IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

Analyze Commercial Cultivation and Collection Practices of Medicinal and Aromatic Plants

Suman C[1] and Dr. Narendra KR[2]
Research Scholar, Department of Botany[1]
Professor, Department of Botany[2]
Sunrise University, Alwar, Rajasthan, India

Abstract: *A number of organizations are advocating for the introduction of native medicinal and aromatic plant (MAP) species into cultivation systems, as the overexploitation of such species becomes increasingly apparent. There are proponents who argue that sustainable harvesting constitutes the preeminent conservation strategy due to the economic significance of the majority of wild-harvested species in the region and their greater long-term worth to harvesters. In addition to poverty and the ineffectiveness of traditional limits, the primary obstacles to sustainable wild-collection encompass an absence of understanding regarding sustainable harvest methods and protocols, ambiguous land-use rights, and insufficient legal and political direction. The evaluation of the costs and benefits associated with different MAP production strategies should form the foundation for determining whether species conservation efforts should be concentrated in nurseries, the open, or both.*

Keywords: Commercial cultivation, sustainable harvesting

I. INTRODUCTION

For nourishment, humans have always harvested plants and animals. Seeds, fruits, herbs, spices, resins, game, and fibers for building houses, cosmetics, medicine, and culture require plants or animals. Plant and animal products support hundreds of millions of developing country residents. Ginseng, black cohosh, goldenseal, and morels, matstake, and truffles are harvested in industrialized nations for economic and cultural reasons. Ginseng, black cohosh, goldenseal, and morels, matstake, and truffles are harvested in industrialized nations for economic and cultural reasons. Foreign markets employ medicinal plants for trade and traditional remedies. "Medicinal and aromatic plants" (MAP) include all plants utilized in sensustricto treatment, the condiment, gastronomic, and cosmetic sectors, which are closely connected and overlap. Demand for many wild species is driven by human needs, populations, and commerce. Many organizations are pushing for native species in agricultural systems as awareness of overexploitation rises. Cultivation may effect conservation, which requires further research. Medical plant cultivation may minimize wild population hunting, but it may also limit genetic variability and the need to conserve wild populations.In situ and ex situ species conservation affect local people, public and private landowners and administrations, industry, and uncontrolled animals. Due to many treatments before sale, primitive medicines have different therapeutic active ingredients. These phases must be focused to benefit humanity. This chapter covers vegetation-affecting factors. Preservation enhances plant traits.Controlled environmental growth makes selecting species, types, and hybrids with phytoconstituents easier and improves plant output. This makes collection and refining simpler than natural sources. Plant secondary metabolite production peaks during cultivation. Consistent facilities facilitate national production. performs well in research. Horticulture benefits:

Pure and effective therapeutic plants are guaranteed. Chemicals make popular medications effective. High-quality pharmaceuticals come from consistent cultivation. Rhizome growth requires fertilizer and water. Carefully cultivated crops contain the most volatile oil and other components. Ginger, turmeric, and alcoholice show this. Keeping foliage out of growing plants reduces raw drug contamination.

Growing provides a foundation. Harvest planning is agricultural. Crude pharmaceutical companies may avoid raw material shortages since farm production is dependable.

DOI: 10.48175/568

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

Aromatic and therapeutic plant cultivation boosts industry. Small firms have grown on Kerala's coffee and cocoa estates. Cinchona cultivation in West Bengal created the Darjeeling cinchona-alkaloid mill. The Ghaziabad state-owned opium factory shows how poppy planting must be structured.

Current agricultural methods include polyploidy, hybridization, and mutation. Pharmaceutical, agrichemical, culinary, and cosmetic sectors use aromatic and therapeutic crops as sustainable raw resources. It promotes rural economies and provides farmers new economic prospects. Modern technology and the confirmation of old knowledge and practices are growing consumer desire for natural goods and their economic significance, notwithstanding historical therapeutic and preventive benefits. These commodities, which span 0.4 million hectares in India, are becoming significant in global agribusiness because to their 10% to 15% annual growth rate. On 0.4 million hectares, these commodities are rising 10–15% yearly in the global agricultural sector.

II. GENERAL ASPECTS INVOLVED IN CULTIVATION OF MEDICINAL PLANTS

2.1 Factors Affecting The Cultivation of Crude Drugs

Altitude

When growing medicinal plants, altitude matters. The following list includes medicinal and aromatic plant species that grow well at each altitude.

Table 1: Altitude for Drug Cultivation.

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

Temperature

Many temperate summer plants cannot withstand winter frost. Variable temperature affects photosynthesis. Increased body temperature increased respiration.

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

Irrigation or Rainfall

Except for xerophytes, most plants need water, precipitation, and irrigation. Plants consume soil minerals dissolved in water, which affects their morphology and physiology. For instance, prolonged precipitation may release water-soluble compounds from roots and leaves.

Soil

Plants need soil for water, nutrients, and mechanical support. It contains air, water, minerals, and organics. For growth, plants choose their soil pH. Some plants produce more alkaloids in nitrogen-rich soil.

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

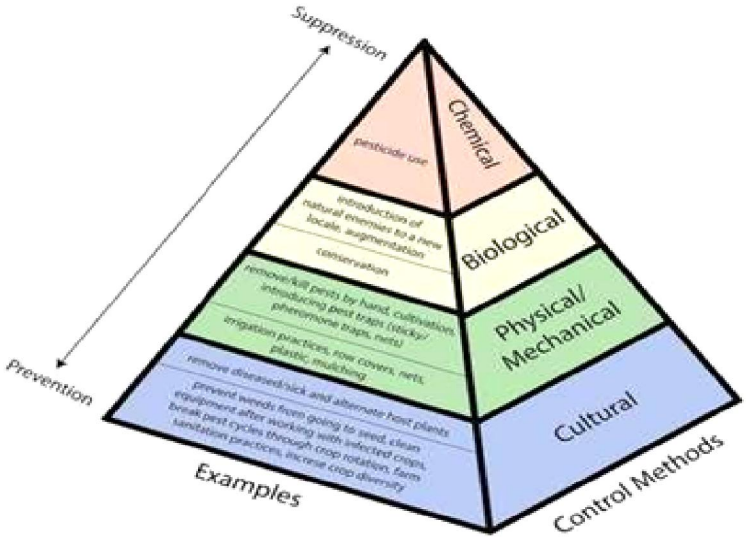
Soilfertility

Soil ability to feed plants with appropriate and balanced nutrients. Leaching and erosion reduce it. Chemical fertilizers, animal manures, and nitrogen-fixing microorganisms may maintain soil fertility.

Control of Pests and Pests

Pests are unwanted plants or animals that damage crops. Parasites that affect therapeutic plants fall from many categories: 1. Microbes and viruses Psalms 2 Finally, plants 4. Non-insect pests. Several methods are used to control vermin. Biological, Mechanical, Agricultural, and Chemical Methods are detailed here.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024



III. POST – HARVESTING TECHNOLOGY OF MEDICINAL AND AROMATIC PLANTS

3.1 Harvesting

Harvesting is crucial to cultivation technique since it affects the economics of unprocessed medicines. Primitive drug harvesting depends on the drug kind and pharmacopeia criteria. Skilled workers can harvest effectively. Machines like diggers and lifters harvest underground medicinal tubers, roots, and rhizomes. Tubers and roots are carefully cleaned to remove dirt. Seed extractors extract tiny fruits, seeds, and flowers.

3.2. Drying

This processing involves several procedures or cures depending on the crude medicines' chemical composition and provenance. To improve quality and prevent microbial development, crude drugs are dried. Drying reduces enzyme activity. Certain drugs need unique methods to fulfill criteria. Dicing and cutting induce dehydration. Glycyrrhizin dehydrates faster when diced and sliced. The flower is shade-dried to maintain its color and volatile oil. Both natural and artificial drying techniques exist. Many natural drying methods exist. Trays, vacuums, and spray dryers are used for shedding, direct sun drying, and artificial drying.

3.3 Garbling

This approach is recommended for removing silt, dirt, and non-substance organic plant components. Extraneous matter in basic medications may lower quality and cause them to fail the pharmacopeia limit.

3.4 Packing

Medication packaging should take into account their morphological and chemical properties, intended use, and storage and transit climate. Aloe is wrapped in bovine hide. Moisture-sensitive, costly medications.

3.5 Storage

Understanding archaic drugs' physical and chemical characteristics is essential for preservation. All pharmaceuticals should be kept in sealed, refillable containers. Watertight, fireproof, and rodent-proof storage is required. Temperature also increases chemical processes that decompose medicinal ingredients, making it important for drug storage.

3.6 Current Good Agricultural Practices

A. Good Agricultural Practice

GAPs are standards for sustainable and secure commodity farming. It helps farmers maximize yields while minimizing production costs and environmental impact. The following processing steps are covered under Good Agricultural Practices:

Seeds and propagation material.

Cultivation.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

Soil and Fertilization.
Irrigation.
Crop maintenance.
Harvesting.
Primary processing.
Packaging.
Storage and transport.
Staff requirements.
Documentation.
Quality Assurance.

3.7. Conservation of Medicinal Plants

Medicinal plants provide novel drugs worldwide. Conserving the environment preserves its potential for future generations while maximizing existing benefits.

Need for Conservation of Medicinal Plants

Many medicinal plants are taken from forests to meet the needs of growing regional and worldwide markets and burgeoning populations. This accelerates natural resource depletion. Thus, conservation is necessary.

Cultivation, maintenance for future use.

In Situ Conservation

Site conservation, often called in situ conservation, preserves genetic resources in their native habitats, such as natural populations or agricultural varieties grown in fields. Preserving medicinal plants in their native environments requires following developing habitat standards.

Natural Reserves

Habitat deterioration and destruction contribute to medicinal plant loss. By protecting essential natural resources, natural reserves conserve and restore biodiversity. Over 12,700 institutions are protected worldwide. To conserve medicinal plants, ecological functions and contributions must be assessed for each habitat.

Wild Nurseries

Wild plantings can preserve endangered and in-demand medicinal plants in situ.
native plants

Ex–Situ Conservation

Ex-situ conservation preserves genetic variety beyond its natural home, preserving biodiversity. Ex-situ genetic conservation meets current and future economic, social, and environmental needs. Conservation includes molecular diversity assessment and propagation.

Methods of improving quality of crops and their application

Plant Breeding

Plant breeding is a technical, scientific, and artistic undertaking that improves plant genetics for human economic benefit. Plant breeding is the scientific and creative modification of plant traits to generate desired traits.

Chemodemes

Chemodemes are species-specific plants with identical morphology but different chemical compositions. Chemical traits are inherited. To confirm chemodemes, numerous generations of the same species must be grown under similar circumstances, ideally from seeds.

Hybridization

Two people with different genetics are crossed to create a hybrid. Natural or artificial hybridization forms halves. Although hybridization does not change organisms' genetic foundation, it creates new gene combinations.

Types of Hybridization:
Intervarietal Hybridization
Distant Hybridization
Tagging, Emasculation, and Bagging constitute the Hybridization procedure.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

Mutation

Mutations are rare and long-lasting changes in nucleotides. Mutations originate from DNA base changes. A nucleotide transition happens when pyrimidines or purines are swapped. Tran's nucleotide alteration replaces purine with pyrimidine.

Polyploidy:

Polyploid cells have more than two paired sets of chromosomes, like triploid or telomeric cells. It has cells with more than two genomes.

Types:

Spontaneous polyploidy is an organic process.

Induced polyploidy is a synthetic technique.

Role of medicinal plants in national economy

Ginger

Synonyms: Zingiber, Zingibers, Sunthi. **Family**: Zingiberaceae.

Biological Source: Ginger is made from dehydrated Zingiberaceae rhizomes, which may be whole or chopped. The desiccated gingerol content must be at least 0.8%.

Geographical Source: It is grown in the Caribbean, Africa, Australia, Mauritius, Jamaica, Taiwan, and India, although it is thought to come from South East Asia. Over 35% of worldwide manufacturing is from India.

Macroscopic Characters:

Coloration: It exhibits a buff exterior. Aromatic and agreeable in nature.

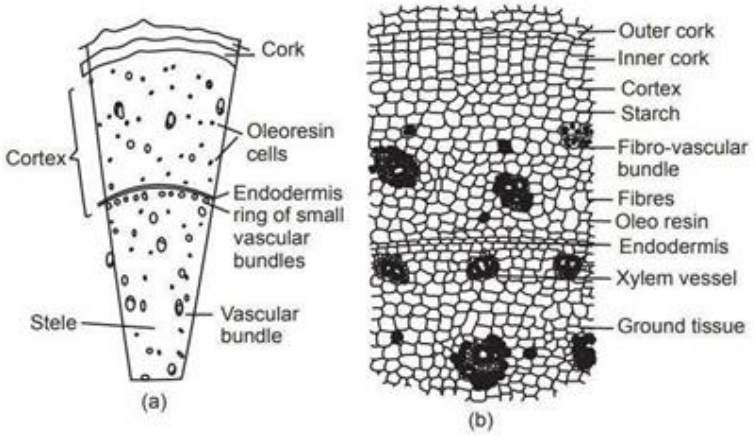
Potent and agreeable in flavor.

Ginger rhizomes range in size from 5 to 15 by 1.5 to 6.5 centimeters. Rhizomes are laterally compressed and have oblique, short, flat branches bearing buds at their apexes on the upper surface.Fracture: fibrous and brief.

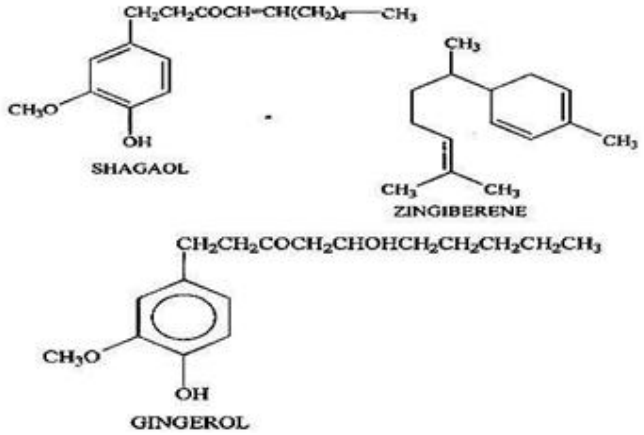
Extra Feature: Ginger's exterior has longitudinal striations and projecting fibers. A transverse slice shows a well-defined endodermis and stele.

Microscopic Characters: Cortex replaces unevenly organized cork. The cortex is narrow-walled parenchyma. Well-defined endodermis separates stele and cortex. Closed fibrovascular bundle collaterals are surrounded by cortex. Vascular bundles near the endodermis are fiberless. Ground tissue contains starch and oleo resinous cells. Endodermis does not contain glucose.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024



(a) Schematic representation (T.S.) and (b) Transverse section of the chemical constituents of the ginger rhizome



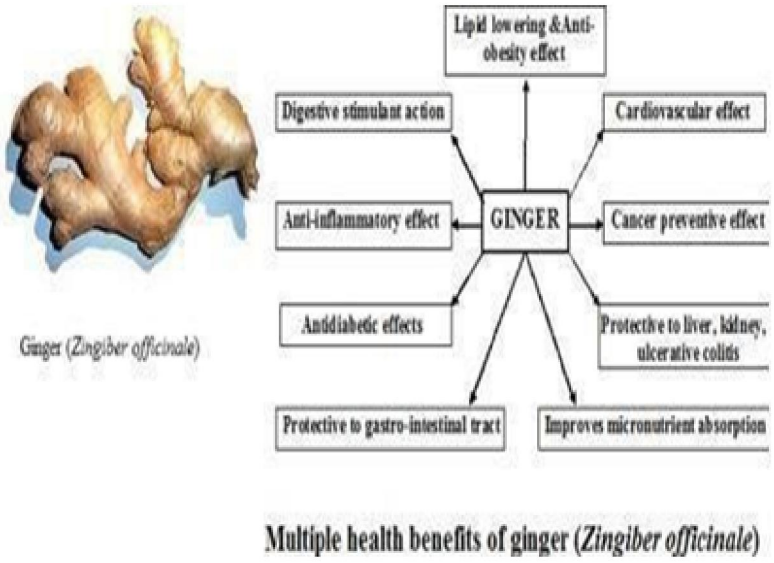
Ginger contains starch, 1–2% volatile oil, and 5–8% pungent principle. Volatile oil contains 6% zingiberene, 6% sesquiterpene hydrocarbon, 6% alcohol, and 6% besaabolene, giving it an aromatic smell. An aliphatic aldehyde and yellow, aromatic oily liquid, gingirol may be transformed to gingirone, a ketone. Gingerol loses water to generate shagaol. Gingirone and shagaol smell less. Gingerol and ginger lose their pungency when cooked with 5% potassium hydroxide or other alkalis. Ginger contains 40%–60% starch, 10% fat, 5% fibrber's, and 6% inorganic substance. Ginger oil contains phenyl propanoids, oxygenated monoterpenes, and hydrocarbons. Ginger is well known for its taste and smell. Flavor, acridity, and pharmacology come from phenols in oleo-resin.

Uses: Ginger is used to cure fevers, malaria, dyspepsia, and stomachaches as a carminative, aromatic, and stimulant. Its main use is treating Kaph and Vat-related diseases. Ginger, lime juice, and rock salt boost hunger and stomach juices. Abdominal pain, anorexia, arthritis, atonic dyspepsia, bleeding, cancer, chest congestion, cold extremities, chronic bronchitis, cholera, chicken pox, colitis, common cold, cough, cystic fibrosis, diarrhoea, difficulty breathing, dropsy, fever, flatulent, indigestion, gallbladder disorders, morning sickness, nausea, rheumatism, sore throat, stomach ache, and stomach ache. Many Ayurvedic pharmacopoeia include ginger. With proper dilution, ginger tincture may be made. Digestive, asthma, and urinary tract disorders are its main uses. Mix 10–15 drops with a half-tbespoon of tepid water two to three times a day with continuous or intermittent use. A 2.5-cm-tall fresh ginger root is chopped or processed into powder for ginger tea. After filtering half a dessertspoon of powdered ginger into a full glass of chilled water, the liquid is gently simmered over low heat, cooked for 5–6 minutes, then filtered.

A cup of freshly made tea may be sweetened with honey and half a lemon juice before cooling. One to two cups of freshly brewed tea in the morning is OK. Digestive problems are recommended. Ginger has fragrant, carminative, stimulating, and flavorful properties. Garlic oil is in mouthwash. Ginger powder may reduce motion sickness. Ginger's

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

adsorbent, aromatic, and carminative qualities may help pollutants accumulate in the gut, while its acidity may increase gastric movement. These medicines may reduce nausea and gastrointestinal symptoms.



Multiple health benefits of ginger (*Zingiber officinale*)

Patenting and regulatoryrequirements of herbal drugs

Patent

Patents are government-granted monopoly rights that restrict others from making, using, selling, or importing innovations for a limited period. A patentee is the person awarded a patent. Any product or process innovation may be patented. The Patents Act of 1970, amended periodically, defines "invention". "An invention is defined as a novel product or purpose that possesses industrial utility and is the result of an inventive process." An invention must meet these characteristics to be patentable: A new innovation exists. Creative process. Utility or industrial use. This system promotes industry progress and public well-being by preserving and innovating them.

Procedure for Patent

Filling an application
Examination of application
Opposition /Claim for patent
Granting and patent seali.
Filling an application for patient:

Patent applications may be submitted on the required form. The applicant must supply the specifics once the patent office receives this information. Name, residence, and country of the creator. A specification details an innovation. Claims: Definition and scope of innovation.

Examination of application:

The patent office considers claims' usability, inventive novelty, and prior filing.

Opposition of any claim of patent:

All patent applications are evaluated for three months before issue.

Granting and sealing of patent:

The patent office grants and publishes patents in the official gazette if the applicant does not object or resolves all objections. A patent's age increases when an annual fee is paid by the deadline. Renewal is possible after expiry.

Farmer's Right:

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

Farmer rights must be protected to preserve cereal genetic variety, which underpins global food and agricultural output. Farmers' rights allow them to maintain and improve agricultural genetic resources and are recognized and compensated for their vital contribution to the global genetic resource. Farmers have this right to secure the availability, conservation, and improvement of plant genetic resources, avoiding the need to contact breeders often. A strong plant variety protection system was established under India's Protection of Plant Variety and Farmers' Rights Act 2001 (PPV&FR act). Farmers' and plant breeders' rights encourage new plant kinds. PPV&FR Act of 2001 grants intellectual property rights to plant breeders, researchers, and producers that generate new plant varieties.

Breeder's Right:

A breeder receives Plant Breeder's Right (PBR) or Plant Variety Right (PVR) for introducing a new plant variety. These rights provide breeders exclusive ownership over a new variety's propagating and harvesting resources for a certain time. The breeder may offer a unique variety or license more kinds with these rights. Novel, distinctive, consistent, and stable varieties qualify for exclusive rights. The International Union awards the PBR to protect new plant types.

Bioprospecting

Biodiversity prospecting involves discovering, extracting, and assessing indigenous knowledge and biological variety for commercial biochemical and genetic resources. Bioprospecting or biodiversity prospecting involves systematic investigation of natural settings for biochemical and genetic data to generate economically viable medicinal, agricultural, cosmetic, and other goods. Bioprospecting involves identifying and commercializing biological goods. The search for pharmaceutical-containing plants and animals. A study of biological entities to determine their economic value. The US National Cancer Institute examined 35,000 plants and animals for anti-cancer chemicals between 1956 and 1976. This initiative ended in 1981 since it failed to find many new anti-cancer drugs.

Biopiracy:

"Patmooney" used the word "biopiracy" to describe a practice in which non-indigenous parties use indigenous knowledge of nature for profit without their agreement or recompense. In cases where medical companies patent indigenous knowledge of medicinal plants that bioprospectors drew without recognizing that the knowledge is not novel or invented by the patent holder, the indigenous community loses the right to commercialize their technology. An inventor or discoverer of a unique and useful enhancement, method, mechanism, production, or composition of matter may get a US patent. In general, a patent must meet four conditions. Patentable subject matter is needed. The innovation must be original and useful. A deceptive innovation is needed.

Case studies of production of some importantm edicinal and aromtic plants

Case Studies of Neem

India and other southeast Asian countries are home to evergreen tropical neem trees. Seed epidermis and leaves include antiseptic, antiviral, antipyretic, anti-inflammatory, antiulcer, and antifungal compounds. Observing neem trees' admiration in India, 'Robert Harson' brought them to his company's headquarters in 1971. He assessed neem's safety and effectiveness. The USDA and WR Grace and Co. bought his invention three years later. WR Grace & Company patented a strong fungicide using neem tree seed emulsion in 1972. The business claimed to have created a new fungicide using tree seed extract in their patent application. Given their decade-long use of this fungicide, Indian producers argue that the patent lacked creativity. The European and Indian Green Parties rejected the patent because it might violate the rights of developing-country producers. Neem was the first patent to challenge European and American biopiracy charges. According to Indian scholars, ancient Indians knew neem was beneficial. European Patent Office EPO revoked USPTO's patent grant to WR Grace et al. to support Indian scientists' claims. Four years of scientific, technical, and environmental investigation led to the success.

Case Study of Curcuma

Eastern India grows tropical turmeric. Turmeric powder is black and bitter. It is used as a dye, food additive, chemical litmus, and medicine. 1995 US patent for turmeric-based wound healing. The Indian Council of Scientific and Industrial Research (CSIR) complained two years later. The CSIR argued that turmeric has been used in India for millennia to treat dermatitis and lesions, making its medical patent not unique. The USPTO investigated the patent's validity. Despite the patent holders' appeal, the USPTO upheld the CSIR complaint in 1997 and canceled the patent for non-novelty.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, February 2024

IV. CONCLUSION

Scientific procedures are needed to grow, preserve, conserve, and use aromatic and therapeutic plants. Quality analysis on medicinal and aromatic plant development program produce is also needed to ensure that all materials are consistent in terms of essential oils, alkaloids, and other chemical constituents that increase market value.

REFERENCES

[1]. A Textbook of Herbal Drug Technology by Dr. G. Arunachalam, Dr.V.E.IdaChristill, Dr. Prashant Kumar (Thakur Publications) Page no. 224 – 229

[2]. A Textbook of Herbal Drug Technology by Dr.V.M. Shinde , Mrs. K.S.BODAS-YADAV Page no 10.20 – 10.21.

[3]. A Textbook of Herbal Drug Technology by Dr.ZeeshanAfsar (PV Publications) Page no. 79-81 11.

[4]. 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

[5]. A Textbook of Pharmacognosy and photochemistry- II by AtulKabra, Dr. Parveen Kumar Ashok, Sanjay Setia. (PV Publications) .Page no 144-148 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4967523/#:~:text=of%20medicinal%20plants-In%20situ%20conservation,conditions%20%5B22%2C%2029%5D

[6]. https://www.researchgate.net/publication/277059910_A_Comparison_of_Cultivation_and_Wild_Collection_of_Medicinal_and_Aromatic_Plants_Under_Sustainability_Aspects https://pharmabookbank.files.wordpress.com/2019/03/14.2.pharmacognosy-by-biren-shahavinash-seth-1.pdfhttp://jnkvv.org/PDF/AERC/Study-93.pdf

[7]. Pradhan, U.C. and Lachungpa, S.T., "Sikkim-Himalayan Rhododendrons", Primulaceae Books, 1990.

[8]. Publications) Page no. 149-151. https://www.yourarticlelibrary.com/biology/resins/ginger-sources-cultivation-anduses/49779 https://www.glocaluniversity.edu.in/files/eContent/eBpharm/Herbal%20Drug%20Technology.pdf

[9]. Roekel, J.V., Kopicki, R., Broekmans, J.E.C. and Boselie, D.M. 2002. Building Agri Supply Chain: Issues and Gudelines. A Guideto Developing Agricultural Markets and Agro-enterprises (ed. Daniele Giovannucci). Agri Chain Competence Foundation. The Netherlands.

[10]. Schippmann, U., Leaman, D.J. and Cunningham, A.B.. "Impact of Cultivation and Gathering of Medicinal Plants on Biodiversity: Global Trends and Issues", Inter-Department Working Group on Biology Diversity for Food and Agriculture, FAO, Rome, 2002.

[11]. Sekar, K. and Srivastava, S.. "Rhododendrons in Indian Himalayan Region: Diversity and Conservation", American Journal of Plant Sciences, 1(2), 131-137, 2010.

[12]. Singh, K.K., Kumar, S., Rai, L.K. and Krishna, A.P.. "Rhododendrons conservation in the Sikkim Himalaya", Current Science, 85(5), 602-606, 2003.

[13]. Souto, T. and Ticktin, T. "Understanding interrelationships among predictors of local ecological knowledge", Economic Botany, 62 (2), 149-164, 2012.

[14]. Textbook of Pharmacognosy and photochemistry by Biren Shah and A. K. Seth. Page no.72-73

[15]. Uniyal, A., Uniyal, S.K. and Rawat, G.S.. "Commercial Extraction of Picrorhiza kurrooa Royle ex Benth. in the Western Himalaya: Patterns of Collection, Processing, and Conservation Threats", Mountain Research and Development, 31(3), 201-208, 2011.

[16]. Ved, D.K. and Goraya, G.S.. "Demand and Supply of Medicinal Plants in India", Bishen Singh and Mahendra Pal Singh, Dehradun and FRLHT, Bangalore, 2008.