COMPARATIVE ANALYSIS OF TOTAL PROTEIN AND FAT CONTENT IN DIFFERENT CULTIVARS OF HYSSOPUS OFFICINALIS L. AND DRACOCEPHALUM MOLDAVICA L.

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Abstract: *this study presents a comparative analysis of total protein and fat content in three Hyssopus officinalis L. cultivars introduced in Armenia (Accord, Inej, and Lazur') and three Dracocephalum moldavica L. cultivars (Gorynych, Moldavia, and Ametist). The cultivars were evaluated for their potential nutritional and functional applications. The results reveal moderate differences in protein and fat content, highlighting their relevance for further selection and utilization.*
Keywords: *moldavian dragonhead, hyssop, macronutrients*

СРАВНИТЕЛЬНЫЙ АНАЛИЗ СОДЕРЖАНИЯ ОБЩЕГО БЕЛКА И ЖИРА В РАЗЛИЧНЫХ СОРТАХ HYSSOPUS OFFICINALIS L. И DRACOCEPHALUM MOLDAVICA L.

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Аннотация: *в данном исследовании представлен сравнительный анализ общего содержания белка и жира в трех сортах Hyssopus officinalis L., интродуцированных в Армении (Аккорд, Иней и Лазурь), и трех сортах Dracocephalum moldavica L. (Горыныч, Молдавия и Аметист). Оценка сортов проводилась с целью выявления их потенциала для использования в функциональных пищевых продуктах. Установлены умеренные различия в содержании белка и жира, что позволяет рекомендовать данные сорта для дальнейшей селекции и прикладных исследований.*
Ключевые слова: *змееголовник молдавский, иссоп, макроэлементы.*

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Hyssopus officinalis L. (hyssop) is a perennial herbaceous plant belonging to the *Lamiaceae* Lindl. family *(syn. Labiatae* Juss.*).* Native to the Mediterranean and Caspian Sea regions, it naturally occurs across a wide geographic range, including southern Europe, the Middle East, Central Asia, North Africa, and parts of North America [5]. Hyssop is traditionally valued for its multifaceted applications in culinary, medicinal, and ornamental domains, primarily due to its aromatic properties derived from essential oils under salt stress at flowering stage [6]. Beyond its phytochemical appeal, *H. officinalis* is notable for its nutritional content, including macronutrients such as proteins and fats, which are increasingly recognized for their potential in food

and health-related applications [11]. Despite the growing interest, most existing studies have primarily concentrated on its essential oil composition, leaving a gap in the understanding of its basic biochemical profile, particularly in relation to varietal differences in protein and fat content.

Dracocephalum moldavica L., commonly known as Moldavian dragonhead, is another aromatic species from the *Lamiaceae* family. This herb is widely appreciated for its high content of essential oils and offering medicinal benefits [9]. In recent years, attention has turned toward its broader phytochemical richness and macronutrient composition, which offer promising avenues for both the food and pharmaceutical industries [2]. However, as with hyssop, comprehensive biochemical analyses - especially regarding total protein and fat across different cultivars - remain limited.

In the context of climate change and its growing impact on agriculture, there is an urgent need to develop adaptive strategies to ensure food security and sustainable livelihoods. Crop diversification and the enrichment of agrobiodiversity - through the cultivation of new species and varieties, including traditional landraces and introductions from other regions - are among the most effective strategies being promoted globally [7]. These approaches not only improve ecosystem resilience but also enhance the nutritional and functional quality of agricultural outputs.

With this in mind, the current study focuses on evaluating the biochemical characteristics of selected varieties of *H. officinalis* and *D.moldavica*, which have been introduced to Armenia. The goal is to assess their adaptability and potential for cultivation under the environmental conditions of the Republic of Armenia, while providing a comparative overview of their protein and fat contents - important parameters for their nutritional and commercial valuation.

Materials and Methods. This study was conducted using three introduced varieties of Hyssopus officinalis - Accord, Inej, and Lazur' - and three varieties of Dracocephalum moldavica - Gorynych, Moldavia, and Ametist. The seeds were taken from the Genebank of the Scientific Centre of Vegetable and Industrial Crops (SCVIC), located in Ararat valley of Armenia [3]. All plant varieties were cultivated under uniform agroecological conditions to ensure comparability of results. The cultivation was carried out on the experimental field of. Aerial parts of the plants were harvested at full flowering stage, the phenological phase known for peak accumulation of essential oils and other bioactive compounds. The statistical calculations were done on separate data from each variety. The experimental data underwent statistical analysis using ANOVA, conducted in the STATISTICA 1.10 software. The total protein content in the aerial parts of hyssop and Moldavian dragonhead cultivars was determined using the Kjeldahl method, a standard and widely accepted technique for estimating nitrogen content in organic substances [4]. The total nitrogen content is converted to protein using a standard conversion factor of 6.25 for plant material. Total fat content was determined using the Soxhlet extraction method, a classical procedure for extracting lipids from plant material using a non-polar solvent, in our case – hexane [8]. The fat content is calculated as a percentage of the initial dry weight of the plant sample.

Results and Discussion. The total protein content across the three cultivars of hyssop ranged from 6.5 g/100 g to 8.1 g/100 g (dry weight basis), with the Accord variety showing a slightly higher value (Table 1). These values are consistent with previous reports indicating a general protein range of 6–9 g/100 g in *Hyssopus officinalis* herb [13].

Table 1. Total protein and total fat content in aerial part of H. officinalis cultivars.

Cultivar	Variables	DF	Biochemical characteristics	
			Total Protein (g/100 g)	Total Fat (g/100 g)
Accord	Samples	20	8.1*	2.7*
	Errors	86	0.78	0.68
	CV%**	-	4.79	3.08
Inej	Samples	20	7.3*	2.6*
	Errors	84	0.85	0.66
	CV%**	-	4.58	4.07
Lazur'	Samples	20	6.5*	2.3*
	Errors	88	0.72	0,71
	CV%**	-	5.23	5.12

* correlation is significant at the 0.01 level (2-tailed)

**ratio of the standard deviation to the mean

Fat content varied between 2.2 g/100 g and 2.9 g/100 g, with Lazur' showing the highest value among the three (Table 1). Literature data confirm that the fat content in hyssop herb typically ranges from 2 g/100 g to 3.5 g/100 g, depending on variety and stage of growth [10].

The results indicate slight variation in total protein and fat content among the three varieties of *D. moldavica* as well. Ametist cultivar showed the highest levels of both protein and fat, making it a promising candidate for further investigation in functional food development (Table 2).

Table 2. Total protein and total fat content in aerial part of D. moldavica cultivars

Cultivar	Variables	DF	Biochemical characteristics	
			Total Protein (g/100 g)	Total Fat (g/100 g)
Gorynych	Samples	20	22.2*	1.6*
	Errors	86	0.69	0.59
	CV%**	-	4.28	3.02
Moldavia	Samples	20	19.8*	1.4*
	Errors	84	0.78	0.55
	CV%**	-	4.44	4.09
Ametist	Samples	20	24.5*	1.8*
	Errors	88	0.66	0,74
	CV%**	-	5.17	4.88

The differences may reflect varietal genetics. These data support the use of *D. moldavica* leaves in developing nutritionally enhanced food products.

Compared to data from other research projects, our data show some differences, particularly protein levels are marginally lower and fat content increases modestly. This can be explained by the influence of local environmental conditions, particularly temperature and sunlight which according to the literature data can significantly influence the chemical composition of aromatic and medicinal plants, including protein and fat content in dried leaves of Moldavian dragonhead and hyssop [1]. Water stress, which is common for Ararat Valley, the experimental filed is located in, could reduce protein synthesis. Higher temperatures, especially during the flowering and maturation stages, can accelerate metabolism and essential oil biosynthesis, but as a rule at the expense of protein accumulation, that is why the content of total protein may decrease due to high temperature during the full flowering stage which coincide with the period with high summer temperature in Armenia - 35-38° C. On the other hand, Armenian conditions with stronger UV can induce stress-related biochemical pathways, potentially enhancing fatty acid and secondary metabolite biosynthesis. As a result, the fat content in the dried aerial parts of *D. moldavica* and *H. officinalis* was moderately higher compared to other regions. A similar study in an agro-climatic profile similar to Armenia observed the same trend, namely protein content was slightly lower than in temperate zones, but oil content increased, likely due to stress adaptation [12].

Conclusion. The comparative assessment of the introduced cultivars of *Hyssopus officinalis* and *Dragocephalum moldavica* under the conditions of Ararat valley of Armenia reveals variation in their total protein and fat content. Differences between varieties may be attributed to genetic factors and phenotypic adaptation to local environmental conditions. The findings provide a preliminary basis for further research into their nutritional applications and selection in breeding programs.

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