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Physicochemical parameters, antibacterial and antifungal characteristics of preparations from the ground parts of the golden mustache (callisia fragrans wood) grown in the conditions of Azerbaijan

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Abstract

Referring to literary sources and our own experimental studies, the article describes the issues of cultivation, determination of physicochemical parameters and some volatile production properties of ground preparations from the traditional medicine plant, golden mustache (Callisia fragrans Wood).

There was shown that preparations obtained from the shoots (tendrils) of this plant have the best antimicrobial and antifungal properties.

Keywords: Callisia fragrans, cultivation, chemical composition, antibacterial and antifungal properties.

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1. Introduction

Under modern conditions for creation of functional products, the so-called products for a healthy diet, plant raw materials and products of its processing play a significant role in solving food, environmental and energy problems, which serve as the most valuable sources of irreplaceable components of natural origin at the same time. [1, 2, 3].

Besides, special attention is paid to the study of the content of antioxidant activity (AO) in extracts of tea, aromatic and medicinal plants and vegetable supplements in the form of powders and extracts in order to use them in the production of functional products [4, 5].

Among them, water-soluble polyphenols are considered typical representatives of AOs, the activity of which is associated with their increased reactivity with respect to active free radicals. Literary sources from near and far abroad testify to their action in preventing and suppressing oncological diseases and reducing the risk of cardiovascular diseases. At the same time, polyphenols of aromatic and medicinal plants have actoprotective and immunomodulatory properties [6, 7, 8].

Therefore, research on the antioxidant properties of preparations from various traditional and non-traditional plant sources deserves attention. In this aspect, the study of the chemical composition, antibacterial and antifungal activity of leaves, shoots, tinctures, sap, powders and other samples obtained from Golden mustache (CallisiafragransWood), a plant

of Mexican origin, prospective for cultivation in Azerbaijan, can be considered urgent [9, 10, 11].

In folk medicine and scientific literature, the plant is also called the basket plant, domestic ginseng, etc. Taking into account the miraculous power of the preparations of this plant, for over 20 years we have been studying the conditions of the growth, acquisition and application of its various preparations in order to use them in functional nutrition. Unfortunately, there is little or no data in the literature on the use of this plant in the food industry and food technology. Although, preparations of the golden mustache are used already in Russia for pharmaceutical purposes.

It is well known that the basket plant (Callisia Fragrans) called domestic ginseng has been used in folk medicine for centuries, and in recent years it has become a promising raw material for the pharmaceutical industry, and for the production of medicinal preparations and balms in the CIS countries, primarily Russia. In addition, based on the use of ground parts of this plant, relevant standards and technical conditions were developed, and various studies were carried out, incl. PhD thesis, at the beginning of the 21st century [11, 12, 13]. There have appeared numerous reports on the advisability of using golden mustache tinctures and extracts as phytocomponents for application in medical industries [14, 15].

Thus, TU 9373 - 011 - 17491338 – 2008, *Fresh Callisia Fragrans Shoots*, and TU 9168 - 012 - 17491338 – 2008, *Golden Mustache Sap*, were developed for Callisia fragrans in the Russian Federation, as well as the technological instruction for procurement, primary processing and storage of fresh shoots of Callisia fragrans which was approved by Vifitech CJSC.

Callisia shoots are very rich in antioxidants, minerals and vitamins, effectively contributing to the strengthening of the immunity of the human body.

As noted above, there has been written a lot in the literature about Basket plant, Callisia fragrans wood, called the golden mustache and its use among the people for the treatment of various diseases. There are scientific data on its antiradical and antioxidant properties [12].

Scientists attribute all this to its amazing chemical composition. Since the ground part of the golden mustache is rich in protein compounds, flavonoids, ascorbic acid, carotenoids, vitamins, minerals and other biologically active compounds. In recent years, the Russian pharmaceutical industry has been producing various ointments and other medicinal preparations using the ground parts of the golden mustache which are prepared taking into account the information of traditional medicine.

Golden mustache is a perennial cultivated herbaceous plant that successfully grows up to 2 meters high both at home and in greenhouse conditions. Researchers of the Pyatigorsk State Pharmaceutical Academy developed specifications (standards) for obtaining sap and technological instructions for procurement and primary processing for its shoots [12]. It was shown that preparations of the golden mustache really have golden properties in truth.

As a heat-loving plant, the golden mustache grows and also lives well in our conditions, i.e. in Azerbaijan (Figure 1). Our experiments and observations at home, laboratory and greenhouse conditions have shown the expediency of growing and using its ground parts for functional purposes. Taking into account the recommendations of traditional medicine and the results of experiments, we obtained alcoholatures, dry residue, oil and other preparations from the chopped post-extraction residues of the shoots of Callisia, and all of them were investigated (Figure 1, 2, 3). It was established that cold brew of daily used tea is very suitable as an extra nutrition (fertilizer) for this plant.

Works on cultivation in the laboratory conditions of the Azerbaijan State University of Economics, as well as in home and greenhouse conditions in Baku showed that the climate and temperature for the growth of the golden mustache are ideal here. The plant grows successfully and gives a sufficient number of shoots, leaves and stems with medicinal

properties (see Figure 1).

Taking into account the recommendations of traditional medicine and existing data from scientific sources, under the guidance and with the direct participation of Associate Professor N.H. Gurbanov, we have been getting saps, infusions and tinctures from basket plant in recent years, which we use to improve the painful condition of the joints and muscles, burns in the outer parts of the body, and help those who wish to prevent certain skin diseases. For almost 15 years in a succession, the first author of this article has successfully grown with watering a cold brew, prepared and applied golden mustache tinctures externally for himself, his family, and friends with the aim of reducing pain in the lumbar dorsal part and joints of the body. So far, he has provided gratuitous assistance in the form of golden mustache tincture to over 150 people.

Taking into account all this and literary data on traditional medicine, the rich chemical composition of all ground parts of the golden mustache, Callisia fragrans, we initially studied the general chemical composition of its shoots and leaves, which we grew in laboratory conditions, using well-known methods.

It should be noted that as a result of sap extraction and production of an alcoholature from the shoots of the golden mustache, a lot of residue remains, which can be successfully used for food purposes after drying under mild conditions (room or vacuum).

In addition, we consider it expedient to use dry natural marc from the golden mustache shoots to obtain tinctures and infusions all year round, if there is a sufficient supply of raw materials.

Figure 1. General view of the golden mustache and shoots (tendrils)

Literature information and our experiments on growing and obtaining extracts from shoots and leaves have shown that regular watering of the golden mustache with cold tea brew and mineralized water under room conditions provides raw materials with the best physical and chemical parameters and a high sap yield.

Callisia fragrans is a perennial herbaceous greenhouse plant. In appearance, it resembles young corn, reaches a height of about 1m and has 2 types of shoots, upright and lateral ones. Horizontal shoots which obtain medicinal properties after formation of at least 9-12 links of "joints" of a cylindrical shape and have underdeveloped leaves 1-3 cm long or more is considered to be its main raw material for pharmaceutical purposes. In addition, the stem (standing part) and shoots (lateral tendrils) have at the end large, simple lanceolate leaves up to 15-30 cm long and up to 5-6 cm wide, sessile and pointed at the end (see Figure 1).

It has been established that the shoots of Callisia lose up to 86.4-91.5% of moisture when dried; contain 9.1-11.1 ash and 0.20-0.35% mineral impurities, which are similar on average to the data of the existing literature [12,13,15].

In addition, the qualitative composition of Callisia shoots includes carotenoids, anthracene derivatives, coumarins, flavonoids, saponins, alkaloids and nitrogenous compounds, carbohydrates, pectin substances, proteins and amino acids, and organic acids [7, 12, 13].

The amount of carbohydrates, amino acids and organic acids contained in dry Callisia shoots is 1.82%, 1.48%, and 0.21%, respectively.

Studies show that after extracting the sap from the Callisia shoots, over 0.2% of amino acids remain in the residue by dry weight. The sap of the golden mustache has a pH of 4.7-6.3, the dry matter content in the shoots is 10-15.0% on average.

Despite all these advantages of the ground parts of the golden mustache for pharmaceutical purposes and for traditional medicine with their special harmonious chemical composition, there is still no evidence in the literature about the scientifically based use of preparations from this plant in food technology. Although, as mentioned above, there is a lot of information about the medical use of the golden mustache. One of the interesting properties of the golden mustache is its bactericidal action and antifungal properties too, which have not been fully studied in its preparations. Considering all this, as well as the prospects for the use of preparations from the golden mustache as a preservative and food, including biological additives, we studied at the Foodstuff Technology Department of ASUE and laboratories of Microbiologic Institute of Azerbaijan National Academy of Sciences the antibacterial and antifungal properties of preparations from the ground parts of the golden mustache, namely sap from its leaves and shoots, oil extracts from leaves and alcoholature from chopped shoots (see Figure 3).

2. Experiments

Preparations from the golden mustache grown by us (tinctures, sap from shoots and leaves, oil extract) were prepared as described in the paper [11]. An alcoholature of the shoots was prepared immediately after they were thinly cut using 50% ethanol, according to the literature description [9, 11].

The general chemical composition (proteins, fats, carbohydrates, etc.) was determined by well-known methods [16]. The mineral composition was determined using the X-ray fluorescence research method [17]. Sample preparation, antibacterial and antifungal properties of samples (preparations) from individual parts were determined according to GOST [18, 19, 20].

3. Results and discussion

The results of the study (see Table 1) showed that all ground parts of the golden mustache contain vital biologically active substances, including proteins, fats, carbohydrates and amino acids, ascorbic acid, organic acids, phenolic compounds and others which are much more in plant shoots. The raw weight of the shoots is about 13% of the ground part of the plant. The ash content in their composition is about 9.5% of solids. The obtained results are in good agreement with the literature data. Apparently, all this in mustacheination determines the antiseptic and other properties of the plant.

The results of determining the mineral composition of golden mustache shoots using X-ray fluorescence analysis are presented in Table 2.

All this simultaneously served as the basis for the analysis of antibacterial and antifungal activity of preparations obtained from individual parts of the golden mustache.

The results of the determination are presented in Table 3.

Figure 2. Chopped shoots of the golden mustache for the preparation of alcoholature

Figure 3. Ready-made alcoholatures from golden mustache shoots

Physical and chemical parameters	Leaves	Shoots	Stem
Weight, %	54.0	15.0 (13.0)	31.0 (33.0)
Humidity, %	93.0	86.4 [93.0]	94.0 (93.5)
Per dry matters: Proteins, fats, %	2.0 (2.1)	3.0 (3.5)	2.4 (2.5)
Organic acids, %	0.15 (0.2)	0.21 (0.25)	0.16 (0.14)
Ascorbic acid, mg %	8.5 (20.0)	34.0 (0.38)	30.0 (25.0)
Carotene pigments, mg %	Not determ. [7.4]	0.34	Not determ.
Sugar, %	12.2	11.5	Not determ.
Total carbohydrates, %	Not determ.	13.4	Not determ.
Pectin substances, %	8.0 (10.3)	12.0 (15.4)	-«»-
Tannins, %	4.5 (6.0)	3.0 (2.0)	-«»-
Amino acids, %	Not determ.	4.95 (4.8-6.3)	-«»-
Sap pH	-	4.95 (4.8-6.3)	-
Ash content, %	-	9.5 [8.4]	-

Table 1. Physical and chemical parameters of individual parts of the golden mustache (% - on dry matter) according to the literature (in brackets) and our data

Macro and microelements	In leaves		In stems	
Potassium	(15000)	16000	(7000)	8000
Calcium	(77000)	55000	(92000)	65000
Manganese	(48)	82	(15)	21
Iron	(210)	250	(120)	120
Cobalt	(3.0)	1.5	(1.5)	0.8
Nickel	(1.5)	0.5	(2.0)	1.0
Copper	(8.5)	7.0	(3.5)	4.0
Zinc	(32.0)	25.0	(60.0)	50.0
Chromium	(35.5)	40.0	(8.4)	9.0
Rubidium	(6.5)	4.0	(5.2)	9.5
Strontium	(312.0)	150.0	(350.0)	300.0
Lead	(1.5)	2.0	(3.0)	3.5
Vanadium	4.5	-	-	

Table 2. The mineral composition of leaves and shoots from the ground parts of the golden mustache (in μg per dry weight) according to the literature (and according to our experiments) [15, 17]

Microorganisms researched	The number of colonies of microorganisms formed in Petri dishes for 12 days, QMAFAM ×103 CFU/g															
	Samples from various parts of the golden mustache (5ml each)															
	Alcoholature of the shoots				Alcoholature of the shoots				Alcoholature of the shoots				Alcoholature of the shoots			
	Study days															
				2				2				2				2
Trichoderma viridi																0
Mucor rasemosus																
Asperqillus niqer																
Yeast mushrooms																
Bacilus subtilis					6	2	0	0				1				
Bacilus cereus					2	6	4	8				4				
Bacilus mezentericus					0	2	9	1				0				
Actinomices bovis																

Table 3. Antibacterial and antifungal characteristics of preparations from the ground parts of the golden mustache

As can be seen from the data presented in Table 3, preparations from ground parts, especially leaves (sap and residue) and shoots (sap and residue) of Callisia fragrans, have strong antibacterial and antifungal properties, and the development of such conditionally pathogenic fungi as MucorHiemalis, Mucorluteus, Mucorrasemosus, Mucormuceto, Trichodermaviridi and others actually does not occur within 3, 4 days. So, within 2 weeks the number of their colonies does not exceed 4-0 $\times 10^3$, i. e. the established allowable norm (limit) for their safety. [22] As for the studied bacteria, such as Bacillussubtilis, Bacilluscereus, Bacillusmezentericus, Aktinomicesbovis, they do not develop completely within 4 days, however, after 2 weeks of development in an agaropeptone medium with the participation of these prepations under thermostat conditions, at 35-37 ^{0}C they show little activity and develop to such an extent that they do not exceed the established allowable rate for their safety.

All this suggests that not only sap and extracts, but also dry residue from the most valuable shoots and leaves of the golden mustache can be successfully used as a preservative and biologically active additive in the production of functional foods. Our research in this direction continues. In conclusion, it should be noted that some of the materials in the form of

abstracts related to the golden mustache were reported at international conferences held in Mogilev and Kiev [21, 22, 23].

4. Conclusion

Based on the above materials, the following can be concluded. Golden mustache, Callisia fragrans, deserves attention for use in the food industry for its chemical composition, antibacterial and antifungal action. The richness and favorable ratio of biologically active components, the antimicrobial and antifungal effect of sap or alcoholature obtained from its shoots, makes the plant a valuable raw material for use in food production, especially for production of functional compositions and products for therapeutic and prophylactic purposes. Since the therapeutic effect of its sap is very strong and it cannot be used in vitro in high doses, we consider it expedient to use all parts of the plant, especially the residue from horizontal shoots (after extracting the sap or in the form of alcoholature) in a dry powdery state as a valuable additive for enrichment bakery and confectionery products, minced meat semi-finished products, etc.

At the same time, the antibacterial and antifungal action of its constituent components brings to the fore its use as a preservative to prolong the shelf life of products, to suppress the development of microflora in the food production process. Therefore, the issues of using its sap and other preparations in food technologies are open to researchers.

In addition to the aforesaid, easy cultivation, favorable climate and temperature conditions in Azerbaijan, the requirement for lower costs for plant care makes it promising as a raw material not only for the pharmaceutical and food industries, but also for other areas of human activity. Over 500 years of use of this plant in folk medicine in many American countries, including Mexico confirm the appropriateness of our judgments.

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