Indian
Medicinal Plants
for
Primary Health Care System

Editor

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Kripa Drishti Publications, Pune.

INDIAN

MEDICINAL PLANTS

FOR

PRIMARY HEALTH CARE SYSTEM

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1. Ashwagandha: A Medicinal Plant in the Context of Indian Medicine Treatment

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1.1 Summary:

The Ashwagandha is a customary plant found in the Indian subcontinent. It is customarily utilized for Ayurveda. The word Ashwagandha is gotten from the Sanskrit words Ashwa (pony) and Gandha (smell). This is on the grounds that its foundations smell like the perspiration of a pony. Ashwagandha helps in the administration of stress, uneasiness and diabetes because of its Rasayana (restoring) and Vata adjusting properties. Ashwagandha root powder, when taken with milk, helps in overseeing male barrenness just as erectile brokenness. This is because of its Spanish fly property. One significant safeguard with Ashwagandha is that it ought to be stayed away from during pregnancy as it would increment uterine compressions. It is accepted that Ashwagandha may work on the person's capacity to manage pressure. Stress expands the discharge of adrenocorticotropic chemical (ACTH) which thus builds the cortisol levels (stress chemical) in the body. Ashwagandha powder diminishes the degree of cortisol and assists with decreasing pressure and stress-related issues.

Keywords: Medical Microbiology, Microbiology, Pathology, Botany.

1.2 Introduction:

Withania somnifera is for the most part found in India and territorially called Ashwagandha. In Ayurveda it's anything but an eminent restorative plant. It's anything but a higher job in the ayurvedic context. According to Ayurveda, tension is related with exasperated Vata dosha, so one should focus on appeasing abundance Vata in the body. Ashwagandha has the property of adjusting Vata dosha and is useful for overseeing nervousness. Current science see Ashwagandha as an intense Spanish fly and may help in pressure prompted male barrenness by working fair and square of testosterone. Ashwagandha has cancer prevention agent property and battles against the free revolutionaries. This forestalls harm and passing of sperm cells prompting better sperm check and quality. In this manner Ashwagandha assists with bringing down the danger of stress-initiated male barrenness alongside improving male sexual wellbeing. Ashwagandha assists with lessening pressure initiated male barrenness by bringing down pressure. This is because of its Vata adjusting property. It likewise assists with decreasing the opportunity of male fruitlessness by further developing sperm quality and amount.

This is a result of its Vrishya (love potion) property. Ashwagandha may control glucose in diabetic patients by expanding insulin creation and further developing insulin sensitivity. Studies express that Ashwagandha makes the cells less impervious to insulin. This further develops insulin affectability and expands glucose use by the cells. Ashwagandha likewise secures and builds the quantity of the insulin-creating cells subsequently expanding insulin discharge. Together, it assists with dealing with the danger of diabete. As indicated by Ayurveda, there are two kinds of diabetes treatment. One is Aptarpana (de-sustenance) and Santarpana (renewal). Aptarpana treatment is valuable in large diabetics with Kapha body type and Santarpana treatment is helpful in slender diabetics normally with Vata or Pitta type body. Ashwagandha may work on the person's capacity to manage pressure and stress-related issues like hypertension. Stress builds the emission of adrenocorticotropic chemical (ACTH) which thus expands the cortisol levels (stress chemical) in the body.

Figure 1.1: The Plant of Ashwagandha

Also, for some more kinds of issues are being fix with the assistance of this therapeutic plant. Both ayurvedic and modern logical view is demonstrated towards the reality. There are a few safeguards for utilizing this therapeutic plant. Ashwagandha may cause gastrointestinal unsettling influences, so kindly counsel a specialist prior to taking Ashwagandha or its enhancements on the off chance that you are experiencing peptic ulcer. The organically dynamic substance constituents of Withania somnifera (WS) incorporate alkaloids (isopelletierine, anaferine, cuseohygrine, anahygrine, and so forth), steroidal lactones (withanolides, withaferins) and saponins (Mishra, 2000 et al., 2000). Sitoindosides and acylsterylglucosides in Ashwagandha are hostile to push specialists. Dynamic standards of Ashwagandha, for example the sitoindosides VII-X and Withaferin-A, have been displayed to have huge enemy of stress movement against intense models of exploratory pressure (Bhattacharya et al., 1987). A significant number of its constituents support immunomodulatory activities (Ghosal et al., 1989). The ethereal pieces of Withania somnifera yielded 5-dehydroxy withanolide-R and withasomniferin-A (Atta-ur-Rahman et al., 1991).

Figure 1.2: Ashwagandha Roots

Figure 1.3: Ashwagandha Root Extracts

1.3 Medicinal Plant Ashwagandha (*Withania somnifera*):

Ashwagandha is the common medicinal plant in whole world. In India this plant is mostly used high on demand because it has many therapeutic activities like Hepatoprotective, antioxidant and analgesic activity. If this plant is regular use it may be help to improve immunity power in many people's. In this plant also contains radical scavenging activity which observed by H2 donor or scavenging capability also used for free radical consisting sitoindosides. Here are some radical scavenging activity enzymes are present such as catalase, dismutase and peroxidase. Ashwagandha, referred to normally as *Withania somnifera*, gooseberry, and winter cherry is a plant in the Solanaceae or nightshade family. [1, 2, 3] A few different animal types in the family Withania are morphologically comparable. In spite of the fact that idea to be valuable as a therapeutic spice in Ayurveda and sold in numerous nations as a dietary enhancement, there is inadequate logical proof that it is protected or compelling for treating any illness. [4, 5] In view of its absence of exhibited adequacy and conceivable results, it is as of now not suggested for any condition. [6] This species is a short, delicate enduring bush growing 36 to 40 cm (13 to 16 inch) tall. Tomentose branches broaden radially from a focal stem. Leaves are dull green, elliptic, generally up to 9 to 13 cm (3.4 to 4.6 inch) in length. The blossoms are little, green and chime formed. The ready natural product is orange-red. [4] Withania somnifera is developed in a considerable lot of the drier areas of India. [7] It is likewise found in many regions of India, Sri Lanka, Nepal and china. [8, 9] It lean towards dry stony soil with sun to incomplete shade. To proliferate it tends to be developed from seed in the late-winter, or from greenwood cuttings in the later spring. [10]

1.4 Phytochemical Constituents of Ashwagandha:

In the plant mainly chemical constituents is withanolides that are triterpene lactones withaferin, steroidal lactones, alkaloids, and phenolics. Some 38 withanolides, 10alkaloids, phenols and sitoindosides have also been found. [4] Withanolides are physically same to the ginsenosides of ginseng, other common name for Withania somnifera, "ashwagandha". The other chemical constituents such as oxidase, catalase, peroxidase, ascorbic acid, Tocopherol, polyphenols and dismutase.

1.4.1 Traditional Use in Therapeutic or Medicinal:

The ashwagandha, especially its root extract, has been utilized for quite a long time in conventional Indian medication. [4, 8] Predominantly because of the low quality of the clinical examination, there is no top notch proof that it gives any therapeutic advantage as a treatment or dietary enhancement, and may cause unfriendly impacts whenever consumed along with professionally prescribed medications. [5]

1.4.2 Assists with Combating Malignant Growth:

It has been demonstrated that Ashwagandha serves to initiate 'customized demise of cells' or apoptosis, if there should arise an occurrence of malignant growth cells. It can likewise hinder the development of new disease cells somewhat. It can likewise be useful to deal with various sorts of tumors like ovarian, cerebrum, colon, lung and bosom malignant growth. Admission of Ashwagandha can likewise forestall metastasis (spread of the disease cells to various organs of the body).

1.4.3 Diminishes Sugar Levels:

Cortisol is a pressure chemical which is delivered during pressure and when glucose levels begin lessening quickly. For certain individuals cortisol levels in their bodies are constantly high which thusly prompts incredibly high glucose level and builds the degree of fat stockpiling in the midsection. In such cases, Ashwagandha can assist with diminishing the cortisol even out and bring it down to ordinary.

1.4.4 Assists with Lessening Nervousness and Stress:

Stress is typically inescapable and can happen whenever, yet it very well may be controlled and diminished if certain techniques are applied. Devouring Ashwagandha consistently basically once per day, can assist with having a colossal effect in our lives. It can decrease the side effects of pressure and tension effectively and assist our minds with getting more loose. Individuals who have nervousness problems or psychological wellness conditions can likewise burn-through Ashwagandha to ease the side effects. Melancholy can likewise be kept under control by devouring it every day.

1.4.5 Expands Fruitfulness and Lifts Testosterone:

Devouring Ashwagandha in the powdered structure or taking enhancements of the equivalent can work on the regenerative wellbeing of men. It has likewise been demonstrated to build the sex drive, sperm check and motility. Couples attempting to consider should attempt ashwagandha for a superior possibility at origination.

This normally works on the grounds that Ashwagandha expands the cancer prevention agent levels in blood. Sperm quality is additionally enormously influenced because of utilization of Ashwagandha consistently.

1.4.6 Builds Strength and Bulk:

Examination shows that Ashwagandha builds strength by further developing the body synthesis of an individual. Individuals who need to lose fat additionally devour Ashwagandha frequently. This in turns advances muscle acquire in the two people.

1.4.7 Ashwagandha Diminishes Irritation:

Ashwagandha builds the resistance of the cells which make you stay solid by battling contamination. It likewise diminishes parts which trigger aggravation like C-responsive protein (CRP). Hence, the chance of fostering a coronary illness is by and large decreased.

1.4.8 Brings Down Fatty Oils and Cholesterol Levels:

Ashwagandha likewise works on the strength of our heart by extraordinarily decreasing fatty oil and cholesterol levels. This happens on the grounds that Ashwagandha has normal properties which make it ideal for diminishing blood fats. Devouring Ashwagandha consistently can keep your heart sound and forestall the odds of a respiratory failure.

1.4.9 Battles Indications of Depression:

Gloom is a piece of life, however for a great many people, it gets persistent and can wreck devastation to their lives. Ashwangandha assists with mitigating and diminish indications of discouragement. As per considers, individuals burning through this spice had a superior mental solidarity to conquer gloom.

Figure 1.4: Health Benefits

1.4.10 Role of Ashwagandha in Blood Pressure:

Ashwagandha powder diminishes the degree of cortisol and assists with decreasing pressure and its related issues like hypertension. Hypertension is known as Rakta Gata Vata in Ayurveda which means raised pressing factor of the blood in the supply routes. The point of Ayurvedic treatment for hypertension is recognizing the main driver of the condition and afterward taking spices that can annihilate the issue from its underlying foundations. Stress or nervousness is additionally a main driver of hypertension and taking Ashwagandha assists with diminishing pressure or uneasiness and in this manner control hypertension.

1.4.11 Role of Ashwagandha in Joint Pain:

Ashwagandha deals with the two kinds of treatments by adjusting Vata and Kapha dosha. Ashwagandha may diminish torment related with joint inflammation. Studies express that Ashwagandha has pain relieving property. It is seen that the roots and leaves of Ashwagandha contain withaferin A which hinders the creation of torment go between like prostaglandins.

This diminishes the torment and irritation related with joint pain. Ashwagandha is valuable to oversee torment in joint pain. As indicated by Ayurveda, joint pain happens because of an exacerbation of Vata dosha and is known as Sandhivata. It causes agony, expanding, and joint versatility. Ashwagandha powder has Vata adjusting property and gives alleviation from the manifestations of joint pain like agony and expanding in the joints.

1.5 Side effects of Ashwagandha:

- Ashwagandha is conceivable safe when taken for as long as 90 days. The drawn out security of ashwagandha isn't known. Enormous dosages of ashwagandha may cause stomach upset, the runs, and retching. Once in a while, liver issues may happen.
- It is possible hazardous to utilize ashwagandha when pregnant. There is some proof that ashwagandha may cause unsuccessful labors. There isn't sufficient solid data to know whether ashwagandha is protected to utilize when bosom taking care of. Stay erring on the side of caution and keep away from use.
- Ashwagandha may build thyroid chemical levels. Ashwagandha ought to be utilized warily or kept away from on the off chance that you have a thyroid condition or take thyroid chemical prescriptions.

1.6 Conclusion:

Ashwagandh (*Withania somnifera*) plant is an important medicinal plant to be cultivated all over the world. This plant is found in different places. However, it is found in tropical and subtropical regions of India and its demand is very high because it has some medicinal activity such as antioxidant and analgesic activity. In addition, this medicinal plant contains chemical constituents that increase its value many times over. This plant is very resistant to prevent various diseases. In addition, this plant increases the immunity power in the human body.

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2. Turmeric: A Neutraceutical Boon

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2.1 Introduction:

The natural plant products are being used for various purposes throughout human history. These natural products are derived as secondary metabolites from higher plants that act as natural defence mechanism against diseases and infections. Many of the natural products have pharmacological and biological activity, hence they are exploited in drug discovery and drug design. Medicines derived from plants are shown to play vital role in health care from ancient and modern times (Newman and Cragg 2007; Prasad and Aggarwal 2011). About 61% of at least 877 drugs introduced worldwide between 1981 and 2002, can be traced back to their origins in natural products. These include vincristine and vinblastine (from *Vinca rosea*), etoposide (from May apple), irinotecan and topotecan (from *Camptotheca acuminata*), paclitaxel and abraxane (from *Taxus brevifolia*), solamargine (from *Solanum dulcamara*), masoprocol (from *Larrea tridentata*), arglabin (from *Artemisia glabella*), alitretinoin (from *Daucus carota*) and others (Prasad and Tyagi 2015).

Figure 2.1: Turmeric Cultivation

In 1989, the term "Neutraceuticals", an union of 'Pharmaceutical' and 'Nutrition' was proposed by Stephan De Felice. According to De Felice, Neutraceuticals can be defined as, "A part of food that provides medical or health benefits, including the prevention and/or treatment of a disease" (Karla 2003; Hay et al., 2019). Turmeric is one of the most studied plant materials due to its medicinal properties. Curcuma longa belong to the family Zingiberaceae, a rhizomatous Perennial herb, native of Southeast Asia and Africa that are ideal places for growth and cultivation. (Pal et al., 2020; Priyadarshini 2014). Turmeric, commonly known as haldi is used as an Ayurvedic medicine for the treatment of cough, diabetes, anorexia, and sinusitis (Nelson et al., 2017). It is also used as one of the ingredients in various food preparations for its characteristic natural color and it acts as a preservative as well (Kotra et al., 2019). It also has wide applications in the dyeing, drug, and cosmetic industries. India is the largest producer and exporter of turmeric in the world accounting for more than 50% of the international trade, thereby fulfilling 90% of the global demand and it has considerable importance in Indian economy (Olojede et al., 2009; Pal et al., 2020). Hence it is the spice of India, also known as "Indian saffron".

2.2 Turmeric:

The genus *Curcuma* comprises of 70 perennial rhizomatous species, which are distributed widely throughout tropical and subtropical regions of the world. Turmeric is popularly consumed in the countries of its origin for a variety of uses, such as dietary spice, a dietary pigment, and an Indian natural medicine for the treatment of various diseases (Yadav and Tarun 2017). The portion of the plant rhizome is powdered and medicinally used. The dried *Curcuma longa* or Turmeric has many names such as Curcum in the Arab region, Indian Saffron, Haridra (Sanskrit, Ayurvedic), Jianghuang (Yellow Ginger in Chinies), Kyoo or Ukon (Japanies) (Labban 2014). The rhizome of the plant that is used medicinally is usually cleaned, boiled, dried and pulverized to get a characteristic yellow powder. (Yadav and Tarun 2017).

2.2.1 Classification of Turmeric:

Figure 2.2: Rhizome of Curcuma Longa

Kingdom: Plantae
Class: Lilliopsida: Monocotyledons
Sub class: Commelinids
Order: Zingiberales
Family: Zingiberaceae
Genus: *Curcuma*
Species: longa

The wild Turmeric is called *Curcuma aromatica* and the Domestic species is called *Curcuma longa* (Chattopadhyay *et al*., 2004; Yadav and Tarun 2017).

2.3 Components of Turmeric:

The active components of turmeric are the flavonoid which constitute 90% Curcuminoids, a mixture of Curcumin or diferuloylmethane (71.5%), monodexmethoxycurcumin (19.4%), and bisdesmethoxycurcumin (9.1%). Curcumin has a melting point of 176–177°C; forms a reddish- brown salt with alkali and is soluble in oil, acetic acid, ethanol, ketone and chloroform and insoluble in water (Nasri *et al.,* 2014).

Water soluble curcumin can be prepared by fusion of sodium dodecyl sulfate, cetylpyridinium bromide, gelatine, polysaccharides, polyethylenegylcol and cyclodextrins into various surfactant microemulsions (Iniaghe *et al*., 2009).

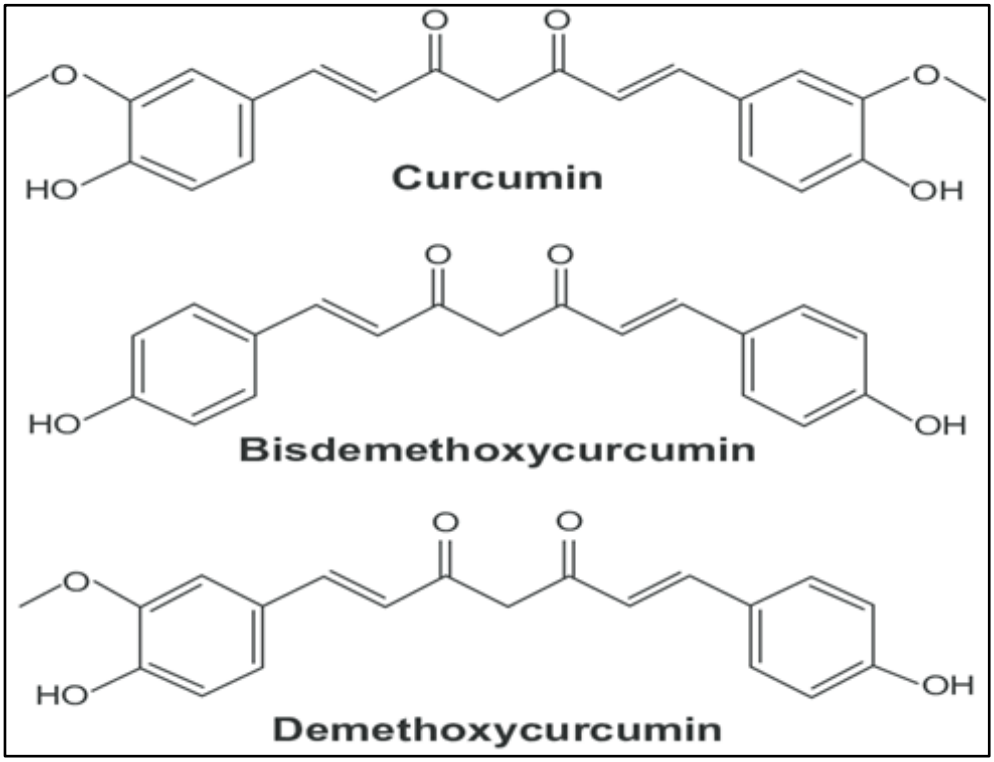

Figure 2.3: Isoforms of Curcumin

2.4 Nutritive value of *Curcuma longa*:

Turmeric is a major source of macro and micro nutrients. It is a good source of energy, and rich in dietary fiber. In ancient times turmeric was known as "Golden Spice" because of its various medicinal properties, which helps in controlling many diseases and also enriching the taste and colour of the food (Mishra and Goel 2020).

The nutritional values of turmeric include moisture (8.92%), crude fiber (4.60%), ash (2.85%), fat (6.85%), crude protein (9.40%), and carbohydrates (67.38%) respectively. The fiber has found to clean the digestive tract of consumere by removing carcinogens from the body and it can also arrest excessive absorption of cholesterol.

It is also adding in bulk to foods and it controls the excessive intake of starchy foods and it may act as guard against metabolic problems such as hypercholesterolemia and diabetes mellitus (Mughal 2019).

Table 2.1: Constituents of *Curcuma longa*

	Composition (w/w)
Curcuminoids	1-6
Volatile Oils	3-7
Fiber	2-7
Mineral matter	3-7
Protein	6-8
Fat	5-1
Moisture	6-13
Carbohydrates	60-70

(Source: Nelson *et al*., 2017)

Table 2.2: Major nutrients in *Curcuma longa* g/100g

Constituents	**Amounts**
Protein	7.66
Ash	6.13
Fat	5.03
Total dietary fiber	21.38
Carbohydrate	49.22
Energy	1174 kJ

(Source: Yadav and Tarun 2016; Mishra and Goel 2020)

Table 2.3: Minerals content in Turmeric mg/100g

Constituents	Amount
Calcium	122
Iron	46.08
Copper	0.44
Sodium	24.41
Potassium	2374
Phosphorus	276
Zinc	2.64

Table 2.4: Vitamins content in Curcuma longa mg/ µg/ 100g

Constituents	Amount
Thiamine	0.06
Riboflavin	0.01
Niacin	1.55
Pantothenic acid	0.13
Biotin	0.76 µg
Total folate	13.86 µg

2.5 Phytocomponents of Turmeric:

Turmeric contains carbohydrates, protein, fat, minerals, and moisture. The essential oil (5.8%) obtained by steam distillation possesses Sesquiterpenes (53%), zingiberene (25%), α- phellandrene (1%), sabinene (0.6%), cineol (1%), and borneol (0.5%). Curcumin (3–4%) is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin III (0.3%) (Ammon and Wahl, 1991). The derivatives of curcumin, Demethoxy and bisdemethoxy have been isolated from turmeric. The melting point of curcumin is at 176-177°C. In rhizome many phytochemicals have been reported such as tumeroneα, tumeroneβ, curzerenone, curdione, mono- and di-demethoxycurcumin. The volatile oils of leaves of *C. longa* have been analyzed by Gas Liquid Chromatography and reported to contain linalool, caryophyllene, geraniol, α-pinene, β-pinene, sabinene, myrcene, α-phellandrene, 1, 8-cineole, p-cymene, C8-aldehyde, and methyl heptanone (Golding *et al*., 1982).

Table 2.5: Biochemical contents in dried turmeric rhizome

Compound	Biological activity
Curcuma longa	Antitumor, Anti-protozoan, anti-inflammatory and Wound-healing

Compound	Biological activity
Methylcurcumin	Anti-protozoan
Demethoxycurcumin and Bisdemethoxycurcumin	Antioxidant
Volatile Oil	Anti-inflammatory, Antibacterial, Antifungal
Curcumin	Antibacterial, Anti-protozoan, Antiviral, Antitumor and Antioxidant

Well known five bisabolane sesquiterpenes and unique sesquiterpene, (6S)-2-methyl-6-(4-hydroxyphenyl-3-methyl)-2-hepten-4-one, two new bisabolane sesquiterpenes, (6S)-2-methyl-6- (4-hydroxyphenyl)-2-hepten-4-one, (6S)-2- methyl-6- (4-formylphenyl)-2-hepten4-one, and two calebin derivatives, 4''-(4'''-hydroxyphenyl3'''-methoxy)- 2''-oxo-3''-butenyl-3-(4'-hydroxyphenyl)- propenoate and 4''-(4'''-hydroxyphenyl)- 2''-oxo-3''-butenyl-3-(4'-hydroxyphenyl- 3'-methoxy)-propenoate have been isolated from Turmeric (Khajehdehi, 2012; Nasri et al., 2014).

Table 2.6: Biological properties of turmeric and its compounds

Component	Quantity	Reference
Curcumin	3.1-3.4%	Verma *et al*., 2018
Anthocyanins	18.9-37.0g/g	Verma *et al*., 2018
Phenols	0.15-0.62%	Verma *et al*., 2018
Tannins	0.32-0.76%	Verma *et al*., 2018
Protein content	3.6-6.8%	Verma *et al*., 2018
Sugars	20.5-43.4%	Verma *et al*., 2018
Oil	3.7-5.3%	Verma *et al*., 2018
Ash	6.9-9.8%	Verma *et al*., 2018
Moisture	90.2-91.3%	Verma *et al*., 2018

Source: (Mishra and Goel 2020)

2.6 Neutraceutical properties of Turmeric:

Turmeric has several therapeutic, food and Pharmacological activities. The active component of Turmeric is known as Curcumin. Many researchers have reported the medicinal properties of Turmeric.

This phytochemical present in turmeric have shown to have a variety of biological functions, such as antimicrobial, antioxidant, anti-inflammatory, anti-carcinogenic, Hepatoprotective properties, etc., and the numerous pharmacological effects of curcumin and established its ability to act as a potential therapeutic agent against several chronic diseases have been confirmed (Labban *et al*., 2014; Nasri *et al.*, 2014).

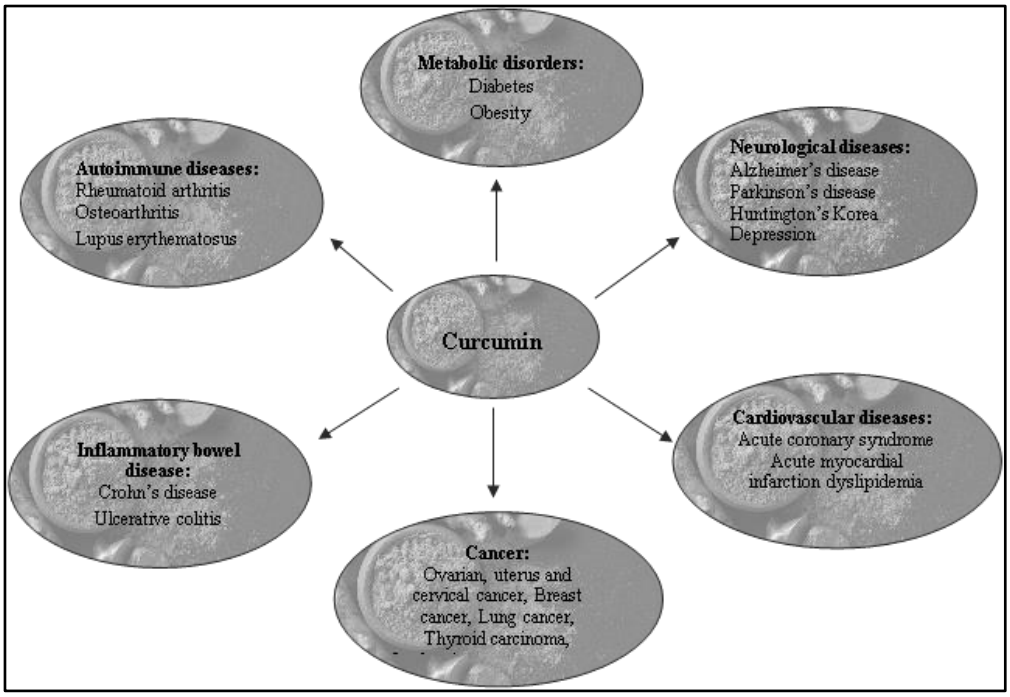

Figure 2.4: Health Beneficial Effects of Turmeric

2.6.1 Cardiovascular Diseases:

Cardiovascular disease is the leading cause of death at global scale (World Health Organisation, 2018). The concerning situation have been associated with many risks factors such as dyslipidemia, high blood pressure, reduced or lack of physical activity, obesity, tobacco consumption, as well as psychological conditions such as stress and depression. In order to bring to the lower grade of developing cardiovascular disease, a best management or avoidance of aforementioned habits are necessary for both healthy and the high-risk group of peoples (Yusuf *et al*., 2001; World Health Organisation, 2018).

Many reports have shown that Curcumin is a beneficial treatment for cancer, which at molecular level can have impact on growth, development and spread of cancer cells. Curcumin act as anti-carcinogenic compound. Although there are various mechanisms, induction of apoptosis plays an important role in its anti-carcinogenic effects. It induces inhibition of cell-cycle progression and apoptosis, both are preventing cancerous cell growth in rat aortic smooth muscle cells (Boonrao *et al*., 2010). The Curcumin also prevent colon carcinoma through arrest of cell-cycle progression independent of inhibition of prostaglandin synthesis. It suppresses human breast carcinoma through multiple pathways. Curcumin also produces nonselective inhibition of proliferation in several leukaemia, no transformed haematopoietic progenitor cells and fibroblast cell lines. On the effectiveness of Curcumin on cardiovascular risk factors in individuals with coronary artery disease, it has been determined that serum triglyceride, LDL and VLDL cholesterol levels decrease considerably in the group of individuals taking Curcumin and it has been used as a safe and well tolerated adjunct strains to control hyperlipidemia.

The curcumin significantly down regulates both p53 and estrogen receptor (ERα) protein levels with decrease in T-47D cell viability. Other studies involving different breast cancer cell lines treated with Curcumin, such as BT-483 and MDA-MB-23, have shown a significant decrease in cell proliferation. Curcumin has been studied as a chemo preventive agent in numerous clinical trials, and it will be examined in vivo and in vitro studies for its effects. The potential and suitability of Curcumin as a treatment modality in hormone dependent breast cancer has been reported (Hallman *et al*., 2017).

2.6.2 Curcumin in Autoimmune Disease:

Many reports were demonstrated as Curcumin inhibits inflammation in many autoimmune and inflammatory diseases such as atherosclerosis, arthritis, experimental autoimmune neuritis and encephalomyelitis. Curcumin decreases the growth expression of adhesion molecules, β3 and β7 integrins, and thereby decrease joint inflammation in Rheumatoid Arthritis and also decrease the expression of pro-inflammatory cytokines (Hay *et al*., 2019; Shpitz *et al*., 2006). Curcumin is a potent anti-inflammatory agent with specific lipoxygenase- and COX-2- inhibiting properties. In vitro, and in vivo studies have demonstrated its effects through decreasing both acute and chronic inflammation (Nasri *et al*., 2014). The turmeric derived polyphenols were suggested in portal inflammation. Many reports have been published on dietary supplements trials of turmeric in various populations. It has been shown that a 5% overall incidence of abnormal liver function associated turmeric dietary supplements use including transaminases, LDH, alkaline phosphatase and/or bilirubin (Lukefahr *et al*., 2018).

Curcumin has been shown to have anti-inflammatory effects on Osteoarthritis through the inhibition of NF-$_{\kappa}$B and the suppression of important regulators of inflammation such as TNF- α, IL-1β, IL-6, MCP1, prostaglandin E2 activator protein-1. The administration of curcumin appears beneficial for the treatment of systemic lupus erythematosus, an inflammatory and chronic autoimmune mediated disease recognized by the accumulation of auto-antibodies and immune complexes in distinct organs. Actually, Curcumin can manage to recover an imbalance present among T-helper cell subsets, regulatory T cells, and dendritic cells observed in these patients (Hay *el al*., 2019; Perkins *et al*., 2017).

2.6.3 Cardiovascular and Anti-Diabetic Effects:

Turmeric exercise cardio-protective effects mainly by antioxidant activity, lowering lipid peroxidation, anti-diabetic activity and inhibiting platelet aggregation. Cardiovascular diseases such as acute coronary syndrome, acute myocardial infraction and dyslipidemia, were against curcumin (Hay *et al*., 2019; Essa *et al*., 2019). It inhibits oxidative stress, apoptosis and inflammation and exerts cardio protective effects. Apart from this, curcumin can be useful for lipoprotein metabolism because it is involved in the reduction of low-density lipoprotein cholesterol and triglycerides and augmentation of high-density lipoprotein. A review reported that 18 atherosclerotic rabbits administered with 1.6-3.2 mg/kg/day of turmeric extract showed a decreased susceptibility of LDL to lipid peroxidation, in addition to lower plasma cholesterol and triglyceride levels. Turmeric will decrease blood glucose level in diabetic rats as well as decreases the complications in diabetes mellitus (Nasri et al., 2014; Selvi *et al*., 2015).

A recent report has been shown that curcumin can be used as a safe and well tolerated adjunct to strains to control hyperlipidemia. Clinical studies need to be performed to discover optimal dosages for cardiovascular protection and lipid or glucose lowering activities (Nasri *et al*., 2014).

2.6.4 Antioxidant Activity:

Turmeric has been reported as a powerful scavenger of oxygen free radicals. Its antioxidant activity is comparable to vitamin C and E. Curcumin can crucially inhibit the generation of reactive oxygen species (ROS) such as H_2O_2, super oxide anions and nitrite radical generation by activated macrophages (Labban 2014). Its derivatives, bisdemethoxy curcumin and Demethoxy curcumin also have antioxidant activities. An *in vitro* study was done for inducible stress protein effect, endothelial heme oxygenase 1, incubation with curcumin resulted in enhanced cellular resistance to oxidative damage. Curcumin is only the anti-mutagenic against mutagens which require metabolic activation (Tiwari et al., 2006). Curcumin was found to block cyclosporine A- resistant phorbol myristate acetate + anti- CD28 pathway of T-cell proliferation. In addition, it shows the properties of intrinsic anti-oxidative abilities of Curcumin such as reduction in testicular damage caused by exposure to di-n-butylphthalate (DBP), by increase in Glutathion (GSH), testosterone levels and glucose-6-phosphate dehydrogenase (G6PD) activity and decrease in malondialdehyde (MDA) levels.

Further research shows to determine the role of lipid peroxidation in pain and other symptomology associated with pancreatitis (Labban 2014; Durgaprasad *et al*., 2005).

2.6.5 Antimicrobial Activity:

Volatile oil and extract of *Curcuma longa* inhibit the growth of various organisms like bacteria, parasites and pathogenic fungi. The chicks infected with caecal parasite *Eimera maxima* when fed with diets supplemented with turmeric resulted in reduction in small intestinal lesion scores and improved weight gain were reported (Nasri *et al*., 2014). It was reported in another animal study that, turmeric oil inhibited dermatophytes and pathogenic fungal infections in guinea pigs at a 7 days post-turmeric applications. The turmeric oil was extracted by using ether, chloroform and also crude ethanol extract having antifungal activity. Turmeric oil has been shown to be active against *Aspergillus flavus, A. parasiticus, Fusarium moniliforme* and *Penicillium digitatum* (Verma et al., 2018). The turmeric extract of curcuminoid and oil showed antibacterial activity against pathogenic bacteria and they showed large inhibition zone against *Bacillus subtilis*. The varying degrees of the sensitivity of the bacterial test organisms are due to the intrinsic tolerance of microorganisms (Naz et al., 2010). The researchers have reported that, in *in vitro* studies the curcumin prevents the growth of *Helicobacter pylori* CagA+ strains. Both curcumin and oil fractions of Turmeric extract suppressed the growth of many bacteria such as *Streptococcus, Staphylococcus, Lactobacillus* etc., (Verma *et al*., 2018). Curcumin is shown to have antiviral activity. It acts as an inhibitor of Epstein-Barr virus (EBV). It also shows anti-HIV activity by inhibiting the viral replication by HIV-1 integrase and also inhibits UV light induced HIV gene 127 expression. Thus, the extract of curcumin and essential oil may be used as novel drug against pathogenic organisms (Araujo and Leon 2001).

2.6.6 Anticancer Activity:

Several animal studies have been reported that turmeric influence on the carcinogenesis. Various studies have demonstrated that curcumin is able to inhibit carcinogenesis in three stages: angiogenesis, tumour promotion, and tumour growth. During initiation and promotion, curcumin modulates transcription factors controlling phase I and II detoxification of carcinogenesis in a variety of cell types in both *in vitro* and *in vivo* studies (Nasri *et al*., 2014; Garg *et al*., 2008). Turmeric and curcumin are able to suppress the activity of mutagens and carcinogens. In a study on colon and prostate cancer the curcumin was shown to inhibit cell proliferation and tumour growth (Kwon and Magnuson 2009). The effects of turmeric and curcumin have been related to direct antioxidant and free-radical scavenging effects, and their ability to indirectly increase glutathione levels and also inhibit nitrosamine formation. Curcumin has been shown to inhibit the mutagenic induction effect of UV rays. The benefit of curcumin or turmeric extract to reducing the chemically induced tumours was studied in many reports. Applications of both the extract in carcinogenesis and promotion resulted in less production of papilloma cells, compared to control. Thus, they specify to produce best properties during the tumour promotion.

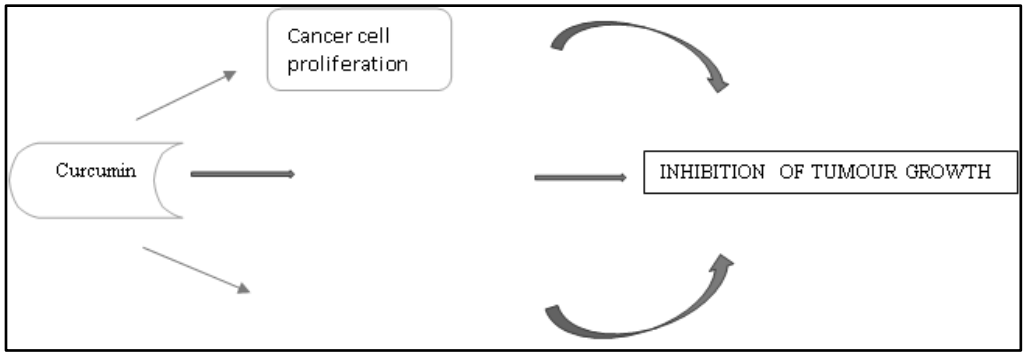

Figure 2.5: Mechanism of action of turmeric on cancer cells: turmeric inhibits the growth of tumours by blocking proliferation and inducing the senescence and apoptosis of cancer cells

The proliferation of many different cancer cell lines and cancer cell growth are suppressed by Curcumin via inducing apoptosis by inhibiting transcription factors. These factors include NF-KB, activator protein 1 (AP-1), cyclooxygenase II (COX-2), nitric oxide synthase, matrix metalloproteinase-9 (MMP-9), and STAT3 (Allegra et al., 2017). Thus Curcuma longa exhibits various health beneficial effects and serve as an important part in the human life.

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3. Health-Related Restorative Potential of Zingeberaceae Members with Distribution in Meghalaya, India

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3.1 Abstract:

Zingiberaceae is one of the largest families in the plant kingdom with around 53 genera and over 1300 species. Of these, around 80 species are mainly distributed in the eastern Himalayas to southern China, India and in South-east Asia. In India, 22 genera and 178 species were recorded of which 9 genera and 70 species are distributed in South India and 19 genera and 88 species were available in the North-Eastern part of the country.

A total of 13 species belong to 6 genera were recorded from the state of Meghalaya, India whose morphological characters, distribution and their medicinal importance are presented here.

Keywords: Zingiberaceae, Meghalaya, medicinal importance.

3.2 Introduction:

Meghalaya is one of the hilly states located in the North-Eastern region of India. Meghalaya means the "*the abode of the clouds*". The state's capital city of Shillong is popularly known as the "*Scotland of the East*". It comprises of 11 districts viz., East Khasi Hills, West Khasi Hills, South-West Khasi Hills, Ri-Bhoi, East Jaintia Hills, West Jaintia Hills, North Garo Hills, East Garo Hills, South Garo Hills, West Garo Hills and South-West Garo Hills. Most recently, one more district has been added into the list whose headquarters was agreed to be based at Mairang town although formality regarding the same has not been publicly made known to the public by the state government.

Meghalya lies between 25 47''-26 10''N latitude and 89 45''-92 45''E longitude and covers an area of approximately 22,429 square Km. The state is bounded on the north, east and west by the state of Assam and on the south by the country Bangladesh. The *Khasis*, *Jaintias* and the *Garos* communities are the main inhabitants of the State.

The earliest mention of the word "*Khasi*" appeared in Sankardeva's 'Bhagavata purana' composed nearly about 1500 A. D. in the Indo Aryan literature (Grierson, 1907; Gurdon, 1915). The state possesses a rich and diverse plant wealth that is yet to be fully utilized on a commercial scale. Such commercial utilization if done correctly could provide abundant benefit to the tribal farmers of the region. In fact, the region has a great potential for the plantation and commercialization of traditional or otherwise scientifically proven medicinal plants due to its ideal agro-climatic conditions, suitable nature of the soil and abundance of rainfall which are the key determining factors for the diverse arrays of vegetation ranging from tropical and subtropical to temperate or near temperate (Kayang *et al*., 2005; Sanglyne *et al*., 2021 a, b, c).

Medicinal plants are generally known as "*Chemical goldmines*" as they contain natural chemicals, which are acceptable to humans and animals systems. All these chemicals cannot be synthesized in the laboratories. Many secondary metabolites of plants are commercially important and find use in many pharmaceutical companies. Human beings have been dependent on plants for their health care needs since the beginning of civilization. Of the 2,50,000 higher plants species on earth, more than 80,000 are medicinal in nature (Uphof *et al.*, 1959; Singh *et al.*, 2018). Zingiberaceous medicinal plants are generally herbs, often large with a pseudo-stem of convolete leaf sheaths. Leaves are radial or cauline and usually membranous. Flowers are hermaphrodite, irregular, solitary or spicate, bracts membranous. Fruits is loculicidally a 3 valved capsule or indehiscent and membranous or fleshy. Seeds are often arillate, albumen floury and embryo small. Zingiberacea family constitutes a vital group of rhizomatous medicinal plants characterized by the presence of volatile oils and oleoresins of export values. Generally the rhizomes and fruits are medicinal, tonic and stimulant and occasionally they are nutritive. *Curcuma, Zingiber, Alpinia, Hydechium, Kaempferia* and *Costus* are the most common plants of the Zingeberacea family. In the genus *Alpinia, A. galanga* is the most important one which finds varying uses in ayurvedic preparation such as "*Rasnadi powder*". *Costus speciosus* is the only species in the genus *Costus* that is medicinally important. In *Curcuma, C. longa* is the most popular one, which has been studied in greater depth already. *C. aromatica* is used in the treatment of the skin disease. *Kaempferia galanga* have been identified to have tremendous effect in curing bronchial and gastric diseases. Of late, it is being use in the preparation of mouth washes and oral deodorants. *K. rotunda* is another related crops under this genus which has great potential medicinal purposes (Yob et al., 2011).

3.3 Systematic Position of Zingeberaceae Family (Joy et al., 1998):

The systematic position of the zingiberaceae family is as follows:

Kingdom: Plantae
Sub-Kingdom: Phanerogamae
Division: Spermatophyta
Sub Division: Angiospermae
Class: Monocotyydonae
Series: Epigynae
Order: Scitaminales
Family: Zingeberaceae

Zingiberaceae family comprises about 50 genera usually found throughout the warm regions of both hemispheres. Out of these nine genera are reported to constitute potential medicinal plants as listed below.

Genus	Species
Curcuma	*C. amada, C. longa, C. zedoaria, C. aromatica*
Kaempferia	*K. rotunda, K. galanga,*
Hedychium	*H. spicatum, H. coronarium*
Amomum	*A. Subulatum*
Zingiber	*Z. officinale, Z. zerumbet*
Alpinia	*A. galanga, A. calcarata, A. allughas*
Elleteria	*E. cardamomum*
Costus	*C. speciosus*
Gastrochilus	*G. pandurata*

A. *Alpinia galanga* (L) Swartz

Vernacular name: Toral

Morphological Description:

A. galanga is a perennial herb of about 2 m high with lower portion covered with smooth leaf sheaths. The leaves are broadly lanceolate, 30 – 60 cm long and 10 -15 cm broad. The flowers are arranged in erect, terminal panicles composed of numerous spreading dichotomous branching each with two to six, pale greenish white faintly fragrant flowers.

Fruits are oblong, constricted in the middle or even pear shaped, three sided and deep orange red in colour. Seeds are ash colour, three angled and towards the hilum. Both the seeds and rhizomes have pungent aroma (Thakur et al., 1989).

Distribution:

Alpinia galanga is distributed in the tropical areas particularly in South India and North East India such as Meghalaya, Arunachal Pradesh and Manipur. The species occurs naturally in shady and marshy lands.

Medicinal Importance:

The rhizomes and fruits are the main parts of the plants that contain many medicinal properties which is useful against rheumatic pains, sore throat, diabetes, kidney problem, bronchitis. Its rhizomes is mainly utilized in the treatment for digestion and a quick reliever of pain (Grieve, 1971).The extracts of the fruit is also useful for the flatulence, dyspepsia, vomiting and stomach sickness (Cliolino and Yeh, 1999; Mohiuddin et al., 2011) (Figure 3.1, A).

B. *Ammomum aromaticum Roxb*

Vernacular name: Ilashi saw

Morphological Description:

Ammomum aromaticum is an herbaceous plant growing from a rhizomatous rootstock, it produces a cluster of leafy stems usually up to 100 cm tall, though sometimes reaching 200 cm or more. The leaves are oblong, lanceolate, glabrous on both sides. The fruits is ovate, oblong, trigonous and somewhat rugose.

Distribution:

Ammonum aromaticum is widely distributed in the Eastern Himalayas such as India, Nepal and Bangladesh and also distributed in West Bengal and Northeast states such as Sikkim, Meghalaya, Arunachal Pradesh and Nagaland.

Medicinal Importance:

The seeds have antibacterial and stomachic properties. They are also use to treat dyspepsia, flatulence, colic, vomiting, diarrhoea and cough. The seeds are also use to gargle or mouth wash to treat toothache, gingivitis and parodontosis. The rhizome is smashed and made into paste in hot water and taken directly during nausea and vomiting. Young shoots is used as condiment and food flavouring agent (Figure 3.1, B).

C. *Costus speciosus J. Konig ex Retz Smith*

Vernacular name: Sla pangmat

Morphological Description:

Costus speciosus is a succulent, erect, perennial, ornamental, herbaceous plant, root stock tuberous stem, sub-woody at the base, thick creeping rhizome (120 – 300 cm) in height with long lanceolate leaves and white fragment flowers in terminal clusters. It is tall and dramatic landscape plants with large dark green sub-sessile, elliptic or obovate leaves arranged on the stalk in the spiral form. The flower are 5-6 cm long with a cup shaped labellum and a crest yellow stamens. Fruits are red in colour, whereas seeds are black, five in number with a white fleshy aril.

Distribution:

Costus speciosus occurs in the moist and wet evergreen areas of the Indo-Malayan region and Sri Lanka. Within India, C. speciosus occurs throughout the foothills of the Himalayas from Himachal Pradesh to Assam, Meghalaya, Arunachal Pradesh, Vindhya-Satpura hills in central India, Eastern Ghats of Andhra Pradesh and Western ghats of Maharashtra, Karnataka, Tamil Nadu and Kerala.

Medicinal Importance:

Costus speciosus possess many pharmacological activities such as antibacterial, antifungal, antioxidant, anti-inflammatory, analgesic, antipyretic, antidiuretic and estrogenic activity. The rhizomes of C. speciosus contain diosgenin which is the natural source that is used in making drugs as steroidal sapogenin for the synthesis of sex hormones and oral contraceptives. Juice of rhizomes is used for headache and fever, decoction of stem is used for dysentery, diarrhoea, cuts, wounds, antidote, burning sensation, constipation, leprosy, skin disease, asthma, worms, rash, nose pain, vomiting, antivermin and abortion.

The rhizomes of C. speciosus improved digestion and is a stimulants herbs that clear toxins. It also have anti-fertility, anabolic properties. The alkaloid extracts of the rhizomes enhances antispasmodic activities. Rhizomes are also given in pneumonia, rheumatism, urinary disease, jaundice etc. The plants is also used in ear and eye infection and formerly used in Malaysia for small pox. It is used as a cosmetic as eye lashes to increase sexual attractiveness, as mentioned in Kama Sutra (Pawar and Pawar, 2014) (Figure 3.1, C).

D. *Curcuma aeruginosa Roxb*

Vernacular name: Shynrai iong

Morphological Description:

Rhizome of *C. aeruginosa* is large, aromatic, blue in the centre, which is highly variable. Sessile tubers are branched, condensed, root fleshy, ovate, oblong. Leaves is distichous, oblong, lanceolate, tip acute base acuminate, glabrous purple or reddish brown patch along the side of the distal half of the mid rib on the upper side.

Inflorescence is lateral, peduncle about 15 cm long and spike about 13 cm. Flowers in cincinnus of 8 -10 in a bract, equal to or slightly shorter than bracts; corolla is pinkish, labellum yellow with a deep yellow median band.

Distribution:

C. aeruginosa is most widely distributed in South and South-East Asia like Malaysia, Cambodia and Myanmar (Srivilai et al., 2011). In India it is mostly found in Meghalaya, West Bengal, Bihar, Corromondal coast, South Karnataka and in Kerala.

Medicinal Importance:

The rhizomes of *C. aeruginosa* had been used in the treatment of rheumatic disorders, gastrointestinal problems such as diarrhoea and fungal infection. Extracts from the rhizomes have been shown numerous medicinal properties including anti-inflammatory activity, antiviral activity and is also use during childbirth.

The rhizomes are also use to treat body ache and pain. It is also use to treat diabetes and lower the cholesterol and dizziness (Rao and Lamo, 2017) (Figure 3.1, D).

E. *Curcuma angustifolia Roxb*

Vernacular name: Niangsohpet

Morphological Description

C. angustifolia is a rhizomatous, slender branched herb with fleshy cylindrical rhizome and small rootstock. The stems are usually short, replaced by pseudo stems formed by leaf sheats. Leaves are typically simple, distichous, green, glabrous and lanceolate with margins that are entire.

They display fine parallel venation of the central midrib. The flower is perennial and bisexual, epigenous, zygomorphic, funnel shaped flowers within tufts of pink terminal bracts.

The bracts are boat shaped and encased the entire perianth of the flower. The corolla is white, hairy, proximally tubular. The fruit is a capsule, fleshy or dry, dehiscent or indehiscent and sometimes berry like. It has strong rhizome which can grow up to 1.5 m in length.

Distribution:

It is distributed throughout Central, Southern and Eastern India, but most commonly reported from the North East such as Meghalaya and Western coastal plains and hills of India. It is also found in Maharashtra, Andhra Pradesh, Madhya Pradesh, Himachal Pradesh, Odisha, Chattisgarh, Tamil Nadu and Kerala. It is also common in Sri Lanka, Burma, Pakistan, Cambodia, Nepal, North Australia and in China.

Medicinal Importance:

The rhizomes of *C. angustifolia* are typically ground into flour which can then be mixed together with milk or water to form a nutritious meal. Tubers yield starch which is easily digestible and highly nutritious recommended for infants and weak children. It is also an ingredient which is use as a replacement of breast milk or as nutritional supplements for babies a short while after weaning.

The root powder is used with milk to treat difficulty in micturition and urination, fever, gastric reflux disorders and when treat with hot water and honey it is used to treat cough and dyspnea. The tuber powder is also used to reducing intestinal inflammation, carminative, astringent, dysentery, flatulence, cardiotonic.

The root stock is also used as tonic, it is also useful in leprosy, burning sensation, dyspepsia, asthma, jaundice, anaemia, stones in kidney and disease of blood, It is also used for intestinal diseases, pectic ulcers, demulscent, bone fracture and swelling of body.

The essential oils extracts from this plants is used for antifungal, antibacterial, antimycotic and antioxidant activities (Rao and Lamo, 2017; Sharma et al., 2019) (Figure 3.1, E).

F. *Curcuma caesia Roxb*

Vernacular name: Sying iong

Morphological Description:

C. caesia is an erect and rhizomatous herb of about 1 – 1.5 m high and the rhizomes are ovoid in shape, acute at the tip, but not so thick as in other species of curcuma. Leaves are about 30 - 60 cm long and up to 15 cm broad, broadly lanceolate or oblong, glabrous with a deep ferruginous purple cloud down the middle, which penetrates to the lower surface. Leaves arise from the underground rhizome.

Inflorescence is a spike, about 15 cm long or altogether about 30 cm high on a basal peduncle. Flowers are pale yellow, reddish at the outer border and shorter than the bracts. Petioles and sheath are about as long as the blade. Spikes appear before the leaves.

Distribution:

C. caesia is mostly found in sub-tropical to temperate region. It is also found in West Bengal, Madhya Pradesh, Orrisa, Chattisgarh and in Uttar Pradesh. It is also found in Pappi hills of East Godavari, West Godavari, North Eastern states and in Central India.

Medicinal Importance:

The rhizome of *C. caesia* are useful in treating leucodemma, piles, bronchitis, asthma, tumour and tuberculosis gland of the neck, enlargement of the spleen, epileptic seizures, inflammations and allergic eruptions, smooth muscles relaxation, haemorrhoids, leprosy, vomiting, menstrual disorder, inflammation, gonnorheal discharge etc. Traditionally the paste of rhizome is applied on bruises and rheumatic pains. The fresh rhizomes are used to get relief from stomach ache. The paste of rhizome is used for the snake bite and scorpion bite. The fresh rhizome juice is mixed with mustard oil and is given to cattle during dysentery. The roots are grounded into powder and used water to treat gastric disorder (Verma et al., 2010; Rao and Lamo, 2017) (Figure 3.1, F).

G. *Curcuma decipiens Dalzell*

Vernacular name: Chymitba

Morphological Description:

C. decipens is rhizomatous herb, its rhizome is ovoid, conical, pale yellow white; roots is fleshy and roots tubers is ovoid and white inside. Leaves is distichous and broadly ovate, base slightly cordate, petiole is equal to lamina, ligule is short, inflorescence is both central and lateral. Flower is 4.5 cm long, 1 or 2 in each bract. Lateral staminodes is oblong, yellow purple towards the base. Anther thecae is parallel, yellow spurred. Ovary is trilocular, densely pubescent, style long, filliform, stigma bilipped. Fruit is ovoid and hairy. Seeds is oblong, brown with a white spot at the tip, aril white, lacerate.

Distribution:

C. decipiens is mostly found in Peninsular India, South west India, North East India, Andaman and Nicobar Island (Sabu, 2006).

It is also found in West Godavari District of Andhra Pradesh, Pallakad district of Kerala, Amravati district and Thane district of Maharashtra.

Medicinal Importance:

The rhizomes are crushed and made into paste and is used in the treatment of cough, cold, boil and for allergy (Rao and Lamo, 2017) (Figure 3.1, G).

H. *Curcuma longa L.*

Vernacular name: Shynrai

Morphological Description:

C. longa is 3-5 tall plants with a short stem and is a sterile plant with no seeds. The rhizome is an underground stem that is thick, oblong, ovate, pyriform and fleshy ringed with the base of old leaves.

Its rhizomes are the source of a bright yellow spice and dye. Leaves are large and oblong and up to 1 m long, dark green on upper surface and pale green beneath. Each leafy shoot (Pseudo stem) bears 8 -12 leaves.

Flower is yellow white and borne on a spike like stalk, they are sterile and do not produce viable seeds.

Description:

It is mostly found in a tropical climate and in countries such as China, East Africa, West Africa, Jamaica and in India it is found in Andhra Pradesh, Tamil nadu, Orrisa, Karnataka, West Bengal, Gujarat, Meghalaya, Maharashtra and Assam.

Medicinal Importance:

The rhizome is crush and make into a paste and used in fracture toe nail, it is also used for stomach ache, blood purifier, cold, vermicide, antiseptic, antiperiodic, diabetes, leprosy, sore throat.

It is also known for its anti-inflammatory, antibacterial, antifungal, antiviral, antiplate, anticoagulant, antiallergic, anti-asthmatic, anti-diabetic and wound healing activity, strengthen the body, rheumatism, sinusitis etc (Reddy et al., 2011; Rao and Lamo, 2017) (Figure 3.1, H).

I. *Curcuma Montana Roxb*

Vernacular name: Sying

Morphological Description:

Rhizome is pale yellow, bitter in taste and camphoraceous. Leaf sheath is purple. Leaves are oblong-lanceolate, green and glabrous. Inflorescence is either lateral or terminal. Coma bracts are white with light purple streak towards the top. Fertile bracts are green and are fused at the base on which a cincinnus of flowers are borne. Corolla is white and the labellum is yellow. Presence of anthers spurs.

Distribution:

C. Montana is distributed in the Indian subcontinent and is found in Kerala, Karnataka, Chennai, Andhra Pradesh, Eastern Himalayas, North East region and particularly in Meghalaya.

Medicinal Importance:

The juice of *C. Montana* mixed with Kaempferia galanga is used to facilitate delivery in women during childbirth (Koh et al., 2009).The rhizomes is boil in water along with the roots and leaves of Acorus calamus and about 1-2 teaspoon of this decoction is given to the expecting mothers (Hynniewta and Kumar, 2010; Rao and Lamo, 2017) (Figure 1, I).

J. *Kaempferia galanga L.*

Vernacular name: Sying kmoh

Morphological Description:

K. galanga is a perennial aromatic herb with a very fragrant underground parts, leaves is spreading flat on the ground and is two or more round ovate, thin, deep, green, petioles very short, channelled, flowers white with purplish spots in the axillary fascicles, corolla tubes 2.5 cm long, connective of anther produced in to a quadrate two lobed appendage, fruits oblong and seeds arillate.

The underground rhizome has one or more prominent, vertically oriented tuberous root stock and many small secondary tubers and roots, their tips becoming tuberous.

Distribution:

K. galanga is native to Indonesia, Southern China, Taiwan, Cambodia, Bangladesh, Myanmar, Sri Lanka, Japan, Vietnam, Nigeria, South Africa and in India it is mostly found in Karnataka, Kerala, Tamil Nadu, West Bengal and in Northeast state like Meghalaya, Manipur and Mizoram.

Medicinal Importance:

K. galanga forms a component of over 59 ayurvedic medicines and is extensively used in the preparation of ayurvedic drugs, perfumery, cosmetics and as a spice ingredients. It is used for the treatment of diarrhoea, migraine and it increases energy to overcome exhaustion and is a constituents of variety of ayurvedic preparations.

The rhizomes and root stocks are thermogenic, acrid, carminative, aromatic, depurative, diuretic, expectorant, digestive, vulnerary, antihelmentic, febrifuge and stimulant. They are good for dyspepsia, leprosy, skin disease, rheumatism, asthma, cough, bronchitis, wounds, ulcers, helminthiasis, fever, malaria, splenopathy, inflammatory tumour, nasal obstructions and haemorrhoids.

Rhizome is taken orally against poisoning, when there is blood vomiting. In infants, the rhizomes is applied for mouth sores and tongue blisters (Preetha et al., 2016) (Figure 3.1, J).

K. *Kaempferia rotunda L.*

Vernacular name: Sying smoh

Morphological Description:

Rhizome is short, stout and strongly aromatic, roots is stout, fleshy, often terminating in ovoid or spindle shaped, leaves are few, radical, erect, lamina, oblong, lanceolate with acute base and gradually acuminate apex, purple beneath, upper surface glabrous, lower surface densely cover with very short hairs, ligule small and hairy. Inflorescence appearing before the leaves, shortly peduncle, enclosed within greenish purple, narrow sheath. Flower is purple, aromatic and spike (Joy et al., 2016).

Distribution:

K. rotunda is native to china and Indian subcontinent including Assam, Meghalaya, Nepal and Bangladesh. It is also found in Malaysia and Costa Rica, Sri Lanka, Myanmar, Thailand and Vietnam.

Medicinal Importance:

The rhizome is used for stress related stomach trouble and as general tonic. The flowers contain the toxin benzyl benzoate which is used to make the ointments to treat scabies. Tubers are widely used as an application for tumours, swellings and wounds. It also removed blood clot and other impurities from the body, improves complexion and cures burning sensation, mental disorders and insomnia.

The juice of the tubers is given in dropsical affections of hands and feet and of effusions in joints. The tubers in decoction form is applied with much benefits to wounds with coagulated blood and with any purulent matter (Joy et al., 1998) (Figure 3.1, K).

L. Zingiber Rubens Roxb.

Vernacular name: Sying makhir

Morphological Description:

Z. Rubens leafy stems grows up to 6 feet tall. Flowers arise from the base of the rhizome with the inflorescence almost embedded on the growing substrate. A short stalk carries the inflorescence with tightly packed bright red bracts.

Single flowers emerge from within the bracts. Flowers have a showy patterned lip. The seed capsules are bright red. Stem dies down and rhizomes remain underground and only the bright red seeds capsules are visible.

Distribution:

Z. Rubens is mostly found in South East Asia and in India it is found in Assam, Meghalaya, Gujarat, Madhya Pradesh, Kerala, West Bengal, Andhra Pradesh.

Medicinal Importance:

The rhizome powder of Z. Rubens is mixed with ripe Morinda citrifolia for the treatment of severe pain, the cooked and softened rhizome is used to treat tooth ache, cough, asthma, worms, leprosy and other skin diseases. The ground and strain rhizome is mixed with water to treat stomach ache. The tuber is also used in bone setting. The rhizome is also used for the treatment of malaria (Figure 3.1, L).

M. Zingiber zerumbets Sm.

Vernacular name: Sying blei

Morphological Description:

Z. zerumbets is an herbaceous perennial plant producing clumps of leaves from a large rhizome. The leaves form a pseudostem, the flowers is of conical or club shaped and its head burst forth on separate and short stalk and when it's mature they gradually fill in with aromatic, slimy liquid and turn into brighter red colour.

The flower stalks usually remain hidden beneath the leaf stalks. The inflorescence is green when young and red when old. Fruit is white and glabrous. The seeds are ellipsoid and black.

Distribution:

Z. zerumbets is native to Asia and Australia, it is also found in Vietnam, Malaysia, Bangladesh, China, Thailand. In India it is mostly found in Assam, Meghalaya and Odisha.

Medicinal Importance:

Z. zerumbets rhizomes is used in the treatment of inflammation, fever, toothache, indigestion, constipation, diarrhoea, severe sprains and to relieve pains as well as antispasmodic, antirheumatic and diuretic agents. It is also used for the cure of edema, stomach ache, sores and loss of appetite while the juice of the boil rhizomes is used to treat worm infestation in children.

The cooked and softened rhizome is used to treat toothache, cough, asthma, worms, leprosy and other skin diseases and the ground and strain rhizomes is mixed with water and drank to treat stomach ache.

The leaves is crushed and made into paste and are used as remedy for cuts and bruised skin and it is also crush with salt to treat headache (Figure 3.1, M).

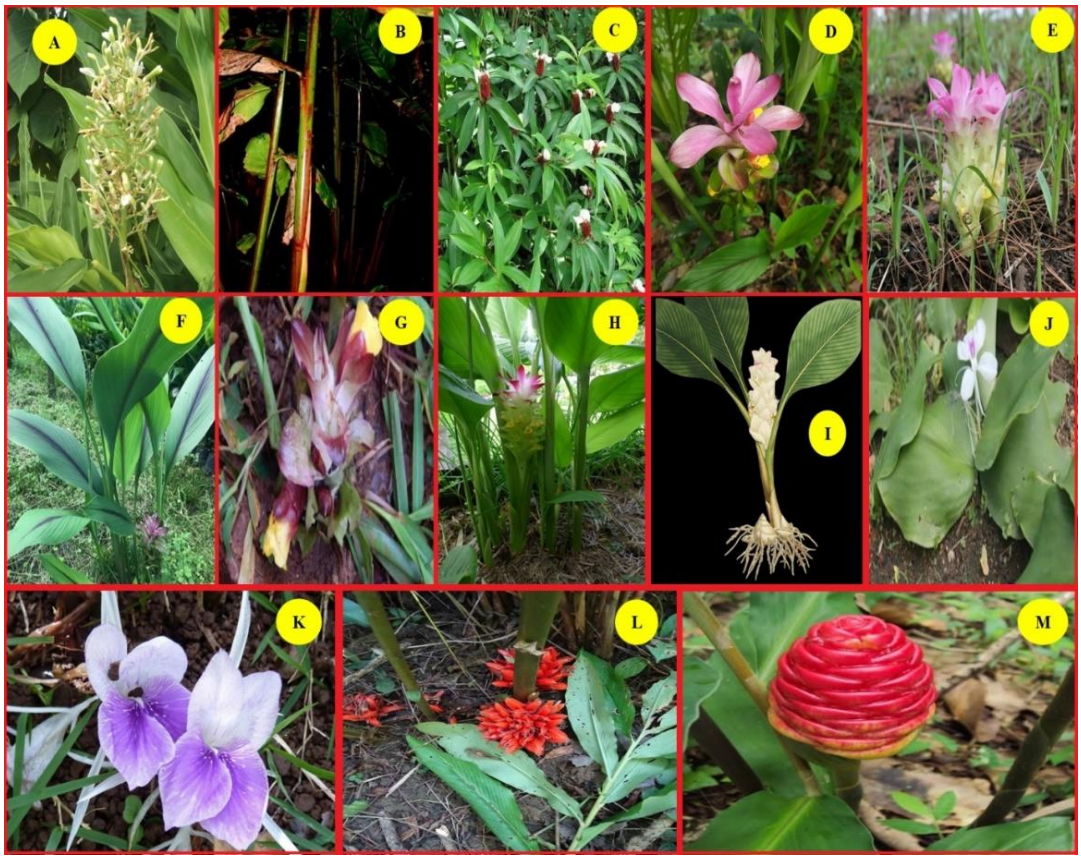

Figure 3.1: Members of Zingeberaceae with distribution in Meghalaya: **A:** *Alpinia galanga* (L) Swartz**; B:** *Ammomum aromaticum* Roxb**; C:** *Costus speciosus* J. Konig ex Retz Smith**; D:** *Curcuma aeruginosa* Roxb**; E:** *Curcuma angustifolia* Roxb**; F:** *Curcuma caesia* Roxb**; G:** *Curcuma decipiens* Dalzell**; H:** *Curcuma longa* L.**; I:** *Curcuma Montana* Roxb**; J:** *Kaempferia galanga* L.**; K;** *Kaempferia rotunda* L.**; L:** *Zingiber rubens* Roxb.**; M:** *Zingiber zerumbets* Sm**.**

3.4 Conclusion:

The chapter presented here dealt with the morphological description, distribution pattern and important medicinal properties of the zingiberaceae family plants of Meghalaya.

It is a comprehensive account and especially the medicinal importance of these zingiberaceae family plants that are found in Meghalaya, India. The information provided here will be useful as a concrete support for future experimental studies on members of zingiberaceae with distribution in Meghalaya.

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4. Medicinal Plants in Everyday Life for Primary Health Care

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Abstract:

Medicinal plants are named so because they possess medicinal properties to cure diseases and they are without side effects and more compatible for human body system. Since ancient times they are used throughout the world. In India a science Ayurveda is dedicated to cure diseases from herbal resources. These plants are easily available in surroundings and can be easily used for primary health care, thus avoiding heavy coast incurred medicines. This present work describes in detail about eleven medicinal plants.

4.1 Introduction:

Medicinal plants are in use since time immemorial to treat various ailments. The use of these plants is described in ancient scriptures like the Rig-Veda, the bible, the Iliad, the Odyssey and in the History of Herodotus. The ancient Chinese are using herbs as far back as 4000B.C. the earliest reference of as use of medicinal plants to cure diseases in 'Eber Papyrus' wrote in 1600 B.C. The Greeks and Romans were also familiar with many of the present day drugs as evident from the work of Hippocrates (460-370 B.C.) Aristotle9384-322B.C.), Theophrastus (370-287B.C.), Pliny and Elder (23-79 A.D.,) Dioscorides (50-100 A.D.)And Galan (131-201A.D.). Hippocrates, father of medicine was the first person to explain the disease on scientific basis. Dioscorides *De Materia Medica* was an authoritive work on medicinal plants. In the 16th century many herbals published, Brunfels (1530), Bock (1539), Fuchs (1542), cordus (1561) and L'Obel (1576). At about same time *'Doctrine of Signatures'* of Paracelsus(1493-1541) was came ,which advocated that all useful plants possessed certain forms and shapes that indicated their use in the treatment of similarly shaped organs of human body, like plants with heart shaped leaves for cardiac disorders, walnut as brain tonic and pomegranate seeds for dental problems. Such superstitions were lost with the advancement of knowledge. In India earliest references to medicinal plants were in Rig-Veda (3500-1600B.C.) and in Atharvaveda. In Ayurveda, definite properties of drugs obtained from plants and their uses have been described. Charak- Samhita and Susruta-Samhita are two important works dealing with about 700 Indian medicinal plants.

In developing countries traditional medicinal plants are still the major source of primary health care, and medicinal plant resources are under enormous pressure. Due to increasing trend towards the use of alternative system of medicinal plant resources are under enormous pressure. Several pharmaceutical industries, institutions, organizations, universities across the world have been engaged in research and documentation of various aspects of these medicinal plants to frame a strategy for their conservation and sustainable use.

Medicinal plants have been identified and used throughout the human history. Plants make chemical compounds that are for biological functions, including defense against insects, fungi and herbivore mammals. At least 12,000 such compounds have been isolated so far, a number estimated to be less than 10% of the total. Chemical compounds in plants mediate their effect on the human body through the processes identical to those already well understood for the chemical compounds in the conventional drugs, thus herbal medicines do not differ much from in term of how they work. This enables herbal medicines not only to have beneficial pharmacology, but also gives them the same potential as conventional pharmaceutical drugs to cause harmful side effects. Moreover, plant materials comes with a variety of compounds which may have undesired effects, through these can be reduced by processing.

The use of medicinal plants pre-dates written human history. Ethno botany the study of tradition medicinal human uses of plants is recognized as an effective way to discover future medicines. In 2001, researchers identified 122 compounds used in modern medicine which were derived from traditional plant sources, 80% of these have had a traditional use identical or related to the current use of active elements of the plant. Some of the pharmaceuticals currently available to physicians are derived from plants that have a long history of use as herbal remedies, including aspirin, digoxins, quinine and opium. Flowering plants were the original source of most plant medicines. Many of the common weeds that populate human settlements, such as neetle, dandelion and chickweed have medicinal properties. The WHO estimates that 80 % of the population of some Asian and African countries presently use herbal medicines for some aspect of primary health care. The use of and search for drugs and dietary supplements derived from plants have accelerated in recent years. Pharmacologists, microbiologists, botanists and natural products chemists are combating the earth for phytochemicals and leads that could be developed for treatment of various diseases.

Among the 120 active compounds currently isolated from the higher plants and widely used in modern medicines today, 80% show a positive correlation between their modern therapeutic use and the traditional use of the plants from which they are derived. In this study some selected medicinal plants has been discussed which are useful for primary health care in everyday life. These are the plants easily available in our surrounding environment as cultivated plants, weeds and some of them are in use in our kitchen as spices.

4.2 Withania Somnifera:

Common Name: Indian Ginseng/Ashwagandha/poison gooseberry/winter cherry
Family: Solonaceae (nightshade family)
Part: used-roots/root bark
Somnifera: “sleep inducing” in Latin

This is a short, tender perennial under shrub growing 35-75 cm. The roots are fleshy, pale yellow or brown in colour. Hairy branches extend from a central stem. Leaves are simple, oval/elliptic, hairy, green, and simple. The flowers are axillary, small, pentamerous, hermaphrodite, hypogynous, and yellow-green and bell shaped. The ripe fruit is an orange-red berry covered with a peppery accrescent calyx.

Figure 4.1: Withania Plant

Part Used: The plant's long, brown, tuberous roots are used in traditional medicine. The fresh roots smell like horse hence known as Ashwagandha. The main chemical constituents are alkaloids and steroidal lactones. These include withanine, withananine, somniferin, tropine and cuscohygrine. The leaves contain the steroidal lactones, withanolides; withaferin A was first isolated from the plant. Other alkaloids are ashwagandhine, ashwaganidhine etc., identified exclusively in the ashwagandha plant only. Ashwagandha, the Indian ginseng/winter cherry has been used as a valuable herb in the Ayurvedic and indigenous medical system for over 4000 years. The roots, leaves and fruits (berry) possess tremendous medicinal value.

Uses: The roots are used to prepare the herbal remedy ashwagandha. The traditional use is as a powder, mixed with warm milk and honey and taken before bed. The root powder acts as an aphrodisiac, diuretic, nacrotic, sedative and is restorative in nature. The dried leaves are made to powder from which a paste is made and used in the treatment of burns and wounds. The berries and leaves are applied externally to tumors, tubercular glands, carbuncles, and ulcers. Ashwagandha is the useful herb in arthritis, which involves painful, dry, swollen and inflamed joints. Ashwagandha has special properties to enhance ojas that is the most subtle, refined level of the physical body is the end result of healthy food which is properly digested. It is responsible for a healthy immune system, physical strength, lustrous complexion, clarity of mind, and sense of well-being.

4.3 Ocimum Sanctum L:

Family: Lamiaceae
Common Name: Tulsi

It is a 30-75 cm high erect herb grown in every part and every house of India as sacred plant. The leaves are opposite-decussate, exstipulate, simple, elliptical-ovate, serrate and acute. The inflorescence is verticillaster with zygomorphic/hermaphrodite flowers. The fruit is a caeruleus. Two types of this plants are known as Sri Tulsi (green) and Krishan Tulsi (purple).

Every Part of the Plant is useful:

Part Used: The plant is a mosquito repllent. Decoctation of root is given as a diaphoretic in malarial fever. The leaves are stimulant, diaphoretic, antiperiodic, diuretic, antiseptic, and expectorant, used in catarrh and bronchitis, ringworm and other cutaneous disease. The leaf infusion is used as a stomachic.

Chemical Constituents: A volatile oil obtained by steam distillation of leaves contains 71.3% eugenol, 3.2% carvacol, 20.4% methyl eugenol and 1.7% carophyllene. The oil possesses antibacterial and insecticidal properties.

Figure 4.2: *Ocimum Sanctum* Plant

Uses: The plant is one of the main ingredients of an herbal drug, Koflet used for cough and various respiratory disorders.

- The plant is also one of the ingredients of the drug sushama, which is used in ointment as well as in pills to cure eczema.
- Tulsi is an ingredient of Tefroli, a propriety medicine for viral hepatitas.
- In Homeopathy, the fresh mature leaves are given to children with nasal catarrah and cough, asthama, fever, constipation, and worms.

- They are also used to treat headache, lachrymation, tonsillitis, and leucorrhoea.
- The seeds are mucilaginous and demulcent and are used in genitor-urinary disorders.

4.4 Azadiracta Indica:

Family: Meliaceae
Common Name: Neem

Neem is one of the most popular, auspicious, and well known tree cultivated throughout the country due to its medicinal properties. It is estimated that India has about 1,38,00,000 neem trees with the potential to produce over 83,000 tonns of neem oil and 3,30,000 tonnes of neem cake from 4,13,000 tonnes neem seeds. Ayurveda of Susruta describes it. It is atradition of eat neem leaves on the first day of Indian new year to the 9th day of Chaittra month.

Figure 4.3: *Azadiracta Indica* Plant

Botanical Description: Neem is an evergreen tree, 12-15m high, with a straight trunk and spreading branches. Leaves are alternate, exstipulate, compound and imparipinnate on long slender petiole. Flowers are cream /yellowish white in axillary panicales.

Fruits are one seeded drupes known as ‘nimboli’. Neem is a native of India and China and is now naturalized in many countries like Pakistan and Malaysia.

Plants grow on almost any kind of soil but flourishes on black cotton soil. The sweet scented flowers appear in March-May and the fruit is ripe in July and August. The tree starts fruiting in 4-5 year and takes 10 years to become full protective and may live upto 200 years.

Part Used: Neem is the most useful for dental hygiene; fresh tender twigs are used to clean teeth particularly in Pyorrhoea.

- The leaves are effective in ulcers and skin disease. They are considered antiseptic and applied to boils in the form of poultice. The leaves are also used in preventing diseases like measeals, chicken pox and small poxetc.
- The leaves are tied on the doors of house and in infectious conditions can be spread on the bed of the patient to eliminate infections from microorganisms/germs.
- A paste of fresh leaves is used for external application in the treatment of rheumatic pain. -The leaf juice is anthehelmintic and is given in worms, jaundice and skin diseases. A decoatation of leaves is also useful in intermittent fevers complicated with congestion of the liver.
- Dried leaves are kept in books for keeping away the months .Odour of burning leaves kills insects.
- The bark of the tree acts as prophylactic against malaria and is useful in intermittent and other paroxysmal fevers, general debility and skin diseases.
- Flowers are tonic and stomachic. An infusion of flowers is given in atonic dyspepsia and general deability.
- The seed contains a resinous oil known as margosa or neem oil, used as a dressing for foul ulcers, as a linimentto rheumatic affections and in headache. It is an effective application intetanus, leprosy, urticaria, eczema, erysipelas, scrofula and skin disease like ringworm, scabies etc. Neem oil may be mixed with other oils and fats for manufacture of medicated soaps.
- The fruits of neem tree are used in leprosy, intestinal worms, piles and urinary diseases.

4.5 Aloe Vera:

Family: Liliaceae
Common Name: Ghrita-kumari, Ghigvar

Aloe is native of North Africa, Canary Islands, and Spain and has spread to East and West Indies, China, India and other countries. Many of the forms of this species are naturalized in India and are found in semi-wild state in all parts from the dry westward valleys of the Himalayas upto Cape Comorin.

Figure 4.4: Aloe Vera

Botanical Description:

Aloe Vera is a perennial, succulent plant with stout, thick, cylindrical and woody stem. Roots are fibrous and fleshy. Leaves are sessile, densely crowded on the short stem with wide dilated bases. The flowers are borne in cylindrical, terminal racemes on a scape arising from the center of the leaf tuft.

Perianth members are tubular, rather fleshy and bright yellow in colour. The fruit is an oblong-ovoid capsule and dehiscing loculicidally. Seeds are numerous and compressed and grows well even in the driest situations and poorest soils. Plant is propagated by suckers.

Uses:

- The plant is gouge cooling, anthelmintic, aperientmmena, carminative, depurative, diuretic, stomachic, emmenagogue and alexeteric. Its application in medicine dates back to the 4th century B.C.
- In Indian medicine aloes are used as stomachic, purgative and emmenagogue. It is regarded as valuable in the treatment of piles and rectul fissures.
- The mucilage is cooling and is used as a poultice for application on inflamed parts.
- It is an effective remedy for intestinal worms in children.
- Fresh juice of leaves is cathartic and refrigerant, used in liver and spleen ailments and for eye troubles. Cathartic properties of aloe are due to the presence of glycosides called 'aloin'.
- Thickened juice of the leaves is used in haemorrhoidal congestion of stomach and spleen.
- Externally the juice is rubbed around the navel to open the bowels in young children. The juice of the leaf is applied to painful inflammation of the body and to the chronic ulcers; its fresh pulp is soothing in case of burn.
- In recent times its finding its way into all sorts of cosmetics, emollients, lotions and shampoos etc.
- The cooling mucilage is poultice onto inflammations caused by X-ray and other raditiaons burns.
- It is also used as flavour ingredients in various food products, including alcoholic and non-alcohalic beverages, frozen dairy desserts, candy, baked goods, gelatins and puddings. Leaves yield a good fiber. A dye is also obtained from this plant.

4.6 Syzigum Aromaticum Syn. Eugenia Caryophyllata:

Family: Myrtaceae
Common Name: clove

Clove is a native plant of Molaccus Island, situated in East Indonesia also known as Spice Island, Portugese discovered Molaccus in 16th century. Clove is cultivated in Mauritius, French reunion, Zanzibar, Tanzania, Indonesia, India and Sri Lanka. In India it is chiefly grown in Kerala and Tamilnadu.

Botanical Description: The clove plant is an evergreen tree. It is branched, 25-40 feet tall and excurrent in habit. Leaves are opposite bright green in colour and aromatic due to the presence of oil glands. Flowers develop in terminal cymes at the apices of lateral branches. They are crimson coloured and are borne in the groups of three. In cultivated trees, the flowers are plucked before a thesis, that is, in closed state. They are tubular, epigynous bearing numerous stamens. The fruit is a single seeded drupe. It trives well in warm and moist climate. Well drained clayey or black soils are considered best. The seedlings of cloves are prepared by growing them in beds .At 6 months stage the plantlets are transferred to pots and kept in shade. When they are12-18 months old they are shifted to soil. Cloves are harvested from 8 years of age till the tree is 60 years old.

Figure 4.5: *Syzigium Aromaticum*

Part Used: The unopened flower buds are plucked when they are green in colour, sun dried until turn dark brown. The brownish-black, crisp and slightly rough clove is the clove of commerce. Cloves are graded according to their appearance.

Chemical Constituents:

Clove contains moisture 5.4%, protein, 6.3%; fat, 15.5%; crude fiber, 11.1%; carbohydrate, 57.7%; volatile oil, 13.2%; minerals, 5.0%; and vitamins. It contains 16% volatile oils in which eugenol (70-90%) is the chief constituent that render it a specific odour and taste. Caryophylline is also present in small quantities.

Uses:

- The Characteristic odour and aroma of clove is utilized to prepare different types of meat, vegetables, soups, sauces and ketchups.
  It is an important constituent of garam masala
- Clove powder is used in bakery and sweet meat preparation.
- It is used in pan to in which it imparts a stimulating effect.
- Clove oil, obtained by distillation is used as a medicine for tooth ache. It is also used in toothpastes and mouthwash.
- The high quality oil is used to make medicines and low quality is in soap industry.

- Clove is an ingredient of an ayurvedic preparation Vismusti Vatis which exhibits antifertility activity but has teratogenic properties.
- Cloves form an ingredient of a pharmaceutical preparation used in the treatment of gastronomic disorders and in prevention of hangovers.
- Clove is a good preservative as well as antioxidants and can be used in processed food by replacing synthetic ones.
- Clove can be used as tonic drugs for antiageing and for body functions.
- It is also useful as skin conditioners, in toothpaste for dental caries and periodontal diseases, therapeutic compositions for dandruff.
- Clove extract is used in foot anti-perspirant and antifungal preparations.
- Antitrichphyton agents useful for treating athletes foot are prepared from it.
  Clove is an ingredient of dentifrices and gargles and also employed as local analgesic for hypersensitive dentines and carious cavities.
- It is used externally as a rubefacient and counter-irritant and internally as a caraminitive and antispasmodic.
- Clove oil is used in topical formulations for use in cryotherapy for treating circulatory diseases such as post traumatic oedema.

4.7 Elettaria Cardamomum:

Family: Zingiberaceae
Common Name: Cardamom

Figure 4.6: *Elettaria Cardamomum* Fruit

Cardamom is native of India which is also the biggest cardamom producing and exporting country in the world. It is known as queen of spices as India earns maximum revenue from it after the black pepper. It is cultivated in Kerala, Karnataka, Maharashtra, Assam, Sikkim, and Tamilnadu.

Botanical Description: The plant is a perennial herb with an underground rhizome. Adventious roots arise from the rhizome. Aerial, leafy branches develop from the above ground parts and are of two types-vegetative shoots and reproductive shoots.

Vegetative shoots are long and have alternately arranged linear lanceolate leaves with sheathing leaf bases .the reproductive shoots are leafless and bear white flowers in a panicle.

The fruit is a triangular capsule covered by a papery pericarp. The fruit is many seeded and each seed is enclosed in a membranous aril.

Useful Plant Parts: Cardamom seeds are used as a flavouring spice .The capsules are plucked when young and sun dried. The seeds are allowed to remain in the pericarp so as to retain their aroma.

Chemical Constituents: The seeds contain 45% starch, 10%protein, 9% fibers, and 8.5% volatile oils along with vitamin A and C. The aroma and taste of cardmom is due to essential oils such as cineol, Terpineol, sabinene and Limorene.

Uses: Cardamom is used as an important flavouring agent in sweets, milk products, cakes, biscuits and bakery products.

- It is popular masticatory, chewed singly or along with betel leaf.
- It is used in making garam masala and as aflavouring agent in tea, coffee and other beverages.
- Cardamom oil is obtained after distillation of fruits is used as an important flavouring agent.
- It is used as a stimulant and carminative agent in medicine.
- Seeds are used as a condiment in cordials, bitters and other pharmaceutical preparations. Medicinally they are used as caraminative, aromatic, stimulant and diuretic and are chiefly used in nausea and vomiting.
- Tinctures of cardamom are used chiefly in medicines for windiness or stomachic, seeds are chewed to prevent bad smell in the mouth, indigestion andpyrosis. Gargaling with the infusion of cardamom and cinnamom cures pharyngitis, sore throat and hoarsness during the infective stage of flu.
- Cardamom possesses anti-inflammatory, analgesic and cariotonic properties.
- Cardamom forms one of the ingredients of Ayurvedic drug Kanchnar guggulu used in the management of various glandular swellings.
- Cardamom is also one of the ingredients of the Unani drug **Majoon-e-Azaraqui,** used as a general nervine tonic.

4.8 Cuminum Cyminum:

Family: Umbelliferae/Apiaceae
Common Name: Cumin

Figure 4.7: Cyminum Cyminum

Cumin is a native of Mediterranean centre of origin. It is cultivated in Malta, Moracco, Turkey, Iran, Russia, Cyprus, Syria, Egypt, India, Japan, Indonesia and many other countries. Iran is the largest producer and exporter of the cumin. In India cumin is chiefly grown in U.P., Punjab, Gujarat, Rajasthan and Tamil Nadu.

Botanical Description: The plant is a small, branched &erect annual herb. The leaves are decompounds and flowers are small, white or light purple in colour and develop in compound umbel infloresence. Two mericarps united by a car pophores constitute the fruit Cremocarp. It is an ovate/elongate structure. The two mericarps split from each other upon maturity. Minute hair is present on the pericarp.

Useful Plant Part: The useful plant part is cumin.

Chemical Constituents: On steam distillation of crushed seeds volatile oil is obtained. The percentage of oil varies upon the quality and age of seeds. It is colourless/pale yellow and turn dark with time .The distinct aroma is due to volatile oils (2-4%) and the taste is slightly bitter. The physiochemical characters of oil are; specific gravity at 150 C, 0.8923-0.9246; optical rotation +3 to +60 30'; refrective index 1.4945-1.5060. Cuminaldehyde920-40%) is the chief constituent of the oil. Besides this cumin contains 10% Fixed greenish oil with a strong aromatic flavour. Cumin seed contains moisture 6.2%, proteins 17.7%, fats 23.8%, carbohydrate 35.5%, mineral 7.7%, crude fiber 9.1%, and vitamins, vitaminB1 0.73, vitamin B20.38, niacin2.5, vit C 17.2, vita 175I.U./100g.

Uses: It is used in soups, souces, pickles, meat and cakes as a spice.

- The fruits are used as a condiment in cooking.
- Roasted seeds are added to curd, buttermilk and other salted drinks to aid in digestion.

- It is used as a stimulant, caraminative and stomachic, astringent useful in dyspepsia and diarrhoea.
- The oil obtained after distillation is used in for flavouring liqueurs, cordials and perfumeries.
- Cumin seeds are one of the constituents of Siddha preprations Attalieuranam, Kalasakadi and Dadi mastaka curna. The seeds have aphrodisiac properties, chiefly used in veterinary medicines.

4.9 Curcuma Longa:

Family: Zingiberaceae
Common Name: Haldi

A native of south eastern Asia, highly esteemed as a condiment, dyestuff, and medicine since time immemorial. Most important and ancient species of India, and has prime position in the world production of turmeric, 80% of world production comes from India. Cultivated throughout the country, in warm and moist places, large scale cultivation is confined to southern and eastern India. Commercial crop of tropics, mainly cultivated in India, Sri Lanka, Indonesia, Taiwan and China.

Botanical Description: Plant is a perennial herb, 60-90 cm in height, with a short thickened rhizome bearing a tuft of large, broad, lanceolate leaves. The pale yellow flowers are borne in dense spikes terminating the stem and remain covered by pink bracts.

Part Used: The main rhizome along with fingerlike offshoots is carefully dug out by hand and the fibrous roots are cut off. Rhizomes are cleared and subjected to various treatments, required for development of the attractive yellow colour and characteristic aroma.

The rhizomes are first boiled in water, drained, dried in sun for 10-15 days until they become dry and hard, cleaned and polished mechanically in hand/power rotated drum. Cured and finished turmeric is deep yellow to orange yellow in colour and has a distinctive pungent flavor.

Figure 4.8: Curcuma Longa Rhizome Plant

Chemical Constituents:

Dry turmeric rhizome contains moisture, 5.8%; protein, 8.6%; fats, 8.9%; carbohydrate, 63%;fiber, 6.9%;mineral matter ,6.8%; calcium 0.015%; phosphorus, 0.26%; iron, 0.05%; sodium,0.015; potassium, 2.5%;vit. A, 175I.U. / 100g; vit B1, 0.09mg/100g; vit B2, 0.19; vit C, 49.8 and niacin, 4.8mg/100g.

On steam distillation it yields orange yellow volatile oil (5-6%), gives it characteristic musky odour.

The main constituent of oil is d-α-phellandrene, d-sabinene, cineol, borneol, zingibrene, and sesquiterpene and the colouring is due to curcumin.

Uses:

- Turmeric is valued for distinctive colour, flavour and aroma.
- It is a condiment and colouring agent, stimulant, and tonic, stomachic and depurative.
- It is widely used for dyeing silk, leather, fiber, paper etc.
- In the Indian system of medicine, turmeric occupies an important place as an ingredient of medicinal oils, ointments, used to aid digestion as a tonic, blood purifier.
- Turmeric is boiled with milk and taken internally; it relieves sore throat and common cold. Burnt termuric used as tooth powder relieves dental problems.
- The juice of rhizome relieves purulent opthalmia.
- It is useful in treating gall stones and also used in compositions for sprains and bruises.
- Various turmeric preparations, like ‘kumkum’ and ‘parani’ are indigenous beauty aids.
- Smearing turmeric paste on the face and limbs clears the skin and beautify the face. It also checks the growth of unwanted hairs on the feminine skin.
- Turmeric oleoresin has significant use in the production of margarine.

4.10 Prosopis Cineraria L:

Family: Fabaceae

Common Name: Khejri

It is native to arid and semiarid portions of South America, Africa, and Asian subcontinent, including Afghanistan, Iran, India, Oman, Pakistan, Saudi Arabia, the United Arab Emirates, and Yemen. In India it founds in the various parts of Rajasthan, Gujarat, Haryana, Uttar Pradesh and Tamil nadu.

Figure 4.9: *Prosopis Cineraria* Plant

Botanical Description:

It is a perennial tree, xerophilous, aculeate up to 12 metres height, straight and scattered prickles. Root system is deep tap root as well as a superficial root system, both having different functions during different seasons, The deep root system is made up of one, two or three (rarely more) main tap roots, which may divide at lower depths. Sometimes reaching to the unusual depth of 40 m, combined with extensive lateral roots. Especially suitable for dry sites with annual rainfall between 150 –700 mm. Once the water source is reached, the roots extend horizontally in the direction of the water flow.

The depth of the roots depends on the quality and structure of the soil and the availability of soil water. Leaves are **green,** bipinnately compound, alternate, 2.5 cm length, and 1 cm Breadth, odourless with a bitter taste, stipulate, stipules modified into spines. Leaflets are in 15–18 pairs, shaped oblong with an entire margin, apiculate apex, obtuse base, and glabrous surface, reticulate venation, petiolate, petiole - 0.5–4cm long. Flowers are solitary or in terminal panicles, Inflorescence is Racemose Spike, fruit is Legume.

Chemical Constituents: Phytochemically a few of phytoconstituents have been isolated from different parts of Prosopis cineraria. Flowers contain patuletin glycoside patulitrin sitosterol, spicigerine, Flavones derivatives were reported by (Sharma et al., 1964). Piperidine alkaloids spicigerine and prosophylline were reported by (Jewers et al., 1976).

The seed lipids, contain a relatively large proportion of unsaturated fatty acids, linoleic and oleic acids, Prosogerin C, was reported by (Bhardwaj et al., 1978). Prosogerin-A and Prosogerin B were reported by (Bhardwaj et al., 1979). Prosogerin D was isolated from the seeds of Prosopis cineraria by (Bhardwaj et al., 1980). Prosogerin E, Gallic acid, patuletin, patulitrin, luteolin, and rutin were reported by (Bhardwaj et al., 1981).

Leaves contain steroids like campesterol, cholesterol, sitosterol and stigma sterol, actacosanol, hentriacontane, methyl docosanoate, Diisopropyl-10, 11 -dihydroxyicosane- 1, 20-dioate, Tricosan-1-ol, and 7, 24-Tirucalladien-3- one along with a piperidine alkaloid spicigerine was reported by (Malik and Kalidhar, 2007).

Gangal et al., (2009) studied that the seed lipids contain a relatively large proportion of unsaturated fatty acids, with linoleic and oleic acids being predominant. A compound Quercetin-3´Undecyloxy-3-galloyl trimethyl ether was reported from the leaves of Prosopis cineraria and it was screened for cytotoxicity activity on human cancer cell lines viz. HeLa and MCF- 7 using MTT assay by Robertson and Narayanan, (2014).

Uses:

- It is called Kalpataru in Ayurveda and Siddha literature (Robertson and Narayanan, 2014). Leaf paste of P. cineraria is applied on boils and blisters, including mouth ulcers in livestock and leaf infusion on open sores on the skin. -The smoke of the leaves is considered to be a good remedy for ailments of the eye.
- The bark is prescribed for scorpion stings (Yoganarasimhan, 2000). *Prosopis cineraria* flower is mixed with sugar and used during pregnancy as safeguard against miscarriage.
- The pod is considered as astringent. Bark of the tree is used in the treatment of asthma, bronchitis, dysentery, leucoderma, leprosy, dyspepsia, muscle tremors and piles.
- The plant is recommended for the treatment of snakebite. It is used traditionally for treatment of various ailments (Nadkarni KM, 1976).

4.11 Moringa Oleifera:

Family: Moringaceae

Moringa oleifera is a fast-growing, drought-resistant tree of the family Moringaceae, native to the Indian subcontinent (Olson, 2010). Common names include **moringa, drumstick tree** (from the long, slender, triangular seed-pods), and **horseradish tree** (from the taste of the roots, which resembles horseradish, and ben oil **tree** or **benzolive tree.**

It is widely cultivated for its young seed pods and leaves, used as vegetables and for traditional herbal medicine. It is also used for water purification Kalibbalaet. Al, 2009, Kalibbala, 2012).

Although listed as an invasive species in several countries, *M. oleifera* has "not been observed invading intact habitats or displacing native flora", so "should be regarded at present as a widely cultivated species with low invasive potential".

Figure 4.10- ***Moringa Oleifera***

Nutrient Content: Fresh pods and Leaves: carbohydrates 12.5 and 3.7%, protein: 6.7 and 2.5%, fat: 1.7 and 0.1%, fiber: 0.9 and 4.8%, Ca: 440 and 30mg, K: 42 and 24mg, Mg: 259 and 260mg and, P: 70 mg and 110 mg, Vitamin A and C are higher than in carrot and orange, all essential amino acids are present.

Parts Used: Fresh leaves, flowers, green pods and Seeds, Flowers are cooked as vegetable, young pods are used in curry for asparagus like taste, seeds are boiled and consumed with other foods.

Medicinal Uses: Nutritious, diuretic, laxative, expectorant, bacterial and fungal infections, anti-biotic, cardiac and circulatory problems, tonic for inflammation, appetizer and digestive, cold remedy, rubefacient, tuberculosis and septicemia.

- **Protecting and Nourishing Skin and Hair:**

Moringa seed oil is beneficial for protecting hair against free radicals and keeps it clean and healthy. Moringa also contains protein, which means it is helpful in protecting skin cells from damage. It also contains hydrating and detoxifying elements, which also boost the skin and hair. It can be successful in curing skin infections and sores.

- **Treating Edema:**

Edema is a painful condition where fluid builds up in specific tissues in the body. The anti-inflammatory properties of moringa may be effective in preventing edema from developing.

- **Protecting the Liver:**

Moringa appears to protect the liver against damage caused by anti-tubercular drugs and can quicken its repair process.

- **Preventing and Treating Cancer:**

Moringa extracts contain properties that might help prevent cancer developing. It also contains niazimicin, which is a compound that suppresses the development of cancer cells.

- **Treating Stomach Complaints:**

Moringa extracts might help treat some stomach disorders, such as constipation, gastritis, and ulcerative colitis. The antibiotic and antibacterial properties of moringa may help inhibit the growth of various pathogens, and its high vitamin B content helps with digestion.

- **Fighting Against Bacterial Diseases:**

Due to its antibacterial, antifungal, and antimicrobial properties, moringa extracts might combat infections caused by *Salmonella, Rhizopus,* and *E. coli*.

- **Making Bones Healthier:**

Moringa also contains calcium and phosphorous, which help keep bones healthy and strong. Along with its anti-inflammatory properties moringa extract might help to treat conditions such as arthritis and may also heal damaged bones.

- **Treating Mood Disorders:**

Moringa is thought to be helpful in treating depression, anxiety, and fatigue.

- **Protecting the Cardiovascular System:**

The powerful antioxidants found in Moringa extract might help prevent cardiac damage and has also been shown to maintain a healthy heart.

- **Helping Wounds to Heal:**

Extract of moringa has been shown to help wounds close as well as reduce the appearance of scars.

- **Treating Diabetes:**

Moringa helps to reduce the amount of glucose in the blood, as well as sugar and protein in the urine. This improved the hemoglobin levels and overall protein content in those tested.

- **Treating Asthma:**

Moringa may help reduce the severity of some asthama attacks and protect against bronchial constrictions. It has also been shown to assist with better lung function and breathing overall.

- **Protecting Against Kidney Disorders:**

People may be less likely to develop stones in the kidneys, bladder or uterus if they ingest moringa extract. Moringa contains high levels of antioxidants that might aid toxicity levels in the kidneys.

- **Reducing High Blood Pressure:**

Moringa contains isothiocyanate and niaziminin, compounds that help to stop arteries from thickening, which can cause blood pressure to rise.

- **Improving Eye Health:**

Moringa contains eyesight-improving properties thanks to its high antioxidant levels. Moringa may stop the dilation of retinal vessels, prevent the thickening of capillary membranes, and inhibit retinal dysfunction.

- **Treating Anemia and Sickle Cell Disease:**

Moringa might help a person's body absorb more iron, therefore increasing their red blood cell count. It is thought the plant extract is very helpful in treating and preventing anemia and sickle cell disease.

4.12 Amaranthus *Cruentus*:

Family: Amranthaceae
Common Name: Chaulai

Botanical Description:

Amaranthus cruentus is an annual herbaceous plant which reproduces only by seeds and has a short growing period of 4–6 weeks (Makinde et.al.2010). It produces one dominant, large, central root (tap root). Thick stems are often straight and branched, 0.1 to 2.0 m in height, ribbed, and red dyed. Leaves are arranged spirally, simple, without stipules, and their shape varies from ovate to rhombic-ovate. Small fine hairs cover leaf and stem

surfaces. Numerous unisexual flowers are green and form finger-like spikes with long and dense terminal panicle and axillary spikes below. At maturity, the whole plant may be reddish (Grubben, 2004; Śmigerska, 2016). The large and complex inflorescence consists of numerous concentrated cymes arranged axillary, ended with racemes and spikes. The top one, with numerous laterals, is perpendicular, with thin branches up to 45 cm long. There 2-3 mm long bracts. The inflorescence is more than 50 cm long, characterized by high colour variability. Each of them produces about 50 000 seeds in round or more often in lenticular shape, 1-1.5 mm in diameter, shiny, and dark brown(Grubben,2004; Robertson ,2003). Either light only or together with high temperatures stimulate germination. Temperatures of 20/35°C and light give the greatest rise (Weaver, 1984). The grain of amaranth is small, around 0.9 to 1.7 mm in diameter. The mass of 1000 seeds is around 0.6-1.0 g (Alvarez-Jubete, 2010). Grains are lenticular, with a color that varies from white, pink, through gold and brown to black. The coat of the seed is smooth and thin (Wolosik, K. and, Markowska, A., 2019).

Figure 4.11: Amaranthus *Cruentus*

Chemical Constituents: Amaranth seeds contain about 1% of inositol, a small amount of glucose, fructose, other monosaccharides (0.05-0.67%) and disaccharides such as raffinose (0.27-2.3%), sucrose (0.4-2%), maltose (0.02-0.36%), and stachyose (0.02-0.29%). The raffinose content is higher than in wheat, but less than that in corn (Januszewska-Jóźwiak and Synowiecki, 2008; Silva-Sánchez et.al., 2004; Lopez, 1994). The contents of low-molecular-weight carbohydrates in *A. cruentus and A.* caudatus were reported in the following ranges (g/100 g): fructose (0.12 to 0.17), glucose (0.34 to 0.42), inositol (0.02 to 0.04), maltose (0.24 to 0.28), raffinose (0.39-0.48), stachyose (0.15-0.130), and sucrose (0.58-0.75) (Venskutonis, and Kraujalis, 2006; Gamel et.al., 1994)

Part Use: Leaves and Seeds: cooked

Fresh leaves of this nutritious legume plants grow as weed in uncultivated land during rainy season are used as vegetable.

Nutrient: carbohydrate-4g/100g, protein 5g, high content of Ca (330mg/100g), Fe (19mg/100g).

Uses: Soup, curry, leaves are cooked with salt, chillies, tamarind, garlic and eaten with sorghum pan cake or finger millet balls.

Medicinal Uses: emollient and vermifuge, dysentry and inflammation, constipation, boils, heart troubles, blood purification. *Amaranthus cruentus* is a pseudocereal with a particularly highly regarded nutritional value, which is determined by:

- Presence of proteins that consist of albumin, globulin, glutelin, and prolamin fractions. Seeds do not contain gluten, so they can be introduced into the diet of patients suffering from celiac disease.
- Large amounts of lysine, tryptophan, and sulfur amino acids that support high nutritional quality of the seed.
- Bioactive peptides and lunasin-like peptides thought to have antioxidant, anticancer, anti-allergic, and antihypertensive properties.
- The main constituent of the carbohydrate fraction found in the seeds is starch, which shows good gelatinization properties and freeze/thaw stability that is appreciated in the food industry.
- The physiological effect of amaranth is important because of the fiber presence.
- Amaranth grain is rich in easily absorbed iron, magnesium, calcium, and potassium.
- The seeds of amaranth are not different from other cereals in composition of vitamins, characterized by the presence of folic acid, pantothenic acid, niacin, and B vitamins, but accumulate significant amounts of both β- and γ-tocotrienols.
- There is a high biological significance of the flavonoids and phenolic acids in amaranth grain.
- Seeds contain more total fat, compared with other cereals: quinoa, wheat, barley, rye, and oat. The lipid fraction contains mostly unsaturated fatty acids with linoleic acid predominant. Palmitic and oleic acids were also found in amaranth seeds. Grains are also a source of valuable squalene, with wide biological activity and antioxidant properties.

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5. Medicinal and Pharmacological Properties *Tinospora Cordifolia*- An Important Therapeutic Medicinal Plant of India

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5.1 Introduction:

Nature is a hub for many medicinal plants which have been in use by mankind for its therapeutic value. Most of the medicinally important compounds now used as modern drugs have been isolated from these natural sources. Traditional medicine has a very important role in the primary health care system in developing countries like India. It is easily affordable and accessible for poor communities. Synthetic drugs are economically high in cost and also cause adverse side effects on human beings. In order to replace synthetic drugs, there is need for screening different plants for their medicinal or therapeutic value.

According to WHO, 80% of world population mainly depends on traditional medicine which involves the direct use of plant extracts or their active constituents (Pandey *et al*., 2008)? India is home for about more than 45000 plant species, rich in source of medicines or medicinal compounds or natural products.

India is regarded as one of the nation of mega biodiversity as it is rich in flora and fauna. Natural products obtained from medicinal plants are gaining importance in the field of medicine and research. India is also rich in ancient traditional systems of medicine like Ayurveda, Siddha, Unani, Homeopathy and folk medicine.

These traditional systems of medicine provides the immense knowledge about various important medicinal plants used in primary health care and also cure for common ailments (Tiwari et al., 2018).

Tinospora cordifolia is a medicinal plant whose status in the field of natural medicine and Ayurveda is of the highest order. Vernacularly speaking, *Tinospora cordifolia* is known "*Guduchi*" whose origin is rooted to Sanskrit; and is known as "Amruthaballi" in Kannada and is an important drug of the Indian System of Medicine (ISM). *T. cordifolia* is an esteemed medicinal plant whose uses and application with reference to human benefits have been praised to indescribable heights in various ayurvedic and Vedic scriptures and the practices.

It is widely and popularly used in the ayurvedic and local forms of medicine is studied in the phytochemical and different components that exhibit the properties that have been celebrated and upheld in the age old traditions and medicinal practices (Gaur *et al., 2014)*.

5.2 Plant Morphology:

Tinospora cordifolia is a perennial climber used in folk and Ayurvedic systems of medicine all over India. All parts of the plant are used, but leaves stem and roots are the most important parts which are medicinally important. It belongs to family Menispermaceae. It is extensively used in Ayurvedic medicine. It is glaborous, succulent, woody climber. It is native to India also found in tropical regions of Asia (Malaysia, Burma and Sri Lanka) and Africa. The stem appears grey or creamy white. The surface of the stems appears to be closely studded with warty tubercles and the surface skin is longitudinally fissured, having3-5 cm length and 3-8 mm in diameter (Reddy et al., 2015). The wood is white in colour, soft and porous. The freshly cut stem when exposed to air quickly turns light yellow. Leaves are simple, alternate, exstipulate, long, petiolate, cordate in shape with multicoated reticulate venation and bright green in colour. Thread like aerial roots arise from branches. Flowers are small and unisexual axiliary and terminal racemes.

The differentiations in the sexes are seen in the form that the male flowers are usually clustered and the female flowers are solitary in positioning. The sepals and petals are 6 in number and are usually free or grouped in 2 or 3 numbers. The fruits are found in an aggregate of 1-3 drupes with scarlet or orange color. The seeds are curved and pea sized and are transverse dehiscent in nature. The roots which are present in this plant are seen in both underground and aerial form.

5.3 Taxonomic Classification:

Kingdom	: Plantae – Plants
Subkingdom	: Trachaeophyta – Vascular Plants
Super-division	: Spermatophyta-Seedbearingplants;
Division	: Magnoliophyta-Flowering;
Class	: Magnoliopsia-Dicotyledons
Subclass	: Polypeptalae-Petals are free;
Series	: Thalamiflorae-Manystamensandflowerhypogynous
Order	: Ranunculales
Family	: Menispermaceae-The Moonseed family
Genus	: Tinospora
Species	: cordifolia

In India, *Tinospora cordifolia* is known by different name in various different languages. (**Tiwari *et al*., 2018; Gaur *et al*., 2014**)

Latin	: Tinospora cordifolia (willd.)Hook. F. and Thomson
English	: Gulancha/ Indian Tinospora
Sanskrit	: Guduchi, Madhuparni, Amrita, Chinnaruha, Vatsadaani, Tantrika, Kundalini and chakralakshanika.
Hindi	: Giloya, Guduchi
Bengali	: Gulancha
Telugu	: Thippateega
Tamil	: Shindilakodi
Marathi	: Shindilakodi
Gujarathi	: Galo
Kannada	: Amrita balli, Madhupa

Tinospora cordifolia is an important medicinal plant used in Indian systems of medicine and used since ages. It is commonly called as Indian bitter. It is prescribed in fevers, diabetes, dyspepsia, jaundice, urinary problems, skin diseases and chronic diarrhoea and dysentery. It has been also useful in the treatment of heart disease, leprosy, and helmenthiasis. The stem is used in cure for many diseases and is highly rich in starch which is considered to be highly nutritive and digestive (Kirtikar *et al*., 1933).

5.4 History and Ayurvedic Aspects:

The use of this medicinal plant has been described in detailed manner in Vedic and ayurvedic scriptures. The plant is known as Guduchi or Amrita in Sanskrit which points to the nature of this plant in the rejuvenating and the retainment of youth and life span of the consumer. In other words, the fountain of life force is an apt title for this medicinal plant. Ayurveda is a 5,000-year-old traditional system of medicine know in India, It describes three elemental substances such as Kapha, Vata and Pitta. As per Ayurveda, Ashtang Hridaya and Sushrut, Charak and other treaties like BhavaPrakash and Dhanvantri Nighantu, T. cordifolia has different names as: Amara, Amritvalli, Chinmarrhuha, Chinnodebha and Vatsadanietc, and most commonly called as Guduchi or Amrita. In SushurtaSamhita, under Tikta-SakaVarga, it is traditionally prescribed for the treatment of several diseases like Svasa (asthma), MahaJvara (fever), Aruci (anorexia) and kustha (leprosy). In AshtangHridaya and Charak Samhita, there is also a great evidence for the treatment of different diseases like Jvara (fever), Vat Rakta (gout) and Kamala (jaundice).

In Bhavya Prakash, it is considered as diuretic, astringent, bitter tonic and potential curative and aphrodisiac against jaundice, diabetes, chronic diarrhea, and dysentery and skin infections. In Dhanvantri Nighantu, it has been described for treatment of bleeding piles, curing itching, erysipelas and promoting longevity. It is also known to possess properties like Deepanam (kindles digestive fire), Laghu (light), Dhatukrit (builds the sevenbodilytissues), Chakshushyam (good for the eyes), Bayasthaapankarakam (maintains youthfulness and longevity) and Medhayam (rejuvenating for the mind). European practitioners in India considered Tinospora as a major source of medicine like tonic, diuretic and antiperiodic and further it was comprised in Bengal Pharmacopoeia of 1868.

It is reported in Ayurvedic literature T. cordifolia is a major constituent of formulations used for the treatment of several disease such as dyspepsia, urinary related diseases, debility and fever. Some of the important formulations prepared from T. cordifolia are: Guduchitaila, Sanjivanivati, Kanta-Kari avaleha, Guduchyadichurna, Chyavnaprasha, Guduchughrita, Guduchisatva, Brihatguduchitaila, Amrita guggulu, amritashtakachurna and manymore. T. cordifoliais the most extensively used as a remedial herb in Folk and tribal medicine for the treatment of various diseases. T. cordifolia is considered to be highly valuable in Ayurveda for its numerous medicinal properties like rejuvenating, immune-boosting, anti-rheumatic and detoxifying properties. In modern medicine, T. cordifolia is presently used for treatment of cold and flu prevention, skin disorders, liver disorders, immune support, gout, arthritis and lately to overcome the adverse effects of chemotherapy. Tinospora cordifoliais an important drug plant used in traditional medicinal system and provides basis for the possible use of this plant in modern medicine.

Recent scientific studies help us to understand the potential prospects for the development of effective therapeutic compounds. The present review aims to highlight the medicinal properties of Tinospora cordifolia and its potential prospects for the further scientific investigation.

5.5 Phytochemistry/ Chemical Constituents:

The detailed scientific studies have yielded the discovery of various compounds in the plant extract of various solvent natures that are either directly or indirectly responsible for the expression of biological characters in the plant or host system. e different classes of compounds which are found in this plant are classed in groups like alkaloids, steroids, terpenoids, polysaccharides, glycosides and different aromatic and aliphatic compounds that are present in their phytoactive form that are responsible for the wide range of medicinal and therapeutic properties. The presence of these compounds is found in various plant parts but highly concentrated in the stem, leaves and root part of the plant.[5] The main compound of this plant is berberine and furan lactone and furthermore compounds like tinosporone, tinosporic acid, cordifolisides A to E, giloin, gilenin, crude giloininand, arabinogalactan polysaccharide, picrotene, bergenin, gilosterol, tinosporol, tinosporidine, sitosterol, cordifol, heptacosanol, octacosonal, tinosporide, columbin, chasmanthin, palmarin, palmatosides C and F, amritosides, cordioside, tinosponone, ecdysterone, makisterone A, hydroxyecdysone, magnoflorine, tembetarine, syringine, glucan polysaccharide, syringineapiosylglycoside, isocolumbin, palmatine, tetrahydropalmaitine, jatrorrhizine are few of the compounds that have been isolated from the plant.

The presence of three compounds like cycloeuphordenol, Cyclohexyl-11-heneicosanone and 2-Hydroxy-4-methoxy-benzaldehyde has been isolated from the plant and has been seen to be present in various other plants. The presence of proteins and miscellaneous compounds has been attributed to the medicinal properties of the plant (Wichtl et al., 2000, Kavya et al., 2015). (Table 5.1).

A study by **Khosa *et al.*, 1971** and **Nasreen *et al.*, 2010** revealed *Tinospora cordifolia* consists of different classes of chemical constituents such as alkaloids, diterpenoid, lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides etc.

In addition to this, many compounds present in the plant that contribute to the medicinal and therapeutic properties of *T. cordifolia* plant. The plant contains a high amount of fiber totaling to an total estimate of 15.9% and the protein content to about 4.5-11.2%, the total carbohydrate estimate to about 61.7 & and a low fat amount estimating to about 3.2% and the mineral content totaling to about 0.845% of potassium, 0.006% chromium, 0.28% of Iron and 0.131% of calcium. All these compounds are involved directly or indirectly in the pathways or regulatory, metabolic and cellular nature. Kirti *et al.,* 2004, Jamal *et al.*, 2016, Sharma *et al.*, 2012

5.6 Medicinal and Pharmacological Aspects of Tinospora Cordifolia:

The plant has been titled to many properties that have been used from time immemorial and few of them include curative properties against Jaundice, fever, gout, urinary and upper respiratory infections and preventive measures against skin infections, chronic diarrhoea, bleeding piles, dysentery, itching and erysipelas. The plant is known for its potent aphrodisiac nature and its rejuvenating nature. The plant extract influences the secretion of bile liquids and is known to enrich the blood constituents. The effect that the plant extract has in both adult and children systems is similar and this is a good factor in the administration of the plant drug irrelevant to the host age which is not the case in synthetic drugs which base the age of the consumer to be a major factor in drug administration.[8,10,11]

The plants show anti-diabetic properties due to the presence of tannins, alkaloids, flavonoids, glycosides, saponins and steroids. The plant has seen to have effect on both the sexual arousal and the sexual performance of the biological systems and these drugs have stimulatory effect on the copulatory behavior and thereby entitled to aphrodisiac activity. The most admirable character of the plant extract is the effect it bears in the cognitive field; its ability to affect the learning and memory cortex of the human intelligence is an admirable trait and this trait has attracted the interest of various scientific and industrial bodies. The plant also bears anti-oxidant, anti-inflammatory, anti-tuberculosis; wound healing, immunomodulatory and immunoprotective, hepatoprotective, anti-osteoporotic, anti-cancer, anti-tumor, anti-malaria, cardio protective nature and many more properties that make them a topic of great importance and interest (Shanti *et al.,2013,* Wichtl *et al.,2000, Kavya et al.,2015).* Many biologically active compounds have been isolated from different parts of the *Tinospora cordifolia*. These compounds have been reported to have different biological roles in pathological conditions. Reddy et al., 2015.

5.7 Anti-Cancer Activity:

Tinospora cordifolia possess anti-cancer activity, this activity is commonly proven in animal models. The extraction of alkaloid palmatine from *Tinospora cordifolia* by using response surface methodology (RSM) clearly indicate the anticancer property in 7, 12-dimethylbenz (a) anthracene DMBA induced skin cancer model in mice in a study conducted by Ali et al., 2013. The anti-cancer activity of secondary metabolite (such as magnoflorine, palmatine, jatrorrhizine, yangambin etc.) isolated from guduchi were tested in different type of tumor cells and among them ‘palmatine’ and ‘yangambin’ reported to treat KB cells while tinocordiside for colon cancer cell and oral cancerous cell (KB) respectively in a study conducted by Bala *et al*., 2015.

A single application of *Tinospora cordifolia* extract at a dose of 200, 400 and 600 mg/kg dry weight, 24 hrs prior the i.p. administration of cyclophosphamide (at the 50 mg/kg), substantially prevented the micronucleus formation .in bone marrow of mice, in a dose dependent manner. C57 Bl mice when acquired 50% methanolic extract of *Tinospora cordifolia* at a dose 750 mg/kg body weight for 30days showed increase in life span and tumor size was considerably reduced as compared to control according to a study conducted by Rahul Verma *et al*.,2011. Mishra *et al*., 2013 studies investigated the anti-brain cancer potential of 50% ethanolic extract of *Tinospora cordifolia* (TCE) using C6 glioma cells. The extract extensively reduced cell proliferation in dose- dependent manner and induced differentiation in C6 glioma cells.

According to a study, the hydro alcoholic extract of aerial roots of *T. cordifolia* when exposed to the liver as well as extra hepatic organs of Swiss Albino mice at 50 and 100mg/kg body weight shows an increase in Glutathione (GSH) level and other metabolizing enzymes. In addition to this, it was also reported, there is a significant decrease in production of malonaldehyde (MLD) level indicating a decrease in free radical formation providing an anti -oxidative state of cell was reported by Singh *et al*., 2006.

A research study conducted by Thippeswamy *et al*., 2007**,** reported that mice having Ehrlich ascites tumor on exposure to hexane extract of *Tinospora* shows inhibition of proliferation of tumor cell (G1Phase) and also enhanced the expression of Bax gene which led to caspases induced apoptosis.

According to study by *Chaudary et al*., 2008**,** it was reported that Guduchi has been reported to possess antitumor activity in a study conducted in mice through a two stage carcinogenesis. This study showed there was decrease in papillary tumors, its weight and its occurrence and also increased the levels of phase II enzymes in the treatment group. As most of the chemotherapeutic drugs are synthetic and have many adverse side effects on patient's health. But *T. cordifolia* is considered to be one of the safest medicinal herbs to treat cancer patients as it has very less side effects.

5.7.1 Anti-Toxin activity:

Guduchi have a potential ability to forage free radical and possess a protective effect by altering different hormone and mineral levels. In a toxicity study conducted by Gupta **et al., 2011**, in Swiss albino mice, it was reported that *T. cordifolia* has reversed the toxicity caused by aflatoxin in kidney and significantly increased the Glutathione hormone level and enzyme activities of catalase and glutathione reductase and decreased the ROS. This antitoxin activity is brought by the alkaloid isolated from Tinospora.

According to Lead nitrate toxicity study in swiss albino mice conducted by **Sharma et al., 2010**, reported a decrease in number of erythrocyte and leucocyte count in blood serum. However, the leaf and stem extract of guduchi has potential to combat these changes in hematological value by overcoming the lead induced toxicity.

Oral administration of plant extract in swiss albino mice countered the effects caused by lead nitrate in mice liver.

According to this study, observed that there is decrease in the level of enzymes like glutamic pyruvic transaminase (GPT) or alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and rise in enzyme level of catalase foer scavenging free radicals was reported by *Sharma* et al., 2010.

Another study by Hamsa *et al., 2012*, reported that *T. cordifolia* has found its importance in overcoming cyclophosphamide induced toxicity by significantly elevating the extent of lowered GSH content, cytokines and gradually declining inflammatory cytokines (Tumor necrosis factor) level in urinary-bladder and hepatic cell preventing the damage which confers its anti-toxin activity.

5.7.2 Anti-Diabetic Activity:

Pharmacological research has verified in vivo antidiabetic potential from various extracts of T. cordifolia. The compounds such as alkaloids, cardiac glycosides, saponins, flavonoids, tannins and steroids isolated from guduchi possess anti-diabetic property. Alkaloids isolated from guduchi noted to possess the effect like insulin hormone and indicate insulin mediated actions. These compounds have been stated to embody different target activities in diabetic conditions, for that reason enabling the potential application in experimental and clinical research.

Kannadhasan *et al., 2010*, find out about stated that 30 days cure of Sedimental extract of *Tinospora cordifolia* (SETc) (1000 mg/kg/p.o.) on diabetic patients was tested for its efficacy and simply establishes the antidiabetic activity with antiobese body. The ethanolic extract of *T. cordifolia* leaves in different dosages (200 and 400 mg/kg b.w.) administered orally for 10 days and 30 days in streptozotocin diabetic albino rats. It is absolutely confirmed that TC has extensive antidiabetic activity in diabetic animals and has an efficacy of 50% to 70% compared to insulin was observed by Chandra Shekar *et al., 2013*. Borapetoside C isolated from Tinosporacrispa (5 mg/kg, i.p.) attenuated the increased plasma glucose in diabetic mice, accelerated glucose utilization, delayed the development of insulin resistance and then improved insulin sensitivity was reported in a study conducted by Ruan *et al., 2012*. The activation of insulin- triggered IR-Akt-GLUT2 expression in liver and the enhancement of insulin sensitivity may additionally have contributed to the hypoglycemic action of borapetoside C was reported by Ruan *et al., 2012*.

The isoquinoline alkaloid rich fraction from stem, including, palmatine, jatrorrhizine, and magnoflorine have been stated for insulin-mimicking and insulin- releasing effect each in vitro and in vivo was reported by Patel et al, 2011.In Ehrlich ascites tumor cells model, water, ethanol and methanol extracts of the herb confirmed glucose uptake stimulatory activity was reported by Joladarashi *et al.,2014*.

The protecting effects of *T. cordifolia* root extract had been reported in presence of higher levels of anti-oxidant molecules and enzymes. Tinospora root extract has been proven to drastically counterbalance the diabetes-associated oxidative stress in the maternal liver by reducing the levels of malondialdehyde and reactive oxygen species and the elevated levels of glutathione and total thiols was reported in a study conducted by Shivananjappa *et al., 2012*.

The stem extract of *T. cordifolia* is stated to have anti-diabetic potential by means of improving the insulin efficiency through its secretion from beta pancreatic cell and promoting a variety of anti-diabetic pathway such as inhibiting glucose formation by means of enhancing glycogenesis etc. thereby reducing the endogenous glucose. It was reported by Sangeetha *et al., 2011*.

Oral administration of leaf extracts of *T. cordifolia* has also observed anti-diabetic potential when examined in diabetic rat model (streptozotocin induced diabetes) through distinct peripheral pathways such as glycogen storage, transportation of glucose and other mechanisms was observed in a study conducted by **Singh et al., 2013.**

5.7.3 Immunomodulatory Activity:

In a clinical study by Sharma *et al.,* 2012 it was reported, chemical constituents such as cordifolioside A and syringin isolated from Tinospora cordifolia are reported a simmunomodulating agent.

As *T. cordifolia* stem is known to alter the level of enzymes such as catalase which promotes stimulation of lymphocyte cells thereby maintaining the immune strength, and highlighting the immuno-protective role of this plant in a study conducted by Aher *et al.,* 2012.

Tinospora is known to enhance antimicroboal activity to protect immunity was reported in Macrophage cells exposed to extract of this medicinal plant in a study conducted by More *et al.,* 2012. Aqueous extract of *T. cordifolia* induces cellular mitosis, thus stimulating the production and activation of cytokine and immune effect or cells in a study conducted by Upadhyaya *et al*., 2012.

A clinical study reported by Castillo *et al*., 2014, *T. cordifolia* lotion shows drop in the level of interleukin i.e. IL-1 and IL-6 in scabies animal model and therefore showing its anti-scabies activity. T. cordifolia is a potent agent for the prophylaxis of immune susceptible diseases as it is able to increase the response of immune cell and neutrophil activity was reported by Sudhakran et al., 2006.

Preclinical tests were conducted by using chemical compounds of *T. cordifolia* such as alkaloids, steroids, aliphatic compounds in a rat model showed a great immunoprotective activity.G1-4A is recognized as a poly- saccharide compound isolated from *T. cordifolia* showed significant increase in the proliferation and differentiation of immune cells i.e. T-cell and B-cell associated with the expression of the anti-apoptotic gene was reported Jahfar *et. al*., 2003, Raghu *et al*., 2009. α-D -glucan compound obtained from *T. cordifolia* has shown to maintain the body physiology by activating the cells of lymphocytes was reported by Koppada *et al*., 2009.Polymorphonuclear leucocyte (PMN) cells are important components of the host defense system. Various Extracts of *T. cordifolia* stimulated the PMN cells for phagocytosis was reported by Salkar *et al*., 2014.

An aqueous extract of *T. cordifolia* named as ‘Ghana’ in Ayurveda was tested on the edema rat model, showed reduction in the edematogenic agents and thus has a potent immunostimulatory action was reported by Umretia *et al*., 2013.

5.7.4 Anti-Microbial Activity:

A study by Singh et al., 2014, silver nanoparticles synthesized from the stem of *T. cordifolia* was found to possess a good antibacterial activity against Pseudomonas aeruginosa in a patient suffering from burn injury. Many strains of bacteria such as S. typhi, K. pneumoniae, E. coli etc. have been tested with different extracts of *T. cordifolia* which showed potential antibacterial activity by inhibiting their growth or controlling the existence of these bacteria in a studies conducted by Narayana *et al*.,2011, Jeyachandran *et al.*,2003, Duraipandiyan et al., 2012. A study by Duraipandiyan et al., 2012 reported that the stem of T. Cordifolia contains an active chemical compound which was found to be effective against E. faecalis and B. subtilis (bacteria and fungus like T. simii and T. rubrum.

The stem and leaves of this plant are capable of preventing urinary tract infections according to a study, which showed maximum inhibitory activity against the clinical urinary pathogens such as Klebsiella pneumonia and Pseudomonas aeruginosa in a study conducted by Shanti *et al*., 2013. A study conducted by Narayanan *et al*., 2011, reported that this medicinal plant has significant effect by decreasing the resistance to different antibiotic therapy by the urinary pathogens and thus checks the microbial infectivity.

5.7.5 Antioxidant Activity:

According to a study conducted by Subramanian *et al*., 2013, in a rat model, Arabinogalactan, a plant derived polysaccharide shows protection against free radicals indicating antioxidant property. Another study conducted by Jayaprakash et al., 2015, reported *Tinospora* modifies the levels of different enzymatic reactions which controls the synthesis of reactive species and controls oxidation by regulating lipid peroxidation.

Tiwari et al., 2018, study reported, *Tinospora* cordifolia is also known to possess other significant properties such as anti HIV activity, anti-osteoporotic activity etc.

5.8 Conclusion:

In the recent years there has been an increasing interest in the use of plant based products, as they are safe compared to synthetic drugs. The present review clearly indicates that Tinospora cordifolia is an important medicinal plant with impressive biological properties like antidiabetic, antimicrobial, antioxidant, etc. It has many pharmacological properties and used in the preparation of tin all the traditional medicinal preparations. It can be grown in many geographical regions with varying climatic conditions.

The *Tinospora cordifolia* plant had been appreciated to high levels for the medicinal, therapeutic, curative, healing and relieving nature. In keeping view of importance characters, an effort has to be made for large scale cultivation of *T. cordifolia* in different regions of India.

Work should be strengthened for isolation, purification and identification of active principles by using advanced technology. More studies should be conducted on various pharmacological activities *T. cordifolia* for the development of new therapeutic drugs.

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Plate I: Morphology of Tinospora cordifolia (plant, flowers, Fruits, stem)

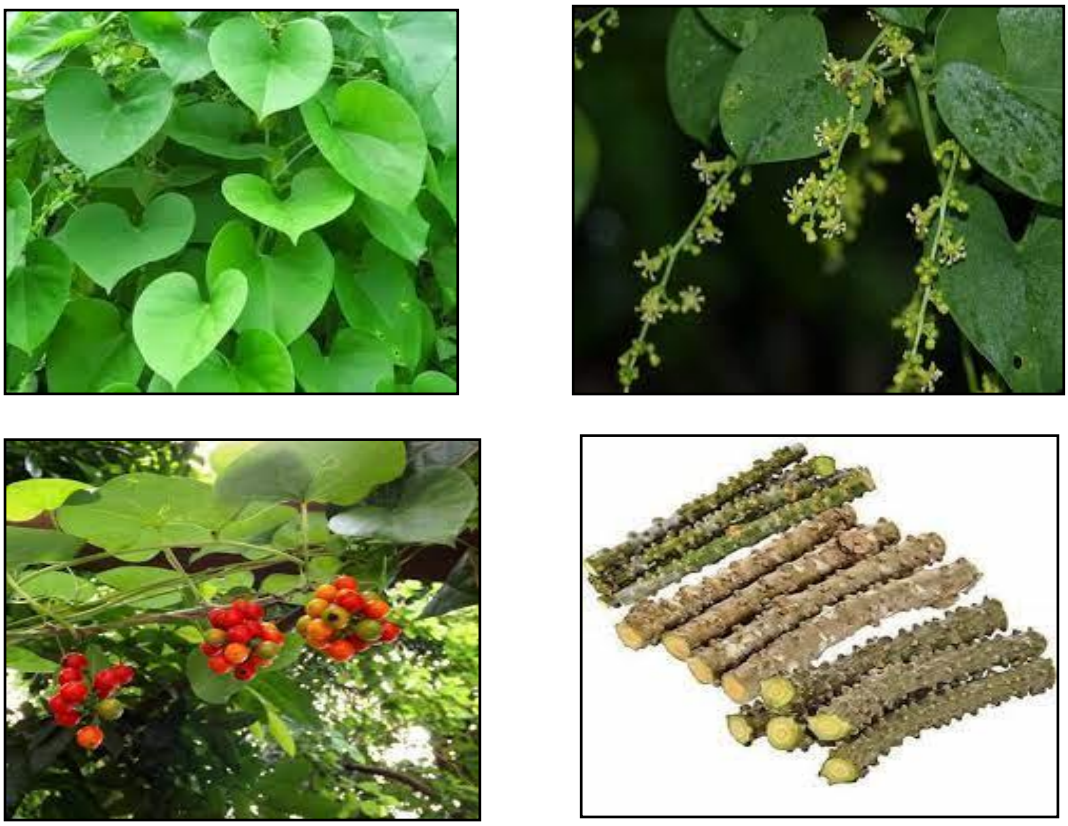
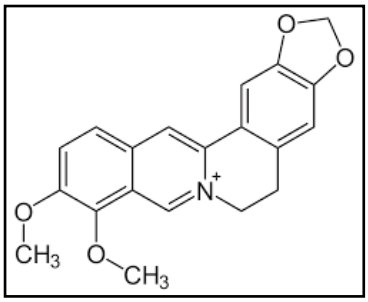


Table 5.1: Chemical constituents of *Tinospora cordifolia*

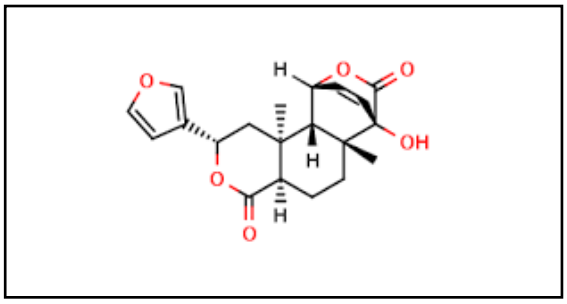
Class	Chemical constituents	Activity	Plant part
Alkaloids	Berberine, Magnoflorine, CholinePalmatin, Tembetarine, Tinosporine, Isocolumbin, Aporphine alkaloids, Jatrorrhizine, Tetrahydropalmatine	Anti-viral infections Neurological, Immunomodulatory anti-diabetes, Anticancer	Stem and Root
Steroids	20 δ - Hydroxyecdysone, δ-sitosterol, β – sitosterol, Giloinsterol Ecdysterone, Makisterone A	1. Inhibits TNF-α, IL-1 β, IL-6 and COX-2. inflammatory arthritis, IgA neuropathy	Shoot
Glycosides	Tinocordiside, Tinocordifolioside, Cordioside, 18-norclerodane glucoside, CordifoliosideSyringin ,	anticancer activities Treats neurological disorders like ALS,	

Class	Chemical constituents	Activity	Plant part
	Syringinapiosylglycoside, FuranoidditerpeneGlucoside, Palmatosides, Cordifolioside A, B, C, D and E, Pregnane glycoside.	Parkinsons, Dementia	Stem
Diterpenoidl-actones	Furanolactone, Tinosporon, Tinosporides , Columbin, Clerodane derivatives, Jateorine	Anti-inflammatory, Anti-microbial, anti-viral. Anti-hypertensive, VasorelaxantInduce apoptosis in leukemia by activating caspase-3and bax, inhibits bcl-2	Whole plant
Sesquiterpenoid	Tinocordifolin	Antiseptic	Stem

Chemical Structures:



Berberine



Tinosporin

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6. Medicinal Plants Practiced by the Endemic Tribal and Bengali Healers of Tripura for Healing Gastrointestinal Diseases: An Ethnobotanical Study

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6.1 Abstract:

An ethno-botanical survey of plants in Tripura state revealed that some less known medicinal plants have been used by the indigenous tribes as well as Bengali communities. This ethno-botanical survey was conducted in the remote hills, forests and rural areas of Tripura, a diversified ethnic people rich state of North-east India, for gathering information about traditional healing methods of different common ailments. The uses of various medicinal plants by the indigenous tribal and Bengali communities of Tripura practiced for health care services were documented. Based on semi structured interview schedules, group discussions and information from the local informants, the valid scientific name, family, local name, dosages and traditional formulations were enumerated under the study. The ethnic people along with Bengali communities of Tripura are involved in using these medicinal plants. In this study, detailed information such as healer's details, preparation and dosage of medicine along with the name of folk plants and their parts used, patient details who had treated by the healers had been collected.

The data was obtained from both primary and secondary sources by the means of pretested interview schedule, whereas primary data sources were more dominant in the purpose of data collection to serve the objective of the study.

Keywords: *Ethnobotanical, medicinal, ailments, traditional, healing, collection*

6.2 Introduction:

Human beings and plants share an age old relationship. Man has been depending on plants for medicinal purpose before the beginning of the written records. Fossil records suggest that even the Neanderthal people were no exceptions.

About 250 years ago, 250,000 to 300,000 higher plants were the source of drugs for the world's population (Duke, 1990). Dependence on plants was still seen and it was estimated that 25% of prescription drugs contain active components derived from higher plants (Farnsworth and Morris, 1976). According to World Health Organization, about 80% of the world's population, especially in rural area depend on herbal medicine for their healthcare needs (Lingaiah et. al., 2013).

Gastrointestinal diseases refer to diseases involving the gastrointestinal tract, namely the esophagus, stomach, small intestine, large intestine and rectum, and the accessory organs for digestion, the liver, gallbladder and pancreas. According to the population census of 2011, about 83% of the Tripura's population of 3.7 million lives in rural area. Rural populations are comprised 69% of Bengali people and 31% of tribal populations. These people are well aware of the traditional use of various plant/forest resources in their daily life.

The present study was undertaken as an initiative for documenting the valuable information from tribes and non-tribal traditional healers and also from few old villagers about their unique knowledge on surrounding plants. By keeping eye on it, the following objectives were selected for the study:

- To prepare a database of the medicinal plants used by the Tribal and Bengali traditional healers of Tripura and to compare the collected data.
- To conduct a survey on Tribal and Bengali communities to observe the curative properties of these medical plants on various diseases.

6.3 Materials and Methods:

The study was conducted among the indigenous tribes and Bengali traditional healers residing in Tripura. In this study, 34 traditional healers were selected from different districts of Tripura. For the validation of the data, an open-ended interview schedule was prepared. All the data were analyzed on the basis of percentage. The study area was from the state of Tripura (Figure 6.1) located in the far end of north east India. The state covers an area of 1,049,169 hectares. Most of our study had been conducted in forested and rural areas of Tribal and Bengali-dominated villages in the North-Western part (22°59′ to 24°14′N and 91°09′ to 92°07′ E) and South-Eastern part (91°18′ to 91°59′ E and 22°56′to 23°45′E) of West Tripura, Sipahijala, Gomati, Dhalai, Unakoti, Khowai, North Tripura and districts of South Tripura. The survey was conducted for a period of 2 (Two) months from the month of January to February, 2020. The data were obtained from both primary and secondary sources by using pretested interview schedule. After collection of data, the obtained data were coded on coding sheets using coding key for each question. The percentages of each response was calculated on the coding sheets and processed as follows:

The percentages of each response was calculated-

$$\text{Percentage}=\frac{\text{Number of responses obtained}}{\text{Total number of respondents}} \times 100$$

Figure 6.1: Study area (Map of Tripura)
Source: www.mapsofindia.com

6.4 Result and Discussion:

The present study was undertaken to obtain data about the practices followed by traditional healers in Tripura. During the study information of about 257 medicinal plants were collected which were used by the traditional healers in healing some common ailments.

The main purpose of the study was to document the traditional knowledge about the treatment of gastrointestinal diseases which was verbal in nature and still undocumented. The obtained findings are as followed:

Age group of the healers: Among the 13 traditional tribal healers, it was revealed that the majority of the healers were under the age group of 40-60 years i.e. 46%, 23% of them were under the age group of 60-80 years, 23% of them were under 20-40 years age group and 8% were fall under the age group above 80 years.

Among 21 traditional Bengali healers, 38% were under 20-40 years, 33% were under 60-80 years, 24% of them under 40-60 years and rest 5% of them were under 80 years and above age group. After analyzing the age distribution, it was revealed that most of the traditional healers were middle aged and elderly people.

Gender distribution of the healers: The study revealed that in Tripura, people take the knowledge of healing as a form of property. It was the social system in which males predominant in roles of social privileges and control of property so the knowledge was mainly transfer to male members of the family for which female traditional healers are less in number than the male healers. In case of tribal healers, among 13 persons, 11 were males and rest 2 of them were females and in case of Bengali healers, 19 were males and 2 were females.

Socio-economic condition of the healers: According to the study, 21% of tribal healers were under LIG (< Rs. 10000) and 79% were under MIG (Rs. 10000-Rs. 25000). In case of Bengali healers. 90% were under MIG (Rs. 10000- Rs. 25000) and rest 10% were under LIG (< Rs. 10,000). Since the entire traditional healer group earn their living by healing people and they do not have any other occupation, so their income level might be limited for which all the traditional healers come under middle and lower income group.

Duration of practice of the healers: In case of tribal healers, the highest percentage i.e. 46% had an experience of 10-20 years and 8% had experience more than 40 years which was minimum. Whereas, in case of Bengali healers, 38% have a healing experience in between 10-20 years which was maximum and 5% have experience more than 40 years which was minimum.

Literacy rate of the healers: In case of tribal healers, most of the healers were under-matriculation which was almost 62% and only 8% of the tribal healers were under graduate. Fifteen percent of them were illiterate which means literacy rate was almost 85%. Among Bengali healers, 33% healers were fall in each group of under matriculation and HSLC pass. Both of H.S passed and under graduate group were found to be 5% and 10% were illiterate which means literacy rate was around 90%.

Knowledge of healing of the healers: The knowledge of healings gained from two different sources. One source was ancestral which means they gained from their forefather, another one was from ancient gurus who deal with such types of medicinal plants and about their compositions. In case of tribal healers, 9 healers got their knowledge ancestral and 4 of them got from their master. On the other hand, in case of Bengali healers, 12 of 21 healers got their knowledge from their forefathers traditionally and rest of them gained from their spiritual teachers (Gurus).

Opinion of the healers regarding their practices: There was no negative feedback about their healing practices since they had a long years of experience. About 91.9 % of the traditional healers follow the traditional healing practices when they themselves or any of their family member fall sick, and rest 8.1 % approached the doctor for treatment. No negative health effects were seen in the healers during their practices.

Materials or items used by the healers: Types of materials used by the healers for their healing practices were different plants parts and the animal parts. Among the 40 healers 87.5% used the plant parts and remaining 12.5 % used animal part for the healing practices. Most of the products used for treatment were domestic and easily available. People still believe in local traditional healers. The healers also had full faith on their practices and believed that they can cure the diseases which they treat. They also claimed for absence of side effects of the treatments.

Preparation and preservation of drugs: All the traditional healers prepared the drug by themselves. Among the 34 healers only 17.65% of the healers i.e. 6 healers used to preserve their drugs. They preserved for more than 1 week to 2 months. The remaining 82.35% healers did not preserve the drug they prepared. They prepared the medicines fresh only when the patient comes.

It was found from the study that all the healers followed herbal method to heal different ailments. The present study revealed that traditional medical practitioners treat all age groups and all problems, using and administering medicines that are readily available and affordable. Their treatment was comprehensive and has curative, protective and preventive elements. So it can be concluded that the healing practices differ from tradition to tradition and person to person.

Types of gastrointestinal ailments treated by traditional healers: from the Table 6.1 it can be seen that most of the plant parts were used to treat anal fistula followed by gastritis and lastly piles. Trachys permum was used in treating almost all the major gastrointestinal diseases followed by Cassia fistula.

Parts of plants used by the healers to heal some common gastrointestinal problem: Among these 40 plants that used by the Bengali healers for healing different ailments. The traditional medicinal plant parts used by the healers for the treatment of some common ailments such as leaves, fruits, roots, whole plants, flowers, stem etc.

The most commonly utilized plant parts were fruit (20%), root (19%), leaf (18%), bark (15%) and whole plant (11%). While flower, rhizome, stem, climber, seeds, latex, wood etc. were rarely used to treat various ailments. One hundred and forty-one plants used by the tribal healers for healing purpose.

The most commonly utilized plant parts were leaf (38%), root (15%), fruit (14%), bark (12%). While flower, rhizome, stem, climber, seeds, latex, wood etc. were rarely used to treat various ailments. For reference study, list of medicinal plants along with common name, scientific name, family, parts used and disease treated had been enumerated in detail (Table 6.1).

6.5 Conclusion:

After the completion of the study, it can be concluded that most of the rural people of Tripura were still believed in the aged old traditional healing and the use medicinal plant in healing different ailment. So, it was the need of the hour to preserve these age old traditions of healing common ailments practiced by the local traditional healer and also the value of different medicinal plants used by them in healing different ailments.

So, it was the high time for preservation and promotion of age old traditions of the indigenous tribal and Bengali community to integrate the traditional knowledge of healer and their healing practices with the modern medicine for the welfare of the mankind as a whole.

Thus it can be concluded that though modern medical science has provided support in healing simple and complicated diseases, but these communities were still depending on traditional healers and their knowledge of healing practices for different ailments. But the mode of practice was mostly oral and it is coming to extinct stages. The study was an attempt to document this fading knowledge in order to conserve it for future generation to come.

6.6 Recommendations:

- For proper documentation more time was required.
- The phytochemical quality and other medicinal properties should be properly analyzed.
- It was recommended that mass awareness should be done regarding the need for conservation of the medicinal plant and also in promotion of knowledge of the traditional healers.

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Table 6.1: List of medicinal plants used by traditional Bengali and Tribal healers to treat gastrointestinal disorders:

Sr No.	Local name	Common name	Scientific name	Family	Part use	Name of diseases to be treated
1.	Chal mugra	Chalmugra	*Hydnocarpus kurzii*	*Achariaceae*	Fruit	Anal fistula
2.	Jangli horitki	Black Myrobalan	*Terminalia citrina*	*Combretaceae*	Fruit	Anal fistula
3.	Neem	Neem	*Azadirachta indica*	*Apiaceae*	Leaf	Anal fistula
4.	Jowan	Ajwain	*Trachys permum*	*Apiaceae*	Fruit	Anal fistula, Piles, gastric problem, gastritis, constipation
5.	Triphola	Amalaki, Vibhitaki, Haritaki	*Emblica officinalis, Terminalia chebula, Terminalia Belerica*	*Phyllanthaceae Combretaceae*	Fruit	Anal fistula
6.	Sona pata	Shyonak	*Cassia fistula*	*Fabaceae*	Leaf	Anal fistula, Piles, gastritis, constipation
7.	Kalomegh	Kalmegh	*Andrographis paniculata*	*Acanthaceae*	Leaf	Anal fistula

Sr No.	Local name	Common name	Scientific name	Family	Part use	Name of diseases to be treated
8.	Ananta mul	Anantamoola	*Hemidesmus indicus*	*Apocynaceae*	Root	Anal fistula
9.	Manjistha	Indian madder	*Rubia cordifolia*	*Rubiaceae*	Climber	Anal fistula
10.	Basak	Basaka	*Adathoda vasica*	*Acanthaceae*	Leaf	Anal fistula
11.	Guduchi	Giloy	*Tinospora cordifolia*	*Menispermaceae*	Climber	Anal fistula
12.	Holud	Termeric	*Curcuma domestica*	*Zingiberaceae*	Root	Anal fistula
13.	Goggul (purified)	Goggulu	*Commiferamukul*	*Burseraceae*	latex	Anal fistula
14.	Jam pata	Black berry	*RubusSp.*	*Rosaceae*	Leaf	Piles
15.	Durba	Bermuda grass	*Cynodon dactylon*	*Poaceae*	Leaf	Piles
16.	Gada phool	Marigold	*Tagetes erecta*	*Asteraceae*	Leaf	Piles
17.	Haritaki	Black myrobalan	*Terminalia chebula*	*Combretaceae*	Fruit	Piles, Gastric problem
18.	Amloki	Indiangoose berry	*Phyllanthus emblica*	*Phyllanthaceae*	Fruit	Piles
19.	Bohera	Vibhitaka	*Terminalia bellirica*	*Combretaceae*	Fruit	Piles
20.	Padma mul	Lotus	*Nelumbo nucifera*	*Nelumbonaceae*	Root	Piles
21.	Chatrak	Mushroom	*Agaricus campestris*	*Agaricaceae*	Whole	Piles , other gastrointestinal ailments
22.	Pipul	Pippala	*Ficus religiosa*	*Piperaceae*	Fruit	Gastritis
23.	Aada	Ginger	*Zingiber officinalis*	*Zingiberaceae*	Root	Gastric problem, constipation
24.	Gulancha	Heart leaved moonseed	*Tinospora cordifolia*	*Menispermaceae*	Stem	Abdominal pain
25.	Pathor kuchi	Air plant	*Kalanchoe pinnata*	*Crassulaceae*	Leaf	Abdominal pain
26.	Khabaron	Garlic chives	*Allium tuberosa*	*Amaryllidaceae*	Leaf	Abdominal pain
27.	Fema fulgach	Crape Jesmine	*Tabernaemontana*	*Apocynaceae*	Flower	Abdominal pain
28.	Lau ishrimula	Lau ishrimula	*Hemidesmus indicus*	*Apocynaceae*	Fruit	Abdominal pain
29.	Lati manglang	Lati manglang	*Cissus repens*	*Cissus repens*	Climber	Abdominal pain
30.	Long / kavanga	Long	*Syzygium aromaticum*	*Myrtaceae*	Fruit	Gastritis
31.	Jaiphal	Nutmeg	*Myristica fragrens*	*Myristicaceae*	Fruit	Gastritis

Sr No.	Local name	Common name	Scientific name	Family	Part use	Name of diseases to be treated
32.	Elachi	Cardamum	*Elettaria cardamomum*	*Zingiberaceae*	Fruit	Gastritis
33.	Sikgasi	Couldn't be identified	-	-	Leaf / bark	Gastritis
34.	Vanjambir	Vanjambir	*Glycosmic pentaphyla*	*Rutaceae*	Leaf	Gastritis
35.	Kutti jurkha	Kutuja	*Holorrhena antidysentrica*	*Apocynaceae*	Stem	Gastritis
36.	Kaladaru	Kaldharu	*Phlogacanthus thyrsiflurus*	*Acanthaceae*	Leaf	Gastritis
37.	Chitamul	Leadwort	*Plumbago zeylanica*	*Plumbaginaceae*	Root	Gastritis
38.	Birongo	Birongo	*Einbelia ribes*	*Primulaceae*	Fruit	Constipation
39.	Lebu	Lemon	*Citrus limon*	*Rutaceae*	Fruit	Gastritis
40.	Gol morich	Black pepper	*Piper nigrum*	*Piperaceae*	Fruit	Gastrointestinal ailments

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7. Significances of Medicinal Plants for the Betterment of Human Life

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7.1 Abstract:

Adam and Eve lived in heaven and they were familiar neither about the disease nor suffering; once they were expelled then they discovered misery and disease. Necessity is the mother of invention, therefore, since ancient time's man has searched for remedies to combat against several diseases Ever since the ancient times, in search for rescue of their disease, people looked for drugs in nature. The use of plants as medicine is increasing worldwide.

Some of the plants have been found to possess significant antibacterial, antifungal, anticancer, anti-inflammatory and anti-diabetic properties. Medicinal plants are important source to combat the serious diseases in all over the world. Medicinal plants are useful for curing human diseases and play an important role in healing due to presence of phytol chemical constituents. The natural and unique medicinal plants are used for curing various ailments. The significance of medicinal plants in the treatment of diseases increases every day. These plants have healing properties and the present chapter focuses on the medicinal uses of plants.

Keywords: medicinal plants, sustainable human health, treatment of diseases……

7.2 Introduction:

The term of medicinal plants include a various types of plants used in herbal methods and some of these plants have a medicinal activities. These medicinal plants consider as a rich resources of ingredients which can be used in drug development and synthesis. Moreover, some plants consider as important source of nutrition and as a result of that these plants recommended for their therapeutic values. These plants include ginger, green tea and some others plants. Early, in the 19th century there was a landmark in the knowledge and use of medicinal plants. It has been estimated that about 13,000 species of plants have been employed as traditional medicines by various cultures around the world. . A list of over 20,000 medicinal plants has been published[2-9]. Some of the drugs believed to be obtained from plants are aspirin, atropine, artemisinin, colchicine, digoxin, ephedrine, morphine, physostigmine, pilocarpine, quinine, quinidine, reserpine, Taxol, tubocurarine, vincristine and vinblastine. Historically, man has explored the nature for two major needs: food for survival and herbs for relieving of pain and diseases. . Worldwide, consumers have a positive intention toward the herbal products. Presently, herbal medicines are often used for healthcare in both developed and developing countries. It is a fact that herbal medicines are natural products and proved to be safe both due to their less side-effect while being used to treat diseases[10-16]. The Indian holy book, Vedas, mentions treatment with plants, which are abundant in country. Many spice plants, such as nutmeg, pepper, clove, etc., that have been used even today originated from India. The use of medicinal plants is increasing worldwide, in view of the tremendous expansion of traditional medicine and a growing interest in herbal treatments. Plants are used in medicine to maintain health physically, mentally and spiritually as well as to treat specific conditions and ailments. Traditional medicine has maintained its popularity in the developing world and its use is rapidly spreading in industrialized countries. Many of the pharmaceuticals currently available to physicians have a long history of use as herbal remedies, including opium, aspirin, digitals and quinine. The use of medicinal plants is increasing worldwide, in view of the tremendous expansion of traditional medicine and a growing interest in herbal treatments.

7.3 Classification of Medicinal Plants:

Classification of medicinal plants is depending on the criteria used. In general, medicinal plants are arranged according to their active storage organs of plants, particularly roots, leaves, flowers, seeds and other parts of plant. They are valuable to mankind in the treatment of diseases.

I. Based on Usage:

The herbs are classified in four parts: medicinal herbs, culinary herbs, aromatic herbs, and ornamental herbs.

- Medicinal Herbs have curative powers and are used in making medicines because of their healing properties like marigold, lemon balm, lavender, Johnny-jump-up, feverfew etc.
- Culinary Herbs are probably the mostly used as cooking herbs because of their strong favours like oregano, parsley, sweet basil, horseradish, thyme etc.
- Aromatic Herbs have some common uses because of their pleasant smelling flowers or foliage. Oils from aromatic herbs can be used to produce perfumes, toilet water, and various scents. For e.g. mint, rosemary and basil etc.
- Ornamental Herbs are used for decoration because they have brightly colored flowers and foliage like lavender, chives, bee balm and lemongrass.

II. Based on the Active Constituents:

According to the active constituents all herbs are divided into five major categories: Aromatic (volatile oils), Astringents (tannins), Bitter (phenol compounds, saponins, and alkaloids), Mucilaginous (polysaccharides), and Nutritive (food stuffs).

- **Aromatic herbs:** The name is a reflection of the pleasant odor that many of these herbs have. They are used extensively both therapeutically and as flavorings and perfumes. Aromatic herbs are divided into two subcategories: stimulants and nerviness.
- **Stimulant herbs:** increase energy and activities of the body, or its parts or organs, and most often affect the respiratory, digestive, and circulatory systems. e.g., fennel, ginger, garlic, lemongrass.
- **Astringent Herbs:** tannins in Astringent Herbs have the ability to precipitate proteins. They affect the digestive, urinary, and circulatory systems, and large doses are toxic to the liver. They are analgesic, antiseptic, an abortive, astringent, emmenagogue, hemostatic, and styptic.

III. Based on Nature:

Natural products are compounds consisting essentially of carbon derived from natural sources and that generally have very diverse and interesting properties. Some of the most relevant applications of the Natural Organic Products are using it as Fuels, plastics, fats, soaps, sugars.

Soap: it is the sodium salt of a fatty acid. Have a partly hydrophilic (dissolves in water) and other lipophilic (fat dissolves dirt).

Sugars: these are natural polyhydroxialdehides or polyhydroxiketones with different functions: structure, energy storage components of the nucleic acids, etc. They are formed by photosynthesis in plants and are classified into monosaccharides (glucose), disaccharides (sucrose) and polysaccharides (cellulose, starch, etc.).

IV. Based on their Physiological Activity:

Approximately one half of the medicines used today are natural products, i.e. alkaloids, antibiotics or synthetic analogs. For that it is usually employed a classification that represents the physiologic activity, such as hormones, vitamins, antibiotics and mycotoxins.

Even though the compounds belonging to each group have different structures and biogenetic origins, a narrow relationship is occasionally between those aspects and activity.

Plants as Drugs: A number of plant species are being used in various human health's around the world. Plant species contain active ingredients such as alkaloids, phenols, tannins and terpenoid (Table.1 and Table.2). These ingredients have been used and found effective as sweeteners, anti-infections and anti-bacterial.

For instance, the bark of *Alstonia boonei* contains alkaloids and histamine, which are useful in the treatment of fever, dizziness and high blood pressure. Ginger (*Zingier officinal*) (Source[17]) and Garlic (*Allium sativum*) (Source[18]) are spicy additions to food that has long been used to maintain human health. It is not an exaggeration to say that medicinal plants have a great role to play in sustainable human health.

Plants have been used as a source of drugs by mankind for several thousand years. With the advancement of synthetic organic chemistry most of the active constituents of plants used in medicine were synthesized. World Health

Organization (WHO) reported that 80% of the earth's population rely on traditional medicine for their primary health care needs and most of this therapy involves the use of plant extracts and their active components.

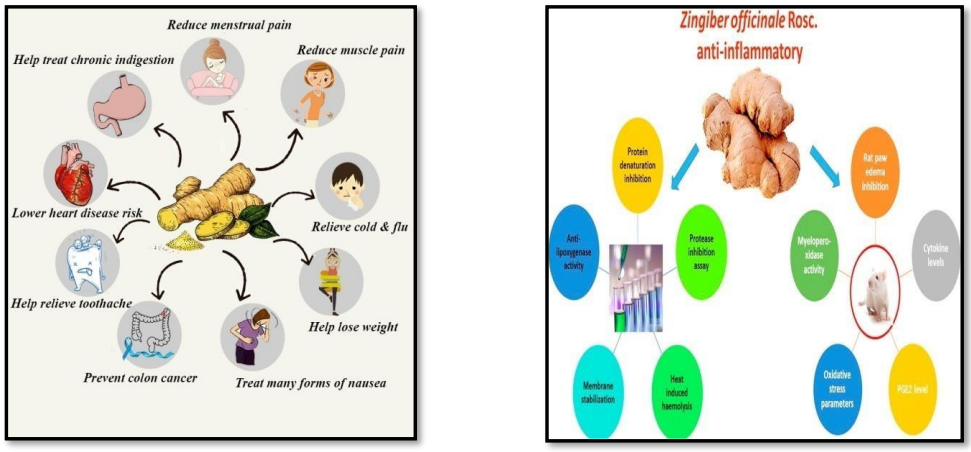

Image 7.3: Medicinal and Anti-inflammatory functions of Ginger (*Zingiber officinale*).

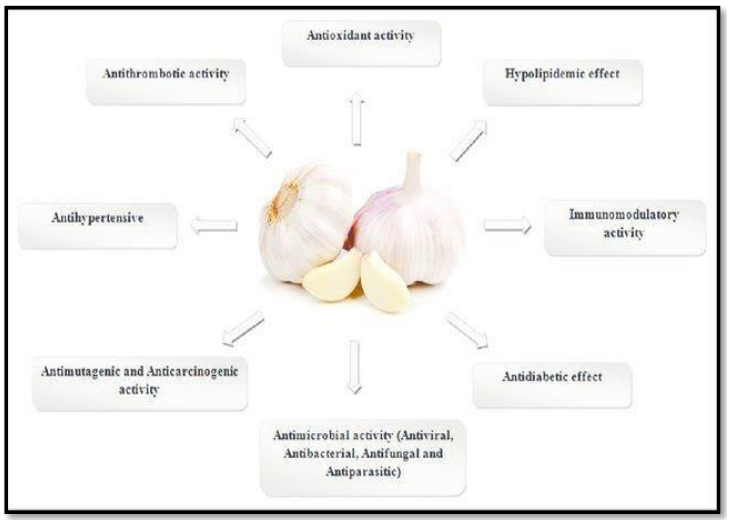

Image 7.4 Medicinal Uses of Garlic (*Allium sativum*)

Medicinal plants have provided mankind a large variety of potent drugs to all eviate or eradicate infections and suffering from diseases in spite of advancement in synthetic drugs, some of the plant-derived drugs still retained their importance and relevance.

The use of plant-based drugs all over world is increasing. Through recent researches on herbal plants or medicine, there have been great developments in the pharmacological evaluation of various plants used in traditional systems of medicine.

Table 1: Some medicinal plants having good antioxidant potential.

Name of the Plant	Part of the Plant	Active Component(s)
Acorus calamus	Rhizomes	Alkaloids
Aegle marmelos	Leaves	Alkaloids, Terpenoids, Saponins
Aloe vera	Leaf	Vitamin A,C,E, Carotenoids
Andrographis paniculata	Whole plant	Diterpenes, Lactones
Carica papaya	Leaves	Terpenoids, Saponins, Tanins
Cassia fistula	Bark	Flavonoids

Table 2: Commonly used plants as herbal drugs

Sr. No.	Plants Name		Plants Parts use in Disease
1.	*Abutilonindicum* (Kanghi)		Seeds are used as laxative and in hemorrhoids (piles)
2.	*Senegalia catechu or Acaciacatechu* (Khair)		The bark of the tree is used in chronic diarrhea.
3.	Acacianilotica (Babul)		The twig of the plant is used as natural toothbrush.
4.	Adhatodavasica (Vasaka)		The leaves are given to cure asthma.
5.	Aloevera (Gwarpatha)		The peelings of the leaves are used in skin burn and also used in facial creams.
6.	Andrographis (Kalmegh)	paniculata	The plant is used for malarial fever.
7.	Anisomelos (Bhandari)	indica	Leaves used in cough and cold.
8.	Anogeissus (Dhawra)	latifolia	Leaves are used in diarrhea.
9.	Argemone (PiliKatari)	mexicana	The extract is used in various skin diseases.
10.	Azadirachta indica (Neem)		Bark is useful in malarial fever.
11.	Boerhaavia diffusa (Punarnava)		Plant used in urinary troubles and in skin diseases.
12.	Catharanthus roseus (Sadabahar)		The leaves and flowers are used to reduce sugar level.

Sr. No.	Plants Name	Plants Parts use in Disease
13.	Cyperus scariosus	The tubers are used in urinary and heart troubles.
	(Nagarmotha)	
14.	Datura metel L.(Dhatura)	Smoke of seeds inhaled in bronchial troubles.
15.	Gymnema sylvestre (Gurmar)	The leaves of the plant are used in diabetics.
16.	Ocimum sanctum (Tulsi)	The leaves are used to cure cough, cold and ulcers.
17.	Urginea indica (Jangli pyaj)	The juice of the bulb is used in respiratory disorders.
18.	Vitex negundo (Nirgundi)	The extract of the leaves is used in body pain.

The role of medicinal plants in human health is clearly enormous. Out of the 252 drugs considered as basic and essential by the World Health Organisation (WHO), 11% are exclusively of plant origin and a significant number are synthetic drugs obtained from natural precursors.

It is estimated that 60% of anti-tumor and anti-infectious drugs already on the market or under clinical trial are of natural origin. Plant derived agents are also being used for the treatment of cancer. Several anticancer agents including vincristine, Taxol, vinblastine, derivatives, irinotecan and topotecan and etoposide derived from epipodophyllotoxin are in clinical use worldwide.

7.4 Conclusion:

Medicinal plants belong to a big plant group with a great interest due to its pharmaceutical, cosmetic and nutritional application. Herbal medications are free from side effects and toxicity. Presently many countries face large increases in the number of people suffering from diseases like diabetes, diarrhea, cancer, rheumatism, inflammation, jaundice, hepatic obstruction, pain, cold, cough, etc. remedies from medicinal plants are used with success to treat the disease.

Plants have provided humans with many of their essential needs. However, medicinal plants are threatened as a result of human impact and uncontrolled wild collection, it is therefore recommended that deliberate efforts are essential for continuous supply of these plant species.

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