

Botanical Peculiarities of *Hynericum perforatum* Z. and Content of Some Heavy Metals in Sprouts in Different Ecological Conditions

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Abstract

The aim of the work is to find out the quantity of content of several heavy metals (HM) in the sprouts of *Hynericum perforatum* Z., highly popular among population. Some problems related to wild useful plants used by the population of Armenia, as well as safety issues in the environment are touched upon. Expert analysis of biological peculiarities of *Hynericum perforatum* Z. in different ecological conditions has been carried out. It has been revealed that the content of heavy metals in the plant changes on different heights above sea surface.

Keywords: Wild herb; Safety of raw material; Tincture

Introduction

All the nations over the world have always been interested in useful plants both as agricultural food, medicine and as dye-stuff and honey stuff both for usage of the tincture itself and after it's processing. It's also an essential selection initial material, especially for immune selection. They are considered the best invaluable sources of floral resources and are ranked among national properties of every country. Many of them were initiated into agriculture and are now cultivated as crops. The humankind will go on taking from the nature everything that is not initiated into the culture yet.

Nowadays the most important problem of the humankind is to create clever relations between the nature and society, correct combination and solution of which supports prosperity and healthy lifestyle of population of a particular country and at the same time supports strengthening of efficiency of natural floral resources and landscapes, their safety, preservation, correct usage and permanent development. And all these are coincided with global processes taking place on the earth.

Ecological clearness of the environment, poorness of sanitary-hygienic conditions caused by ecological and anthropogenic factors, decrease of the quantity and dangerousness of numerous ecologically harmful waste, toxic substances, usage of toxics in agriculture, clearness of agro-ecosystem and natural landscape and the most important thing, providing mankind with safe and clean food, herbs and spices have been and remain the top priority of humankind. Existence of heavy metals in wild useful plants, including in herbs, is of importance. Though their small doses help normal growth of plants but they cause negative processes in surroundings, rich with heavy metals and their components. Heavy metals penetrating into a person's organism through food and infecting it may cause different diseases. Heavy metals are especially dangerous for humanity because of their influence on genome that may cause even genetic diseases, malignant tumors. Dangerousness of heavy metals continually decreases. We have some doubts that the reason of cancer spread in the Lori region more than in any other regions of Armenia may be usage of wild useful plants by the population because of their being rich with heavy metals /wild greens/ [1-4] that may be of upmost attention in the case of *Hynericum perforatum* Z. as well. By the way, no acceptable limit of existence of heavy metals for any wild useful plant is decided while the whole population uses it.

Today a number of international organizations make various decisions, work out conventions of various characters which pay attention to correct development of the global populations' economic

profit, to ecological problems of wild useful plants and animals that must be localized by every country, according to peculiarities of its flora and fauna and must serve its population, led by international norms.

Armenia is known for its rich variety of valuable useful plants, floral variety and biodiversity, for exceptional richness of local species and their components [5]. It's a result of genetically beneficial conditions of the rind of the region, complicated geological structure, and climate, variety of lands, relief and flora. According to 2014 data, there are about 3650 types of plants in Armenia, about 480 of which are used by mankind.

Herbs are of most importance among wild useful plants. They are both taken by the population directly from nature and tincture are prepared with the help of corresponding technologies, then people themselves make use of them. Most of the population gathers the herbs from nature, later sales them in the market, just fresh or dried. Herbs taken from the nature are more profitable and acceptable for agriculture having lack of raw material, for countries having unusable lands like Armenia. No serious researches have been done by now for reservation of wild plants, multifactorial permanent development of inventory, safety issues, though separate wild plants are cultivated in agriculture. Issues of quantity and quality of heavy metals are of importance from the point of view of safety; here ecological conditions and anthropogenic problems are taken into consideration [6]. It already becomes a necessity to improve usage and reservation of wild herbs. Factually, in conditions regulated by natures, we have a possibility to take from nature a valuable raw material without interference of mankind and additional expenses and to use it for treatment of numerous diseases within frames of herbal medicine.

Materials and Methods

Hynericum perforatum Z. is 20-60 cm tall perennial herb belonging to *Hynericum perforatum* Z. *H. perforatum* Z. family, with sharp,

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slick sprout, leaves are sessile, with opposite order of leaves, oval and wrinkled. It has numerous flowers with gold petals and small seeds. It has brown root with many brunches. It flowers during the whole summer and fruits in August and September. It grows in dry and light places, forest and semi-steppe zones, on the height of 2300 m above the sea surface. Many species of usual *Hynericum perforatum* Z. are used as a medicine.

On the territory of Armenia *Hynericum perforatum* Z. has various folk names: arevquyrik, yeznatsaghik dashti, teyi tsaghik, hazartsaghik, hayfatizon, hipericon, hotmot, mkan aghiq, mshahamuk, popghak.

Hypericum perforatum Z. includes 10-20% of murrain, dyes, hypericin and pseudohypericin, resin, 5-6% of anthocyanin, saponins, glycoside, hyperoside, vitamin C, rutin, niacin, carotene choline, alcohols and quercetin, 0.2-0.3% of essential oils. It's also rich with microelements.

The vegetative part of the herb is used for medical purposes, it's stored during the flowering period, before its fructifying, cutting it with scissors or hook, without rigid part of the stem. Its green part in dried on a roof /in shadow/, in conditions of strong wind, hung or spread on the floor. Dried raw material which makes about 25% of the wet mass is chopped, rigid parts are taken away and the herb is kept in paper-wrapped boxes. Bunch of sprouts is sold in the market (Figure 1).

The herb has an old history of usage, Hippocrates, Plinius, Dioscorides, Paracelsus, Tabernemontanus, Avicenna, *M. heratsi*, Amirdovalt and today people have used it for treatment of different diseases. *Hynericum perforatum* Z. is used for treatment of different diseases in India, Russian Federation, Uzbekistan, Kazakhstan, France, Poland, Czech Republic and other countries. Antibiotics named Imani and Novoimani are synthesized from *Hynericum perforatum* Z. (Ukraine).

Biological researches are done on the example of 20 plants in places of growth on different height above the sea surface. Average samples are taken from the same places for quantitative and qualitative analysis of existence of heavy metals. The content of heavy metals was measured at NAS RA Center for Ecological-Noosphere Studies, with the help of equipment named innoy X-5000, with the method of X-ray fluorescent analysis. Samples were taken from such places which are far from techno genic objects (chemical industry).



Figure 1: Sale of *Hynericum perforatum* Z. in Vanadzor market (10.04.2015).

Discussion of Results

Results of biological studies are presented in Table 1. Analysis of biological peculiarities of *Hynericum perforatum* Z. in different ecological conditions shows that on different geological heights above the sea surface (600 m-2600 m) the plants were 42.3-54.6 cm tall, the number or sprouts on a plant was 4.0-7.3, the number of leaves was 52.7-64.0, the surface of leaves were 10.2-12.1 sq. cm, the period from blossoming to beginning of lowering lasted from about 62-72 and of full flowering about 111-121 days. The underground and ground mass of the plants also differs.

Table 2 presents results of analysis of some heavy metals in the sprouts and flowers of the *Hynericum perforatum* Z.

We can see from presented data that everywhere, with some exceptions, there is more Fe, then Mn, Zn, Ni, Cr. The quantity of Fe in the plant grows directly proportional to height above sea surface. The quantity of Zn, Cu, Mn decreases, there is no regularity in other.

So, the content of heavy metals in the plant changes on different heights above sea surface. And this can be explained with their quantity in soil, their transparency and rate of migration from soil to the plant.

We tried to compare acceptable limit of heavy metals in bread, vegetable, fruit, juices and non-alcoholic drinks (Liohim 2005, narod. ru/himiya/metalli.doc/(MPC)) with its indicator in *Hynericum perforatum* Z. As a result of our experiments in Lori it turned out that indexes of Fe, Zn, Cu, Mn, Co, Ni, Cd, Hg, Pb, Cr in *Hynericum perforatum* Z. extends for many times the acceptable limit of heavy metals in floral stuff, ready food and non-alcoholic drinks and juices what is very upsetting. We find that the issue should be regulated and limited, the usage of natural raw material of *Hynericum perforatum* Z. by the population should even be prohibited and responsible bodies should work out acceptable standard of deepness of heavy metals in *Hynericum perforatum* Z. Some work should be done here and efforts should be made as the population of Lori region gets some profit from sale of *Hynericum perforatum* Z. that supports decrease of poverty. According to our average calculations (as a result of survey held among the population) a person may annually get a profit of up to 8,00,000 and more dram.

Conclusion

1. The height of sea surface affects the growth and development of the *Hynericum perforatum* Z. by its geographic positioning, in low territories the plants have many leaves but they are small, the plants are tall, more under the ground than on the ground, the vegetation ends early.
2. The place where the *Hynericum perforatum* Z. grows affects the quantity of heavy metals in it. The quantity of Fe, Cd, Hg increases and the quantity of Zn, Cu, Mn decreases directly in correspondence to the height of the sea surface. Anthropogenic influence also exists.
3. The quantity of some heavy metals in the natural raw material of *Hynericum perforatum* Z. in Lori marz is many times more than it is found in other natural raw material of floral origin, food and juices.
4. In order to provide the mankind with safe raw material, usage of natural raw material of *Hynericum perforatum* Z. should be regulated in Lori region, within different ecological conditions, and the maximum acceptable limit of content of heavy metals in it must be decided and fixed and it will regulate the problem of the raw material taken from nature and its sale.

N	Observations		One plant							
	Place (community)	Height of sea surface (m)	Height of plants (sm)	Num-ber of sprouts (quan-tity)	Leaves		Duration of flowering (days)		Ground, dry mass	Root
					Number (quantity)	Surface (sq sm)	beginning 10-15%	ending 70-75%		
1	Shnogh	600	42.3 ± 2.5	7.3 ± 0.8	64 ± 2.4	10.2 ± 0.06	62 ± 3	111 ± 8	10.1 ± 1.2	10.6 ± 1.1
2	Chkalov	1400	47.1 ± 1.8	6.9 ± 0.7	60 ± 2.7	10.9 ± 0.05	64 ± 4	115 ± 6	11.3 ± 0.9	9.1 ± 1.4
3	Darpas	2200	52.5 ± 1.7	6.3 ± 0.4	53.2 ± 1.9	11.8 ± 0.07	69 ± 3	117 ± 4	13.5 ± 1.1	9.5 ± 0.9
4	Maymekh	2600	54.6 ± 2.1	6.0 ± 0.4	52.7 ± 1.6	12.1 ± 0.06	72 ± 3	121 ± 8	12.4 ± 1.8	9.8 ± 0.8

Table 1: Average data of growth and development of *Hynericum perforatum* Z. on different heights above sea surface, 2013-2015.

N	Heith above sea surface / m										
		Fe	Zn	Cu	Mn	Co	Ni	Cd	Hg	Pb	Cr
1	1400	245.1	124.2	114.1	121	0.7	35.0	0.7	0.03	0.91	0.3
2	1700	160	84.4	24.3	104.1	0.8	2.4	0.64		0.12	2.4
3	2000	132	65	19.7	84.3	0.9	10.4	1.3	0.8	0.8	1.8

Table 2: The maximum quantity of content of heavy metals in sprouts and flower of *Hynericum perforatum* Z., 2014-2015.

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