

## A COMPREHENSIVE REVIEW ON COMMERCIAL COLLECTION AND CULTIVATION ASPECTS OF MEDICAL AND AROMATIC PLANTS

Sanjay K Bais, Amol V. Pore, Shreya Kamavaram

Fabtech College of Pharmacy, Sangola

Corresponding author Mail ID: shreyakamavaram04@gmail.com

### ABSTRACT:

*Several organizations are advocating the introduction of wild species into agricultural systems due to the growing awareness of the overexploitation of many wild medicinal and aromatic plant (MAP) species. Others argue that since most wild species are valuable to local economies and have a higher long-term value to harvesters, sustainable harvesting is the most important conservation technique. The primary obstacles to sustainable wild-collection, in addition to poverty and the collapse of traditional restrictions, are a lack of information regarding sustainable harvest rates and practices, ambiguous land-use rights, and a lack of political and legal direction. Determining whether species conservation should occur in the wild should be based on an understanding of the costs and benefits of the various MAP production options.*

**Keywords:** *Aromatic Plants, phytoconstituents, Collection, Cultivation*

### INTRODUCTION

Since the beginning of time, humans have collected plants and animals for their own purposes of time. Examples include eat nuts, fruits, herbs, spices, chew gum and fibers used to construct houses and other constructions, as well as foods prepared from plants or animals for use in medicine, cosmetics, or culture. For their everyday needs and income, still today, Hundreds of millions of people, mostly in underdeveloped countries, depend primarily on crops and livestock. High-quality goods such medicinal herbs (ginseng, black walnut) and mushrooms (morels, mat stake, and truffles) For both cultural and commercial purposes, developed nations continue to collect plants (goldenseal, cohosh). Superior quality Products like medicinal herbs (ginseng, black cohosh, goldenseal), mushrooms (morels, mat stake, and truffles), and being collected in industrialized nations even now for cultural and commercial purposes, industrialized nations continue to collect high-value goods like truffles, black cohosh, and morel mushrooms, as well as medicinal herbs like ginseng, goldenseal, and black cohosh. Among these applications, medicinal plants are important since they are frequently employed in far-off markets as traditional medicines and trade goods. “Medicinal and aromatic plants” (MAP) is defined for the sake of this article as the entire spectrum of plants employed in the related and frequently overlapping fields of condiments, gastronomy, and cosmetics, in addition to constrictor therapeutic applications. As human needs, populations and economies expand, so does the demand for more wildlife.

Numerous organizations are advocating for the integration of wild species into agricultural systems as the over-exploitation of certain wild species gains more widespread recognition. But it’s important to learn more about any potential effects farming may have on conservation. For example, growing medicinal plants may lessen the amount of wild populations that are taken, but it may also negatively impact the ecosystem, reduce genetic diversity, and negate the need to protect wild populations. In determining the relationship between ex situ

conservation of space and species there is a positive impact on local residents, public and private leaders and property owners, large businesses and, of course, wild animals.

The range of processes that crude medicines undergo prior to being introduced into the pharmaceutical industry and market will determine the kind and amount of active chemicals that possess therapeutic activity. If a drug is to benefit humanity as much as possible, those stages demand greater attention. This chapter discusses the potential influences on plants. Plant quality is enhanced by cultivation. The regulated growth in the environment leads to better plant products and facilitates the selection of species, variations, or hybrids that possess the necessary phytoconstituents. This makes the process easier to write and maintain compared to wild sites. During cultivation, plants produce large amounts of secondary metabolites. Here is a list of the benefits of gardening:

1. Increase the effectiveness and purity of medicinal herbs. The chemicals in prescription drugs are what give them their usefulness. Maintaining homogeneity during the cultivation process can result in the production of high-quality drugs. Rhizomes require careful cultivation with the right type of irrigation and a sufficient amount of fertilizer. Careful cultivation ensures the highest yield of essential oils and other products. To illustrate this idea, you can use liquorice, ginger, and turmeric. It is simple to prevent contaminating raw drugs by keeping weeds out of the growing plants.

2. Cultivating a crude drug guarantees a steady supply. Crop planning can also be thought of as an agricultural system. By ensuring sustainability, crop planning can help businesses that rely on harmful chemicals avoid famine.

3. Cultivation of spices and herbs also made it more economical. Numerous cottage and small-scale businesses have emerged from Kerala's coffee and cocoa plantations. Cinchona was grown in West Bengal, leading to the establishment of a cinchona alkaloid factory near Darjeeling. The government of poppy countries successfully demonstrates the importance of thinking about poppy cultivation. Opium in Ghaziabad.

4. The utilization of modern technological components like polyploidy, hybridization, and mutation is made possible by cultivation. For the food, cosmetic, agrichemical, and pharmaceutical industries, cultivating aromatic and medicinal crops provides a sustainable, high-value supply of industrial raw materials. Additionally, it gives farmers new chances to increase their income levels and leaves a large amount of space for growth in the rural economy. Although these plants have been used as medicine since ancient times, advances in technology and discreet and practical use have increased consumer demand for nature and led to an increase in the economic value of crops.

These crops, which only occupy about 0.4 million hectares in India, are expected to grow at a rate of 10-15% per year, making them much more important in the world of agribusiness. At a growth rate estimated at 10-15% per year, these crops, which presently occupy only 0.4 million hectares in India, are becoming more and more important in the global agribusiness.<sup>2</sup>

## **GENERAL ASPECTS OF MEDICINAL PLANTS CULTIVATION:**

### **Factors Affecting the Cultivation of Crude Drugs**

#### **A. Altitude:**

Altitude is a crucial factor to take into account when growing medicinal plants. Below is a list of herbs and spices that can be grown at any altitude.

**Table No.1: Altitude**

Sr. No.	Plant	Altitude (Meter)
1	Tea	1000-1500
2	Cinchona	1000-2000

**B. Temperature:**

In temperate climates, many plants can thrive in the summer, but they are not resistant enough to survive winter frost. Temperature variations have an impact on photosynthesis rate. As the temperature rose, so did the rate of respiration.

**Table No.2: Temperature**

Sr. No.	Plant	Temperature (°F)
1.	Cinchona	60 - 75
2.	Coffee	55 - 70

**C. Rainfall or Irrigation:**

With the exception of xerophytes, most other plants require water, appropriate irrigation, and enough rainfall to grow. Water dissolves minerals in the soil, which are absorbed by plants. Water affects plant morphology and physiology. For example, regular rainfall can cause water (a soluble substance) to leave the leaves and roots.

**D. Soil:**

Water, nutrients, and mechanical support are all provided by the soil to help plants grow. It is made up of mineral matter, organic matter, water, and air. For their growth, plants can choose the pH range of the soil. Soil that contains nitrogen can be very helpful in increasing some plants' alkaloids production.

**E. Fertility of the soil:**

It is the ability of the soil to give plants the right amount and balance of nutrients. Erosion and leaching also cause it to diminish. Chemical fertilizers, nitrogen-fixing bacteria, and animal manures can all be used to preserve soil fertility.

**F. Pest and Vermin Control:**

An undesirable plant or animal that destroys farmed plants is called a pest. The various pest species that affect medicinal plants include the following: 1. Viruses and fungi 2. Bugs 3. In weeds 4. Pests other than insects. Various methods are employed to accomplish pest management efficiently. Here is a discussion of these techniques: Biological method, Chemical method, Agricultural method, and Mechanical method.

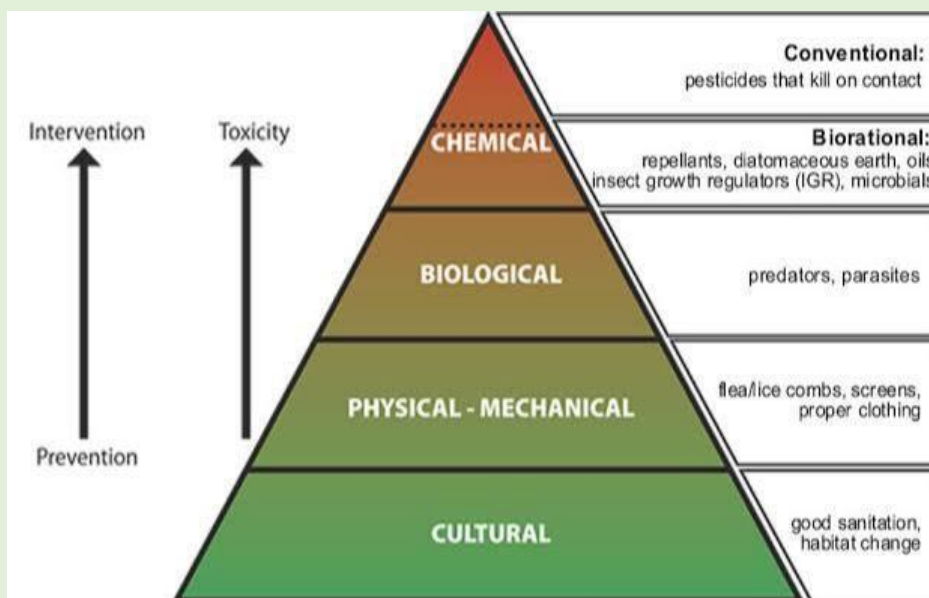


Fig. 1.: IPM FOR PESTS OF ANIMAL AND PETS<sup>3</sup>

## POST – HARVESTING TECHNOLOGY OF MEDICAL AND AROMATIC PLANTS:

### 1.Harvesting:

In cultivation technology, harvesting is a crucial process since it affects the raw pharmaceuticals' financial value. The sort of medicine to be harvested and the pharmacopeia requirements it must meet determine how crude pharmaceuticals are collected. Skilled laborers can harvest effectively in every way. The illicit substances in Such tubers, roots, rhizomes, etc. Are collected using mechanical tools like lifters or diggers. The roots, or tubers, completely cleaned in water to remove any dirt. For instance, a tool called a seed stripper is used to gather flowers, seeds, and small fruits.

### 2.Drying:

Depending on the crude drug's chemical makeup and source, this processing involves a number of steps or extractions. To improve quality and make the crude drug resistant to bacterial growth, sufficient water must be removed from the drug during the drying process. Halfway through an enzymatic reaction, drying inhibits it. With some medications, achieving certain standards necessitates using some unique techniques. This is sliced and chopped into smaller. The pieces are completed to improve drying. Like glycyrrhizin, slicing and breaking into small pieces is also to cure dryness. To preserve their hue and ephemeral oil content, the flowers are dried under shade. Natural and artificial drying are the two types of drying techniques. Numerous techniques exist for natural drying. Sunlight and Shed Drying Vacuum, spray, and tray dryers are examples of artificial and drying devices.

### 3.Garbling:

This process is better when sand, dirt and exotic plants that are unsuitable for use as medicine need to be removed. The quality of medicinal products sometimes does not exceed the pharmacopoeial limit if foreign products are allowed in the raw drug.

#### **4.Packing:**

When packing drugs, one should consider their physical and chemical makeup, intended use, and the impact of ambient temperature on storage and transit.

For example: Goat skin, filled with aloe. The medications that are expensive and extremely susceptible to moisture.

#### **5.Storage:**

The physical and chemical properties of crude drugs must be thoroughly understood in order to preserve them. Each and every medication should be kept in tightly sealed containers, preferably filled. It is recommended that they be kept in areas that are resistant to fire, water, and rodents. Temperature is another crucial element in the preservation of the medications, as it increases the rate of various chemical reactions that cause the constituents to break down.

#### **Good Agricultural Practices:**

Crop production that is both sustainable and safe is governed by a set of guidelines called GAP. By reducing production costs and environmental impact, it seeks to assist farm owners in maximizing yields. These are the descriptions of the different processing stages that are part of Good Agricultural Practices:

- 1.Seeds and propagation material.
- 2.Cultivation.
- 3.Soil and Fertilization.
- 4.Irrigation.
- 5.Crop maintenance.
- 6.Harvesting.
- 7.Primary processing.
- 8.Packaging.
- 9.Storage and transport.
- 10.Staff requirements.
- 11.Documentation.
- 12.Quality Assurance

#### **Conservation of medicinal plants:**

Medicinal plants are an important source of new medicines for the world. The goal of conservation is to manage the biosphere so that future generations can continue to benefit from it and that it remains potentially rich.

##### **A. Need for Conservation of Medicinal Plant**

Many medicinal plants have become extinct to meet the needs of the growing population and growing regional and international medicinal product markets. Therefore, maintenance, conservation, and conservation are required for future use.

##### **B. In Situ conservation**

The preservation of genetic material to which it has adapted, whether in the form of a microcultivar in a farmer's field or the wild, is known as in situ conservation, or site conservation. Growth habitats are necessary for effective in situ conservation.

### **C. Natural reserves**

A primary factor in the depletion of resources related to medicinal plants is the deterioration and destruction of habitats. The purpose of natural reserves, which number more than 12,700, is to protect and restore significant wild resource areas. Evaluating the needs of key natural habitats is necessary to conserve medicinal plants. Contributions and ecosystem roles of every type of habitat.

### **D. Wild Nurseries**

A wild nursery containing unique and in-demand medicinal plants can be a successful strategy for their in-situ conservation. Planting needed crops and plants in wild nurseries would be a good idea to protect them.<sup>4</sup>

## **METHODS OF IMPROVING QUALITY OF CROPS AND THEIR APPLICATION**

### **1. Mutation**

A mutation is characterized as a permanent, comparatively uncommon alteration to the nucleotide sequence or number. Stated differently, mutations result from changes in the bases of DNA. Transition: A change in the nucleotide that occurs when one pyrimidine is replaced with another pyrimidine or one purine with another purine is called a transition.

Tran's version: A purine is substituted with a pyrimidine in the nucleotides.

### **2. Chemodemes**

A group of plants belonging to the same species that differ only in their chemical makeup are referred to as chemodemes. Chemical traits in chemodemes are inherited. Only by cultivating several plants of the same species under the same circumstances—ideally from seeds for several generations—can the observation of chemodemes be verified.

### **3. Plant breeding**

The definition of plant breeding is the art, science, and technology of enhancing a plant's genetic composition in relation to its economic value to humans. The art and science of modifying a plant's traits to generate desired qualities is known as plant breeding.

### **4. Hybridization**

Hybridization is the process of creating a hybrid through the crossing of two individuals with dissimilar genetic compositions. Hybridization is the process, whether natural or artificial, that leads to the creation of a hybrid. While hybridization creates new gene combinations, it does not alter an organism's genetic makeup. Emasculation, Bagging, Tagging is the process of Hybridization



**Types of Hybridization:**

- Inter varietal Hybridization
- Distant Hybridization

**5.Polyploidy**

Polyploidy occurs when a cell has more than two paired chromosomes, such as in triploid or tetraploid cells. It is a condition where a cell has more than two genomes.

Types:

- 1.Spontaneous Polyploidy: - It is Natural Method.
- 2.Induced Polyploidy: - It is an Artificial Method.<sup>5</sup>

**ROLE OF MEDICINAL PLANTS IN NATIONAL ECONOMY****1. Ginger**

**Fig.2: Ginger Rhizome**

**Synonyms:**

Zingiber, Zingibers, Sunthi

**Biological Source:**

Ginger consists of whole or cut, dried scrapped or unscrapped rhizomes of *Zingiberofficinale* Roscoe, It contains not less than 0.8 per cent of total gingerols on dried basis.

**Family:**

Zingiberaceae

**Macroscopic Characters:**

Color – Light yellow exterior.

Odor – pleasant and aromatic.

Taste – Pungent and spicy.

Size – Ginger rhizome is approximately 5-15 x 1.5-6.5 cm. Shape – The rhizome is laterally compressed with short, straight, oval and oblique branches at the top and buds at the apex. Cut – short and fibrous.

**Geographical source:**

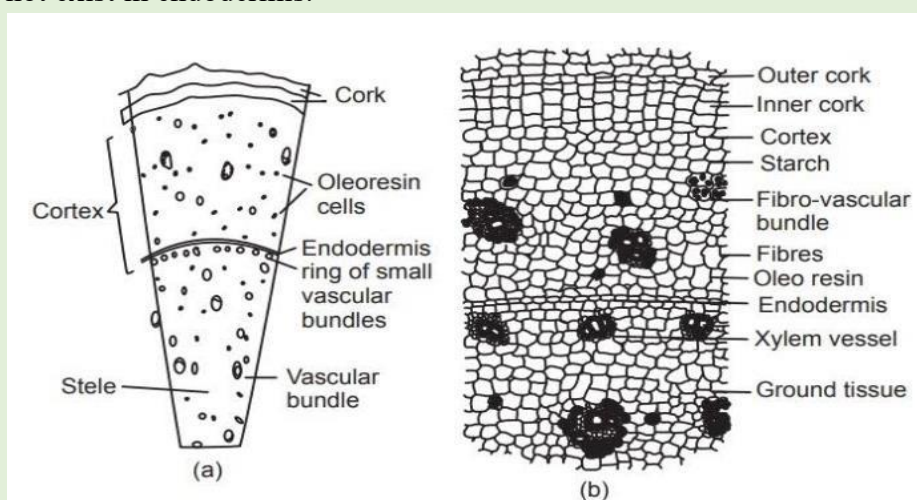
It is believed to be native to Southeast Asia, although it grows in the Caribbean, Africa, Australia, Mauritius, Jamaica, Taiwan and India. Indian products account for more than 35% of global production.

**Extra Feature:**

The surface of ginger contains intermittently projecting fibers and longitudinal striations. Stele and endodermis are clearly visible on the transversely cut surface.

**Microscopic Features:**

Cork is made up of haphazardly arranged cells, and Cortex is the next in line. Thin-walled parenchymatous tissue makes up the cortex. A well-defined endodermis differentiates the cortex from the stele. Numerous closed collateral fibrillar bundles are surrounded by cortical tissue. The vascular bundles immediately within the endodermis are devoid of fibres. Grains of starch and oleo resinous cells are distributed throughout the ground tissue. Starch does not exist in endodermis.



**Fig.3:(a) Schematic diagram (T.S.) and (b) cross section of ginger rhizome**

**Chemical constituents**

Ginger contains 1% to 2% essential oil, 5% to 8% spicy substances, starch and resin. The fragrance comes from the essential oil consisting of bisabilone, zingiberene (6% sesquiterpene), hydrocarbon ginger and sesquiterpene alcohol.

The yellow, pungent, oily liquid zingerol produces zingerones, ketones, and fatty aldehydes. Ginger loses water and forms shagaol. Gingirone and Shagaol have less odor. When zingerol and ginger are boiled with 5% potassium hydroxide or other alkalis, their pungent properties are eliminated. 40–60% starch, 10% fat, 5% fiber, and 6% inorganic material make up ginger. Phenyl propanoids, oxygenated monoterpenes, and hydrocarbons make up ginger oil. The two main qualities of ginger are flavor and aroma. <sup>6</sup>

**Uses**

Commonly used for fevers, stomach-aches, malaria, and indigestion, ginger is a carminative, pungent, and stimulant. It is primarily used to treat illnesses brought on by Kaph and Vat morbidity. Ginger, lemon juice and rock salt increase appetite by stimulating saliva secretion. It treats abdominal pain, anorexia, gout, atonic dyspepsia, bleeding, cancer, chest tightness, influenza, cholera, pneumonia, flu, influenza, colic, colitis,



influenza fever, cough, cystic fibrosis, diarrhea, shortness of breath, shortness of breath, edema, fever, gas, indigestion, gallbladder disease, morning sickness, nausea, rheumatism, sore throat, sore throat, stomach pain, and vomiting. An essential component of many pharmacopoeia Ayurvedic formulations is ginger.

Ginger has many uses such as aromatic, carminative, stimulant and sweetener. Mouthwash contains ginger oil. There have been reports of success using ginger powder to treat motion sickness. It has been proposed that the G.I. tract's adsorbent, aromatic, and carminative qualities lead to the adsorption of toxins and acid enhanced gastric motility. These could most likely have a blocking effect on G.I. reactions.<sup>7</sup>

## **HERBAL DRUGS: REGULATORY AND PATENTING REQUIREMENTS**

### **Patents:**

A patent is a government-granted monopoly that prohibits others from creating, utilizing, importing, or for a limited time, selling specific inventions. A patent has been awarded to the following person: addressed as a patent holder. An invention linked to any technique or product may be granted a patent. The definition of "invention" is found in the Patents Act of 1970, as amended from time to time. "An invention is a fresh idea." Something or something with an inventive step and an industrial application. It is only possible to grant a patent for an Invention for which the requirements listed below are met:

### **Procedure for Patent:**

1. Filling an application
2. Examination of application
3. Opposition /Claim for patent
4. Granting and patent seal.<sup>8</sup>

### **1) Completing a patent application:**

A patent application may be submitted using the template form. The applicant must provide the following information in order to obtain this from the Patent Office. Name, nationality, address, and title of the inventor. Specification: Outlining the specifics of the innovation. Claims: Defining the invention and its extent.

### **2) Application examination:**

The patent office looks into the utility, the type of claim, and whether the patent has been filed before.

### **3) Opposition to any Patent Claim:**

All applications are allowed three months to be submitted before the patent is granted and sealed.

### **4) Patent Grant and Sealing:**

The patent is issued by the patent office and presented in the official gazette if there is no opposition or if the applicant has satisfactorily addressed all of the objections. An annual fee must be paid by a certain date in order to keep a patent active and extend its lifespan. Upon expiration, it may be renewed.<sup>9</sup>

**Farmer's Rights:**

Preservation of crop genetic diversity is essential to global food and agricultural production. It is contingent upon the protection of farmers' rights. By protecting and enhancing crop genetic resources, farmers are granted the right to be acknowledged and compensated for their essential contributions to the worldwide genetic resource pool. Farmers are granted this right in order to optimize, preserve, and make plant genetic resources more readily available, saving them from constantly visiting breeders. In order to facilitate the creation of an efficient system for plant variety protection, the Indian parliament passed the safeguarding of Plant Variety and Farmers Right Act 2001 (PPV&FR act). Farmers and plant breeders have the right to promote the creation and cultivation of novel plant varieties. Farmers, researchers, and plant breeders who have created a new plant variety are granted intellectual property rights under the PPV&FR act of 2001.<sup>10</sup>

**Breeders right:**

Plant The breeder of a new plant variety is awarded Plant Variety Rights (PVR) or Breeder's Right (PBR). With these rights, the breeder has the sole authority to handle the harvested and propagating materials of a new variety for a predetermined period of time. The breeder can use these rights to market a proprietary variety or to get a license to produce other varieties. To be eligible for these exclusivities, a variety must be new, distinct, uniform, and stable. For the purpose of protecting novel plant varieties, the International Union grants PBRs (UPOV).

**Bioprospecting:**

The bioprospecting method - In order to find economically important genetic and biochemical resources, biodiversity prospecting entails exploring, extracting, and screening biological variety and indigenous knowledge. Bioprospecting, also known as biodiversity prospecting, is the methodical search for genetic and biochemical data in the natural world with the goal of creating commercially valuable products for use in cosmetic, agricultural, pharmaceutical, and other applications. Finding and bringing to market novel products derived from biological resources is known as bioprospecting. The search for animal and plant species that can yield pharmaceuticals and other substances with high commercial value. The study of living things to determine how humans can profit from them commercially. The United States National Cancer Institute examined 35,000 plants and animals between 1956 and 1976 in an effort to find anti-cancer substances.

**Biopiracy:**

The phrase "biopiracy" was first used by "Patmooney" to refer to the practice of someone using another person's indigenous knowledge of the natural world for their own financial gain without the indigenous people's consent or payment. An instance of this would be if a bio prospector drew upon indigenous knowledge of a medicinal plant that was subsequently patented by medical companies, failing to acknowledge that the knowledge was not created by the patentee and eliminating the indigenous community of the right to profit from the technology they had developed. According to US patent law, anyone who creates or discovers a novel and practical process, device, manufacturing process, material composition, or novel and practical improvement is entitled to a patent. To qualify for a patent, an applicant must generally meet the following four requirements. The topic needs to be eligible for patents. Both novelty and similar utility or usefulness are requirements for an invention. It has to be a cunning invention.<sup>11</sup>

**CASE STUDIES OF SOME IMPORTANT AROMATIC AND MEDICINAL PLANTS PRODUCTION :****1. Case Study of Neem:**

Native to India and other south-east Asian nations, the neem tree is a tropical evergreen. The bark of the seeds, leaves have substances that have been shown to have antibacterial, antiviral, antipyretic, anti-inflammatory, anti-ulcer, and antifungal properties. When US timber importer “Robert Harson” noticed in 1971 that trees were useful in India, he started bringing neem seeds into the corporate office. He tested the neem plant’s performance and safety. Three the year later, he sold his creation to WR Grace, a multinational chemical company, and the US Department of Agriculture.

The formula for a potent fungicide that was made from the seeds and emulsion of neem trees was legally obtained by WR Grace and Co. In 1972. The company claimed in its patent application that it had created a new fungicide using an extract from tree seeds, but Indian farmers have been using this fungicide for ten years, so they argue the patent was not adequately novel. The patent was opposed by Indians and European Union Green Party members who felt that it would violate the rights of impoverished farmers in developing nations. Neem patents were the first to be challenged on the grounds of biopiracy against US and European patents. Native Americans have long been aware of neem’s therapeutic benefits, according to Indian scientists. The US Patent Office’s order to grant the patent to WR Grace and co. Was rejected by the European Patent Office (EPO), which took the arguments put forth by Indian scientists into consideration. Four years of work by the Science, Technology, and Environment Research Foundations have paid off with this victory.<sup>12</sup>

**2. Case Study of Curcuma:**

East India is home to the tropical herb known as turmeric. The taste of turmeric powder is bitter, and it has a deep, distinct color. It serves as a dye, a culinary ingredient, a litmus substitute in chemical reactions, and a medication. a 1995 US patent that addressed the application of turmeric to the treatment of wounds. Two years later, the Indian Council of Scientific and Industrial Research (CSIR) filed a complaint. CSIR’s claim to patent its medicinal application is not new, as turmeric has been used in India for thousands of years to treat rashes and sores. The USPTO (United States Patent and Trademark Office) investigates the validity of a patent. Despite the patent owner’s objection, the USPTO approved CSIR’s objection and revoked the 1997 patent for lack of novelty.

**CONCLUSION**

Scientific measures need to be taken for the sustainable use, long-term storage and cultivation of aromatic plants and herbs. Additionally, in order to guarantee materials of consistent quality in terms of alkaloids, essential oils, and the development of plans for other drugs, pharmaceuticals and aromatic plants that make the plant useful in the market should be followed by determining the quality of the product.

**REFERENCES:**

1. [https://www.researchgate.net/publication/277059910\\_A\\_Comparison\\_of\\_Cultivation\\_an\\_Wild\\_Collection\\_Of\\_Medicinal\\_and\\_Aromatic\\_Plants\\_Under\\_Sustainability\\_Aspects](https://www.researchgate.net/publication/277059910_A_Comparison_of_Cultivation_an_Wild_Collection_Of_Medicinal_and_Aromatic_Plants_Under_Sustainability_Aspects)
2. <https://pharmabookbank.files.wordpress.com/2019/03/14.2.pharmacognosy-by-birenshahavinash-seth> 1. pdf <http://jnkvv.org/PDF/AERC/Study-93.pdf>
3. Textbook of Pharmacognosy and photochemistry by Biren Shah and A. K. Seth. Page no.72-73

4. A Textbook of Pharmacognosy and photochemistry- II by AtulKabra, Dr. Parveen Kumar Ashok, Sanjay Setia. (PV Publications). Page no 144-148
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4967523/#:~:text=of%20medicinal%20plants,In%20situ%20conservation,conditions%20%5B22%2C%2029%5D>
6. A Textbook of Pharmacognosy and photochemistry by Dr.KuntalDas(NiraliPrakashan) Page no. 2.32 – 2.33
7. A Textbook of Pharmacognosy and Phytochemistry 2 by Dr.K.Prabhu, Dr. G. Arunachalam (Thakur Publications) Page no. 149-151.
8. <https://www.yourarticlelibrary.com/biology/resins/ginger-sources-cultivationanduses/49779>
9. <https://www.glocaluniversity.edu.in/files/eContent/eBpharm/Herbal%20Drug%20Technology.pdf>
10. A Textbook of Herbal Drug Technology by Dr. Zeeshan Afsar (PV Publications) Page no. 79-81 11.
11. A Textbook of Herbal Drug Technology by Dr. G. Arunachalam, Dr. V. E. Ida Christill, Dr. Prashant Kumar (Thakur Publications) Page no. 224 – 229
12. A Textbook of Herbal Drug Technology by Dr. V.M. Shinde, Mrs. K.S. BODASYADAV Page no 10.20 – 10.22.
13. A V Pore SK Bais Anjali Bhausahab Sathe Review on Commercial Cultivation and Collection Aspects of Medicinal and Aromatic Plants International Journal of Advanced Research in Science Communication and Technology Volume3 Issue1 January 2023 ISSN (online)2581-9429 P No550