

Biochemical Characteristics of Saint Mary's Thistle Varieties (*Silybum marianum* L. Gaertn.) under Soil-Climate Conditions of the Khorezm Region

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Abstract

This article deals with the biochemical characteristics of varieties of Saint Mary's Thistle such as Panacea, Debut and Samaryanka. Based on the studies, it was found that the highest oil content was found in the species Debut (26%). The lowest oil content was observed in the variety Samaryanka (19%). The highest protein content and the sum of total amino acids in the seeds of St. Mary's Thistle varieties were found in the variety Debut (131.1), and the lowest indication was observed in the species Samaryanka (79.2). By the number of replaceable amino acids existing in the seeds of the species of St. Mary's Thistle, it was found in the Varieties Debut (126.3), and the lowest indication was observed in the variety Samaryanka (112). Based on the results of studies and the noted biochemical characteristics and varietal differences of the St. Mary's Thistle, the possibility and expediency of expanding the crops of this species in the soil and climatic conditions of the Khorezm region are suggested. The research was conducted 2017-2019 y.

Keywords

St. Mary's Thistle, Variety, Biochemical Properties, Chemical Composition, Oil Content of Seeds, Oil Quality, Essential and Replaceable Amino Acids Vitamins, Soil and Climatic Conditions, Khorezm Region

1. Introduction

Medicinal plants, as well as preparations obtained from them, are used in medi-

cine for therapeutic and prophylactic purposes. The need for medicinal raw materials is increasing, in connection with which a comprehensive study of medicinal plants is relevant. Much depends on both the search for new plant species and the in-depth study of existing ones in solving this problem. Long-term forecasting of the rational use of medicinal resources should be based on a focus from artificial plantations onto the gradual transition of raw materials [1].

Improving the provision of effective medicines for the population can be achieved by increasing the sources of herbal plants. The biological, physiological and biochemical features of the growth and development of the crop, its environmental conditions, the technology of cleaning, drying and storage of medicinal raw materials for a particular plantation region have a significant impact on the yield and quality of raw materials for medicinal crops [2].

Day by day the demand for herbal medicines in Uzbekistan remains stable and quite high in the world economy, in particular in Uzbekistan. In this regard, there is a need to expand the raw material base due to cultivated and wild herbal plants. As you know, the cultivation of medicinal plants in controlled conditions contributes to the preservation of natural genetic resources and the production of higher quality raw materials compared with wild harvesting. The expansion of sown areas under certain medicinal crops is often constrained by a limited amount of sowing material due to the relatively low seed yield due to the biological characteristics of plants, an extended flowering-fruiting period, and shedding. For such crops, techniques for increasing seed productivity are undoubtedly relevant [3].

The main reason for introducing medicinal plants into the culture is that the harvesting of wild-growing species cannot always meet the production needs. In many cases, medicinal plant raw materials harvested under natural conditions are inferior to cultivated species, primarily in such indicators as the content of active substances, the presence of impurities, and others [4].

The development of cultivation methods and the introduction of wild-growing medicinal, ornamental, and other useful plants into the culture allows us to meet the need for these species, which will help to prevent the complete destruction of their stocks in the natural environment. However, work on attracting rare and endangered plant species and their study is still completely insufficient. They thirstily and significantly need to be expanded and activated [5].

To increase the yield of high-quality raw materials from medicinal plants, it is necessary to develop new technologies for its production based on a thorough study of biological and biochemical characteristics, taking into account the climate conditions in cultivation area. St. Mary's Thistle (*Silybum marianum* L. Gaertn.) is very significant among these species, which is considered a new cultivated plant in the Republic of Uzbekistan, in particular the Khorezm region. However, the possibilities of its application and cultivation technology, varietal differences, biological, physiological and biochemical features in the Khorezm region have not been studied yet [6].

This article presents the results of studies of varietal differences in the dynam-

ics of the content of chemical composition, oil content of seeds, yield of oil, vitamins, as well as in the content of proteins, interchangeable and irreplaceable amino acids of varieties of St. Mary's Thistle cultivated on saline soils of the Khorezm region.

2. Research Objects and Methods

The purpose of our research is to study the biochemical parameters of various varieties of St. Mary's Thistle (*Silybum marianum* L. Gaertn.) Panacea, Debut and Samaryanka. The studies were conducted at the experimental area of the Khorezm Mamun Academy in Khiva district, Khorezm region.

The experimental data were obtained using the following instrument base: electronic scales "ADAM AAA-100 L"; Specord 50 SA spectrometer (Analyst Jena, Germany); pH meter "MP-225"; magnetic stirrer with adjustable heating "MM3M 9619"; HPLC chromatography, Agilent Technoligns 1200; double-beam atomic absorption spectrometer ACC nov AA 330 SA with a flame automatizer.

The laboratory method was used in the laboratory of experimental experiments of the Institute of Bioorganics, Academy of Sciences Republic of Uzbekistan during the experimental work.

The content of active substances was determined on the basis of chemical analyzes according to the VILAR method (according to V.N. Zaitseva and others). The presence of fat was determined by the Sockett method. To determine fiber, the sample was initially treated with acid, then with alkali, and then with alcohol and ether. The ash content was determined by dry ashing.

3. Result and Discussion

Cultured Thistle is the most valuable of medicinal plants. Medicinal raw materials are seeds. They have a unique composition: they contain 25% - 32% fatty oil, 15% - 17% protein, water-soluble (groups B) and fat-soluble (A, D, E, K, F) vitamins, mono- and disaccharides, micronutrients, dietary fiber and enzymes, mucus up to 5%, flavolignans 2% - 3%, nitrogen-containing compounds, essential oils up to 0.1% and other substances. St. Mary's Thistle seed oil includes the following acids: linoleic 52% - 62%, oleic 18% - 25% and a number of others. The acid volume is not more than 3.5, the saponification amount is 179 - 190, the iodine amount is 57 - 59, and the oxidation index is not more than 5 [1].

Many authors argue that the fruits of St. Mary's Thistle contain unique compounds—flavonolignans, which are the leading group of biologically active compounds (ALS). The second, no less important ALS group is fatty oil. The fruits also contain such compounds as: flavonoids, saponins, bitterness, essential oils, and sugar [7] [8] [9].

At contemporary science field the chemical composition of St. Mary's Thistle grass has not been studied completely. Literature review indicates that there is great interest in studying the chemical composition of biologically active compounds, as well as studying the pharmacological aspects of the use of St. Mary's

Thistle fruits [10] [11] [12].

In our studies, there were some differences in the chemical composition of the seeds of varieties of St. Mary's Thistle (**Table 1**). For example, Panacea seeds contain an average of 5.32% fat, 33.22% fiber, 20.3% ash, 29.52% nitrogen-free extractives (BAEAV), 13.58% water, 9.69% protein and 1.4% nitrogen.

In the Debut variety, these indicators averaged as follows: 5.12%; 33.41%; 20.6%; 30.16%; 13.03%; 9.31%; and 1.57%, respectively. The chemical composition of seeds of the Samaryanka variety averaged 5.12% fat, 33.37% fiber, 20.44% ash, 29.74% nitrogen-free extractives (BAEAV), 13.39% water, 9.49% protein and 1.18% nitrogen.

In our studies, we also determined the amount of oil, the yield of oil and the acidity in the seeds of varieties of St. Mary's Thistle (**Table 2**). In these studies, varietal differences in St. Mary's Thistle were also identified. The highest oil content was found in the variety Debut (26%). The lowest oil content was observed in the variety Samaryanka (19%), and the Panacea (23%) took an intermediate place.

The yield of oil from the Panacea varieties is 266 kg/ha; the variety Debut has 313 kg/ha and the variety Samaryanka 274 kg/ha. The acidity of these varieties averaged 0.30 mg/kg; 0.27 mg/kg; 0.32 mg/kg, respectively.

Significant differences in the protein content and the content of essential amino acids were found in the seeds of St. Mary's Thistle varieties in **Table 3**. The results obtained at the end of experiments are.

The Panacea contains 13.8% protein, and of the essential amino acids as: threonine—8.2; lysine—9.7; histidine—6.7; arginine—25.0; valine—13.7; methionine—3.5; isoleucine—9.5; leucine—19.8; phenylalanine—12.9; tryptophan—2.6. In the variety of Debut, these indicators averaged as follows: 15.6; 9.4; 11.1; 7.6; 30.5; 15.6; 4.4; 10.9; 23.4; 14.9 and 3.3, respectively.

Table 1. The chemical composition of varieties of St. Mary's Thistle on average, in 2017-2019.

Varieties of St. Mary's Thistle	Content of absolutely dry matter, %						
	Fat	Fiber	Ash	Without Nitrogen Extractive Substances	H ₂ O	Protein	N
Panacea	5.32	33.22	20.3	29.52	13.58	9.69	1.4
Debut	5.12	33.41	20.6	30.16	13.03	9.31	1.57
Samaryanka	5.12	33.37	20.44	29.74	13.39	9.49	1.18

Table 2. Oil content of seeds and oil yield of varieties of St. Mary's Thistle.

Varieties of St. Mary's Thistle	Oil content, %				Oil yield, kg/ha				Acidity amount, mg			
	2017	2018	2019	Average	2017	2018	2019	Average	2017	2018	2019	Average
Panacea	22.7	20.8	23.1	23	266.1	253.7	278.3	266	0.32	0.29	0.30	0.30
Djbut	25.3	24.8	25.7	26	315.2	291.5	332.3	313	0.28	0.29	0.24	0.27
Samarianka	20.6	17.9	18.4	19	286.8	263.5	271.6	274	0.35	0.30	0.31	0.32

Table 3. The amount of protein and essential amino acids in the seeds of St. Mary's Thistle varieties.

Varieties of St. Mary's Thistle	Protein, %	Threonine	Lysine	Histidine	Arginine	Valine	Methionine	Isoleucine	Leucine	Phenylalanine	Tryptophan	Amount
Panacea	13.8	8.2	9.7	6.7	25.0	13.7	3.5	9.5	19.8	12.9	2.6	111.6
Debut	15.6	9.4	11.1	7.6	30.5	15.6	4.4	10.9	23.4	14.9	3.3	131.1
Samaryanka	12.1	5.3	10.1	5.4	20.7	8.5	2.9	5.3	10.0	9.3	1.7	79.2

The protein content of the variety Samaryanka was 12.1%, and of the essential amino acids: threonine—5.3, lysine—10.1, histidine—5.4, arginine—20.7, valine—8.5, methionine—2.9, isoleucine 5.3, leucine 10.0, phenylalanine 9.3 and tryptophan 1.7.

The highest protein content and the sum of total amino acids in the seeds of St. Mary's Thistle varieties were found in the variety Debut (131.1), and the lowest—in the variety Samaryanka (79.2), and the Panacea variety (111.6) took an intermediate place.

Significant differences were also observed in determining the amount of replaceable amino acids in the seeds of St. Mary's Thistle varieties (**Table 4**). For example, there are following interchangeable amino acids in the Panacea; cysteine—3.0, glycine—14.0, alanine—12.0, tyrosine—7.5, aspartic acid—19.4, serine—1.01, glutamic acid—42.1 and proline—15.5. In the variety Debut, these indicators averaged as follows: 3.2; 14.2; 12.3; 8.7; 19.7; 10.2; 42.3 and 15.7, respectively.

Variety Samaryanka contains the following interchangeable amino acids as cysteine—3.8, glycine—8.9, alanine—8.7, tyrosine—5.6, aspartic acid—19.7, serine—9.0, glutamic acid—43.7 and proline—12.6. The largest amount of replaceable amino acids in the seeds of St. Mary's Thistle varieties was found in the Debut (126.3), and the lowest—in the Samaryanka (112) while the Panacea (123.6) took an intermediate place.

Significant contrastive features were observed in the composition of St. Mary's Thistle seeds when determining the amount of vitamins (**Table 5**). The indicators averaged as follows according to the results of the experiment: in the Panacea—vitamin A is 0.4 ME, vitamin D is 4.3 ME, vitamin E is 7.4 mg/kg, B1 is 5.2 mg/kg, B2 is 4.7 mg/kg, B3—14.6 mg/kg, B4—2010 mg/kg, B5—46.5 mg/kg, B6—7.5 mg/kg and B12—0.5 mg/kg; in the variety Debut—0.5%; 4.9; 6.8; 5.8; 5.3; 16.4; 2010; 52.0; 8.5 and 0.4 mg/kg, respectively. The following indicators were observed in the amount of vitamins in the Samaryanka variety: vitamin A—0.3 IU, vitamin D—4.0 IU, vitamin E—6.5 mg/kg, B1—4.7 mg/kg, B2—4.1 mg/kg, B3—13.0 mg/kg, B4—2000 mg/kg, B5—41.5 mg/kg, B6—8.0 mg/kg and B12—0.6 mg/kg.

4. Conclusions

Based on the studies, we can make a conclusion as in the following:

Table 4. The content of non-essential amino acids in the seeds of varieties of St. Mary's Thistle.

Varieties of St. Mary's Thistle	Cysteine	Glycine	Alanine	Tyrosine	Aspartic Acid	Serine	Glutamic Acid	Proline	Amount
Panacea	3.0	14.0	12.0	7.5	19.4	10.1	42.1	15.5	123.6
Debut	3.2	14.2	12.3	8.7	19.7	10.2	42.3	15.7	126.3
Samaryanka	3.8	8.9	8.7	5.6	19.7	9.0	43.7	12.6	112

Table 5. The content of vitamins in the seeds of varieties of St. Mary's Thistle, on average, in 2017-2019.

Varieties of St. Mary's Thistle	A, ME	D, ME	E, mg/kg	B ₁ , mg/kg	B ₂ , mg/kg	B ₃ , mg/kg	B ₄ , mg/kg	B ₅ , mg/kg	B ₆ , mg/kg	B ₁₂ , mg/kg
Panacea	0.4	4.3	7.4	5.2	4.7	14.6	2010	46.5	7.5	0.5
Debut	0.5	4.9	6.8	5.8	5.3	16.4	2010	52.0	8.5	0.4
Samaryanka	0.3	4.0	6.5	4.7	4.1	13.0	2000	41.5	8.0	0.6

The highest oil content was found in the variety Debut (26%). The lowest oil content was observed in the variety Samaryanka (19%); the highest protein content and the sum of total amino acids in the seeds of St. Mary's Thistle varieties were found in the variety Debut (131.1), and the lowest—in the variety Samaryanka (79.2); by the number of replaceable amino acids present in the seeds of St. Mary's Thistle varieties were found in Debut varieties (126.3), and the lowest—in the Samaryanka variety (112).

5. Recommendations to Production

Thus, based on the research results and the noted biochemical features and varietal differences of the St. Mary's Thistle, the possibility and expediency of expanding the varieties of this crop in the soil and climatic conditions of the Khorazm region are shown.

To form and obtain stable crops with good sowing, economically valuable and technological qualities on saline and irrigated alluvial-meadow soils of the Khorazm region, it is recommended to sow varieties of St. Mary's Thistle Debut and Samaryanka for certain products.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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