The Book of Herbs

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THE BOOK OF HERBS

Erasmus+

AGROPUZZLE 4 PROJECT

"Puzzle for businessmen in agriculture carrying business in a permanently maintainable way IV"

Presa Universitară Clujeană
2022

This Book is structured according to the information provided by the partners of the Agropuzzle 4 project regarding the use of aromatic, medicinal and medicinal plants in the participating countries, based on the professional activities carried out by the authors:

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AGROPUZZLE 4 PROJECT

”Puzzle for businessmen in agriculture carrying business in a permanently maintainable way IV”

ERASMUS PLUS PROGRAM

Key Action: for innovation and the exchange of good practices

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CONTENTS

INTRODUCTION

The project **"***Agropuzzle 4 - Puzzle for businessmen in agriculture carrying business in a permanently maintainable way IV*" is a project of partnership in the Erasmus plus program, Key Action: Cooperation for innovation and the exchange of good practices, Action Type: Strategic Partnerships for vocational education and training aimed at developing, updating and supplementing profile specific skills and training in sustainable agriculture and agribusiness.

This project is aimed at **exchange of experiences as well as increase of practical** self-confidence, **promotion of professional development** and growth of the participants who will work together on the issue of farming, **support of rural environments, agri-business** in selected small family farms, their stories and background.

This project intends to give an original and efficient contribution to the agricultural sector promoting the specific focus of medicinal and aromatic and melliferous plants and apiculture in sustainable/organic system.

The project is generally aimed at keeping the topic of agriculture alive including beekeeping, aromatic plants and the planting of herbs. These will be the main points of the agriculture zone. Herbs and honey have been playing a major role for years to improve the overall health of the body; they help in healing wounds faster, make up for nutritional supplements and also deliver a host of other benefits. Herbs and honey strengthen the immune system, lower blood sugar and cholesterol, have anti-inflammatory properties, and prevent Alzheimer's diseases and various types of cancer.

Countries in Southern Europe are the greatest consumers of honey. In the developed countries of Europe, due to industrial environmental impact and due to introduction of bee parasite *Varroa Destructor*, beekeeping is the only tool that can keep bees in the open nature and protect the whole eco-system against collapse. Each EU country has a slightly different approach to beekeeping. They use different methods, treatments, wintering and feeding. Southern EU countries and island areas have the advantage of longer seasons.

As a part of agricultural production, aromatic and medicinal plants and honey are getting more popular in many countries. The aim is to compare the production and the conditions of the markets for local herbs in several EU countries.

It is really necessary to appreciate everyone who is involved in the real work that feeds all of us, and it is important to teach the next generation to follow those principles. The next generation should be given the opportunity to learn about new trends and innovations from other EU countries so that the young people can compare these aspects and use the experience as inspiration for their own work. In Europe nowadays, the topic of agriculture (the farming of herbs and aromatic plants) is rather neglected, but is still very important. In the era of globalization, we are

really missing the story of families that jointly run their businesses and affect their rural community. There are also small family farms timidly developing along with those which allow the integration of disadvantaged groups of people, possibly with physical or mental disabilities, who are able to contribute by being in the countryside. Inclusion of these people shows a good example of solidarity and tolerance of each community within the EU countries.

Another goal of the project is about linking the know-how of partners from the European countries, the professional diversity and specificity of individual countries, the exchanges of experiences, the possibility to compare the levels of support to agriculture and farming, the working conditions and marketing strategies.

The structure of partners is such that the organizations discuss and inspire each other; there are representatives of educational institutions (i.e. theoretical organizations) as well as the representatives of professional organizations (i.e. those involved in the work).

The aim of this ***"BOOK OF HERBS"*** is to spread some information about the uses and characteristics of traditional medicine and aromatic plants in partner countries and also for all those interested in this subject.

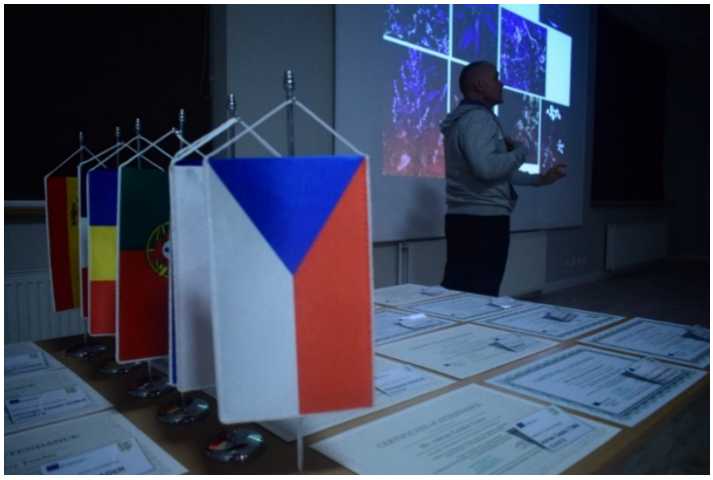
There are a lot of species employed in the country, and we have selected some of these. For each plant a summary sheet has been prepared with several data included scientific name, common name, varieties, morphology y biology, climatic and soil suitable conditions, plants organs of medicinal and aromatic interest, chemical composition (nutritional), valorization, economic importance, product obtained, and some remarks in direct relation to Agropuzzle 4 main task (significance for rural environment/localities/family development and proposals for improving the present status).

This book presents some of the most important species of aromatic, medicinal and meliferous plants present in the partner countries of the Agroupuzzle 4 project.

From the multitude of species present in the specific literature of each partner country, a few were selected according to: popularity, importance and used in medicine or the pharmaceutical and food industries, in the preparation of various traditional foods or beverages, and importance as melliferous plants.

For each country, 10 plants were chosen (Latin name, Synonyms, Common name), which were described in terms of climate and soil requirements, importance and uses and their presentation will be done in alphabetical order.

PARTNERS OF AGROPUZZLE 4 PROJECT



The partnership of the project is made up of:

Coordinator:

- **Chamber of Agriculture in Opole, Poland**: is acting for the farming, influences the forming of agricultural policies and participates in the environmental protection, the culture, the sightseeing and preserving the cultural heritage of rural areas. Activities of the chamber are connected with large-scale support to the agricultural environment by coordinating joint actions in the area of the farming, with supporting initiatives and creating the image of a modern farmer, and also supporting the agricultural education in the province.

Partners:

- **Masaryk Secondary School of Agriculture and Higher Vocational School of Opava, Czech Republic** provides its students with quality secondary and higher vocational education. Students can also focus on the study of three-year study fields ending with a final exam. The school offers education in the field of agribusiness, ecology and the environment, chemist operator. Also, the institution organise the training courses for farmers in the branch of agriculture, gardening, machinery.

- **Natura Opava Organization, Czech Republic** is a non-governmental and non-profit organization that has been dealing with environmental education, training and consultancy in the branch of environmental protection since 1992. The training programs are aimed to teaching pupils and students to get familiarized with the nature by using own experience, also provide consulting services in the branch of environmental education and practical lessons of biology to schools.

- **Macaurii Agricultural High School, French Guiana-France -** offers training in different field profficiences, which prepares students to the many agricultural and rural world experiences: agricultural production, horticulture, floriculture, fruit-bearing production, animal production, food processing of farm products and rural enviroment services.

- **Rural Development Association (RUDE), Portugal** is involved in the innovative initiatives in the development of rural areas, contributes to the well-being and quality of local population life, improve the competitiveness of agriculture and forestry, promote sustainability of rural areas and natural resources, historical heritage, tourism and environment, organic agriculture and livestock, school gardens or seed banks.

- **Confederation of Rural Development Centers (COCEDER), Spain** is non-governmental organization offers training courses, for employed and unoccupied in domain: sustainable entrepreneurship in the rural environment, conservation of the agricultural biodiversity, social issues, agriculture processing.

- **University of Agronomic Sciences and Veterinary Medicine of Bucharest (USAMVB), Romania** provides BSc, MSc and PhD education and scientific research activities in order to train top specialists whose competences meet the demands of the labor market in the fundamental fields of "Engineering Sciences" and "Biological and biomedical sciences". USAMVB offers students both the necessary adequate infrastructure for education and research, fully equipped laboratories and scientific research stations, and great opportunities for spending their free time in the university. Also, the University is involved in the field of vocational education and training in the agricultural sector, i.e. in the design and the delivery phase of the quality-certified training of organic farmers; identification of the required competences for all operators in the organic agricultural sector, or organic apiculture.

CHAPTER 1

IMPORTANCE OF AROMATIC, MEDICINAL AND MELIFEROUS PLANTS

An old wise saying goes that nature knows no problems but only solutions (Chirilă, 1987). And nature is an inexhaustible source of elements that help maintain life on earth, with cures to restore the body's vital activity and perpetuate life.

The beneficial and miraculous effects of some herbs have been observed and researched over time. Some were drawn to their benevolent side and continued to search tirelessly for their salutary effects, while others ignored them altogether.

Medicinal plants have always been the raw material for treating various ailments, representing basic remedies or sometimes almost the only remedy in ancient times. In the early days of medicine, the treatment of diseases was done mainly with the help of plants and, along with the plant material, were used materials of animal origin (blood, horn powder) or others of mineral origin (powders, flints, clay).

As time went on, medicine developed, as did chemistry, which led to the identification and extraction of chemicals from plant material. In the next stage, the development of chemistry and biochemistry made it possible to obtain in a synthetic way the substances identified in medicinal plants. This is how research on the production of sulfamides and antibiotics developed later. In this situation, the importance of natural remedies has diminished, they have not been completely abandoned, being maintained in folk medicine, in less economically developed areas of the globe, and have returned to attention for various reasons. One of these is the intensification of efforts to find remedies for certain incurable diseases. It has been found that very important chemical remedies in the acute stages of the disease have a violent effect on the body, have side effects that occur frequently, and some contraindications.

Also, in the current context, in the economically developed countries, and not only, there is an attempt to return to nature, to traditions. It has been found that there is an artificialization of life, which focuses on chemicals that do not solve food or health problems, but which can also create some adverse effects on human or animal health, but also pollution on the environment. Thus, interest in natural remedies, homeopathic treatments and organic farming arose.

The development of chemistry, of medicine, allowed the attraction of new plants in the vegetal circuit. Analyzes can be performed on a variety of plant material in which the therapeutic effect can be tested. There are areas around the world where a wide variety of medicinal plant species are found, new species to which new therapeutic qualities are being discovered (for example: Indian cucumber used in the treatment of diabetes).

Natural remedies, which are based on medicinal plants, are back in vogue today due to the substances they contain, known as active principles that make them useful in treating various ailments. The effect of these substances from plants offers a gentler and more complex treatment on the body, but it takes a longer time to achieve the expected results. However, there are side effects or contraindications in herbs, and therefore treatment should always be done under the supervision of a physician.

Prolonged use of herbs in medicine is a sure indication of their value and usefulness. It is estimated that worldwide, they are currently used in phytotherapy approx. 20,000 species of medicinal and aromatic plants, of which the most used are approx. 300 species (Tudor et al., 2011).

Natural medicine is primarily based on Phytotherapy and collaborates with other related medical specialties, such as: Homeopathy (herbal remedies, especially toxic plants, administered at the beginning, in lower doses), Diet therapy (which is based in the first on herbal products) and Aromatherapy (treatment based on essential-volatile oils) (Bojor, 2015).

Recently, WHO (World Health Organization) estimated that 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants (WHO),

As per data available over three-quarters of the world population relies mainly on plants and plant extracts for their health care needs. More than 30% of the entire plant species, at one time or other were used for medicinal purposes. It has been estimated, that in developed countries such as United States, plant drugs constitute as much as 25% of the total drugs, while in fast developing countries such as India and China, the contribution is as much as 80%. Thus, the economic importance of medicinal plants is much more to countries such as India than to rest of the world. These countries provide two third of the plants used in modern system of medicine and the health care system of rural population depend on indigenous systems of medicine.

Herbal, medicinal and aromatic plants have been an important resource for human healthcare from prehistoric times to the present day. According to the World Health Organization,

the majority of the world's human population, especially in developing countries, depends on traditional medicine based on organic herbs. Between 50,000 and 70,000 plant species are known to be used in traditional and modern medicinal systems throughout the world (International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants, 2007).

Aromatic and medicinal plants are part of a wide variety of products on the market such as: plant extracts, traditional herbal medicines, pharmaceuticals, homeopathic, teas obtained from medicinal and aromatic plants, dietary supplements, spices and herbs seasonings used in cooking, flavors and fragrances, cosmetics and body care products, food and beverages, food ingredients, flavors and essences / odorants, coloring / coloring agents, etc. High demand for plants results from high local and international / European market demand.

These species are of major importance for rural economy due to their contribution to agricultural diversification and better use of land, their economic potential and the opportunities they provide for medicines' use diversification. They have been used by local populations in traditional ways for many centuries. Their novelty is thus not related to their introduction to new areas but rather to the ways in which old and new uses are being re-addressed to meet today's needs (https://www.nhp.gov.in/introduction-and-importance-of-medicinal-plants-and-herbs_mtl).

Forests and meadows offer countless opportunities to harvest beautiful flowers and precious medicinal herbs, especially in summer and autumn. Many of these wild herbs are not only suitable for cooking, but also dried in the form of spices or teas, with multiple beneficial effects on the body. Also, aromatic and medicinal plants can be used in herbal baths, aromatherapy, for relaxation, but also for skin care. They can also be integrated into various natural cosmetics, which are enjoying increasing popularity.

"*Green medicine*", as it is called the manufacture of various pharmaceuticals herbal, it is appreciated to have great potential, so medicinal plants have has become the raw material for a whole range of industries such as: chemical, pharmaceutical, cosmetics, food and others.

"*Medicinal plants*", ie those that contribute to regaining health, they have penetrated more and more into the consciousness of mankind as the inexhaustible dowry and which is the main form of healing, although lately their role by allopathic medicine.

Medicinal and aromatic plants are a precious fundamental part of our natural resources. There are more than 35.000 natural herbs species known in nature; among those nearly 2.500 have been widely used and inserted into a world business (FIPPO and Italian Agriculture Ministry). In

the whole world the main producers - as economic providers - of plant species with proved medical effect or aromatic characteristics are China, India, Thailand, Vietnam and the USA. Those countries have effectually managed to process their natural and traditional heritage into a healthy and profitable business.

According to Eurostat, statistical office of EU, within European Union there are about 2.000 different herbal species that are cultivated for their natural properties. Germany is the most important producer in Europe – providing about 1.500 herbal species to the international market. France produces about 900 species, Czech Republic about 300 species, and Hungary 270 species.

Of these, 130-140 plant species are cultivated. This includes species which may be obtained from both cultivated and wild stock (e.g. yellow gentian "*Gentiana lutea*"), and a few which are invariably from cultivated stock (e.g. peppermint "*Mentha x piperita*"). Frequently, cultivation is done under contract to industrial users. Countries with many hectares under cultivation are France, Hungary and Spain. Medicinal and aromatic plant material is traded in most cases in dried form (e.g. Germany: 95%; Albania and Turkey: 100%), and to a small extent fresh, or preserved in alcohol. Plant parts may be traded in their whole form or comminuted e.g. cut, rasped or powdered. In international trade, this plant material is frequently traded whole, or at most coarsely chopped. However, there is a trend towards trading cut plant material.

The structure of medicinal and aromatic plant trade is complex within Europe, and varies from country to country, depending much on whether the country is a consumer (Germany, France, UK, Spain) or a source (Albania, Bulgaria, Hungary, Turkey). In most countries, trade is dominated by a few wholesalers, only. In particular, in eastern and south-eastern European countries, several smaller companies also operate, but for several of them it is not their only business. In producer countries, in general, the plant material is purchased from collectors and cultivators through several middlemen, e.g. district traders, local dealers, or village co-operatives. Medicinal and aromatic plants material is delivered to other wholesalers, the pharmaceutical industry, extract producers, packaging companies, the cosmetic, food and colouring agent industries, and different kinds of retail outlets.

CHAPTER 2

CURRENTS STATUS OF MEDICINAL, AROMATIC AND MELLIFEROUS PLANTS

2.1. Current status of medicinal, aromatic and melliferous plants in the world

Due to its complex nature and multiple uses, (for food as herbs, in phytotherapy, as natural remedies for various diseases, as basic extracts for medicines, uses in alternative medicine, as food supplements, various lotions or other products for hygiene and health, as honey plants), we find them in statistics under different names, such as: medicinal and aromatic plants (MAPs); herbs; honey plants; herbal supplement and remedies; nutraceutical herbs; culinary herbs; spices.

Medicinal and aromatic plants are cultivated or spontaneously grown plant species that, through their chemical composition, have pharmaceutical properties. They are used in natural remedies and treatments in both human and animal therapy.

According to the Food and Agriculture Organization (FAO), the worldwide production of medicinal and aromatic plants is estimated to 330 million tons from a total area of 77 million ha. However, it is not easy to accurately assess how many medicinal and aromatic plants are commercially traded on an international or even on a national level, due to the fact that many of the quantities used or traded are not reported in the statistics (FAO, 2011).

Currently the total global market of Herbal Products and Medicinal Plants is US$ 60 billion with a double digit growth. The diversified use of plant derived products and its acceptance worldwide made the sector very promising one. According to the World Bank Report 1998, world trade in medicinal plants and related products is expected to be US$ 5 trillion by 2050 (https://bpc.org.bd/mphpbpc/).

In Europe, there are over 36,000 companies dealing with the cultivation, processing and distribution of medicinal and aromatic plants with an area exceeding 200,000 ha (Eurostat, 2021).

The World Health Organization's (WHO) strategy, 2014–2023, aims to strengthen the role of traditional medicine, emphasizing the importance of promoting and including the utilization of medicinal plants in the health systems of its member countries (WHO, 2014).

Globally, an estimated 60,000 species are used for their medicinal, nutritional and aromatic properties, and every year more than 500,000 tons of materials from such species are traded (WHO, 2015).

European Plant Conservation Strategy (EPCS) states that 90% of MAP species native to Europe are still collected from the wild.

The Herbal Medicines market in the U.S. is estimated at US$22.8 Billion in the year 2021. The country currently accounts for a 18.4% share in the global market. China, the world's second largest economy, is forecast to reach an estimated market size of US$32.9 Billion in the year 2026 trailing a Compound annual growth rate (CAGR) of 10.8% through the analysis period. Among the other noteworthy geographic markets are Japan and Canada, each forecast to grow at 7.4% and 7.1% respectively for the next 5 years. Within Europe, Germany is forecast to grow at approximately 6.5%, respectively US$35.8 Billion by the end of year 2026 (Global Industry Analysts, Inc., 2021).

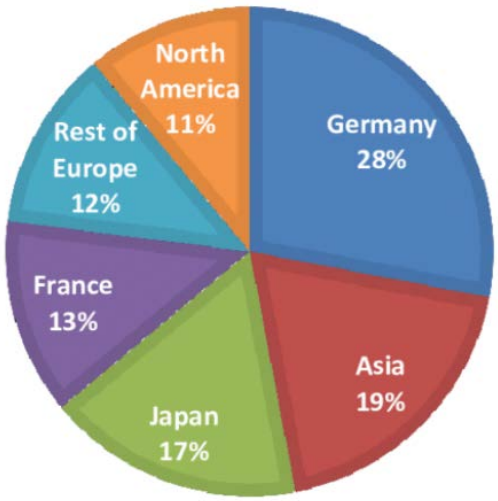


Figura 2.1. Georghraphical disctribution of herbal market
(Source: Global Industry Analysts, Inc., 2021)

The demand for herbal supplements has been predominantly concentrated in the West, due to relatively high levels of health consciousness, and widespread and easy access to products. An ageing population, changing health perception and the threat posed by antimicrobial resistance are driving the demand for herbal supplements and remedies. Major factors driving growth in emerging countries include expanding population base, growing tendency of living healthy among consumers, increasing consumer awareness about wellness and dietary requirements, and growing demand for natural remedies. Growth in the region is supported by cultural affinity to herbalism and strong consumer confidence in the efficacy and safety of herbal ingredients.

The hospital & retail pharmacies segment accounted for the largest market share of 55.82% in 2017 (Market Research Future, 2018).

The global market of medicinal and aromatic plants was $98.60 billion in 2021. For the next 8 years will be over $391 Billions (Figura 2.2).

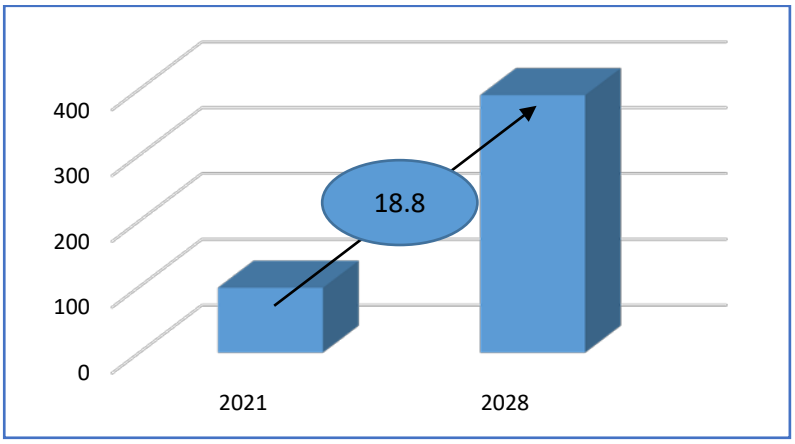


Figura 2.2. Global market of medicinal and aromatic plants (2021-2028) (Billions $)
(Source: https://www.verifiedmarketresearch.com/product/herbal-medicine-market/)

According to table 2.1, it can be seen that the cultivated area has increased steadily in recent years, from over 1.1 Million ha, in 2014 to 1.4 Million ha in 2018. However, the production was lower, due to the less favorable climatic conditions in 2018.

Table 2.1

Currents status of spices at world level
(source: FAO Database, 2021)

Year	Area harvested (ha)	Yield (kg/ha)	Total production (tonnnes)
2014	1,155,281	2,250	2,600,058
2015	1,236,576	1,895	2,343,344
2016	1,285,536	2,063	2,652,359
2017	1,091,366	2,503	2,732,111
2018	1,417,130	1,864	2,642,611

2.2. Current status of medicinal, aromatic and melliferous plants in Europe Union

The European Union is the main market for pharmaceutical ingredients and covers 36% of global pharmaceutical production. About 2000 species of plants are used at European level for medicinal purposes; the main markets are: Germany as the main importer and France and Italy as the main processors and traders of medicinal plants. Among the Eastern European countries, Poland, Bulgaria, the Czech Republic, Hungary and Romania are the main markets; In the

European Union, about 1200-1300 species are harvested from spontaneous flora and only 130 species are cultivated. In Spain, the demand for herbal/natural pharmaceutical products has increased, with Spain being a major producer of aromatic and medicinal plants. In Portugal and Slovakia, the production of aromatic and medicinal plants has increased significantly.

With regard to this market, food safety and, in particular, food safety must be ensured in the light of the dangers that may arise along the food chain such as chemical contaminants in the environment and microbiological contaminants. Contamination can also occur during processing when good production practices are not well implemented. The food chain of aromatic and medicinal plants is a very dynamic process in terms of legislation, new scientific evidence and new knowledge, which must be disseminated to all market players.

In Europe, many of the medicinal plants widely used and marketed do not belong to its historical medical tradition; markets for medicinal plants and related preparations utilise plants and plant products originating from outside Europe or previously consumed only in some parts of the continent. Migrant populations moving into Europe and Central Asia from other regions have also brought their own traditional knowledge and related medicinal practices with them, and evidence suggests that these communities rely largely on plants and plant products imported from their home countries rather than alternatives which occur naturally from their new home regions (Pieroni et al., 2013; Quave et al., 2012).

In Europe there is a significant increase of over 50 thousand hectares for the year 2020 compared to 2019.

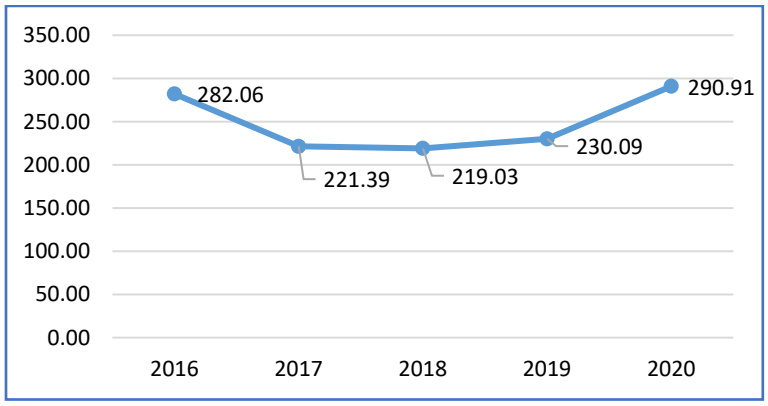


Figure 2.3. Aromatic, medicinal and culinary plants in Europe (Area of cultivation/harvested (1000 ha)) (Source: Eurostat, 2021)

2.3. Current status of medicinal, aromatic and meliferous plants in Agropuzzle 4 projet Partners Countries

2.3.1. Czech Republic

The medicinal, aromatic and meliferous plants are one of the domestic agricultural commodities with a long tradition in Czech Republic and their cultivation provides an opportunity for agricultural diversification.

In 2016, according to the Agriculture Ministry of the Czech Republic, was cultivated on 7,46 thousand ha, and in 2017, a relatively significant increase in the area, by up to thousandmore ha (https://eagri.cz/public/web/file/581592/ publikace_ MZe_ 210x210mm_ ENG .pdf).

According of Eurostat database, in 2019, the area cultivated with medicinal and aromatic plants in the Czech Republic was only 5.6 Thousand ha compared to 2020, when the area increased to 7,25 thousand ha (Figure 2.4).

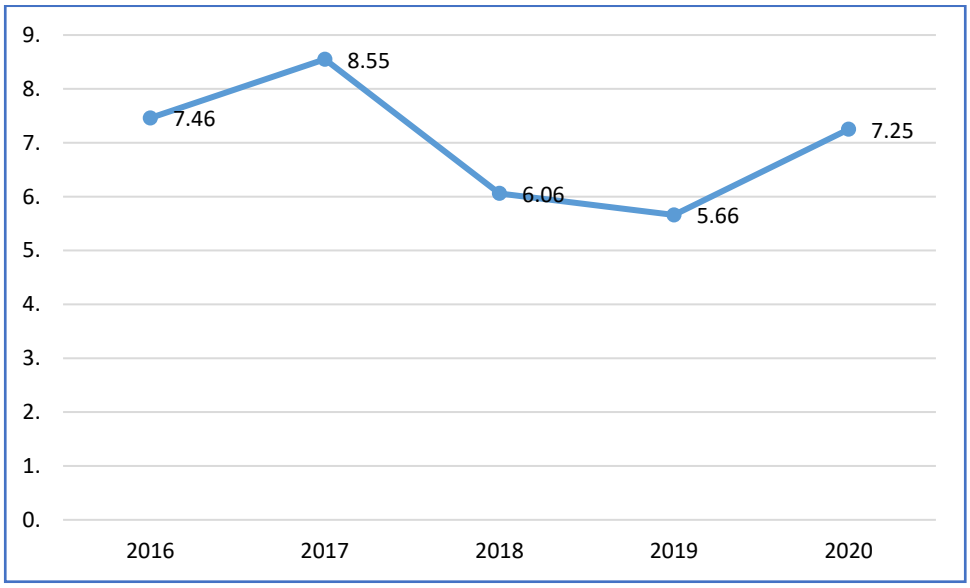


Figure 2.4. Aromatic, medicinal and culinary plants in Czech Republic (1000 ha) (Source: https://ec.europa.eu/eurostat/databrowser/)

2.3.2. French Guiana

In French Guiana (overseas territory belonging to France), agriculture is largely undeveloped and is mainly confined to the area near the coast of Indian Ocean and along the rivers. Due to this aspect, as well as due to the climate and the specificity of the landscape,

there are no official statistics on the areas cultivated with medicinal and aromatic plants or honey in French Guiana.

In French Guiana, traditional phytotherapies are an important part of self-healthcare, however, a precise understanding of the interactions between local phytotherapies and biomedicine is lacking (Odonne et al., 2021).

The gathering of medicinal plants in French Guiana is a relatively unknown practice, underestimated and often perceived as an anecdotic or insignificant one. However, everyday people can be seen harvesting plants on the road sides, for their own needs or in small proportions, for selling (Tareau et al., 2019).

2.3.3. Poland

The medicinal and aromatic plants are an important part of traditional medicine in Poland. Polish agriculture has the largest area of the cultivation of herbal plants in Europe, over 74 thousand ha, in 2021 (Eurostat, 2021).

The number of producers fluctuates at about 20,000 farms a year. They operate specialized, controlled plantations, according to the requirements set by the contracts with food processing companies. Growing herbs is an important part of the production structure, a source of complementary income. It also supports the diversification of agricultural activities of individual farms (Spychalski, 2013).

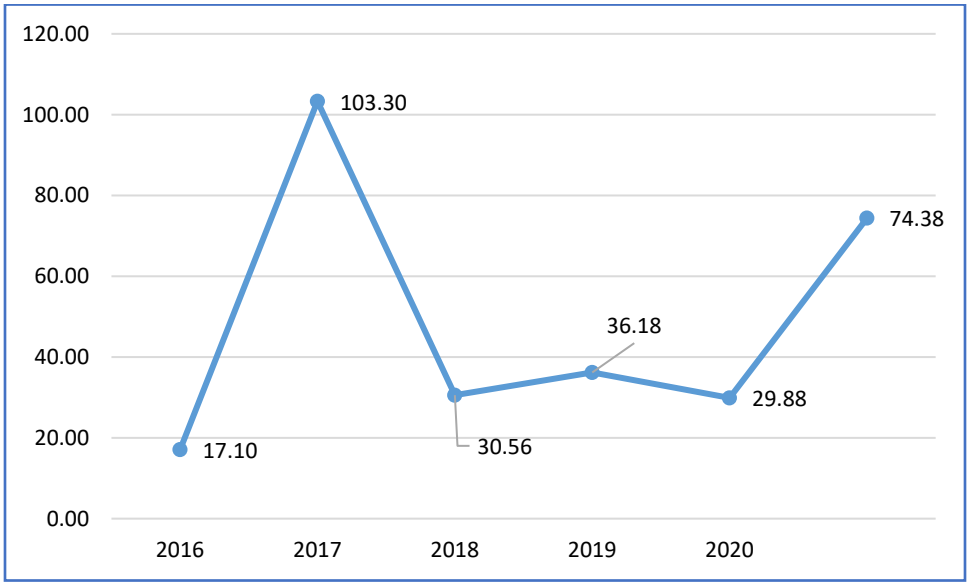


Figure 2.5. Aromatic, medicinal and culinary plants in Poland (1000 ha) (https://ec.europa.eu/eurostat/databrowser/)

2.3.4. Portugal

While Portugal is a Mediterranean region due to its edaphoclimatic conditions, the country has a high phytodiversity and inherent resources with a high potential for medical purposes (Cunha et al., 2011). For a long time, people from Portuguese regions have been living in particular ecological and socioeconomic conditions and relying on interactions between natural environment and traditional farming systems, which enabled an adaptative resource management, enhanced local knowledge on plant-use, allowing the survival of a rich and interesting folk medicine (Carvalho et al., 2012).

The current situation of medicinal plants in Portugal is very limited, and there are no FAO or Eurostat statistics on the current status of cultivation areas. But, according to figures provided by the Ministry of Agriculture the farms increased considerably from 2009 to 2012, with an increase from 80 to 180 hectares in farms area. Also, it was possible to observe an increase in the number of producers from 93 to 147 producers (Ministry of Agriculture, 2013).

2.3.5. Spain

Spain is one of the richest countries in plant diversity along the Mediterranean basin, and many representatives of the Spanish flora are medicinal plants (Draper at al., 2016).

The area cultivated with medicinal and aromatic plants shows that in 2020 the area was over 23 thousand ha, which means it increased by about 15 thousand ha, compared to 2015 (Figure 2.6).

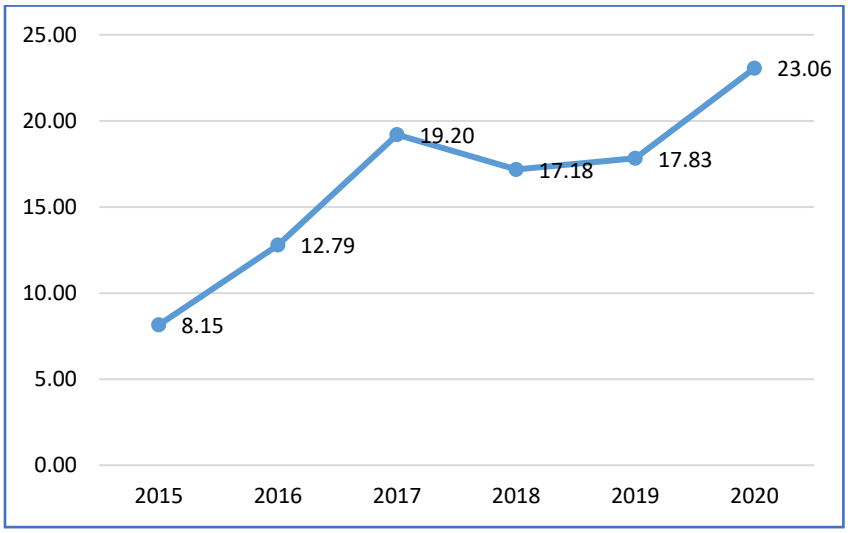


Figure 2.6. Aromatic, medicinal and culinary plants in Spain (1000 ha) (https://ec.europa.eu/eurostat/databrowser/)

2.3.6. Romania

In Romania, there is a long tradition of using medicinal and aromatic plants. But according to data provided by the Ministry of Agriculture and Rural Development, the medicinal and aromatic plants sector is not sufficiently exploited at this time, although it has enormous potential.

So, the area cultivated with medicinal and aromatic plants in Romania ranged between 3.2 thousand ha in 2008 and 1.8 thousand ha in 2020 (Figure 2.7).

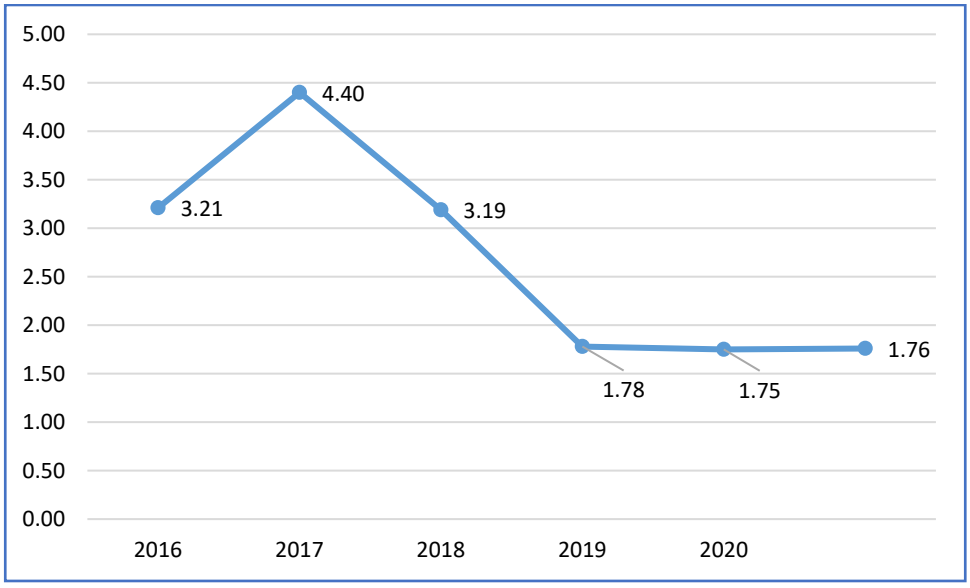


Figure 2.7. Aromatic, medicinal and culinary plants in Romania (1000 ha) (https://ec.europa.eu/eurostat/databrowser/)

CHAPTER 3

CLASSIFICATION OF AROMATIC AND MEDICINAL PLANTS

The number of plant species which have at one time or another been used in some culture for medicinal purposes can only be estimated. An enumeration of the World Health Organisation from the late 1970s listed 21,000 medicinal species (Penso, 1980). However, in China alone 4,941 of 26,092 native species are used as drugs in Chinese traditional medicine (Duke and Ayensu 1985), an astonishing 18.9%. If this proportion is calculated for other well-known medicinal floras and then applied to the global total of 422,000 flowering plant species (Bramwell, 2002; Govaert, 2001), it can be estimated that the number of plant species used for medicinal purposes is more than 50,000 (Schippmann at al., 2002).

Medicinal and aromatic plants can be classified according to several criteria, such as: therapeutic effect and uses, lifespan, etc. However, the most widely used method of classification is the *botanical family*, which corresponds to the *International Code of Nomenclature for algae, fungi, and plan*. The *International Code of Nomenclature for algae, fungi, and plants* is the set of rules and recommendations that govern the scientific naming of all organisms traditionally treated as algae, fungi, or plants, whether fossil or non-fossil, including blue-green algae (*Cyanobacteria*), chytrids, oomycetes, slime moulds, and photosynthetic protists with their taxonomically related non-photosynthetic groups (but excluding *Microsporidia*). Before 2011 it was called the *International Code of Botanical Nomenclature* (ICBN) (https://www.iapt-taxon.org /nomen/ main.php).

The most well-known medicinal and aromatic plants (latin name and common name) belong to these families (in alphabetic order):

- *Apiaceae (Umbelliferae) Family*
  - *Carum carvi (cumin, caraway)*
  - *Foeniculum vulgare (fennel)*
  - *Coriandrum sativum (coriander)*
  - *Pimpinella anisum (anise)*
  - *Angelica archangelica (angelica)*

- *Asphodelaceae Family*
  - *Aloe vera (aloe)*
- *Asteraceae (Compositae) Family*
  - *Matricaria chamomilla (chamomile)*
  - *Calendula officinalis (marigold)*
  - *Echinacea angustifolia, E. pallida, E. purpurea (echinacea)*
  - *Artemisia absinthium (wormwood)*
  - *Cichorium intybus and C. spinosa (chicory)*
  - *Silybum marianum (milk thistle)*
  - *Cynara scolymus and C. cardunculus (artichoke)*
  - *Artemisia dracunculus (tarragon)*
  - *Cnicus benedictus (St. Benedict's thistle, blessed thistle, holy thistle)*
  - *Tagetes patula (pots)*
  - *Centaurea cyanus (centaury, centory, starthistles, knapweeds, centaureas)*
  - *Arnica montana (mountain arnica)*
  - *Taraxacum officinalis (dandelion)*
  - *Achillea ptmarmica (sneezewort yarrow)*
  - *Achillea mellifolium (yarrow)*
  - *Inula helenium (gass-seaweed)*
  - *Helichrysum stoechas (everlating flower)*
  - *Santolina chamaecypariussus (cotton lavander)*
- *Bixaceae Family*
  - *Bixa orellana (lipstick tree, annatto)*
- *Brassicaceae (Cruciferae) Family*
  - *Sinapis alba (white mustard)*
  - *Brassica nigra (black mustard)*
  - *Capsella bursa pastoris (shepherd's purse)*
- *Boraginaceae Family*
  - *Symphytum officinale (common comfrey)*
  - *Echium vulgare (snake's tongue)*
  - *Borago officinalis (borago)*

- *Pulmonaria officinalis (candle)*

➢ *Caryophyllaceae Family*

- *Saponaria officinalis (soap dish)*
- *Gypsophila paniculata (bride's veil, crotch)*

➢ *Caprifoliaceae Family*

- *Succisa pratensis (Devil's bit scabious)*

➢ *Cucurbitaceae Family*

- *Momordica charantia (bitter melon)*

➢ *Ericaceae Family*

- *Ledum palustre (wild rosemary)*
- *Vaccinum myrtillus (blueberry)*

➢ *Fabaceae (Leguminosae) Family*

- *Glycyrrhiza glabra (licorice)*
- *Trigonella foenum-grecum (fenugreek)*
- *Robinia pseudacacia (acacia)*
- *Sophora japonica (Japanese acacia)*
- *Laburnum anagyroides (yellow acacia)*
- *Galena officinalis (galena)*

➢ *Hyperaceae Family*

- *Hypericum perforatum (St. John's wort)*

➢ *Lamiaceae (Labiatae) Family*

- *Mentha piperita (mint)*
- *Mentha crispa (created mint)*
- *Lavandula angustifolia (lavender)*
- *Lavandula hybrida (lavandin)*
- *Melissa officinalis (mellisa, lemon balm)*
- *Salvia officinalis (sage)*
- *Salvia sclarea (clary, clary sage)*
- *Betonica officinalis (Stachys officinalis) (purple betony)*
- *Dracocephalum moldavica (Moldavian dragonhead)*
- *Hyssopus officinalis (hyssop)*

- *Origanum majorata (Marjorana hortensis) (marjoram)*
- *Thymus vulgaris (thyme)*
- *Satureja hortensis (thyme)*
- *Satureja montana (winter savory, mountain savory)*
- *Nepeta cataria (handcuffs)*
- *Ocimum basilicum (basil)*
- *Rosmarinus officinalis (rosemary)*
- *Lamium album (white nettle)*
- *Origanum vulgare (oregano)*
- *Thymus serpilum (field thyme)*
- *Glechoma hederacea (gill-over-the-ground)*
- *Marrubium vulgare (horehound)*
- *Plectranthus forsteri cv marginatus (Swedish Ivy)*

➢ *Malvaceae Family*

- *Althaea officinalis (mallow)*
- *Althaea rosea (garden mallow)*
- *Malva glabra (field mallow)*

➢ *Menyspermaceae Family*

- *Tinospora crispa (brotowali)*

➢ *Myristicaceae Family*

- *Myristica fragrants (mallow)*

➢ *Myrtaceae Family*

- *Syzygium aromaticum (cloves)*

➢ *Papaveraceae Family*

- *Papaver somniferum (poppy, garden poppy)*
- *Papaver bracteatum sin. P. orientale (Iranian poppy or Persian poppy)*
- *Papaver glaucum (tulip poppy)*
- *Glaucium flavum (yellow poppy)*

➢ *Plantaginaceae Family*

- *Plantago lanceolata (ribwort plantain)*
- *Plantago major (greater plantain)*

- *Ranunculaceae Family*
  - *Aconitum napellus (monk's-hood, aconite wolfsbane)*
  - *Nigella sativa (black caraway, black cumin, nigella kalonji)*
  - *Adonis vernalis (spring beetle)*
- *Rosaceae Family*
  - *Agrimoria eupatoria (common agrimony)*
  - *Aruncus dioicus (goat's beard)*
  - *Rosa damascena (roses oil)*
  - *Filipendula ulmaria (meadowsweet)*
  - *Crataegus monogyna (hawthorn)*
- *Scrophulariceae Family*
  - *Digitalis purpurea (red finger)*
  - *Digitalis lanata (woolly finger)*
- *Solanaceae Family*
  - *Atropa belladonna (deadly nightshade)*
  - *Solanum laciniatum (australian rattlesnake)*
  - *Datura innoxia (pricklyburr, recurved thorn-apple, downy thorn-apple, Indian-apple)*
  - *Datura stramonium (thorn apple, jimsonweed)*
  - *Hyoscyamus Niger (henbane, black henbane)*
- *Valerianaceae Family*
  - *Valeriana officinalis (valerian)*
- *Violaceae Family*
  - *Viola arvensis (European field pensy)*
- *Zingaberaceae Family*
  - *Alpinia zerubet (pin porcelain lily, shell ginger)*
  - *Curcuma longa (Indian saffron, turmeric, curcumin)*
  - *Zingiber officinale (ginger)*
  - *Elattaria cardamomum (green cardamon)*

CHAPTER 4

ACTIVE PRINCIPLES OF AROMATIC AND MEDICINAL PLANTS

The active ingredients (active substances) present in medicinal plants are those that give the therapeutic effect. They can be products of the primary metabolism of carbohydrates, resulting from the process of photosynthesis or products of the secondary metabolism of plants, nitrogen metabolism.

Each plant is in principle of interest for a certain active substance, which can be isolated by industrial processes being accompanied by a complex of substances, and the therapeutic effect is complex. Examples of active ingredients include: alkaloids, glycosides, saponins, bitter principles, tannins, aromatic substances, volatile or essential oils, fatty oils, vegetable mucilages, antiseptics.

Alkaloids. Alkaloids are compounds that contain nitrogen, have an alkaline reaction, and are very strong poisons. They are used in pure medicine after industrial extraction. There are recommendations for direct extraction from plant material by percolation. In therapy they are used in extremely small doses, they have a beneficial effect, but when the dose is higher they can become poisons. The pharmaceutical forms in which they are found are: tablets, dragees, suppositories, ampoules for injections, such as: Scobutyl, which is based on scopolamine extracted from hairy laurel plants. Other examples of alkaloids present in plant material are: colchicine from cranberry root, or capsaicin from hot pepper. Also, morphine, codeine, papaverine, from poppy seeds, as well as the complex of alkaloids in the drying horn: ergotoxin, ergotamine, ergometrine, are of interest for their beneficial effect in regulating heart rate and relieving pain. Other alkaloids, such as fenugreek trigonelline, are used as an aphrodisiac condiment and for dressing wines, and atropine of *Atropa belladonna* is used to detect eye conditions.

Glycosides (Glucosides). They are substances resulting from the secondary metabolism of nitrogen and which have the role of ensuring the transport and penetration into the body of a compound called aglycone which gives the therapeutic effect. *Thioglycosides* are substances characteristic of *Brassicaceae* species, which appear in horseradish root, in white or black mustard seeds, and are accompanied by an enzyme, which decomposes them after consumption and thus highlights the spice. Hydrocyanic acid derivatives under the action of saliva release the acid and with it comes the specific aroma but also a certain toxic effect, such as: bitter almonds, pigeon

flower, shock flower, cherry fruit or cherry. *Cardioglucosides* are important in therapy, having a beneficial effect on heart rate. But substances in plants, such as woolly finger and red finger, are particularly strong poisons for growers, any contact with plants gives allergic symptoms.

Saponins. They are complex substances with a glycoside-like structure. The main property of saponins is that they greatly reduce the surface tension of water, have a foaming effect and produce emulsions. Saponins are usually present in plants such as: the bride's soap and veil, red thistle or white thistle. When introduced into the body, these substances lead to the rupture (hemolysis) of red blood cell cells, release hemoglobin, and the effect is to irritate the mucous membranes, to cause the relaxation of intestinal muscles, to increase bronchial secretion, having an expectorant, diuretic and urinary tract disinfectant. It exists in the birch leaf, in the ginseng root.

Bitter principles. They are substances that are found in a large number of plants, have a bitter taste, excite taste cells, stimulate appetite and the secretion of gastric juices. From a chemical point of view, they have a complex composition that includes some glycosides. They can be used in the form of plant juice as such, for example: wormwood used to make wormwood wine or to straighten wines, as a preservative. It can also be used to correct the aroma of some drinks, entering the herbal mixtures for vermouth, consumed as an appetizer such as absinthe. But when consumed in large quantities it leads to addiction having a toxic effect on the body, as well as benedictine obtained from *Cnicus benedictus*.

The tannins. They are substances with a very different chemical composition and have the characteristic of coagulating albumin, heavy metals and alkaloids. They have an antitoxic effect and are soluble in water. By coagulating the albumen, the bleeding is stopped and the healing and healing of the wounds is favored. Tannins are present in walnut leaves, oak bark, blueberry leaves and fruits, raspberries or blackberries. As a therapeutic effect it is distinguished by treating inflammations of the oral cavity, bronchitis, burns, frostbite in plaques, excessive sweating. They can also be used as an antidote to plant alkaloid poisons.

Aromatic substances. They have a very different chemical composition and can be used for flavoring various medicinal preparations through their specific therapeutic effect. Thus, chestnut esculin has a beneficial effect on blood vessels, varicose veins, hemorrhoids, or is used as a sunscreen in specific lotions and creams for skin protection. Routine, present in blueberries, but also in raw buckwheat shoots, has a therapeutic effect on blood vessel sclerosis. Also, silymarin

present in the fruits of armurariu and hawthorn, has an effect on liver function, regenerating the sclerotic cells of the liver after hepatitis or other bile problems.

Volatile oils (essential oils, essential oils). They are volatile liquids with a characteristic odor, which exist in a very large number of plants being produced in specific tissues. They can accumulate in all the organs of the plant and can be extracted by several methods, but usually the plant material is distilled with water vapor. The volatile oil in a certain plant has a specific aroma of that plant, it contains a complex of substances, but only a certain substance is specific. For example: in mint the main component of the volatile oil is menthol, in thyme it is thymol, in dill it is anethole, in lavender it is linalool, for lemon balm it is citral. Volatile oils are used to obtain perfumes in cosmetics, but also to correct the taste and aroma of some medicines. Volatile oils have a disinfectant, bactericidal effect, irritate the mucous membranes, have an expectorant effect, disinfect the respiratory and digestive tract, including liver function, can be used as flavorings in the kitchen or in the manufacture of sausages, have antirheumatic effects. They have the disadvantage that they are difficult to store in completely closed containers, in the dark, because they oxidize in light.

Lipids, present in some species or in their seeds, at ambient temperature are solid, insoluble in water and soluble in organic solvents. The therapeutic effect and uses are also related to the manufacture of various creams for external treatments. Vegetable oils may also be used as a solvent for other substances or may contain other substances with a therapeutic effect (castor oil).

Vegetal mucilages. They are polysaccharides, which in the presence of water swell, form gels, and if the water is hot they form colloidal substances, they gel after cooling. In the plant they have the role of retaining water. The therapeutic effect is to reduce irritation, inflammation of the mucous membranes, alleviate pain in contusions, having a diuretic effect. Examples of plants in which such substances are found include: mallow leaves and roots, flax seeds, presented in various forms of pharmaceutical preparations used and as gastric bandages.

Plants antiseptics. They are substances with antibiotic, antimicrobial effect, they are quite unstable from a chemical point of view, because they are very volatile. They can act in the form of aerosols, in the respiratory tract, such as: plantain, various conifers, onions, garlic. They are heterogeneous in terms of chemical composition, are nitrogen-free and have a disinfectant, antioxidant and flavoring effect.

CHAPTER 5

GENERAL ASPECTS REGARDING HARVESTING MEDICINAL AND AROMATIC PLANTS

Harvesting is done according to the species, the plant material, so as to obtain a maximum of active substances from the plant. According to the specialized literature on aromatic and medicinal plants, ***the production*** represents the obtaining by cultivation or harvesting from the spontaneous flora of the medicinal and aromatic plants, and the producer is the natural or legal person who cultivates medicinal and aromatic plants; ***processing*** is the ***conditioning*** of medicinal and aromatic plants in: teas, natural spices, as well as in raw materials for processing; *processing* is the transformation of raw materials obtained by processing into products that are sold: medicines, cosmetics, nutritional and dietary supplements, food flavoring additives.

Because the effectiveness of the phytotherapy of medicinal and aromatic plants is based on the relationship between active substance and therapeutic action, of prime importance is the quality of the plant material from which the various preparations will be prepared. For each plant and for each organ of the plant or therapeutic use, two important aspects are important at harvest, namely:

- ***The optimum time of harvest***, so that the plant material contains the maximum amount of active ingredients; strict rules are formulated, there is the possibility that it can be expressed in calendar, by seasons and even month, phase of vegetation or the time of day when it can be harvested; also in connection with the time of harvest, the time of day and the meteorological conditions when harvesting are to be taken into account. In general, medicinal and aromatic plants are harvested in dry weather, in the morning, after the dew has risen, or in the afternoon, until sunset. Medicinal plants containing volatile oils should be harvested especially in the morning, before sunrise.
- ***The harvesting methods*** refers to the harvesting action itself, which can be mechanical or manual and which aims to keep the harvested material to its maximum active principles; In order to protect perennial medicinal and aromatic plants and to ensure the perpetuation of the species, certain rules of great importance for the coming years must be taken into account when harvesting.

Harvesting is done differently depending on the species, the organ of the plant and the season.

Harvesting of underground organs (Radix, Rhisoma, Tuber, Bulbus). They are usually harvested in autumn, after the aerial part has withered, so after the vegetation has ceased, in good weather, when the soil is rejuvenated. In the underground organs accumulate reserve substances necessary for the passage of winter and for the start of vegetation of the plants, in spring and in the following years. Some of the substances migrate to the underground parts and these become valuable at full maturity. There are extreme situations when we cannot harvest in the fall due to bad weather, and then we can harvest in the very early spring, when the weather allows, before the vegetation resumes. Harvesting for underground organs should be done from 2-3 year old plantations. Examples of plants from which we harvest underground organs are: valerian, iris, Jerusalem artichoke, mallow.

Harvesting of air organs

Buds (Turionnes, Gemmae). It is harvested in late winter or early spring, in February or March, when the buds have swelled, but it is mandatory before they open. They are easily detached manually from the branches and it is desirable that the branches be cut first and then the buds are detached. In this way the mother plant is taken care of. Examples of species from which we harvest buds are: pine, willow, poplar, fir, spruce.

Cortex. It is usually harvested in the spring, during flowering or shortly before the flowers open (May). The bark is detached from the branches for 1-2 years, being careful not to destroy the plant. Examples: oak, cinnamon.

Whole plant (Herba). It is recommended that it be harvested at the beginning of flowering, when the plants contain volatile oil, the pruning should be done without bumps or shocks. The work can be done by cutting with a sickle, scissors, or by hand mowing with a scythe or mowing equipment. Examples: mint, lemon balm, basil, thyme.

The leaves (Folia, Folium). It is harvested at the beginning of flowering, when the leaves have reached their maximum size. We do not have to harvest all the leaves from one shoot at a time, because we can stop the vegetation of the plants. It is harvested in stages, first at the base and later at the top.

There are two methods of harvesting the leaves, namely: by pinching or turning. By pinching, the petiole is broken, leaf by leaf, obtaining a material of the best quality. By turning, the shoots are passed by hand, the harvest yield is higher, but the plant material breaks and there are large losses of active ingredients.

Flowers (Flores, Flos). Harvesting of flowers for some species should be done just before opening (acacia), and for others containing volatile oils, when they are fully open. If the flowers wither, they no longer contain volatile oils or other active ingredients in the same proportions and there are qualitative crop losses. Various optimal harvest times are recommended depending on the species; thus, for chamomile and marigold, the harvest will be done when the ligulate flowers have a horizontal position; and corn silk should be harvested after fertilization, so after the withering of the silk.

Fruits and seeds (Fructus, Semen). These will be harvested at full maturity. The fruits are harvested in batches (rosehips, armurariu), when they contain a maximum of vitamins, carbohydrates, pectins, then followed by drying and ripening in storage, and others when they have reached full ripeness (blueberries).

The seeds are harvested shortly before ripening, at low humidity, then immediately spread for drying in thin layers.

CHAPTER 6

TRANSPORTATION, CONDITIONING AND DRYING OF MEDICINAL AND AROMATIC PLANTS

After harvesting, ***the vegetal material must be transported*** immediately, using special means of transport for this operation. Various packaging can be used: crates, boxes, tarpaulins, so that the harvested material is not damaged, and also all operations must be carried out under very strict hygiene conditions.

For the use of medicinal plants as such in the form of teas or as a raw material for the production of various pharmaceutical preparations, the plant material must be as high as possible. This is done by ***pre-cleaning and pre-conditioning the harvested material***. Thus, all impurities, plant debris or soil, seeds or weed fragments, or plants attacked by disease or pests must be removed.

Figure 6.1. Pre-cleaning and pre-conditioning the harvested material in Portugal (original)

The next most important operation for obtaining and preserving a good quality plant material is ***drying***. All vegetable raw materials are dried immediately after harvest. For industrial purposes or in case of bad weather, drying is done in solariums or in special dryers. For use in home pharmacy, the plants are cut into small pieces immediately after harvest and can be dried in well-ventilated attics, laid out on clean sheets of paper, mats or tarpaulins.

For the plant material used for teas it is necessary that there are no changes in the external appearance or in the chemical composition, as a result of drying. It is also important to observe the drying temperature and to avoid contact of the plant material with sunlight. The drying of the vegetal material must be done in thin layers, in order to avoid the heating and degradation by temperature increases.

There are several types of drying material depending on the drying agent used.

Natural drying in the sun is a traditional method that allows, in the hot season, the rapid, economical evaporation of water from plant material. It is used for the material with hard tissues (roots, seeds, grass), provided that it contains the most stable active principles (alkaloids, glycosides).

Natural drying in the shade is the most suitable method for any type of plant material. Drying yields vary depending on the species and the organ of the plant, but also on the area required for drying. Thus, the drying yield is for 5: 1 grass, for 3: 1 roots, for 3: 1 fruit for 1.2-1.5: 1 seeds. For 1 m² of space are needed: 2-3 kg of roots , 3-4 kg seeds, 1-2 kg grass, or 0.5-1 kg flowers or inflorescences.

Figure 6.2. Natural drying of seeds in Romania (original)

Artificial drying. The lack of space for natural drying, the technological requirements of some species, the large quantities of products harvested in the fields, as well as the atmospheric

conditions (fog and precipitation) from certain periods require in many cases the drying of plants in special dryers. This special equipment called dryers is fueled. Equipment equipped with photovoltaic cells is being expanded, using solar energy as a drying agent. During the drying operation it is necessary to know the drying temperature for each plant or organ of the plant. Thus, for the vegetal material containing volatile oil, the drying temperature is maximum 30-40ºC, (mint, basil, thyme), and for the plants containing alkaloids (red finger, woolly finger, mallow) the drying temperature is 35- 45°C.

Figure 6.3. Artificial drying of seeds by drying machine in Portugal (original)

After drying, the vegetable ***material will be packed in paper bags or cloth bags or in cardboard boxes***, in no case in plastic packaging. Store at room temperature, in a clean place, protected from direct sunlight, without high humidity, protected from insects and rodents.

For the use of medicinal plants as such or as tinctures, extracts or other preparations, they must be of the highest possible purity. Medicinal plants from industrial areas or from land where chemicals, weeds or pests have been controlled shall not be used.

Figure 6.4. Storage of medicinal and aromatic plants in Portugal (original)

CHAPTER 7

EXTRACTION OF VOLATILE OIL

Plant Volatile Oils have been used for over 5,000 years, due to their therapeutic effect on the nervous system, muscle, or other organs in the human body.

These oils can be extracted from various organs of the plant or from the whole plant. They can be used for massage, baths, vaporization, inhalations, drops, washes or more recently in aromatherapy. Aromatherapy is a complementary therapy based on the treatment of diseases with the help of volatile oils.

Volatile oils have an antibacterial disinfectant role, refreshing the air of a room, stimulating certain organs, digestion and labor. Volatile oils should not be used without a doctor's advice, as they can cause serious health problems: high blood pressure, loss of pregnancy. They will not be used directly on the skin, but only by evaporation, using a special lamp for aromatherapy.

The content in these substances depends on the phenophase in which the plant is located, on the pedoclimatic conditions and on the applied culture technology.

Examples of uses of various oils can be:

- Lavender oil is an excellent antiseptic, reducing the microbial flora of wounds. It can be taken in the form of warm baths, taken an hour before bedtime, because it has sedative effects on the nervous system and soothes the pain caused by migraines;

- rose oil is highly sought after for its highly flavored fragrance, used especially in perfumery or cosmetics;

- peppermint oil is used as a deodorant for rooms, mouth, corrects unpleasant taste and smell, can also be used as mouthwash.

Extraction of volatile oils

The best method of obtaining a quality volatile oil is pressing, but this process could not extract the entire amount of plant material.

In common practice, the extraction of volatile oils is done either by steam distillation or with the help of various organic solvents.

Steam distillation is a common method of obtaining volatile oils and can be used for most medicinal and aromatic plants. This method is based on the property of oils to turn into steam when heated to boiling. Thus, the fresh or dried vegetable material is placed in a container (boiler) over

which water is poured. By heating, the water extracts volatile oils from the plant tissues, which are transformed into vapors, are passed on through a generator, condense, and the resulting liquid is collected in a separating vessel (Florentine vessel). The water will remain at the base of the vessel because it is denser, and the lighter volatile oil will be on top.

Due to the high energy consumption, and due to the fact that a large amount of water has to be evaporated, this method has been replaced by the one with ***superheated and pressurized water vapor***. The vapors are introduced into the container in which the plant material is present, destroying the tissues containing the oil, entraining the volatile oils and then the process is carried out as in the method presented above. In this way, energy consumption is lower and the resulting water can be reused. There are batch distillation plants that use fixed boilers, but also mobile boilers. Another method of extracting oils is to ***macerate the plant material*** in another vegetable oil (for example, sunflower oil). Thus, the vegetable material containing volatile oil is placed in a container, the vegetable oil is introduced, and then it is left to soak for 5-6 days. The result is a mixture of vegetable oil with volatile oil, which can be used as such for various ailments or absolute ethyl alcohol can be added and then the resulting preparation can be used for rubbing.

Figure 7.1. Distillery of medicinal and aromatic plants in Spain
(Palentica de Aromaticas Cooperatives, 2021) (original)

CHAPTER 8

THE MELLIFEROUS VALUE OF MEDICINAL AND AROMATIC PLANTS

Melliferous plants are plants that produce nectar and are visited by bees that turn nectar into honey. In general, all plants that are pollinated by insects produce nectar to attract them. The production capacity of honey plants is expressed in the form of the amount of honey that can be obtained from one hectare cultivated with that plant, on average; In any case, honey production depends very much on the weather during the harvest period, as well as on the variety of cultivated plant - for example, some sunflower hybrids are much less productive than others.

Aromatic plants or Herbs or Spices are used in cooking to give them a specific taste.

All herbs are an important source of vitamins, minerals and essential oils rich in antioxidants. Most herbs also have medicinal and therapeutic properties.

Aromatic and medicinal plants can be of great importance for beekeeping, due to their honey potential. This group includes a whole series of species, both cultivated plants and species of spontaneous flora that have an important economic-beekeeping weight.

The life of bees is in permanent contact with the plant world because they, in different stages of development, both in the adult phase and in the brood phase, feed exclusively on plant products, nectar and manna, as energy substances, and pollen as a protein substances and minerals.

These species of plants that, through nectar secretions, pollen and hand secretions, provide bees with the raw material necessary to maintain and develop their families, are called honey plants.

In order to practice pastoral beekeeping and superior capitalization of existing honey resources, it is necessary to know more about the main honey species, their flowering period and their nectar-pollen capacity, as well as practical ways to improve them.

The honey bees forage is provided by:

- Pollen plants that provide bees only pollen being in very small numbers.
- Nectariferous plants offer bees exclusively nectar: *Vicia cracca*, *Cirsium rivulare*, and so on.
- Nectar-polleniferous plants provide both nectar and pollen, being the most widespread, being of the greatest beekeeping importance. Examples: *Acacia* sp., *Vaccinium myrtillus*,

Taraxacum officinalis, Tillia sp., *Acer pseudoplatanus, Helianthus annuus, Brassica oleifera, Sinapis alba,* etc.

The main food sources for bees are nectar and flower pollen. Bees also harvest sweet secretions from the extrafloral glands arranged on different parts of the plant as well as manna - a product of the excretion of insects that feed on the sap of the plants they parasitize. of time. Functional changes have occurred on both sides, with plant adaptations to attract pollinators, and bees have adapted to suckling and licking nectar and collecting pollen.

In other words, success in beekeeping depends on the beekeeper's ability to to use the most appropriate technologies to obtain the strongest and healthiest families, of high biological value and to make the best use of the honey flora. On the other hand, the environmental factors play an essential role because they influence the level of plant secretions.

The name nectar was given by J. Ruelius in 1543 and was adopted in biology in 1583 by A. Caesalpini. The nectar is secreted by special organs called nectaries or nectarines. The nectaries can be floral or extrafloral, depending on where they are located, in flowers or outside them. Floral nectars can be housed in different areas of the flowers depending on the plant species. The secretory function of the nectar glands enters into activity immediately after flowering and lasts until pollination takes place: petiole (cherry, apricot) and is generally of little importance for beekeeping.

Nectar secretion and production vary depending on: plant (species, variety, variety, plant age, flowering stage, etc.); soil (chemical composition, degree of fertility, humidity, groundwater level, applied agrotechnics, etc.); weather conditions.

According to the honey potential, the plants from our country were grouped in 5 categories, of which only the first three are of interest:

- plants with a very high importance for apiculture: acacia, lime, sunflower, raspberry;

- plants with a high importance for apiculture: coriander, mustard, fly, jugastria, willow, other species of acacia, spruce, fruit trees, pumpkins, etc.

- plants with a low importance for apiculture that provide only maintenance crops: artichoke, clover, spontaneous flower, flax, etc.

Table 8.1

Some examples of aromatic, medicinal and meliferous plants and the maximum quatity of honey per ha (source: Ion et al., 2008)

Latin name	*Flowering month*	*Nectar, Pollen, Manna*	*Estimated honey production (kg/ha)*
Tilia tomentosa	6 - 7	N, P	1200
Robinia pseudacacia	5 - 6	N, P	1000
Tilia cordata	6 - 7	N, P	1000
Tilia platyphyllos	6 - 7	N, P	800
Phacelia tanacetifolia	5 - 10	N, P	300-1000
Asclepias syriaca	7 - 8	N, P	600
Acer tataricum	5 - 6	N, P	300-600
Echium vulgare	6 - 9	N, P	380-400
Dracocephalum moldavica	7 - 8	N, P	300-400
Melillotus albus	7 - 9	N, P	200-500
Epilobium angustifolium	7 - 8	N, P	100 - 600
Sophora japonica	7 - 8	N, P	300-350
Coriandrum sativum	6 - 7	N, P	100-500
Acer campestre	5 - 6	N, P, M	200-400
Salvia officinalis	7 - 8	N, P	300
Leonurus cardiaca	7 - 8	N, P	200-400
Salvia pratensis	5 - 7	N, P	280
Cynara scolymus	7 - 9	N, P	150-400
Borago officinalis	6 - 7	N, P	250-300
Gleditschia triacanthos	6	N, P	250
Acer pseudoplatanus	4 - 5	N, P, M	200-300
Melilotus officinalis	7 - 9	N, P	150-300
Mentha aquatica	6 - 10	N, P	220
Onobrychis viciaefolia	6 - 8	N, P	120-300
Thymus serpyllum	6 - 10	N, P	200
Taraxacum officinalis	4 - 10	N, P	200
Stachys officinalis	5 - 7	N, P	100-200
Mentha piperita	7 - 8	N, P	100-200
Acer platanoides	4 - 5	N, P, M	100-200
Stachys annua	7 - 9	N, P	120-150
Stachys palustris	7 - 9	N, P	100-150
Melissa officinalis	6 - 8	N, P	100-150
Rubus idaeus	6 - 8	N, P	50-200
Trifolium hybridum	5 - 10	N, P	120
Medicago sativa	5 - 10	N, P	25-200
Ocimum basilicum	6 - 10	N, P	100-120
Allium cepa	6 - 7	N, P	70-150
Cichorium intybus	7 - 10	N, P	100
Mentha crispa	7 - 8	N, P	100
Elaeagnus angustifolia	6	N, P	100
Archangelica officinalis	7 - 8	N, P	90
Sambucus nigra	6 - 7	N, P	80
Hyssopus officinalis	7 - 8	N, P	50-100
Lavandula spica	7 - 9	N, P	50-100
Helianthus annuus	6 - 9	N, P	35-100
Crataegus monogyna	5 - 6	N, P	35-100
Brassica napus	5 - 6	N, P	35-100
Foeniculum vulgare	7 -8	N, P	25-100

CHAPTER 9

IMPORTANT SPECIES OF AROMATIC, MEDICINAL AND MELLIFEROUS PLANTS IN CZECH REPUBLIC

9.1. General aspects of Czech Republic

Geographic characteristics. The Czech Republic is a small advanced country (population 10.6 million) located in the heart of Europe with a long industrial tradition and a highly decentralized administration (14 regions and over 6000 municipalities) (https://eacea.ec.europa.eu/).

The Czech Republic, also known by its short-form name Czechia and formerly known as Bohemia, is a landlocked country in Central Europe.

It is bordered by Austria to the south, Germany to the west, Poland to the northeast, and Slovakia to the east. The Czech Republic has a hilly landscape that covers an area of 78,871 square kilometers (30,452 sq mi) with a mostly temperate continental and oceanic climate (https://en.wikipedia.org/wiki/Czech_Republic).

The country has been traditionally divided into three lands, namely Bohemia (Čechy) in the west, Moravia (Morava) in the east, and Czech Silesia (Slezsko; the smaller, south-eastern part of historical Silesia, most of which is located within modern Poland) in the northeast. Bohemia, to the west, consists of a basin drained by the Elbe (Czech: Labe) and the Vltava rivers, surrounded by mostly low mountains, such as the Krkonoše range of the Sudetes. The highest point in the country, Sněžka at 1,603 m (5,259 ft), is located here. Moravia, the eastern part of the country, is also hilly. It is drained mainly by the Morava River, but it also contains the source of the Oder River (Czech: Odra) (https://en.wikipedia.org/wiki/Czech_Republic).

The partner of Agropuzzle 4 - *Masaryk Secondary School of Agriculture and Higher Vocational School of Opava*, from Opava city, in eastern country, on the border with Poland. Natural mixed forest with elements of Carpathian flora is situated in the Hlučín upland, on the highest point of the Hlučín Region - Almin hill (Almin kopec) (315 m).

Figure 9.1. Czech Republic map
(Source: https://www.expats.cz/czech-news/article/)

Phytogeographically, the Czech Republic belongs to the Central European province of the Circumboreal Region, within the Boreal Kingdom. According to the World Wide Fund for Nature, the territory of the Czech Republic can be subdivided into four ecoregions: the Western European broadleaf forests, Central European mixed forests, Pannonian mixed forests, and Carpathian montane conifer forests (https://en.wikipedia.org/wiki/Czech_Republic).

There are four national parks in the Czech Republic. The oldest is Krkonoše National Park (Biosphere Reserve), and the others are Šumava National Park (Biosphere Reserve), Podyjí National Park, Bohemian Switzerland (https://en.wikipedia.org/wiki/Czech_Republic).

The three historical lands of the Czech Republic (formerly some countries of the Bohemian Crown) correspond with the river basins of the Elbe and the Vltava basin for Bohemia, the Morava one for Moravia, and the Oder river basin for Czech Silesia (in terms of the Czech territory) (https://en.wikipedia.org/wiki/Czech_Republic).

Climate and soil conditions. The Czech Republic has a temperate climate, situated in the transition zone between the oceanic and continental climate types, with warm summers and cold, cloudy and snowy winters. The temperature difference between summer and winter is due to the landlocked geographical position.

Continental influences are marked by large fluctuations in both temperature and precipitation, while moderating oceanic influences diminish from west to east. In general, temperatures decrease with increasing elevation but are relatively uniform across the lower portions of the country. The mean annual temperature at Cheb in the extreme west is 7°C and rises

to only 9°C at Brno in southern Moravia. High temperatures can exceed 32°C in Prague during July, and low temperatures may drop as low as −17°C in Cheb during February. The growing season is about 200 days in the south but less than half that in the mountains (https://www.britannica.com/place/Czech-Republic/Land).

Annual precipitation ranges from 18 inches (450 mm) in the central Bohemian basins to more than 60 inches (1500 mm) on windward slopes of the Krkonoše Mountains of the north. Maximum precipitation falls during July, while the minimum occurs in February. There are no recognizable climatic zones but rather a succession of small and varied districts; climate thus follows the topography in contributing to the diversity of the natural environment (https://www.britannica.com/place/Czech-Republic/Land). The soil profile of the Czech Republic consists of some rich, black chernozems and good-quality brown soils in the drier and lower areas. Podzols are found in the wet districts, and stony mountain soils are typical at high elevations. Alluvial soils occur in the river basins, and heavy clay soils are found in the eastern ridges (https://www.britannica.com/place/Czech-Republic/Land).

Socio-economic aspects. The most important sectors of the Czech Republic's economy in 2018 were industry (30.2%), wholesale and retail trade, transport, accommodation and food services (19.2%) and public administration, defence, education, human health and social work activities (15.5%).

Intra-EU trade accounts for 84% of the Czech Republic's exports (Germany 32%, Slovakia 8% and Poland 6%), while outside the EU 2% goes to both the United States and Russia.

In terms of imports, 76% come from EU Member States (Germany 29%, Poland 9% and Slovakia 6%), while outside the EU 8% come from China and 2% from the United States.

The Czech Republic supports projects preventing migration from cities, strives for regional and supra-regional accessibility, infrastructure modernization, greenery planting and care. It helps develop sustainable tourism at the regional and local levels, promotes sound land use, organic farming, local food production and comprehensive landscape management. Further efforts are aimed at supporting diversification of economic activities, entrepreneurship, revival of traditional crafts and production industries in rural and peripheral areas.

The food and beverage manufacturing sector in the Czech Republic is structurally wide, very complex with a significant share of small and medium-sized enterprises. Food manufacturing businesses process agricultural raw materials of domestic origin as well as produce of foreign

origin (sea food, coffee, tea, etc.). The key industries include manufacture of other food products, meat processing, dairy production and bakery production (https://www.urbanagendaplatform.org/ sites/ default/files/2020-09/Czech-Republic-National-Report.pdf).

9.2. Important species of aromatic, medicinal and melliferous plants

Czech Republic is a both competitor and a producer market in aromatic, medicinal and melliferous domain. The retail shelf of the country has availability of major consumer packaged products and brands from the developing countries, which are popular for their herbs and spices owing to suitable weather conditions.

There are several ethnic food shops, which sells spices and herbs traditionally used in countries outside of Europe and are mainly used to serve ethnic communities - this in turn has led to increase in demand for spices from all around the world (https://www.mordorintelligence.com /industry-reports/ czech-republic-spices-and-herbs-market).

Czech Republic spices and herbs market is segmented on the basis of product type and application. By product type the market is further sub segmented into Chilli, Pepper, Caraway, Coriander, Basil, Oregano, Mint and Others.

In the Czech Republic the main commodity is caraway (*Carum carvi*), which is cultivated annually on an area exceeding 2,000 hectares. Caraway is also the only crop in the sector showing a positive external trade balance. Other herb plants cultivated include coriander and fennel; among the main medicinal plants cultivated are mainly silybum, chamomile, marigold, peppermint and lemon balm. Chamomile (*Chamomilla Bohemica)* and caraway (*Český Kmín*) growers use the *Protected Designation of Origin Chamomilla Bohemica and Český Kmín* for their products (https://eagri.cz/public/web/file/581592/ publikace_ MZe_ 210x210mm_ ENG .pdf).

In recent years there has been an increase in medicinal, aromatic and meliferous plants grown organically, the medicinal, aromatic and meliferous plants grown for harvesting the green leaves also known as fresh herbs, and also its grown in pots or containers.

The most important species of aromatic medicinal and melliferous plants from Opava region of Czech Republic are present in Table 9.1.

Table 9.1

The most important species of aromatic, medicinal and melliferous plants from Opava region of Czech Republic

(Masaryk Secondary School of Agriculture and Higher Vocational School of Opava team)

Scientific name	Name in Czech language
Achillea millefolium	Řebříček obecný
Agrimonia eupatoria	Řepík lékařský
Aruncus dioicus (sylvestris)	Udatna lesní
Bellis perennis	Sedmíkráska chudobka
Betonica officinalis	Bukvice lékařská
Calendula officinalis	Měsíček lékařský
Camelina sativa	Lnička setá
Carum carvi	Kmín
Cichorium intybus	Čekanka obecná
Coriander sativum	Koriandr
Crambe abyssinica	Katrán habešský
Feniculum vulgare	Fenician
Filipendula ulmaria	Tužebník jilmový
Galega officinalis	Jestřabina lékařská
Glechoma hederacea	Popenec břečťanovitý
Leucanthemum vulgare	Kopretina bílá
Liatris spicata	Šuškarda klasnatá
Matricaria chamomilla	Heřmánek
Melilotus albus	Komonice bílá
Melissa officinalis	Meduňka lékařská
Salvia officinalis	Šalvěj lékařská
Silybum marianum	Ostropestřec mariánský
Taraxacum officinalis	Smetánka lékařská
Thymus vulgaris	Mateřídouška obecná

9.2.1. Agrimonia eupatoria L. (Common Agrimony, Church Steeples, Stickwort)

Importance and uses. *Agrimonia eupatoria* L. is an herb of the *Rosaceae* family, widely used in traditional (folk) medicine for its beneficial effects. Its water extracts (infusions and decoctions) are used in the treatment of airway and urinary system diseases, digestive tract diseases, and chronic wounds. The aerial parts are harvested from June to August. *Agrimonia* preparations are obtained by crushing (reduction to very small particles) dry parts of the plant. They can also be used to prepare extracts with water and alcohol. Herbal medicines containing this plant are usually available in the form of teas for drinking or gargling. They are also available in liquid form for application to the skin or use as an additive for bath water. This plant can also be found in combination with other plant substances in some herbal medicines. The chemicals present in high amounts in the composition of the plant are apigenol, quercitrozide, agrimonolid, ursolic acid, luteol, hyperoside and rutoside. In some regions this plant was used as a pigment in the yellow dyeing of natural fibers, in the Middle Ages people believed that the plant has magical powers

placed under the pillow brings a deep sleep, the person would sleep until it was removed. Exceeding the recommended doses can lead to severe spasms, damage to the bile ducts and kidneys, it is not recommended to consume the plant by those suffering from heart disease, gastric ulcer (Bojor, 2021).

Morphological and biological characteristics. Common agrimony is a herbaceous, pubescent and perennial plant, about 1.5 meters tall. The plant develops strong roots and a large rhizome, which continues above the ground with a straight stem that can reach a height of 80-90 cm. The stem of the turret is cylindrical, covered with fine light green hairs.

Figure 9.2. *Agrimonia eupatoria* L.
(Source: https://www.naturplant.ro/agrimonia-eupatoria-turita-mare/)

The leaves are feathery-compound and have long petioles, light green and slightly serrated at the edges. The flowers grow like a candle gathered in a spike at the top of the stem. They have five golden-yellow petals, numerous stamens and are highly sought after by bees and insects. The flowers open in June-September. During this period, it is also recommended to harvest the aerial parts, because they are richer in active principles.

Climate and soil requirements. Common agrimony grows in moist soil and can be found frequently in groves, meadows, at the edge of forests, in bushes or on roadsides.

Melliferous value. Covered in soft hairs, the plant has serrated edged pinnate leaves and a striking spike of five-petalled yellow flowers that bloom throughout the summer months of June, July and August. The flowers have a faint smell of apricots and have a generous pollen supply that is ideal to attract hoverflies, flies and honey bees. About 180 kg/ha of honey can be obtained.

9.2.2. Aruncus dioicus L. (Synonyms: Aruncus sylvester, Aruncus vulgaris) (Goat's Beard)

Importance and uses. *Aruncus dioicus* belong *Rosaceae* family. It has been used as a remedy in skin care, detoxification, blood stanching, tonsillitis. Goat's beard has an astringent, antipyretic, tonic and soothing effect on the stomach. Studies have shown that the leaves and stems of the plant contain small amounts of cyanogenic compounds, so the plant is not recommended for continuous use or in large quantities.The poulticed root is applied to bee stings. A tea made from the roots is used to allay bleeding after child birth, to reduce profuse urination and to treat stomach pains, diarrhoea, gonorrhoea, fevers and internal bleeding. The tea is used externally to bathe swollen feet and rheumatic joints. A salve made from the root ashes is rubbed onto sores (http://www.naturalmedicinalherbs.net/herbs/a/aruncus-dioicus=goat's-beard.php).

Budlings, stems and young leaves are cooked. In the past, in folk medicine, the roots, seeds and all the aerial part were used, but today, the plant no longer has any role in herbal medicine, but is used only as an ornamental plant.

Morphological and biological characteristics. The plant is an imposing perennial, 100-200 cm tall. The stems bear several twice- or thrice-pinnately compound leaves, the segments prominently toothed. The large, feathery clusters of small, white flowers are reminiscent of astilbes. Male and female flowers are borne on separate plants, the staminate being more attractive (https://www.wildflower.org/plants/result.php?id_plant=ardi8). It is in flower from June to August. The species is dioecious (individual flowers are either male or female, but only one sex is to be found on any one plant so both male and female plants must be grown if seed is required). and is pollinated by insects. The plant is not self-fertile.

Figure 9.3. *Aruncus dioicus* L.
(Source: https://www.gardenexpert.ro/flori/plante-perene/barba-caprei.html)

Climate and soil requirements. Habitat of the herb means damp woods, shady places and by streams, usually in mountainous areas. The plants are suitable for: light (sandy), medium (loamy) and heavy (clay) soils, with pH: acid, neutral and basic (alkaline) soils and can grow in very acid and very alkaline soils.It can grow in semi-shade (light woodland) or no shade. It prefers dry moist or wet soil (https://pfaf.org/User/Plant.aspx?LatinName=Aruncus+dioicus).

Melliferous value. Very good plant for early summer. Flowers attract many types of insects including a variety of butterflies, wasps, bees and other polinating insects. The quality of polen and honey could be 50-90 kg/ha.

9.2.3. Betonica officinalis L. (Synonym: Stachys officinalis) (Purple Betony, Wind Grass)

Importance and uses. Betonica is an herbaceous perennial in the *Lamiaceae* (mint) family. For therapeutic purposes, the aerial part of the plant is used, which is harvested during flowering during dry weather, contains - mineral salts - phosphorus, manganese, magnesium, choline - a water-soluble vitamin that supports the proper use of fats and cholesterol by the body, tannins, betanin, caffeic acid, rosemary acid, chlorogenic acid.

People use betony for asthma, heartburn, diarrhea, bladder and kidney stones. Important active substances: betaine, mucilages, tannins, bitter substances, volatile oil. It also acts on the nervous system, improving mood. Cures are often used to treat ailments such as asthma, pharyngitis, stomach or intestinal disorders (including diarrhea), and kidney stones. In large quantities, healing preparations can be toxic, especially affecting the liver.

Morphological and biological characteristics. This a plant with a short woody rhizome from which many roots start, the stem straight, up to 1 meter high, hairy or rake has four edges, the leaves are elongated-ovate, placed opposite pairs, long petiolate, notched on the edge, are rough covered with numerous hairs and secretes a bitter aromatic oil, the flowers are grouped in spike-shaped inflorescences at the top of the stem, have a purple-purple color, flowering takes place in summer in June-August. Healing is considered a medicinal plant due to its content of substances beneficial to health and is used in various therapeutic preparations. It has actions: astringent, antidiarrheal, antiseptic, antihemorrhagic, anti-inflammatory, cholagogue, antipyretic, stomachic, through preparations for internal and external use.

Figure 9.4. *Betonica officinalis* L.
(Source: https://gorjeanul.ro/vindecea-betonica-officinalis-beneficii-si-proprietati/)

Climate and soil requirements. Betony grows in mountainous areas at the edge of forests, especially deciduous trees, on meadows, in clearings, or as a weed in gardens and orchards.

Betony prefers damp but not waterlogged sites and although it can be found in slightly calcareous situations it has a definite preference for weakly acidic soils. Habitats include meadows, lightly grazed pasture, hedge banks and open woodland. It spreads by means of seed dropped late in the season and by slow but steady vegetative spread (https://wildseed.co.uk/species/view/132).

Melliferous value. Betonica is known for attracting bees, beneficial insects, butterflies/ moths and other pollinators. It nectar pollen rich flowers and has medium values (around 200 kg/ha) (Ion et al., 2008).

9.2.4. Carum carvi L. (Cumin, Carraw)

Importance and uses. *Carum carvi* belongs of *Apiceae* Family. Cumin is a herbaceous plant, which grows naturally in the grasslands of the mountainous region, but is also cultivated.

It is grown mainly for fruit, rich in volatile oil, but sometimes also for fresh grass. It has multiple uses in both medicine and human nutrition. Known since antiquity, cumin is still considered a carminative good of plant origin. The infusion prepared from a teaspoon and a half of fruit in a cup of water has carminative properties, regulates stomach functions, fights intestinal inflammation, calms colic, fluidifies bronchial secretions and increases diuresis. If cumin fruits are associated in equal parts with fennel and coriander fruits, then the resulting tea has an excellent carminative effect (Roman et al., 2008).

In food, the fruits and substances extracted from them are used in the preparation of soups, liqueurs, cakes, cheeses and bread. They are also used in the manufacture of soaps and other perfumery. Cakes can be used as concentrated feed. Cumin is also a very good honey plant.

The most important active ingredient in cumin is essential oil (3-7%) consisting of carvone (up to 60%), limonene, carveol, dihydrocarbon. It also contains fatty oils, carbohydrates, proteins, tannins. Cumin oil is active against some species of fungi of the genera Aspergillus and Candida. It can be used in veterinary medicine in various treatments for indigestion and overload in cows or horses, as part of the treatments allowed in the organic farming system. Due to the fact that it occurs spontaneously in natural hayfields, cumin increases the quality of hay, as it is consumed with more pleasure by animals, helps digestion, stimulates milk secretion. For these properties, cumin can be introduced in certain proportions into the hayfields (Roman and Toader, 2007).

Morphological and biological characteristics. Cumin is a biennial plant (in the first year it forms a rosette of leaves, and in the second year the stem with flowers, fruits and seeds), and sometimes perennial. The plant is up to 100 cm tall, with a furrowed stem, branched and covered with sparse and deeply divided leaves. The root of the cumin is pivoting, fleshy, slightly branched, light brown on the outside and white-dirty on the inside. The flowers are placed in compound umbels, with uneven, white-pink petals, which bloom from May to July. Pollination is allogamous, entomophilic (Roman and Toader, 2007).

Figure 9.5. *Carum carvi* L.
(Source: https://www.lumeasatului.ro/articole-revista/agrotehnica/3982-cultura-chimenului.html)

Climate and soil requirements. Cumin is widespread throughout Europe, Iran and Tibet. In our country it is very common in wet meadows, from hilly to subalpine. Cumin is usually grown in wetter, cooler areas on river meadows. In the plain areas it tends to degenerate, and in conditions of drought and heat, production is compromised. Being a plant of Mediterranean origin, it prefers loose soil, with good water drainage, strong light and good air circulation.

Cumin is less demanding on heat, with a minimum germination temperature of 6-8°C. Excessive humidity, but also drought and especially dry winds negatively affect production.

It is less demanding on the soil, succeeding well on any type of soil and withstands pH values from 4.8 to 7.8.

Melliferous value. Both nectar and pollen are produced by caraway flowers. Caraway honey has a smoky aroma and a distinctive bitter aftertaste similar to caraway seeds.

9.2.5. Filipendula ulmaria L. (Synonym: Spiraeae ulmaria) (Meadowsweet, Bittersweet, Bridewort)

Importance and uses. Filipendula is a perennial plant of the *Rosaceae* family. The plant is also called "natural aspirin" because it contains: salicylic acid, flavone-glycosides, essential oils and tannins. The plant can be grown in the same way as any spice or medicinal plant, either in a pot culture, for personal use, or in a garden or larger crops. For medicinal practices, flowers, rhizomes, leaves are harvested.

The most commonly used preparation is the infusion. Important active substances are: tannins, vanillin, heliotropin, glucosides, salicylic acid, iron, sulfur, calcium. The crayfish infusion is astringent, tonic, diuretic and antihydropic.

Flower preparations help to relieve the pain caused by rheumatoid arthritis. The infusion of hawthorn flowers reduces fever, as well as pain caused by kidney and gallstones.

According to the British Herbal Pharmacopoeia (1974/1983), *Filipendulae ulmariae* herba is used in combinations with *Althaea officinalis* and *Melissa* (for gastric conditions), and with *Ballota* (antiemetic). At present, combination products containing *Filipendula ulmariae* herba are on the market in several EU Member States, amongst others: Czech Republic (combinations with *Salicis cortex*, *Violae tricoloris* herba, *Harpagophyti radix*, *Equiseti* herba, *Solidaginis* herba, *Callunae* herba, herbal tea for oral use (https://www.ema.europa.eu/en/documents/herbal-report).

Morphological and biological characteristics. It develops quite a lot, reaching up to 120 cm in height, the aerial stems being scattered. The underground stem, the rhizome, is almost stony.

The plant blooms in July and August, the flowers are usually white, sometimes with shades of yellow.

The main leaves are alternate and occur as pairs of serrate (toothed) leaflets, whose undersides are downy white.

Often, pairs of small leaflets alternate with pairs of larger ones. The terminal leaflets at the tip are large and three- to five-lobed.

Figure 9.6. *Filipendula ulmaria* L.
(Source: https://gorjeanul.ro/cretuscafilipendula-ulmaria-beneficii-si-proprietati/)

Climate and soil requirements. It is commonly found on the edge of running water, from the plain to the upper limit of the beech, as well as in wet meadows.

Melliferous value. *Filipendula ulmaria* is a honey plant well known by beekeepers. The honey obtained from the flowers of this plant has exceptional therapeutic qualities.

9.2.6. Galena oficinallis L. (Galega, Goat's-Rue)

Importance and uses. *Galega officinalis* is an herbaceous plant of the *Fabaceae* family. The plant has long been used in traditional European medicine to treat diabetes, due to its considerable hypoglycaemic effect and also, for to stimulate lactation. The plant is kept dry and is usually used as a dry powder. The dried flowering plant is used. The plant contains flavonic derivatives and vitamin C and it has diuretic, galactogogue, hypoglycemic and sweating properties.

In high doses, extracts from *Galegae* herba induce a series of side effects similar to those caused by guanidine compounds. For this reason, patients who use infusion should consult their doctor. In ruminants, poisoning has been reported due to the ingestion of large amounts of the plant, but there are no indications that it is toxic to humans (https://plantemedicinale.site/plante-medicinale/ciumarea-galega-officinalis/).

Morphological and biological characteristics. Galena is a plant of 0.50 to 1 meter high, perennial. The root system of the plant is pivotal, powerful. The length of the root sometimes exceeds eighty centimeters, while having numerous horizontal processes, of which new shoots appear. Shrub can consist of up to twenty stems. They are erect, tubular, hollow inside, painted

green. The leaves are large, pinnate, petiolate, with stipules. Their length can reach twenty-five centimeters. Castings consist of fifteen pairs of leaflets, oval elongated shape. To the top, they are a little pointed.

Galega officinalis blooms from early summer to mid-autumn. The flowers are light purple or pale blue in color, large, with long pedicels, resembling bells. They form upright inflorescences-brush length up to twenty centimeters. After flowering, galega forms a fruit - standing beans, having from five to eight reniform, smooth seeds of yellowish-green color, hard to the touch. Full ripening occurs in September.

Figure 9.7. *Galega oficinallis* L.
(Source: https://all.biz/galega-seeds-g8188959RU)

Climate and soil requirements. Galega is a light-loving plant. It needs a lot of light. In the first 40-50 days after germination, it especially needs sunlight. The soil should be loose, permeable to water, with a slightly acidic or neutral reaction. Grows on fertile or preluvosol soil, podzolic or on recovered peatlands. Galega can also grow near rivers, swamps and streams, among bushes, or on meadows, resisting very well the stagnation of water on the ground for about 2 weeks (https://artremstroi.ru/ro/galega-ili-kozlyatnik-lekarstvennyi-pri-diabete-pravila/).

Melliferous value. Its beautiful violet blue flowers have good quality nectar that attracts honeybees. The flowers are pollinated by bees. It makes a good honey plant. Galega has long been recognized as an excellent honey plant. Bees collect about 200 kg/ha of nectar from one hectare of galega crops.

9.2.7. Glechoma hederacea L. (Synonyms: Nepeta glechoma, Nepeta hederacea) (Gill-over-the-ground, Creeping Charlie)

Importance and uses. *Ghechoma is* perennial and herbaceous plant of *Lamiaceae* family. The plant contains the following chemicals: bitter substances, fatty substances, saponosides, tannins, waxes, resins, choline, volatile oil.

The main qualities of roundabout are: anti-inflammatory, antiscorbutic, antidiarrheal, diuretic, antilithiasis, behic, emollient, deworming, healing, also normalizes intestinal transit, limits and helps eliminate stones, stimulates appetite, heals wounds, helps with healing. liver, kidney and spleen diseases.

In phytotherapy the aerial part of the plant is used.

Rotunjoara is an edible plant with a special taste, predominant, so it is used in salads, soups or dishes only in small quantities. Being very aromatic, it perfumes any tea, giving it a special, very pleasant note.

Morphological and biological characteristics. Creeping Charlie is a creeping plant that does not grow taller than 30 cm. The leaves are reniform and have crenate edges. The flowers are blue or purple, arranged 2-6 at the base of the leaves and bloom from March to May.

Figure 9.8. *Glechoma hederacea* L.
(Source: https://all.biz/galega-seeds-g8188959RU)

Climate and soil requirements. *Glechoma hederacea* prefers areas shaded by moist soil, so it grows very well in deciduous forests or in the darker edges of gardens, but can also spread to areas exposed to direct sunlight. It is found in the spontaneous flora of the plain and hill areas, starting with early spring. Due to its multiplication by stolons, the plant survives mowing or even

mowing the car, which is why in some places it is considered a big hassle and some gardeners do their best to get rid of it.

Melliferous value. Creeping charlie draws a lot of insect visitors, including bees. Sweat bees, bumble bees, and honey bees are among its most popular insect visitors. They produce nectar with an average volume of 0.3 ml per flower, but the amount of nectar varies greatly, with a range of 0.06-2.4 ml of nectar available per flower (https://beeinformed.org/2017/07/10/lucky-hit-nectar-in-creeping-charlie/).

9.2.8. Matricaria chamomilla L. (Chamomile, Camomile)

Importance and uses. Chamomile is one of the best known and most widely used herbs of *Asteraceae* Family. Chamomile oil has been used since antiquity as a rub against neuralgia and rheumatism. Among the ancient Egyptians, chamomile was considered, due to its power to lower fever, as the "flower of the sun god". The name Matricaria is derived from the Latin "mater" which means mother, because chamomile is used in various diseases of mothers, but also for women in general (Bojor, 2021).

The plant is cultivated for inflorescences (*Chamommillae flos*), which contain 0.5 - 1.5% volatile oil, rich in azulene, flavonoids and coumarins. Chamomile tea has a sweating, calming, antispasmodic, disinfectant and anti-inflammatory effect in inflammations of all kinds, especially of the mucous membranes. Externally, chamomile is administered in the form of compresses and washes in conjunctivitis, rash or gargle in toothache. Throat and sinusitis improve quickly if chamomile vapors are inhaled.

Chamomile is the plant with the widest applications in cosmetics, having anti-inflammatory, antiseptic, anesthetic, decongestant, disinfectant, healing, emollient properties. Chamomile flowers are mainly used as an infusion for eye, skin and hair care (Roman et al., 2007).

Morphological and biological characteristics. Chamomile is an annual herbaceous species with a pivoting root that explores a small volume of soil. The stem is erect, very branched, 30-75 cm high, with sessile leaves of different lengths. The inflorescence is a capitula, with a variable diameter, 1-1.5 cm, with ligulate, sterile flowers, white on the outside and tubular flowers arranged centrally, yellow - golden. The receptacle until flowering is full of marrow, and from flowering it becomes empty inside. Flowering is staggered, from April to August, which can be an

impediment to harvesting as it requires a large volume of labor. The flowers have a pleasant scent due to the volatile oil.

Figure 9.9. *Matricaria chamomilla* L.
(Source: https://www.paradisverde.ro/plante-medicinale/musetelul-leacul-pentru-orice-boala)

Climate and soil requirements. Chamomile has great ecological plasticity, appearing spontaneously throughout the country. The most favorable cultivation conditions are found in the southern area; it is recommended, however, to avoid cultivation in dry areas (Coiciu and Racz, 1962). It has low requirements for climate and soil factors. Chamomile withstands low winter temperatures well, which explains why it is so widespread.

Melliferous value. Chamomile is cultivated in March-April and blooms in June-July-August, lasts 30-50 days during which the bees intensely examine the flowers, but from a beekeeping point of view it is not particularly important, producing little nectar.

9.2.9. Taraxacum officinalis (Dandelion, Common Dandelion)

Importance and uses. Dandelion is a perennial plant of the *Asteraceae* family. It is part of the spontaneous flora, it is one of the first sources of food for bees, spring and beloved for its benefits as a medicinal plant. It is also a tasty ingredient in salads, sandwiches and teas. The roots are used in the production of coffee substitutes, and flowers in the production of wines. The plant is widely cultivated and is used for liver disease. Also, the plant is used to treat biliary and liver

disease, gastritis, rheumatism, atherosclerosis and varicose veins. Among other things, dandelion teas have been shown to be effective in combating obesity, intestinal disorders and eliminating toxins from the blood. In addition, dandelion leaves are delicious in salads.

Morphological and biological characteristics. It grows aggressively with the help of vertical rhizomes and is fixed with a pivoting root that can exceed 15 centimeters in soil depth. The stem is cylindrical and hollow inside, and the leaves are lanceolate. The large yellow flowers can be grouped in groups of dozens of flowers, to the delight of the spring eye. The flower opens in the morning and closes in the evening.

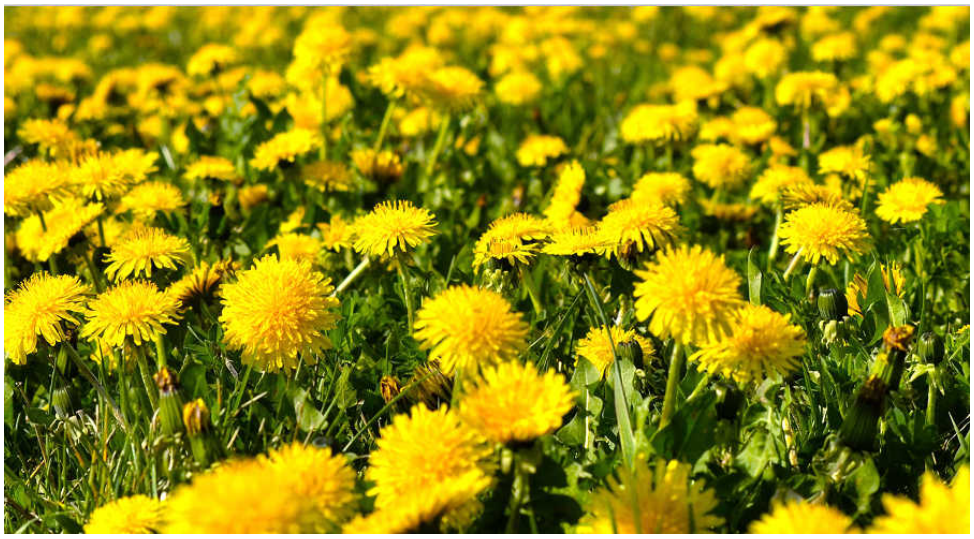


Figure 9.10. *Taraxacum officinalis* L.
(Source: https://www.gabrielafaur.com/2370/papadia-proprietati-beneficii-mod-de-utilizare-contraindicatii/)

Climate and soil requirements. Dandelion is remarkable for its resistance and can adapt to all types of soil and grows in meadows, on roadsides across the country from the plains to the mountains.

Melliferous value. Dandelion is a perennial plant that blooms from April to September. Honey production was estimated at 200 kg per hectare (Cîrnu et al., 1980).

9.2.10. Silybum marianum L. (Holy Thistle, Lady's Thistle, Milk Thistle, St. Mary's Thistle)

Importance and uses. *Silybum marianum* is a anual plant of *Asteraceae* family. *Sylibum marianum* is used in industry, human medicine, veterinary medicine and beekeeping. It is grown for fruits, which contains various active ingredients, the most important of which are silybin and

silymarin. Fruit extracts are used in the preparation of hepatoprotective pharmaceuticals in the treatment of liver damage, after hepatitis, such as the pharmaceutical product "silymarin". The aerial parts of the plant can be used as a bitter tonic. In addition to its beneficial effect on liver or bile diseases, silymarin also has a strong antioxidant effect and is recommended for heavy metal poisoning or poisonous fungi.

Morphological and biological characteristics. The root is well developed and the stem is 50-150 cm high and ribbed. The leaves are large, can reach up to 15 cm in length and have spines on the terminal ribs. The inflorescence is a head (anthodi) with tubular, red-purple flowers. Flowering takes place from July to September. The fruit is an elongated, brown achene with a papule.

Figure 9.11. *Sylibum marianum* L. (original)
(Moara Domneasca Experimental Field)

Climate and soil requirements. The most favorable cultivation areas for *Sylibum marianum* are the warmer regions in the south and west of the country. Plants require high temperatures throughout the growing season. They have moderate humidity requirements; however, summer drought can affect production. The plants are not pretentious to the type of soil, but gives higher yields on medium soils, deep, well drained and with sufficient moisture.

Melliferous value. The flower of *Sylibum marianum* is a modest melliferous species, with a nectar production of 0.44 mg / flower, and honey production of about 50-60 kg/ha (Ionescu, 2018).

CHAPTER 10

IMPORTANT SPECIES OF AROMATIC, MEDICINAL AND MELLIFEROUS PLANTS IN FRENCH GUIANA

10.1. General aspects of French Guiana

Geographic characteristics. French Guiana was an overseas department of France and is now a French region, located at the central northern coast of South America, bordering the Atlantic Ocean in north. Countries with international borders to French Guiana are Brazil and Suriname. With an area of 83,534 km², the country is about the size of Austria, or slightly larger than the U.S. state of South Carolina.

The partner of Agropuzzle 4 - Macauria Agricultural High School, French Guiana-France is located in French Guiana, in the municipality of Macouria, halfway between Cayenne and Kourou, the Institution of Local Public Education and Vocational Training Farm (EPLEFPA) has four training centers. It depends on the Ministry for Agriculture and Fisheries.

Figure 10.1. French Guiana map
(Source: https://www.mappr.co/political-maps/french-guiana-political-map/)

There are three main regions: the coastal plain in the north, a hilly plateau in the middle, and the Tumac-Humac Mountains in the south. Most of the interior (83 percent of it) is dense tropical rain forest. There are more than twenty rivers that flow into the Atlantic Ocean from French Guiana. The most important of these are the Oyapock, which forms the southeastern border with Brazil, and the Maroni, which forms the border with Suriname (https://www. encyclopedia.com/places/latin-america-and-caribbean / south-american-political-geography).

Climate and soil conditions. In French Guiana, a country located just north of the Equator, the climate is tropical, hot and humid throughout the year, with a relatively dry, slightly warmer season from July to November and a rainy season from December to June.

Temperatures are high all year round: lows are always above 20°C, while highs in Cayenne range from 29-30°C between January and May to 32.5°C in September and October, which are the hottest months because they are the driest and sunniest. However, at this time, the humidity is a bit lower, around 65% during the warmest hours, while in the rest of the year, it exceeds 70%. In the hottest days, however, the temperature can reach 35°C on the coast and 38°C in the interior of country, from May to November.

Precipitation in French Guiana is definitely abundant, in fact, it exceeds 2,500 millimeters per year, and in many areas, it even exceeds 3,000 mm. Within the rainy season from December to June.

Ninety-seven percent of its territory is covered by one of the least impacted tropical forests in the world, attracting global scientific interest (de Pracontal and Entraygues, 2009).

French Guiana is home to many different ecosystems: tropical rainforests, coastal mangroves, savannahs, inselbergs and many types of wetlands. It lies within three ecoregions: Guayanan Highlands moist forests, Guianan moist forests, and Guianan mangroves (https://en.wikipedia.org/wiki/French_Guiana).

The soils could be considered anthroposols, and they have different structures and textures than natural tropical forest soils in the same topographic position. French Guiana has some of the poorest soils in the world. The soil is low in nutrients (e.g., nitrogen, potassium) and organic matter. Soil acidity is another cause of the poor soils, and it requires farmers to add lime to their fields. The soil characteristics have led to the use of slash and burn agriculture (https://en.wikipedia.org/wiki/French_Guiana).

Socio-economic aspects. The economy is closely tied to France. Shrimp and other seafood production is the major economical asset. The European Space Agency in Macouri has become the second most important asset, with predictions for even more growth. Forestry of the untapped interior holds economic potential. Sugar-cane and other cash crops are grown by the agricultural sector.

The diversity of cultures has given the local foods their flavor. Caribbean and Creole style foods are common along with Western foods and such Asian cuisines as Vietnamese and Chinese. Seafood, especially shrimp, is eaten quite often. Rice accompanies most of the dishes.

Family members still comprise the farm labor. Locally grown vegetables and fruit are sold in markets along with fish and meats. The demand for livestock is heavy and likewise can be profitable for the sellers. Small craft-work is sold to both tourists and locals. The building materials for these crafts and for carpentry projects are also sold. Among the major buyers of these materials are the many small-scale construction companies. The service sector is also important at the local level.

10.2. Important species of aromatic, medicinal and melliferous plants

Agriculture of French Guiana produces only a small part of Gross Domestic Product (GDP). Subsistence farming predominates and centres on the growing of cassava, rice, bananas, and cabbages. Most small farms are worked and owned by families, but there are some large estates engaged in growing cash crops, largely for export to metropolitan France.

The heavily forested land includes valuable commercial species. Some forestland is reserved by the state, but most is open to exploitation. Most of the timber cut is used for industrial purposes, and of that about two-fifths is exported.

French Guiana abounds in authentic and varied medicinal plants with immense therapeutic potential. Also, the region is in a particular position as a “regional conservator” of the Amazonian flora, given the protection afforded by its membership in France and the existence of a national park over a large part of the territory. This flora is an essential part of tradition and culture. In French Guiana, attempts are being made to market various palm oils, local herbal fragrances, beer of potato red, and the traditional Amerindian plants (*Rosa sinensis*, *Hibiscus sabdariffa*, *Momornica harantia* (https://www.jardinsdefrance.org/aromatiques-et-medicinales-dans-les-domcom-de-lidentite-et-de-la-culture-a-leconomie-moderne/).

Currently, according to the Pharmacopoeia of French Guiana, about 450 plants are traditionally present and under a pharmaceutical monopoly, ie their sale is limited to pharmacies. From this list, however, 148 plants are for sale free of charge if they are sold as such, ie unprocessed. This is the case with some aromatic plants (black pepper, thyme, etc.) (https://biostrategе.com/les-plantes-medicinales-guyanaises-de-la-pharmacopee-francaise/).

The most important species of aromatic, medicinal and melliferous plants in French Guiana are present in Table 10.1.

Table 10.1

The most important species of aromatic medicinal and melliferous plants in Macaurii areas of French Guiana (Macaurii Agricultural High School team, French Guiana)

Scientific name	Name in French language
Allium sativum	Ail commun
Aloes vera	Aloes
Alpinia zerumbet	Atous maux
Annona muricata	Corossol
Annona squamosa	Pomme cannelle
Bixa orellana	Roucou
Carica papaya	Papaye
Cassia alata (senna alata)	Impedigo bush
Cecropia shreberiana	Bois canon
Cinnamomum verum	Cannelle
Citrus aurantium	Orange
Coffea arabica, coffea ssp	Café
Crescentia cujete	Calebasse
Curcuma longa	Curcuma
Cymbopogon citratus	Citronnelle
Hibiscus rosa-sinensis	Hibiscus
Hibiscus sabdariffa	L'oseille de Guinée, Groseille pays
Kalanchoe pinnata	Herbe mal tete
Mellisa officinalis	Mélisse *(lippia alba), guiana mint*
Momordica charantia	Sorossi sauvage
Morinda citrifolia	Noni
Myristica fragrans	Muscade
Phyllantus amarus	Graine en bas feuille blanc
Pimenta racemosa)	Bois d'inde
Plectranthus amboinicus	Gros thym
Psidium guajava	Goyave
Pogostemon heyneanus	Patchouli
Syzygium aromaticum	Girofle
Thebroma cacao	Cocoa
Tinospora crispa	Liane amer
Vetiveria zizanioide	Vetiver
Zingiber officinal	Gingembre

10.2.1. Aloe vera (L.) Burm.f. (Synonyms: Aloe barbadensis Mill., Aloe vera var. chinensis (Haw.) Baker) (Aloe)

Importance and uses. *Aloe vera* belongs to the family *Asphodelaceae* (*Liliaceae*). *Aloe vera* is a plant with multiple benefits and uses in both medicine and cosmetics. It contains more than 75 active substances and is recognized for its beneficial effect in supporting the immune system, relieving irritable bowel syndrome or soothing burns and irritations. Aloe vera, nicknamed the "elixir of youth", is a plant with multiple uses in alternative medicine and cosmetics. The ancient Egyptians called it the "plant of immortality" and placed it among the funeral gifts buried with the pharaohs, to ensure, even after death, the health of the pharaoh's spirit. Hundreds of years ago, Africans hung the plant in bundles above the door to ward off evil spirits (https://www.secom.ro/articles/aloe-vera-un-elixir-cu-75-de-substante-active-proprietati-beneficii-si-utilizari).

Aloe vera contains antiseptic agents, such as lupeol, salicylic acid, urea, cinnamic acid, phenols and sulfur, all of which have an inhibitory effect on fungi, bacteria and viruses. Applied locally, aloe vera gel has a calming and analgesic action. It is especially helpful for people who suffer from pain caused by rheumatoid arthritis. Studies have shown that aloe vera relieves pain caused by sciatic nerve disorders. *Aloe vera* is also used in the form of macerate, aloe vera syrup, tincture or tea.

Aloe vera var. *chinensis* has uses in medical treatments. It has narrow, fragile, freckled leaves, much more disordered, and the flowers are orange. Both young and mature leaves have similar characteristics. It is the most common and accessible aloe vera variant, recommended only for external use. Consumption of *Aloe vera* var. *chinensis* will have a strong laxative effect - the plant has been used for this purpose over time.

Morphological and biological characteristics. With the right care, the plant can live to be over 100 years old. Due to its long lifespan, it is known as the "immortal plant". When the plant is about 3 years old, the leaves are harvested; The sap obtained after cutting the leaves is used with the gel for therapeutic purposes. It has wide and thick leaves, very fleshy, gray-green, and the flowers are yellow. The young leaves have freckles, while the mature leaves that can be used for medicinal purposes have a uniform color. It is the most cultivated version of aloe vera, recommended for both internal and external use. The thick, green, fleshy leaves of this plant, which can reach a length of about 30 to 50 centimeters, contain plant tissue capable of storing water.

Figure 10.2. *Aloe vera* (L.) Burm.f.
(Source: La Palette - Guyane website)

Climate and soil requirements. *Aloe Vera* grows in areas with mild climates, where temperatures do not fall below 0 degrees for a long time and can be recognized by the fleshy, lanceolate leaves that grow directly from the ground, with the edges of a sawtooth.

Melliferous value. The Aloe vera flowers also gives nectar, so it is in the honey-medicinal category.

10.2.2. Alpinia zerumbet (Synonyms: Alpinia speciosa, Alpinia nutans misapplied) (Pin Porcelain Lily, Shell Ginger)

Importance and uses. *Alpinia zerumbet* is a tender herbaceous perennial in the *Zingiberaceae* Family. The plant grown throughout the world for its attractive flowers and foliage. Atoumo is an important plant in the *Creole pharmacopoeia* and it entered the *French pharmacopoeia* in 2013.

Toutes les parties de la plantes sont comestibles et médicinales. *Alpinia zerumbet* is used to treat the flu. The main advantage of the atmo is that it is rich in germicidal essential oils and anti-oxidants.

Morphological and biological characteristics. Plants grow in upright clumps from heavy, fleshy rhizomes that look (and smell) like that of culinary ginger (*Zingiber officinale*). *Alpinia zerumbet* produces an inflorescence on old growth, so flowers are usually not seen on plants grown as annuals or stored for the winter. Unlike most gingers, this species produces drooping racemes at the ends of the leafy stems rather than directly from the rhizomes. The waxy, funnel-shaped

flowers are a pearly white tinged with light pink on the outside, but inside are bright yellow with red markings. It is the appearance of the flowers which resemble pearlescent seashells, especially when in bud, that inspired the common name of shell ginger. The flowers are slightly fragrant when in bloom. Sometimes flowers are followed by striated fruits (https://hort.extension. wisc.edu/articles/variegated-shell-ginger- alpinia-zerumbet-variegata/). It is a tall, aromatic rhizomatous herb up to 3 meters tall. The leaves are alternate, oblong, stiff, shiny and dark green, they are ornamental and measure up to 70 cm long. The flowers, remarkable and fragrant, are hanging spikes. They are pearly white, pink at the apex and streaked red with yellow edges. Orange fruits are in clusters, hollow and the size of grapes, with small seeds inside.

Figure 10.3. *Alpinia zerumbet* L.
(Source: https://www.carib-beans-plants.com/accueil/fiches-de-plantes/alpinia-zerumbet/)

Climate and soil requirements. Habitat of the herb means damp woods, shady places and by streams, usually in mountainous areas. The plants are suitable for: light (sandy), medium (loamy) and heavy (clay) soils, with pH: acid, neutral and basic (alkaline) soils and can grow in very acid and very alkaline soils.It can grow in semi-shade (light woodland) or no shade. It prefers dry moist or wet soil (https://pfaf.org/User/Plant.aspx?LatinName=Aruncus+dioicus).

Melliferous value. The species bloomed during the rainy season from late April to early July, and the average flowering period of each flower was approximately 23 days.

10.2.3. Annona muricata L. (Soursop, Guanabana, Prickly Custard Apple, Durian Belanda, Graviola, Durian Europa, Durian Makkah, Durian Benggala)

Importance and uses. *Annona muricata* is a plant of *Annonaceae* Family. Is a tropical plant species known for its edible fruit which has some medicinal merits, but also some toxicological effects. Traditional medicinal uses of *A. muricata* have been identified in tropical regions to treat diverse ailments such as fever, pain, respiratory and skin illness, internal and external parasites, bacterial infections, hypertension, inflammation, diabetes and cancer (Coria-Téllez et all, 2018). Different parts of *A. muricata* especially the leaves have been used for various ethnomedicinal purposes by traditional healers to treat several diseases including cancer, inflammation, diabetes, liver diseases, and abscesses (Wahab et al., 2016).

Morphological and biological characteristics. *Annona muricata* is a low-branching and slender yet slender as its limbs are upturned. Normally evergreen, the leaves have an offensive smell, alternate, smooth, glossy and is dark green on the surface, lighter beneath. Leaves are oblong, elliptic or narrowobovate, pointed at both ends and is 6.25 – 20 cm long and 2.5 – 6.25 cm wide. Flowers may appear anywhere on the trunk, branches or twigs and is borne singly. Flower, short stalk, 4 – 5 cm long, plump, in a triangle-conical shape, have 6 petals, with 3 yellow green slightly spreading fleshy petals as the outer layer and 3 pale yellow close-set petals as the inner petals. Ripe fruit is dark green, covered with soft, short spine and is pseudocarp, broadly ovoid or elipsoid (https://www.nparks.gov.sg/florafaunaweb/flora/3/2/3258).

Figure 10.4. *Annona muricata* L.
(Source: https://www.mygarden.org/plants/7172-soursop-tree)

Climate and soil requirements. Grows best in the moist, humid tropical and subtropical lowlands at elevations up to about 1,000 metres. Prefers a moist but well-drained, sandy loam with a pH in the range 5.5 - 6.5. Succeeds in light-textured, alkaline soils. *Annona muricata* can tolerate dry soil conditions, but the trees shed too many leaves if they experience prolonged drought.

Melliferous value. Flowers are protandrous, and the pollen is shed as the outer petals open towards the evening. The inner petals open much later and only very slightly, admitting small insects attracted by the fragrance of the flowers. Presumably these insects effect cross-pollination, though rather inadequately, for few flowers set fruit and many fruits are misshapen since numerous ovules are not fertilized. Hand pollination is effective in improving fruit yield and quality

10.2.4. Bixa orellana L. (Synonym: Bixa Acuminata Bojer) (Lipstick Tree, Annatto)

Importance and uses. The is a very unique shrub or small tree belongs to the *Bixaceae* family. The flowers of this tropical tree are white or bright pink, but the fruit is actually the most desirable part of the plant, made up of spiky brown and red pods that grow in clusters. When those pods dry and crack open, they expose seeds of a red color, from which red pigment can be extracted. This is why the achiote tree is often called the *lipstick tree*.

Annatto first spread in the form of food coloring, also known as paprika, a condiment widely used in cooking to enhance the color of food. The local population administer the whole plant as a natural drug for the treatment of fever, dysentery, burns, inflammation, burns, and various skin problems. *Bixa orellana* extract comes in the form of seed paste or seed oil. It works as a food, cosmetic and textile dye. Annatto oil is rich in carotenoids and works as a powerful antioxidant. This ingredient is found in facial moisturizer, soap, hair dye, lipstick, shampoo/ conditioner, and tanning products.

It is also used as a condiment in certain parts of the world. It has a floral and nutty smell and is mildly peppery to taste. In the Caribbean and Central American cultures, annatto has been used for thousands of years to cure everything from mild to potentially life-threatening diseases, making it an ancient “superfood”. Annatto, due to its powerful antioxidants, possesses antimicrobial properties and it can kill various pathogens, and bacteria in the body. It is also very effective against various foodborne diseases (https://centerofthewebb.ecrater.com/p/11058382 /lipstick-bush-annatto-bixa-orellana-25).

Morphological and biological characteristics. *B. orellana* is a small tree or shrub measuring from 3 to 5 meters in height, sometimes reaching a height of 10 meters. The trunk is short, measuring 20–30 cm in diameter, with dark gray bark with lenticels in vertical rows. The leaves are alternate, 10 to 20 cm long and 5 to 10 cm wide, sharp, green on both sides, and with extended petioles (de Araújo Vilar et al., 2014).

Figure 10.5. *Bixa orellana* L.
(Source: https://centeroftheweb.ecrater.com/p/11058382/lipstick-bush-annatto-bixa-orellana-25)

Climate and soil requirements. Annatto requires a frost-free, warm, humid climate. It can grow at elevations from sea level up to 2,200 metres in tropical to subtropical climates where a mean annual rainfall of 2,500 - 5,000 mm is distributed throughout the year. It can withstand droughts of up to 4 months, but thrives best with well distributed rainfall and a dry season for seed ripening (http://proseanet.org/). It prefers a mean annual temperature in the range 28 - 32°C, with a mean maximum temperature of 22 - 27°C and a mean minimum temperature of 18 - 26°C. An easily grown plant, it succeeds on almost all soil types, preferring a moist, but well-drained neutral or slightly alkaline soil in a sunny position. Prefers a slightly acid soil, the pH in the range 5.5 - 7.5, tolerating 4.5 - 8.5. It grows into a larger tree when planted in deeper and more fertile soil, rich in organic matter (http://www.worldagroforestry.org/).

Melliferous value. The flowers are an important source of nectar for honey production and also, a huge source of pollen for bees nutrition. Honeybees are observed in plenty around the plant. The duration of flowering is 60-80 of days.

10.2.5. Curcuma longa L. (Turmeric, Indian-Saffron, Common Turmeric, Curcumin)

Importance and uses. *Curcuma longa*, a member of the *Zingiberaceae* family, has rhizomes below the ground. *Curcuma longa* has been used for thousands of years as a remedy in the traditional Indian and folk medicine for the cure of a large variety of illnesses, such as inflammation, infectious diseases, and gastric, hepatic, and blood disorders (Tung et al., 2019).

The active substance of turmeric - *curcumin* (diferuloylmethane), possesses multiple therapeutic properties. In recent years, many detailed research (tests in vito and in vivo) along with clinical trials have revealed its very valuable biological activities related to its anti-inflammatory, antioxidant and cancer preventive properties, which are presented in numerous publications (Pescosolido et al., 2014). The rhizomes represent the economic interest of cultivated turmeric, being characterized and evaluated by the presence of the coloring curcumin, essential oils and oleoresin, besides other nutritive constituents (Cecílio Filho et al., 2000).

Turmeric flowers are used in traditional raw vegetable salads known as “ulam”. In an ulam salad, Turmeric flowers are sliced finely and paired with green beans, bean sprouts, onions, dried shrimp, red chiles, peanuts, and grated coconut. Turmeric flowers may also be cooked with rice to impart an aromatic fragrance. Turmeric flowers are highly perishable, and should be used on the same day that they were bought. To store turmeric flowers, place them in a bag in the refrigerator, where they will last for around a day (https://specialtyproduce.com/ produce/ Turmeric_ Flowers_ 15984. php). Turmeric is the main ingredient in curry powder.

Morphological and biological characteristics. The plant belongs to the herbaceous and perennial type, with 120 to 150 cm height in favorable environmental conditions.

Turmeric is an erect plant with subterranean stem (rhizome) from where four or five leaves with long sticks are formed, alternate disposition, lancet in form, flat and light green color, presenting oblique furrows in the abaxial or ventral side and 25 to 50 cm length and 12 to 16 cm width, forming a kind of stem at the base (Cecílio Filho et al., 2000).

Figure 10.6. *Curcuma longa* L.
(Source: https://www.indiamart.com/proddetail/organic-turmeric-seeds-22638449848)

Climate and soil requirements. Turmeric can be grown from sea level to 1500 m in the hills, at a temperature range of 20-30ºC with a rainfall of 1500-2250 mm per year. It is also grown as an irrigated crop. It thrives best in a well drained sandy or clayey loam rich in humus content. Many soil types are suitable. However well-drained sandy clay loam soils rich with organic matter and sandy loam are the most suitable soil types. Poorly drained rocky or clay type soils are not suitable (http://www.dea.gov.lk/turmeric/).

Melliferous value. Turmeric flowers are available in the summer months. Turmeric flowers are considered to be a rare item, as the Turmeric plant does not blossom frequently. They bloom from July to August. The flowers are sterile.

10.2.6. Momordica charantia L. (Bitter Melon, Bitter Apple, Bitter Gourd)

Importance and uses. *Momordica charantia* is a plant of the *Cucurbitaceae* family, widely grown in Asia, Africa, and the Caribbean for its edible fruit. *Momordica charantia* is also called *insulin vegetal*, and has the following benefits in the fight against diabetes: low blood sugar level; improves blood sugar levels; stimulates insulin production. The fruits of the bitter cucumber are harvested when they are still green, because as they ripen and change color, their flesh becomes excessively bitter, at this stage being toxic and causing gastrointestinal disorders, manifested by abdominal pain, nausea and vomiting, diarrhea.

The uses in gastronomy are innumerable, from hot salads to soups, from breads to rolls, from meat filling to teas.

Fruits contain albuminoids, carbohydrates and pigments. The leaves contain momordisina, momordina, carantina, resin and oil. The root contains momordial acid and oleanolic acid. Seeds contain saponins, alkaloids, triterprenoid, and momordial acid. Large content of beta-carotene to prevent cancer, heart attacks and viral infections (https://www.dlium.com/2020/06/bitter-melon-momordica-charantia.html).

Morphological and biological characteristics. It is an annual herbaceous, perennial plant that grows spontaneously in the tropics, including the Amazon Basin, the Caribbean, Africa, Asia, and South America. The voluble plant, with its stems, has a stem up to 2 m long, deeply lobed leaves, yellow flowers, and the oblong fruit is fleshy, yellow-green, sharp at the tip and more dilated at the base, with a warty surface, resembling a cucumber. The ripe fruit is harvested, from which the juice is obtained by pressing, or dried, when the dry product is extracted. The extracts are processed after removal of the solvent into oral pharmaceutical forms.

Figure 10.7. *Momordica charantia* L.
(Source: https://all.biz/galega-seeds-g8188959RU)

Climate and soil requirements. Temperature is an important factor for optimal growth of bitter cucumber. It prefers temperatures between 22-30°C, but also withstands absolute temperatures between 15-38°C. Momordica prefers bright places (light temperament). The soil is

recommended to be well drained, clay-sandy, with moderate fertility and an optimal pH between 6-6.5, it can withstand higher pH values of 6-8.

Melliferous value. it has a suitable honey value, with a smal production of honey, however, because it is cultivated in stages during the summer, it ensures maintenance. Bees almost do not collect pollen from *Momordica* flowers.

10.2.7. Myristica fragrans Houtt (Nutmeg)

Importance and uses. *Myristica fragrans* belongs *Myristicaceae* Family. Nutmeg is the fruit of an exotic tree, known especially for its uses in the field of gastronomy and pastry. In the natural treatments, as well as in the gastronomy, the kernels of the fruits harvested in July-August are used. Seeds are a very popular spice, with a strong aroma, spicy taste, sweet, slightly bitter. The seeds are rich in essential oil, fatty oil, pectins, dyes. The higher quality ones are used as spices, and the lower category kernels are used to extract the essential oil. Be careful, ground nutmeg quickly loses its flavor, especially in light, air and moisture, so it is recommended that the grind be done just before consumption (https:// ziarul lumina.ro/societate/sanatate/arborele-de-nucsoare-un-rezervor-de-remedii-binefacatoare-135188.html). For therapeutic purposes, infusions, tinctures, essential oil and nutmeg butter are used, which are included in various recipes for ointments, ointments and Nerval balm.

Morphological and biological characteristics. Nutmegs are dioecious tropical forest trees, with 8-15 m of high, sometimes even 20 m. The dioecious nature of nutmegs has long been a problem for nutmeg cultivation, because while some male trees are needed for pollination, only female trees produce the cash crop (Sharma and Amstrong, 2013). The bark is greenish. To facilitate fruit harvesting, trees in intensive plantations are shaped to a height of about 2-3 m. The leaves are dark green, oval, large. The flowers are small, bell-shaped and yellow. The fruit is round, has various colors from light brown to reddish, depending on the variety and contains a fairly large stone. The nutmeg tree begins to produce delicate, yellow flower clusters, from which the fruit emerges, only after at least 8-9 years of vegetation. The nutmeg is not the fruit of the nutmeg tree. The nut is not a nut, but it is the seed of the fruit of this tree, a peach-like fruit. This seed is wrapped in a skin that separates it from the pulp of the fruit. This skin is called *mace*, it is red in fresh form and becomes brown when dry (https://ziarullumina.ro/societate/sanatate/arborele-de-nucsoare-un-rezervor-de-remedii-binefacatoare-135188.html).

The fruit of the nutmeg tree is edible, having a woody texture and being very sour. When the tree bears fruit, the ripening period lasts 9 months from flowering to harvest. The fruits are felled from the tree with the help of long bamboo sticks. In general, nut dries separately from mace. The evergreen leaves are large, glossy, thick, oval, dark green. The flowers are small, bell-shaped, yellow in color and appear on trees over 7 years old. The fruits are fleshy, round, with different colors, from dark brown to reddish. Inside there is a large, brown, peach-like stone (https://gardendrum.com/2013/09/11/nutmeg-and-mace/).

Figure 10.8. ***Myristica fragrans*** **Houtt**
(Source: https://gardendrum.com/2013/09/11/nutmeg-and-mace/)

Male trees usually bear clusters with more flowers. Still, it is difficult to distinguish the sex of the tree before it reaches maturity. Therefore, seedling plants are mainly used as rootstock to graft on the cuttings from selected male and female trees.

Climate and soil requirements. In the tropics, it can be grown below 700 m altitude. The optimal temperaturę range 25-30ºC, and rainfall 2000-3500 mm. Nutmeg can grow on any kind of soil provided there is sufficient water but without any risk of waterlogging. It prefers soils of volcanic origin and those with high contents of organic matter with pH 6.5-7.5. While the Myristica species love a drenching rain, the soil in which the trees are planted must drain well - the shallow roots won't tolerate chronically soggy conditions. For this reason, nutmeg trees are usually grown on mountain slopes. Clay loam, sandy loam and red laterite soils are ideal.

Melliferous value. Flowering occurs on and off throughout the year, with the flowers opening at night and emitting a sweet fragrance to attract moths, the trees specialist pollinators. For this reason there is no question of the honey value of this species.

10.2.8. Syzygium aromaticum (L.) Merr. & L.M. Perry (Synonym: *Eugenia aromatica (L.) Baill.*) (Clove, Bouton Floral de Clou de Girofle, Caryophylli Flos, Caryophyllum, Clavo de Olor, Clous de Girolfe)

Importance and uses. Clove are the aromatic flower buds of a tree in the *Myrtaceae* Family. *Syzygium aromaticum* is a traditional spice that has been used for food preservation and possesses various pharmacological activities. *S. aromaticum* is rich in many phytochemicals as follows: sesquiterpenes, monoterpenes, hydrocarbon, and phenolic compounds. Eugenyl acetate, eugenol, and β-caryophyllene are the most significant phytochemicals in clove oil (Batiha et al., 2020).

The clove is harvested primarily for the unopened flower buds borne in clusters, which are dried to produce whole clove buds, i.e. the familiar spice of commerce. The other products of clove are ground clove, volatile oils produced from clove buds, stem or leaf and oleoresins (Nurdjannah and Bermawie, 2012). Clove essential oil has been used as a topical anesthetic and flavoring for years. It is known to have antimicrobial, antiinflammatory, and antioxidant activity, mostly related to its content of eugenol and other polyphenolic compounds. Other uses of clove have also arisen, like insect repellent or growth promoter agent. Clove essential oil has a controlling effect over native microflora and over pathogenic microorganisms such as *Escherichia coli* (Goñi et al., 2016).

Morphological and biological characteristics. The clove tree is composed of leaves and buds (the commercial part of the tree) and the flowering bud production begins four years after plantation. The flowers are held in terminal, cyme-like panicles. The blooms are made up of a

cylindrical calyx that matures from pale green to red-pink and is topped by the petals, filamentous stamens, and style. The flowers are followed by ellipsoid fruits that contain one seed and mature from red to dark purple-black. When clove is picked for use as a culinary spice, the flower buds are removed when the stamens and style are still wrapped tightly in the unopened petals (Batiha et al., 2020).

Figure 10.9. ***Syzygium aromaticum*** **(L.) Merr. & L.M.Perry**
(Source: https://antropocene.it/en/2020/08/04/syzygium-aromaticum/)

Climate and soil requirements. Clove is strictly a tropical plant and requires a warm humid climate having a temperature of 20 to 30^{o}C. Humid atmospheric condition and a well distributed annual rainfall of 150 to 250 mm are essential. It thrives well in all situations ranging from sea level upto an altitude of 1500 metres and also in places proximal to and away from sea. Deep black loam soil with high humus content found in the forest region is best suited for clove cultivation. It grows satisfactorily on laterite soils, clay loams and rich black soils having good drainage. Sandy soil is not suitable. It is an evergreen tree, and in favorable climates, it grows up to more than 8 meters high, while the cultivated varieties are of a smaller height of around 5 meters. The clove tree trunk has smooth bark with green and grayish-yellow aromatic foliage. It is a slow-

growing but a long-lived tree and can exceed 100 years of age easily (https://balconygardenweb. com/how -to-grow-cloves-cultivation-and-growing-cloves/).

Melliferous value. Clove attracts large numbers of honeybees and native bees since it is a prolific flowerer with a large amount of pollen and a reasonable amount of nectar (https://www.agrifutures.com.au/wp-content/uploads/publications/12-014.pdf).

10.2.9. Tinospora crispa (L.) Hook. F. and Thomson (Brotowali, Akar Aliali)

Importance and uses. *Tinospora crispa* (L.) Hook. f. & Thomson is a medicinal plant belongs to *Menispermaceae* family. The plant has been used traditionally in the treatment of jaundice, rheumatism, urinary disorders, fever, malaria, diabetes, internal inflammation, fracture, scabies, hypertension, reducing thirst, increasing appetite, cooling down the body temperature, and maintaining good health. *T. crispa* is an ingredient in Thai folk remedies. Decoction from the stem of *T. crispa* has been used as an antipyretic, in the treatment of internal inflammations, decreasing thirst, enhancing hunger, cooling down body temperature, and for the maintenance of good health (Kongsaktrakoon et al., 1984; Dweck and Cavin, 2006). The cold infusion of the seed has been used to treat intoxication caused by drugs or alcohol. An infusion of its stem is drunk as vermifuge, a decoction of the stem is used to wash aching eyes and syphilitic sores, the crushed leaves are applied on wounds and made into dressing for itch. In Indonesia (Borneo) it has been used for the treatment of diabetes, hypertension, and backache (Dweck and Cavin, 2006). In Ayurvedic Medicine, Guduchi is classed as bitter and astringent with a special action to destroy toxins – both internally and externally. It is traditionally used to promote life and longevity, increase strength, increase appetite, as an aphrodisiac, a blood cleanser, digestive aid, to alleviate skin disorders and as an adaptogen (https://www.indigo-herbs.co.uk/natural-health-guide/benefits/guduchi).

Morphological and biological characteristics. *Tinospora crispa* is a deciduous, dioecious, climbing shrub about 15 m long with stems of up to 1 cm thick and aerial roots.

The stems of *T. crispa* are fleshy, with prominent blunt tubercles whereas younger stems are slightly fleshy, thin epidermis, membranous, brownish, and glabrous. The leaves are large, heart shaped 6–12 cm long and 7–12 cm wide. Petioles are glabrous and 5–15 cm long. Leaf blade is slightly fleshy, both surfaces glabrous and very delicate when dried. The herb contains two or three small and yellow or greenish yellow color flowers which are fascicled. Male inflorescences is very slender, 5–10 cm or longer. Male flower has six green and glabrous sepals in two whorls.

Outer three are ovate (1 mm) while inner three are obovate. There are 3–6 yellow color petals and six stamens equivalent in length to petals. Female inflorescences are 2–6 cm long, mostly one flower per node. Female flower has sepals and petals as in male. The fruit is 7–8 mm in length (Ahmad et al., 2016).

Figure 10.10. *Tinospora crispa* (L.) Hook. F. and Thomson
(Source: https://stock.adobe.com/ro/search?k=%22tinospora+crispa%22&asset_id=203638651)

Climate and soil requirements. The plant grows in subtropical and tropical climate. Light medium sandy loam soil rich in organic matter, and with adequate drainage, is suitable for its cultivation. It does not tolerate high rainfall or waterlogged conditions.

Melliferous value. Flowers are yellow, unisexual, minute, and less than 2 mm in size. Male flowers are grouped in axillary racemes, while female flowers are solitary. Fruit is an ovoid and succulent drupe, lustrous, red in colour, and of the size of a large pea, having a single seed. Seed is fleshy and curved. Flowering occurs in May–June, while fruiting is witnessed in September–October. The melliferous value is not present enough in the literature, but the flowers by color and duration of flowering could be important for beekeepers.

10.2.10. Zingiber officinale Roscoe (Ginger)

Importance and uses. *Zingiber officinale* belong to *Zingiberacae* Family, is one of the famous spices all over the world. Ginger is a flowering plant whose rhizome, ginger root or ginger, is widely used as a spice and a folk medicine. The plant has a number of chemicals responsible for its medicinal properties, such as antiarthritis, antiinflammatory, antidiabetic, antibacterial, antifungal, anticancer, etc. It is rich in various chemical constituents, including phenolic compounds, terpenes, polysaccharides, lipids, organic acids, and raw fibers. The health benefits of ginger are mainly attributed to its phenolic compounds, such as gingerols and shogaols. Accumulated investigations have demonstrated that ginger possesses multiple biological activities, including antioxidant, anti-inflammatory, antimicrobial, anticancer, neuroprotective, cardiovascular protective, respiratory protective, antiobesity, antidiabetic, antinausea, and antiemetic activities (Gupta and Sharma, 2014). Ginger powder is contraindicated in people with gastritis, gastric or duodenal ulcers, as the volatile oil in the product has an irritating effect on the intestinal mucosa (https://plantemedicinale.site/plante-medicinale/ghimbir-zingiber-officinale/).

Morphological and biological characteristics. It is a herbaceous, perennial plant, over 1 m tall, with large lanceolate leaves and flowers grouped in a spike. In the ground the plant has branched rhizomes, with nodules, with a length of 7-15 cm and a width of 3-4 cm, it is gray to gray-brown. It develops a pleasant aromatic smell, and the taste is aromatic and spicy. Ginger is propagated by planting rootstalk cuttings and has been under this type of cultivation for so long that it no longer goes to seed. Harvesting is done simply by lifting the rhizomes from the soil, cleansing them, and drying them in the sun. The dried ginger rhizomes are irregular in shape, branched or palmate. Their colour varies from dark yellow through light brown to pale buff. Ginger may be unscraped (with all of its cork layer); partly scraped; or scraped or peeled (with all of its cork, epidermis, and hypodermis removed). Ginger flowers are located on long basal stems. Before the appearance of these stems, it is impossible to determine the approaching flowering.

Ornamental, or flowering, gingers are different from the edible variety. These are just for show, and they can certainly be beautiful, with a range of sizes, flower shapes, and colors (Ellis, 2014).

Individual species may bear such uninteresting names as “red ginger” or “yellow ginger,” but collectors should choose plants based on the Latin name to avoid mislabeled plants and

muddled taxonomy issues. Gardeners just looking for an attractive container plant can look for a plant in bloom that they admire, as all tropical gingers thrive under similar growing conditions.

Figure 10.11. *Zingiber officinal* Roscoe
(Source: https://www.gardentags.com/profile/treefrog44/zingiber-officinale/1397472)

Climate and soil requirements. Ginger likes moisture and heat, so the soil should be kept moist. Water should not stagnate because the roots may rot. The optimum temperature is at least 20 degrees.

Ginger does not withstand temperatures below 10 degrees.

Melliferous value. Ginger flowers are very decorative, pink and red, and in recent years are increasingly used to make arrangements for festive occasions, but the flowers are sterile. The flowers of spiral gingers come in different colors and shapes to attract different types of pollinators. Bee-pollinated flowers have stripes on their petals and a lip where bees can land, whereas hummingbird-pollinated gingers have bright-red tube-shaped flowers full of nectar (Hunter, 2017).

CHAPTER 11

IMPORTANT SPECIES OF AROMATIC, MEDICINAL AND MELLIFEROUS PLANTS IN POLAND

11.1. General aspects of Poland

Geographic characteristics. Poland lies at the physical centre of the European continent, approximately between latitudes 49° and 55° N and longitudes 14° and 24° E. Irregularly circular in shape, it is bordered to the north by the Baltic Sea, to the northeast by Russia and Lithuania, and to the east by Belarus and Ukraine. To the south the border follows the watershed of the Beskid (Beskidy), Carpathian (Karpaty), and Sudeten (Sudety) mountains, which separate Poland from Slovakia and the Czech Republic, while to the west the Neisse (Nysa Łużycka) and Oder (Odra) rivers define the border with Germany. Topographically, Poland is a diverse country; although most of the central terrain is flat, there is an abundance of lakes, rivers, hills, swamps, beaches, islands and forests elsewhere (https://en.wikipedia.org/wiki/Geography_of_Poland).

During the *Agropuzzle 4 project* activities, mobilities and professional study visits were organized both in the Opole area and in the Bialylistok area.

Figure 11.1. Poland map
(Source: https://www.onestopmap.com/poland/poland-14/)

Climate and soil conditions. The natural landscape of Poland can be divided broadly into three relief groups: the lowlands, the highlands, and the mountains. The eastern extremes of Poland display characteristics common to eastern Europe, but the rest of the country is linked to western Europe by structure, climate, and the character of its vegetation. The lowland characteristics predominate: the average elevation of the whole country is only 173 metres above sea level, while more than three-fourths of the land lies below 198 metres. Poland is the fourth most forested country in Europe. On average, precipitation in summer is twice of that in winter, providing a dependable supply of water for crops. The growing season is about 40 days longer in the southwest than in the northeast, where spring arrives latest (https://en.wikipedia.org/wiki/ Geography_of_ Poland#cite_ note-ref_ name = rap BIP-9).

The average annual precipitation for the whole country is 600 mm, but isolated mountain areas receive as much as 1,300 mm per year. The total is slightly higher in the southern uplands than in the central plains. A few areas, notably along the Vistula between Warsaw and the Baltic Sea and in the far northwest, average less than 500 mm. Forests cover about 30.5% of Poland's land area based on international standards (Centrum Informacyjne Lasów Państwowych, 2012).

Socio-economic aspects. In 2018, the most important sectors of the Polish economy were: wholesale and retail trade, transport and accommodation and catering services (26.2%); industry (25.6%) and public administration, defense, education, health and social assistance (14.0%). 80% of Poland's exports are made to the EU (Germany 28%, Czech Republic and France 6% each). Outside the EU, 3% of exports go to Russia and the United States, respectively. Polish imports come from 69% of the other EU Member States (Germany 27%, the Netherlands 6% and Italy 5%). Imports from outside the EU include those from China (8%) and Russia (7%) (https://european-union. europa. eu/ principles- countries-history/country-profiles/poland_ro).

11.2. Important species of aromatic, medicinal and melliferous plants

Many plants and animals that have since died out in other parts of Europe still survive in Poland, such as the wisent in the ancient woodland of the Białowieża Forest and in Podlaskie.

Białowieża Forest is one of the last and largest remaining parts of the immense primeval forest that once stretched across the European Plain. The forest is home to 800 European bison, Europe's heaviest land animal. UNESCO's Man and the Biosphere Programme designated the

Polish Biosphere Reserve Białowieża in 1976 and the Belarusian Biosphere - *Belovezhskaya Puschcha* in 1993 (https://en.wikipedia.org/wiki/ Bia% C5% 82owie% C5% BCa_Forest).

The most important species of aromatic, medicinal and melliferous plants in Poland, developed by Agricultural Chamber of Opole, are present in Table 11.1.

Table 11.1

The most important species of aromatic medicinal and melliferous plants in Poland (Agricultural Chamber of Opole team, Poland)

Scientific name	Name in Polish language
Achillea ptarmica	Kichanie, Czyszcz
Artemisia absinthium	Piołun, Absynt
Chamomilla recutita	Rumianek
Cichorium intybus	Endywia
Cyanus segetum	Jagody
Hypericum perforatum	Grzechotki
Inula helenium	Duża trawa, Wielka trawa
Juniperus communis	Jałowiec
Ledum palustre	Dziki rozmaryn
Linum usitatissimum	Len
Mellilotus officinalis	Nostrzyk żółty
Mentha piperita	Mennica
Papaver somniferum	Mak roślina
Pinus silvestris	Sosna
Plantago major, Plantago media	Babka zwyczajna
Sambucus nigra	Roślina szokowa
Succisa pratensis	Czarcikęs
Sylibum marianum	Ostropest plamisty
Urtica urens	Pokrzywa żegawka
Vaccinium myrtillus	Borówka czarna
Valeriana officinalis	Kozłek lekarski
Viola arvensis	Fiołek polny

11.2.1. Achillea ptarmica L. (Sneezewort Yarrow, Sneezewort, Bastard Pellitory)

Importance and uses. *Achillea ptarmica* is a European species of herbaceous, perennial flowering plant, in the *Asteraceae* Family. Leaves can be eaten raw or cooked. *Achillea ptarmica* yields an essential oil that is used in herbal medicine. The leaves are used as an insect repellent. The root is used as medicine. People make a tea from dried sneezewort root and use it for joint and muscle pain, toothache, diarrhea, nausea, vomiting, intestinal gas, tiredness, urinary tract problems, and loss of appetite (https://en.wikipedia.org/wiki/Achillea_ptarmica).

Morphological and biological characteristics. *Achillea ptarmica*, commonly called sneezewort or sneezeweed, is a rhizomatous perennial featuring loose corymbs of small white flowers which bloom throughout summer on plants clad with sessile, linear to lanceolate, finely toothed leaves that are aromatic when crushed. Species plants are native to Europe and western

Asia. The genus name *Achillea* refers to Achilles, hero of the Trojan Wars in Greek mythology, who used the plant medicinally to stop bleeding and to heal the wounds of his soldiers. Specific epithet is from Greek and refers to plants which caused sneezing. Elegant sprays of pure white, double and semi-double pom-pom flowers are borne over a long period from June to August above finely toothed, dark green leaves (https://www.rhsplants.co.uk/plants/_/achillea-ptarmica-the-pearl-group-the-pearl-clonal/ classid. 164/). Stems are mostly erect, usually branched, hairy on the upper stems and usually smooth below. Plants can form colonies from spreading rhizomes.

Figure 11.2. *Achillea ptarmica* L.
(Source: https://upload.wikimedia.org/wikipedia/commons/a/ad/Achillea_ptarmica_2.jpg)

Climate and soil requirements. *Achillea ptarmica* is most often found on damp acid grassland and frequently beside streams, especially on heavy clay-based soils. Other sites where you are likely to find *Achillea ptarmica* include heathland, watermeadows and marshes. Tolerant of summer heat and humidity.

Melliferous value. The flowers first appear in July and sneezewort usually continues blooming into September, therefore it has a good honey value.

11.2.2. Hypericum perforatum L. (St. John's Wort)

Importance and uses. *Hypericum perforatum* belongs *Hyperaceae* Family. St. John's wort is one of the oldest and most widely used medicinal plants. In phytotherapy, the aerial part of the plant, harvested during flowering, is used. Contains tannins (bitter substances) up to 12%, but also small amounts of volatile oil located in the transparent points of the leaves, flavonic glycosides

such as hyperin, rutin, located in the petals and epidermis of the stem of the leaves, as well as hypericin (purple pigment, almost black) in flowers (0.2-0.3%) (Coiciu and Racz, 1962). Hypericin is soluble in lipids and gives the plant a healing and antiseptic action, and tannin has astringent properties.It is used as an infusion in chronic colitis, liver disease, or hyperacidity. Externally it can be used in baths, in poultices to relieve pain and heal wounds, especially in burns. It can also be used as an infusion for gargling, as it has anti-inflammatory action on the gums or teeth. This plant can also be used in the beverage industry, in the preparation of various liqueurs.

Morphological and biological characteristics. It is a herbaceous, perennial plant, with heights of 20-80 cm. The root is represented by a short rhizome, and the stem is cylindrical, with 2 longitudinal edges, lignified at the base. The leaves are opposite, oval or elliptical, with black dots at the top. The flowers have free, yellow petals. The fruit is an oval capsule, the seeds are cylindrical, blackish-brown. It blooms from May to September.

Figure 11.3. *Hypericum perforatum* L.
(Source: https://www.bzi.ro/ceai-de-sunatoare-pentru-stomacul-bolnav-reteta-4021523)

Climate and soil requirements. St. John's wort has high ecological plasticity, with low requirements for climate and soil factors. It is a light-loving plant, but grows in very different areas, not being pretentious to soil types.

It occurs spontaneously in sunny places, from the plains to the hill area, and can be grown in all parts of the country. We can also find it in meadows, at the edge of fields or in forests.

Melliferous value. St. John's wort is a herbaceous plant with yellow flowers without nectar, with many stamens gathered in a bunch from which bees collect a lot of pollen in the morning (Ion et al., 2008).

11.2.3. Inula helenium L. (Grass-seaweed, Horse-Heal, Elfdock)

Importance and uses. *Inula helenium* is a widespread plant species in *Asteraceae f*amily. The important substance present in the roots is inulin, which, although it is a polysaccharide compound, like sugar, does not lead to an increase in blood sugar. The roots also contain a volatile oil in the amount of 1-3%, its cold deposition in the solid state forms the so-called camphor of inula or helenine, a mixture of various scviterpenes (allantolactone and similar compounds). In addition, terpenic substances, phytoncides (plant-synthesized antibiotics), fridelin, damaradeniol, stigmasterol and others have been identified (https://www.csid.ro/plante-medicinale/iarba-mare-inula-helenium-11490520/).

According to the principles contained, the preparations of seaweed root have an expectorant, spasmolytic, choleretic, cholagogue and diuretic effect as well as a general tonic action. Phytoncides give herbal remedies anthelmintic, bacteriostatic and antiviral properties. The effect mentioned by the specialized treatises on the tubercle bacillus is remarkable. According to laboratory studies, sesquiterpenes appear to have inhibitory properties on tumor cells (https://www.csid.ro/plante-medicinale/iarba-mare-inula-helenium-11490520/).

Morphological and biological characteristics. Grass-seaweed is one of the plants with large yellow flowers, commonly found in the mountains and hills. It is a hardy herbaceous plant, quite tall, which grows especially in wet places by the water's edge. It has a thickened root with ring-shaped scars, from which long but thinner branches emerge. The seagrass blooms from June until late September. The flowers are sometimes more than 5 cm in diameter, and their intense yellow color makes them easily visible even from a distance.

Figure 11.4. *Inula helenium* L.
(Source: https://gorjeanul.ro/iarba-mare-inula-helenium-beneficii-si-proprietati/)

Climate and soil requirements. *Inula helenium* has a high ecological plasticity, being met both in the plain and hilly area, but also in the mountains, in the forest edge or along the waterline. It is present even in places where the sun penetrates harder (conditions where its width is lower). From the soil's point of view, the plant finds favorable conditions on moderately weak acid soils, not very demanding in term of soil structure, which gives it some easiness to adapt to the conditions of introduction into culture (https://ga-online.org/wp-content/uploads/2020/11/O1-Manual-for-rural-entrepreneurship-through-producing-and-valorising-of-herbs-that-are-endangered-or-available- only-from-spontaneous-flora-1.pdf).

Melliferous value. Yellow flower heads of ele-campane develop in June-August, growing individually orin corymbs. Honeybees love the sneezewort 's abundance of pollen and nectar.

11.2.4. Ledum palustre L. (Ait.) Hult. (Synonym: Rhododendron tomentosum Harmaja) (Wild Rosemary, Marsh Tea, Marsh Rosemary, Northern Labrador Tea)

Importance and uses. *Ledum palustre* is a plant in *Erichaceae* Family. Plant from the Mediterranean area, whose leaves are rich in minerals (iron, calcium), vitamin B6, volatile oils, flavonoids, tannins, having antiseptic, diuretic, carminative, antibacterial, expectorant, blood circulation stimulant, astringent, nerve tonic, being recommended in digestive disorders, cardiovascular disorders, hair loss, premenstrual syndrome, liver disorders. The plant is having

heavy aromatic odour and a camphoraceous bitter taste. The leaves and branches of wild rosemary emit a pungent odor, which is explained by the content of a complex essential oil of the plant, which has poisonous properties that affect the nervous system and cause dizziness, headache, nausea, vomiting and sometimes loss of consciousness. In folk medicine, wild rosemary is used for diseases of the respiratory system; bronchitis, tracheitis, laryngitis, pneumonia, flu, asthma, cough, whooping cough, sores, and snake and insect bites (https://ro.mygardenspaces. com/ 6593572-ledum-is-an-intoxicating-plant-care-cultivation-reproduction-medicinal-properties-kinds- photo-and-mdash).

Morphological and biological characteristics. An evergreen shrub, upto 1 meter in height, with several clustering rounded branches, covered with a rust coloured fur; stem-bark ash coloured. The rhizome is well developed, growing in the soil to a depth of about 50 cm. The stems of wild rosemary can be erect, ascending or lying down, which during the growth of the plant take root in moist soil. The bark of young shoots is rust-brown, with tomentose pubescence, the old branches are gray-brown and bare. Leaves with 5 cm long, alternate, short petioled, lanceolate, rolled back on edges, glabrous, green and shinning above, red, rust-coloured and downy below. Flowers are grouped in dense terminal corymbs, with filiform, pubescent pedicles, white or pale rose red colour (http://www. hplism. nic. in/ sites / default/files/ledum-palustre.pdf).

Figure 11.5. *Ledum palustre* L. (Ait.) Hult.
(Source: https://ro.mygardenspaces.com/6593572-ledum-is-an-intoxicating-plant-care-cultivation-reproduction-medicinal-properties-kinds-photo-and-mdash)

Climate and soil requirements. *Rhododendron tomentosum* prefers wetlands in coniferous forests and wetlands themselves. It also grows in peat bogs. It is resistant to cold, but rarely used in gardening because it is very poisonous (https://rum.manteton.com/ miscellanea/ 20464- cum-s-creti-un-rozmarin-frumos-in-ar.html).

Melliferous value. The species is hermaphrodite (has both male and female organs) and is pollinated by bees.

11.2.5. Papaver somniferum L. (Poppy, Breadseed Poppy)

Importance and uses. *Papaver somniferum* is a species of *Papaveraceae* Family. National Flowers (**kwiaty narodowe**) are symbols representing a country. Some national flowers have cultural or religious roots (**korzenie kulturowe lub religijne)** that go back hundreds or even thousands of years and may or may not have been officially adopted. The national flower of Poland is a beautiful red poppy (**czerwony mak**) (https://blogs.transparent.com/polish/did-you-know-that-poppy-is-the-national-flower-of-poland/).

Poppy has been cultivated since ancient times for its seeds for food. In Europe, the plant was first used to extract oil, and after 1930 it was used for pharmaceutical purposes to extract opium. Today, due to the fact that heroin can be extracted from opium, all poppy crops are under the control of international bodies. The capsules are used for pharmaceutical purposes. Capsules and opium (latex obtained by incising green capsules) contain a large amount of alkaloids, mainly morphine, then narcotine, codeine, papaverine (Muntean, 1988). The alkaloid content depends on the variety, climatic conditions and cultivation technology. Morphine is one of the most powerful pain relievers, with important uses in medicine. Morphine and its derivatives have a euphoric (low dose), hypnotic (high dose) action, dangerous for humans, being included in the list of drugs. Codeine has a sedative effect on the cough center, being less toxic than morphine. It is part of a cough medicine (Codenal, Tusigal, Codeine phosphate). Papaverine is a valuable non-toxic spasmodic used in smooth muscle spasms. It is part of Lizadon. Poppy capsules are part of medicinal teas, but very well dosed, against colic or sedative (Chirilă et al.,1987). Poppy seeds can also be used for confectionery, pastry, bakery. The lipids from the seeds extracted by cold pressing are edible, and from a second hot pressing, drying oil is obtained, used in industry.

Cakes are a concentrated feed of great nutritional value to animals.

The leaves are used in the feeding of silkworms, and the stems for fire.

Morphological and biological characteristics. The poppy is an annual herbaceous plant. The root is pivoting, well developed, with numerous branches, spread over a radius of about 20-35 cm. The stem is erect, 70-140 cm high, green-bluish-gray, branched at the top, usually covered with a waxy start (Mihalea, 1998). The leaves are petiolate, ellipsoidal, with an irregular edge and a prominent median rib. The flowers are large, solitary at the top of the main stem and each branch. The petals have a purple or black spot at the base. The poppy blooms in mid-August. The fruit is a capsule, spherical in shape, which contains seeds, kidney-shaped, white, yellowish or bluish-gray.

Figure 11.6. *Papaver somniferum* L. (original)

Climate and soil requirements. It is native range is probably the eastern Mediterranean, but is now obscured by ancient introductions and cultivation, being naturalized across much of Europe and Asia. The poppy prefers wetter and cooler areas, but it needs higher temperatures and less rainfall to synthesize morphine. The minimum germination temperature of poppy seeds is around 1-2^{o}C. The plant withstands temperatures down to -4^{o}C, in the phase of 3-4 leaves (Mihalea, 1988). It has high humidity requirements, especially in the first part of the growing season. Nebulae and rains contribute to the decrease in the amount of alkaloids in the capsules (Coiciu and Racz, 1962). The garden poppy needs strong light, being sensitive in the early stages of vegetation to shading caused by weeds or too high density of plants in the field (Roman et al.,

2007). The poppy has no special demands on the soil. However, it manages to accumulate a higher amount of alkaloids on neutral, deep, permeable, nutrient-rich soils.

Melliferous value. The poppy is an excellent honey plant and can also be grown as an ornamental plant (Mihalea, 1988).

11.2.6. Plantago lanceolata L. (Ribwort Plantain, Narrowleaf Plantain)

Importance and uses. *Plantago lanceolata* is a species of flowering plant in the plantain family Plantaginaceae. *Plantago lanceolata* is a medicinal plant known and used since ancient times. The fresh leaves are applied in the form of poultices to heal wounds (due to the presence of vitamin K), and the syrup has emollient, anti-inflammatory action, facilitates ejaculation and is used especially in treating bronchitis or respiratory diseases (Dumitrescu, 1988). Also, it is cultivated for the leaves that are the basis for obtaining medicinal preparations such as: syrups, teas, tinctures. It contains mucilaginous substances and tannins with antibacterial, healing and astringent effect (Haznagy, 1971, quoted by Dumitrescu, 1988).

Morphological and biological characteristics. Narrow plantain is a herbaceous, perennial plant with short, thick roots and 10-20 lanceolate leaves arranged in a basal rosette. The inflorescence is spiciform, located at the top of the stem, white-yellow. It blooms from May to June. The fruit is an ovoid capsule, which can contain two seeds. The seeds are black.

Figure 11.7. *Plantago lanceolata* L.
(Source: https://mancamsanatos.ro/patlagina/)

Climate and soil requirements. Ribwort plantain has high ecological plasticity, being found spontaneously in all areas of the country, in grassy areas, on roadsides, in pastures, in weed crops. Demonstrates moderate requirements for climatic factors and soil. It withstands drought and low winter temperatures well. The most favorable conditions are found in the forest-steppe areas, on chernozems and on crust-free soils.

Melliferous value. With the pollen being wind-dispersed for the most part, the plant is occasionally pollinated by bees.

11.2.7. Succisa pratensis Moench. (Devil's Bit Scabious, Devilsbit)

Importance and uses. *Succisa pratensis* is a herbaceous plant that is part of the *Dipsacaceae (Caprifoliaceae*) family. The plant is recommended for upper respiratory tract infections, pulmonary congestion, bronchitis, pneumonia, asthma, flu, laryngitis, tracheitis, hoarseness.

Morphological and biological characteristics. It is a perennial herbaceous plant, the rhizome is black. The stem, measuring between 30-100 centimeters, has vertical branches, covered with hairs. The leaves, oval-oblong, are located opposite the base of the stem, and the flowers, located at the top of the vines and gathered in spherical heads, are blue-purple. The fruits are achene. The ruin blooms from July to October. For therapeutic purposes, the leaves and flowers are used, which are harvested during the maximum flowering period, but also the roots.

Figure 11.8. *Succisa pratensis* Moench.
(Source: https://gorjeanul.ro/ruin-succisa-pratensis-beneficii-si-proprietati/)

Climate and soil requirements. A perennial herb, growing in a wide range of moist to moderately free-draining habitats, and favouring mildly acidic soils. It occurs in woodland rides, in heathland and grassland and in medows, and in the uplands on cliff ledges and in ravines.

Melliferous value. It is a good source of nectar for bees and is the larval food plant of the marsh fritillary (https://en.wikipedia.org/wiki/Succisa_pratensis).

11.2.8. Vaccinium myrtillus L. (Blueberry, European Blueberry)

Importance and uses. *Vaccinium myrtillus* belongs to the *Ericaceae* family. The leaves contain tannins, catehic tannins and proanthocyanidin. Compared with cranberry, blueberry leaves do not contain any arbutin whatsoever. The blue colour of the fruit is due to mirtilene, an anthocyanin. In addition, the fruits contains tannins and anthocyanin glycosides. The leaf tea has carminative and diuretic effects, due which it can be used in case of kidney or bladder problems (http://www.naturalherbs.ro/project/european-blueberry-vaccinium-myrtillus/).

Blueberry jam, syrup and wine are all are very popular and delicious products, the latter improving the strength of the human body.

Blueberries frutis have antioxidant, antiviral and antibacterial properties and contain very few calories compared to other fruits, with a low glycemic index, which is recommended in any diet, including the diet of people with diabetes.

Blueberries fruits contain in large quantities vitamins A, B6, C, E, K, calcium, magnesium, potassium, but also sodium. However, what makes them really valuable are the antioxidants in the composition. Also, contain anthocyanins, coloring antioxidants, resveratrol and quercitin. In addition, blueberries contain healthy protein, fiber and carbohydrates.

Morphological and biological characteristics. Blueberry grows in the form of a bush, which can reach up to 1-2 m in height. The root system develops superficially and can reach 40 cm depth. The shrub develops numerous stems from the package area, which are approximately equal and fruitful in the second year after planting. The stems are weakly branched, and their color varies from green to reddish-brown. The vegetative buds have a triangular shape and are located on the annual branches. The flower buds are round and form on the top of the stems. The leaves are elliptical, short peduncled and the flowers are grouped in racemose inflorescences. The blueberry plant is a self-fertile species, with spherical berry fruit, flattened, blue in color and covered with a layer of plum (wax).

Figure 11.9. *Vaccinium myrtillus* L. (original)

Climate and soil requirements. Blueberry is widespread throughout Europe, besides Northern Europe it is generally found on high hills or in mountain areas. It prefers fresh, acid soils and avoids the calcareous ones (http://www.naturalherbs.ro/project/european-blueberry-vaccinium-myrtillus/). Blueberry is a species resistant to low temperatures, depending on the variety. During the vegetative rest it resists temperatures of -20 ℃, but the late frosts destroy the flower buds, causing the drastic decrease of the production. The shrub is sensitive to drought, but also to excess moisture in the soil. The best results are obtained in areas where 800-1000 mm of rainfall falls annually, evenly distributed throughout the year. On well-lit lands, blueberries bear abundant fruit, but they also support lightly shaded lands. Being sensitive to air currents, the plot on which the shrubs were planted must be surrounded by protective curtains. A limiting factor in blueberry cultivation is the soil, because this shrub grows and grows on acidic soils, with a pH between 4.2 and 4.8. Also, the soil must be well drained and rich in humus.

Melliferous value. Blueberries have a flowering period between May and July or August, depending on the variety. The melliferous value is made up of pollen and nectar and 10-20 kg of honey / ha can be obtained (Ion et al., 2008).

11.2.9. Valeriana officinalis L (Valerian)

Importance and uses. *Valeriana officinalis* is a medicinal plant belongs *Valerianaceae* Family. Valerian known and used for therapeutic purposes since ancient times, but the recognition of the sedative therapeutic action has been made since the eighteenth century. The name derives from the Latin "valere" which means to be healthy, to be strong, thus showing its therapeutic properties (Morariu, 1961).

Valerian is cultivated because the whole plant contains volatile oil, but the underground parts are richer. The volatile oil content of fresh roots is 0.05-0.22%. The chemical composition of valerian is very complex, and the therapeutic action of the various compounds has not been fully understood. The raw material is rhizomes and root. The active compounds (volatile oil, acids, alkaloids) have a sedative action on the nervous and cardiac system and also an antispasmodic action. Valerian can also be used to fight insomnia or heart neurosis. It is part of Extraverar and other products, as well as teas: calming, gastric, sedative and against heart disorders. Uninterrupted use leads to addiction, and overdose leads to negative effects on the digestive tract, causing headaches and nausea (Roman and Toader, 2007).

Pharmacodynamic, ensures sedation of the nervous system, reduces the state of arousal, regulates the heart rhythm, helps in insomnia, anticolic and antispastic, antiasthmatic, emetic, hypotensive (https://jorjette.ro/valeriana/).

Morphological and biological characteristics. Valerian is a perennial, herbaceous plant that forms a rosette of leaves at the beginning of the growing season and in summer, or the following year, flowering stems appear. If it is grown only for root harvesting, then it is considered an annual plant crop. The root system consists of a 2-4 cm long rhizome, brown in color, with short stolons and adventitious roots, consisting of 60-70 roots, with many branches, and a characteristic odor after drying. The stem is branched, 80-150 cm high, green-violet. The leaves at the base are imparipinnate, with serrated or entire edges. The inflorescence is a corymb-shaped raceme, and the flowers are pink or white. The fruit is an achene, which ends at the top with a narrow part, either in the shape of a crown or in the shape of a funnel. The fruits are yellow-brown in color and contain a single seed. It blooms from May to August (Roman and Toader, 2007).

Figure 11.10. *Valeriana officinalis* L.
(Source: https://all.biz/galega-seeds-g8188959RU)

Climate and soil requirements. Valerian has moderate temperature requirements, germinating at temperatures of 4-5^{o}C, and over the winter it can withstand temperatures of -20^{o}C.

It can also be found spontaneously, through forests, hayfields, wet depressions, in the hill and mountain area, with high humidity requirements. The best production results are obtained on deep, humus-rich, well-drained soils with shallow groundwater, as well as on turbid soils. Clay-rich soils are not recommended because they reduce the development of the root system and create problems when harvesting roots.

Melliferous value. It blooms in June-July and gives bees only nectar. Sometimes due to competition with other honey plants that bloom at the same time, valerian flowers are weak or not at all researched by bees.

11.2.10. Viola arvensis (Synonym: Viola tricolor ssp. arvensis) (European Field Pansy, Field Pansy, Field Violet, Wild Pansy)

Importance and uses. *Viola arvensis* are annual to perennial flowers (depending on winter temperatures) in the *Violaceae* family. For therapeutic purposes, the aerial part of the plant is used, harvested during the flowering period from May to the end of August. The plant has expectorant action, diuretic, stimulating the activity of the kidneys, antiallergic, dermal regenerating,

antipyretic, sweating due to methyl salicylate and salicylic compounds, choleretic action, slightly laxative, a strong depurative action (https://www.csid.ro/plante-medicinale/trei-fra%c5%a3i-p%c4%83ta%c5%a3i-viola-tricolor-11662964/).

The plant contains volatile oil, saponin as well as coloring pigments. The tender leaves give a special flavor to salads green. The flowers are used in the production of perfumes. Stems in preparation of ointments.

Morphological and biological characteristics. Viola arvensis is an annual herbaceous plant, with a thin root of 3-5 cm long. The stem is arched at the base or ascending, simple or branched, with a height of 8-40 cm. Leaves are different in shape (the lower ones are wide-oval and long petiolate, then the petiole shortens to become elongated lanceolate at the top). The flowers have different colored petals (2 upper ones dark or light purple, sometimes white-yellow, the lower one yellow with dark stripes, 2 sides white, yellow or purple-bluish).

The fruit is an elongated-ovate capsule (https://bionutris.ro/trei-frati-patati-beneficii-pentru-sanatate-proprietati- terapeutice- mod- de-utilizare-efecte-secundare-contraindicatii/).

Figure 11.12. *Viola arvensis* L.
(Source: https://lataifas.ro/medicina_naturista_alternativa/1004/trei-frati-patati/)

Climate and soil requirements. Viola arvensis is a herbaceous plant that grows in meadows, at the edge of forests, meadows, on the coasts and cliffs from the hill to the subalpine

area. The plant grow anywhere, but prefer moist, slightly acidic soil and a cold climate. It can be placed in the sun or in a more shady place, where the light only slips.

Melliferous value. Produces Nectar for Bumblebees and may be visited by Honeybees, but are a minor source for both. Pollinated by bees.

CHAPTER 12

IMPORTANT SPECIES OF AROMATIC, MEDICINAL AND MELLIFEROUS PLANTS IN PORTUGAL

12.1. General aspects of Portugal

Geographic characteristics. Portugal is a country lying along the Atlantic coast of the Iberian Peninsula in southwestern Europe. To its north and east is Spain, which makes up the rest of the peninsula; to the south and the west is the Atlantic Ocean; and to the west and southwest lie the Azores (Açores) and the Madeira Islands, which are part of metropolitan Portugal. Portugal is not a large country, but it offers a great diversity of physical geography, ranging from low-lying coasts and plains to the Estrela Mountains, which rise to nearly 6,500 feet (2,000 metres).

Figure 12.1. Portugal map
(Source: https://bialog.ro/2013/04/portugalia-pe-val-10-locurimotive-pentru-care-as-vizita-o/

Climate and soil conditions. The climate of Portugal is temperate and influenced by the Atlantic Ocean. In the north, the climate is cool and rainy, while moving south it becomes gradually warmer and sunnier; in the far south, the region of Algarve has a dry and sunny

microclimate. In the interior, on the border with Spain, the climate is a bit more continental. In the north-central there are also mountain ranges. In the highest, Serra da Estrela, you can ski in winter. In summer, Portugal is protected by the Azores High, so it's usually sunny everywhere, however, a few weather fronts can still affect the northern part of the country. In the rest of the year, and especially from November to March, rainfall can occur, especially in the north where it is more frequent and abundant (https://www.climatestotravel.com/climate/portugal).

Along with climatic variation, topographic differences between north and south are obvious. Tagus River, running (angle of ≈ 45° with North) from the eastern Spanish border towards the western cost, divides the country in two large regions. North of Tagus River, land is hilly, slopes are steep and soils are shallow, with the obvious exceptions of large river valleys. South of Tagus River, topography is rolling and soil depth tends to be greater (http://www.set-revue.fr/combining-soil-water-balance-models-and-water-stress-indicators-irrigation-scheduling-case-study).

Socio-economic aspects. The most important sectors of Portugal's economy in 2018 were wholesale and retail trade, transport, accommodation and food services (24.9%) and public administration, defence, education, human health and social work activities (19.1%) and industry (18.5%). Intra-EU trade accounts for 76% of Portugal's exports (Spain 25%, France 13% and Germany 11%), while outside the 5% go to the United States and 3% to Angola. In terms of imports, 76% come from EU Member States (Spain 31%, Germany 14% and France 8%), while outside the EU 3% come from China and 2% from both the United States and Russia (https://european-union.europa.eu/principles-countries-history/country-profiles/portugal_en).

12.2. Important species of aromatic, medicinal and melliferous plants

Portugal, crossroad of peoples and cultures which, allied to geographical factors, has given rise to very diverse environmental niches, is cradle to a rich flora, comprising 3,800 described species of which, 500 are of aromatic and/or medicinal potential. These species are distributed mainly by the families *Apiaceae, Asteraceae, Cupressaceae, Hypericaceae, Lamiaceae, Lauraceae, Leguminosae, Liliaceae, Malvaceae, Myrtaceae, Oleaceae, Pinaceae, Rosaceae and Rutaceae*. Some of these species are endemic, sometimes with very vulnerable ecological niches. Many of these species are the subject of monographs in European and Portuguese pharmacopoeias.

The most important species of aromatic, medicinal and melliferous plants in Portugal provided by Rural Delepment Organisation of Covilha as partener of Agropuzzle 4 project, are present in Table 12.1.

Table 12.1

The most important species of aromatic medicinal and melliferous plants in Portugal (RUDE of Covilha, Portugal)

Scientific name	Name in Portuguese language
Aloe vera	Babosa
Artemisia absinthium	Absinto
Artemisia dracunculus	Estragão
Coriandrum sativum	Coentro
Echinacea purpurea	Equinácea
Elettaria Cardamomum	Cardamomo
Foeniculum vulgare	Fenício
Gomphrena globosa	Perpétua
Jasminum officinale	Jasmim
Juniperus communis	Zimbro
Lavandula angustifolia	Lavanda
Lavandula pedunculata	Lavanda francesa
Marrubium vulgare	Marrubio, Hierba Del Sapo O Toronjil
Matricaria recutita	Camomila
Melissa officinalis	Melissa
Mentha spicata	Hortelã
Ocimum basilicum	Manjericão
Origanum vulgare	Orégano
Petroselinum crispum	Salsinha
Plectranthus forsteri marginatus	Ivy sueca
Rosmarinus officinalis	Alecrim
Salvia officinalis	Sábio
Satureja montana	Salgados de inverno
Verbena officinalis	Algebrado, Aljabão, Argebão

12.2.1. Artemisia dracunculus L. (Tarragon)

Importance and uses. *Artemisia dracunculus* belongs to the *Asteraceae* family and has its origin in the has its origin in Europe and Asia. It is used as a digestive, to lower fevers and destroy roundworms. *Artemisia dracunculus* is an aromatic plant rich in antioxidants, vitamins and minerals known for its ability to stimulate appetite and lower blood glucose levels. The raw materials obtained from this species are herb and leaf. The presence of essential oil with a highly variable composition, as well as flavonoids, phenolic acids, coumarins and alkamides, determines the medicinal and/or spice properties of the plant (Ekiert et al., 2021).

The rich and pleasant scent of tarragon makes it a wonderful addition to delicate dishes with chicken, sour cream, mayonnaise or mushrooms. But most often it is used in salads. Frequently flavor vinegar or olive oil for salads. For this purpose, it can be combined with capers.

Tarragon is best highlighted when used in cooked vegetables, marinades, steaks, fish and poultry fillings, mayonnaise, pickled cucumbers in vinegar, tartar sauce and cucumber salad. Tarragon has a very strong aroma, a little bitter. Its leaves are very fragrant, but also rich in vitamins (A and C), mineral salts and iodine. Tarragon successfully replaces salt, pepper, vinegar. It should, however, be used sparingly because too much can taste bitter to the food. Chopped tarragon leaves fit perfectly and sprinkled on top of egg dishes (omelette or mesh), but also in game dishes. Tarragon is the typical flavoring for Béarnaise sauce that can be considered the most spicy version of Dutch sauce. Tarragon is a plant with special properties. The pleasantly flavored leaves and stems are used to season foods, soups, soups, marinades, as well as to flavor semi-preserved vegetables (pickles) or canned meat and vegetables.

Morphological and biological characteristics. *A. dracunculus* is a hairless perennial, reaching a height of up to 150 cm. Its straight stems are ribbed and have no flowers in the lower parts. The leaves are arranged alternately, sessile. The lower leaves are tripartite at the apex, while the middle and upper leaves are lanceolate. The tip of the leaf is sharp and the leaf blade margins entire. Yellow, tubular flowers are gathered in hanging, spherical capitula forming loose panicles. The fruit are achenes (Ekiert et al., 2021).

Figure 11.1. *Artemisia dracunculus* L.
(Source: https://agro.afacereamea.ro/tarhonul-artemisia-dracunculus-planta-aromatica-si-medicinala-3209/)

Climate and soil requirements. Prefers well-drained sandy or clay soils with neutral or alkaline pH. It needs good sun exposure and is indifferent to soil moisture as it adapts to both moist

and dry soil. Tolerates drought. Its habitat is the river banks and the prairies. It has a perennial life cycle. At sowing, the seeds of this plant should be sown to the surface of the greenhouse in late winter or early summer. Its germination is rare.

Melliferous value. The flowers are small, white-yellow in color and are attractive to insects, especially bees.

12.2.2. Elettaria cardamomum (L.) Maton (Synonyms: Amomum cardamomun L., Zingiber cardamomum (L.) Stokes) (Green Cardamon, True Cardamom)

Importance and uses. *Elettaria cardamonum* belongs *Zingiberaceae* family. There are two main types of cardamom: black cardamom and green cardamom, and there is also white cardamom, which is a bleached version of green cardamom. Green cardamom (*Elettaria cardamomom*) is known as true cardamom. Cardamom has a strong, sweet and pungent aroma, with a slight lemon and mint scent. It is most commonly used for sweet or savory foods. The bleached version, white cardamom, has less flavor. It is grown in tropical areas, including India, Malaysia and Costa Rica, Portugal. Black cardamom (*Amomum subulatum*) has larger, dark brown fruits. It has a slight smoky taste that makes it more suitable for salty foods, but it is also used in sweet foods, especially in southern India. It is grown in the eastern Himalayas (https://www.libertatea.ro/ lifestyle/ cardamon- beneficii-contraindicatii-3458457).

Cardamom can be used as a spice in food, in aromatherapy as an essential oil. Cardamom is found in the garam masala spice blend, which is seasoned with meat and vegetable dishes, and in hot beverages such as chai masala and Turkish coffee (https://www. paradisul verde. com/ blog/ cardamonul-elettaria-cardamonum-samanta-dragostei/).

Cardamom can also be taken as a dietary supplement, due to its benefits for the body, as it contains phytochemicals with anti-inflammatory and antibacterial properties. Most often, it is mixed with other spices with medicinal properties to relieve discomfort, nausea and vomiting. It is often used in Ayurvedic medicine to strengthen the airways and adrenal cortex (https://slabire.koshachek.com/articles/virtutile-si-utilizarile-cardamomului.html).

Cardamom is used in all olfactory families and especially in eaux de Colognes. It is used in both perfumes for men and perfumes for women. It is particularly well suited to the woody, chypre and oriental families. It is one of the most expensive spices after saffron and

vanilla. When ground into a powder, it loses its fragrance very quickly (https://www.sylvaine-delacourte.com/en/blog/cardamom-the-plant-and-its-fragrances).

Morphological and biological characteristics. Cardamom is a robust, perennial, herbaceous plant, 2 to 5 metres high that grows at medium altitude in tropical rainforests. It is a plant with thick rhizomes that produce white flowers with red veins.

Flowering shoots, approximately 1 metre long, may be upright or sprawling; each bears numerous flowers about 5 cm in diameter with greenish petals and a purple-veined white lip. The whole fruit, 0.8 to 1.5 cm, is a green three-sided oval capsule containing 15 to 20 dark, reddish brown to brownish black, hard, angular seeds. The essential oil occurs in large parenchyma cells underlying the epidermis of the seed coat. The essential oil content varies from 2 to 10 percent; its principal components are cineole and α-terpinyl acetate. The capsules are harvested when they attain physiological maturity, which is indicated by dark green colour of rind and black coloured seeds. Harvesting of ripened capsules is avoided as it leads to the loss of green colour and also causes splitting of capsules during curing process. Immature capsules on processing yields uneven sized, shriveled and undesirably coloured produce (http://www.spices.res. in/pdf/ package/ cardamom. pdf).

Figure 11.3. *Elettaria cardamomum* (L.) Maton
(Source: https://www.amazon.in/M-Technologies-Cardamom-Elettaria-cardamomum-Elaichi/dp/B08KR3CPCW)

Climate and soil requirements. Its habitat is warm climates and exposure in half shadow, permeable soil. Cardamom grows luxuriantly in forest loam soils, which are generally acidic in nature with a pH range of 5.5-6.5. Growth of cardamom is enhanced, when planted in humus rich soils with low to medium available phosphorous and medium to high available potassium (https://vikaspedia.in/agriculture/crop-production/package-of-practices/spices/cardamom).

The crop thrives well in regions which receive a well-distributed annual rainfall of 1500-2500 mm with a mean temperature of 15°C to 35°C and 600-1200 m altitude.

Melliferous value. The study of Sharma et al., in 2018, confirming that pollination by honey bees, in addition to bumble bees, contribute to increased fruit and seed set of cardamom resulting into high yield (Sharma et al., 2020).

12.2.3. Gomphrena globosa L. (Globe Amaranth, Purple Perpetual)

Importance and uses. *Gomphrena globosa* is an edible plant from the Amaranthaceae family. The species is an annual herb native to Central America now cultivated worldwide as an ornamental, as well as having uses in traditional medicine and as a source of betacyanins for use in the food and cosmetic industry (Ventosa-Febles, 2017). It is an ornamental plant and resists quite well as a cut flower. The infusion from this plant is used to treat sore throat, stomach pain, cough and laryngitis. For centuries, the medicinal power of plants and flowers have been used to prepare infusions that take the most out of the energizing, diuretic and rejuvenating natural properties. The flowers are a very suitable source of betacyanins with strong pigmentation features, together with many other desirable bioactive properties and used for coloring various foods.

Morphological and biological characteristics. *G. globosa* is herbaceous annuals that grows to 20–60 cm tall and 0.15–0.3 cm wide. Leaves are opposite, oblong to oblong-obovate (2–13 cm long, 0.5–5 cm wide). Young leaves are woolly-white and turn green with sparsely white hairs when matured. Stem is erect, stout and branched with grey strigose hairs. Shortly after the seeds germinate, flower buds quickly appear and then the flower within a short time.Terminal clover-like globose inflorescence about 20–25 mm wide and up to 38 mm long. Flowers are inconspicuous with papery showy bracts. Bracts are ovate with acuminate apex, 3–5 mm long, and come in shades of white, pink and purple. Bracteoles are dentate-cristate, 7–12 mm long and 2–3.5 mm wide (https://www.nparks.gov.sg/florafaunaweb/flora/2/0/2037).

Figure 11.4. *Gomphrena globosa* L.
(Source: https://anthesis.ro/gomphrena-globosa-qis-mix-imortele)

Climate and soil requirements. The plant does not require special care and tolerates very poor and dry soils. Gomphrena prefers neutral to alkaline soils with a pH between 6.1 and 7.5. Its natural habitat is arid regions and refers sandy or clay soils, and sun exposure. It cannot tolerate frost, but it is quite tolerant of summer heat. Globe amaranth will survive drought, but performs best with regular watering, especially during hot weather (http://www.prairie-state-beekeepers. com/ uploads/1/0/6/4/10649295/bee_forage_plants.pdf).

Melliferous value. Globe amaranth produces small, globe-shaped flowers in shades of purple, pink, yellow, or white**.** The flowering period is from July to September. With its long bloom time—early summer to frost —it is desirable in a good plant for honey bees. Floral volatiles likely play a significant role in the reproductive success of the plant by promoting the attraction of pollinators (https://moviecultists.com/does-gomphrena-attract-butterflies).

12.2.4. Jasminum officinale L. (Jasmine)

Importance and uses. *Jasminum officinale* belongs *Oleaceae* family. In China, jasmine tea is extremely popular and is consumed at almost any meal. The Chinese appreciate jasmine tea due to its pleasant taste, relaxing aroma, but also health benefits. Called by the Persians "yasmin", meaning "gift of God", jasmine has been used for centuries for the natural fragrance of the skin and for its aphrodisiac effects. Arab women added it to the baths and applied jasmine oil to their bodies. Both effects are appreciated today, when jasmine has become one of the essential ingredients used by perfumers around the world and a plant frequently found on the list of ingredients of cosmetics (https://povesteacasei.ro/iasomia-plantare-si-beneficii/). The essential oil of *Jasminum officinale* is used in aromatherapy. Jasmine absolute is known as the 'King of Oils', and its heavy, sweet scent is loved by most people (https://en.wikipedia.org/ wiki/ Jasminum_ officinale). Due to the pleasant aroma but also the volatile oils in the composition, jasmine calms, relaxes, reduces stress and fatigue, and can successfully treat insomnia. However, it also has a moderate caffeine content, so consuming excess tea can cause insomnia. Jasmine tea has other health benefits related to improving the body's functions. It lowers cholesterol and regulates intestinal transit, soothing the unpleasant symptoms of indigestion. Many experts claim that the antioxidants in jasmine tea could stop the growth of cancer cells in the body, if consumed regularly (https://www.gardenersworld.com/plants/jasminum-officinale/).

Due to its calming and anti-inflammatory effect, jasmine tea can relieve headaches, joint pain, rheumatism, fatigue and muscle fever, muscle contractions and spasms and can treat migraines to some extent (https://a1.ro/lifestyle/casa-si-gradina/iasomia-planta-afrodisiaca-darul-lui-dumnezeu- ingrijire-si-beneficii-id870063.html).

Morphological and biological characteristics. Jasmine is widely cultivated for the fragrance of its flowers and can be with leaves that fall in autumn or that remain green all year round. The flowers are generally about 2.5 cm in diameter and are white or yellow, although in rare cases they may be slightly reddish. The flowers are arranged in clusters of at least three flowers, although they can also be solitary at the ends of the branches. Each flower has about four to nine petals and one to four eggs. Jasmine flowers have two stamens with very short filaments. They are usually very fragrant, and jasmine fruits are berries that turn black when ripe (https://www.libertatea.ro/lifestyle/iasomie-plantare-si-ingrijire-beneficii-ceai-3541650). Jasmine

needs plenty of light and the sun helps to make many flowers. It can withstand shade, but needs a lot of space to grow and spread.

Figure 11.5. *Jasminum officinale* L.
(Source: https://a1.ro/lifestyle/casa-si-gradina/iasomia-planta-afrodisiaca-darul-lui-dumnezeu-ingrijire-si-beneficii-id870063.html)

Climate and soil requirements. The jasmine shrub is very unpretentious in terms of soil type. It grows in sand, clay or clay and tolerates both alkaline and acid soils. Excess water and puddles during flowering can lead to loss of buds.

Melliferous value. Jasmine blooms in clusters from spring until well into the fall. The sweet flowers are most often cream, white or yellow, depending on the variety, and will attract bees and other pollinators. *Jasminum officinale* has no toxic effects reported (https:// www. gardeners world.com/plants/ jasminum-officinale-f-affine/).

12.2.5. Juniperus communis L. (Juniper, Common Juniper, Siberian Juniper)

Importance and uses. *Juniperus communis* is a species of *Cupressaceae* family. Juniper is a medicinal plant whose therapeutic properties are used to treat many ailments and diseases: it treats rheumatism, colds, bronchitis, skin diseases, removes the existing stone in the bladder. Juniper fruits are also a natural remedy for anemia, lack of appetite, osteoarthritis, ensuring optimal

functioning of the body. The powder resulting from the crushing of juniper fruits is very effective in treating obesity, intestinal worms, fatigue, arteriosclerosis. Juniper tea soothes digestive disorders and bloating. It is important to note that juniper frutis should not be eaten by pregnant women and people with urinary tract injuries. Another natural remedy offered by juniper is tincture of jenuper effective in curing urinary disorders, influenza, bronchitis, fermentation colitis (Craciun et al., 1991).

Ecologically, the tree is important as a food source for a number of birds and wild mammals, as well as livestock. Different cultivars of the species are also widely planted as ornamentals in parks and gardens (Elbert, 1971).

Juniper is the only botanical which is in all gins. The cones of the juniper bush (often referred to as "juniper berries") are required by legal statute, to be present and perceptible, in order for a spirit to be called gin. J

Juniper is designated as spieces of gins. The juniper berry is known for imparting the traditional pine note of gin, although it can also come across as resiny, waxy, herbaceous, or even green and fresh. The juniper in gin is generally *Juniperus communis*; however, occasionally distillers use local species which can have a very different flavor in gin (https://theginisin.com/botanicals-list/juniper/).

Morphological and biological characteristics. Juniper is a native, evergreen shrub or columnar tree. Shrubs or small trees dioecious, to 4 m (if trees, to 10 m), multistemmed, decumbent or rarely upright; crown generally depressed.

Bark brown, fibrous, exfoliating in thin strips, that of small branchlets (5-10 mm diam.) smooth, that of larger branchlets exfoliating in strips and plates. Branches spreading or ascending; branchlets erect.

Leaves green but sometimes appearing silver when glaucous, spreading, abaxial glands very elongate; adaxial surface with glaucous stomatal band; apex acute to obtuse, mucronate. Seed cones maturing in 2 years, of 2 distinct sizes, with straight peduncles, globose to ovoid, 6-13 mm, bluish black, glaucous, resinous to obscurely woody, with 2-3 seeds. Seeds 4-5 mm (Adams, 1993).

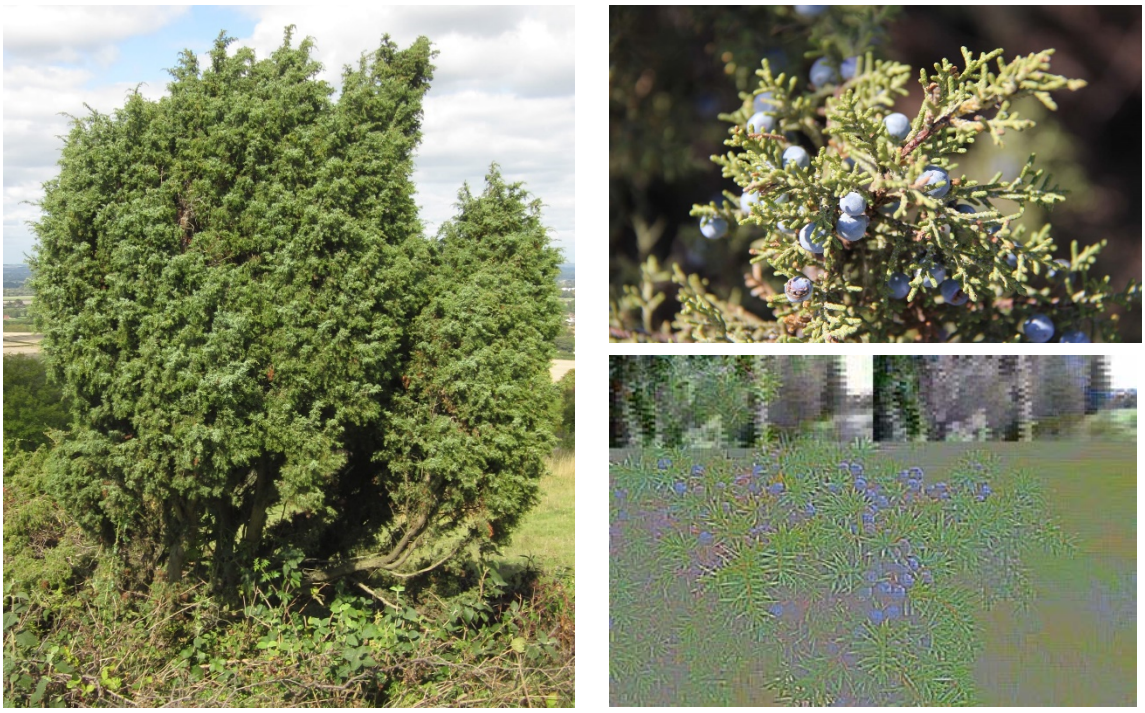


Figure 11.6. *Juniperus communis* L. (original)
(Source: https://www.britannica.com/plant/juniper)

Climate and soil requirements. Juniper grows in various habitats, in elevations up to 2400 m, with one subspecies even occurring above the tree line in the Euro-Siberian mountains. The tree grows in a multitude of soils and on rocks and is also found in open grasslands or in mixed stands with both broadleaved and coniferous trees. The juniper is a hardy species, tolerant to poor soils, drought and low temperatures, but the species does require abundant light (http:// www. euforgen.org/ species/juniperus-communis/). It is useful in preventing soil erosion (Elbert, 1971).

Melliferous value. The plant is the source for the production of honeydew. Honeydew is a sugary excretion from plant sap sucking insects such as aphids or scales. There are many trees that are hosts to aphids and scale insects that produce honeydew. Honeydew can be obtained in forest areas, which can be both coniferous (fir, spruce, pine, etc.) and deciduous (maple, oak, etc.), including species of *Cuprasaceae* family, as *Juneperus*.

12.2.6. Marrubium vulgare L. (Horehound)

Importance and uses. *Marrubian vulgare* is a species of *Lamiaceae* Family. *M. vulgare* is useful in treating bronchitis with dry cough. For phytotherapeutic purposes, the leaves and flowers are used, their harvest being done during the flowering period.

The plant combines the action of relaxing muscles and stimulating mucous secretions, thus causing sputum. It is also used to treat whooping cough. The bitter action stimulates the secretion of bile from the gallbladder, aiding digestion. The plant is also used externally to heal wounds.

The main actions are emollient, expectorant and antipyretic. It can replace quinine in people who are intolerant to this substance. Sodium and potassium salts of marubic acid have choleretic properties. Extracts from the upper aerial parts harvested during flowering have positive effects on cardiac arrhythmia, due to potassium nitrate and choline in the plant. Extracts from this plant are recommended in cardiac arrhythmia, acute bronchitis and anorexia (https://www.remediu.ro/ unguras- proprietati-terapeutice-i133.html).

Morphological and biological characteristics. Perennial herbaceous species, 30-80 cm high, with a general whitish gray appearance, due to the bristles. The stem has four edges, and the leaves, almost round, with an irregularly toothed edge, are placed opposite on the stem and branches. The flowers, grouped at the upper nodes, are small, whitish, with a calyx with 10 broken teeth, with a bilabiate corolla.

Figure 11.7. *Marrubium vulgare* L.
(Source: https://flora-on.pt/index.php#/hAPZh)

Climate and soil requirements. It grows in direct light and is well adapted to drought. Spread all over the country on uncultivated land, degraded and arid pastures, especially in steppe areas.

Melliferous value. The flowers are small, dirty-white, grow around the stem at the base of the leaves and are grouped several in the bouquet. It blooms between June and September. It is less interesting from a honey point of view, having a reduced nectariferous capacity.

12.2.7. Origanum vulgare L. (Origanum, Wild Marjoram)

Importance and uses. *Origanum vulgare* belongs *Lamiaceae* Family. Origanum is a plant that has been grown in the Mediterranean region since ancient Times and has a great importance in the pharmaceutical, medical, and agricultural industries. For medicinal purposes, oregano leaves, flowers and seeds are used because they contain volatile oil (thymol, carvacrol), caffeic and rosemary acids, tannin and serpilin.

Oregano has many benefits, but is best known for its digestive, expectorant, antiviral, antibacterial, antifungal, antiparasitic, antioxidant and anti-inflammatory properties. In addition, oregano is known for its powerful antioxidant properties, such as antimutagenic and anticancer.

Oregano oil can cause side effects in people who are allergic to herbs (*Lamiaceae* family). Oregano oil is also forbidden for pregnant women or people with iron deficiency anemia, as it can reduce the body's absorption of iron (https://www.csid.ro/plante-medicinale/oregano-origanum-vulgare-11641341/).

The herb has long been an essential ingredient of Mediterranean cooking and is widely used to season many foods. Culinary varieties, such as Greek or Italian oregano, have a strong aroma and a warm pungent taste. Ornamental cultivars are typically more bland in flavour and not suitable for cooking (https://www.britannica.com/plant/oregano).

This is a very good natural spice. It is used to season meat dishes, salads, sauces and pasta.

Morphological and biological characteristics. It is a perennial semi-woody plant, a shrub that can reach 60 cm in height. In the soil it has a 2-3 cm thick lignified rhizome from which arise both sterile and flowering stems, four angular, straight and branched at the top, but also numerous filiform roots.

The leaves are opposite, 1-4 cm long, oval in shape, almost glabrous, with a full or slightly toothed edge.

The flowers grow together in bouquets at the top of the stem and branches, are pink-purple, rarely white, bloom from June to August. The leaves and stems give off a very pleasant and fragrant smell if crushed between the fingers.

Figure 11.8. *Origanum vulgare* L. (original)

Climate and soil requirements. Plants grow through meadows in hilly and mountainous regions, in orchards, bushes, dry places, vineyards, near forests and through stony places to the alpine region. Oregano prefers dry, infertile and calcareous soil.

Melliferous value. The plant is harvested in July and August. Origano is definitely a tremendous favourite with bees, butterflies and hoverflies and provides lots of nectar.

12.2.8. Plectranthus forsteri cv marginatus Benth. (Synonymous: P. coleoides f. variegata; P. forsteri f. variegatus) (Swedish Ivy, Variegated Plectranthus)

Importance and uses. *Plectranthus forsteri* is an attractive herbaceous perennial plant with variegated fragrant leaves in the *Lamiaceae* family (https://plants.ces .ncsu. edu/ plants/plectranthus-forsteri-marginatus/). "*Marginatus*" is a cultivar that is particularly noted for its attractive foliage. Plants have been used by humans since ancient times for medicinal purposes (Newman and Cragg, 2010). The herbal preparations are important healthcare resources remaining the most affordable medicines in developing countries (WHO, 2013). The main compound of the plant polar extract from *Plectranthus* is rosmarinic acid, a common compound in the *Lamiaceae* family. This compound has been connected to the antioxidant and anti-acetylcholinesterase activity of the extract (Falé et al., 2009). Flavonoids and the caffeic acid derivates, nepetoidin A

and B have also been reported in a chemotaxonomic study (Grayer et al., 2003). The leaves emit a mild citrus fragrance when bruised. In cold climates, it is typically grown as a container annual.

Morphological and biological characteristics. *Plectranthus* can be annuals, evergreen perennials or shrubs, with opposite, ovate or heart-shaped, sometimes fleshy leaves, and 2-lipped, tubular flowers borne in whorls forming spikes or panicles. The plant has leaves with scalloped and mottled edges, with cream-white edges. The flowers are pale purple or white and appear in autumn. Is a bushy small shrub to 25-30 cm tall and 60 or ore cm wide with green, scalloped leaves about 5 cm long. The stems should be cut after flowering (or in early spring in cooler areas, if there is a risk of frost). Fruits (nutlets) has 0.7-1 mm long, with dark brown colour, shiny, almost spherical.

Figure 11.9. *Plectranthus forsteri marginatus* L.
(Source: https://plantsam.com/plectranthus-forsteri-variegata/)

Climate and soil requirements Lectranthus needs well-drained soil of moderate fertility in dappled shade. Most species are not hardy and will not survive outdoors in temporate regions. If grown indoors, provide full light but with protection from hot sun. Water freely and fertilise monthly during active growth, but keep just moist in winter. It is easily grown in rich, humusy, dry to medium moisture, well-drained soils in part shade. Best performance occurs in part shade or sun dappled areas with regular and even moisture. Avoid poorly drained clay soils. Plants are intolerant of frost. It can grow in shady places and can form a dense carpet under trees or shrubs.

Melliferous value. This plant will provide nectar and pollen for bees and the many other types of pollinating insects.

12.2.9. Rosmarinus officinalis L. (Rosemary)

Importance and uses. *Rosmarinus officinalis*, originates in South America and the Mediterranean region and is part of the *Lamiaceae* family. Rosemary is a plant that has been used over time in the culinary field, in aromatherapy, but also in medicine, due to its beneficial properties for the body. The properties of rosemary are given by the leaves and inflorescences.

Rosemary has been used since ancient times, due to its medicinal properties. The ancient Greeks and Romans used rosemary mainly in the kitchen or as a medicinal plant. This plant was traditionally used to relieve muscle pain, to support the immune and circulatory systems, but also to help improve memory or hair growth (https:// pubmedn. bncbi. nlm.nih.gov/17708648/). Rosemary has choleretic and cholagogue properties, being helpful in maintaining the health of the digestive system, as well as diuretic properties (Bojor, 2021). Recent studies show that rosemary stimulates mental activity, oxygenates the brain and improves people's daily activity. Rosemary leaves contain natural bioactive substances of vegetable origin such as essential oil, tannin, saponosides, but also ursolic acid, polyphenol which has the role of helping to burn fat, oleanolic acid, vitamin C and mineral salts (https://www.libertatea.ro/lifestyle/ceai-de-rozmarin-cum-se-prepara-3045982). Rosemary often grows near the sea, where drops of sea water could justify the name "sea dew". It is possible that the name refers to the navy blue flowers of rosemary (https://www.paradisulverde.com/blog/rozmarinul-rosmarinus-oficinalis-sau-copacul-de-tamaie/).

As a spice, it is used in omelettes, fruit salads and soft drinks. Rosemary can also be used to flavor vinegar. It does not lose its aroma by prolonged boiling, like many other leaves. Fresh leaves have a purer scent and are therefore preferred. Rosemary is recommended as a spice for potatoes and very suitable for vegetables fried in olive oil (eggplant, zucchini, tomatoes), as it is often prepared in Mediterranean countries. In Greek, it is called "dendrolivano", which translates as "incense tree" (Roman et. al., 2007). It is a well-known remedy for heart and circulatory disorders. It is recommended for regaining blood pressure, being effective in hyper but especially in hypotension and for improving blood circulation. It is a traditional remedy to combat colds of the extremities (hands and feet), the formation of thrombi (clots), frostbite (Bojor, 2021).

Rosmarin volatil oil also has antimicrobial properties, being active against many fungi and gram-positive and gram-negative bacteria (*Staphylococcus aureus, Staphylococcus albus,*

Escherichia coli, *Vibrio cholerae*). In addition, it has been shown to have a bactericidal effect on the strain *Lysteria monocytogenes* (Yang et al., 2011).

Morphological and biological characteristics. Rosemary is a sub-shrub that can reach a height of about 150 cm. It has linear, persistent leaves, caught on rough shoots. In the soil it has a woody, branched root, with many mustaches, above the ground the stem is curved, very branched, with thin branches. The opposite leaves are sessile, leathery, glabrous, linear like those of conifers (no more than 3 cm long and 4 mm wide), with slightly curved edges; on the upper side they are bright dark green, and on the lower side they are silvery green, being covered with numerous hairs.

On the underside of the leaves on the upper branches appear pale blue bilabiate flowers, arranged in pseudo-vertices, from which are then formed nuts-shaped fruits, brown, ovate. They have a pungent, bitter, aromatic taste and a pleasant, camphorated smell.

Figure 11.10. *Rosemarinus officinalis* L. (original)

Climate and soil requirements. Rosemary grows wild in the Mediterranean area, mainly on calcareous soils but can also be grown in gardens. Rosemary prefers clay-sandy, fertile and well-drained soils, being more sensitive to excess soil moisture. Instead, it resists drought well and

grows well on soils with a pH of 6-7. The Mediterranean origin makes this plant pretentious to light. Places that benefit from direct sunlight for several hours a day are ideal for rosemary planting.

Melliferous value. The small, light blue flowers are attractive to insects, and rosemary is also considered a honey plant. The flowers secretes a lot of nectar. The honey produced from this plant has a delicate aroma, a thick texture and an amber-like color. At the same time, the crystallization is quite fast and the granulation is fine. Rosemary honey is rich in minerals and vitamins, rosemary pollen, glucose and fructose, and the fact that it has a balanced spectrum of sugars is very important. In order to preserve all its properties, rosemary honey must be kept well closed, in the dark, at a recommended temperature of 14ºC. At lower temperatures, it crystallizes quickly. At higher temperatures, the flavors are lost and darken in color. Exposed to the sun, light and heat destroy enzymes and vitamins (Ion et al., 2008).

12.2.10. Verbena officinalis L. (European Vervain, Vervain)

Importance and uses. *Verbena officinalis* belongs of *Verbanaceae* Family. Vervain has been known since antiquity, and has been used to cure headaches ever since. Specialists recommend the use of vervain to treat diseases of the digestive tract, circulatory system, excretory organs. The plant is also recommended in the treatment of febrile conditions and intoxications. The powder obtained from the dried leaves of vervain is considered an excellent remedy in treating insomnia, slow digestion, physical fatigue, irregular menstruation, headaches, mental fatigue, liver pain (https://sanatatecuplante.ro/verbina-verbena-officinalis).

The vegetable product contains iridoid glycosides (verbenin, verbenalin, aucubin, bastatoside), bitter principles, tannin, volatile oil (citral, geraniol, limonene, verbenone), mucilages, alkaloids, saponins (Duke, 1979).

Morphological and biological characteristics. The flowers can have various shades of pink, red, yellow, purple or can be white and are usually in one color, with the middle in a light shade.

Figure 11.11. *Verbena officinalis* L.
(Source: https://gradina-de-vis.shopmania.biz/en/cumpara/verbena-officinalis-7277290)

Climate and soil requirements. *Verbena officinalis* is a species found in Europe, North Africa, China and Japan, found in open areas, near dwellings, hillsides and roadsides in temperate, subtropical and tropical areas worldwide, waste grounds, roadsides, cultivated fields, mountain slopes, ditches, pastures, meadows, railroad grounds, urban areas, rocky paths, ballast dumping grounds, shipyards and gardens (Flora of China Editorial Committee, 2020; Flora of Pakistan, 2020; PFAF, 2020). It grows at elevations of 100 to 2000 m (Flora of China Editorial Committee, 2020; Flora of Pakistan, 2020). The plant needs heat to grow and bloom, and the optimum temperatures are between 18 and 28^{o}C. Perennial species survive the winter in the garden (Ciocîrlan, 1970). Although it comes from the Mediterranean climate, the plant is not very resistant to drought, which means that it needs water, especially during the heat. Lack of water makes the plants grow small and bloom very little (http:// www. gradinamea. ro/ Verbena flori_vedeta_in_gradini_si_balcoane_6847_543_1.html). It has no pretensions to atmospheric humidity, as long as it is in well-ventilated spaces, with very good ventilation. It is tolerant to the soil but must allow good water drainage and a neutral pH.

Melliferous value. The flowers can self-pollinate or are cross pollinated by bees, flies, moths and butterflies, with long flowering period from May to September. It has nectar/pollen rich flowers (https://www.gardenersworld.com/plants/verbena-officinalis-var-grandiflora/).

CHAPTHER 13

IMPORTANT SPECIES OF AROMATIC, MEDICINAL AND MELLIFEROUS PLANTS IN SPAIN

13.1. General aspects of Spain

Geographic characteristics. Spain is located in south-west Europe, and includes a main part in the Iberian Peninsula sharing with Portugal, two archipelagos (Canary Islands in the Atlantic Ocean and Balearic Islands in the Mediterranean Sea, and two autonomous cities (Ceuta and Melilla on the coast of North Africa). The country's territory borders France and Andorra to the north-east and Portugal to the west Ceuta and Melilla borders Morocco.

Figure 13.1. Spain map
(Source: https://www.britannica.com/place/Spain)

Spain separates the Atlantic Ocean from the Mediterranean Sea. There are different mountain ranges. Spain has a high average altitude due to it is plateaus and mountains become a mountain country with an average above 660 m of altitude, only surpassed by Switzerland.

Spain has a large area with various characteristics. The relief of Spain is composed of: mountains - Iberian, Castile, Pyrenees, Cantabrici, Sierra Morena, Sierra Nevada; plateaus - Castile (Spanish Plateau); plains - Aragon, Andalusia.

Climate and soil conditions. Spain is characterized by the overlap of one fundamental climatic division (between humid and semiarid and arid zones) by another (the threefold division of the peninsula into maritime, continental, and mountain climates). This complexity results from the peninsula's size, which is large enough to generate a continental thermal regime; its location close to the Atlantic Ocean and North Africa, exposing it to both maritime and Saharan influences; and its mountainous relief, which not only produces its own climatic zones but also exaggerates local aridity through the creation of rain shadows on the mountains' leeward sides.

There are five major soil types in Spain. Two are widely distributed but of limited extent: alluvial soils, found in the major valleys and coastal plains, and poorly developed, or truncated, mountain soils. Brown forest soils are restricted to humid Galicia and Cantabria. Acidic southern brown earths (leading to restricted crop choice) are prevalent on the crystalline rocks of the western Meseta, and gray, brown, or chestnut soils have developed on the calcareous and alkaline strata of the eastern Meseta and of eastern Spain in general. Saline soils are found in the Ebro basin and coastal lowlands (https://www.britannica. com/place/Spain).

Calcretes (subsoil zonal crusts [toscas], usually of hardened calcium carbonate) are particularly well developed in the arid regions of the east: La Mancha, Almería, Murcia, Alicante (Alacant), and Valencia, as well as the Ebro and Lleida (Lérida) baśni (https://www.britannica. com/place/Spain).

Socio-economic aspects. Spain is a parliamentary monarchy. It has a politic-administrative organization based in three levels: municipalities, provinces and autonomous communities. The first level ate the Autonomous Communities and currently has 17 plus 2 Autonomous cities (Ceuta and Melilla), and each one has himself autonomy statute, with different powers it depends of the community. These are divided into fifty provinces which are the second level in the organization scale. The third level it is composed of municipalities. The provinces did not serve an administrative function, although they did mark the differences in habits, linguistic peculiarities and socio-cultural characteristics. In general, each region has their own customs and sociocultural characteristics, special and different of the rest of regions.

Human activities like building, deforestation, introduction of new species, agriculture, livestock and many other activities (specially economics) causes a loss of biodiversity including the plants. All of these factors determine the distribution of the medicinal and aromatic plants along the Iberian Peninsula.

Spain is a plurilingual country, where in addition to Spanish, there are 5 more languages co-oficial in their regions (Catalan, Occitan or aranesp, valencian, galician and basque).

The most important sectors of Spain's economy in 2016 were wholesale and retail trade, transport, accommodation and food services (23.4%), public administration, defence, education, human health and social work activities (18.9%), and industry (17.8%). Intra-EU trade accounts for 67% of Spain's exports (France 15%, Germany 11% and Italy 8%), while outside the EU 4% go to the United States and 3% to Morocco. In terms of imports, 62% come from EU countries (Germany 15%, France 12% and Italy 7%), while outside the EU 7% come from China and 4% from the United States (https://european-union.europa.eu/principles-countries-history/country-profiles/spain_en).

13.2. Important species of aromatic, medicinal and melliferous plants

The combination of these climatic, social and economic organizations, topographic and geological variations produces a very complex and heterogeneous landscape. As a result, Spain is one of the most interesting and richest territory in Europe, as well as countries with a Mediterranean climate.

The most important species of aromatic, medicinal and melliferous plants in Spain provided by COCEDER as partener of Agropuzzle 4 project, are present in Table 13.1

Table 13.1

The most important species of aromatic medicinal and melliferous plants in Spain (COCEDER team, Spain)

Scientific name	Name in Portuguese language
Allium schoenoprasum	Cebollino
Apium graveolens	Apio
Calendula officinalis	Caléndula
Crataegus monogyna	Espino blanco (majuelo)
Echium vulgare	Viborera ("paquetequieromañosa")
Helichrysum stoechas	Manzanela
Hyperycum perforatum	Hipérico
Jasonia glutinosa	Té de roca (té de aragón)
Lavandula angustifolia	Lavandula
Lavandula x intermedia	Lavandera
Lavandula latifolia	Lavandera
Lavandula lanata Boiss	Lavandera
Matricaria chamomilla	Manzanilla
Melissa officinalis	Melisa
Mentha piperita	Menta
Mentha pulegium	Poleo
Mentha sativa	Hierba buena
Moringa oleífera	Moringa
Ocinum basilicum	Albahaca
Oreganum vulgare	Orégano
Origanum majorana	Mejorana
Petroselinum hortense	Perejil
Plantago major	Llantén
Rosmarinus officinalis	Romero
Rumex scutatus	Acedera
Salvia officinalis	Salvia
Santolina chamaecyparissus	Manzanilla amarga
Satureja montana	Ajedrea

13.2.1. Crataegus monogyna L. (Hawthorn, Oneseed Hawthorn)

Importance and uses. *Crataegus mongyna* belongs of *Rosaceae* Family. Nicknamed the heart plant, in our lands the hawthorn is also called the "Fruit of God". It is one of the most widespread herbs in folk medicine (http://www.naturalherbs.ro/ro/project/paducelul/). For medicinal purposes, hawthorn flowers, leaves, branches and fruits are used. Both fruits and flowers are used in the preparation of infusions, capsules and tinctures. Hawthorn flowers and fruits contain aromatic amines such as tyramine, lavonoid, anthocyanins, volatile oils, triterpene acids, crategic acid, ursolic acid, pectins, phytosterols, vitamin C, B complex. Hawthorn-based preparations have a cardiac, diuretic, hypotensive, astringent and vasodilating tonic effect. Hawthorn-based products are indicated in cases of angina pectoris, hypertension, heart neurosis, insomnia, fatigue, irritability (https://www.csid.ro/plante-medicinale/p%c4%83ducel-crataegus-monogyna-11477460/).

Morphological and biological characteristics. Hawthorn is a thorny shrub that grows spontaneously along roadsides and is often used to build hedges throughout Europe. It can reach a height of 10 m. It has strong roots that go deep into the soil. It also grows in the shape of a tree with several stems. The branches are covered with short or long spines. The oval leaves are wedge-shaped at the base. The white flowers are gathered in large numbers in corymb-shaped inflorescences. Ovoid fruits are not too large (10 - 14 mm long) and are red.

Figure 13.2. *Crataegus monogyna* L.
(Source: https://www.infuziedesanatate.ro/paducelul-prietenul-inimii-tale/)

Climate and soil requirements. Hawthorn grows spontaneously especially at the edge of forests, in deforested areas, on pastures, in thickets and in thickets. The shrub is not demanding to climate and soil, is resistant to frost or high temperatures and drought, is tolerant of shade, does not require special care and lives an extremely long time.

Melliferous value. The hawthorn blooms in May, dressing the edge of the woods in a fragrant white cloak, which attracts a lot of pollinating insects and where the bees hum non-stop. Hawthorn is more appreciated by beekeepers. They take their hives to the edge of the forests where this plant grows because hawthorn honey is very tasty.

13.2.2. Echium vulgare L. (Viper's Bugloss, Blueweed)

Importance and uses. *Echium vulgare* belongs to the *Boraginaceae* family. For therapeutic purposes, the aerial part of the plant is harvested, which must be flowered. Medicinally, it contains potassium, calcium, tannin, alkaloids, allantoin, resins, mucilages, choline - that's why

it has a good antibiotic, antiseptic, astringent, expectorant, emollient, purifying, diuretic, healing action.

Morphological and biological characteristics. *Echium vulgare* is a biennial herbaceous plant that grows to a height of 1 m. It has a black and pivoting root, and the stem is gray, rigid and covered with hairs, although simple and with a branched base. The leaves are elongated and also covered with hairs, the ones at the base of the plant are petiolate and placed in the shape of a rosette. The flowers are blue, purple, red, pink or white-pink, have red stamens and bloom between June and September. The fruits of this plant are shaped like miniature nuts.

Figure 13.3. *Echium vulgare* L.
(Source: https://bodygeek.ro/plante-medicinale-iarba-sarpelui-echium-vulgare)

Climate and soil requirements. It is found more in abandoned places, on railway embankments, on the side of roads, in parlors and meadows.

Melliferous value. Is one of the best honey plants, according to beekeeping specialists. The first plants bloom in the first decade of June, and the flowering is spread over a period of 30 days. This plant has a high honey value and can produce large amounts of honey of 300-400 kg / ha. The honey obtained is of superior quality and has the color of amber (Ion et al., 2008).

13.2.3. Helichrysum stoechas (L.) Moench (Everlasting Flower, Curry Plant, Eternal Flower)

Importance and uses. *Helichrysum stoechas* is a perennial aromatic species belonging to the *Asteraceae* family. Extracts of *Helichrysum stoechas* have been used in traditional medicine to treat colds, as a nerve tonic, to reduce inflammation, and facilitate the healing of bruises (Denni, 1995). There have been a number of studies of the phytochemical and pharmacological properties of the constituents of its flowers, stems and foliage which have confirmed that it has an inhibitory effect on some bacteria and viruses (Roussis et al., 2002). The predominant active constituents are nerol acetate, curcumin, pinene, limonene, kaempherol, quercetin, luteolin, linalool, and geraniol, in addition to other flavonoids, sesquiterpenes and hydrocarbons (Ascensão et al., 2001).

Morphological and biological characteristics. This herbaceous plant grows up to 50-70 cm in height. Its stems are lush, gray in color, and the inflorescences are about 15 cm long.

Figure 13.4. *Helichrysum stoechas* (L.) Moench (Source: https://identify.plantnet.org/ro/the-plant-list/species/Helichrysum%20stoechas%20(L.)%20Moench/data)

The flowers are yellow, arranged in chapters gathered in terminal glomeruli. The presence of glandular and non-glandular trichomes is interesting, especially on the underside of the leaves. These trichomes play an important role in the secretion of essential oils from leaves and flowers,

α-pinene being the main compound of the essential oil (https://ro.warbletoncouncil. Org / helichrysum -stoechas-15755).

Climate and soil requirements. Dry and sunny climates. It is resistance to dry season. If they are seem in cooler regions, it is necessary to spread a mound in the foot to protect it from frost and plant it out if the wind on dry soil. Originally from Mediterranean region, the plants grow up in dry, rocky and arid soils, frequently near to sea. It prefer very drained or sandy soils, not too much fertile, neutral and slightly chalky. Not tolerate wet.

Melliferous value. This plant will provide nectar and pollen for bees and the many other types of pollinating insects (https://www.rhs.org.uk/plants/8545/common-shrubby-everlasting/ details).

13.2.4. Jasonia glutinosa (L.) DC. (Rock Tea)

Importance and uses. *Jasonia glutinosa* is a plant of *Asteraceae* Family. It is a species used in the traditional medicine of the Iberian Peninsula and appreciated as an herbal tea regarding digestive properties (Valero et al., 2013). Alhough some previous phytochemical works reveal the presence of monoterpenes, sesquiterpenes and flavonoids (Gonzalez Romero et al., 2003; Guillén and Ibargoitia, 1996; Pascual Teresa et al., 1980; Rubio et al., 1995; Sanchez-Martinez et al., 2000; Villaescusa et al., 1995), there is a gap in the pharmacological knowledge of the plant, especially about the properties reported in traditional medicine. Its name derives from its characteristic of being a shrub that grows in rocky areas, especially in sunny areas. It is a protected species in Italy and Spain (https://www.jardineriaon.com/ro/jasonia-glutinosa.html). It is also used in the treatment of psychiatric or psychological conditions, such as depression, which is why the plant has been attributed stimulating properties. the plant is used in the preparation of liqueurs in the region of Catalonia. In France it is used to flavor cigarettes, and in Germany it is used in the treatment of heart disease, while in the Anglo-Saxon countries it is used only externally. The infusion can be prepared with water, milk or anise, and the stems can be used either dried or freshly taken from the plant. It is used to make a traditional homemade drink served in many bars and restaurants in Spain, offered as a digestive, especially when the meal includes meat, because it helps digestion. The infusion is also used in the preparation of ice cream or other traditional desserts with sugar or honey (https://www.jardineriaon.com/ro/jasonia-glutinosa.html).

Morphological and biological characteristics. It is a perennial plant with a strong woody stem. During the spring, new shoots emerge from the plant that are initially reddish in color. The leaves are aromatic, elongated, sharp, about 3 cm long, with glandular hairs that produce a particular aroma, alternately, without petiole and in the final part of the stems appear inflorescences with yellow tubular flowers.

Figure 13.5. *Jasonia glutinosa* (L.) DC.
(Source: http://herbariovirtualbanyeres.blogspot.com/2010/04/jasonia-glutinosa-te-de-roca-arnica.html)

Climate and soil requirements. It is a shrub widespread in the Mediterranean Sea, so it can be seen in the south of France, Spain, the Balearic Islands and even in Morocco. This plant is very common in the eastern part of the Iberian Peninsula, especially in Catalonia, Valencia, the Basque Country and Mallorca, Pyrenees, Sierra Nevada, among other regions of the peninsula. This shrub grows in cracks in limestone rocks. It lives exclusively in fissures and landings of vertical calcareous rocks or in horizontal cracks, forming part of the so-called rock heaths, sometimes also in stony.

Melliferous value. Flowering takes place from June to late August. the value for bees is small and little known, but may be included in the spontaneous honey flora in the areas where it grows.

13.2.5. Melissa officinalis L. (Melissa, Lemon Balm, Hive Grass)

Importance and uses. *Melissa officinalis* belongs of *Lamiaceae* Family. It tastes and smells like lemon. The active ingredients of the plant are volatile oil rich in citrol (citronellol, geraniol, linalool), caffeic acid and a bitter principle. Lemon balm is an aromatic and medicinal plant, known for its therapeutic effects on stomach ailments (soothes stomach spasms, removes gas from the stomach), soothes nervousness, removes diarrhea, increases bile secretion, balances digestion, and stimulates appetite. Green and dried lemon balm leaves are used to season and flavor a wide range of dishes and to make liqueurs.

The plant contains essential oils, terpenic hydrocarbons (pine, lemon, ocimen), tannins, mucilages, carbohydrates, bitter substances, mineral salts of iron, aluminum and potassium, which determine its use in food, pharmaceutical industry, perfumery, cosmetics. The leaves have therapeutic uses, acting as antiseptic, carminative, sedative, healing, antirachitic.

Lemon balm is known for its powerful insecticidal effect on moths (Roman et al., 2007). Lemon balm leaves, due to the volatile oil (citral) have antispasmodic and sedative action, and caffeic acid, tannins and bitter principles are responsible for the choleretic, carminative and stomachic actions of this vegetable product. The resulting vegetable product has a lemon flavor. In some Moldovan villages from Romania, the plant is a spice for meat dishes, especially steaks and sausages.

Morphological and biological characteristics. It is a perennial plant, which has a horizontal, articulated rhizome in the soil, with numerous adventitious roots. The stem is edged, branched, 60-120 cm high, erect, sometimes creeping, slightly pubescent.

The leaves are ovate, have a dull tip, serrated-crenate edges, are pubescent, with a pleasant aroma and slightly bitter taste. The white or reddish flowers are grouped in whorled inflorescences and bloom from June to the end of August. The fruits, improperly called seeds, are ovoid, smooth, chestnut, and small in size.

Figure 13.6. *Mellisa officinalis* L. (original)

Climate and soil requirements. Native to southern Europe and the Mediterranean region, it is a plant that supports any condition, although its leaves will have better quality if we plant it in semi-shade. Lemon balm is a plant sensitive to low temperatures, which gives good results in regions with mild winters. It has high demands on light, shading affects the development of the plant and the accumulation of essential oils. It requires light, sandy-clayey soils, exposed to the sun, without excess moisture and not too fertile, because the excess humus reduces the content in essential oils.

Melliferous value. It is also called hive grass. Besides the fact that it is used by beekeepers to rub the hive to capture the swarm, but this weed is also much loved by bees, being a honey plant. Therefore, any polyfloral honey also contains nectar collected from lemon balm. Honey production can be 100-150 kg/ha (Ion et al., 2008).

13.2.6. Moringa oleifera Lam (Synonyms: Guilandina moringa L., Hyperanthera moringa (L.) Vahi, Moringa pterygosperma Gaerth. Nom. Illeg.) (Moringa, Drumstick Tree)

Importance and uses. *Moringa oleífera* is a plant of *Moringaceae* Family. Moringa is highly prized due to the healing properties of its small, light green leaves. Almost all parts of the tree are eaten or used as ingredients in traditional herbal medicines. Its leaves have been consumed for thousands of years as a supplement, being considered one of the most complete plants in terms of nutrition. It is an excellent source of minerals, macro minerals, vitamins and phytonutrients. In

addition, it is a source of quality protein and dietary fiber. Moringa powder can be added to healthy smoothies or sprinkled in soups or salads. It can also be used effectively as a thickener for soups or sauces. The most common way to consume it is to add it to juices, water, yogurt or morning cereals. It is very rich in healthy antioxidants and bioactive plant compounds. *Moringa oleifera* is rich in various antioxidants, including quercetin and chlorogenic acid. Moringa leaf powder can increase blood antioxidant levels. Moringa leaves may lead to reduced blood sugar levels, but more research is needed before any solid recommendations can be made (https://www. healthline. com/ nutrition/ 4-supplements-as-powerful-as-drugs#TOC_TITLE_HDR_2).

Morphological and biological characteristics. Moringa have a long central root become the tree resistant in dry season. Trees can be easily cultivated by seems or cuttings. Leaves are composed of about 20 cm long, with narrow leaflets, oblong or oval (1-2 cm long) and light green.

Seems are fleshy, covered by a brown fine shell. They have winged or semi-winged structures (2,5 - 3 mm long). Removing the shell is obtained the endosperm which is whitish and very oleaginous. The inflorescence is an axillary paniculate cyme and produces an average number of 15-50 flowers which anthese over a period of 5-14 days. The flowers are medium-sized, white, non-tubular, mildly fragrant, bisexual and zygomorphic. The calyx is green and consists of five small sepals. The corolla has five free petals, two small and three long, which form a cup-like structure at the base to hold nectar. The stamens are five with hairy filaments and yellow anthers with cream coloured pollen. The style is simple and stands almost at the level of anthers (Suneetha and Solomon Raju, 2019).

Figure 13.7. *Moringa oleífera* Lam
(Source: https://epochtimes-romania.com/news/moringa-alimentul-costisitor-care-are-mai-multa-vitamina-c-decat-portocalele---277096)

Climate and soil requirements. *Moringa oleifera* is located worldwide, particularly in the tropics and sub-tropical zones. It grow in almost any kind of soil, even in places with a high seasonal level of aridity, therefore this plant is a good resource to population in this areas. It grow up better with directly solar light under 1400 m altitude. Minimal requirements in precipitation are between 250 mm and 3000 mm, but in soils waterlogged the roots have tendency to putrefaction. In areas with strong rainfall, trees can be planted in small slopes to promote surface run-off water. The ranges of temperatures are between 25 and 35^{o}C, but the tree can tolerate until 48^{o}C shadow and can survive a light freeze. It tolerate a wide range of conditions of soils. Thanked sandy soils with good drainage or clay soil.

Melliferous value. The flowers are large, white to creamy white and nectariferous and is a good source of nectar and pollen for pollinating insects, including bees. Since the plant produces flowers massively on daily basis, it serves as an important source of nectar throughout the day.

13.2.7. Origanum majorana L. (Synonym: Majorana hortensis Moench.) (Marjoram, Sweet Marjoram)

Importance and uses. *Origanum majorana* belongs of *Lamiaceae* Family. Marjoram is used as a spice plant but also as a medicinal plant. Marjoram has a sweet aroma of pine and lemon and is consumed fresh, in food as an aromatic plant, dried in infusions, or in the form of essential oil. It is a natural remedy in the treatment of bloating, intestinal spasms, rheumatic pains, toothaches, canker sores and gingivitis, insomnia, kidney disease, gastritis. Marjoram tea is recommended for urinary tract diseases, palpitations and bronchitis. The raw margarine sprinkled finely chopped over the culinary preparations gives a delicate aroma to the food but also to the salads. Marjoram essential oil contains thymol and carvacrol, with antiseptic, flavonoid, triterpene acid properties such as ursolic (with anabolic and lipolytic effects), oleanolic (with hepatoprotective, antitumor and antiviral effect) and phenolic (with renal, hepatic, draining and antioxidant metabolic action strong) (https://bio-co.ro/b/maghiran-origanum-majorana).

In the kitchen, it is used, fresh or dried, to flavor and enhance the flavor of soups, meats, pizza, fillings, stewed vegetables and legumes.

Young leaves and marjoram flowers are rich in volatile oils (terpinene, pinene, carvacrol), fatty acids, triterpenes, flavonoids, vitamins A, C, yarn, calcium and phenylpropanoids (chemicals

with anti-inflammatory effect). Therapeutic preparations with marjoram are not indicated during pregnancy and lactation, for people suffering from blood pressure fluctuations, diabetes or who have suffered a stroke because supplements with this plant can inhibit blood clotting. (https://www.gabrielafaur.com/2314/maghiran-proprietati-beneficii-mod-de-utilizare-)

Morphological and biological characteristics. Marjoram is a herbaceous, fragrant plant that grows in the form of a bush, reaching 60 cm in height. The root system is poorly developed. The stem, very branched, has four edges. The leaves are long and oval, covered with whitish hairs. The flowers and fruits are small. It blooms from July to September.

Figure 13.8. *Origanum majorana* L.
(Source: https://ierburiuitate.files.wordpress.com/2014/09/maghiran.png)

Climate and soil requirements. Marjoram, native to Northeast Africa and Central Asia. It grows well in slightly acidic, neutral or slightly basic soils. The plant is moderately demanding to moisture and light, but is very sensitive to frost.

Melliferous value. The flower are pale pinkor white and highly attractive to bees and butterflies. The species is hermaphrodite (has both male and female organs) and is pollinated by bees.

13.2.8. Rumex scutatus L. (Sorrel Buckler Leaf, Lemon in a Leaf, French Sorrel)

Importance and uses. *Rumex scutatus* belongs *Polygonaceae* Family, used as a culinary plant. It is a traditional spicy-leafed species and is used in salads or soups. The leaves have a tangy taste, with hints of citrus. They may be harvested as a baby leaf and used in salads, but can also be harvested when mature and cooked like spinach. *Rumex scutatus* works well as an accompaniment

to fish, meat and egg dishes, and as an ingredient in soup and gratins. Leaves may also be added raw to dishes (https://www.gardenersworld.com/plants/rumex-scutatus/).

Plants can contain quite high levels of oxalic acid, which is what gives the leaves of many members of this genus an acid-lemon flavour. Perfectly alright in small quantities, the leaves should not be eaten in large amounts since the oxalic acid can lock-up other nutrients in the food, especially calcium, thus causing mineral deficiencies. The oxalic acid content will be reduced if the plant is cooked. People with a tendency to rheumatism, arthritis, gout, kidney stones or hyperacidity should take especial caution if including this plant in their diet since it can aggravate their conditio (Bown, 1995)

Morphological and biological characteristics. Rumex can be annuals, biennials or perennials with mostly basal, simple leaves and erect panicles or racemes of small greenish or reddish flowers followed by reddish-brown, triangular fruits. Erect and striated stem plant that can reach up to 60 cm in height. It usually has a reddish color at the base. It has a tuberous strain from which many fine roots are grown.

Figure 13.9. *Rumex scutatus* L.
(Source: http://www.freenatureimages.eu/plants/flora%20o-r/Rumex%20scutatus%2C%20French%20Sorrel/index.html#Rumex%2520scutatus%252010%252C%2520Spaanse%2520zuring%252C%2520Saxifraga-Rutger%2520Barendse.JPG)

Fleshy lanceolate, edible and sour tasting leaves. The lower leaves are supported by a long petiole that is shortened in the upper leaves, until almost disappearing completely.

The flowers are dioecious and appear on the upper part of the stem forming corsages of reddish-green flowers that mature when they turn purple. There are female plants and male plants.

It blooms in spring and summer.

This original Perennial of Europe can reach sixty centimeters in height and sixty centimeters in width.

Climate and soil requirements. Common in the Iberian Peninsula, although is scarce in the south. An interesting aspect to comment is that it withstands drought well and does not tolerate pitting, so the planting area must be very well drained. It is moderately demanding in lighting needs, and can be located in a place with semi-shade or with direct exposure to the sun interchangeably. It can withstand even frost and strong winds. Its growth rate in optimal conditions is average. European native plant that can grow in any type of soil, although it prefers those rich in iron. It appears in humid places and with a lot of grass. It prefers stony areas and even fissures in the rocks. The species *Rumex scutatus* will develop better in soils with acidic, neutral or alkaline pH. Its underground part will grow vigorously on supports with a sandy, frank or clayey texture, these can generally be kept moist.The species is found in meadows and rubble in the subalpine and alpine region

Melliferous value. *Rumex scutatus* uses anemophilia to pollinate its flowers with hermaphrodite reproductive units. Finally, this species attracts wildlife.

13.2.9. Santolina chamaecyparissus L. (Cotton Lavender)

Importance and uses. *Santolina chamaecyparssus* is a plant of *Asteraceea* Family. The herbaceous part is used as a deworming remedy and at the same time to regulate menstruation. Similar to those of chamomile, it helps with the problems of slow digestion, excess gas in the stomach and fights possible infections with worms (parasites) for its sedative effect, also whets the appetite against anorexia. Antiseptic to prevent wound infections, expectorant, to decongest and externally antibacterial, antifungal and healing (https://www.flowertime.ro/santolina-516.html).

The main components of the plant are: terpenes, alkaloids, resins, tannins that helps in cases of hysteria, anxiety and nervousness, insomnia and depression, in relieving neck and headaches, but also in the treatment of dysmenorrhea. Being an effective antiseptic, a good detoxifier and antibiotic helps to disinfect wounds and purify the body (https://www.flowertime.ro/santolina-516.html).

Morphological and biological characteristics. It forms a round bush 30-60 cm high and 60-90 cm in diameter, sometimes much larger, depending on the growth and nature of the soil.

They are covered with evergreen and fragrant leaves, exuding a fragrance that is reminiscent of olive and turpentine oils. The small leaves are cut very fine, very sweet and silvery in color, arranged in a variety of white albumen. Inflorescences appear during the summer, from June to August.

The flowers are small, from 1 inch to 1.5 cm in diameter, round and curbated, with small yellow buttons.

Figure 13.10. *Santolina chamaecyparissus* L.
(Source: https://stock.adobe.com/search?k=chamaecyparissus&asset_id=368331945)

Climate and soil requirements. It comes from the Mediterranean area and is found both on hilly lands, arid and sunny hills, but also in culture. Santolina is considered an evergreen aromatic plant that withstands temperatures of 0 degrees Celsius very well, but also drought. It needs sunlight. In summer, flower essences (flowering tops) are collected, drying in the shade or in the dryer. It is packed tightly so as not to lose the essences.

Melliferous value. Ecologically, *Santolina chamaecyparissus* flowers are attractive to pollinating insects including honey bees. However, it has been known to repel the adult stages of some lepidoptera. It blooms in the summer months through pollination by bees and other insects (https://www.flowertime.ro/santolina-516.html).

13.2.10. Satureja montana L. (Winter Savory, Mountain Savory)

Importance and uses. Satureja montana is a plant of Lamiaceae family and used to flavor food. The plant contains pinene, carvacrol 30–40%, cymene 20–25%, terpenes 40–50%, cineol, and a small amount of thymol (Aluyor and Oboh, 2019). A hardy evergreen herb with excellent culinary and medicinal uses. A very useful herb, the strongly aromatic leaves are used as a flavouring in cooked foods and it makes a good tea. Winter savory has marked medicinal benefits, especially upon the whole digestive system. A sprig of the plant rubbed onto bee or wasp stings, brings instant relief (https://www.balkep.org/satureja-montana.html).

Morphological and biological characteristics. Is a perennial, semi-evergreen herb. It has dark green leaves and summer flowers ranging from pale lavender, or pink to white. The closely related plant, summer savory (*Satureja hortensis* L.) is an annual plant. It grows to between 10 and 40 cm tall. The leathery, dark green leaves are opposite, oval-lanceolate, (or needle-like, 1–2 cm long and 5 mm broad. The flowers appear in summer, between July and October, and range from pale lavender or pink to white. The flowers are smaller than summer savoury flowers (https:// en. wikipedia.org/wiki/Winter_savory).

Figure 13.11. *Satureja montana* L.
(Source: https://anthesis.ro/seminte-satureja-montana-savory-winter-cimbru-peren)

Climate and soil requirements. *Satureja montana* is a native to warm temperate regions of southern Europe, the Mediterranean, and Africa. It can be found growing in old walls, on dry banks and rocks on hillsides or rocky mountain slopes. Usually on calcareous, or alkaline soils (Gutzerová, 2015; Beckstrom et al., 2003).

Melliferous value. The flowers open in the summer, adorning the plant with tiny pink/white blossoms that are very attractive to insects.

CHAPTER 14

IMPORTANT SPECIES OF AROMATIC, MEDICINAL AND MELLIFEROUS PLANTS IN ROMANIA

14.1. General aspects of Romania

Geographic characteristics. Romania is bounded by Ukraine to the north, Moldova to the northeast, the Black Sea to the southeast, Bulgaria to the south, Serbia to the southwest, and Hungary to the west. The country forms a complex geographic unit centred on the Transylvanian Basin, around which the peaks of the Carpathian Mountains and their associated subranges and structural platforms form a series of crescents. Beyond this zone, the extensive plains of the south and east of the country, their potential increased by the Danube River and its tributaries, form a fertile outer crescent extending to the frontiers. There is great diversity in the topography, geology, climate, hydrology, flora, and fauna, and for millennia this natural environment has borne the imprint of a human population.

Figure 14.1. Romania map
(Source: https://www.britannica.com/place/Romania)

The relief of Romania is dominated by the Carpathian Mountains, which can be divided into the Eastern Carpathians, the Southern Carpathians, and the Western Carpathians.

The Romanian landscape is approximately one-third mountainous and one-third forested, with the remainder made up of hills and plains. The climate is temperate and marked by four distinct seasons. Romania enjoys a considerable wealth of natural resources: fertile land for agriculture; pastures for livestock; forests that provide hard and soft woods; petroleum reserves; metals, including gold and silver in the Apuseni Mountains; numerous rivers that supply hydroelectricity; and a Black Sea coastline that is the site of both ports and resorts.

Climate and soil conditions. Romania's location in the southeastern portion of the European continent gives it a climate that is transitional between temperate regions and the harsher extremes of the continental interior. In the centre and west of the country, humid Atlantic climatic characteristics prevail; in the southeast the continental influences of the Russian Plain (East European Plain) make themselves felt; and in the extreme southeast there are even milder sub-Mediterranean influences. The average annual temperature is in the low about 11°C in the south and in the about 8°C in the north, although, as noted, there is much variation according to elevation and related factors. Extreme temperatures range from about 45°C in the Bărăgan region to –37°C in the Brașov Depression.

Romania has generally fertile soils. About one-fifth of the country is covered with chernozem—humus-rich black soils. These and reddish brown forest soils are found on the plains to the south and east of the Carpathians, as well as in the Banat. Gray-brown podzolic (leached) soils are found at higher elevations. A broad expanse of alluvial soils covers the Danube floodplain.

Socio-economic aspects. The most important sectors of Romania's economy in 2018 were industry (26.1%), wholesale and retail trade, transport, accommodation and food services (20.2%) and public administration, defence, education, human health and social work activities (14.5%). Intra-EU trade accounts for 77% of Romania's exports (Germany 23%, Italy 11% and France 7%), while outside the EU 3% go to Turkey and 2% to the United States. In terms of imports, 75% come from EU Member States (Germany 20%, Italy 9% and Hungary 7%), while outside the EU 5% come from China and 4% from Turkey (https://european-union.europa.eu/principles-countries-history/country-profiles/romania_en).

14.2. Important species of aromatic, medicinal and melliferous plants

Romania occupies over 11 million hectares of honey flora, half of which is agricultural and half is forestry. However, 80% of the country's honey production is supplied by sunflower varieties and hybrids, acacia and lime forests (MADR, 2021).

For medicinal and aromatic purposes, for domestic needs and for export, in Romania are systematically harvested over 150 species with aromatic and medicinal role. Thus, in recent years, Romania has been among the top countries in the world in the production and export of products obtained from medicinal and aromatic plants. In the field of production and capitalization of medicinal and aromatic plants, the products obtained from them, our country has conditions for further increasing the availability for export, in addition to fully satisfying the ever-increasing domestic needs. Romania's honey flora has a potential of over 200 thousand tons of honey, can ensure good conditions for over 1.7 million bee families and can produce goods of 35 thousand tons / year. Romania's resources in this field are very diverse. In the spontaneous flora there are 3,700 species recognized with phytotherapeutic action, of which 800 species have certain phytotherapeutic properties, and 370 species have properties recognized as having pharmacodynamic effects (Ion et al., 2018).

In Romania grow approx. 150 spontaneous species of medicinal plants, of which only a small part are spread in culture. However, in some parts of the country, medicinal plants are being grown on larger and larger areas, as a result of the ever-increasing demands of the pharmaceutical and cosmetics industries. These cultivated areas are important sources of honey for bees. The most well-known cultivated medicinal plants, with honey value, are: mentha (*Mentha piperita*), lavender (*Lavandula angustifolia*), hyssop (*Hyssopus officinalis*), sage (*Salvia officinalis*), etc. The geographical diversity and richness of the honey base offer quality harvests.

The most important species of aromatic, medicinal and melliferous plants in Romania provided by Faculty of Agriculture, University of Agronomic Sciences and Veterinary Medicine of Bucharest, as partener of Agropuzzle 4 project, are present in Table 14.1.

Table 14.1

The most important species of aromatic medicinal and melliferous plants in Romania (Faculty of Agriculture from Bucharest, Field Crop Production Department team, 2021)

Scientific name	Name in Romanian language
Achillea millefolium	Coada-șoricelului
Artemisia absinthium	Pelin
Atropa belladonna	Mătrăgună
Borago officinalis	Limba mielului
Calendula officinalis	Gălbenele
Carum carvi	Chimen (Chimion)
Coriandrum sativum	Coriandru
Cynara scolymus	Anghinare
Datura innoxia	Laur păros
Dracocephalum moldavica	Mătăciune
Echinacea angustifolia	Echinacea
Foeniculum vulgare	Fenicul
Glycyrrhiza glabra	Lemn dulce
Hypericum perforatum	Sunătoare
Hyppophae rhamnoides	Cătină
Hyssopus officinalis	Isop
Lavandula angustifolia	Lavandă
Matricaria chamomilla	Mușețel
Melissa officinalis	Melisă (Iarba stupului)
Mentha piperita	Mentă bună
Nigella sativa	Negrilică (Chimen negru)
Ocimum basilicum	Busuioc
Phacelia tanacetifolia	Facelia
Papaver somniferum	Mac
Pimpinella anisum	Anason
Robinia pseudocacia	Salcâm
Salvia officinalis	Salvia
Saponaria officinalis	Săpunariță
Silybum marianum	Armurariu
Sinapis alba	Muștar alb
Tagetes patula	Crăițe
Taraxacum officinalis	Păpădie
Tilia tomentosa	Tei argintiu
Thymus vulgaris	Cimbru de cultură
Thymus serpilium	Cimbrisor
Valeriana officinalis	Valeriană

14.2.1. Cynara scolymus L. (Artichoke)

Importance and uses. *Cynara scolymus* belongs *Asteraceae* Family. Artichoke can be used as a vegetable in various dishes, but also as a medicinal plant. Artichoke is also highly prized as a food. Its edible parts are the fleshy leaves at the base of the inflorescences and the inflorescences before flowering. In therapeutics, artichokes were introduced in the 16th century, but it was not until 1931 that the choleretic action of this plant was established. Later studies confirmed that these properties are due to cynarin and polyphenols. From this plant are used the

leaves which contain cynarin, polyphenols, flavones, bitter principles, inulin and potassium and magnesium salts (Muntean, 1990). From a therapeutic point of view, artichoke leaves are characterized by favorable effects on liver and kidney disease, having the property of increasing bile secretion and diuresis, while regulating the formation of cholesterol and carbohydrate levels. Artichoke is the basis for obtaining the Romanian product "Anghirol", used due to its cholagogue-choleretic, diuretic, metabolic and antiallergic actions. Not recommended for children under 3 years of age, as well as for those suffering from acute liver or biliary diseases.

Artichoke contains cinnarine, oxidase, polyphenols, flavones, vitamins A, B, C, manganese, phosphorus, iron, lipids, sugars. Artichoke is also an important source of fiber, inulin - a substance that stimulates the immune system, facilitates intestinal transit, increases the assimilation of magnesium and calcium in the body.

Artichoke treatment in the form of tea will not be followed for more than 30 days, as overdose often causes hepatobiliary colic.

It can also be used to make aperitif drinks.

Artichoke has the most antioxidants of all vegetables, which means that it helps the immune system fight free radicals responsible for many diseases.

Vitamin C of artichoke leaves is effective in mucositis, fibrosis, breast cancer, and the extract of artichoke leaves are used to induce the death of diseased cells and cell regeneration, but also to the proliferation of cells when injected into the cancerous masses.

It can be used fresh immediately after harvest, or can it be marinated in oil, vinegar or pickled in various saline solutions.

Morphological and biological characteristics. The artichoke is native to the Mediterranean area. In North Africa, where they are still found in the wild. Today, the largest producers of artichokes are Italy, Spain and France. In the United States, California provides almost 100% of the United States artichoke crop.

Artichoke is a perennial, herbaceous plant, which forms in the first year of vegetation the rosette of leaves and, in the following year, the flowering stems. In culture, artichoke is considered an annual plant, due to the fact that the leaves harvested in the first year of vegetation are the plant material used for therapeutic purposes. In the following years, the production of leaves is very low, and therefore its cultivation as a perennial plant is not justified. If it is grown for seed, then it is considered a biennial plant, and is left only in the second year for seed production.

The root system is well developed, and the stem is branched, 80-180 cm high, dark green and has hairs although soft. The leaves of the first year are in the form of a rosette, and those that form on the stem, in the second year, are alternate. The leaves are large, have spiky hairs and are green-gray in color.

The inflorescences are anthodium, large, globose, with red or purplish-red flowers. The leaflets are membranous, spiny and fleshy at the base. The fruit is a glossy brown achene, with a yellowish pappus on the tip.

Figura 14.2. ***Cynara scolymus*** **L. (original)**
(Biobase of the Faculty of Agriculture Bucharest)

Climate and soil requirements. Artichoke is demanding of temperature and brightness; therefore, the favorable areas are located in the south of the country, in the counties bordering the Danube. To germinate, artichokes need a temperature above 8oC. It is also recommended to cultivate in deep soils, rich in nutrients, permeable, with a neutral or slightly alkaline reaction.

Melliferous value. It blooms from July to September. Artichoke is an ideal honey plant,

Artichoke is an ideal honey plant, which has a higher nectar-polleniferous potential. honey production estimated at 150-400 kg / ha confirms the characteristic of secreting a large amount of nectar. artichoke pollen has a superior chemical composition, with a protein content of 30-41%, which places it along with the richest pollen varieties (Ion et al., 2008).

14.2.2. Dracocephalum moldavica L. (Moldavian Dragonhead, Moldavian Balm)

Importance and uses. *Dracocephalum moldavica* is species of *Lamiaceae* Family. In phytotherapy is used the aerial part of the plant. Due to its components, the volatile oil has antispasmodic and carminative properties, being used in the same way as *Melissa officinalis*. Vitamin A can be obtained industrially method from citral. For the food industry it can be used to make syrups or soft drinks.

It is also used in the perfume industry. In Romania, monks used the leaves of the plant to obtain "lemon balm water" (Coiciu and Racz, 1967), from where the plant is also known as "monastery basil" (Paun et al., 1986, 1988; Toader and Roman, 2014). The preparations of this plant have therapeutic effects in case of: digestive disorders (gastrointestinal diseases, biliary dyskinesia, intestinal colic, diarrhea); facilitates digestion, soothes vomiting in women, fights aerophagia and bloating; nervousness and insomnia; in eye conditions and skin wounds or irritations.

Morphological and biological characteristics. Herbaceous plant, annual, aromatic and honey, with erect stem, 30-70 cm high, branched at the base, with 4 edges, covered with small hairs, often reddish. The leaves are opposite, short-petiolate, elongate-lanceolate, divided into 3-7 narrow segments, with crenellated edges and glandular points on the underside. The flowers are blue-purple or white and are grouped 6-10 at the apex at the base of the leaves at the upper nodes.

Figure 14.3. *Dracocephalum moldavica* L.
(Source: https://gradina-de-vis.shopmania.biz/cumpara/%EF%BB%BFmataciunea-moldoveneasca-dracocephalum-moldavicum-l-7277231)

Climate and soil requirements. The species is native to Siberia and the Himalayas. In Romania it exists in the spontaneous or cultivated flora from the south of Moldova, Transylvania,

Crisurilor Plain, Baraganului Plain and Dobrogea. Moldavian Dragonhead prefers sunny, light or medium-textured soils, rich in humus, sufficiently moist but permeable, as the silt is extremely sensitive to excess water.

Melliferous value. *Moldavian Dragonhead* is a very good honey plant, obtaining about 200 kilograms of honey/ha and the flowers are intensely researched by bees. The flowers secretes nectar and in less favorable soil and climatic conditions. Having a short vegetation period, it can be cultivated by beekeepers in stages, thus flowering in stages from June to October, ensuring a long harvesting period for honey bees (Ion et al., 2008).

14.2.3. Lavandula angustifolia L. (Lavander)

Importance and uses. *Lavanda angustifolia* is a plant of *Lamiaceae* Family. There are over 40 plants species that are technically considered lavender. As for the main varieties of lavender, they are:

- *English Lavender* (*Lavandula angustifolia*). It blooms in June-August being the most appreciated variety. The leaves are gray-green, and the flowers are extremely fragrant and can have shades of purple, dark blue to purple, light pink or white. Although of Mediterranean origin, this variety is called English lavender because it has successfully adapted to the cold climate and, of course, is indispensable in British gardens. English lavender is ideal in the culinary field due to its low camphor content. Another variety of English lavender is *Lavandula angustifolia* ("Munstead"), with a high heat tolerance.

Figure 14.4. *Lavandula angustifolia* L.
(Biobasis of Bucharest Agriculture Faculty) (original)

- *French Lavender* (*Lavandula dentata*). It blooms in early summer and lasts until autumn. It can reach a height of 15 cm or more, and the flowers are light purple. This variety of lavender is also known as fringed lavender. Even though the flowers are not as fragrant as those of English lavender, the fresh leaves have a strong rosemary-like aroma.

Figure 14.5. *Lavandula angustifolia* L.
(Source: https://ro.pinterest.com/pin/23925441755142327/)

- *Spanish Lavender* (*Lavandula stoechas*). It blooms in mid-summer towards the end of it, and the plants can reach a height of up to 60 cm. The flowers are dark purple in color, resembling a small pineapple with two long rabbit ears. Even if the flowers do not have an intense scent, the light green leaves are extremely fragrant.

Figure 14.6. *Lavandula stoechas* L.
(Source: https://magazinuldeplante.ro/magazin/lavanda-stoechas-p17/)

- *Portuguese Lavender (Lavandula latifolia).* This species grows long, pale lilac flower spikes with a distinctive scent that is stronger and more pungent than the English lavender. The evergreen plants flower between mid-late spring and late summer.

Figure 14.7. *Lavandula latifolia* L.
(Source: https://worldoffloweringplants.com/lavandula-latifolia-spike-lavender/)

- *Lavandin (Lavandula x intermedia).* These are a hybrid variety, obtained by combining English lavender (*Lavandula angustifolia)* with Portuguese lavender (*Lavandula latifolia*). They bloom from mid-summer to late, and can reach a height of 60 cm. The flowers can be dark purple or white. Lavendin are not recommended for consumption due to their high camphor content, but flowers are often used in lavender bags for room fragrance.

Figure 14.8. *Lavandula x intermedia*
(Source: https://worldoffloweringplants.com/lavandula-latifolia-spike-lavender/)

- *Egyptian Lavender (Lavandula multifida*). These perennial plants grow pale lilac flowers on a long stalk, between late spring and late summer. The flowers have a stronger pungent aroma compared to most other lavenders.

Figure 14.9. *Lavandula multifida* L.
(Source: https://www.mygardenlife.com/plant-library/2100/lavandula/multifida)

Most of the varieties come from either the English lavender (*Lavandula angustifolia*) or the French/Spanish lavender (*Lavandula stoechas*) (https://www.gardenmandy.com/types-of-lavender-plants/).

Lavender is used for cooking, in natural medicine for various teas, oils and tinctures, but also in the cosmetics industry for perfumes, soaps and body lotions. Lavender has been used as a medicinal plant since ancient times, but the therapeutic properties of the essential oil extracted from this plant were discovered in the early twentieth century. Thousands of tons of lavender are used to extract essential oil by distillation or dried in well-ventilated rooms. More than 40 components have been identified in the composition of the plant that cannot be obtained by synthesis in the laboratory. The composition of the plant includes: olifalic alcohol, acetic acid, tannin and bitter principles, which give lavender healing properties for more than 70 diseases. It has sedative, antispasmodic, antiseptic, hypotensive, carminative, diuretic and sweating properties. Lavender also reduces inflammation and speeds up wound healing. An infusion cup prepared from a mixture of herbs: lavender, lime, sulphine and captalan flowers (one teaspoon each) is recommended twice a day for depressed people (Toader and Roman, 2014).

Morphological and biological characteristics. Lavender is a shrub up to 50 cm tall, with slender, woody stems, small gray-green leaves, reddish-lilac flowers, and lignified roots up to 2-3 cm thick. The depth and richness of the root system gives lavender drought resistance. The stem is strongly branched at the base, forming an almost globular, hemispherical bush, 30-70 cm high or higher. The mature stem is brown, with exfoliated bark, and the young stems (branches) are quadrangular, pubescent. The branches have inflorescences 25-35 cm long and have leaves only at the bottom. The leaves are opposite, linear-lanceolate, acute, with ciliated edges. The leaves at the base are gray, 1-2 cm long and 1.5-2 mm wide, on both sides hairy, with branched, stellate hairs. The upper leaves are greenish-gray, 2-3.5 cm long and 3-6 mm wide, less hairy. Lavender leaves do not fall in autumn at the end of vegetation. The flowers specific to the labia, with an aromatic scent due to the oleiferous glands, are grouped in a spiciform inflorescence. The corolla may be purple-bluish, sometimes light blue to white. The fruits are walnuts, located at the base of the persistent calyx, with a brown or gray surface, smooth and glossy (Toader and Roman, 2014).

Climate and soil requirements. Lavender is a plant native to North Africa and the mountainous regions of the Mediterranean area. Lavender has high temperature requirements, requiring 10-15^{o}C. During the winter months, lavender withstands temperatures of -15^{o}C in winters without snow and up to -30^{o}C. Young plants withstand temperatures of -8^{o}C after emergence. Lavender is a light-loving plant. When plants grow in sunny places, they produce large bushes and accumulate more volatile oil. With respect to the soil, lavender does not have high requirements, succeeding on very different soils, sandy, calcareous or even rocky. However, it is not recommended to cultivate lavender on cold soils with excess moisture and shallow groundwater. In terms of humidity, lavender is less demanding, withstanding drought well, thanks to the well-developed root system. Lavandin is more sensitive to low temperatures, especially when it is accompanied by winds and in the absence of a protective snow layer. Under such conditions, lavender plants perish by more than 50%, and in some years flower production is compromised (Toader and Roman, 2014).

Melliferous value. Lavender is a honey plant that produces abundant nectar and is therefore widely visited by bees. One hectare of lavender can give 100-150 kg of honey. Lavender honey is light in color, very fragrant, fine and has disinfectant properties (Ion et al., 2008).

14.2.4. Nigella sativa L. (Synonym: Nigella cretica Mill.) (Black Caraway, Black Cumin, Nigella, Kalonji)

Importance and uses. *Nigella sativa* species belongs of *Ranunculaceae* Family. The cultivated species is *Nigella sativa*, but there are other species, with similar characteristics, namely: *Nigella damascena* and *Nigella hispanica*, cultivated more as a decorative plant; *Nigella arvensis*, which appears as a weed, especially in Iraq, Turkey, Israel.

Figure 14.10. *Nigella sativa* L.
(Source: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:711687-1)

Figure 14.11. *Nigella damascena* L.
(Source: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:711687-1)

Figure 14.12. ***Nigella hispanica*** **L.**
(Source: https://higgledygarden.com/wp-content/uploads/2011/08/0211.jpg)

Figure 14.13. ***Nigella arvensis*** **L.**
(Source: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:711687-1)

Nigella sativa it is the most important from a therapeutic point of view but also for food. Black caraway is a species that has been cultivated since antiquity for its seeds used as a spice by Arabs, Greeks or Romans, or for its aphrodisiac properties.

The name comes from the Latin "nigellus" which means blackish, with express reference to the appearance of the seeds. The seeds of this plant are mainly used for flavoring various varieties of cheese. They can also be used in baking or for preserving vegetables.

The volatile oil present in the seeds contains nigelon, as well as lipids and albumin. Due to these compounds, they have diuretic, antihistamine properties in bronchial spasms. Other therapeutic uses include the use of seeds in various pharmaceutical forms (infusion, decoction) as a diuretic, carminative and aphrodisiac.

Its seeds have a very specific, aromatic scent that can be used in perfumery.

In the United States, the Food and Drug Administration classifies Nigella sativa L. (black cumin, black caraway) as Generally Recognized as Safe (GRAS) for use as a spice, natural seasoning, or flavouring (US Food and Drug Administration).

The seeds of N. sativa are used as a spice in many cuisines (Engels and Brinckmann, 2017). In Palestine, the seeds are ground to make bitter qizha paste (Berger, 2019).

The dry-roasted seeds flavour curries, vegetables, and pulses. They can be used as a seasoning in recipes with pod fruit, vegetables, salads, and poultry. In some cultures, the black seeds are used to flavour bread products, and are used as part of the spice mixture panch phoron (meaning a mixture of five spices) and alone in many recipes in Bengali cuisine and most recognizably in naan (Braman, 2011). Nigella is also used in tresse cheese, a braided string cheese called majdouleh or majdouli in the Middle East.

Morphological and biological characteristics. Black caraway is an annual herbaceous plant with a slender, pivoting root. The stem is branched, has hairs, and the leaves are alternate, 2-3 cm long, secta 2-3 times. The flowers are solitary, located at the top of the branches, with white leaflets, towards the top having a bluish color. It blooms in May-June. The fruit is a globular capsule with small seeds, 2-4 mm wide, black, glabrous and wrinkled.

Climate and soil requirements. The species is native to eastern Europe (Bulgaria, Cyprus and Romania) and western Asia (Turkey, Iran and Iraq), but naturalized over a much wider area, including parts of Europe, northern Africa and east to Myanmar (https://powo. science. kew. org/ taxon/ urn:lsid:ipni.org:names:711687-1).

Black caraway has moderate temperature requirements, but is a light-loving plant. Favorable areas for cultivation are those in the south of Romania.

It thrives on all types of soil, but is preferred to be grown on medium-textured, fertile and loose soils. It can also be found in gardens. Sometimes it also appears spontaneously, as a weed, in the sunnier areas.

Melliferous value. The flowering period lasts from May to August, the black caraway being known as the honey plant. Black caraway is very attractive to bees and it is a good honey plant.

14.2.5. Mentha piperita L (Mint)

Importance and uses. *Mentha piperita* is a species of *Lamiaceae* Family.

Mint is one of the oldest known medicinal and aromatic plants. The raw material can be leaves or the whole plant. Mint can have uses in the medical-pharmaceutical, food, cosmetic industries, it is part of some medicinal teas with stomachic, carminative, anti-vomiting, choleretic or cardiotonic action. In dry leaves it contains 0.5-3.5% volatile oil, and fresh grass has a volatile oil content of between 0.15 and 0.55%.

The main component of the oil is menthol for *Mentha piperita* (about 75%).

Morphological and biological characteristics. Mint is an annual herbaceous plant with a very well branched aerial part. The root consists of a very large number of fibrous adventitious roots, which reach a depth of up to 40-60 cm.

The stem is annual, composed of nodes and internodes, more or less erect, strongly branched. Depending on the pedoclimatic conditions, it can grow up to 1 m and even more. From the buds located on the lignified portion of the stem, below ground level, stolons are formed. At the nodes of the stolons, small leaves, adventitious roots and new aerial shoots form. Branched stolons grow horizontally by 20-50 cm per year, leading to self-extension of the plant (Muntean, 2007). The leaves are large, arranged opposite, short peduncled, oval-lanceolate, strongly toothed edge, sharp at the tip and dark green. The flowers are grouped in spiciform tops, placed at the top of the branches, and the corolla is pink-purple. It blooms from June to September.

The fruit consists of 4 small seeds, covered with persistent calyx.

Figure 14.14. *Mentha piperita* L.
(Source: https://adelaparvu.com/2014/04/02/la-orastie-in-inima-daciei-a-inceput-traditia-plantelor-medicinale-din-romania/)

Mentha crispa is a hybrid obtained from two species of mint, which appeared probably spontaneously. It has erect stems, with grouped branches, up to 120 cm high and colored green with anthocyanin shades. The leaves are large, glabrous, dark green, without petiole, oval, with strongly toothed edge and wrinkled tongue surface. The inflorescences are grouped in large spikes, placed at the top of the stem and branches. The corolla is colored pink-purple.

The plant is characterized by the fact that it does not bear fruit and multiplies exclusively by vegetative means, through underground stems (stolons). At the nodes of the stolons, small leaves, adventitious roots and new aerial shoots form. The stolons branch out and grow in a horizontal direction, leading to self-extension of the bush. Stolons are formed every year, starting from the flowering period and ensure the restoration of the aerial part of the plant, in the following year. There are oleiferous glands on all the aerial organs, their density being lower on the dorsal side of the leaves.

Figure 14.15. *Mentha spicata* var. *crispa* L.
(Source: https://www.culinaryherbco.co.uk/products/mint-curly/)

Climate and soil requirements. Mint has great ecological plasticity and is widespread on all continents also is of English origin, being the result of a cross between *Mentha aquatica* and *Mentha viridis*. It does not grow in the spontaneous flora, but is cultivated mainly in South European countries, but also in North America and Asia. The largest growers are: England, Spain, Italy, Portugal, France, the United States, Tunisia, Morocco, Turkey, Argentina, Brazil, China and Japan. In Romania, mint finds favorable vegetation conditions in all natural areas, preferring light, loose, fertile, alluvial soils, wet, dry and slightly shady places. It is cultivated, especially, in the Timiş Plain, the south of Oltenia, the Burnaz Plain, Băragan, Dobrogea and Ţara Bârsei. In Romania, the most favorable cultivation areas are found in the Bârsa Depression, Olt and Mureş Valleys, Banat Plain and in the Romanian Plain, under irrigation conditions. It is also grown in small areas in gardens.

Plant vegetation begins in early spring, at temperatures of 3-5ºC; mint stolons withstand temperatures down to -20ºC. The optimum temperature during the summer is 18-22ºC, and the sum of the temperatures throughout the vegetation period reaches 1500-1600ºC.

Mint is demanding of soil moisture, with water being a limiting factor in production. During the whole vegetation period, the plant consumes about 6000 m3 of water.

Mint is also demanding of light, a factor that favors the accumulation of volatile oil in the plant.

Mint grows very well on loose, permeable soils and well supplied with nutrients. It is recommended to cultivate on alluvial and turbid soils, with medium to light texture and with shallow groundwater. However, it can be grown on any type of soil under irrigated conditions.

Melliferous value. Mint has a high melliferous value, being able to produce an estimated honey production of over 200 kg/ha.

14.2.6. Robinia pseudocacia L. (Synonym: Robinia pseudoacacia var. rectissima (L.) Raber) (Acacia, Black Locust, White Locust)

Importance and uses. *Robinia pseudoacacia* is a species of *Fabaceae* family. Acacia flowers, pleasant in taste and smell, have a great therapeutic value. Acacia preparations (infusion, tincture, powder) are alkalizing, antispasmodic (acts on the smooth gastric and pulmonary muscles), sedative and calming. Due to these properties, acacia flowers have a calming effect on diseases of the nervous system, digestive tract and lung disease. The benefits of acacia preparations, which maintain good health, are due to the complex chemical composition of acacia, which contains many active substances: tannins, carbohydrates, mucilaginous substances, acacia and volatile oil. All of these are helpful in treating irritability, restful sleep, or memory problems (https://bunatatidinnatura.ro/Floare-de-Salcam).

Acacia are recommended in the treatment of digestive disorders and in the control of muscle cramps of a nervous nature. Acacia flowers have anti-acid and gastric calming effects.

Acacia flowers can be eaten fresh or cooked. One of the classic recipes, perhaps the most common, is acacia flowers in dough, but they can be added to cakes or salads alike. In Romania the flowers are sometimes used to produce a sweet and perfumed jam. This means manual harvesting of flowers, eliminating the seeds and boiling the petals with sugar, in certain proportions, to obtain a light sweet and delicate perfume jam.

Although the bark and leaves are toxic, various reports suggest that the seeds and the young pods of the black locust are edible. Shelled seeds are safe to harvest from summer through fall, and are edible both raw and boiled.

Acacia is a rustic species of forestry interest: it grows rapidly, is highly productive and has the ability to fix flying sands. Acacia wood is of high quality, with good mechanical and technological properties.

Acacia bark contains robin, a phytotoxin and should therefore be used with caution. But it has also been used in traditional medicine to regulate hyperacidity, to treat gastric and duodenal ulcers and as a purgative.

Morphological and biological characteristics. It is a tree that can grow to a height of 25-30 m and has a longevity of about 100 m. Rooting in the first 2-3 years is pivoting, on sandy soils reaching 1.5-2 m. Later the lateral branches develop strongly, reaching up to 20 m from the trunk.

Figure 14.16. *Robinia pseudocacia* L.
(Source: https://www.gardenexpert.ro/arbori/arbori-ornamentali/salcam.html)

The stem is straight, well pruned in a tight massif, and in sparse plantations it is short, forked. The bark of the trunk has many cracks, the crown has an irregular shape, and the young branches have thorns. It is the most common *Acacia* species, adapted to the climate of Romania, in some areas, becoming even an invasive species. It has imperceptibly compound leaves, which grow late in May. Blooms after leafing, in May-June, the flowers are white, fragrant, growing in

racemes. The fruits are brown, smooth pods. It presents several varieties appreciated for the shape of growth, foliage or special flowers.

The roots of black locust contain nodules that allow it to fix nitrogen, as is common within the pea family.

Climate and soil requirements. Acacia originated in North America and was introduced to Europe in 1601. Parts of the world, such as Africa, North America, Australia, Asia, have concentrated 80% of these beautiful plants on their territories. In Europe, acacia began to be cultivated in the 18th century. Depending on the variety and habitat, the plant can be a tree or a shrub.Acacia is proving to be a demanding species in terms of soil and climate. Acacia prefers bright places, but also supports light shading. In general, they are frost-resistant trees. Early autumn frosts, frost and wind can affect them. Acacia need full heat during the summer. Acacia species prefer temperate, light, fertile soils that drain water well. Acacia is more sensitive to drought, while other species tolerate drier soils and are often used to reforest land. The first forest crop was created in Băileşti, Oltenia in 1852, in order to fix the continental sands, as well as to afforest the compact soils from Bărăgan. After 1880, large areas were forested in southeastern Oltenia, northeastern Muntenia, northeastern Transylvania, southern Moldavia, and heavy steppe and forest-steppe soils.

Romania has proven to be a second home for acacia (arid and arid climate): the most beautiful stands in the natural and cultural area (eg Ciurumela forest, Calafat forest district) have been reported. Between 1985 and 1989 there were 120,000 ha of acacia forest. Apart from the massive plantations, acacia is widespread in other regions of the country from 200 m altitude to 400 m altitude, where it is also found sporadically (http://www.apicultura. freesoul.ro/ resursele/ arbori_ si_arbusti.htm).

Melliferous value. Acacia is the most important honey source in Romania, due to the richness of nectar flowers. However, honey production is uncertain if it blooms either when the wind blows, it rains, or the temperature is too low, or all together. Sometimes too short a time in the spring until the acacia blossoms, but also the reduced flowering period in favorable years associated with frequent unfavorable weather conditions that partially or completely affect the harvest, can cause insufficient honey production (Ion et al., 2008).

Traditionally harvested, acacia honey can also be used for therapeutic purposes: boost immunity, contributes to the cure of memory disorders, asthenia and neurosis, is expectorant,

sedative and healing, treats gastric distress, stimulates cardiac activity (http://www.tainavie. ro/ totul - despre-miere/valoarea-terapeutica-a-mierii.html).

Acacia honey is transparent, almost colorless, or may be pale yellow. It is very fragrant, but not very sweet compared to polyfloral honey. It has a fine texture and a pleasant, delicate taste, being the assortment most easily assimilated and digested by the body, offering many benefits, nutrients and bio-active substances, but also a lot of Energy (https://sfatnaturist.ro/mierea-de-salcam-de-ce-este-considerat-cel-mai-bun-produsul-apicol-si-ce-indicatii-terapeutice-are/).

The production of honey per hectare, established by research done in Romania, is 1365 kg for forests and 643 kg for young plantations (Ion et al., 2008).

Yellow acacia blooms in May-June for 14-20 days. According to the literature, the production of honey in favorable conditions can reach up to 350 kg per hectare. The honey is transparent, solidified, white in color, with medium-sized crystals, without any smell and with a pleasant taste, similar to white acacia honey. It is very resistant to drought and fros (http://www.apicultura.freesoul.ro/resursele/arbori_si_arbusti.htmt).

14.2.7. Salvia officinalis L. (Sage)

Importance and uses. Salvia officinalis belongs of *Lamiaceae* Family. Salvia can be of several types, starting with Salvia officinalis, one of the most well-known culinary plants and also used as a medicinal and aromatic plant. Sage is one of the best known and most widely used medicinal plants, being considered a "universal panacea" since antiquity, due to its special therapeutic qualities (Cucu et al., 1982).

The name sage comes from the Latin "salvare" which means to heal. The raw material - the leaves or the whole plant - contains volatile oil (0.38% in fresh leaves and between 0.39 and 2.35% in dry ones). Volatile oil, like other components (bitter-tasting tannins, flavones or vitamins) have an astringent, carminative, antispasmodic, antiperspirant, choleretic and antidiarrheal effect (Cucu et al., 1982).

It is used as a tincture, sage tea, but also as a spice - fresh or dried.

Sage can be used in the perfume industry, as a spice in various dishes or as a honey plant. The leaves are used in the composition of antiasthmatic tea and for gargling, as well as in gingival or stomach disorders (Toader and Roman, 2014).

Salvia is used in Italian cuisine where dried, very fragrant and spicy leaves are used. sage complements the flavor of the meat very well when preparing pasta sauces intensifies the aroma of fresh or cooked vegetables sometimes it can also be used to flavor different cheeses (Roman et al., 2011).

Salvia contains over 160 distinct polyphenols, which are herbal chemical compounds that act as antioxidants in the body. Chlorogenic acid, caffeic acid, rosmarinic acid, ellagic acid and rutin - all found in sage - are all linked to impressive health benefits, such as a lower risk of cancer and improved brain and memory function (https://www.libertatea.ro/lifestyle/salvie-beneficii-contraindicatii-retete-3456638).

Morphological and biological characteristics. Sage is a perennial subshrub, with a very well branched aerial part and which lignifies from the second year of vegetation. The root system is very well developed, pivoting, and the stem is pubescent and can reach 100 cm in height. The leaves are opposite, lanceolate or ovate, finely serrated at the edges and can reach lengths of 2-3 cm. The fungi are pubescent, silvery-green or white-gray, with ribs covered with thick hairs.

Figure 14.17. *Salvia officinalis* L. (original)

The inflorescences are whorled, with flowers that have a blue-purple corolla, rarely pink or white. It blooms in June-July, and the pollination is entomophilous allogamous. The fruits are spherical nuts, grouped in groups of four, of which only one reaches maturity, up to 3 fruits. They

are dark brown or blackish. The plant has a specific smell, due to the volatile oil, and the leaves have a slightly bitter taste.

Climate and soil requirements. In the areas of origin (south-eastern Europe) it grows spontaneously, and in Romania, only cultivated.

Salvia has high temperature requirements. The most favorable cultivation areas are found in the south or in the west, in slightly higher places, with groundwater located at depths greater than 2 m, rich in limestone. Due to the fact that it has a well-developed and deep root system, it can be cultivated on sloping lands to prevent soil erosion, as well as to fix sands. It is not recommended to grow on clayey or excessively moist soils.

Melliferous value. It blooms in June, July and August. The honey is dark golden yellow with a pleasant aroma. Honey production is 300-400 kg/ha.

14.2.8. Sinalis alba L. (White Mustar)

Importance and uses. *Sinapis alba* is an annual plant of the *Brassicaceae* Family. Reported for over 3000 years, mustard is one of the oldest spices, it is used in powder or grain form by the ancient Asian and Egyptian peoples. It was originally cultivated in China and then spread around the world. White mustard is widely used in food, as it retains its specific taste even after mixing with water.

White mustard leaves can be eaten in salads, but can also be used as fodder. Edible oil extracted from seeds does not rancid easily. In Asia, in ancient times, it supplemented the lighting fuel industry and also gave flavors to various dishes. Mustard consumption is recommended for health. It is low in calories and cholesterol, but contains protein, calcium, magnesium and potassium. As an ingredient for various sauces, mustard must be added to the sauces shortly before it is ready, because if it is heated too much, it loses its flavor.

Mustard seeds are used to preserve vegetables (cucumbers, donuts), but also to flavor them. In combination with warm water, mustard increases blood pressure and leads to better blood circulation. This is not recommended for those with high blood pressure.

Mustard baths can be taken in case of cold and cough. It also has beneficial effects for treating migraines (by applying mustard paste on the back of the neck). On the other hand, the seeds have a laxative action (1 teaspoon of seeds is recommended 2-3 times a day with water).

Cakes resulting from oil extraction can be used in animal feed.

The active ingredient in mustard seeds is sinalbina. Mustard seeds also contain about 4-6% minerals, and mucilages are also found in large quantities, about 20%. Lipids represent 30% of the seed composition and consist mainly of erucic, linoleic and oleic acids. White mustard is also a valuable honey plant.

White mustard is commonly used as a cover and green manure crop in Europe (between UK and Ukraine).

Morphological and biological characteristics. White mustard (Figure 9) is an annual herbaceous species. The root is pivoting and branched. The stem is erect, 50-150 cm high, branched and pubescent. The leaf has 3-5 irregularly shaped lobes with sectional edges. The flowers are grouped in racemes, yellow in color, the petals being arranged in a cross. Pollination is allogamous, entomophilous, and the flowering period is about 20-25 days. The fruits are siliceous, arranged approximately perpendicular to the branches. The seeds are globose, white to yellowish to light yellow.

Figure 14.18. *Sinapis alba* L. (original)

Climate and soil requirements. Most common in Europe, North Africa, the Middle East and Central Asia, it can be found worldwide. It has been found as far north as Greenland,[2] and naturalized throughout Great Britain and Ireland (Capland et al., 1978). White mustard has high

ecological plasticity, not being pretentious to temperature, brightness or soil type. Due to this, it can be grown in all parts of the country.

The vegetation period is relatively short, 90-100 days. The minimum germination temperature is 1-3ºC, and the young seedlings can withstand -5ºC for a short time.

In relation to the soil, mustard has low demands, but gives higher yields on medium-textured, fertile soils and well supplied with water.

Melliferous value. White mustard is a rich honey plant, especially good for pollen. A plant can have between 900 and 2,000 flowers. Bees collect a lot of pollen from mustard, which has many nutrients. Also, the nectar of the flowers, which they secrete at the base of the stamens, is abundant. In this honey plant, flowering occurs in May, before the acacia blooms or may coincide with it. Honey production per hectare is 40-150 kg, depending on the weather. In rainy and hot weather, the production is maximum. The temperature of the dry air concentrates a lot of nectar, and the bees then harvest less from the mustard. The honey has a light yellow color, with a pleasant aroma, with a slightly pungent taste at first (https://cultivaprofitabil.ro/mustar-alb-o-planta-melifera-bogata-buna-si-pentru-polen/).

14.2.9. Tilia tomentosa Moench. (Lime, Lime Tree, Silver Linden, Silver Lim)

Importance and uses. *Tilia tomentosa* is a plants belonging to the *Tiliaceae* family.

The therapeutic virtues of lime have come to light since ancient times, which is not at all unexpected if we consider the odorous properties that keep it at the forefront of the most popular remedies today. Lime flower honey has also become, before others, a highly sought-after product on all meridians. Lime flowers tea has a calming, emollient effect (fights the dryness of the mucous membranes), sedative, antispasmodic, expectorant and sweaty. Lime tea is an effective remedy for headaches, abdominal pain, indigestion and muscle fever and more recently it is used in cosmetics. Thanks to its sedative effects, it is indicated in insomnia, nervousness and intellectual overload.

Lime tea consumed in excess does not stimulate sleep but contributes to the onset of insomnia.

The tree is mainly used for ornamental purposes in urban conditions due to its tolerance to pollution, soil compaction, drought and heat. It stands out for the silvery-white foliage on the underside of the leaves, making it look shiny.

Morphological and biological characteristics. There are many species of *Tilia*, about 30 species of deciduous trees, flowering mainly in the northern hemisphere, in temperate climates (https://www.botanistii.ro/blog/sfaturi-ingrijire-cultivare-teiul/). Most species are tall trees, which can reach 20-40 m in height, have cordate leaves. They are hermaphroditic species, with female and male flowers on the same plant. Lime tree is an outdoor decorative tree, being found in parks and gardens, as solitary specimens or in groups and alignments. They grow slowly in the first years, after which they grow quite fast and have a longevity of about 200 years (https://www. botanistii. ro/blog/sfaturi-ingrijire-cultivare-teiul/). Lime is another honey tree, but picking lime is conditioned by the weather and is impossible for many years due to rain. Lime blossoms 15-20 days after acacia. Lime harvest is long lasting than acacia. In Romania are three species: large-leaved lime, small-leaved lime and white lime. The flowering time of the three species is on average 30 days depending on the geographical position. The first species to bloom is the large-leaved lime tree, followed by the small-leaved lime tree, and the last to bloom the white lime tree.

The most common lime species in Romania are:

- *Tilia tomentosa* Moench. It is native to southeastern Europe and southwestern Asia, from Romania and the Balkans east to western Turkey, occurring at moderate altitudes. It grows as a first-sized tree and can reach a height of 30 m.

Figure 14.19. *Tilia tomentosa* Moech.
(Source: https://www.pepinieramizil.ro/plante-foioase/tei-argintiu-tilia-tomentosa-00000702.html)

It forms a wide, thick, oval-shaped crown with tomentose vines. The leaves are cordiform, with a pointed tip and serrated edge. On the upper side they are glossy, dark green, and the lower part is tomentose, gray. The flowers are yellow, with velvety sepals and have a strong scent.

- *Tilia platyphyllos* Mill. It is a deciduous tree, native to much of Europe, including locally in southwestern Great Britain, growing on lime-rich soils. Tilia platyphyllos is a narrowly domed tree with a moderate growth rate, and can eventually attain a height of 40 m. The reddish-brown young stems later develop dark grey bark with fine fissures and furrows. The branches spread upwards at wide angles. The twigs are reddish-green and slightly pubescent (Martin, 1965). The foliage consists of simple, alternately arranged leaves. As indicated by its common name, this tree has larger leaves than the related Tilia cordata (small-leaved lime), 6 to 9 cm (exceptionally 15 cm).

Figure 14.20. *Tilia platyphyllos* Mill.
(Source: https://upload.wikimedia.org/wikipedia/commons/7/79/Tilia_platyphyllos_02.JPG)

- *Tilia cordata* Mill. (small-leaved lime or small-leaved linden**).** It is native of Europe, it has a straight trunk and a globular, oval crown. The leaves have a cordiform shape, are smaller than the other species, have a dark green color on the upper part; the lower part is greenish-blue

and has brown tuft tufts. The flowers appear in June-July, are grouped in pendulous racemes, are small, white-yellow, pleasantly fragrant. The fruit is a small capsule with soft walls.

Figure 14.21. *Tilia cordata* Mill.
(Source: https://www.olx.ro/d/oferta/tei-pucios-tilia-cordata-IDffNyh.html)

Climate and soil requirements. In Romania, lime is a tree widespread in the western, eastern and southern forests. According to the data published in the literature, the linden massifs in our forests occupy an area of 54,102 ha.

In forests it is very rarely found in pure massifs, usually growing in a mixture with other forest species (oak groves, oak, elm, ash, horn, hazel, maple, jugastra, etc.). In the composition of these stands, lime represents various proportions, between 10 and 30% and less often 50-90%, as for example can be found in northern Dobrogea (Babadag, Isaccea, Niculitel, Tulcea). In general, lime can grow up to. at the age of 200-250.

All varieties of lime in our country are honey, but there are years when - especially lime in the forests located in the steppe regions - does not secrete nectar. The most widespread species of lime is white lime, which blooms in June and is the most sought after by bees. Sometimes the

secretion is so great that in the sunlight the nectar appears like a drop of dew. There is little pollen on the anthers of the flowers, which is why they are not even researched by bees. Only in the absence of nectar do bees collect pollen. The flowers are small, yellow-green in color, with a characteristic aroma that spreads far and wide.

The determinations made regarding the production of lime nectar showed the following: the amount of honey produced per hectare is 940 kg for silver lime and 460 kg for lime lime.

Melliferous value. From the end of spring, pale yellow flowers appear, strongly fragrant. When it is in full bloom, it is so full of bees that their humming can be heard from many meters away. Lime honey takes over from the exceptional qualities of the flowers from which it comes. Lime honey is one of the best and most appreciated varieties of honey, its content being rich in vitamins (especially vitamin B1), amino acids, pollen (with all its properties). Lime honey has a lemon-yellow to orange-yellow color, with a pronounced lime flavor and aroma, slow natural crystallization with irregular crystals (https://www.planteea.ro/miere-tei-500g-institut-apicol/).

The secretion of lime nectar begins at a minimum temperature of 16 degrees Celsius, so that it increases visibly only after the temperature exceeds 20^{o}C. The secretion of nectar ceases completely at 32^{o}C, when the flower dehydrates and falls. The nectar begins to be secreted only when there is a minimum humidity of 51-60% in the atmosphere. The pollen of the linden flowers is slightly gray-light in color, with microscopic grains of a triangular shape, and on the edges with three black dots. Bees usually carry this pollen between 10 am and 4 pm, when the nectar glands do not fully secrete nectar. In general, the percentage of sugar from most of the lime species described above varies in flowers from 0.3-0.7 to 1.1 mg, and the total production of honey per hectare varies from 800 to 1,200 kg (https://cultivaprofitabil.ro/teiul-importanta-sa-ca-planta-melifera/).

Due to the significant amount of pollen contained and the specific aroma, some people have allergies, in this case the consumption of lime honey is contraindicated (https:// inlumea albinelor .com/2019/06/10/teiul-arborele-melifer/).

14.2.10. Thymus vulgaris L. (Thyme, Common Thyme, German Thyme, Garden Thyme)

Importance and uses. *Thymus vulgaris* is a plants belonging of *Lamiaceae* family. Thyme is an aromatic species, known and used for therapeutic purposes for a long time. The first

descriptions of this plant appeared in Romania in 1923, in the work "Pharmaceutical Botany" by C. Grinţescu (Păun, 1988).

Thyme is cultivated for the aerial part processed in green or dried form, to obtain the volatile oil. The volatile oil content can vary depending on the cultivation and climatic conditions, between 0.2 and 0.9% in the fresh material and between 0.5 and 2.65% in the dry material. In addition to volatile oil, thyme also contains flavonoids, tannins and organic acids, pentosans and vitamins C and B1 (Cucu et al., 1982).

Due to this complex of compounds, thyme can be used in various respiratory ailments, such as sinusitis, bronchitis, hoarseness, whooping cough. It can also be included in colic or pectoral teas. The volatile oil can also be used as a disinfectant in mouthwash, gargle or toothpaste. Thyme is also used in cosmetics in the form of lotions, and dried herbs are part of various food preparations, such as canned food or as a spice (Muntean, 1990).

This species can also be grown for ornamental purposes and is also a popular honey plant.

Figure 14.22. *Thymus vulgaris* L.
(Source: Biobase of Bucharest Faculty of Agriculture)

Thyme is similar to other species of the genus Thymus, with which it is often confused: *Thymus serpyllum* L. and *Satureja hortensis* L.

Thymus serpyllum L. grows in hilly and mountainous areas, through dry pastures and meadows, on hills or in alpine meadows. It is suitable on stony, arid lands and sunny areas. The flowers are white-purple, with small, elongated leaves. Even with the stem, it can be between 5

and 30 cm tall. To the touch, it emits a specific scent that smells of air. It can be harvested from the end of April until September. It is used similarly to *Thymus vulgaris*. It has an antiseptic, antispasmodic and deworming effect, mainly due to thyme, present throughout the plant. In folk medicine it is used in the form of teas, decoctions, tinctures and oils. Its scent helps to clear the nose, and in the form of inhalations soothes sinusitis. Its antitussive action is useful during bronchitis. A natural expectorant syrup can be obtained in combination with bee honey. It helps to fight fatigue and shortens the duration of the convalescence period. It promotes digestion and by its antispasmodic action calms colic. In the form of a decoction or infusion, it can help treat colitis and constipation. For wounds that are difficult to heal, applying thyme oil or compresses with thyme extract can help with healing. In the kitchen it is appreciated for its organoleptic qualities and for its digestive effect. It is ideal as an ingredient in stews, steaks, fish and vegetables. It is a good flavoring for oil, vinegar and wine (https://www.lapensiuni.ro/ro/extra/farmacia-naturii:-cimbrisorul-de-munte-327).

Figure 14.23. *Thymus serpilium* L.
(Source: Biobase of Bucharest Faculty of Agriculture)

Satureja hortensis L., a spicy plant that is no longer present in any kitchen, has been cultivated since antiquity, first for its medicinal virtues. Phytotherapists recommend it even today, being considered an excellent expectorant and a remedy for rheumatism patients. In food and phytotherapy, only the upper part of the plant is used, with young, non-woody branches, which is why the optimal harvesting period is when the thyme blooms. In natural medicine, thyme preparations are recommended for their antiseptic, antifungal, bactericidal, anthelmintic, astringent (due to tannins), stomachic, antidiarrheal, carminative, choleretic, expectorant, antirheumatic, antineuralgic effects (Bojor, 2018).

In the food, *Satureja hortensis* is used to season hard-to-digest dishes (beans, peas, cabbage, mushrooms), to flavor vegetable salads, sauces, pork steaks, game and fried or boiled fish, sausages, preserves, omelette, eyes, cheeses, pickles (cabbage, gogonele, cucumbers, donuts).

Figure 14.24. *Satureja hortensis* L.
(Source: https://www.gardenexpert.ro/flori/plante-aromatice/cimbru.html)

Morphological and biological characteristics. Thyme is a perennial shrub. The root is pivoting, and from the second year of cultivation it branches very much. The stem can reach

heights of 40 cm and is lignified at the base. The leaves are arranged opposite, ovate-lanceolate, small and hairy on the dorsal side.

The inflorescences are spiciform, loose, with flowers that have a red-purple corolla. It blooms from May to July. The fruits are walnuts, grouped four in a persistent calyx, brown in color.

Climate and soil requirements. The thyme is native to the Mediterranean area, where it is widespread in its spontaneous flora. It is grown in some European countries. Thyme is a plant demanding to climatic factors. It has high temperature requirements, being affected in winters with not very low temperatures, but with strong winds and no snow (Păun, 1988). It is a drought-resistant species, but in the early stages of vegetation it needs a larger amount of water for its uniform development.

Thyme is a light-loving plant, which is necessary for the accumulation of volatile oil.

It thrives on all types of soil and can be grown in favorable areas in the south and west of the country. However, the best harvests are obtained on deep, well-drained, loose, fertile, and slightly warm soils.

Melliferous value. All thyme species have a good honey value. The flowering period is long from April to late autumn (September) which helps a lot the honey bee harvest period.Aabout 200 kg of honey/ha can be obtained.

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