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Review on Comerersial Cultivation and Collection Aspects of Medicinal and Aromatic Plants

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Abstract: *As the overexploitation of numerous wild medicinal and aromatic plant (MAP) species becomes increasingly obvious, a number of organisations are recommending that wild species be brought into cultivation systems. Others say that sustainable harvesting is the most important conservation strategy because most wild-harvested species are significant to local economies and have a higher long-term value to harvesters. Along with poverty and the failure of conventional limits, the main barriers to sustainable wild-collection are a lack of knowledge about sustainable harvest rates and procedures, uncertain land-use rights, and a lack of legal and political guidance. Understanding the conservation advantages and costs of the various production strategies for MAP should serve as the basis for decisions about whether species conservation should take place in the wild, in nurseries, or both.*

Keywords: Aromatic Plants

I. INTRODUCTION

Since the beginning of time, people have been harvesting plant and animal resources for their needs. Examples include foods made from plants or animals for use in medicine, cosmetics, or culture, as well as edible nuts, fruits, herbs, spices, gums, game, and fibres used to build homes and other structures. For their daily necessities and revenue, hundreds of millions of people still rely largely on harvested plant and animal products, most frequently in developing countries. High-value products like mushrooms (morels, matstake, and truffles) and therapeutic herbs (ginseng, black cohosh, goldenseal) are still being harvested in developed countries for cultural and economic reasons. High-value products like mushrooms (morels, matstake, and truffles) and therapeutic herbs (ginseng, black cohosh, goldenseal) are still being harvested in developed countries for cultural and economic reasons. Among these uses, medicinal plants play a significant role as they are commonly used in distant marketplaces as both trade items and traditional medicines. For the purposes of this article, the phrase "medicinal and aromatic plants" (MAP) is defined to include the complete spectrum of plants used not only sensustricto therapeutically but also in the related and usually overlapping domains of condiments, gastronomy, and cosmetics. Along with the growth of human needs, populations, and trade, there is an increasing demand for a wide variety of wild species. As the over-exploitation of some wild species becomes more widely recognised, numerous organisations are pushing for the integration of wild species into agricultural systems. However, there may also be implications of farming on conservation that need to be better understood. For instance, while cultivating medicinal plants can reduce the quantity of wild populations that are taken, it can also have detrimental consequences on the ecosystem, genetic diversity loss, and the need to preserve wild populations.When examining the relationship between in situ and ex situ conservation of species, there are interesting consequences for local people, public and private land owners and managers, entire industries, and, of course, wild animals. [1]

The type and quantity of active chemicals that are responsible for therapeutic activity will vary depending on the several processes that crude medicines go through before being released onto the market and into the pharmaceutical industry. Those phases require more focus if a drug is to be as helpful to mankind as feasible. The factors that could affect plants are the subject of this chapter. Cultivation improves the quality of the plant.Better plant products are produced as a result of the regulated environmental growth, which also makes it easier to choose the species, variations, or hybrids that have the needed phytoconstituents. Compared to wild sources, this makes the collection and processing processes simpler. The production of secondary metabolites within the plants is maximised during cultivation. It supports national manufacturing by consistently delivering plants. serves as a useful research tool. Following is a list of horticulture's advantages:

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1. It makes sure that medicinal plants are pure and effective. What makes basic medications helpful are their chemical constituents. High-quality medications can be produced if uniformity is maintained throughout the cultivation process. It's critical to use the proper kind of irrigation and an adequate amount of fertiliser when cultivating rhizomes. A crop that has the most volatile oil and other components is produced as a result of meticulous cultivation. You can use ginger, turmeric, and liquorice as examples to demonstrate this concept. By keeping weeds out of the growing plants, it is easy to avoid contaminating raw drugs.
2. A crude drug's consistent supply is ensured by cultivation. In other terms, crop planning is a system of agriculture. Planning crop production ensures a predictable supply, which prevents a raw material deficit in the sectors that rely on crude pharmaceuticals.
3. Industrialization is also accelerated to a greater extent by the cultivation of aromatic and medicinal plants. Kerala's coffee and cocoa plantations have spawned a number of cottage and small-scale enterprises. The cinchona-alkaloid mill near Darjeeling was founded as a result of the cultivation of cinchona in West Bengal. The importance of carefully thought-out poppy farming is eloquently demonstrated by the government-owned opium mill in Ghaziabad.
4. Cultivation enables the use of contemporary technological elements like polyploidy, hybridization, and mutation. The growing of medicinal and aromatic crops offers a natural, sustainable source of high-value industrial raw materials for the pharmaceutical, agrichemical, food, and cosmetic industries. It also creates new opportunities for farmers to earn higher levels of income and offers a significant amount of room for improvement in the rural economy. Despite the fact that these plants have been used to treat and prevent illnesses since antiquity, modern technical developments and the confirmation of conventional wisdom and usage are encouraging consumer preference for natural products and raising the commercial worth of these crops. With an expected annual growth rate of 10-15%, these crops, which currently only cover an area of roughly 0.4 million hectares in India, are becoming significantly more prominent in the global agribusiness. Such crops in India now covering an area of merely about 0.4 million hectares are finding a much higher place in international Agri- business with an estimated annual growth rate of 10-15 per cent. [2]

II. GENERAL ASPECTS INVOLVED IN CULTIVATION OF MEDICINAL PLANTS

2.1 Factors Affecting The Cultivation of Crude Drugs

A. Altitude

An important consideration in the cultivation of medicinal plants is altitude. The examples of medicinal and aromatic plants that can be successfully grown at each altitude are listed below.

Table 1: Altitude for Drug Cultivation.

PLANT	Altitude (Meter)
1.Tea	1,000 – 1500
2.Cinchona	1,000 – 2000

B. Temperature

Many plants will grow in temperate regions during summer, but they lack the resistance to withstand frost in winter. The rate of photosynthesis is affected by change in temperature. The rate of respiration increased with increase in temperature.

Plant	Temperature (**°F**)
1.Cinchona	60 - 75
2.Coffee	55 - 70

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C. Irrigation or Rainfall

Except the xerophytes most other plants need water and proper irrigation and sufficient rainfall for their development. The minerals in the soil get dissolved in water and are then absorbed by plants water influences morphological and physiology of plants. E.g., Continuous rain can lead to a loss of water – soluble substance from leaves and root by leaching.

D. Soil

Soil provides mechanical support, water and essential foods for the development of plants. It consists of air, water, mineral matter and organic matters. The plants are able to determine their own soil pH range for their growth. Nitrogen containing soil has a great useful for raising the production of alkaloids in some plants.

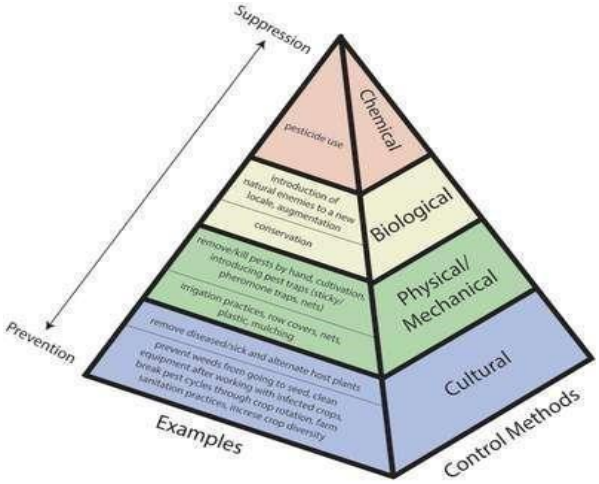
SUBSTANCE SIZE (Diameter)	THE SOIL TYPE
1.Less than 0.002 mm	Fine Clay
2.0.002 – 0.02 mm	Coarse Clay
3.0.02 -0.2 mm	Small Sand
4.0.2 – 2.0 mm	Fine Sand

E. Soilfertility

It is the capacity of soil to provide nutrients in adequate amounts and in balanced proportion to plants. It is also diminished through leaching and erosion. Soil fertility can be maintained by addition of animal manures, nitrogen fixing bacteria or by application of chemical fertilizers.

F. Control of Pests and Pests

Pest is an undesired animal or plant which causes loss of cultivated plants. The different types of pests infecting medicinal plants are as follows: 1. Fungi/Viruses 2. Insects 3. Weeds 4. Non insects' pests. Different techniques are followed to achieve pest control effectively. These methods are discussed as follows: Mechanical Method, Agricultural Method, Biological Method, and Chemical Method. [3]



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III. POST – HARVESTING TECHNOLOGY OF MEDICINAL AND AROMATIC PLANTS

3.1 Harvesting

Harvesting is an important operation in cultivation technology, as it reflects upon economic aspects of the crude drugs. The harvesting of crude drugs depends upon the type of drug to be harvested and the pharmacopeia standards which it needs to achieve. Harvesting can be done efficiently in every respect by the skilled workers. The underground drugs like roots, rhizomes, tubers, etc. are harvested by mechanical devices, such as diggers or lifters. The tubers or roots are thoroughly washed in water to get of earthy-matter.

Example: Flowers, seeds and small fruits are harvested by a special device known as seed stripper.

3.2. Drying

This processing includes several operations or treatments, depending upon the source of the crude drugs and its chemical nature. Drying consists of removal of sufficient moisture content of crude drugs, so as to improve its quality and make it resistant to the growth of microorganisms. Drying inhibits partially enzymatic reactions. In certain drugs, some special methods are required to be followed to attain specific standards. The slicing and cutting into smaller pieces are done to enhance drying. The slicing and cutting into smaller pieces are done to enhance drying, as in case of glycyrrhizin. The flowers are dried in shade so as to retain their color and volatile oil content. Methods of drying are Natural Drying. and Artificial Drying. In the Natural Drying there are so many methods Shed Drying, Direct sun Drying and Artificial Dryings are Tray Dryers, Vacuum dryers, Spray dryers.

3.3 Garbling

This process is desired when sand, dirt and foreign organic parts of the same plant, not constituting drug are required to be removed. If the extraneous matter is permitted in crude Drugs, the quality of drug surfers and at times, it does not pass pharmacopeia limit.

3.4. Packing

The morphological and chemical nature of drug, its ultimate use and effects of climatic conditions during transportation and storage should be taken into consideration while packing the drugs. Examples: Aloe is packed in goat skin. The drugs which are very sensitive to moisture and also costly at the same time.

3.5 Storage

Preservation of crude drugs needs sound knowledge of their physical and chemical properties. All the drugs should be preserved in well closed and possibly in the filled containers. They should be stored in the premises which are water proof, fire proof and rodent proof. Temperature is also very important factor in preservation of the drugs, as it accelerates several chemical reactions leading to decomposition of the constituents

3.6 Current Good Agricultural Practices

A. Good Agricultural Practice

(GAP) is a set of standards for the safe and sustainable production of crops. It aims to help farm owners maximize yields and minimizing production costs and environmental impact. The various stages of processing which are included in Good Agricultural Practices are described as follows:

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.

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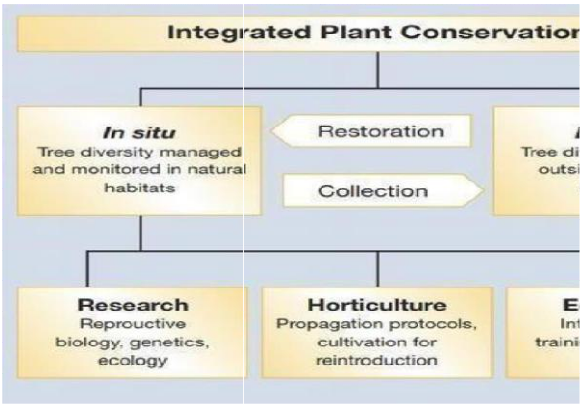
10. Staff requirements.
11. Documentation.
12. Quality Assurance. [4]

3.7. Conservation of Medicinal Plants

Medicinal plants are globally valuable sources of new drugs. Conservation is the process of management of the biosphere in order to obtain the greatest benefit for the present generation and maintain the potential for the future.

A. **Need for Conservation of Medicinal Plants**

To meet the requirements of expanding regional and international markets healthcare products and needs of growing populations, large quantities of medicinal plants are harvested from forest. As a result, the natural sources are rapidly depleting. o Hence there is a need for conservation,



Cultivation, maintenance for future use.

B. In Situ Conservation

In Situ or site conservation involves maintaining genetic resources in their natural habitats i.e., within the ecosystem to which it is adapted, whether as wild or crop cultivar in farmers field as components of the traditional agricultural system. Successful in situ conservation depends on rules, regulations and potential compliance of medicinal plants within growth habitats.

C. Natural Reserves

The degradation and destruction of habitats is a major cause of the loss of medicinal plant resources. Natural reserves are protected areas of important wild resources created to preserve and restore biodiversity. Around the world, more than 12,700Protected. Conserving medicinal plants by protecting key natural habitats requires assessing the contributions and ecosystem functions of individual habitats.

D. Wild Nurseries

Wild nurseries can provide a effective approach for in situ conservation of medicinal plants that are endemic, endangered and in demand.

E. Ex–Situ Conservation

Ex-Situ Conservation involves conservation of biodiversity outside the native or natural habitat where the genetic variation is maintained away from its original location. The Ex-Situ genetic conservation fulfils the requirement of present or future economic, social and environmental needs. Conservation also includes propagation and assessment of molecular diversity.[5]

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IV. METHODS OF IMPROVING QUALITY OF CROPS AND THEIR APPLICATION

4.1. Plant Breeding

Plant breeding can be defined as an art and science and technology of improving the genetic makeup of plants in relation to their economic use for mankind. Plant breeding is the art and science of changing the traits of plants in order to produce desired characteristics.

4.2. Chemodemes

Chemo demes are regarded as a group of plants of a species which have identical morphological characters, but differ in their chemical nature. The chemical characters of chemo demes are hereditary. The observation of chemo demes can be confirmed only by growing different plants of a species in identical conditions, preferably from the seeds for many generations.

4.3. Hybridization

The production of a hybrid by crossing two individuals of unlike genetic constitution is known as hybridization. The natural or artificial process that results in the formation of hybrid is known as hybridization. Hybridization does not change genetic contents of organisms but it produces new combinations of genes.

Types of Hybridization:

1. Intervarietal Hybridization
2. Distant Hybridization

Emasculation, Bagging, Tagging is the process of Hybridization.

4.4. Mutation

Mutation is defined as the permanent and relatively rare change in the number or sequence of nucleotides. In other words, mutations arise due to change in DNA bases. Transition: change in the nucleotide may involve replacement of one pyrimidine by another pyrimidine or one purine by another purine, known as Transition. Tran's version: A change in the nucleotides involves substitution of a purine by pyrimidine.

4.5. Polyploidy:

If a cell contains more than two paired cells of chromosomes are polyploidy E.g., Triploid,
Tetraploid. It is condition in which cell contain more than two genomes. Types:

1. Spontaneous Polyploidy: - It is Natural Method.
2. Induced Polyploidy: - It is an Artificial Method. [6]

V. ROLE OF MEDICINAL PLANTS IN NATIONAL ECONOMY

5.1 Ginger

Synonyms: Zingiber, Zingibers, Sunthi.

Family: Zingiberaceae.

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

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Geographical Source: It is said to be native of South East Asia, but is cultivated in Caribbean islands, Africa, Australia, Mauritius, Jamaica, Taiwan and India. More than 35 per cent world's production is form India.

Macroscopic Characters:

Color – Externally, it is buff colored.

Odor – Agreeable and aromatic.

Taste – Agreeable and pungent.

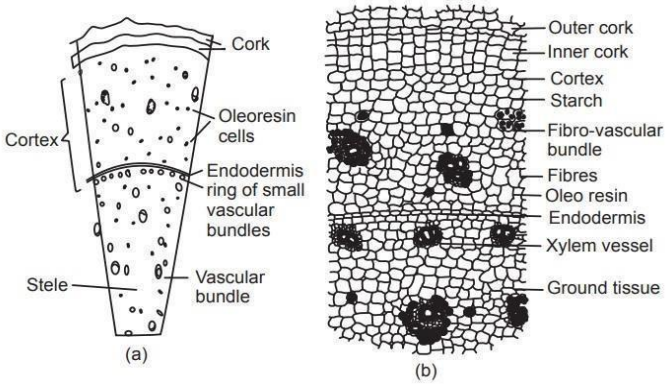
Size– Rhizomes of ginger are about 5-15 x 1.5-6.5 cm. Shape – The rhizomes are laterally compressed, bearing short flat, ovate and oblique

Branches on the upper side, with bud at the apex.Fracture – Short and fibrous**.**

Extra Feature: Longitudinal striations and the occasional projecting fibers are present on the surface of ginger. Transversely cut surface shows well marked endodermis and stele.

Microscopic Characters: Cork consists of irregularly arranged cells, followed by Cortex. Cortex is made up of thin-walled parenchymatous tissue. Well-marked endodermis distinguishes

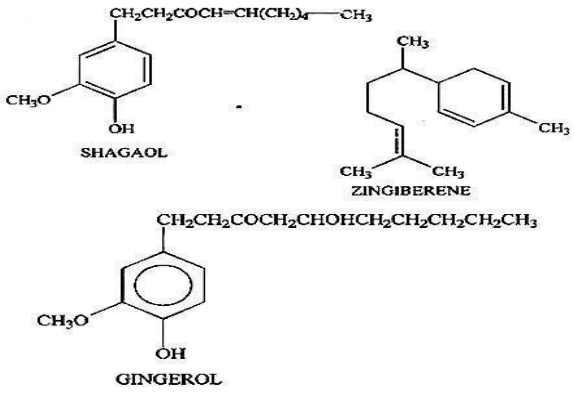
the stele and the cortex. Cortical tissue encloses several closed collaterals fibro-vascular bundles. Vascular bundles just inside the endodermis are free of fibers. Oleo resinous cells and starch grains are found throughout the ground tissue. Endodermis is free of starch.



(a) Schematic diagram (T.S.) and, (b) Transverse section of Ginger rhizome

Chemical Constituents:

Ginger contains 1 to 2% volatile oil, 5 to 8% pungent principle, resinous mass and starch. Volatile oil is responsible for the aromatic smell and consists of zingiberene 6% sesquiterpenes hydrocarbon zingier a sesquiterpenes alcohol and besaabolene. Gingirol is a yellow pungent oily liquid and yields gingirone a ketone and aliphatic aldehyde. Shagaol is formed by loss of water from gingerol. Shagaol and gingirone are less pungent. The pungency of gingerol and ginger is destroyed, when boiled with 5% potassium hydroxide or other alkalis. Ginger consists of Starch 40 to 60%, fat 10%, Fibber's 5%, and Inorganic material 6%. Ginger oil is composed of hydrocarbons, oxygenated mono terpenes, and phenyl propanoids. Aroma and flavor are the main characteristics of ginger. The flavor, pungency and pharmacological action are exerted by phenolketenes of oleo-resin.



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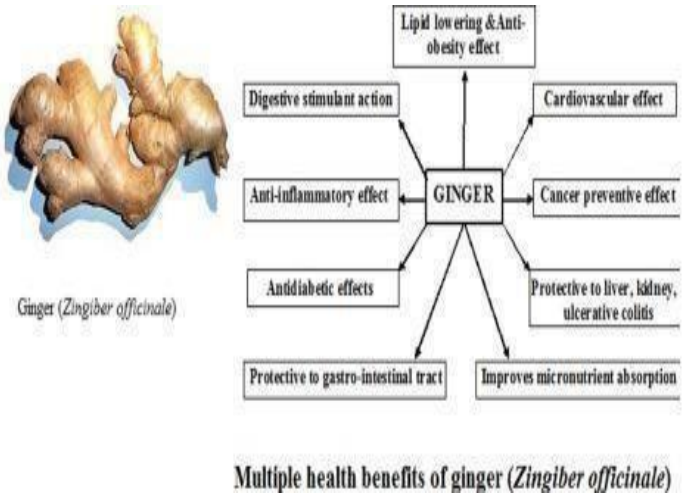
Uses: Ginger is carminative, pungent, stimulant, used widely for indigestion, stomach-ache, malaria and fevers. It is chiefly used to cure diseases due to morbidity of Kaph and Vat. Ginger with lime juice and rock salt increases appetite and stimulates the secretion of gastric juices. It is said to be used for abdominal pain, anorexia, arthritis, atonics dyspepsia, bleeding, cancer, chest congestion, chicken pox, cholera, chronic bronchitis, cold extremities, colic, colitis, common cold, cough, cystic fibrosis, diarrhoea, difficulty in breathing, dropsy, fever, flatulent, indigestion, disorders of gallbladder, hyperacidity, hypercholesterolemia, hyperglycemia, indigestion, morning sickness, nausea, rheumatism, sore throat, throat ache, stomach ache and vomiting. Ginger forms an important constituent of many pharmacopoeia Ayurvedic formulations. You may prepare ginger tincture using a proper dilution. Primary areas of use are digestive problems, asthma and complaints related to urinary tract. Drink it continuously or when necessary, by adding 10 to 15 drops into half a tablespoon of lukewarm water for 2 or 3 times a day. In order to prepare ginger tea, a 2.5 cm tall fresh ginger root is sliced or used in powdered form. Next, half a dessertspoon of ginger refined using a grinder is added to a full glass of cold water, heated up to the boiling degree in a mild temperature, then boiled in a mild temperature for 5 to 6 min and drained. [7]

If necessary, a cup of freshly brewed tea is sweetened by squeezing juice of half a lemon and adding honey; and drinks it before it cools down. There is no inconvenience in drinking 1 or 2 cups of freshly brewed tea a day. The tea is preferred especially in complaints related to digestive system. Ginger is used as an aromatic, a carminative, stimulant and flavoring agent. Ginger oil is used in mouthwashes. Ginger powder has been reported to be effective in motion sickness. It has been suggested that adsorbent, aromatic and carminative properties of ginger on G.I tract cause adsorption of toxins and acid enhanced gastric motility. These may have probably blocking effects of G.I reactions and nausea. [8]



Multiple health benefits of ginger (*Zingiber officinale*)

VI. PATENTING AND REGULATORYREQUIREMENTS OF HERBAL DRUGS

6.1 Patent

A patent is a set of monopoly rights given to a patentee by the government that excludes others from making, using, selling, or importing particular inventions for a limited period of time. The person who has been granted a patent is called a patentee. A patent can be granted for an invention which may be related to any process or product. The word "Invention" has been defined under the Patents Act 1970 as amended from time to time. "An invention means a new product or purpose having industrial application and involving an inventive step". A patent may be granted only for an invention in respect of which the following conditions are satisfied: The invention is new. Involves an inventive step. Is capable of industrial application or utility. The purpose of this system is to encourage inventions by promoting their protection and invention so as to contribute to develop industries which in turn provides better utility to the society. [9]

Procedure for Patent

1. Filling an application
2. Examination of application

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3. Opposition /Claim for patent
4. Granting and patent seali.

1. Filling an application for patient:
A patent application can be made on prescribed application form. This can be obtained from Patent office; the applicant has to furnish the following information. Title, name, address and nationality of inventor. Specification: Giving the details of invention. Claims: Definition and scope of invention.

2. Examination of application:
Patent office examines patent applications with respect to usefulness, nature of claim and weather the patent has been filed earlier.

3. Opposition of any claim of patent:
A three-month time is given for any application before granting and sealing of the patent.

4. Granting and sealing of patent:
In case of no opposition or clearly satisfaction of all the objections by the applicant, the patent is granted by the patent office and published in the official gazette. A patent can be Kept alive by paying an annual fee within date which increases the age of the patent. It can be renewed after its expiry.[10]

Farmer's Right:
Farmer's rights are a precondition for the maintenance of crop genetic diversity, which forms the basis of all food and agriculture production in the world. Farmer's right enables the farmers to maintain and develop crop genetic resources and recognize and reward them for their vital contribution to the global pool of genetic resources. This is the right given to farmers for the improvement, conservation and availability of plant genetic resources so that farmers need not go to the breeder every time. The protection of plant variety and farmers right act 2001(PPV&FR act) is an act of parliament of India that was enacted to provide for the establishment of an effective system for protection of plant varieties. The rights of the farmers and plant breeders are to encourage the development and cultivation of new varieties of plants. The PPV&FR act 2001 was enacted to grant intellectual property rights to plant breeders, researchers and farmers who have developed any new plant variety.

Breeder's Right:
Plant Breeder's Right (PBR) or Plant Variety Rights (PVR) are granted to the breeder of anew variety of plant. o These rights give the breeder exclusive control over the propagating materials and harvested materials of a new variety for a number of years. With these rights, the breeder can become the marketer of an exclusive variety, or can obtain the license for other varieties. A variety should be new, distinct, uniform and stable to qualify for these exclusive rights. The PBR is granted by International Union for the protection of new varieties of plants (UPOV).

Bioprospecting
Biodiversity prospecting involves exploration, extraction and screening of biological diversity and indigenous knowledge for commercially valuable genetic and biochemical resources. Bioprospecting or biodiversity prospecting is the systematic search for biochemical and genetic information in nature, in order to develop commercially valuable products for pharmaceutical, agricultural, cosmetic and other applications. Bioprospecting is the process of discovery and commercialization of new products based on biological resources. The search for plants and animal's species from which medicinal drugs and other commercially valuable compounds can be obtained. The investigation of the living things to see how they can be commercially useful to human beings. Between 1956 and 1976, the U. S. National Cancer Institute screened 35,000 plants and animals for anti-cancer compounds. But this program failed to identify a greater number of new anti-cancer agents, and thus was ended in 1981.

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Biopiracy:

The term Biopiracy was coined by "Patmooney" to describe a practice in which indigenous knowledge of nature, originating with indigenous people is used by others for profit without authorization or compensation to the indigenous people themselves. For examples, when bio prospector draws an indigenous knowledge of medicinal plant which is later patented by medical companies without recognizing the fact that that and knowledge is not new or invented by the patentee and depriving the indigenous community to the rights to commercial exploitation of the technology that they themselves had developed. Under US patent law, any person who invents or discovers any new and useful process, machine, manufacture or composition of matter or any new and useful improvement is eligible to obtain patient. In general, four requirements have to be satisfied to quality for a patent which are as follows. The subject matter must be patentable. The invention must be novel; the invention must have same utility or usefulness. The invention must be devious.[11]

VII. CASE STUDIES OF PRODUCTION OF SOME IMPORTANTM EDICINAL AND AROMTIC PLANTS

7.1 Case Studies of Neem

The neem tree is a tropical evergreen tree native to India and is also found in other south east countries. The seeds bark and leaves contain compounds with proven antiseptic, antiviral, antipyretic, anti-inflammatory, anti-ulcer, anti-fungal properties. In 1971, US timber importer 'Robert Harson' observed that the trees usefulness in India and began importing neem seeds to his company headquarters. He conducted safety and performance test of neem. Three years later he sold his invention to the US Department of agricultural and Multinational chemical corporation WR Grace and co. In 1972 the WR Grace and co secured its right to the formula that used the emulsion from the neem trees, seeds to make a powerful fungicide. In applying for the patient, the company had argued that it had used an extract of the trees, seed to make a new fungicide but the Indians claim that its patent was not sufficiently novel as Indian farmers have used this fungicide for decade. The Indians and members of the green party in the European union opposed the patent because they believed that the rights of the poor farmers in developing countries will be harmed. The neem patent became the first to challenge European & US patents on grounds of biopiracy. The Indian scientists argued that the Indians have known the medicinal properties of neem long back. The European Patent Office EPO accepted the arguments offered by Indian scientists and rejected the order of the US patent office to award the patent to WR Grace and co. The victory is a result of four yearlong efforts by the research foundations for science technology and environment.

7.2 Case Study of Curcuma

Turmeric is a tropical herb grown in east India. Turmeric powder has a deep distinct colour and bitter taste. It is used as dye, cooking ingredient, litmus in chemical tests and for medicinal purpose. A United States patent 1995, specifically for the use of turmeric in wound healing. Two years later, a complaint was filed by India's council of scientific and industrial research (CSIR). CSIR argued that turmeric has been used in India for thousands of years for healing wounds and rashes and therefore the patent on its medicinal use was not a novel invention. United States patent and trade mark office (USPTO) investigated the validity of the patent. In 1997 despite an appeal made by the patent holders, the USPTO upheld the CSIR objection and cancelled the patent due to lack of novelty. [12]

VIII. CONCLUSION

There is an urgent need to adopt scientific measure for their cultivation, long term preservation, protection and sustainable utilization of medicinal and aromatic plants. Further, the development program me on medicinal and aromatic plants is required to be monitored by quality analysis of the produce in order to ensure materials of uniform quality in term of alkaloid, essential oil and other chemical constitution for which these plants are valuable in the market.

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