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INTEGRAL SYSTEMIC ANALYSIS OF BIOMEDICAL AND ECOLOGICAL DATA ON NATIVE LITHUANIAN VASCULAR MEDICINAL PLANT SPECIES

Summary of doctoral dissertation
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VILNIAUS UNIVERSITETAS

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LIETUVOS SAVAIMINIŲ VAISTINIŲ INDUOČIŲ AUGALŲ RŪŠIŲ BIOMEDICININIŲ IR EKOLOGINIŲ DUOMENŲ INTEGRALI SISTEMINĖ ANALIZĖ

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INTRODUCTION

Medicinal plants are defined as plants having structural parts that invoke specific reactions in human and animal organisms when used for therapeutic purposes (NAUMAVIČIUS, NAUJALIS, 2009). There are over 35 000 common medicinal plant species worldwide (VAN WYK, WINK, 2004), although some sources state that the number of such species might be as high as 70 000 (GUDŽINSKAS, BALVOČIŪTĖ, 2008). Considering few exeptions, medicinal properties are most common in land ecosystem dominant vascular plants. Usage of medicinal plants, both for preventional purposes and in treatment of particular illness (KOVNER, 1878; ŠLIŪPAS, 1934), dates back to early history. In distant past medicinal plants were main means of treatment. Nevertheless, in the XXI century medicinal plants have retained their value. In many countries people actively use specific local or imported plants in order to treat and prevent illness. The significance of medicinal plants is determined by the fact that approximately 80% of all medicaments in the world are produced from medicinal plants (BARNES et al., 2007). Therefore thorough research on medicinal plants remains highly relevant.

Every country has a different number of medicinal plant species with consequently different taxonomic composition and levels of their medical recognition and application in practical therapy. The concept of medicinal plant is a complex of experiences and data defining those experiences, formed in course of human – environmental interaction. General number of medicinal plant species and their taxonomic composition mostly depends on the territory of specific country and its geographical position. Medical plant usage in health promotion and threapy is determined by the following factors: 1) ethnomedical traditions in a particular country, 2) qualificaion of specialists working in area of phytotherapy (medics, botanists), 3) universal accessibility of data on medicinal plants.

Lithuania is situated in the lands where traditions of treating people with medicinal plants are significantly old and respected. There have always been many qualified specialists working in phytotherapy in our country (PETKEVIČ, 1911; ŠIMKŪNAITĖ, 1944; PETKEVIČIŪTĖ, MEKAS, 2011). Therefore, accumulation and analysis of reliable data on medicinal plants remains relevant nowadays. It is highly important to get to know our local medicinal plants of natural origin as nowadays phytotherapists often prioritize foreign imported medicinal plants (RAGAŽINSKIENĖ, 2009). There are approximately 1350 natural vascular

plant species known in our country (GUDŽINSKAS, 1999). This number includes a significant amount of medicinal plants, although views of various authors on such number of plant species in our land are realatively different (GUDANAVIČIUS, 1960; PIPINYS et al., 1972; RAGAŽINSKIENĖ et al., 2005; GUDŽINSKAS, BALVOČIŪTĖ, 2008). For example, some sources appoint that there are 462 (RADUŠIENĖ, JANULIS, 2004) to 550 (LEKAVIČIUS, 1986) or even 800 (JASKONIS, 1996) medicinal plant species in Lithuania. However, information provided by other important publications indicate only 226 (PIPINYS et al.,1960) ore even lower number of medicinal plant species (GUDŽINSKAS, BALVOČIŪTĖ, 2008).

There is significant lack of exact information on native vascular medicinal plants in Lithuania (NLVMP), as the authors analysing medicinal properties of plants usually do not differentiate between members of flora of natural origin and introducted and adventitious plants. Therefore various types of publications (GUDANAVIČIUS, 1960; RAGAŽINSKIENĖ et al., 2005) tend to denote that NLVMP species comprise only approximately 50% of the described medicinal plants. There is even no scientifically approved inventory list ultimately rendering Lithuania‘s natural medicinal vascular plant species. Therefore a systemic analysis on such species is highly relevant.

As research on medicinal plants is conducted by scientists of various scientific areas, data of the research are consequently presented in publications of highly variant sorts (such as publications of botany, medicine, biochemistry, pharmacy). Thus a somewhat “chaotic situation“ developed regarding data on medicinal plants, as there is a fair amount of diverse data available on medicinal plants that are not inter-coherent and has been only analysed one-sidedly. Therefore a significant demand for an integral analythical biomedical data system on medicinal plants remains. Solely the creation of an integral analythical database will enable successful accumulation of diverse biomedical data on native Lithuanian vascular medicinal plant species.

Objective of the work – to research biomedical and ecological data on native Lithuanian vascular medicinal plant species on the basis of integral systemic analysis.

Main tasks of the work:

1) to inventory NLVMP species;

2) to determine the taxonomic structure in population of NLVMP species;

3) explain the variety of life forms in NLVMP species;

4) to investigate pecularities of geographic distribution of NLVMP species;

5) to identify the relationship between NLVMP species and ecosystems as well as plant communities;

6) to research ecological characteristics of NLVMP species according to Elenberg‘s indicator values;

7) to create identification coding for NLVMP species;

8) to perform analysis of the structural parts of NLVMP species used in extraction of raw medicinal plant material;

9) to determine pecularities of traditional use and pharmacological impact of NLVMP species;

10) to classify NLVMP species in respect of the determinant medical data values;

11) to identify patterns for inclusion of NLVMP species in medicinal plant registers;

12) to perform analysis on NLVMP species included in the "*Lithuanian Red Book*" and their medicinal properties.

Novelty of the work. Native Lithuanian vascular medicinal plant (NLVMP) species are being unprecedentedly analysed botanically, ecologically and medically as an extraordinary scientific research object. Based on the information provided by scientific literature sources from 1938 to 2009, a unanimous NLVMP species inventory register constituant of 458 medicinal plant species was created. In order to perform analysis on NLVMP registered species an original "*Medicinal plant evaluation model*" was applied by the author of the work. Data on analysis of population of NLVMP species complement our knowledge with botanical, ecological and medicinal properties of Lithuanian medicinal plants. The newly created bioecological and medical data catalog of 458 NLVMP species contains data on medicinal plant properties registered by identification coding for the first time.

Scientific and applied significance of the work. The concept of medicinal plant and original system for medicinal plant analysis – "*Medicinal plant evaluation model*" was used in the dissertation in order to perform an integrated data analysis. The system may be useful in future scientific studies and research. 458 bioecological and medical data on NLVMP species collected and catalogued prove a more effective assimilation of natural medicinal plant resource in Lithuania and focused formation of medicinal plant collections in botanical gardens. The coding used in the catalogue for bioecological indicators of medicinal plants enables effective comparative analysis. Analysis of medical type of data on NLVMP species according to the categories of medicinal value enables integration of phytotherapic experiences of our country‘s ethnomedicine and experimental medicine.

Theses:

1. NLVMP species may be of greater scientific value as part of natural renewable resource in our land.

2. The concept of a medicinal plant is a complex of experiences and data defining those experiences, which has formed in course of millenial human-environmental interaction. Therefore, in order to study medicinal plants application of an integral systemic analysis methodology is requied.

3. The formation of medicinal plant database must be based on the methodology for an integral systemic analysis "*Medicinal plant evaluation model*".

4. Application of identification coding in course of cataloging of biomedical and ecological data on NLVMP species allows thorough and effective analysis of biological features of these plants.

5. Biomedical and ecological NLVMP data catalog was created and medicinal value categories were distinguished, thus enabling assimilation of historical and scientific phythotherapic potential of our country in comparison with foreign phythotherapic data.

Approbation of the work. The results of the work were assesed in the period of 2008 -2013 during sessions of yearly doctoral atestations at Vilniaus University, Faculty of Natural Sciences. Results of the research on native Lithuanian vascular medicinal plants published by 3 science journals, "*Botanica Lithuanica*", one included in Institute for Science Information (ISI) register, one included in scientific dissertation published register and one included in the register of scientific works. The results of the work were presented in a number of scientific events, both in Lithuania and internationally (7 theses included in conference publications. Some of the work results are included in educational material: 1) Phytotherapy in Traditional Chinese medicine (2008, 2009, 2011, 2012) Lithuanian University of Health Sciences (previously Kaunas University of Medical Sciences), Specialist studies of Pharmacy; 2) Vilnius University of Applied Sciences, Faculty of Healthcare. Course included in 2008/2009, 2009/2010, 2010/2011, 2011/2012 study programmes for third year students of Physiotherapy.

Extent and structure of the work. The doctoral dissertation includes 141 pages comprising of: Introduction, Literature review, Object of study, Material and methodology, Research results and discussion, Conclusions, References (approximately 320 sources), Appendix (50 pages, 8 tables), Publications on the topic by the author (2) and lists of other publications (1). The doctoral dissertation is illustrated by 16 figures and 15 tables.

1. RESEARCH SUBJECT, MATERIALS, METHODOLOGY AND METHODS

Research subject. The subject of the research – native Lithuanian vascular medicinal plants. Various authors describing medicinal plants either denote relationship between a plant and specific medicament or define such plants only as raw medicinal material (BUTKUS, 1987; BLINOVA, 1990; JAKOVLEVA, 1990; JASKONIS, 1996). In the course of the research a concept of medicinal plant was formed defining medicinal plant as a complex of experiences and data defining those experiences, as a result of millenious human – environmental interaction. The basis of the concept of a medicinal plant is constituted of a combination of various data describing the researched object in two main aspects – *bioecological* and *anhropogenic-medical*. These two aspects indicate an inherent bond between medicinal plants as research objets as well as two areas of biomedical science – *biology* and *medicine*. The two essential aspects of medicinal plant concept are presented in the scheme created by the author of the work "*Medicinal plant evaluation model*". Data of bioecological aspect reflect biological features of a medicinal plant. Data of *Anthropogenic-medical* aspect define medicinal plant as therapeutic. In case of *anthropogenic-medical* data abscence, botanical object – plant would not be considered as medicinal. In case of abscence of *bioecological* aspect data on specific plant species – the *botanical* object which might be used in therapy would not be recognized. It can be stated that the notion of "*medicinal plant*" is a reflection of human-plant interaction (Fig. 1).

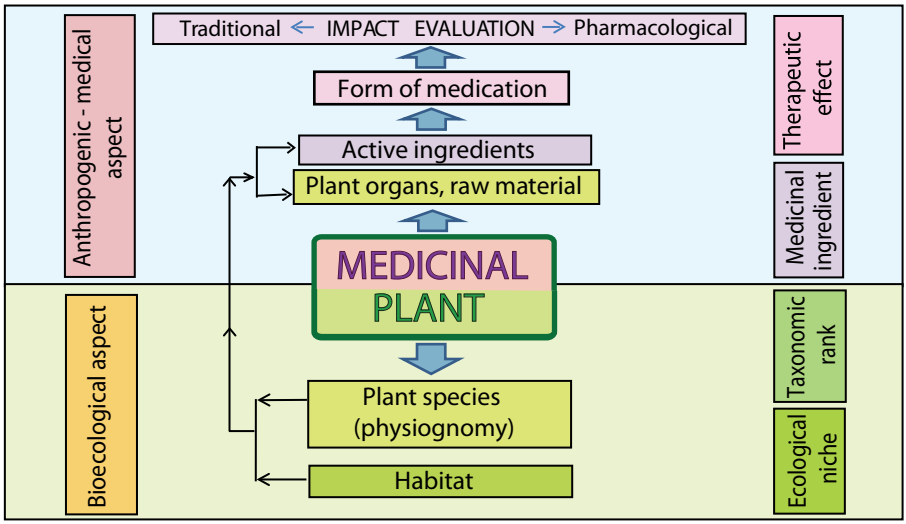

Fig. 1 Medicinal plant evaluation model

Further by the approach, plants of every species may be potentially considered medicinal. Nevertheless, attribution of specific plant species to medicinal plant categories generally depends either on the experience accumulated or the results of experimental research on such plants. Thus, medicinal plant is a plant having structural parts which invoke specific reactions in human and animal organisms when used in therapy (Naumavičius, Naujalis, 2009).

Research material. Diverse Lithuanian publications by 15 authors (co-authors) of period 1938-2008 years were selected in order to perform a systemic medical plant analysis (Dagys (ed.), 1938; Kanopka, Dagys, 1948; Natkevičaitė-Ivanauskienė (ed.), 1959, 1961, 1963, 1971, 1976; Gudanavičius, 1960; Snarskis, 1968; Pipinys et al., 1972; Dudėnas et al., 1976; Natkevičaitė-Ivanauskienė et al., 1980; Butkus et al., 1987; Smaliukas et al., 1992; Jaskonis, 1996; Juknevičienė, Juronis, 2000; Dagilis et al., 2002; Baronienė, 2004; Ragažinskienė et al., 2005; Gudžinskas, Balvočiūtė, 2008). General botanical, morphological, chorological and ecological data defining native Lithuanian vascular medicinal plant species were derived from various scientific publications. Medical (pharmacologic, therapeutic) data on plants derived from previously listed literature sources, where plants of different species were defined as medicinal by various authors.

Method of plant analysis. The concept of medicinal plant is a complex of experiences and data defining those experiences. In order to systematically understand medicinal plant and analyse data defining that type of plants a unanimous system is required that could help analyse different types of data on singular basis. Systemising data on medicinal plants by modules allows analysing without losing the whole understanding (Liu Gong Wang, 1995; Naumavičius, 2002; Jakovleva, 2006). Originally created universal medical plant data analysis methodology system data are divided into modules according to science fields relevant in order to familiarize with the object. Such methodological system called "*Medicinal plant evaluation model*" (Naumavičius, Naujalis, 2008, 2009, 2011) is created for systematic accummulation and analysis of data on medicinal plant species. Diverse data on medicinal plants are divided into modules in accordance with four scientific fields: *Botany, Ecology, Pharmacy, Medicine*. Thus the importance of the latter scientific areas in research of medicinal plants is emphasised without losing the whole. It provides an oppurtunity to integrally reveal specific medical plant properties. In the course of the research data on medicinal plants was accummulated and organized in accordance with the following methodological system (Fig. 2).

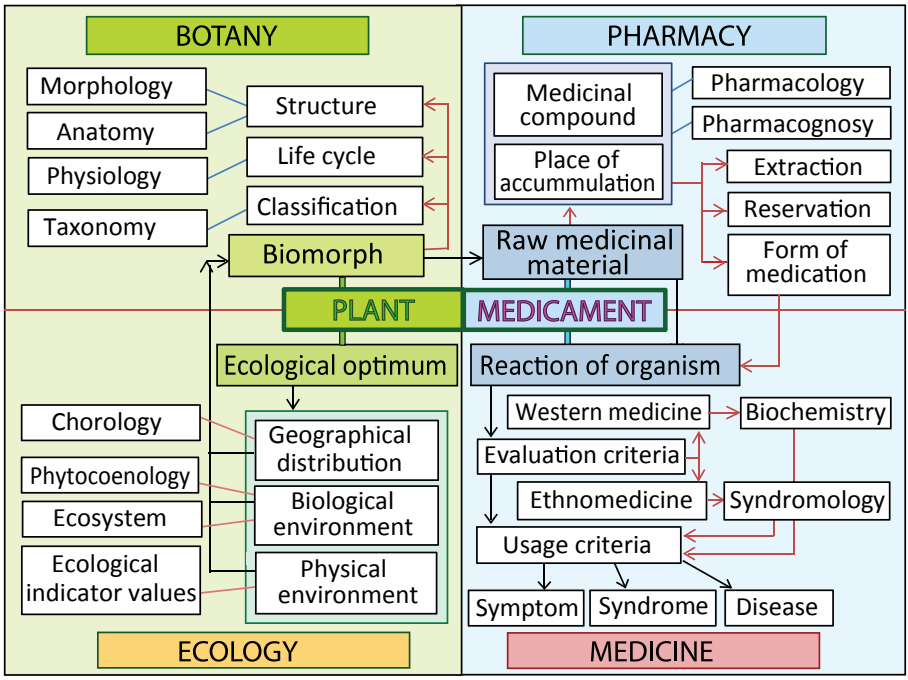

Fig. 2. Integral evaluation model for medicinal plant properties

Estimation of quantitative volume of NLVMP species. There are 1350 native vascular plant species common in Lithuania (GUDŽINSKAS, 1999). The quantitative population of NLVMP plant species was determined by analysing data in most common Lithuanian literature sources on medicinal plants. Lithuanian literature sources on medicinal plants were selected according to the following criteria: 1) Lithuanian language of publication, 2) medicinal plant species of Lithuanian flora presented in the publication, 3) author or co-outhors of the publication recognized in Lithuania as medicinal plant specialists, 4) botanical correctiveness of information published on plant names (botanical nomenclature), 5) universal reader accessibility of the publication.

Bioecological characteristics: Botanical, morphological, chorological, ecological and syntaxonomical data defining native Lithuanian vascular medicinal plant species included in the inventory list collected and classified according to various scientific publications and electronic database introduced classification systems (NATKEVIČAITĖ-IVANAUSKIENĖ (ed.), 1959, 1961, 1963, 1971, 1976; MEUSEL et al., 1965, 1978; ELLENBERG, 1974; NATKEVIČAITĖ-IVANAUSKIENĖ et al., 1977;

Natkevičaitė-Ivanauskienė et al., 1980; Natkevičaitė-Ivanauskienė, 1983; Takhtajan, 1987; Balevičienė, 1991; Laasimer et al., 1993; Kuusk et al., 1996, 2003; Jankevičienė, 1998; Gudžinskas, 1999; Motiekaitytė, 2002; Navasaitis et al., 2003; Naujalis et al., 2005; Ozolinčius, 2005; Naujalis et al., 2009; http://www.floraweb.de/; http://www.jcbi.ru/eco1/index.shtml). In case of data discrepancy information from works by Lithuanian scientists were prioratised. In the course of the research a quantitative analysis of data on bioecological characteristics of selected medicinal vascular plants was performed.

Coding and formulas for collected data. In the course of the research thorough bioecological and medical data on LSVCIA species collected and cataloged were organized according to the "*Medicinal plant evaluation model*" (Naumavičius, Naujalis, 20008, 2009) created by the author of the doctoral dissertation. Medicinal plant indicators were encoded. The coding for medicinal plant indicators was performed by particularly created abbreviations and digital definitions as well as by methods of registering botanical-geographical diagnosis and ecological plant characteristics (Meusel et al., 1965, 1976; Ellenberg, 1974; Natkevičaitė-Ivanauskienė, 1983; Laasimer et al., 1993; Kuusk et al., 1996, 2003). In accordance with this method, information is registered by identification codes (family, biomorph, chorological zoning, chorological regioning, type of ecosystem, classes of plant communities, plant significance within community, ecological values). Along with the botanical name of a plant, data for particular plant species constitute formulas reflecting compexes of bioecological features of those species, e.g.: *Achillea millefolium* – common yarow – /Astr /H /1ESib /IIMAc /6246781/ medical category **A**. Using thus presented (registered and systemized) data allows more effective comparison of biomedical and ecological indicators of plant species and evaluation of their features.

Medical classification of medicinal plants. The evaluation of the format of data on medicinal plants presentation (Berger, 1949–1967; Snarskis, 1954; Šass, 1962; Chotina et al., 1967; Wallis, 1967; Turova, 1974; Dudėnas et al., 1976; Gammerman, Grom, 1976; Blinova et al., 1990; Pharmakopea of P. R. China, 1997; Belousov et al., 1997; Jakovleva et al., 2006; Barnes et al., 2007; Melik-Guseinov, 2011) revealed medical data being usually analysed by the following aspects: use of structural parts of plants in extraction of raw medical material, tradicional-ethnomedical use of medicinal plants, research-based pharmacological effect (pharmacological groups). Medical data on inventories NLVMP species were accummulated and organized according to the same literature sources of various authors, where plants of different

species were defined as medicinal. Having performed qualitative analysis on such data medicinal plant species were divided into three groups in accordance with the degree of their medical examination (JAKOVLEVA (ed.), 2006): In case of scientific evidence of pharmacological effect of medicinal plants, the following species were assigned to phytotherapically effective category **A** group of species. In case data available on medicinal plant impact on human organism are not substantiated by research (unfinished or unperformed pharmacological, clinical or pharmacognostic research of the character), accordingly, the following species were assigned to phytotherapically viable category **B** group of species. In case there is data proving plants being used for medical purposes (traditional use), although lacking specific knowledge of such usage, those species were assigned to phytotherapically potential **C** category group of species. The medical value of NLVMP species is determined by specific data reflecting the degree of examination of a specific plant species. In course of the research attribution of NLVMP species to **A**, **B** or **C** categories and possible bioecological data indicator correlations were analysed.

2. NATIVE LITHUANIAN VASCULAR MEDICINAL PLANT SPECIES INVENTORY REGISTER

As qualitatively and quantitively new NLVMP species population analysis was performed, an inventory register of NLVMP species was created. The register includes 458 LAVIA species (which constitutes approximately 34% of all vascular plant species in Lithuania. The analysis of material gathered indicates the highest number of all medicinal plants introduced in one publication of 658 species (DUDĖNAS et al., 1976), and the lowest – 74 species (GUDŽINSKAS, BALVOČIŪTĖ, 2008). These tendencies are also visible when studying the species included in publications analysed. The highest number of such species in one publication is 240 (DAGYS (ed.), 1938), the lowest – 72 (GUDŽINSKAS, BALVOČIŪTĖ, 2008). However, the latter work shows the highest match (97% level) between the general indicated number of medicinal plant species and the attribution of those species to natural flora of our country.

The performed analysis revealed that the ten authors agreed only on 82 NLVMP species to be defined as medicinal. This indicates that literature sources used for the analysis encompass a wide range of medicinal plant species and authors of literature sources do not duplicate on another. It also revealed that some NLVMP species are recognized as medicinal only by few authors. General number of NLVMP species of single

publication is is 140 species, comprising 30,6% of all general number of such species. The latter group of NLVMP species selected in course of analysis requires a separate systemic analysis (NAUMAVIČIUS, NAUJALIS, 2012). Formed inventory list of NLVMP species allows further accumulation and organisation of phytotherapy data (Table 1).

Table 1. Data on literature sources and provided medicinal plant species numbers used in creation of NLVMP species inventory

No.	Author	Year	Title	General number of medicinal plant species published	Number of native vascular plant species published
1	DAGYS (red.)	1938	Lietuviškas botanikos žodynas. I Dalis	329	240
2	KANOPKA, DAGYS	1948	Vaistingieji augalai ir jų paruoša	133	91
3	GUDANAVIČIUS	1960	Vaistiniai augalai	145	76
4	NATKEVIČAITĖ-IVANAUSKIENĖ (red.)	1959-1980	Lietuvos TSR flora. T.1-6	353	233
5	SNARSKIS	1968	Vadovas Lietuvos augalams pažinti	193	170
6	PIPINYS (red.)	1972	Vaistiniai augalai	226	163
7	DUDĖNAS ir kt.	1976	Vaistingieji augalai (katalogas)	658	210
8	BUTKUS ir kt.	1987	Mažieji miško turtai	126	119
9	SMALIUKAS ir kt.	1992	Lietuvos naudingieji augalai	254	233
10	JASKONIS	1996	Augalai mūsų gyvenime	147	121
11	JUKNEVIČIENĖ ir kt.	2000	Medicinal plants (Collection of Kaunas Botanical Garden of Vytautas Magnus University)	229	65
12	DAGILIS ir kt.	2002	Fitoterapija (mokomoji medžiaga)	267	126
13	BARONIENĖ	2004	Svetimžemių vaistinių medžių ir krūmų auginimas ir svarba Lietuvoje	705	50
14	RAGAŽINSKIENĖ ir kt.	2005	Vaistinių augalų enciklopedija	173	99
15	GUDŽINSKAS, BALVOČIŪTĖ	2008	Lietuvos vaistiniai augalai	74	73
			Total:	1000	458

3. BIOECOLOGICAL CHARACTERISTICS OF INVENTORIED NATIVE LITHUANIAN VASCULAR MEDICINAL PLANTS

Catalog of characteristics of inventoried NLVMP species. A catalog for bioecological data of NLVMP species was created (Table 2), containing species grouped by taxonomic plant system (TAKHTAJAN 1987; GUDŽINSKAS, 1999). Similarly, the catalog provides data on biomorphs of NLVMP species, type of their worldwide distribution as well as attribution to ecosystems and plant communities. Furthermore, ecological characteristics of plants are indicated in accordance with the indicator values.

Table 2. Bioecological data catalog of native Lithuanian medicinal vascular plant species (Fragment of Table from disertation)

Taxonomic ranks (phylum, class, species)	Bioecological indicators				
	Family	Biomorph	Chorology (group, region)	Ecosystem, syntaxon, phytocoenotic significance	Ecological values according to Ellenberg
	1	2	3	4	5
LYCOPODIOPHYTA D. H. Scott					
LYCOPODIOPSIDA Bartl.					
Diphasiastrum complanatum (L.) Holub	Lyc	C	3C	IVPc	6474120
Diphasiastrum tristachyum (Purch)Holub	Lyc	C	3C	IVPc	8755111
Huperzia selago (L.) Bernh. ex Schrank et Mart.	Lyc	C	2C	IVPc	4336350
Lycopodium annotinum L.	Lyc	C	3C	IVPc	3436330
Lycopodium clavatum L.	Lyc	C	3C	IINrdc	8434220

Taxonomic structure of NLVMP species. The taxonomic analysis of the inventoried medicinal plants revealed 458 NLVMP species belonging to 7 orders, 93 families and 275 genera of 5 phyla: *LYCOPODIOPHYTA* – 1 family, 3 genera, 5 species; *EQUISETOPHYTA* – 1 family, 1 genus, 4 species; *POLYPODIOPHYTA* – 5 families, 5 genera, 6 species; *PINOPHYTA* – 2 families, 3 genera, 3 species; *MAGNOLIOPHYTA*– 84 families, 263 genera, 440 species.

NLVMP species generally belong to 93 families. Each 20 and more NLVMP species come from 6 families of Lithuanian flora: *Asteraceae* – 46, *Rosaceae* – 32, *Lamiaceae* – 29, *Fabaceae* – 25, *Scrophulariaceae* – 20, *Apiaceae* – 20. 10 to 19 NLVMP species come from 8 families of Lithuanian flora: *Polygonaceae* – 19, *Ranunculaceae* – 18, *Brassicaceae* – 17, *Salicaceae* – 17, *Ericaceae* – 15, *Cyperaceae* – 14, *Caryophyllaceae* – 10, *Poaceae* – 10. 3 to 9 NLVMP species belong to 15 families of Lithuanian flora: *Boraginaceae* – 9, *Orchidaceae* – 7, *Betulaceae* – 6, *Chenopodiaceae* – 6, *Geraniaceae* – 5, *Convallariaceae* – 5, Convolvulaceae – 5, *Primulaceae* – 5, *Gentianaceae* – 5, *Rubiaceae* – 4, *Nymphaeaceae* – 4, *Papaveraceae* – 4, *Plantaginaceae* – 4, *Violaceae* – 4, *Campanulaceae* – 3 species.

It was noticed that families with highest number of NLVMP species determined (*Asteraceae* – 46, *Rosaceae* – 32, *Lamiaceae* – 29, *Fabaceae* – 25, *Scrophulariaceae* – 20, *Apiaceae* – 20), are not thoroughly medically examined. From this approach the "richest", i.e. most medicinally valuable are families of *Ericaceae* – 100%, *Salicaceae* – 89%, *Lycopodiaceae* – 71%, their medicinal potential is used at nearly maximum. In the future families with few medicinally approved species might become the source of our land's raw medicinal plant material. Such analythically potential species come from the following families: *Orchidaceae* – 19%, *Caryophyllaceae* – 18%, *Poaceae* – 8,4%, *Liliaceae* – 4%. Considering the analysed publications, it is established that no medicinal species come from *Patamogetonaceae* (2 genera, 24 species), *Onagraceae* (4 genera, 14 species) families, although these families, based on their diversity of species, are more abundant.

The variety of life forms of natural vascular medicinal plant species in Lithuania. In order to emphasise main and most common medicinal plant life form features, NLVMP species were merged into five groups (lignifying, herbaceous perennial, herbaceous annual, herbaceous crypthophytes, biomorphically dynamic herbaceous). It was established that the group of herbaceous perennial plants containing hemicryptophytes (H–186) and herbaceous chamephytes (C-18). Lignifying life forms include 79 plant species (17,25%). This group constitutes of phanerophytes (P–20), nano-phanerophytes (N–24), lignified chamephytes (Z–19); lignifying plant species of dynamic biomorpf: (ZH–2, PN–8, NZ–5, ZP–1). Annual herbaceous plants comprise (T terofitai) 53 species (11, 6%). Herbaceous cryptophytes, reproductive buds of which are situated underground or underwater, include 54 species (11,8%). This group comprises of of geophytes (G–35) and water plants (A–11, GA–5, CG–2, CA–1). Herbaceous plant group of dynamic biomorh includes 68 species (14, 6%). This group includes annual-biennial (TH–26, CT-1), hemicryptophytes-geophytes (HG–22), hemicryptophytes and chamephytes (HC–10), hemicryptophytes-water plants (HA–9). According to biomorphic composition the most consistent source of medicinal raw material in Lithuanian flora, perennial herbs (204 species) and lignifying plants (79 species) are dominant.

Geographic distribution of native Lithuanian vascular medicinal plant species. On the basis of the plant zoning analysis, chorological groups of NLVMP species were formed. The determined majority (136 species, 28%) of native Lithuanian vascular medicinal plant species are widely spread and fall into I plurizonal group of species. Fewer NLVMP species (85 species, 19%) belong to III – boreo-temperate group. 14% comprises both V – temperate-submeridial group (67 species) and

X – European temperate-submeridional group (64 species). Within the VII – European boreal group none of the medicinal plant species were identified. As few as 3 species were ascribed to XI – adventitious group of plants. The comparison of zonal differences between Lithuanian flora (Natkevičaitė-Ivanauskienė et al., 1977) and NLVMP species revealed that approximately 35% of Lithuanian flora species are medicinal, regardless of the number of species in the chorological group. There is an exemption of VII European boreal group of species, where none of medical plant species were identified. The chorologic regioning spectre and oceanic-continental analysis of NLVMP species revealed that all Northern hemisphere plant species are common in Lithuanian ecosystems. The fewest species among NLVMP species are cosmopolitan – 18 species (4%), with largest numbers in Europe (155 species, 33,8%) and Eurasia (123 species, 26,8%). According to chorological cycles Euroceanic (179 species 39%) and indiferential (180 species, 39%) species are dominant, with the least of subcontinental species (8 species, 1,7%). People use medicinal plants all over the world, therefore, in accordance with data of chorological spectre on NLVMP species, a fair amount of valuable data on approximately 155 NLVMP species may be found in European (Lenhart, 2005), 75 – Canadian, USA (Lewis, 1977) and Russian (Malik-Huseinov, 2011) scientific publications. Additional data on approximately 198 NLVMP species geographically belonging to Eurasian region and circumpolar zone may be found in Chinese medical literature sources (Natchatoy, 2009; Chen, Chen, 2004; Hong-Yen Hsu et al., 1996).

Natural medicinal vascular plant species in Lithuanian ecosystems and plant communities. The analysis revealed attribution of NLVMP species to 7 types of ecosystems. Among 458 NLVMP species grassland (123 species, 26%), forest (107 species, 23%) and anthropogenic area (101 species, 22%) plants are dominant. Such distribution of NLVMP species may be associated with ecosystems that are naturally dominant in Lithuania. In the course of the research data on NLVMP species attribution to comunities (on the level of sytaxonomic class) and their phytocoenotic relevance was accumulated and organized. The research found that NLVMP species belong in 27 syntaxonomic class communities. Among 458 NLVMP species communities are prevailed by dominants (344, 75%). As few as 114 NLVMP species concominant. Phytocenotically distinctive (dominant or forming communities) species are segnificant for their biological body, which directly affects the amount of raw medicinal material. Although NLVMP species belong to syntaxons of 27 classes, the most abundant among these classes are classes of fertile soil (Cl. *Molinio-Arrhenatheretea elatioris* – 70 species) and broadleaf forest

(Cl. *Querco-Fagetea sylvaticae* – 63 species) ecosystems. Other medicinal plant classessignificant by their abundance come from classes of coniferous forests (Cl. *Vaccinio-Piceetea abietis* – 39 species) and anthropogenic zones (Cl. *Artemisetea vulgaris* – 34 species, Cl. *Stellaretea mediae* – 29 species). Fewer medicinal plant species are identified in classes of grassland – Cl. *Festuco-Brometea erecti* (28 species), sand – Cl. *Kolerio-Corynephoretea canescentis* (24 species) and wetland ecosystems – Cl. *Alnetea glutinosae* (19 species). These syntaxomic classes and their dominant communities constitute a major part of natural medicinal resources, including 66% inventoried NLVMP species. Medicinal plant species abundant in other syntaxonomic classes are significant of their specific therapeutic effect, regardless of the amount of their raw medicinal material. Phytosociological knowledge of attribution of medicinal plant species to certain ecosystems and communities denote distribution of medicinal plant resources in certain territory.

Ecological characteristics of native Lithuanian vascular medicinal plant species. Data on ecological needs of NLVMP species collected and organized in course of the research. Specific ecological indicators of separate medicinal plant species were identified in respect with indicator values of ecological factor created by H. ELLENBERG (1974). It was also determined that a significant part of NLVMP species are indifferent to illumination (161 species, 35%) and soil acidity (139 species, 30%). Among NLVMP species, species of dry and semi-dry soil are dominant (159 species, 35%). NLVMP species (256 species 56%) are common in soils of different fertility levels ar similar proportions (an average of species 8%). The majority of NLVMP species (377 species, 82%) are saline soil intolerant. Data on ecological conditions for NLVMP species may serve for comparison of ecological conditions for same species of local and foreign habitats. On the basis of accummulated data, proper selection of areas for medicinal plant plantations may be performed.

Identification coding of native Lithuanian vascular medicinal plant species. NLVMP catalog was created containing bioecological data on NLVMP species. The information of these medicinal species was encoded by specific abbreviations as well as digitally. The coding denotes biomorphic similarities and diffrences, distribution, attribution to ecotopes and plant communities as well as specific ecological factors. The process of coding involved the following stages: accumulation of data on plant species, encoding of the data and evenually grouping of codes into segments in accordance with scienific research area. On the basis of the segments, formulas were created, denoting complex of bioecological features of the species. Decoding was performed in such order: selection

of formula reflecting species and general complex of its bioecological features as well as segment of the formula denoting area of scientific research; furthermore, selection and decoding of segment characteristics. E.g.: the parameters of four NLVMP species of *Galium* genus were compared using identification codes:

Galium aparine	/Rub / T / 1EAs / VIIGUc / 753X69?/
Galium mollugo	/ Rub / HKrp / 1Esib / IIMAc / 7X35XX0/
Galium odoratum	/Rub / Krp / 5Eas / IQFc / 2525X50/
Galium verum	/Rub / HKrp / 1EAs / IITGc / 75X4730

The species analysed come from the family of *Rubiaceae, Galium* genus; and are of different biomorphs: one – teraphyte, one – crypophyte, two – hemicryptophytes. The majority of these plants are distributed in Eurasia (3 species) and Eurosiberia (1 species). Furthemore, the plants atribute to different ecosystems: 2 – grassland, 1 – forest, 1– anthropogenic. One of each species may be found in rich grassland and prarie grassland communities as well as broadleaf forest and nitrophilic moist soil communities. The analysed species of *Galium* genus are semi light-tolerant. With an exception of G. *odoratum*, which is a shade plant (50% light); the majority of them are of medium temperature, and G. *mollugo* is indifferent to warmth. Plants of the researched group dominate oceanian and suboceanean habitats, however, species of G. *verum* is indifferent to this factor; whereas G. *aparine* is indifferent to soil moisture. Species of G. *odoratum* and G. *mollugo* are indifferent to soil acidity, while the remaining species are accomodated to medium acidity or mild alkaline soil. G. *mollugo* is indifferent to soil fertility (nitrogen (N) saturation), while other species are accomodated to soil of diverse fertility. All of these species are soil-salinity intolerant. In course of evolution, plant species of this genus formed different biomorphs, which consequently differentiated during adverse period of vegetation. Additionally, the species differeniated at the level of ecosystems, thus avoiding innterspecial competition within genus. The species of the researched group tend too be indifferent to one or another ecological factor.

The encoding of NLVMP species provides an opportunity of efficient and quality analysis of bioecological indicators and pecularities of plant species. The number of comparative characteristics may be amplified in the future, i.e. including and encoding additional data on raw medicinal material, active ingredients etc.

Bioecological characteristics of NLVMP species included in the "*Lithuanian Red Book*". 36 Lithuanian natural medicinal vascular plant species of 25 families were included in the *"Lithuanian Red Book"* in 2007 (RAŠOMAVIČIUS (ed.), 2007). The majority of endangered medicinal

plant species reside in *Lamiaceae* (4 species), *Orchidaceae* (4 species) and *Gentianaceae* (3 species) families, each of other 19 families contain 1 species. The evaluation of geographical distribution of endangered species identified domination of European (18 species), Eurasian (8 species) and Eurosiberian (7 species) regions. This shows that in the majority of cases of species analysed (92%) Lithuania is on the edge of their areal. In accordance with zonal flora differences, members of European temperal-submeridial (10 species) and European temperate (6 species) groups are dominant. In accordance with ecosystem types, forest (11 species) and grassland (9 species) plants are dominant. Species of wider ecological amplitude are less frequently included in registers of endangered species.

4. MEDICAL CHARACTERISTICS FOR INVENTORIED NATIVE LITHUANIAN VASCULAR MEDICINAL PLANT SPECIES

Spectre of structural parts of native Lithuanian vascular medicinal plant species used in extraction of medicinal ingredients. In the cource of the research, data on extraction of raw medicinal material from structural parts of NLVMP species was accummulated. Having analysed the accumulated data, a spectre of structural parts of NLVMP species used in extraction of medicinal engredients was created. Most commonly medications are produced from overground parts of herbacious plants (202 species). The least common methods of medicament production involve use of plant bark (35 species) as well as blossom ring and corona (38 species). 45 raw medicinal materials, derived from 20 species of NLVMP were officialy pharmacologically identified. Several different types of raw medicinal materials are derived from one species of plants, therefore data on medicament production does not match the number of medicinal plants.

Pecularities of traditional usage and pharmacological effects in native Lithuanian vascular medicinal plant species. The aim of this work is to represent a maximum wide spectre of therapeutic properties in NLVMP species. Therefore material collected in the course of analysis contains data not only on pharmacologically approved medicinal plant effect, but also data on ethnomedicinal usage of such plants. The analysis revealed that NLVMP species are most widely used in treatment of digestive disorder (146), infectional inflammations (126), kidney - urinal system (98) and skin disease (69), central neural system (68 species). The least usage of NLVMP species was found to be detoxication (6 species) pre-cancer treatment (3 species). In the course of the analysis data on traditions for use 112 NLVMP species in our country‘s ethnomedicine was accummulated. In accordance with purpose of therapy those species are

divided into 14 groups. These groups of 112 NLVMP species were identified to be mostly used in digestive disorder treatment (16 species) as well as in case of body surface injuries and wounds (16 species). Authors (DAGYS, 1938; PIPINYS (ed.), 1972; JASKONIS, 1996), describing the use of 18 medicinal plant species denote that specific species may be used in therapy of several organism disorders. There is no data on therapeutic properties of 19 plant species provided by the authors (BUTKUS et al., 1987; SMALIUKAS et al.., 1992; JASKONIS, 1996), nevertheless it is noted that these plants are acknowledged as containing biologically active ingredients. Analysis of ethnomedical data reveals that people initially tend to accummulate knowledge and ecperience on medicinal plants which posess therapeutic features for treatment of more frequent organism disorders. There is no data on therapeutic use of additional 87 NLVMP species.

Medical value categories for Native Lithuanian vascular medicinal plant species. The analysed NLVMP data accummulated from literature sources were divided according to the medicinal value categories of plants. According to the plant examination level three groups for NLVMP species were distinguished: phytotherapically effective– **A** category, phytotherapically perspective – **B** category, phytotherapicaly potential – **C** category. Such grouping enables integral evaluation of medicinal plants and foreseing of further processes in course of deeper examination of these plants. The results of analysis on previously presented data on the therapeutical use of NLVMP species revealed, that 259 of 458 all inventoried species belong to group **A** category, 112 – **B** and 87 – **C** category. The medicinal value of more than half of all (56%) NLVMP species (**A** category) included in the inventory register were identified as proven by scientific research and acknowledged by contemporary medicine. Medicinal value of pproximately 25% of NLVMP species (**B** category) is solely based on data of ethnomedical use. Medicinal value of appriximately 19% species (**C** category) was identified solely in accordance with popular medicine experience references. The analysis revealed scientific knowledge of as few as (56%) native Lithuanian medicinal flora species. The remaining species require pharmacognostic and clinical research (**B** category 25%) and at least an analysis of ethnomedical data (**C** category 19%).

In course of the research subordination of NLVMP species to taxonomic families according to medical value categories was analysed. The research identified that NLVMP species subordinate to 93 families are distributed inconsistently by categories of medical value.

NLVMP species of **A** category are subordinate to 77 families. The majority of plant species of this category come from *Rosaceae* family – 24 species, *Asteraceae* family – 23, *Salicaceae* – 16, *Lamiaceae* – 15,

Ranunculaceae – 12, *Scrophulariaceae* – 11, *Fabaceae* – 10 and *Apiaceae* families – 12 species. None of NLVMP species of **A** category were identified in *Alismataceae, Araceae, Aspleniaceae, Balsaminaceae, Campanulaceae, Caprifoliaceae, Chenopodiaceae, Hydrocharitaceae, Lemnaceae, Liliaceae, Lobeliaceae, Malvaceae, Ophioglossaceae, Saxifragaceae, Sparganiaceae* and *Typhaceae* families.

NLVMP species of **B** category are subordinate to 37 families. The majority of plant species of this category are in *Cyperaceae* family – 12 species, *Polygonaceae* – 11, *Asteraceae* – 10, *Fabaceae* – 7, *Ranunculaceae* – 6, *Lamiaceae* – 6, *Chenopodiaceae* – 6, *Apiaceae* – 6, *Scrophulariaceae* – 5 and *Rosaceae* family – 5 species.

NLVMP species of **C** category are subordinate to 29 families. The majority of plant species of this category come from *Asteraceae* family – 13 species; *Fabaceae* – 9, *Lamiaceae* – 8, *Caryophyllaceae* – 6, *Brassicaceae* – 6, *Scrophulariaceae* – 5 and *Poaceae* family – 5 species. The majority of NLVMP species are subordinate to 14 families of plants.

Most medically valued **A** category medicinal plant species reside in 11 families (Fig. 3).

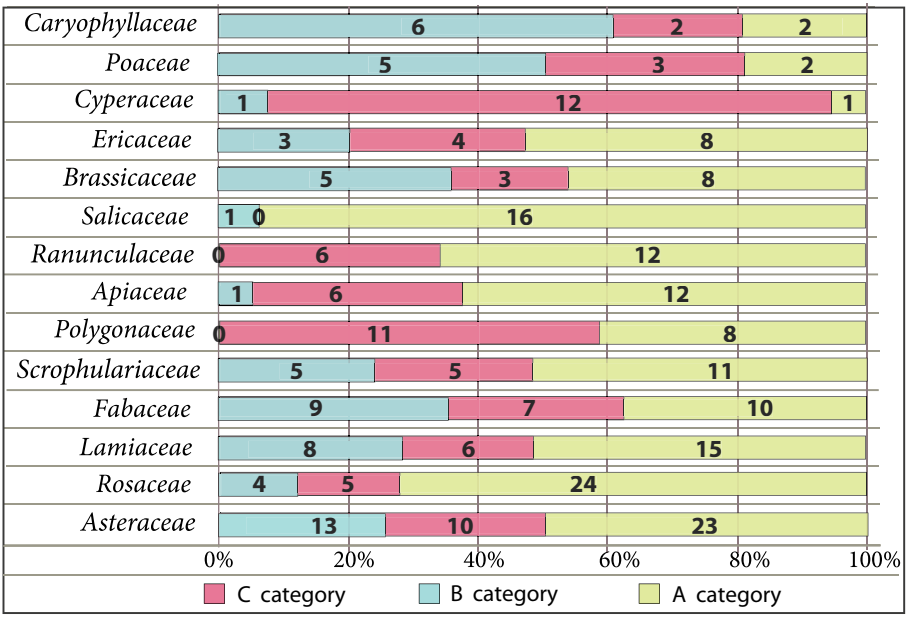

Fig. 3. Distribution of NLVMP species subordinate to different categories in respect of categories of medical value

A percental analysis on the degree of examination of medicinal plant species was performed on the level of families. Families are constituted of not only diverse numbers of medicinal plant species but also diverse degree of examination of these species. *Salicaceae* family consists of 16 species of **A** category, while family of *Cyperaceae* contains only 1 species of **A** category, and even 12 species of **B** category. *Caryophyllaceae* family contains 6 species of **C** category, that comprise more than half of all species in this family.

It was also established that separate medical value categories of species comprise a certain percental part of all species in a family. NLVMP species of **A** category somprise 40 to 60%, while species of **C** category comprise up to 30% of the established general number of medicinal plants in a family. In the cource of the research chorological distribution analysis for NLVMP species of different medical values was performed (Table 3). The performed analysis revealed that medicinal plant species of all three categories were most likely of European distribution (phytotherapically effective **A** category contains 86 species; phytotherapically perspective **B** category contains 36 species; phytotherapically potential **C** category contains 33 species). In respect to other chorological regions, plant ditribution differs significantly: medicinal plants of **A** category are abundant among Eurasian species, **B** – among Circumpolar, **C** – among Eurosiberian. Chorological distribution of species in all three medical value categories is quite consistent with the exception of species from **C** category European distribution, as the amount of the latter is relatively higher (Table 3).

Table 3. Chorological distribution of NLVMP species with different medical value

Nature of chorological distribution of plant species	Medical value categories of NLVMP species		
	A	**B**	**C**
Cosmopolitan	10	7	1
Circumpolar	35	27	13
Eurasian	83	24	16
Eurosiberian	45	18	24
European	86	36	33
Total:	259	112	87

Moreover, an analysis of attribution of different medical value NVLMO species to Lithuanian ecosystems was performed (Table 4). The analysis revealed that separate categories of plant species medicinal value comprise a particular procental part of family of species in every ecosystem. Regardless of the type of ecosystem it contains approximately 50-60%

medicinal plant species, which fall to phytotherapically effective **A** category. Medicinal plant species belonging to phytotherapically perspective **B** category constitute approximately 20-30% in all ecosystems. However, medicinal plants of grassland ecosystems from **C** category are found realtively more often and constitute approximately 30%.

Table 4. Attribution of different medicinal value NLVMP species to ecosystems

Ecosystems	Category of medical value			
	A	**B**	**C**	Total
Forests	68	23	16	107
Grasslands	58	26	39	123
Wetlands	29	12	6	47
Sands	13	9	4	26
Shrublands	17	3	1	21
Aquatic and coastal zones	16	12	5	33
Anthropogenic zones	58	27	16	101
Total:	259	112	87	**458**

Medicinal value of species included in "Lithuanian Red Book". 36 NLVMP species are included in the "*Lithuanian Red Book*". The majority (20%) of species in this group belong to **A** category (phytotherapically effective) and **C** category (11%) (phytotherapically potential). The least number of plant species (5%) atribute to **B** category (phytotherapically perspective). All 20 medicinal plant species of **A** category are identified to posess wide spectre of pharmacological effectiveness. However, practical use of plants with such environmental status is possible only by forming specific habitats suitable for them to flourish in (exceptionally for species of 5(Rs) Restored category).

Division of NLVMP species in accordance with categories of their medical value provides suitable conditions for universal integral evaluation of medicinal plants empirically as well as experimentically.

5. REASONS AND PATTERNS FOR NATIVE LITHUANIAN VASCULAR MEDICINAL PLANT SPECIES BEING RARELY INCLUDED IN LITHUANIAN MEDICINAL PLANT REGISTERS

As discussed above, our country's botanists and phytotherapists of different generations have acknowledged 458 members of NLVMP species as medicinal. Thorough data analysis revealed fair amount of inconsistencies appearing in evaluation of potentially medicinal plant medicinal properties. The reason for such inconsistencies is fairly high number 31% (140 species) of all medicinal plant species that are "unpopular" or "realatively forgotten" by botanists and phytotherapists.

A few rasons for such situation may be distinguished: 1) medicinal plants are nor examined medically enough, 2) medicinal plants are regarded as endangered botanical objects, 3) medicinal plant properties may impair human health, 4) members of particular medicinal plant species are taxonomically familiar, 5) chorological distribution of medicinal plant species is identical. In the course of plant species structural analysis several patterns of poor phytotherapical acknowledgement were recognized for such species being rarely included in Lithuanian medicinal plant registers:

1. The analysis of researched examination degree for plant species revealed that species of lower degree of examination are less frequently presented in publications of medicinal plants. This confirms the attribution of NLVMP species rarely included in Lithuanian medicinal plant registers to medical value categories: 28 of 140 such species are of **A** category, 49 – **B** category and 63 – **C** category.

2. Specific environmental plant species status – inclusion in the "*Lithuanian Red Book*" may be an important reason of the latter species not being included in the medical plant registers.

3. Plant toxicity is not relevant for including species in medicinal plant registers.

4. Taxonomic relativity may as well be one of the main reasons for species being excluded from medicinal plant registers.

5. The abundance pf plant species in families highly enhance the chances of being included in medicinal plant registers.

6. Botanical-geographical location of species is not relevant factor when including or excluding species in medicinal plant register.

CONCLUSIONS

1. Analysing medicinal plant data provided in diverse scientific publications by Lithuanian authors of different generations 1938-2009 revealed 458 native Lithuanian vascular species of medicinal flora regarded as medicinal plants. They comprise approximately 34% of all native Lithuanian vascular flora species.

2. NLVMP species come from 5 phyla, 7 classes, 93 families and 275 genera. The highest number of NLVMP species is typical in *Asteraceae* (46 species) and *Rosaceae* (32 species) families. Relatively highest number of medicinal plant species is common in *Ericaceae* – (all 15 species) as well as *Salicaceae* (16 of 17 species, 89%) families. Relatively lowest number of medicinal plant species comes from *Caryophyllaceae* (2 of 11 species, 18%), *Poaceae* (10 of 119 species, 8%) and *Liliaceae* (1 of 25%) families.

3. In accordance with biomorph composition among 458 NLVMP species herbaceous perennial plants hemicryptophytes (186 species, 41%) and lignified plants phanerophytes (79 species, 17%) are dominant. There are signifficantly less chamephytes among NLVMP species (18 species, 4%), cryptophytes (54 species, 11%) and therophytes (53 species, 11%). Herbaceous and lignified plants are most commonly found amongst NLVMP species and constitute a botanically significant and consistent part of raw medicinal plant material in Lithuania.

4. Although NLVMP species are geographically associated with all other regions of the North hemisphere, the majority of medicinal plants reside in European (155 species, 34%) and Euroasian (123 species, 27%) territories. Only 18 of NLVMP species (4%) are cosmopolitan. NLVMP species belong to nearly all chorological flora groups. However, plants of plurizonal (136 species, 30%) and boreo-temperate (85 species, 19%) groups are dominant. Chorological circle data denote that indiferential (180 species, 39%) and Euroceanic (179 species, 39%) species are dominant. Every chorological group of Lithuanian flora contains 30 to 40% plant species that are medicinal. Abundance of Eurasian, European, Eurosiberian and Euroceanian species amongst NLVMP species allows integrating foreign phytotherapic experience.

5. NLVMP species are attributed to ecosystems of 7 types. The majority of medicinal plant species are subject to grassland ecosystems (123 species, 27%), woodlands (107 species, 23%) and anthropogenized theritorries (101 species, 22%). Our land‘s medicinal plant species come from syntaxons of 27 classes. Among NLVMP species members of *Molinio-Arrhenatheretea elatioris* (70 species, 15%) and *Querco-Fagetea sylvaticae* (63 species, 14%) classes are dominant. Phytosociological data on medicinal plant attatchment to ecosystems and communities denote distribution of medicinal plant resources in our country.

6. Ecological data are essential when selecting medicinal plant species for cultivation as well as in order to evaluate their potential habitats. Significant part of NLVMP species are indifferent to light (161 species, 35%) and soil acidity (139 species, 30%). NLVMP species are dominated by species of dry and semi dry soil (159 species, 35%). NLVMP species (256 species, 56%) in similar proportions (average number of species 8%) flourish in soils of diverse fertility. The majority of Lithuanian medicinal plants (377 species, 82%) are saline soil intolerant.

7. Original identification coding for NLVMP species allows effective and quality comparison of bioecological indicators denoting features of medicinal plant species.

8. For the production of medicinal plant substance various structural parts of NLVMP are used. IN course of raw medicinal material preparation overground structural parts of herbacious plants used most frequently. (202 species, 44%). The least production of medicaments is based on usage of plant bark (35 species, 7%) blossom and corona (38 species, 8%). Plants of single species can be used in production of several medicinal substances. 20 NLVMP plant species allow production of 48 different medicinal substances entitled to pharmacological identification. This explains why the number of medicinal plant species used for production of medication does not match the botanical number of plant species.

9. Pharmacological effect was acknowledged in 259 NLVMP plant species. Medicinal plants are most commonly used in treatment of digestive disorder (146 species, 32%) and infectious inflamation (129 species, 28%). A significant number of medicinal plants (98 species, 21%) are used for kidney – urinal system treatment. However, use of approximately 112 medicinal plant species is only known from ethnomedical type of data. No specific data exist on therapeutic use of approximately 87 NLVMP species.

10. Medicinal value of NLVMP species is diverse. 259 of 458 NLVMP species (56%) belong to phytotherapically effective group of **A** category, 112 species (24%) belong to phytotherapically perspective **B** category and 87 species (19%) belong to phytotherapically potential **C** category. NLVMP species categorization according to mecidal value categories enables both emphyrical and experimental universal integral analysis of collected data on medicinal plants.

11. As many as 140 (31%) of all 458 NLVMP species are rarely encluded in Lithuanian medicinal plant registers. The main reason for medicinal properties these medicinal plants being unrecognized is insufficient degree of medical examination of such plant species. Furthermoe, an important reason for poor acknowldegement of medicinal properties in plants may be taxonomic relativity of species. Plant toxicity, geographical distribution and environmental status does not impact their inclusion in medicinal plant registers.

12. The "*Lithuanian Red Book*" includes 36 NLVMP species. In accordance with medical value, the majority of these species (20 specie, 55%) belong to phytotherapically effective **A** category, whereas their practical use is possible only in case of recovery of natural populations.

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Participation in studies:

1. 2007-2009: Series of lectures and workshops (20h) on Chinese medicine for year 6 students of medical sciences (8h) in Kaunas university of Medical Sciences.

2. 2007-2008: Lecture for year 4 students of pharmacy read in Kaunas university of medical sciences: "The essence of Chinese medicine"

3. 2007-2013: Yearly lectures given on "Phytotherapy in traditional Chinese medicine". Lithuanian university of medical sciences (previously Kaunas university of medical sciences), studines for specialists in Pharmacy.

4. 2008/2009, 2009/2010, 2010/2011, 2011/2012: Series of lectures given for 3d year students of Physical therapy study programmes in Vilnius university of applied sciences, Faculty of Healthcare (2 credits – 72h): "Traditional Chinese Medicine".

SANTRAUKA

Vaistiniais vadinami augalai, kurių struktūrinės dalys, pavartotos terapijos tikslais, sukelia specifines žmogaus ar gyvūno organizmo reakcijas (NAUMAVIČIUS, NAUJALIS, 2009). Pasaulyje nurodoma iki 70 000 vaistinių augalų rūšių (VAN WYK, WINK, 2004; GUDŽINSKAS, BALVOČIŪTĖ, 2008). Vaistinės savybės daugiausiai nustatytos sausumos ekosistemose vyraujantiems induočiams augalams. Vaistiniai augalai nuo neatmenamų laikų žmonių vartojami ne tik profilaktiškai, bet ir konkrečioms ligoms gydyti (KOVNER, 1878; ŠLIŪPAS, 1934). Šiuo metu apie 80% pasaulyje pagaminamų vaistinių preparatų yra gaminami iš vaistinių augalų (BARNES et al., 2007), todėl vaistinių augalų visapusiški tyrimai nepraranda svarbos.

Vaistinio augalo samprata yra kompleksinė patirčių ir jas nusakančių duomenų visuma, susiformavusi žmogaus ir jo aplinkos sąveikos eigoje. Konkrečios šalies bendras vaistinių augalų rūšių skaičius ir jų taksonominė sudėtis daugiausia priklauso nuo šalies dydžio ir geografinės padėties. Vaistinių augalų naudojimą sveikatinimui ir gydymui lemia šie veiksniai: 1) konkrečios šalies etnomedicinos tradicijos, 2) fitoterapijos srityje dirbančių specialistų (medikų, botanikų) kvalifikacija, 3) visapusių duomenų apie vaistinius augalus prieinamumas.

Ir anksčiau ir dabar mūsų šalyje yra nemažai fitoterapiją išmanančių kvalifikuotų specialistų (PETKEVIČ, 1911; ŠIMKŪNAITĖ, 1944; PETKEVIČIŪTĖ, MEKAS, 2011). Ypač svarbu giliau pažinti savo krašto vietinius, savaiminius pagal kilmę, vaistinius augalus, nes dabartiniu metu dažnokai fitoterapeutai prioritetą teikia svetimžemiams, iš kitų kraštų kilusiems augalams (RAGAŽINSKIENĖ, 2009). Šiuo metu mūsų šalyje žinoma apie 1350 savaiminių induočių augalų rūšių (GUDŽINSKAS, 1999). Tarp jų nemažai yra vaistinių augalų, tačiau įvairių autorių požiūriai apie tokių augalų rūšių kiekį mūsų krašte gana skirtingi (GUDANAVIČIUS, 1960; PIPINYS ir kt., 1972; RAGAŽINSKIENĖ ir kt., 2005; GUDŽINSKAS, BALVOČIŪTĖ, 2008). Pavyzdžiui, kai kuriuose šaltiniuose nurodoma, kad Lietuvoje žinoma nuo 462 (RADUŠIENĖ, JANULIS, 2004) iki 550 (LEKAVIČIUS, 1986) ar net 800 (JASKONIS, 1996) vaistinių augalų rūšių.

Tikslios informacijos apie Lietuvos savaiminių vaistinių induočių augalų (LSVIA) rūšis labai trūksta todėl, kad paprastai autoriai, nagrinėdami augalų vaistines savybes, neišskiria savaiminės floros atstovų nuo introdukuotų ar adventyvinių augalų (GUDANAVIČIUS, 1960; RAGAŽINSKIENĖ ir kt., 2005). Lietuvoje kol kas netgi nėra moksliškai pagrįsto ir maksimaliai atspindinčio Lietuvos savaiminių vaistinių induočių augalų rūšis inventorinio sąrašo. Todėl tokių rūšių visumos sisteminė analizė yra ypač aktuali.

Vaistinius augalus tyrinėja įvairių mokslo šakų atstovai, todėl duomenys apie juos pateikiami labai skirtingų krypčių (botanikos, medicinos, biochemijos, farmacijos ir kt.) leidiniuose. Dėl šios priežasties susiklostė tam tikra duomenų apie vaistinius augalus „chaoso situacija", kai įvairaus pobūdžio duomenų apie vaistinius augalus yra gana daug, bet jie nėra susieti tarpusavyje ir analizuojami vienpusiškai. Todėl išlieka aktualus integruotos analitinės biomedicinių duomenų apie vaistinius augalus sistemos poreikis. Sukurta integrali analitinė duomenų sistema, sudaro sąlygas sistemingai kaupti įvairius biomedicininio pobūdžio duomenis apie Lietuvos savaimines vaistinių induočių augalų rūšis.

Darbo tikslas – integruotos sisteminės analizės pagrindu išnagrinėti biomedicininius ir ekologinius duomenis apie Lietuvos savaimines vaistinių induočių augalų rūšis.

Darbo uždaviniai:

1) inventorizuoti LSVIA rūšis;
2) nustatyti LSVIA rūšių visumos taksonominę struktūrą;
3) išaiškinti LSVIA rūšių gyvenimo formų įvairovę;
4) išnagrinėti LSVIA rūšių geografinio paplitimo ypatumus;
5) nustatyti LSVIA rūšių ryšius su ekosistemomis ir augalų bendrijomis;
6) išnagrinėti LSVIA rūšių ekologines charakteristikas pagal Elenbergo indikacines vertes;
7) sudaryti LSVIA rūšių bioekologinius identifikacinius kodus;
8) atlikti LSVIA rūšių struktūrinių dalių, naudojamų vaistinės augalinės žaliavos gamybai, analizę;
9) nustatyti LSVIA rūšių tradicinio vartojimo ir farmakologinio poveikio ypatumus;
10) suklasifikuoti LSVIA rūšis pagal jas apibūdinančių medicininių duomenų vertes;
11) nustatyti LSVIA rūšių įtraukimo į vaistinių augalų sąrašus dėsningumus;
12) atlikti LSVIA rūšių, įtrauktų į Lietuvos raudonąją knygą, vaistingumo analizę.

Darbo naujumas. Pirmą kartą Lietuvoje mūsų krašto savaiminių vaistinių induočių augalų (LSVIA) rūšių visuma analizuojama botaniniais, ekologiniais ir medicininiais aspektais kaip ypatingas mokslinio tyrimo objektas. Remiantis moksliniuose literatūros šaltiniuose, išleistuose nuo 1938 iki 2009 metų, esančia informacija, pirmą kartą buvo sudarytas visuminis LSVIA rūšių inventorizacinis sąrašas iš 458-ių vaistinių augalų rūšių. Inventorizaciniame sąraše esančių LSVIA rūšių analizei atlikti pritaikytas darbo autoriaus sukurtas originalus

„*Vaistinio augalo vertinimo modelis*". LSVIA rūšių visumos įvairiapusiški lyginamųjų analizių duomenys papildo mūsų žinias apie Lietuvos vaistinių augalų botanines, ekologines ir medicinines savybes. Naujai sudarytame 458 LSVIA rūšių bioekologinių ir medicininių duomenų kataloge pirmą kartą duomenys apie vaistinių augalų ypatumus užrašyti identifikaciniais kodais.

Darbo mokslinė ir praktinė reikšmė. Disertacijoje, integruotai duomenų analizei panaudota vaistinio augalo samprata ir originali sistema skirta vaistiniams augalams analizuoti – „*Vaistinio augalo vertinimo modelis*", kuri ir ateityje galėtų būti naudojama moksliniuose tyri-muose ir studijose. Surinkti ir kataloguoti 458 LSVIA rūšių bioekologiniai ir medicininiai duomenys pagrindžia efektyvesnį Lietuvos natūralių vaistinių augalų išteklių įsisavinimą ir kryptingą vaistinių augalų kolekcijų formavimą botanikos soduose. Kataloge panaudoti vaistinių augalų bioekologinių rodiklių identifikaciniai kodai leidžia efektyviai atlikti jų lyginamąją analizę. Medicininio pobūdžio duomenų apie LSVIA rūšis išanalizavimas pagal medicininės vertės kategorijas, leidžia integruoti mūsų šalies etnomedicinos ir eksperimentinės medicinos fitoterapines patirtis.

Ginami teiginiai:

1. LSVIA rūšis reikia moksliškai išsamiau įvertinti kaip mūsų krašto savaime atsinaujinančių natūralių gamtinių išteklių dalį.
2. Vaistinio augalo samprata yra kompleksinė patirčių ir jas nusakančių duomenų visuma, susiformavusi tūkstantmetės žmogaus ir ir jo aplinkos sąveikos eigoje, todėl vaistinių augalų tyrimui būtina taikyti integruotą sisteminės analizės metodologiją.
3. Vaistinių augalų duomenų informacinės bazės suformavimas turi būti pagrįstas integruota sisteminės analizės metodologija „*Vaistinio augalo vertinimo modelis*".
4. LSVIA rūšių biomedicininių ir ekologinių duomenų katalogizavimas, taikant identifikacinį kodavimą, leidžia visapusiškai ir efektyviai nagrinėti šių augalų biologinius ypatumus.
5. Sudarytas LSVIA biomedicininių ir ekologinių duomenų katalogas bei išskirtos medicininės vertės kategorijos leidžia kaupti ir įsisavinti istorinį bei mokslinį mūsų krašto fitoterapinį potencialą, lyginti jį su kitų šalių fitoterapiniais duomenimis.

Rezultatai

Integruotai LSVIA rūšių bioekologinių ir medicininių duomenų analizei panaudota nauja vaistinio augalo samprata ir originali sistema „*Vaistinio augalo vertinimo modelis*". Pateikiami apibendrinti rezultatai apie 458 LSVIA rūšių bioekologinius ypatumus bei medicininio ištirtumo lygį pagal medicininės vertės kategorijas.

Įvairių kartų Lietuvos autorių (1938-2009 m.) išleistuose skirtingo pobūdžio moksliniuose leidiniuose pateiktų duomenų apie vaistinius augalus lyginamoji analizė parodė, kad vaistiniams augalams priskirtos 458-ios Lietuvos savaiminės induočių augalų floros rūšys. Tai sudaro apie 34% visų Lietuvos savaiminių induočių augalų floros rūšių.

Šios LSVIA rūšys priklauso 5 skyriams, 7 klasėms, 93 šeimoms ir 275 gentims. Didžiausias LSVIA rūšių skaičius būdingas *Asteraceae* (46 rūšys) ir *Rosaceae* (32 rūšys) šeimoms. Santykinai didžiausias vaistinių augalų rūšių kiekis būdingas *Ericaceae* – (visos 15 rūšių) ir *Salicaceae* – (16 iš 17 rūšių, 89%) šeimoms. Santykinai mažiausiai vaistinių augalų rūšių priklauso *Caryophyllaceae* (2 iš 11 rūšių, 18%), *Poaceae* (10 iš 119 rūšių, 8, 4%) ir *Liliaceae* (1 iš 25, 4%) šeimoms. Nustatyta, kad *Patamogetonaceae* (2 gentys, 24 rūšys, *Onagraceae* (4 gentys, 14 rūšių) šeimose vaistinių rūšių neišskirta, nors šios šeimos pagal rūšių įvairovę yra gausesnės. Geriausiai mediciniškai ištirtos rūšys (**A** kategorijos) yra *Rosaceae* šeimoje – 24 rūšys, *Asteraceae* šeimoje – 23, *Salicaceae* – 16 rūšių. **A** kategorijos (fitoterapiškai efektyvių) rūšių nenustatyta: *Alismataceae, Araceae, Aspleniaceae, Balsaminaceae, Campanulaceae, Caprifoliaceae, Chenopodiaceae, Hydrocharitaceae, Lemnaceae, Liliaceae, Lobeliaceae, Malvaceae, Ophioglossaceae, Saxifragaceae, Sparganiaceae* ir *Typhaceae* šeimose.

Pagal biomorfų sudėtį tarp 458-ių LSVIA rūšių vyrauja žoliniai daugiamečiai augalai hemikriptofitai (186 rūšys, 41%) ir sumedėję augalai fanerofitai (79 rūšys, 17%). Kur kas mažiau tarp LSVIA rūšių yra chamefitų (18 rūšių, 4%), kriptofitų (54 rūšys, 11%) ir terofitų (53 rūšys, 11%). Lietuvoje žoliniai ir sumedėję augalai vyrauja tarp LSVIA rūšių ir yra botaniškai reikšminga bei pastovi vaistinių augalų žaliavų dalis.

LSVIA rūšys geografiškai yra susijusios su visais šiaurės pusrutulio regionais, tačiau daugiausia vaistinių augalų priklauso europinėms (155 rūšys, 34%) ir eurazinėms (123 rūšys, 27%) teritorijoms. Tik 18 LSVIA rūšių (4%) yra kosmopolitinės. LSVIA rūšys priklauso beveik visoms floros chorologinėms grupėms, tačiau tarp jų vyrauja pliurizoninių (136 rūšys, 30%) ir boreotemperatinių (85 rūšys, 19%) grupių augalai. Mediciniškai labiausiai ištirtos (**A** kategorijos) yra Eurazinės (83 rūšys, 67%), nors Europinių yra panašus kiekis (86 rūšys). Chorologinių ratų

duomenys rodo, kad tarp vaistinių augalų vyrauja indiferentinės (180 rūšys, 39%) ir euriokeaninės (179 rūšys, 39%) rūšys. Kiekvienoje Lietuvos floros chorologinėje grupėje nuo 30 iki 40% augalų rūšių yra vaistinės. Eurazinių, europinių, eurosibirinių ir euriokeaninių rūšių gausa tarp LSVIA rūšių leidžia integruoti kitose šalyse sukauptą fitoterapinę patirtį.

LSVIA rūšys prieraišios septynių tipų ekosistemoms. Daugiausia vaistinių augalų rūšių priklauso pievų (123 rūšys, 27%), miškų (107 rūšys, 23%) ir antropogenizotų teritorijų (101 rūšis, 22%) ekosistemoms. Mūsų krašto vaistinių augalų rūšys priklauso 27-ių klasių sintaksonams. Tarp LSVIA rūšių vyrauja *Molinio-Arrhenatheretea elatioris* (70 rūšys, 15%) ir *Querco-Fagetea sylvaticae* (63 rūšys, 14%) klasių atstovai. Mediciniškai labiausiai ištirtos yra miškų ekosistemų augalų 68 rūšys (63%), visose likusiose ekosistemose po 50% rūšių yra **A** kategorijos. Fitosociologinės žinios apie vaistinių augalų rūšių prieraišumą ekosistemoms ir bendrijoms nurodo vaistinių augalų išteklių pasiskirstymo pobūdį mūsų šalyje. Ekologiniai duomenys yra svarbūs atrenkant vaistinių augalų rūšis auginimui ir potencialių augaviečių įvertinimui. Reikšminga LSVIA rūšių dalis yra indiferentiškos apšvietimui (161 rūšis, 35%) ir dirvožemio rūgštingumui (139 rūšys, 30%). Tarp LSVIA rūšių vyrauja sausų ir vidutinio dirvožemio drėgnumo rūšys (159 rūšys, 35%). LSVIA rūšys (256 rūšys 56%) artimomis proporcijomis (rūšių vidurkis apie 8%) tarpsta skirtingo derlingumo dirvožemiuose. Dauguma Lietuvos vaistinių augalų (377 rūšys, 82%) nepakantūs druskingiems dirvožemiams.

Naujai sukurti ir pritaikyti LSVIA rūšių identifikaciniai kodai leidžia efektyviai ir kokybiškai tarpusavyje lyginti vaistinių augalų rūšių ypatumus nusakančius bioekologinius rodiklius.

Vaistinėms žaliavoms ruošti dažniausiai naudojamos žolinių augalų antžeminės dalys (202 rūšys, 44%). Rečiau gydomieji preparatai gaminami iš augalų žievės (35 rūšys, 7%), žiedų bei žiedynų (38 rūšys, 8%). Iš 19-kos LSVIA rūšių augalų ruošiamos 48 skirtingos vaistinės žaliavos, kurioms suteiktas farmakologinis identifikacinis vardas. Tai paaiškina, kodėl literatūros šaltiniuose nurodomas vaistinių preparatų gamybai naudojamų augalų rūšių skaičius nesutampa su botaniniu vaistinių augalų rūšių skaičiumi.

Farmakologinis poveikis nustatytas 259-nių LSVIA rūšių augalams. Dažniausiai vaistiniai augalai naudojami virškinimo trakto sutrikimams (146 rūšys, 32%) ir infekciniams uždegimams (129 rūšys, 28%) gydyti. Nemažai vaistinių augalų (98 rūšys, 21%) vartojama inkstų bei šlapimo sistemos gydymui. Apie 112-os vaistinių augalų rūšių farmakologinį poveikį žinoma tik iš etnomedicininio pobūdžio duomenų. Dar apie 87-ių LSVIA rūšių vartojimą gydymui konkrečių duomenų apskritai nėra.

LSVIA rūšių medicininė vertė yra nevienoda. Iš 458-ių LSVIA rūšių – 259 rūšys (56%) priklauso fitoterapiškai efektyvių rūšių **A** kategorijai, 112 rūšių (24%) priklauso fitoterapiškai perspektyvių rūšių **B** kategorijai ir 87 rūšys (19%) priklauso fitoterapiškai potencialių rūšių **C** kategorijai. LSVIA rūšių skirstymas pagal medicininės vertės kategorijas sudaro sąlygas integruotai vertinti empiriškai ir eksperimentiškai sukauptus duomenis apie vaistinius augalus.

Iš 458-ių LSVIA rūšių augalų net 140 (31%) yra retai įtraukiami į lietuviškus vaistinių augalų sąvadus. Pagrindinė šių vaistinių augalų rūšių nepripažinimo priežastis yra tokių augalų nepakankamas mokslinis ištirtumas. Gana svarbi menko vaistinių augalų rūšių vaistingumo nepripažinimo priežastis gali būti augalų rūšių taksonominis gimininguma. Augalų nuodingumas, geografinio paplitimo pobūdis ir gamtosauginis statusas neturi didesnės reikšmės jų įtraukimui į vaistinių augalų sąvadus.

Į „*Lietuvos raudonąją knygą*" įrašytos 36 LSVIA rūšys. Dauguma šių rūšių augalų pagal medicininė vertę (20 rūšių, 55%) priklauso fitoterapiškai efektyvių rūšių pirmai **A** kategorijai, tačiau praktinis jų panaudojimas gali būti įmanomas tik atsistačius natūralioms populiacijoms.

GYVENIMO, MOKSLINĖS IR KŪRYBINĖS VEIKLOS APRAŠYMAS

Gimė 1964 10 07 Kaune. 1987 m. baigė Kauno Pr. Mažylio medicinos mokyklą įgydamas medicinos sesers specialybę. 1992 m. baigė Medicininės akupunktūros kursus bei praktinius mokymus Rygoje, 1998 m. Lietuvos respublikos švietimo ministerijos siuntimu mokėsi Kinijos Tiandzinio Kinų medicinos universitete, kur baigė kinų medicinos ir akupunktūros studijas. 2007 m. baigė kineziterapijos studijų programą Vilniaus kolegijos Sveikatos priežiūros fakultete ir įgijo kineziterapeuto kvalifikaciją.

1999-2004 metais studijavo Vilniaus pedagoginiame universitete biologiją ir įgijo biologijos bakalauro laipsnį bei mokytojo kvalifikaciją. 2006 m. įgijo biologijos magistro laipsnį. Nuo 2008 m. Vilniaus universiteto doktorantas.

Nuo 1997 metų dalyvavo 18-oje tarptautinių konferencijų, 11-je – su moksliniais pranešimais.

Nuo 2004 metų Pasaulinės kinų medicinos federacijos (WFCMS) valdybos narys ir atstovas Europai. Nuo 2008 Pasaulinės kinų medicinos federacijos komiteto mokymo instrukcijų (EIC of WFCMS) tikrasis narys. Nuo 2011 egzaminų ir vertinimo komiteto narys (CEE of WFCMS). Nuo 2011 metų asociacijos „Lietuvos sveikos gyvensenos ir natūralios medicinos rūmai" viceprezidentas (atsakingas už natūralios medicinos sektorių).

CURRICULUM VITAE

Born on 7 October 1964 in Kaunas. In 1987 graduated Nursing from Pr. Mažylio medical school in Kaunas. In 1992 completed a course of Medical accupuncture including practical training in Riga, in 1998 referred by the Ministry of education and science of the Republc of Lithuania studied at the Tianjin Medical University in China, Chinese medicine and acupuncture. In 2007 graduated from Vilnius University of Applied Sciences, Faculty of Healthcare, acquiring the qualification of physical therapist.

In 1999-2004 studied classic biology at the Lithuanian University of Educational Sciences and graduated with a Bachelor degree and qualification for teaching. PhD student at Vilnius University since 2008.

Since 1997 participated in 18 international conferences, presented scientific reports at 11 conferences.

Member of the board and European representative of the World Federation of Chinese Medicine Societies since 2004. Established member of Education Instrucion Committee of the World Federation of Chinese Medicine Societies (EIC of WFCMS) since 2008. Member of Examination and Evaluation Committee of World Federation of Chinese Medicine Societies (CEE of WFCMS) since 2011. Vice-president of the association "Lithuanian house of healthy lifestyle and natural medicine", in charge of the sector of natural medicine.

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