

CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences

International Development and Agricultural Economics



Master's Thesis

**What is the role of exotic and domestic plant
species in herbal medicine?**

**Example of herbal dietary supplements used
by Czech adults**

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Declaration

I hereby declare that this thesis entitled “What is the role of exotic and domestic plant species in herbal medicine? Example of herbal dietary supplements used by Czech adults” is my own work and all the sources have been quoted and acknowledged by means of complete references.

In Prague-Suchdol, 27 April 2017

.....
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Abstract

The consumption of herbal dietary supplements (HDS) is typical for developing countries, but the consumption increases in developed countries, such as the Czech Republic, as well. As there is documented in other studies that developed countries very often use local herbs for healing purposes, studies on prevalence and use towards exotic ones lack. Thus, the aim of the thesis were to document (i) who is a typical consumer of HDS in the Czech Republic and what are their attitudes towards HDS, (ii) what are the most preferred herb species with special focus on exotic species, (iii) for which ailments and illnesses are particularly used, (iv) which sources are used to get more information on HDS and (v) the most common purchasing places of HDS. Total number of 601 respondents individually approached by our trained personnel in the streets of different residential areas participated in this survey. Study documented that the typical consumer is a woman of middle age, non-smoker, with secondary education living in large cities. Purposively pre-defined plant species, representing different geographical areas, underlined high and strong prevalence of domestic herbs, which were commonly used by the Czech population for ages. Nevertheless, tendencies toward exotic plant species were documented as well with significant differences between men and women. Men tended to use *Echinacea purpurea* (61.8%; $p=0.001$), while women preferred *Melaleuca alternifolia* (39.6%; $p=0.001$). Boosting immunity (64.2%), improving digestive system (43.9%) and psychical disorders such as insomnia or depression (38.4%) were the most frequent ailments healed by our respondents. Besides gender, differences in use of HDS were obtained also at rural-urban gradient. Respondents who lived in capital or regional cities used HDS for purpose of boosting immunity (66.6%, $p=0.021$), skin diseases (29.6%, $p=0.002$), small injuries (27.2%, $p=0.001$) and against obesity (15.8%, $p=0.005$). Psychological problems (50.7%, $p=0.000$) and urological issues (35.8%, $p=0.020$) were significantly more used in sub-regional cities. The HDS were bought mostly in drugstores (69.2%) or specialised shops (61.6%) and almost all respondents were willing to spend for these products up to 20 USD per one visit. Generally, the origin of HDS was not significant indicator, even for example for those who travelled outside the Europe. Most common source of information on HDS came from professional literature (16.6%), pharmacists (11.3%) or promotional material (10%). However, the information was also obtained from less official sources, such as friends (16.6%), internet (15.9%) or family tradition (9.1%). Moreover, 31.1% of respondents reported taking HDS together with conventional medicaments, very often without reporting their physicians. Our study shows that using of exotic HDS is very common among the Czech population, however, domestic species are still preferred. Origin of HDS is not important to our respondents and thus, they used them with rare consultation with physician, which may cause side effects or even health problems. Both HDS provider as well as policy-makers should pay more attention to legislation and providing the user with more and relevant information.

Keywords: consumer's attitudes; population survey; adverse side effects; herbal products; herbs; Czech Republic

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List of abbreviations

CSO	Czech Statistical Office
EU	European Union
HDS	Herbal Dietary Supplements
OECD	Organisation for Economic Co-operation and Development
TCAM	Traditional, complementary and alternative medicine
TM	Traditional Medicine
USA	United States of America
WHO	World Health Organization

1. Introduction

Herbal dietary supplements (HDS) use herbs and herbal material containing different parts of plants, such as seeds, berries, roots, leaves, bark, or blooms, as active ingredients particularly in times when supplies of conventional medicine fail or among low income and/or isolated population groups (Jaminson et al., 2006; Akabas et al., 2016; Song et al., 2016). They represent an important part of traditional, complementary and alternative medicine (TCAM), initially connected to wild plant species collected from surrounding ecosystems for healing purposes since pre-Neolithic period. Even today, large percentage of population, particularly in developing countries, still depends on herbs for maintaining their primary healthcare (Schuppan et al., 1999; Kamboj, 2000; Wills, 2000; Rivera et al., 2006; Kaan, 2014). In developed countries, HDSs are used for primary healthcare and for maintaining healthy life style as well, which is documented from developed countries such as Germany, France, USA, Japan, Australia or United Kingdom (Drew and Myers, 1997; Barret et al., 1999; Kamboj, 2000; Wills, 2000; Uchiyama, 2010). In these countries, herbal products are popular due to the lower appearance of side effects and better compatibility with the human organism (Schuppan et al., 1999; Kamboj, 2000; WHO, 2005; Kaan, 2014). Nowadays HDS are available in many forms, particularly capsules, powders, tablets, or liquids (U.S. Department of Health and Human Services, 1995). Hence, increasing use of HDS has encouraged multinational companies to focus more on their marketing and commercialization (Calixto, 2000; U.S. Department of Health and Human Services, 1995). These tendencies however put emphasis on gross sales and identification of socio-economic characteristics, such as age, gender, income, educational level and life style of the consumers in order to understand their attitudes and behaviour towards HDSs use in order to better create any marketing strategy (Morris and Avorn, 2003; Delgoda et al., 2010).

Published studies explain popularity of HDSs through their ability to support organism against very common illnesses and ailments such as respiratory diseases, different aches, digestion problems, allergies, psychical disorders, gender-related issues and immunity support (Calixto, 2000; Delgoda et al., 2010; Samojlik et al., 2013). Overall

tendency toward HDS popularity could be also explained through the fact that herbal products are perceived as more effective, safe, culturally acceptable, bringing health benefits and using renewable resources and raw materials by eco-friendly processes compare to conventional medicine (Kamboj, 2000; Saad et al., 2005; WHO, 2005). Consumer decisions are not influenced only by the disease itself, but are linked to a vector of factors that play a crucial role in prevalence and use of HDS. One of the typical predictor is the consumers' interest to use herbal medicine. The belief that HDSs could be of effective benefit in the treatment of certain diseases is enormous, where conventional therapies and medicines have proven to be inadequate and/or where HDS could serve as supportive medium (Howard et al., 2001; La Caille and Kuvaas, 2011).

Above mentioned tendencies represent a strong stimulation toward self-medication, very often not-prescribed or even not-consulted with the physician (Calixto, 2000; Knotek et al., 2012; Samojlik et al., 2013). Literature describes rising tendency of HDS use is not without limitations as there is a lack of sufficient and reliable information as well as scientific evidence on real effects of herbal plants, particularly those from different ecosystems (Kwan et al., 2006; Molinero and Márquez, 2009; Samojlik et al., 2013). One of the most cited problems is a co-medication, e.g. use of herbs together with conventional medicine without any consultation with medicine provider (Davis, 1999; Haller and Benowitz., 2000; Greger, 2001; Ervin et al., 2004; Aziz and Tey, 2009; Delgoda et al., 2010). HDS is a part of the TCAM system, which is unique for each world region and so the knowledge of potential consumers. The plant species increasing the possibility of adverse side effects are especially *Ginkgo biloba*, *Ephedra sinica*, *Panax ginseng* and *Piper methysticum*. Those species are together with *Echinacea purpurea*, *Aloe vera* and *Ephedra sinica* the most popular herbs used for HDS preparation in Europe, but their geographical origins are in other world regions (Grunwald and Buttel, 1996; Davis, 1999; Kamboj, 2000; Wills, 2000; Morris and Avorn, 2003; Gardiner et al., 2007; Delgoda et al., 2010; Samojlik et al., 2013).

These potential threats were already documented in OECD countries (Ernst and White, 2000; Hirayama et al., 2008; Guo et al., 2009; Dickinson et al., 2012; Schnabel et al., 2014) or other European regions, such as Serbia (Samojlik et al., 2013). Outcomes of these studies call for more research on increasing tendencies among the population from

developed countries to support their health and life style with HDS of exotic origin. This could be example of the central European country, such as Czech Republic, as well. A great history of collection and use of herb species for self-treatment created strong tendencies of Czech population toward the use of domestic herb species ([Drabek, 1972](#); [Knotek et al., 2012](#)). Nevertheless, with increasing income and awareness during the last decades may lead to changes in Czech consumer behaviour to use not only domestic herb species, but it can turn the attention towards exotic HDSs as well ([Knotek et al., 2012](#)).

2. Literature review

2.1. Traditional world medicine

Traditional medicine is defined as the total sum of the skills, knowledge and practices based on the beliefs, theories and experiences which originate from different cultures of the world, whether explicable or not, used in the health maintenance as well as in the diagnosis, prevention, amelioration or treatment of physical and mental diseases (WHO, 2017). It is estimated that up to four billion of people (representing 80% of the world's population) living in the developing countries depend on herbal medicinal products as a source of primary healthcare and traditional medical practice which includes the use of herb species and it is viewed as an integral part of the culture in those communities. Traditional, complementary and alternative medicine (TCAM), as a system, has been developed in different regions and cultures, has been used worldwide in last decades across all generations (WHO, 2005; Bandaranayake, 2006).

2.1.1 Aboriginal traditional medicine

Aboriginal traditional medicine is holistic and considers mind, body and spirit and it is based on native herb species. The traditional healing process is about group ceremonies, with prayers, sharing food and the use of traditional medicines. Good health as a complex system includes connectivity with the ground, recognition of spirit and ancestry and social, mental, physical and emotional wellbeing. According to healers the imbalance can cause health related issues. *Melaleuca alternifolia*, *Eucalyptus globulus* and *Piper methysticum* are plants which were used in the past and nowadays they are extended to other countries (Oliver, 2013; Sadgrove and Jones, 2013).

2.1.1.1 *Eucalyptus globulus*

Eucalyptus globulus is a tree which can grow up to 70 metres. Its leaves are used as extract or essential oil. It has antifungal, antibacterial, mosquito repellent and

antioxidant properties. The leaf is also used for treating infections, fever, poorly healing ulcers, asthma, pulmonary tuberculosis, osteoarthritis, rheumatism, acne, burns, liver and gallbladder issues (Salari et al., 2006; Serafino et al., 2008).



Figure 1

Eucalyptus globulus

Source: Pinterest, 2016

2.1.1.2 *Melaleuca alternifolia*

Melaleuca alternifolia is a small tree which grows up to 7 metres. The essential oil from it, also famous as tea tree oil, has been used for almost 100 years in Australia. It has the anti-inflammatory and antimicrobial properties. It is effective in the treatment of infections or conditions such as herpes or oral candidacies. Moreover the inhalation of the oil treats coughs and colds (Hammer et al., 2003; Carson et al., 2006).



Figure 2

Melaleuca alternifolia

Source: Pinterest, 2016

2.1.1.3 *Piper methysticum*

Piper methysticum, commonly known as kava, is a shrub with heart-shaped glossy dark green leaves. It is used to reduce stress and against insomnia. It is also utilized for attention deficit-hyperactivity disorder, alleviation of epilepsy, menstrual discomfort, psychosis, depression, migraines and other headaches, chronic fatigue syndrome, tuberculosis, common cold and other respiratory tract infections and muscle pain (Boullata and Nace, 2000; Sarris et al., 2011).



Figure 3

Piper methysticum

Source: Pinterest, 2016

2.1.2 American traditional medicine

The American traditional medicine is classified as an indigenous healing tradition. It refers to the combined health practices of over 500 distinct nations that inhabited the America before the European arrival at the end of the fifteenth century. Specific practices were different among tribes, but all of them are based on the understanding that people are part of nature and health is a matter of balance. They have used herbs to, not only heal the body, but, also to purify the spirit and take balance into their lives and surroundings. The plants which are also used nowadays are for example *Echinacea purpurea*, *Serenoa repens* or *Uncaria tomentosa* (Mehl-Madrona, 1999; Johnston, 2006).

2.1.2.1 *Echinacea purpurea*

Echinacea purpurea is a perennial plant which has been used as medicine for centuries. It contains many compounds, e. g. polysaccharides, glycoproteins, alkaloids, volatile oils, and flavonoids. The medicaments are made from flowers, leaves and roots. It is consumed due to its potential to boost immunity as well as contribute to official treatments of the common cold, bronchitis, coughs, upper respiratory infections and some inflammatory conditions ([Percival 2000](#); [Planta et al., 2000](#)).



Figure 4

Echinacea purpurea

Source: Pinterest, 2016

2.1.2.2 *Serenoa repens*

Serenoa repens, commonly known as saw palmetto, is a small palm, growing to a maximum height of 3 metres. It is used to treat the lower urinary tract symptoms, which are frequently associated with benign prostatic hyperplasia. Thus, the medicinal products are more used primarily by men. It is estimated that benign prostatic hyperplasia affects 70% of men who are older than 70 years old ([Gerber and Fitzpatrick, 2004](#); [Lowe, 2009](#); [Argirović and Argirović, 2013](#)).



Figure 5

Serenoa repens

Source: Pinterest, 2016

2.1.2.3 *Uncaria tomentosa*

Uncaria tomentosa, commonly known as cat's claw, is a creeper plant of the tropical rainforest. It is used for the treatment of several illnesses, primarily as a potent anti-inflammatory agent. Moreover, it can also treat arthritis; decreases high blood pressure and boost immunity. It can be in the form of capsule, tablets or liquid extract ([Shi et al., 2013](#); [Navarro et al., 2015](#)).



Figure 6

Uncaria tomentosa

Source: Pinterest, 2016

2.1.3 Arabic-African traditional medicine

African traditional medicine is holistic approach which includes the body and the mind. Human beings consist of various aspects such as physical, spiritual, moral, and social. Individual is in good health condition assuming the aspects are equal and harmonious. Inhabitants have great access to rich biological diversity. Nowadays, many people are still dependent on the herb species. They do not have adequate access to conventional medicaments due to the fact that it is too costly or there are no medical service

providers. The healer, who uses indigenous herb species in treatment, takes full account of the social and cultural background of the people and provides the counselling (Elujoba et al., 2005; Mahomoodally, 2013). The traditional Arabic medicine was used in the Middle East since ancient times. It refers to beliefs, spiritual therapies, mind-body practices healing practices and prevent illnesses and maintain well-being. The traditional plant species are still commonly used for the treatment of various illnesses (AlRawi et al., 2017). The typical plants of these traditional medicines are *Aloe vera*, *Nigella sativa* and *Aspalathus linearis* (Mahomoodally, 2013; Al Rawi et al., 2017).

2.1.3.1 *Aloe vera*

Aloe vera is a casus which grows readily in hot and dry climates. It consists of two parts, the outer rind and the inner colourless parenchyma aloe gel and both of them have healing effects. In general it has anti-inflammatory, antifungal, antibacterial, anti-arthritic and hypoglycemic properties (Jain et al., 2016; Saniasiaya et al, 2017).



Figure 7

Aloe vera

Source: Pinterest, 2016

2.1.3.2 *Nigella sativa*

Nigella sativa is usually known as a black cumin and is an herbaceous plant, which consists of several constituents like moisture, oil, proteins, carbohydrates, vitamins and minerals. The blooms are mostly blue and white and consist of five to ten petals. The seed are used to treat digestive tract conditions, respiratory conditions, e. g. asthma,

allergies, cough, bronchitis, decrease the cholesterol level and blood pressure ([Rahman et al., 2017](#)).



Figure 8

Nigella sativa

Source: Pinterest, 2016

2.1.3.3 *Aspalathus linearis*

Aspalathus linearis, commonly known as rooibos, is a shrub which is naturally cultivated in the Cederberg area in the Western Cape Province of South Africa. It is used as herbal tea and manufactured as fermented or unfermented rooibos which includes high level of antioxidants. It boosts the immunity, treats insomnia and allergies ([Monsees and Opuwari, 2017](#)).



Figure 9

Aspalanthus linearis

Source: Pinterest, 2016

2.1.4 Ayurveda

Ayurveda is considered as one of the oldest system of medicine in the world. It was established in India during the period 2000-1000 B.C. It describes the beneficial, non-beneficial, happy and unhappy aspects of life. Health is classified as the state of equilibrium. It is based on the principle that the entire universe and the human body are one, and that the same principles lead both. The changes that happen in the universe with the passage of time also occur in the human body. Therefore, the substances of natural origin are congenial to the human body and help to maintain the balance of its components. The universe and the human body consist of five elements. A balanced state of these elements in the body brings health, and an imbalance causes illnesses. The most worldwide used Ayurvedic medicinal plants are *Withania somnifera*, *Azadirachta indica* and *Santalum album* (WHO, 2010; Patwardhan et al., 2010).

2.1.4.1 *Withania somnifera*

Withania somnifera is an erect shrub with yellow or greenish blooms with red berries containing yellow seeds. The roots and leaves are used for medicinal. It contains more than 80 chemical compounds, especially alkaloids and steroids. It has a wide range of health benefits, e. g. ability to treat cancer and diabetes, as well as decrease the inflammation, arthritis, asthma, hypertension, stress, and rheumatism and boost immunity purposes (Mishra et al., 2000; Verma and Kumar, 2011).



Figure 10

Withia somnifera

Source:Pinterest, 2016

2.1.4.2 *Azadirachta indica*

Azadirachta indica or also called neem is a tree which grows up to 20 metres. Most of the plant parts such as fruits, leaves, seeds, roots and barks contain compounds with proven antiseptic, antiviral and anti-inflammatory uses. It reduces inflammation, decreases fevers, promotes healing and generally improves body functions. It destroys a wide range of parasitic organisms and leaves are used to treat malaria (Ogbuewu et al., 2011; Kumar and Navaratnam, 2013).



Figure 11

Azadirachta indica

Source: Pinterest, 2016

2.1.4.3 *Santalum album*

Santalum album is a tropical tree which grows up to 20m high and the most important part of this tree is the heartwood and the essential oil derived from it are useful for many medicinal purposes. It is used in the treatment of common colds, bronchitis, fever, dysentery, scabies and infection of the urinary tract, inflammation of the mouth and pharynx, liver and gall-bladder complaints, stimulant, carminative, digestive and reduces muscle pain (Kumar et al., 2012).



Figure 12

Santalum album

Source: Pinterest, 2016

2.1.5 Chinese traditional medicine

Chinese traditional medicine can be traced back more than 2000 years and it is still commonly practised not only by the Chinese people but it is widespread all around the world. However, few countries have not yet established specific training or developed legislation to regulate this practice (Chen et al., 2007; Jiang, 2005; WHO, 2010). It has its own unique theories for treating disease and to enhance health and it uses herbal materials, traditional herbs, herbal preparations and completed herbal products (WHO, 2010). Chinese medicine is often used to treat the chronicle illnesses and also for some acute conditions. It is used in many fields of medicine, e. g. in internal medicine, gynaecology, paediatrics, traumatology, external medicine, dermatology, emergency medicine, and eye, ear, nose and throat. Traditional Chinese medicine is guided by a unique theoretical paradigm with key concepts like Ying-Yang, the five elements theory, meridians, blood and body fluids theory and the differential diagnosis of syndromes (Chen et al., 2007; WHO, 2010). There are about 7000 species of medicinal plants in China and some of them are worldwide familiar, particularly *Ephedra sinica*, *Ginkgo biloba* and *Panax ginseng* (Jiang, 2005).

2.1.5.1 *Ephedra sinica*

Ephedra sinica is Chinese plant with long history of traditional use for over 5000 years. It is perennial horsetail plant which might grow up to 75 cm in height. It produces leafless, segmented round canes. The fruits are red and contain small round black seeds.

It is primarily used to treat asthma. However, it has wide usage, the stems and the roots are used to treat lung and bladder disorders and the stems are used to treat fever, colds, headaches, and hay fever. The root may also be used to treat night-sweats ([Haller and Benowitz, 2000](#); [Kemper, 2000](#); [Bent et al., 2005](#)).

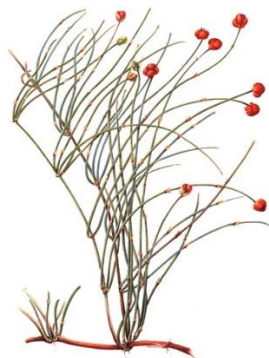


Figure 13

Ephedra sinica

Source: Dharmananda, 2000

2.1.5.2 *Ginkgo biloba*

Ginkgo biloba has found widespread utilization in a variety of conditions and several products, e. g. elixirs, extracts, tea, as well as in form of capsules and tablets. The products are made from the dried root of this plant ([Boullata and Nace, 2000](#)). The whole root which contains ginsenosides is often used due to compounds which have specific pharmacologic effects. The leaf extracts also contain active compounds which are useful in improving blood circulation ([Boullata and Nace, 2000](#); [Ekor, 2014](#)). It acts to enhance oxygen utilization and thus improves memory, concentration, and other mental faculties and it is mostly used by older people ([Snitz et al., 2009](#)).



Figure 14

Ginkgo biloba

Source: Pinterest, 2016

Panax ginseng

Panax ginseng has a long history use going back over 5,000 years. The main active components are ginsenosides which are contained in the roots and have few beneficial effects, e. g. anti-inflammatory and antioxidant effects. Some people use it to treat breast cancer and prevent ovarian, lung, liver and skin cancer. Moreover, *Panax ginseng* can improve psychological function, immune function and conditions associated with diabetes ([Kiefer and Pantuso, 2003](#); [Helmes, 2004](#)).



Figure 15

Panax ginseng

Source:Galland, 2008

2.1.6 European traditional medicine

European traditional medicine can be traced back more than 2000 years in Greece and continued to develop in the Europe. The medicine of medieval Europe was influenced by the Crusaders who brought the herbal skills which they learnt from Arab adversaries. Health is considered as a balance of the soul and disease as imbalance. For many centuries the herbal plants were the main medicaments which were used to treat illnesses across the Europe. Nowadays, *Mentha piperita*, *Melissa officinalis* and *Plantago lanceolata* are one of the most well-known European plant species (Firenzuoli and Gori, 2007; Micke et al., 2011).

2.1.6.1 *Mentha piperita*

Mentha piperita is perennial plant which can be used in few forms, e. g. oil, leaf extract, leaf water and leaf. The oil is utilized in aromatherapy and topical preparations. However, mint has wide range of health and medicinal uses. It helps to improve nausea, bronchitis, headache, flatulence, ulcerative colitis, liver complaints and women use it against menstrual issues (İşcan et al., 2002; Herro and Jacob, 2010).



Figure 16

Mentha piperita

Source: Pinterest, 2016

2.1.6.2 *Melissa officinalis*

Melissa officinalis is perennial plant which is used alone or as part of various herbal products. White flowers or bright pink consist of small clusters of 4 to 12 blossom. It is

used for digestive problems, insomnia, flatulence, and colic; for pain, including menstrual cramps, toothache and headache and also for mental disorders (Kennedy et al., 2002; Moradkhani et al., 2010).



Figure 17

Melissa officinalis

Source: Pinterest, 2016

2.1.6.3 *Plantago lanceolata*

Plantago lanceolata is a rosette-forming perennial plant which consists of 20 cm long and linear lanceolate leaves with parallel venation. For centuries the leaves have been used as wound healing medicine. It improves the skin issues, immunity, respiratory problems, digestive problems and it is against infections. The tea from the leaves is utilized against cough (Gomez-Flores et al., 2000; Samuelsen, 2000).



Figure 18

Plantago lanceolata

Source: Pinterest, 2016

2.2. Complementary and alternative medicine

Generally, the use of HDS is connected with different types of complementary and alternative medicine (CAM); the most popular are acupuncture, aromatherapy, homeopathy, chiropractic, massage, meditation and exercises and nutritional counselling. These therapies have been practiced for centuries worldwide (Fries, 2008; Schachter, 2008).

2.2.1 Aromatherapy

Aromatherapy was practised thousands of years ago in ancient Egypt, China or India (Krishna et al, 2000). It uses as the main therapeutic agents the concentrated essential oils extracted from flowers, leaves, stalks, fruits and roots, and also distilled from resins (Cooke and Ernst, 2000; Ali et al, 2015). Essential oils are mixture of saturated and unsaturated hydrocarbons, ethers, esters, alcohol, ketones, aldehydes, oxides phenols and terpenes, which can produce specific aroma (Cooke and Ernst, 2000). They are so concentrated so that they work on pressure points and revitalize. There are various methods by which they are administered in small quantity like inhalation, massage or simple applications on the skin surface; sometimes they can be also taken internally. Primarily inhalation and the external application are used especially to treat mental and physical balance. The aromatherapy is used to mitigate the stress, revitalize and regenerate. Olfactory nerves from the nose to the brain are the site of action for these essential oils which have well proven antibiotic, antibacterial and antiviral properties (Cooke and Ernst, 2000; Ali et al, 2015).

2.2.2 Homeopathy

Homeopathy is a system of medical practice which was found by German physician Samuel Hahnemann (Bellavite et al., 2005). It is based on the idea that substances which produce symptoms of sickness in healthy individuals will have a curative effect when given in very dilute quantities to sick people who exhibit the similar symptoms. The effectiveness of homeopathy is still subject to controversial discussions (Cucherat

et al, 2000; Khuda-Bukhsh, 2003; Bellavite et al., 2005; Sahng et al., 2005). However, the patient's satisfaction is high and the main reasons for them to consult a homeopathic physician are related to limited effectiveness of conventional medicaments in cases of chronic illnesses, adverse side-effects of drugs, and the invasiveness of conventional medicine (Cucherat et al., 2000; Marian et al., 2008).

2.2.3 Chiropractic

The chiropractic focuses on the relationship between structure (especially the vertebral column) and function (as coordinated by the nervous system) and how the relationship influences the preservation and restoration of health. Chiropractic is a form of manual therapy that uses controlled forces which are applied to specific articulations or anatomic regions to induce a therapeutic response via caused changes in joint structures, neurologic reflexes and muscle function (Waaen et al., 1999; Haussler, 2000).

2.2.4 Massage

Massage can be defined as the systematic manipulation of soft tissues of the body for pain reduction or other therapeutic purposes (Ernst, 2003). It can be perceived as a safe therapeutic modality without any significant risks or side effects (Kumar et al., 2013). Throughout the history it has been used not only by ill persons but also by the healthy people for therapeutic, restorative as well as preventive purposes (Tanwir et al., 2013). There are many types of massages, e. g. shiatsu, Thai massage or acupressure body massage (Ernst, 2003; Chatchawan et al., 2005; Chen et al., 2008).

2.2.5 Meditation

Meditation is defined as any activity in which the individual's attention is primarily focused on a repetitious cognitive activity. It has been developed in Eastern cultures and has documented history of more than several thousands of years. It is a method by which the person can regularly attain a state of mental peace and tranquillity, e. g. stress relief (Manocha, 2000). It is used to help develop habitual, unconscious micro

behaviours that may potentially produce widespread positive effects on psychological and physical functioning (Kim et al., 2013). There are many meditation techniques such as transcendental meditation, mindfulness and Sahaja yoga (Manocha, 2000).

2.2.6 Nutritional counselling

Nutritional counselling targets the treating imbalances which lead to psychological issues through therapeutic diet and supplements. The lack of certain dietary nutrients may contribute to certain mental health disorders. It can be offered in the context of general psychological counselling. It has been used more often to treat mood imbalances and other mental health conditions such as anxiety and depression. The nutritional counsellor, typically a registered dietician or nutritionist determines where changes need to be made. It is also important to know about any health issues, such as heart disease, along with any medications (Huang et al., 2005; King, 2005).

2.2.7 Acupuncture

Acupuncture is a traditional medicine that it is been practiced in China and other Asian countries for thousands of years and nowadays it is used worldwide (Ernst and White, 2011). It can be effective for certain health issues, the World Health Organization (1991) has identified more than 40 medical conditions which are effectively treated or improved by acupuncture, e.g. gastrointestinal, neurologic, or musculoskeletal disorders. It is based on stimulation of special points on the human body, usually by the insertion of fine needles (Vickers and Zollman, 1999). More than 2,000 acupuncture points on the human body are connected with 12 main and 8 secondary pathways, called meridians. Chinese medicine practitioners believe that these meridians conduct energy or called “Qi” between the surface of the body and internal organs. The points are seen to correspond to physiological and anatomical features such as peripheral nerve junctions, and diagnosis is made in purely conventional terms. Acupuncturists use the trigger point which is an area of increased sensitivity within a muscle. It causes a characteristic pattern of referred pain in a related segment of the body. Qi regulates spiritual, emotional, mental, and physical balance and it is influenced by the opposing forces of yin and yang. Yin represents the cold, slow or passive principle. Yang

represents the hot, excited or active principle (Vickers and Zollman, 1999; Sierpina and Frenkel, 2005).

2.3. Rules and EU regulation

HDS like conventional medicaments hold a product licence dependent on quality, safety and efficacy. Obligatory the product or product package must be labelled or contain leaflet where the consumers can find the comprehensive information about using and storage of the product, indications, precaution, adverse side effect and the regulatory information for the safe use (Raynor et al., 2011; Ekor, 2014). The European Union regulation on Traditional Herbal Medicinal products is currently based in Directive 2001/83/EC of the European Parliament and of the Council of 6 November 2001 on the Community code which is related to medicinal products for human use, as amended by Directive 2004/24/EC, which set up a simplified registration procedure for herbal substances, herbal preparations, traditional herbal products and their combinations intended for oral, external and/or inhalation preparations, in so far as they meet some conditions (Fontaine and Reynders, 2001).

Currently, the European Union (EU) implemented a directive to harmonize the regulation of traditional herbal products across the whole EU and establish easier licensing system to inform people about proper use of herbal medicinal products. The obligations are that all manufactured herbal products either achieve a product license of the type required to manufacture conventional products or become as traditional herbal medicinal product registered (Fontaine and Reynders, 2001; Raynor et al., 2011; Ekor, 2014).

2.4. Quality control

As was mentioned, the evaluation of the safety of HDS has become an important issue for consumers, healthcare professionals and regulatory authorities. The analysis of adverse side effects connected to the use of these products is much more complex comparing to conventional medicaments (WHO, 2005; Ekor, 2014). The evaluation of safety is complicated by many factors, e. g. the geographical origin of herb species,

route of administration, different processing techniques and compatibility with other medicinal products (WHO, 2005).

Generally, the quality of herb species is dependent not only on genetic factors, but also on external factors, e. g. environmental conditions, good agricultural techniques and ability of collection practices for medicinal herb species, including plant selection and cultivation which make difficult to perform quality controls on the raw materials of herbal products (WHO, 2005). According to good manufacturing practice the right identification of the herb species, unique storage, sanitation and cleaning methods for various materials are significant requirements for quality control of starting materials. The main challenge is with the mixture of herbal supplements; it is hard to determine the inclusion of all herbs or starting material. Therefore the quality control of herbal products is more complex comparing to conventional medicaments (WHO, 2005; Ekor, 2014).

2.5. Advertising and mass media

Various companies increase awareness about HDS through their marketing strategies such as advertising in the mass media including television, magazines or radio programmes. They have given the HDS credibility and respectability (Brevort, 1998; Parle and Bansal, 2006; Ekor, 2014). The advertising targets different group of people or it may be focused on gender, educational level or different age groups. The promotion targeting children and their mothers is touched on nutritional values of herbal products to support healthy growth, development and boost the immunity. Young people are encouraged to consume HDS for their euphoric effects, supply essential ingredients to help them to face up to stress and prevent or relent the beginning of illness or allergies. Older people take also the HDS to relent the beginning of illness , the second reason for them is easier to purchase HDS comparing to conventional medicine because HDS is without prescription (Morris and Avorn, 2003; Parle and Bansal, 2006; Delgoda et al., 2010; Souza Silva et al., 2014).

2.6. Adverse side effect

Nowadays, a lot of people take many medicaments, especially older people consume three times more prescribed medication comparing to younger. They are also frequent consumers of HDS which are in most cases available to consumers without prescription (Bandaranayake, 2006; Souza Silva, 2014). However, few clinical studies have systematically assessed that the consumption of herbal dietary supplement with conventional medicaments increases the possibility of adverse side effect, so the most endangered group are old people (Davis, 1999; Cherniack, 2001; Babgaleh et al., 2006; Marinac et al., 2007). The Food and Drug Administration (FDA) recorded between 4 years 800 reports of adverse side effect connected with herbal dietary supplement. The most mentioned plant was *Ephendra sinica* containing ephedrine alkaloids which may cause the heart palpitation, cardiac arrest, insomnia, stroke and tremor (FDA, 1998; Kamboj, 2000; Shekele et al., 2003). However, *Ephendra sinica* is not the only plant which causes the health issues. *Ginkgo biloba*, *Panax ginseng* and *Piper methysticum* can also cause adverse side effect with complementary medicaments (Davis, 1999; Kamboj, 2000; Wills, 2000; Morris and Avorn, 2003; Gardiner et al., 2007; Delgoda et al., 2010).

2.4.1. *Ephendra sinica*

Nowadays, *Ephendra sinica* is an ingredient in preparation which heals common cold, asthma or reduces weight (Haller and Benowitz, 2000; Bent et al., 2005). The herb extract contains several ephedra alkaloids, including the primary active constituent, ephedrine, as well as smaller amounts of pseudoephedrine, phenylpropanolamine, methylephedrine, methylpseudoephedrine, and norpseudoephedrine. These drugs have sympathomimetic activity and may lead to various physiologic responses, including bronchodilation, vasoconstriction and increases in blood pressure, heart rate, cardiac contractile force and transient blindness (Bent et al., 2005; Skoulidis et al., 2005; Schoepfer et al., 2007; Varlibas et al., 2009; Ekor, 2014).

2.4.2 *Ginkgo biloba*

The plant extracts is perceived as relatively safe, however, the headache, dizziness, restlessness, nausea, diarrhoea, vomiting and dermal sensitivity are the most usual adverse side effects that have been documented. It was reported to be capable of inhibiting platelet-activating factor and altering bleeding times. Thus the attention was given to individuals or patients on anticoagulants therapy (Boullata and Nace, 2000; Ekor, 2014). The ability of *ginkgo biloba* to cause liver cancer in experimental model was documented currently and genotoxic mechanisms were suggested to play a role in the carcinogenic process (Dunnick and Nyska, 2013; Ekor, 2014). Moreover, the spontaneous bleeding from the iris into the anterior chamber of the eye was connected to the use of extract from ginkgo (Rosenblatt and Mindel, 1997).

2.4.3 *Panax ginseng*

Panax ginseng has been documented to cause uneasiness, sleeplessness, and elevation of blood pressure while mastalgia and vaginal bleeding were monitored at recommended doses (Dunnick and Nyska, 2013). Moreover it may cause transient nervousness, excitation, inability to concentrate, headache, epistaxis, and allergic reactions (Ekor, 2014).

2.4.4 *Piper methysticum*

Commonly reported side effects of *Piper methysticum* are headache, dizziness, gastrointestinal discomfort, and localized numbness after oral ingestion. Huge dosages was documented to be capable of giving rise to dry, scaly skin, and yellowish discoloration of the skin and nails, redness of the eyes and photosensitivity. Photophobia and diplopia might be caused by excessive consumption of kava ([Boullata and Nace, 2000](#)).

The products which contain kava were linked with liver-related injuries like cirrhosis, hepatitis and liver failure with some of the affected patients who needs liver transplants ([FDA, 1998](#)).

5.5.5 *Hypericum perforatum*

Hypericum perforatum, mostly known as St. John's wort, consists of active compounds, e. g. hypericin, melatonin and hyperforin. It is used to treat viral infections but also for light depressive symptoms ([Bennett et al., 1998](#)). Adverse side effects are related to dizziness, allergic reactions, restlessness, fatigue, headache, dry mouth, nausea, vomiting, constipation, and photosensitivity. The other documented issues were hyperesthesia and a syndrome of dyspnea and hyperventilation with flushing headache, palpitations, mydriasis, nausea, and tremor. Interaction of *Hypericum perforatum* with antidepressants and anticoagulants has been proved and the herbal dietary supplements are often not recommended to pregnant women because of its uterotonic activity ([Bennett et al., 1998](#); [Rey and Walter, 1998](#)).

3. Objectives of the thesis

The main aim of the thesis was to document the prevalence and use of HDS of exotic origin among the Czech population.

Specific objectives were to document (i) who is a typical consumer of HDS in the Czech Republic and what are their attitudes towards HDS, (ii) what are the most preferred herb species with special focus on exotic species, (iii) for which ailments and illnesses are particularly used, (iv) which sources are used to get more information on HDS and (v) the most common purchasing places of HDS.

4. Methodology

4.1 Study site description

The Czech Republic is a land-locked country in the central Europe with population exceeding 10.56 million and more than half (73%) live in the urban areas. Historically independent kingdom became an integral part of Habsburg Empire in 1526 and together with Slovakia gained independence in 1918. In 1993 Czechia and Slovakia went their separate ways and both countries joined European Union in 2004 ([Čechura, 2009](#); [CSO, 2016](#); [European Union, 2016](#); [World Bank, 2016](#)). Czech history represents periods of prosperity changing with war conflicts, and more recently struggling under Nazi (1938-1945) and Communist rule (1948-1989). After the fall of communism regime in 1989 the borders were open again to the international markets and especially the membership in EU launched the international trade ([Vodička and Cabada, 2003](#); [Frejka et al., 2008](#); [European Union, 2016](#)). The Czech Republic is developed country, the first from the former socialist block joined OECD ([OECD, 2016](#)). Per capita income was last recorded at 32,167 USD and ranking the country at 40th place in the world ([World Bank, 2016](#)). Previously the Czech Republic was multinational state with larger minority of Germans. However, in the Czech Republic live nowadays roughly 500,000 foreigners, while 270,000 of them with permanent residence, particularly Ukrainians, Vietnamese, Slovaks and Russians are predominant nationalities ([Ministry of the Interior of the Czech Republic, 2017](#)).

4.2 Data collection

Data were collected from 601 adults (>18 years old) who participated in interviewer-administered questionnaire from February 2012 to November 2013. Participation was voluntary and anonymous, without any financial compensation. Only respondents who purchased or used non-domestic/exotic herbal dietary supplement during the past year prior to interview were included in our survey. Inspired by previous studies ([Little, 2004](#); [Ben-Arye et al., 2008](#); [Sirois, 2008](#); [Thomson et al., 2012](#); [Samojlik et al., 2013](#)),

we decided to collect our data across the Czech Republic (see Figure 19) in metropolis, peri-urban and rural areas at frequented locations near shopping centres and markets from passing-by people. Every potential respondent was approached individually and asked for willingness to participate.

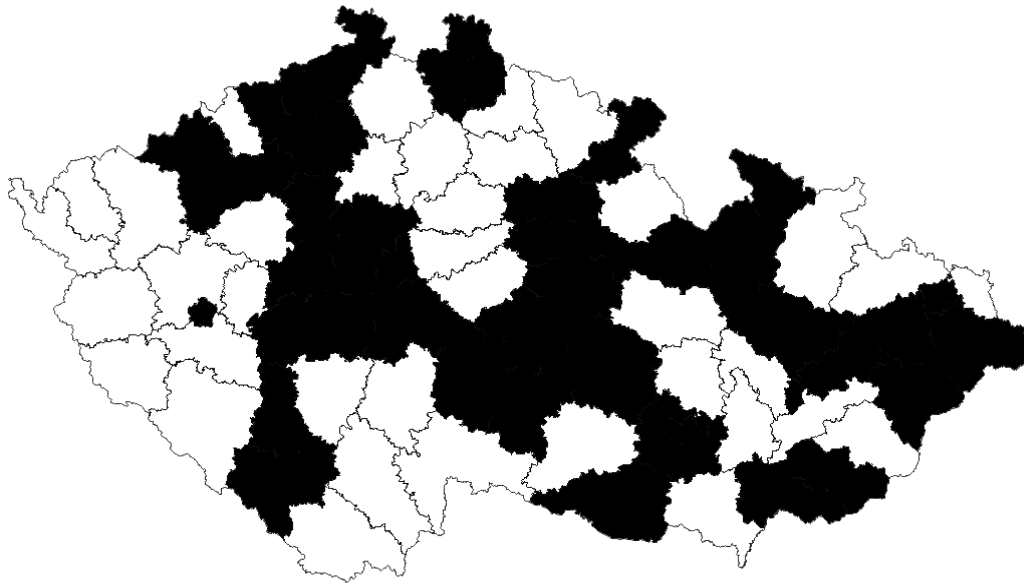


Figure 19

Map of the Czech Republic

Note: highlighted regions of respondent's residence

Interviews were carried out by students and trained pharmacy staff that used semi-structured interview consisting of twelve questions, both open and close ended, as the main technique for data collection. First of all, purpose of the study was explained to each potential respondent. Every question was explained and official terms clarified. Nevertheless, interviewers have always tried to avoid any influence of the responses of our respondents. As stated earlier, first question was about purchasing or using of herbal dietary supplement during the last twelve months in order to support health or healthy life style and which one. Consequently, 18 herb species representing different world regions of traditional medicine, e.g. American, Arabian-African, Ayurveda, Aboriginal, Chinese and European, were purposively identified in order to document the knowledge as well as the use of herbs by the Czech population with respect to different geographical origin of that species. In the next step, we asked whether and how

important this knowledge is for the Czech user. Consequently, we raised questions on the frequency of use, main illnesses and ailments treated consumption of HDS with other medicaments, the high of the costs spent on the one purchase of HDS, which source of information were used, and the most favourite selling places. Questionnaire was finished with documenting of social and demographic background of the respondent as well as a place of his/her residence to understand potential differences between larger and smaller cities. According to previous international studies and to be comparable with them ([Gardiner et al., 2007](#); [Marinac, 2007](#); [Aziz and Tey, 2009](#); [Samojlik et al., 2013](#)) we decided to convert the answers which were given in Czech crowns to the USD (United States dollar).

4.3 Data analysis

Collected data were transferred into the data set in MS Office Excel® and pre-coded. They were statistically analysed in the statistical analysis software STATISTICA ©StatSoft 12 and descriptive statistics were applied in order to analyse demographic and socioeconomic data about the respondents.

To deeply explore differences between groups which involve comparing percentages, the z- score test was used. It was undertaken to determine associations between HDS use and demographic characteristics. Test was 2-tailed and a p-value < 0.05 was considered statistically significant.

5. Results

5.1 Demographical and socio-economic profile of consumer

The socio-demographic characteristics of the respondents are summarized in Table 1. The mean age of respondents was 43 years, with the range between 18 and 88 years.

Table 1 Demographical information about respondents

Indicator	n	%
Gender		
Male	217	36.1
Female	384	63.9
Educational level		
Primary education	32	5.3
Secondary education	353	58.7
Higher education	212	35.3
Employment status		
Student	103	17.1
Employed	415	69.1
Unemployed	7	1.2
Retired	83	13.8
Maternity leave	20	3.3
Monthly income (USD)		
<400	30	5.0
401 – 600	95	15.8
601- 1,000	200	33.3
1,001 - 1,800	179	29.8
≥1,801	44	7.3
Unlisted	53	8.8
Smoking status		
Smoker	66	11.0
Non-smoker	443	73.7
Occasional smoker	90	15.0
Sport activity		
Actively	93	15.5
Recreationally	337	56.1

Passively	168	28.0
Travelling out of Europe		
Yes	181	30.1
No	410	68.2

The most frequent age of the respondents was 25 and 53 years and in general the clear majority of them were women with secondary education, employed, non-smoking and lived in metropolis. She does not travel out of the Europe, does sport recreationally and household income is between 601- 1,000 USD.

5.2 Herb species preferences, knowledge and use

Using a free listing approach, our study identified 85 plant species that are used by the Czech population in the form of herbal dietary supplements, while *Echinacea purpurea*, *Paullinia cupana*, *Scutellaria baicalensis*, *Uncaria tomentosa*, *Eucalyptus globulus*, *Melaleuca alternifolia*, *Serenoa repens*, *Tabebuia impetiginosa*, *Aloe vera*, *Schizandra sinensis*, *Ginkgo biloba*, *Simmondsia chinensis*, *Leuzea carthamoides*, *Yucca schidigera* and *Ananas comosus* were the most often mentioned ones. Nevertheless, in order to document whether Czech respondents do prefer domestic or non-domestic species, 18 typical herbs representing main world traditional medicinal systems were chosen. Figure 20 shows that out of that 18 predetermined herb species, ten were familiar to at least 50% of our respondents and at least 20% really used them in practice.

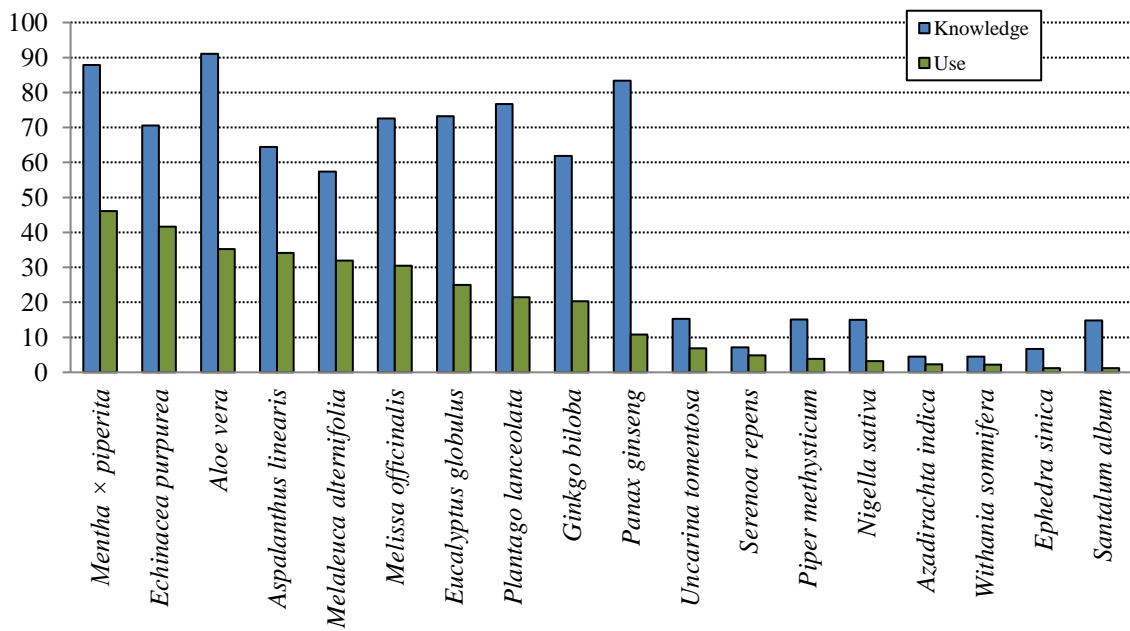


Figure 20

Use of predetermined herb species

Note: *Mentha × piperita*, *Melissa officinalis* and *Plantago lanceolata* were indicated as domestic (European) herb species

Generally, out of these species, *Mentha × piperita*, representing domestic botanical region, was the most favourite one, followed by *Echinacea purpurea*, *Aloe vera* and *Aspalanthus linearis*. Furthermore, Figure 21 shows use of herb species from the gender perspective that is statistically significant. Based on our results, more than half of male respondents confirmed use of *Echinacea purpurea* (61.8%; $p=0.001$), while women expressed their preferences towards *Mentha × piperita* (47.9%; $p=0.000$), *Melissa officinalis* (35.2%; $p=0.000$), *Melaleuca alternifolia* (39.6%; $p=0.001$) and *Plantago lanceolata* (23.4%; $p=0.003$).

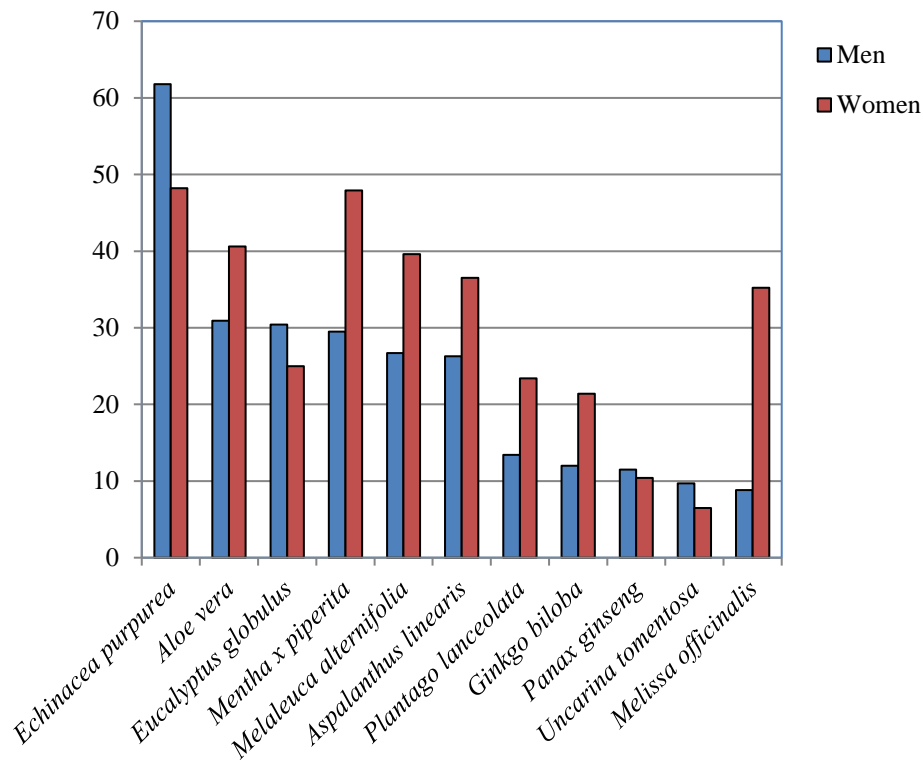


Figure 21
Use of predetermined species by women and men

However, our respondents did not consider the origin of herb species as a significant factor influencing their decision to purchase certain HDS. Figure 22 shows that majority of our respondents (83.2%) considered the origin of herbs as not important, 14.0% preferred rather domestic species and only 2.8% acknowledged the exotic origin of herbs used.

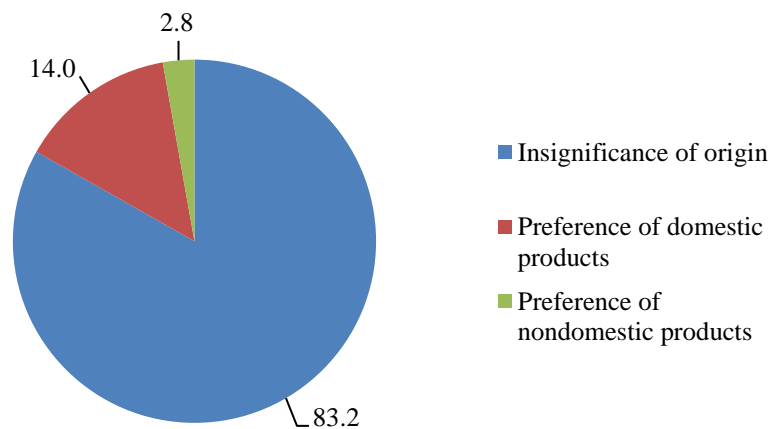


Figure 22
The significance of origin of HDS (%)

Travelling outside Europe has not influence on species preferences. There was no significant difference between respondents who spent their holidays outside or within European continent with respect to geographical preferences of herb species.

Question is how strongly geographical location of herbs is perceived by the Czech population. We found differences between which worlds traditional medicinal systems are familiar to our respondents and the knowledge they have on typical species used by these systems (Table 2).

Table 2 The tendencies towards traditional medicine

Traditional medicine	%	Species
Domestic plant species	30.5	<i>Menta</i> × <i>piperita</i> , <i>Melissa officinalis</i> , <i>Plantago lanceolata</i>
Arabic-African traditional medicine	22.4	<i>Aloe vera</i> , <i>Nigella sativa</i> , <i>Aspalathuslinearis</i>
Aboriginal traditional medicine	18.8	<i>Eucalyptus globulus</i> , <i>Melaleuca alternifolia</i> , <i>Piper methysticum</i>
American traditional medicine	16.5	<i>Echinacea purpurea</i> , <i>Serenoa repens</i> , <i>Uncaria tomentosa</i>
Chinese traditional medicine	10.0	<i>Ephedra sinica</i> , <i>Ginkgo biloba</i> , <i>Panax ginseng</i>
Ayurveda	1.8	<i>Withania somnifera</i> , <i>Azadirachta indica</i> , <i>Santalum album</i>

Traditional Chinese Medicine, American traditional medicine and Ayurveda system were the most cited TCM systems by our respondents. However, the herbs they used represented different geographical zones as well as medicine systems, particularly Arabic-African, Aboriginal and American traditional medicine. HDS related to Chinese traditional medicine, especially *Panax ginseng*, were more consumed in the metropolis comparing to sub regional town.

5.3 Purpose for purchasing and the frequency of use

Boosting immunity (64.2%), improving digestive system (43.9%) and psychical disorders such as insomnia or depression (38.4%) were the most frequent ailments healed by our respondents (see Figure 23).

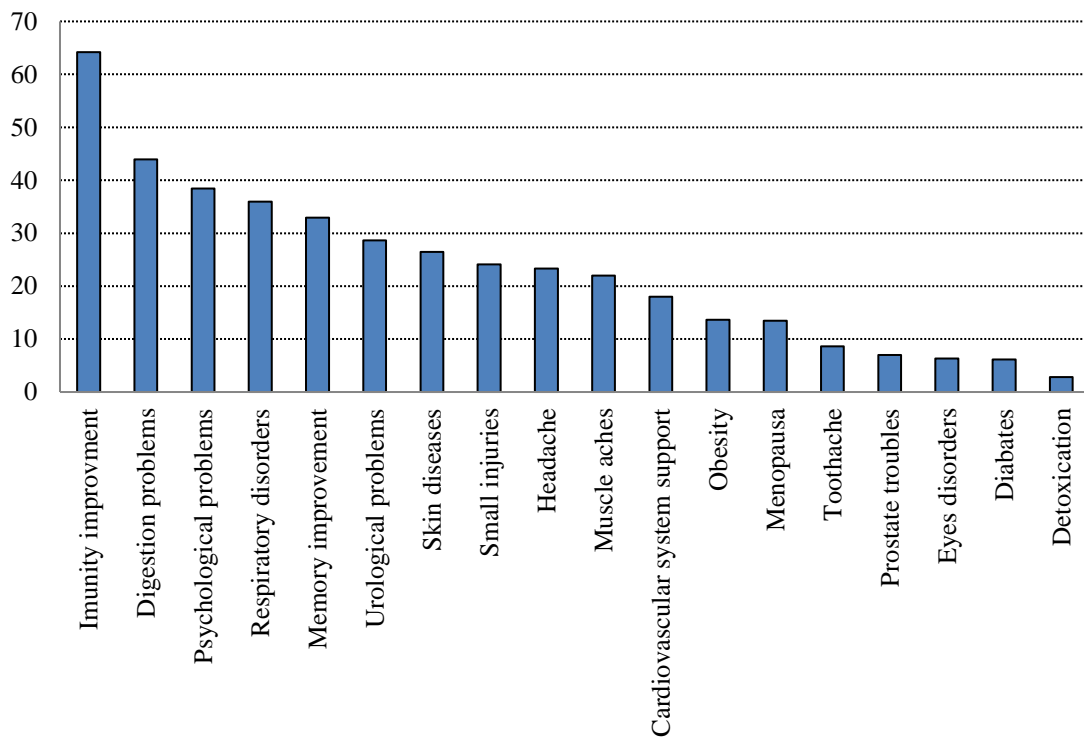


Figure 23
Purpose of use of HDS

The main purpose of using HDS for men was respiratory problems (43.8%, $p= 0.002$) or improvement of cardiovascular system (24.9%, $p= 0.001$) while women used them for boosting immunity (67.5%, $p=0.027$), improvement of mental health (43.5%, $p=0.001$), urological problems (34.9%, $p=0.000$), skin problems (33.6%, $p=0.000$) and headache (27.6%, $p=0.001$).

To deeply understand differences of the purpose of HDS use we decided to divide the results into the two groups of larger and smaller cities. Respondents who lived in capital or regional cities used HDS for purpose of boosting immunity (66.6%, $p=0.021$), skin diseases (29.6%, $p=0.002$), small injuries (27.2%, $p=0.001$), obesity (15.8%, $p=0.005$), toothache (9.4%, $p=0.000$) and diabetes (7.1%, $p=0.000$). Psychological problems (50.7%, $p= 0.000$), urological issues (35.8%, $p=0.020$) were statistically significant in sub- regional cities (see Table3).

Table 3 The purpose of HDS use in larger and smaller cities

Purpose of HDS use	capital and regional cities (%)	sub-regional cities (%)	p-value
Immunity improvement	66.6	56.1	0.021*
Digestion problems	41.9	49.3	0.114
Psychological problems	34.3	50.7	0.000*
Respiratory disorders	36.1	34.5	0.719
Memory improvement	34.5	26.4	0.059
Urological problems	25.8	35.8	0.020*
Skin diseases	29.6	16.9	0.002*
Small injuries	27.2	13.5	0.001*
Headache	21.6	28.4	0.091
Muscle aches	21.2	23.7	0.052
Cardiovascular system support	19.4	14.2	0.156
Obesity	15.8	6.8	0.005*
Menopause	13.1	13.5	0.904
Toothache	9.4	6.1	0.000*
Prostate troubles	6.7	8.1	0.555
Eyes disorders	7.4	2.7	0.042*
Diabetes	7.1	3.4	0.000*
Detoxication	2.9	2.7	0.900

Note: * are significance at 95%

Nevertheless, our results show that 29.7% of respondents used HDS permanently, while almost half of the Czech population (46.3%) used herbal dietary supplements irregularly, i.e. in the time of necessity, and 24.0% used it seasonally (see Figure 24).

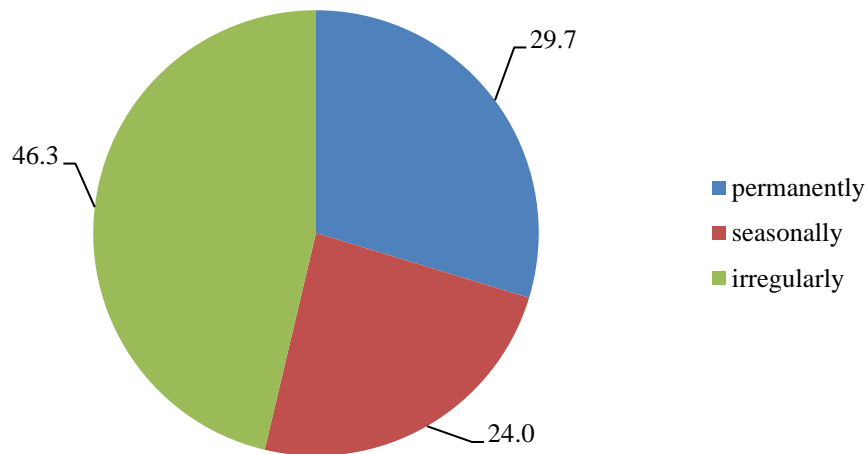


Figure 24
The regularity of HDS use (%)

There was a statistically difference between non-smokers and smokers. Respondents who smoked used HDS irregularly (24.4%, $p=0.024$) comparing to non-smokers who used more HDS permanently (13.3%), however, there was no statistically significance. Also people who did not do any sport activity comparing to active athlete used permanently the HDS (39.9%, $p=0.000$) (see Table 4).

Table 4 Consumption of HDS according to sport activity

Consummation of HDS	Active athlete (%)	No sport activity (%)	p-value
Irregularly	36.56	33.93	0.667
Permanently	5.38	39.88	0.000*
Seasonally	20.43	16.67	0.447

Note: * are significance at 95%

Our respondents connected the use of HDS with certain type of CAM. The most known was acupuncture which was however the least used one. Nutritional counselling and massages were on the other hand practised by more than 40% of our respondents. The high prevalence of nutritional counselling was recorded in sub- regional cities (68.9%, $p=0.000$).

5.4 Information about herbal dietary supplements and place for purchasing

Respondents found out the information about HDS particularly from professional literature (16.6%), pharmacists (11.3%) or promotional material (10%) (see Figure 25). However, large proportion of respondents ascertained facts from sources which can be considered as rather informal, such as information obtained from friends (16.6%), internet (15.9%) or family tradition (9.1%). It is important to mention that 31.1% of respondents reported taking HDS together with prescribed or purchased medicaments, particularly in case of urological difficulties, digestive problems or influenza. Moreover, 28.6% used prescribed medicine with herbs which may cause adverse side effect such as *Ginkgo biloba*, *Ephendra sinica*, *Panax ginseng* and *Piper methysticum*.

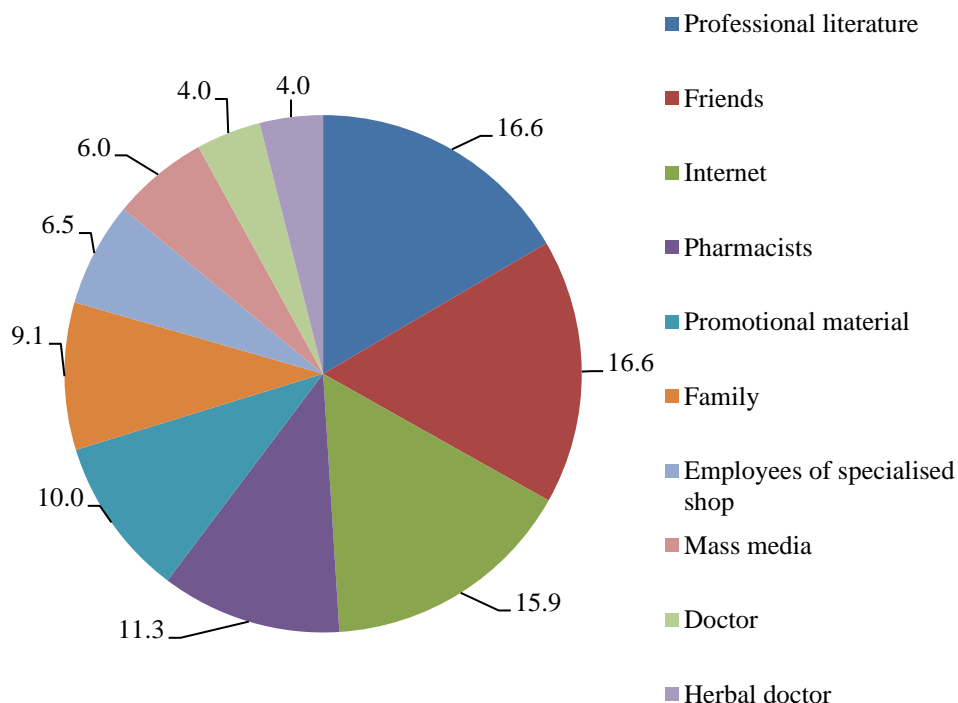


Figure 25
Information about use of HDS (%)

The HDS were bought mostly in drugstores (69.2%) or specialised shops (61.6%) and almost all respondents were willing to spend for these products up to 20 USD per one visit. Difference between men and women were observed in purchasing places. Women prefer pharmacies (72.7%; $p=0.000$), specialised shops (64.8%; $p=0.000$) or official distributors (8.9%; $p=0.001$), while men use more e-shops. Both genders use supermarkets as a place for purchasing different HDS (see Table 5).

Table 5 Place of purchase of HDS by men and women

Place of purchase of HDS	Women (%)	Men (%)	p-value
Pharmacy	72.7	47.5	0.000*
Specialised shop	64.8	45.6	0.000*
Distributors	8.9	1.8	0.001*
E-shop	22.1	25.8	0.308
Supermarket	14.8	13.4	0.617

Note: * are significance at 95%

The results divided into two groups (capital, regional cities and sub-regional cities) show the differences between the obtaining of information about HDS. The most frequented sources in capital and regional cities were family (37.4, $p=0.000$) and doctor (16.0, $p=0.006$) while the smaller cities preferred obtaining the information from mass media (31.8%, $p=0.000$) and promotional material (48.0%, $p=0.002$) and the herbal doctor had a stronger tendencies comparing to doctor (see Table 6).

Table 6 Information about use of HDS

Sources	capital and regional cities (%)	sub-regional cities (%)	p-value
Internet	57.2	52.0	0.267
Herbal doctor	14.9	10.1	0.142
Pharmacy	40.3	38.5	0.700
Doctor	16.0	7.4	0.006*
Professional literature	57.9	61.5	0.441
Staff of specialised shop	23.2	22.3	0.826
Promotional material	31.2	48.0	0.002*
Friends	60.8	52.7	0.082
Family	37.4	18.2	0.000*
Mass media	17.8	31.8	0.000*

Note: * are significance at 95%

6. Discussion

Typical user of herbal dietary supplements in the Czech Republic is 43-years-old woman, with secondary education, non-smoker, recreational athlete and earning monthly income between 600 and 1,000 USD equal to national average. In this respect our study fits to the results of other published reports on similar issues from USA (Kelly et al., 2006; Marinac, 2007), Australia (Mac Lennan et al., 2006), Serbia (Samoljik et al., 2013), as well as from less developed countries, such as Jamaica (Delgoda et al., 2010) or Mongolia (Oyunchimeg et al., 2017). It may be justified that women are still the main purchaser of foods in a household and take care of the health and well-being of the whole family (Bech-Larsen and Scholderer, 2007). There is general linkage between maintaining of healthy life style, tendencies toward sport activity or quitting the smoking and preferences to complementary and alternative medicine observed in other studies as well (Gilbert, 1999; Greger, 2001). Similar studies documented that individuals who exercised regularly, means at least three times per week, had more tendencies to use HDS comparing to people who do not sport (Lyle et al., 1998; Greger, 2001). Also, and correspondingly with our research, non-smokers used more HDS than current smokers (Lyle et al., 1998; Patterson et al., 1998; Greger, 2001). Furthermore, the female dominance in our research could be also explained by one more argument that women in general take care of themselves more comparing to men (Bertakis et al., 2000).

Generally, our results show that Czech population tend to use herbs of domestic origin as all three purposively predefined herb species that represented local flora, i.e. *Mentha×piperita*, *Melissa officinalis* and *Plantago lanceolata* were among the most used ones. It was also proved by documenting the use of HDS during the last year prior to study, where species of domestic origin dominated. Moreover, those findings correspond to previously published study where domestic species dominated among pharmacy consumers (Knotek et al., 2012). Nevertheless, herbs representing world traditional medicinal systems were frequently used as well. The reason for that could be that we employed respondents into our survey who were approached individually in the streets, so we worked with more diversified sample. Typical example of exotic herb species used by Czech adults is *Echinacea purpurea*, which is globally consumed due to

its potential to support organism as well as contribute to official treatments of the common cold, bronchitis, coughs, upper respiratory infections and some inflammatory conditions (Percival 2000; Planta et al., 2000; Kennedy, 2005; Babgaleh et al., 2006; Gardiner et al., 2007; Marinac, 2007). The use of coneflower is reported from the USA (Kelly et al., 2006; Gardiner et al., 2007; Marinac, 2007), where is the origin of that species, but also from other countries all around the world, both developed, such as Italy (Facchinetti et al., 2012), Australia (Foster et al., 2006) or Brazil (Junior et al., 2016).

However, we cannot use *Echinacea purpurea* phenomena as the main criteria to understand tendencies to local or exotic origin of HDS. In USA, for example, there are also other herbs of non-domestic origin used as HDS, such as *Panax ginseng* and *Ginkgo biloba*, both representing the Chinese traditional medicine (Kennedy, 2005; Babgaleh et al., 2006; Gardiner et al., 2007; Marinac, 2007). Similarly, in Thailand, where *Echinacea purpurea* was very popular herb of exotic origin, the most commonly used plant species were *Andrographis paniculata* and *Moringa oleifera* which had the origin in the South or Southeast Asia (Tangkiatkumjai et al., 2013). The similarities were recorded in China, *Panax ginseng* and *Ginkgo biloba* were commonly used (Xie, 2006; Xiang et al., 2008) and Australia where the *Eucalyptus globulus* was popular among the population (Skouteris et al., 2008). Correspondingly in Serbia, local population used not only domestic plant species, but also exotic species (Samoljik et al., 2013).

Certain differences in demographic and socio-economic characteristics which influence consumer decision were documented in the Czech Republic as well. In comparison with Czech consumers, these herbs were familiar, however not so often consumed. Only *Panax ginseng* was used by the population in larger cities. It might be related to our results about purpose of HDS use and division into the size of the cities, specifically *Panax ginseng* is used for boosting immunity (Kang and Min, 2012).

The preference of domestic plant species, i.e. *Menta×piperita*, *Melissa officinalis*, *Plantago lanceolata*, by women may be caused that these plants are not only easy to purchase and to cultivate but also due to the strong tradition of collection of medicinal herbs, which is supported by use of literature and family tradition as very usual

information sources (Knotek et al., 2012). Women had also tendencies to use more *Melaleuca alternifolia*, commonly known as tea tree oil, comparing to men. Tea tree oil has wide range of use in the household because of its antimicrobial activity. According to our results women used HDS for purpose of skin problems and tea tree oil is appropriate for that and also it can be used as cosmetics product to treat for example acne (Hammer et al., 2003). On the other hand, men preferred to use *Echinacea purpurea* which might be due to the treatment of common illnesses, usually very irregularly and the fact that it is available in pharmacies without any prescriptions.

Generally, it seems that the origin of the herbs was not significant for Czech consumers. This attitude was also confirmed by following answers about using of traditional medicine and using of herb species which are typical for one culture. The Traditional Chinese Medicine (TCM) and Ayurveda are worldwide known systems, but Czech respondents had very low experience with typical herb species used. We can assume that efficiency of HDS against certain illnesses, disorders or its supportive impact on organism seem to be more significant driving forces that influence consumer behaviour of the Czech population.

Czech consumers used HDS to boost immunity (64.2%), improve digestive system (43.9%) and psychical disorders such as insomnia or depression (38.4%) which corresponds to other studies from USA (Kennedy, 2005; Babgaleh et al., 2006; Gardiner et al., 2007), Brunei (Chong et al., 2010), Australia (Mac Lennan et al., 2006), Lebanon (El Khoury et al., 2016) or Thailand (Tangkiatkumjai et al., 2013). In generally, HDS are produced to be used regularly in order to support healthy life (Barret et al., 1999; Wills, 2000; Uchiyama, 2010). Based on the ailments and disorders mentioned by our respondents, we can conclude that Czech adults use HDS for immunity support or during the digestion problems. On the other hand, our results show that 46.3% of Czech respondents use herbal dietary supplements irregularly, very probably to reduce the pain or to overcome seasonal illnesses, which were stated by 24% of the respondents, who might try to react to certain seasonal illness such as reduction the risk of allergies, cold, fever or respiratory problems. Almost every third respondent (29.7%) used HDS permanently to support his/her healthy life style. This finding is significantly less compared to Thai people, where HDS were used regularly by 45% of population

(Tangkiatkumjai et al., 2013). Also in Canada, the products were used permanently by 40% of respondents (Spanner and Duncan, 2005). Our results are similar to American population where 29% used regularly (Grabe and Garrison, 2004).

Using of HDS is usually connected to complementary and alternative medicine (CAM). Nutritional counselling and massages were practised by more than 40% of our respondents, while meditation, aromatherapy or homeopathy was familiar to Czech respondent, but less used. This finding however did not prove any tendencies to complementary and alternative medicine. We can assume that nutritional counselling might be connected to the increasing awareness about healthy lifestyle and well-being to treat for example the obesity (Atallah et al., 2014). On the other hand, massages could be related to psychological problems for example stress alleviation. Besides connection HDS to practices of CAM, self-medication is another issue worth of our interest as it is very common feature of herbs use, and, what is more alarming, such self-medication is not reported to official health-care provider (Kamboj, 2000; Dasgupta, 2003; Shekele et al., 2003; Ekor 2014). This issue is discussed worldwide, which is documented by number of published studies from Brunei (Chong et al., 2010), the USA (Gardiner et al., 2007; Marinac, 2007), Thailand (Tangkiatkumjai et al., 2013) and Serbia (Samojlik et al., 2013). This could be a problem particularly in the case of herbs of exotic origin, the Czech population has only little experience with and all information are gathered predominantly from informal information sources, such as internet, family or friends. Our study shows that HDS were used together with prescribed and/or purchased medicines conventional medicine by every third respondent. The issue is that plant species stated by our respondents as commonly used, might cause the serious side effects, such as *Ginkgo biloba*, *Ephendra sinica*, *Panax ginseng* or *Piper methysticum* (Kamboj, 2000; Wills, 2000; Morris and Avorn, 2003; Gardiner et al., 2007) or significantly reduce the efficiency of any healing process as well.

As stated earlier, prevalence, attitudes or even inappropriate use of HDS, such unreported co-medication, are related to the source of information on HDS usually used by the consumers. Based on our survey, the most reported information source about HDS was the recommendations from family members, friends or advertisement in the television. This source dominated in smaller cities, which was also recorded from the

USA ([Harnack et al., 2001](#)). Alarming, physicians and pharmacists belonged among less mentioned sources, again similarly to other studies from the USA ([Marinac, 2007](#)), Brunei ([Chong et al., 2008](#)), Germany ([Schnabel et al., 2014](#)), Thailand ([Tangkiatkumjai et al., 2013](#)) and Mongolia ([Oyunchimeg et al., 2017](#)).

Overall problem of HDS is that they are not considered as medicine and thus, they are available without any prescriptions in the pharmacies, supermarkets or e-shops. Besides pharmacists, it eliminates any physician's effort to prescribe right medicine, to understand and reduce negative side-effects and/or provide the patient with effective healing process. Particularly older people find easier to only purchase the HDS against seasonal issues as well as chronic illnesses than to pay for prescribed medicaments. As a result, the probability of adverse side effect is higher comparing to younger population ([Canter and Ernst, 2004](#); [Souza Silva et al., 2014](#)). Positive finding is that the HDS were purchased mostly from pharmacies, direct sale companies and specialised shops, which also correspond to other studies ([Marinac, 2007](#); [Tangkiatkumjai et al., 2013](#)). These distributors usually provide any consumer with certain consultations and advices, which are however less followed compare to recommendations received by physician.

Our results and main findings may provide a basis for physicians, pharmacists, health care providers as well as for the pharmaceutical companies which might target on different types of consumers to better design any marketing strategy. However, they should also attract policy makers, who could react with proper regulations towards HDS use, for example in the case of co-medication. At the same time, our study documented that HDS use is typical for middle-class households who are active in sport and quite smoking. This should lead to further support of HDS use among Czech population, with clear impact on regular use of herbs to support healthy lifestyle or to efficiently face global ailments and disorders, support the healing process based on conventional medicine or make it even more efficient and to generally enlarge the knowledge of the Czech respondents towards HDS of exotic origin. Last but not least, it is necessary to provide Czech consumers and public with adequate information on their proper use.

Nevertheless, further research is needed to understand better consumer's behaviour and the interactions between HDS and conventional medicaments. Any research should be

also extended on question about the health status when they use HDS with prescribed medicine. Also it may be useful particular in order to better document the change over time in consumer behaviour towards HDS. Interesting would be also to document the reasons why respondents give priority to HDS. Also in the further research should be taken into the consideration the consumption of alcohol which may influence the consumer's attitudes towards HDS use (Lyle et al., 1998; Patterson et al., 1998; Greger, 2001). As our data were not collected from the distributors/seller of HDS and doctors, more complex study should be carried out in the future as well (Samojlik et al., 2013).

Our results should be understood with certain limitations since certain factors might have affected respondent's answers and thus our results. First, respondents might not truthfully answer to our questions, especially on those linked to the social and demographical parts which might be perceived as a sensitive like income or age of the respondents. Secondly, we used in our questionnaire predefined herb species to understand knowledge and real use of herbs in Czech Republic. However, some interesting and commonly used plant species remained omitted such as *Zingiber officinale* or *Allium sativum* (Kennedy, 2005; Babgaleh et al., 2006; Gardiner et al., 2007). Thirdly, very important economic aspects, such as expenditures on HDS per one visit, were probably not very well understood by our respondents, but we have received similar answer to our previous study (Knotek et al., 2012). However, lower understanding or the willingness to share real values made our results less comparable with other international studies where the monthly expenditures used for HDS purchasing range from 5 USD to 100 USD (Kennedy, 2005; Marinac, 2007). Last, despite the fact our data were collected in relatively long period, we cannot guarantee that the effect of seasonal illnesses was avoided. Our respondents were recruited from individuals walking in the streets and their answers could be more general without any deep enthusiasm in CAM. Despite of all above mentioned limitations, we consider our study as the very first attempt to document use of HDS of exotic origin among Czech consumers and we pointed out some emerging issue that call for further studies.

7. Conclusion

Our results confirmed the use of HDS of domestic and also exotic origin by the Czech population. In general, domestic plant species were more favoured for the Czech population. Purposively chosen 18 predefined plant species showed that the most preferred were *Mentha × piperita*, which represents the domestic botanical region, followed by exotic species *Echinacea purpurea*, *Aloe vera* and *Aspalathus linearis*. Based on our data, we identified 85 herb species used by Czech adults and we can also conclude that the typical purchaser of the HDS was middle-aged woman with secondary education, non-smoker, living in metropolis and preferring domestic plant species with tendencies to use non-domestic ones as well. Among the most popular plant species of exotic origin were those connected to Arabic-African and Aboriginal traditional medicine. Czechs used HDS particularly for boosting immunity, improving digestive system, and against psychological disorders. Relevant information on herbs use was gathered from both formal and informal sources. Most inspiration and knowledge came from professional literature, but friends or family members and the internet also played an important role. Particularly using of such informal sources pointed at the strong tendency towards self-medication as one third of respondents reported taking HDS together with conventional medicaments, however, with low or no consultation with physician. Pharmacies represented primarily place for purchasing of HDS, followed by specialised shops and e-shops. Generally, our results showed that the Czech respondents did not consider the origin of herbs as important factor influencing their decision to buy or use.

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