29.69
nutritive units	natural forage	0.16	0.29	0.26	0.53
Carotene, mg/kg		39.99	33.8	24.0	30.12

Table 3. The content of organic acids in haylage of *Galega orientalis*

	pH	Organic acids,%									Sum of lactic+ butyric + acetic	Correlation of lactic acids in % of the total		
		Free			Fixed			Totals						
		acetic	butyric	lactic	acetic	butyric	lactic	acetic	butyric	lactic		acetic	butyric	lactic
Haylage	5.18	0.04	0	0.64	0.37	0	2.28	0.41	0	2.92	3.33	12.31	0	87.69

The fresh mass of *Galega orientalis* was characterized by a rather high content of carotene – 39.99 mg/kg, gradually, during the process of producing haylage, this index decreased to 33.8 mg in the wilted mass and 24.0 mg in the obtained haylage. In the hay made from *Galega orientalis*, the carotene content was higher in comparison with the haylage, reaching 30.12 mg/kg.

The pH of the haylage from *Galega orientalis* was 5.18 units and met the superior quality standards (Table 3).

The amount of organic acids accumulated during the process of lactic acid fermentation was 3.33%. It is significant that of all the organic acids, lactic acid in the haylage of *Galega orientalis* constituted 87.69%, mostly being accumulated in fixed form. Acetic acid was accumulated almost entirely in fixed form, butyric acid was not detected, which is indicative of the high quality of the obtained forage.

The green mass of *Galega orientalis* used for preparation of hay, leaves remain on the stem,

which helps ensure higher forage value. The content of nutrients in the absolutely dry matter of the hay prepared from *Galega orientalis* is characterized by: 87.25% of absolutely dry matter, 2.76% of nitrogen, 17.23% of crude protein, 7.41% of ash and 34.03% of NFE. One kg of hay contains 0.53-0.60 NU.

In conditions of semiarid continental east Croatia fodder galega hay had higher leaf portion (44.90% against 33.05% in lucerne), protein concentration (20.85% against 17.61% in lucerne hay) and concentration of Mg, K and P, whreas lucerne hay had higher fibre content (39.67% ADF and 45.21% NDF against 39.09% ADF and 43.98% NDF in fodder galega hay) and Ca concentration than fodder galega hay.

Relative feed value of fodder galega hay was a little higher than that of lucerne hay (124 against 119), and calcium/phosphorous ratio in fodder galega hay was more favorable than in lucerne hay (Stjepanović et. al. 2007).

CONCLUSIONS

Galega orientalis, in the Republic of Moldova, is characterized by rapid growth and development rates, the budding stage starts 3 weeks earlier as compared with alfalfa, but the fodder harvested in this period is poorer in dry matter.

The nutritional value of the non-traditional crop *Galega orientalis* is almost at the same level as the traditional fodder crop – alfalfa. The dry matter of the harvested fodder contains 15-20% crude protein, 2.7-3.9% crude fat, 32.2-37.8% crude fibre, 7.3-8.8% ash and 30.6-39.5% NFE.

The haylage prepared from *Galega orientalis* is characterized by organoleptic and biochemical indices such as green-brown leaves and yellowish-green stems, pleasant smell of fruits and pickled vegetables, pH 5.18, lactic acid constituted 87.69%, butyric acid not detected.

For preparation of hay leaves remain on the stem which helps ensure higher forage value.

The non-traditional fodder plant *Galega orientalis* is fully suitable for preparing high quality feed, can be a good additional fodder to lucerne.

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