Review Article

Botanical Pharmacies: The Blooming Frontier of Biopharming in Horticulture

Abstract

The emergence of botanical pharmacies marks a revolutionary stride at the crossroads of biotechnology and horticulture. Termed as the "Blooming Frontier of Biopharming in Horticulture," this field exploits the inherent potential of plants to act as living factories for the synthesis of pharmaceutical compounds. Through genetic engineering, specific genes are introduced into plants to trigger the production of valuable medicinal substances, presenting a sustainable and cost-effective alternative to conventional pharmaceutical manufacturing. This innovative approach not only offers a renewable and scalable platform for drug manufacturing but also holds promise for addressing challenges related to the cost and sustainability of pharmaceutical production. While the potential benefits are significant, the field faces challenges in terms of regulatory frameworks, public acceptance, and ecological considerations. Striking a balance between innovation and ethical responsibility is vital as botanical pharmacies pave the way for a transformative shift in the pharmaceutical landscape.

Keywords: innovative, transformative, medicinal, and controlled

Introduction

Both pharmacy and medicine are activities that have been practiced by humans for a very long time. These activities have been tightly connected to the socio-economic, cultural, and religious possibilities that occurred within the communities in which they were formed. Using information about pharmaceuticals and the effects they have, pharmacy is a knowledge system that delivers healthcare services to patients[1]. Having its origins in the very beginning of human civilization, it is an area of human activity and knowledge that has been around for a very long time.

Beginning with the drafting of recipe books, which served as the forerunners of the pharmacopoeia that is used today, the development of pharmacy in Bosnia and Herzegovina started[86]. Herbaria were established as a result of the need to categorize therapeutic herbs and make them accessible to common people. This made the information and descriptions of plants accessible to a wider audience, not only the nobles. Padua was the location where the first Department of Pharmacognosy was established in the year 1545[2].

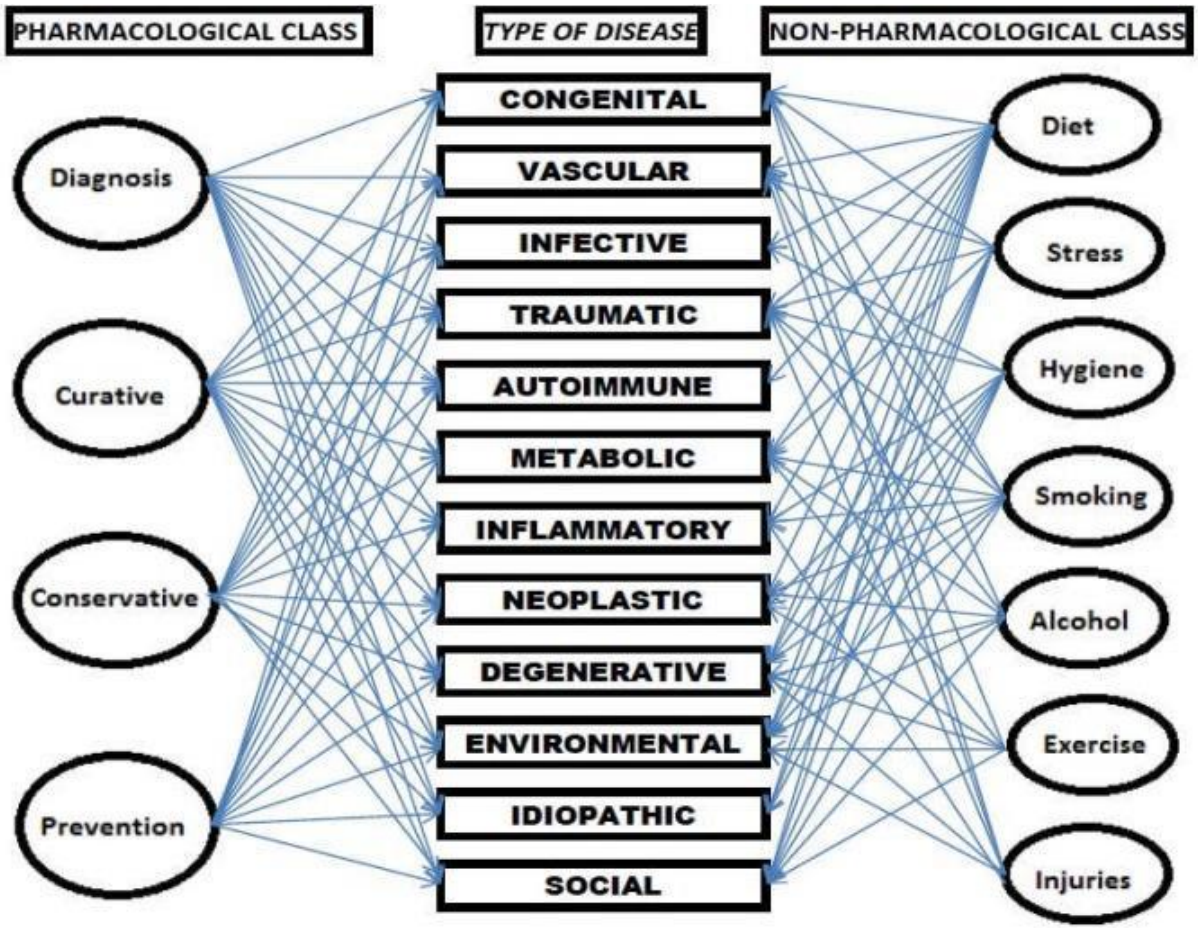


Fig 1. Types of diseases

There was no regulated medical treatment in the past, and the majority of medical specialties had their own experts. These specialists were mostly based on superstition. However, over the 400 years that the Ottoman Empire was in existence, some occupations were found to be more skilful than others[87]. These occupations included Djerrahs, Hapars, and Attars, who were responsible for the production of medicines using oils and herbs. Despite the fact that the official literature was published in Turkish and Arabic languages, medical books known as "Ljekaruše" included a significant amount of both traditional medicine and Sina's medicine that had been perfected. However, these publications were only accessible to the most influential members of society[3].

They were responsible for the development of folk and traditional medicine, and they were drug experts who practiced in Bosnia and Herzegovina throughout the 16th century. In 1492, they arrived at the same time as sefard Jews from Spain, who possessed expertise derived from Arabian medicine. Their arrival coincided with their introduction[88]. Together, they formed unions, although Jews continued to labour separately. The majority of them were located in larger cities, and they augmented their knowledge of attaric from official literature[4].

There were certain individuals who went a great distance from Bosnia in order to get education from renowned colleges and then returned to Bosnia in order to cure the community[89]. In order to play a significant part in the prevention of epidemics, they were

required to take an oath that they would not engage in the practice of performing abortions using artificial means. The first formal pharmacy opened its doors in 1852, although it was later shut down not long after[90]. The oldest reports of a pharmacy date back to the 16th century. The occupation of Austria-Hungary resulted in the opening of new pharmacies. Attar shops, traveling doctor's pharmacies, and public pharmacies that were run by trained physicians and pharmacists from Europe and Istanbul were the three variety of pharmacies that existed throughout the 17th century[5].

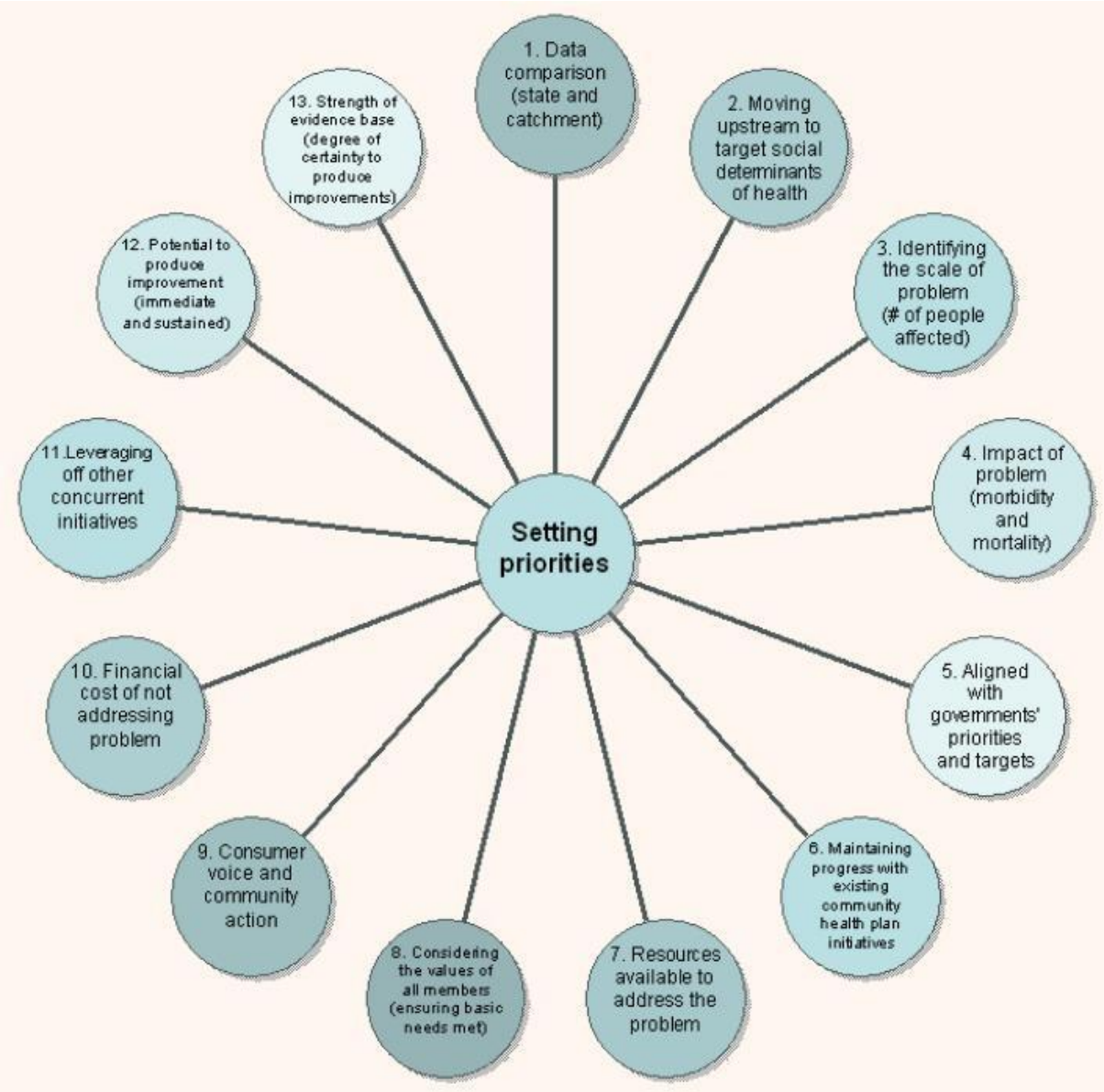


Fig 2. Setting priorities

The research, production, and marketing of food supplements, nutraceuticals, and functional foods are all activities that are enjoying fast growth within the food sector. Consumer views such as "Natural is good" and the rising expense of medications are driving the development of these goods, which provide extra health advantages in addition to their usual nutritional value[91]. Nutraceuticals, botanicals, and herbal treatments, on the other hand, are particularly significant in terms of their recognition as contemporary forms of natural

substances.
The future of these goods may be adversely impacted by a number of issues, such as an imbalance between the promises made about them and the products themselves, rules that restrict their use and safety, and fast controls that verify their composition[6]. There is no discernible shift in customer choices, despite the presence of these unfavourable variables. Numerous plant extracts are being explored for their potential use as innovative nutraceuticals and functional foods. These extracts are being studied for their functional qualities[7].
The safety of the composition that is acquired by analytical methods is the most important part of the validation process for these items. Both the significance and the originality of functional food lay in the rediscovery of the safe use of plants for the purpose of preserving human health in unique forms that are suitable to the current era[8]. The 'other substances' market is entering the maturation period, and there are three important arguments that need to be addressed: (a) security in composition, production, and sale, avoiding easy conversions or convenient approaches; (b) definition of metabolic aspects, including scientific validation; and (c) regulatory aspects, such as claims definition and relative influences respectively.
It is necessary to take into consideration the role that the European Food and Safety Authority (EFSA) plays in the market of the European Union (EU), since unfavourable verdicts regarding claims of 'other substances' may have repercussions in the laws of each individual nation[9].

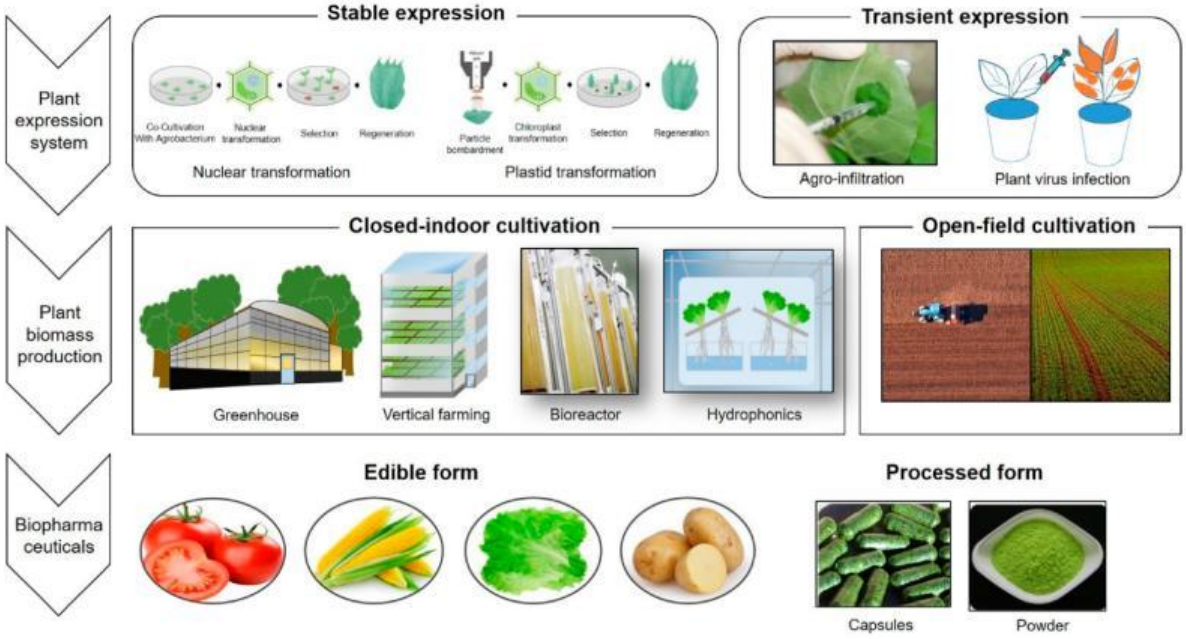
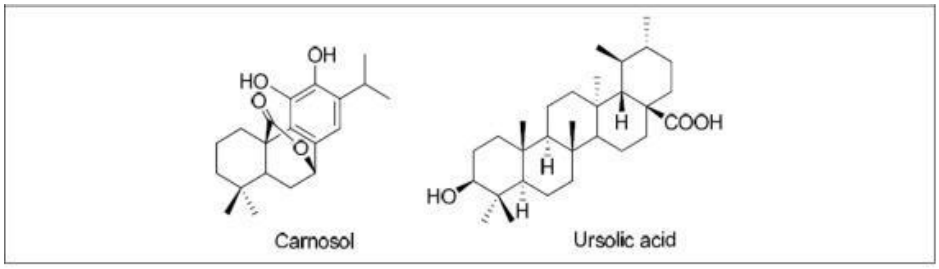


Fig 3.The 'other substances' market is entering the maturation period

Historical perspective

By the year 3500 B.C., the ancient Egyptians began to link less magic with the treatment of sickness, and by the year 2700 B.C., the Chinese had begun employing herbs in a more scientific manner. On the walls of temples and in the Ebers papyrus, which was written about 1550 BC and includes over 700 different medical recipes, the Egyptians documented their

knowledge of ailments and healing methods[10]. Hippocrates, who is considered to be the "Father of Medicine," established a method of diagnosis and prediction that used plants. He further categorized herbs according to their fundamental features, which included hot and cold, wet and dry combinations. Aristotle, the philosopher, was also responsible for compiling a list of medical plants. He did this during a conversation with his most devoted pupil, Theophrastus, in which they discussed herbs as medicines, the types and portions of plants that were utilized, gathering techniques, and the effects on both dogs and people[11]. Dioscorides, who published De Materia Medica about the year 60 AD, provided the most important addition to the descriptions of medicinal plants. This book, which was composed of five volumes and included around 500 plants and nearly 1000 simple medications, was written by Dioscorides. India is the origin of the first Ayurvedic literature on medicine, which date back to around 2,500 BC[12]. Herbal remedies and dietary adjustments are used in Ayurvedic medicine to bring about a state of homeostasis, which is the basis for the Ayurvedic theory of sickness. Abdullah Ben Ahmad Al Bitar, an Arabic botanist and pharmaceutical expert, was born in 1021 and died in 1080 AD. He is known for writing the Explanation of Dioscorides Book on Herbs and, subsequently, the Glossary of Drugs and Food Vocabulary, which included the names of 1,400 different medications[13].
Galen, who was known as the "medical pope" of the Middle Ages, wrote extensively on the four "humors" of the body. These were the four fluids that were believed to permeate the body and impact its health. The medicinal products that Galen invented were formulated from plants that were gathered from all around the globe[14].
Monasteries were responsible for the majority of reading and writing throughout the Middle Ages, which led to the development of a particularly strong relationship between the fields of botany and medicine[92]. Herbals were made by monks in accordance with the pattern of Greek botanical compilations, and monks laboriously copied and assembled manuscripts during the process of herbal preparation. Early herbalists often blended religious incantations with herbal medicines, with the belief that the patient would be healed with "God's help" if they were successful[15].



Terpenoids from rosemary

Fig 4. Chemical formulation

For the purpose of treating a patient who was suffering from acute dropsy as a result of heart failure in the year 1775, Dr. William Withering conducted experiments with the herbs that were included in the recipe. The foxglove, also known as Digitalis purpurea, was the plant that he considered to be the most important, and in 1785, he published his account of the foxglove and some of its medicinal applications[16].

One of the first medications to be separated from a plant was morphine, which was discovered by Frederich Serturner in Germany in the year 1803. He discovered a white crystal that was extracted from crude opium poppy extract. Aconitine was extracted from monkshood, emetine was extracted from ipecacuanha, atropine was extracted from deadly nightshade, and quinine was extracted from Peruvian bark. Other comparable procedures were soon used by scientists[17].

The first time that scientists were able to successfully synthesize salicin, which is an active component found in willow bark, was in the year 1852. By the year 1899, the pharmaceutical firm Bayer had transformed salicin into a more gentle form of aectylsalicylic acid and introduced asprin to the international market[18].

A complete forty percent of the medications that are sold behind the counter of a pharmacy in the Western world are derived from plants that humans have used for generations. This includes the twenty prescription medications that are now the most popular sellers in the states of the United States. As a means of alleviating stomach and intestinal gas brought on by certain meals, mints have been used[19].

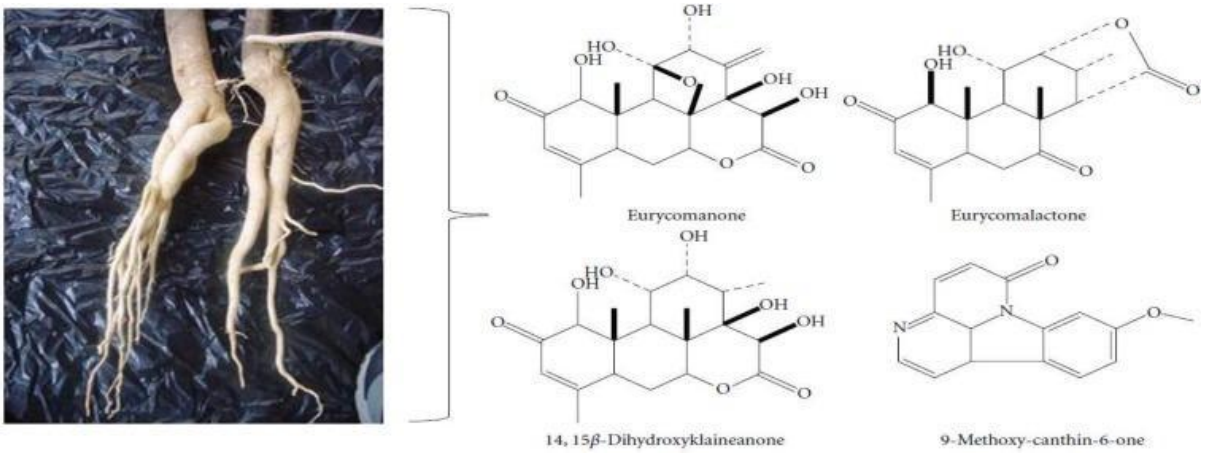


Fig 5.Synthesis of salicin

Horticulture and health, interdisciplinary

From the beginning of human history, people have been deeply concerned with the connection between plants and health. Diet and the use of plants for medical purposes are both essential components of human health. A strong relationship between nutrition and medicinal plants was created by ancient civilizations such as Sumer, Babylonia, Greece, China, and India[20]. These civilizations believed that the eating of vegetables, fruits, and herbs was beneficial to one's health. Ancient Egyptian records such as the Ebers Papyrus and the Edwin Smith Papyrus include accounts of the use of plants as medicine. These writings date back to antiquity, which is when the first medico botanical treatises of the West were written[21].

There was a connection between Greek medicine, which was directed by Asklepios, the deity of medicine and healing, and healing temples that included medicinal plants. Root diggers were the ones who first gained knowledge of plants that had curative properties, which led to the development of the ancient Greek tradition of herbal medicine[93]. Drug traders, also

known as pharacopuloi, are credited with the origin of the term "pharmacy." Additionally, the ancient botanical treatise Enquiry into Plants, which was authored by Theophrastus in the fifth century BCE, devoted Book IX to the use of plants for medical purposes.[22]
There were over 400 different therapeutic plants that were listed by the Hippocratic school, which is generally regarded to be the Father of Medicine. A balance of humours, which were observable phenomena and theoretic entities, was the foundation of Hippocrates' theory that health was founded on a balance of humours. The observational experience that took place in relation to the observation of symptoms served as the foundation for the notion of humoralism. There were four temperaments or complexions that were related with the number four in Greek culture. These temperaments were the phlegmatic, sanguine, choleric, and melancholy temperaments. The Greeks attributed importance to the number four[23]. Galen posited six reasons that impact health, which are referred to as "non-naturals" in Latin translations. These causes are as follows: food and drink, ambient air, movement and rest, sleep and wakefulness, elimination and retention, and psychological states. Hippocrates' medical views were further expanded by Galen[94]. Byzantine and Arab doctors first accepted, improved on, and further refined these notions, which ultimately came to dominate the field of medicine until the 18th century. In the case of a sick patient, it was the responsibility of the physician to determine the factors that were responsible for the loss of balance and to devise a therapy that included components that had qualities that were opposite to those of the defecting humor. This was done in accordance with the compensatory concept contraria contrariis[24].
The ancient medical scholarship of Eastern medicine was far higher than that of Western medicine. Chinese medicine and Indian medicine, sometimes referred to as Ayurveda, which may be translated as "the science of life," are the two most prominent medical traditions. People who lived during the Hsia and Shang dynasties in ancient China employed prayer as a method of treatment for those who were ill. For every 180,000 individual oracle bones (chia-ku-wen), there were 36 pieces that recorded the names of ailments. However, these bones merely included prayers for healing and did not specify any herbal remedies[25].

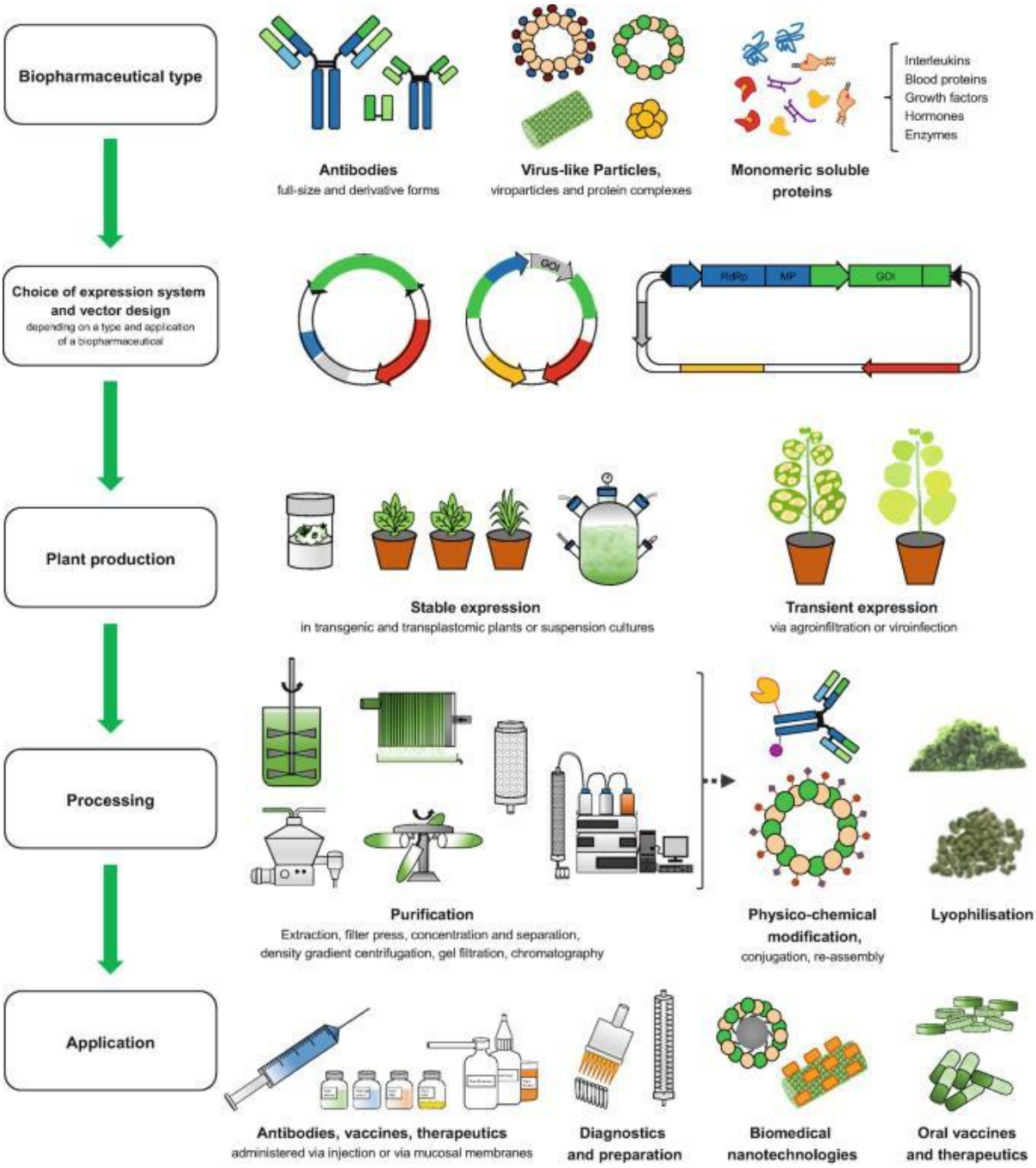


Fig 6.Horticulture and health, interdisciplinary

It was believed that the commencement of the healing arts in traditional Chinese teaching was related with the mythical Huangdi, also known as the Yellow Emperor, who lived about 2698 BCE. The cultivation of silkworms, the construction of boats and carriages, as well as the development of writing, music, and medicine are all areas in which his name is connected with technological advancements[25]. One of the most important texts in Chinese medicine is called the Huangdi neijing, which literally translates to "Yellow Emperor's Inner Classic." There is little question that the Huangdi neijing is the most significant classic in the history of

Chinese medicine. It had a significant impact on the intellectual development of medical practitioners in the centuries that followed. The fact that humoralism was not a component of Chinese medicine is evidence that it emerged independently of both Greek and Indian influences upon its development[26].

The Sanskrit scriptures that form the foundation of the Indian medical system known as Ayurveda date back to between the years 200 and 200 CE. Furthermore, it sees health as the product of both external factors, such as lifestyle and nutrition, and interior effects, such as body humors. It establishes a connection between spirituality and the prevention and cure of illness. Disease is seen as a state of imbalance, and the use of herbs is a factor that helps to the restoration of equilibrium in the patient. It is possible that Ayurvedic medicine was influenced by ancient Greek medicine owing to the remarkable parallels between the two systems of healing[27].

Through the herbal tradition, which includes the Greek herbal Peri Ylis Iatrikis, the medicinal qualities of more than five hundred plants were enumerated. Many of these species were intended to be used in the cultivation of horticultural crops. The term "herbals" was used to describe to compendia that were founded on the Dioscoridean tradition and focused on plants, their qualities, and the virtues they had throughout the medieval and Renaissance periods[28].

The late 15th century marked the beginning of the great era of printed herbals, which were mostly written by writers from five different countries: Germany, Flemish, Italy, France, and England. Herbal works such as Das Buch zu Distillieren, Herbarum Vivae Eicones, Kreuter Buch, De Historia Stirpium, New Herbal, Commentarii, Crôÿdeboeck, and the Herball are among the most renowned herbal works[29].

Until the 18th century, when both medicine and botany began to take on a more scientific approach, they were virtually in sync with one another. Beginning at this point, botanical writings would basically disregard the practical applications of medicinal plants, and medical works would be devoid of any plant information[30]. Despite the doubtful effectiveness of many common herbs and the fact that many herbal suggestions are based on superstition and astrology, the use of plants for therapeutic purposes continues to be a popular alternative type of medicine that continues to be practiced even in the current day[31].

It is only very recently that contemporary science has led to the development of a modern system of horticulture and nutrition. Scurvy is a condition that is not known to be caused by a shortage of L-ascorbic acid (Vitamin C) in the diet. Its origins may be traced back to the ancient discovery that fresh plant food might be used to combat the terrible effects of scurvy[32]. The findings of scientific study have revealed the existence of a variety of vitamins and chemicals that are needed by a variety of creatures, including humans, in very minute quantities. It has been shown that fruits and vegetables are excellent providers of a variety of vitamins. Antioxidants, carotenoids, flavonoids, glucosinolates, polyphenols, polysaccharides, organic acids, and lipids are antioxidants that have been linked to the prevention of certain illnesses[33,95].


Fig 7. Analytical study process

Natural chemicals synthesised from horticulture crops

Since ancient times, people have relied on salicylic acid, a naturally occurring chemical that can be found in the bark of willows and birches as well as wintergreen, to alleviate pain. Semisynthetically, it is synthesized from natural salicylic acid, while phenylalanine is the most common source of its production[34]. Because of the presence of the acetyl group, the synthetic medication aspirin, which was produced by Bayer in the latter part of the 19th century, has antiplatelet effects that are long-lasting. When it comes to youngsters, however, it is essential to steer clear of consuming birch beer or syrup, and those who suffer from asthma or are using blood thinners should exercise care[35,96].

Gaultheria procumbens is a little evergreen shrub that has gorgeous blooms and fruit that may be eaten. Native Americans use it to treat minor aches and pains via the use of herbs. There are numerous different kinds of wintergreen that all have a scent that is similar to that of menthol. Snowdrops, which are also known as galantamine, were first used as a non-depolarizing muscle relaxant antagonist[36]. It was later discovered that snowdrops had the potential to be employed in the treatment of Alzheimer's disease. The manufacturing of galantamine for Alzheimer's disease on a commercial scale, on the other hand, has been generated by a synthetic technique since the 1990s[37].

Foxglove, which contains digitalis glycosides, is a natural source of cardiac glycosides that have been used in the treatment of heart failure and other illnesses in the past. The extinction of this species may be attributed to its toxicity as well as the deleterious effects of xanthopsia. Due to the fact that foxgloves are cardiotoxic and actively proliferate in damp forests, it is

important to exercise care while implementing any plant materials into the lives of youngsters, pregnant women, and animals[38].
Temporary pain relief may be achieved with the use of atropine, which is derived from the natural source of the antimuscarinic medicine atropine and its namesake. In the event of an emergency, such as an exposure to a nerve toxin, muscarinic mushroom, or pesticide, the creation of antidotes on the spot is not acceptable. For the purpose of preventing inadvertent exposure, it is recommended that this plant be kept in a fenced-in area that is closed and kept away from food crops, animals, and things that are appealing to children and dogs. After touching the sap, it is important to use gloves and wash your hands well since it is a skin irritant[39].

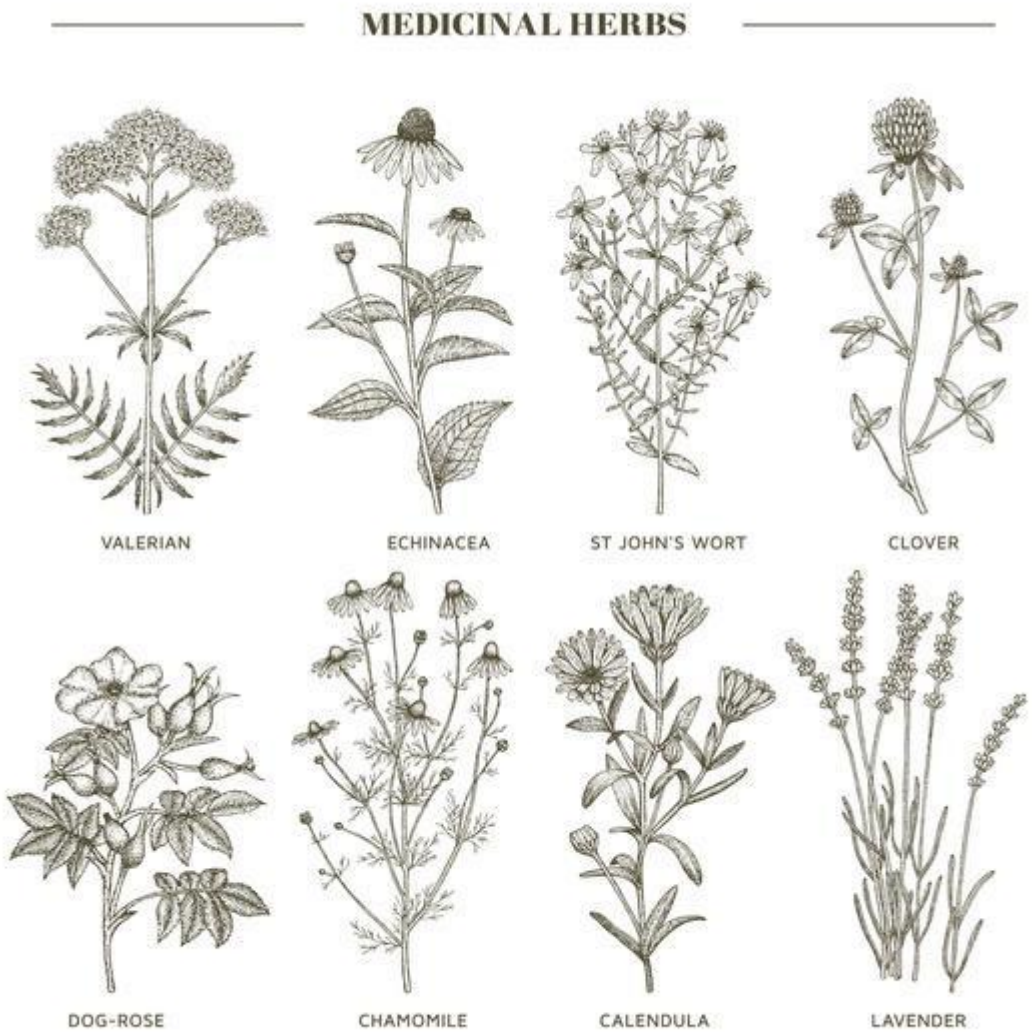


Fig 8. Medicinal herbs

A homeopathic medicine known as capsaicin is administered to those who are experiencing musculoskeletal aches and pains in order to provide them with brief pain relief. Capsaicin used topically must to be followed by consultation with a qualified medical practitioner. Capsaicin is able to disrupt the functioning of substance P, which is a substance that is

present everywhere and has several purposes[40]. The presence of salicylates and menthol in sweet peppers, which are indigenous to tropical parts of the Americas, makes them an appealing component for design. However, due to the fact that peppers belong to the nightshade family, capsaicin should not be ingested or applied to the skin, nor should it be applied to any other part of the plant[41].

Although it is thought to be safe for a variety of skin ailments, the effectiveness of aloe vera, which is a company that has been around for two millennia and is worth thirteen billion dollars, is not entirely certain. In the year 2024, the Food and Drug Administration mandates that all stimulant laxatives be withdrawn off the market. Cactus soil or freeze-free desert settings are ideal for cultivating aloe vera, although it may also be cultivated inside. The topical use of camphor, which is a component of menthol and paregoric decongestant ointments, is indicated for the treatment of skin disorders such as pruritus, light burns, and arthritic pain[42,97].
Camphor is an evergreen tree that grows to a height of 70 feet and has a fragrant aroma when crushed leaves and bark are peeled off. It is suggested for the treatment of skin diseases such as pruritus, light burns, and arthritic discomfort. Senna glycosides, which are also referred to as Cassia angustifolia, are laxative products that are used in complementary and alternative medicine[43]. They are used in conjunction with pharmaceutical grade senna formulations. The eating of senna may interfere with the body's ability to absorb nutrients and medications, and even the unintentional consumption of small quantities can result in severe diarrhea, particularly in children and animals[44,98].

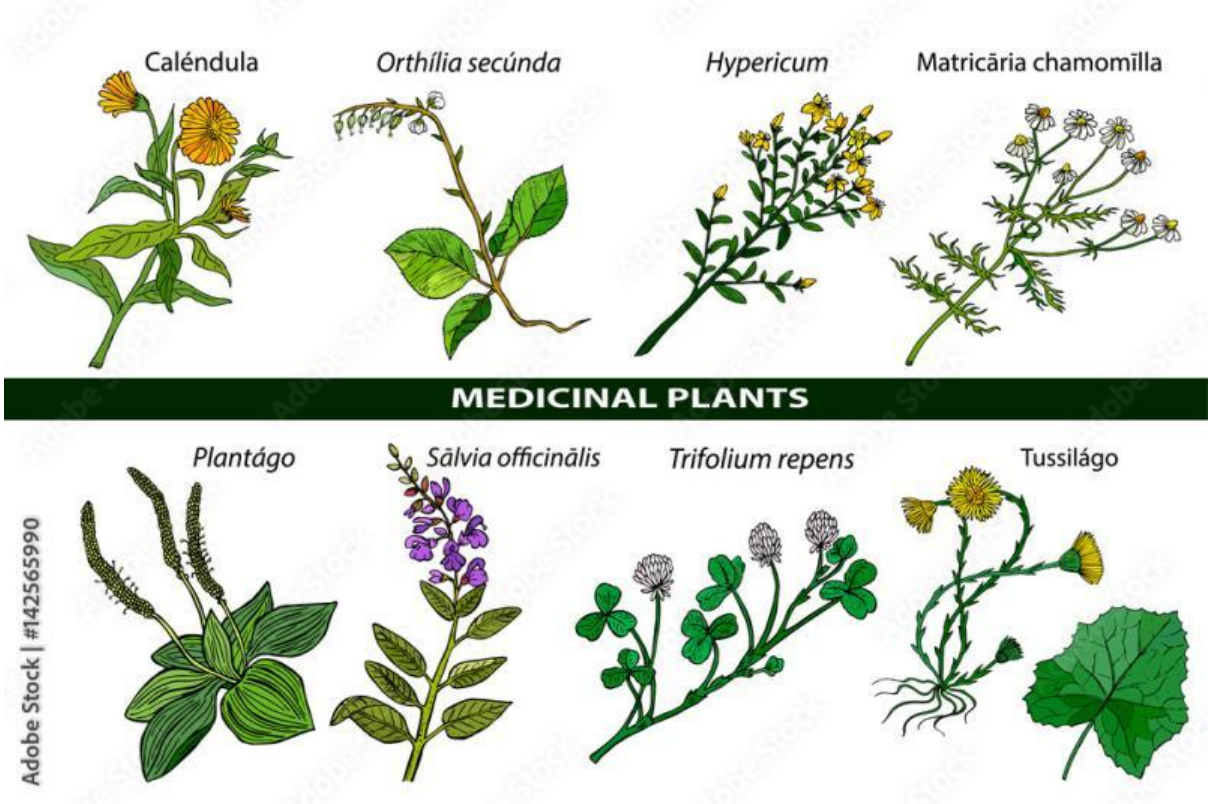


Fig 9. Medicinal plants model

Both as a laxative and to induce labour, castor bean oil is used; however, the effectiveness of the latter application is not well understood. Beginning within a few hours of intake, a meagre 1 mg of ricin may cause the typical adult to become dehydrated, which can lead to death within a few days. This dehydration can be caused by vomiting and diarrhea[45]. Possession of ricin is against the law, however prohibitions on entire beans are uncommon. It is not recommended to try to cultivate opium poppies (Papaver somniferum) or cannabis because of their unique characteristics. Despite the fact that the Controlled Substances Act prohibits the growth of these species in the United States without proper regulation, other varieties of poppy are widely used as ornamentals, especially in climates that are Mediterranean. Prior to the implementation of a crackdown in 1951, cannabis plants were commonplace on empty lots around New York City, as well as in rural areas of Brooklyn and Queens[46].

There are a number of typical preventative measures that gardeners of medicinal plants should use in order to safeguard children and animals. These measures include fence, monitoring, and isolation from food crops. When there is a possibility that someone has been poisoned, it is important to contact the Poison Help hotline and provide information about the afflicted individual, including their age, weight, and health concerns, as well as the identity of the plant, the quantity of exposure, and the period of time[47,99].

An improvement in the property's beauty, an enjoyable pastime, and a conversation starter are all potential outcomes of planting a garden with a pharmacy theme. It is possible to cultivate these therapeutic plants in both temperate and tropical settings, and they might be of interest throughout the whole year[48].

Role of medicinal plants in health

It is important to note that health promotion, disease prevention, and chronic illness management are all proactive approaches to healthcare that concentrate on avoiding diseases at various times along the continuum of health care. Activities that fall under the category of primary prevention include health promotion, education, and protective measures. On the other hand, secondary prevention is aimed at reducing the number of instances of diseases or illnesses that have already been diagnosed in the community[49]. Tertiary prevention is concerned with the limiting of disabilities and rehabilitation, while secondary and tertiary preventive actions are cantered on the maintenance of the health of those who are living with chronic disorders[50,100,101].

In order to achieve a future that is conducive to human habitation, it is essential to have a comprehensive awareness of the interrelationships that exist between public health, diet, food production, and the environment. As an example, the treatment of moderate hypertension has the potential to avoid a majority of chronic kidney illnesses, as well as obesity, malignancies, coronary heart diseases (CHDs), and diabetes[51].

Individual and group poverty, limited resources, poor communication, huge distances, and low levels of education are some of the factors that contribute to the considerable difficulties that developing nations throughout the globe confront in the realm of healthcare. Various factors contribute to the perpetuation of poverty in various nations, particularly in rural areas, which are home to around 80 percent of the total population[52,102]. It is difficult for

traditional health care to reach portion of the world's population because of their nomadic lifestyle. It is believed that there are between fifty and one hundred million nomads in the globe.

The discrepancy in life expectancy that exists between industrialized nations and developing countries is a reflection of the inequality in healthcare that exists between the two types of countries. In 2009, for instance, the life expectancy at birth was predicted to be 51 years in Angola and Burkina Faso, while it was 47 years in Malawi (and other African nations)[53]. This is in contrast to the life expectancy of 80 years in the United Kingdom, the United States of America, and Austria.Any strategy for disease prevention in poor nations, particularly in Africa, must take into account the great variety of plants in the African Region and the relatively cheaper cost of employing plant-derived medications rather than processed synthetic chemicals. This is necessary in order to address the socioeconomic aspects that are contributing to the spreading of illness[54].

Policy integration, safety, effectiveness, quality, access, and rational use are the major principles that the World Health Organization (WHO) adheres to during the first and second decades of the development of traditional medical techniques. The policy goal is to integrate complementary and alternative medicine (CAM) and traditional medicine (TM) into national healthcare systems, with the goals of promoting safety, efficacy, and quality by expanding knowledge bases, increasing availability and affordability, and encouraging therapeutically sound use by both providers and consumers[55].

The World Health Organization (WHO-AFRO) has identified strategies for the development of Traditional Medicines (TM) in the African Region. These strategies include the formulation of policies, the building of capacities, the promotion of research, the support for the local production of traditional medicines, and the protection of intellectual property rights and traditional medical knowledge[56].

In the past, communicable diseases (CDs) were the primary causes of illness and death in impoverished nations. On the other hand, non-communicable diseases (NCDs) were more frequent in developed countries as a result of better living circumstances and broad deployment of technology. In spite of this, the advent of novel infectious illnesses and the re-emergence of existing disease agents have resulted in a twofold disease burden, especially for nations with low and intermediate incomes[57].

Surveillance, outbreak investigations, and vaccination are three key techniques that are essential to the control of communicable illnesses. Medicinal herbs play a significant role in the prevention of these diseases. There is evidence that medicinal plants have been used to improve immune response to a variety of disease agents, despite the fact that these plants may seem to have limited involvement in these techniques[58].

An intersectoral, multi-level strategy was outlined in the World Health Organization's (WHO) Action strategy for the worldwide Strategy for the Prevention and Control of Noncommunicable Diseases (NCDs) from 2008 to 2013. The plan's primary emphasis was on poor and middle-income nations in order to limit the growing worldwide incidence of NCDs[59]. The plan aimed to map the emerging epidemic of non-communicable diseases (NCDs), determine the social, economic, behavioural, and political factors that contribute to them, reduce exposure to common modifiable risk factors, and improve healthcare for people who suffer from non-communicable diseases by establishing evidence-based norms,

standards, and guidelines for interventions that are cost-effective[60].
Plants used for medicinal purposes have a distinct role in improving healthcare prospects for persons who have noncommunicable diseases (NCDs) and in controlling biologic risk factors for NCDs, particularly in the early stages of the disease. There are two primary types of approaches that have been advocated for the purpose of addressing major public health issues[61]. The first is the whole-population strategy, which aims to control the occurrence of new diseases by targeting the entire community. The second is the high-risk strategy, which identifies individuals who are most at risk for a disease or outcome and then employs preventative measures to target that particular group[62].
By bringing together a number of health advocates who are working for the elimination of common risk factors as a means of disease prevention, the common risk factor strategy seeks to accomplish its goal. This strategy has the potential to be beneficial in a number of ways, including the engagement of other health promoters, the combating of various types of sickness, and the advocacy of medicinal plant ideas[63].

Fig 10. Common medicinal plants use as pharmaceutical drugs

Plants that can help to fight various diseases

The research investigates a wide range of medicinal plants and evaluates the possible uses of these plants in the treatment and prevention of cancer. In addition to garlic and onion, Allium cepa and Allium sativum are also recognized for their ability to act as chemopreventive agents against cancer[64]. It has been shown that the consumption of dialyl trisulfide (DATS) derived from Allium species may lower the chance of developing breast cancer, lung cancer, and stomach cancer. In mouse skin, the promotion of tumors by DMBA/TPA and BP/croton oil was prevented by onion oil, but the promotion of tumors by DMBA/TPA was reduced by garlic oil[65].
Studies have been conducted to investigate the anti-proliferation and anti-metastatic properties of Panax ginseng C.A. Mayer, which belongs to the family Araliaceae. The cytotoxic potential of ginsenosides and their synthetic variants against a variety of cancer cells has been investigated and assessed[66]. It has been discovered that ginsenoside Rp1 may suppress the growth of breast cancer cells as well as the creation of breast cancer cell colonies that are reliant on anchoring or independent of anchorage mechanisms. The fact that

it was able to reduce the stability of the IGF-1R protein in breast cancer cells is further evidence that it has the potential to be used as an anticancer medication[67].

The administration of white and red ginseng via the mouth inhibited the development of colon cancer in rats that were treated with 1,2-dimethylhydrazine (DMH). Ginseng has three active components known as ginsenosides: Rg3, Rg5, and Rh2. These ginsenosides may either operate alone or in conjunction with one another to prevent cancer[68]. In mice, the methanol extract of san-chi ginseng inhibited the development of skin cancer caused by DMBA/TPA, liver cancer caused by DEN/Phenobarbital, and lung cancer caused by 4NQO/glycerol. The ginsenoside Rg1 had a marginally inhibiting effect on the promotion of tumors in mouse skin caused by DMBA/TPA[69].

Additionally, Eurycoma longifolia Jack (EL) is a medicinal plant that has the potential to be used as an alternate therapy for osteoporosis in males that is caused by a lack of testosterone. The proandrogenic effects of EL include an increase in testosterone levels, a stimulation of osteoblast proliferation and osteoclast death, a maintenance of bone remodelling activity, and a reduction in bone loss. Because of its antioxidative nature, the phytochemical components of EL have the ability to prevent osteoporosis as well. As a result, it has the potential to be used as a supplemental therapy for osteoporosis in males[70].

Research is being conducted with the goal of discovering novel therapeutic options to prevent and treat coronary heart disease (CHD), which is a serious problem for the health of people all over the world. As dietary supplements, medicinal plants including artichoke, garlic, gingko, guggul, hawthorn, and tea have been used to lessen the incidence of coronary heart disease (CHD) as well as the death rate associated with it[72].

Olive oil-loaded mice were found to have lower blood triglyceride levels after consuming artichoke because it contains phenolic acids at a concentration of 6% and sequiterpene latones at a concentration of 5%. The use of garlic, on the other hand, has been shown to lower total cholesterol levels in adults via the usage of randomized controlled trials. In the treatment of hyperlipidemia and hypercholesterolemia, the herb known as guggul, which has been used since 600 BC, has been used. E- and Z-guggulesterone, which are both sterols, are thought to be bioactive chemicals that are found in the plant[73].

As a conclusion, the research emphasizes the potential of medicinal plants and their potential in the treatment and prevention of cancer among other possible applications. Researchers are able to design more effective therapies for a variety of health issues if they have a better grasp of the processes and targets via which these plants operate[74].

There is a high prevalence of micronutrient deficiencies in impoverished nations, which are often brought on by insufficient intakes, hereditary disorders, parasite diseases, and viral diseases. Some of the negative effects that these deficits may have on a person's health include reduced growth, immunological competence, mental and physical development, and poor reproductive results[75]. Because the amount of certain micronutrients that are found in plant-based diets is reliant on the trace elements that are found in the soil, environmental factors also contribute to the worsening of these deficits[76].

Fig 11.potential of medicinal plants

Strategies to reduce micronutrient deficiencies in developing countries, such as supplementation and food-based approaches, are desperately needed. These strategies should ideally be implemented in conjunction with public health interventions, such as the promotion and support of breastfeeding, as well as the control of infectious and parasitic diseases[77]. A home garden is a long-term plan that contributes to combatting vitamin A and other nutritional deficiencies. Fruits and vegetables are an excellent source of vitamins and minerals, and home gardening is a method that will help battle these inadequacies.
Oxidative stress, which is brought on by reactive oxygen species, is a significant contributor to a wide range of chronic and degenerative illnesses, including atherosclerosis, ischemic heart disease, cancer, diabetes mellitus, neurodegenerative disorders, and the natural process of aging[78]. As a result of the fact that the risk of developing chronic illnesses is inversely connected to the presence of natural antioxidants in fruits and vegetables, natural antioxidants may be considered an alternative method of disease prevention and treatment. Phenolic chemicals, because of their oxidative activity, have the potential to be agents that promote the prevention and treatment of a wide variety of disorders that are associated with oxidative stress[85]. The antioxidant activity of some therapeutic plants is much higher than that of ordinary dietary plants. If the extract of these plants is not poisonous, it may be utilized as a food additive and can also be considered for disease prevention[79].
Oral illnesses are significant health issues, with dental caries and periodontal diseases being among the most frequent infectious diseases that may be prevented on a worldwide scale. There is a correlation between poor oral health and chronic disorders as well as systemic diseases. There is a well-established connection between oral illnesses and the oral microbiota[80]. The majority of bacteria that are found in the mouth are considered to be

commensals, and just a few of them are known to be associated with oral disorders. There is a need for alternative prevention and treatment options that are safe, effective, and economical in developing countries. This is because of the prevalence of oral diseases, the growing resistance of bacteria to antibiotics, the adverse effects of certain antibacterial agents that are currently used in dentistry, and the financial constraints that are present in these countries[81].

There is a substantial body of research suggesting that plant extracts, essential oils, and phytochemicals that have been undergone purification have the potential to be transformed into medicines that may be used as therapeutic treatments or preventative measures for oral disorders. It will be essential to do more research on the safety and effectiveness of these compounds in order to determine whether or not they provide therapeutic advantages, either on their own or in conjunction with traditional medicines, that may contribute to a reduction in the number of oral illnesses that are prevalent around the globe[82].

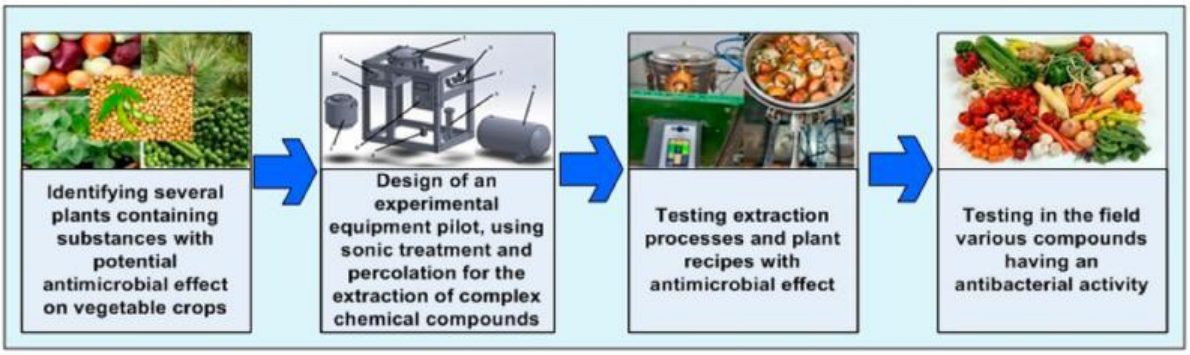


Fig 12.Plant extracts, essential oils, and phytochemicals

Gargles made with plants such as Spilanthes sp, Guiera senegalensis, and Waltheria indica, chewing sticks used for preventive dental care, and preparations for preventing road accidents using the occult power of herbs are some of the various practices that exist in Africa for the purpose of preventing diseases through the use of medicinal plants[83]. However, these more recent preventative applications of medical plants, which include the occult power of herbs, could be beyond the capacity of scientific investigation to demonstrate that they are effective[84].

Conclusion

As a conclusion, Botanical Pharmacies are an intriguing new frontier in the field of bio pharmacy within the horticulture industry. This burgeoning subject combines the fundamentals of botany and pharmaceuticals in a seamless manner, which opens up a broad range of opportunities for the development of creative solutions in the fields of health, agriculture, and other areas. The capacity to harness the natural processes of plants in order to manufacture medicinal chemicals has the potential to transform the process of drug development, making it more sustainable, cost-effective, and environmentally friendly. Furthermore, the incorporation of biopharmaceutical practices into horticulture paves the way for the production of rare and very important medicinal plants, therefore addressing concerns

about the robustness of supply chains and the preservation of biodiversity. When we are navigating the rapidly expanding frontier of botanical pharmacy, it is very necessary to approach these breakthroughs with ethical concerns. This will ensure that the resources of nature are used responsibly and that they are stewarded correctly. For the purpose of maximizing the advantages of biopharmaceutical research while simultaneously limiting the possible hazards, the partnership of botanical experts, pharmaceutical researchers, and agricultural specialists will be of significant importance. Essentially, the merger of botany and pharmaceuticals in botanical pharmacies represents a hopeful chapter in the history of scientific discovery. This convergence helps to promote an approach that is both sustainable and interconnected in order to satisfy the ever-changing requirements of society.

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