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Anti-Tubercular Activity of Indian Medicinal Plants – A Review

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ABSTRACT

Tuberculosis is a bacterial infectious disease caused by Mycobacterium tuberculosis. It is highly infectious and opportunistic disease. The synthetic drugs for anti-tuberculosis effect have been prescribed for symptomatic control of disease but produce much adverse effect. Naturally obtaining medicinal plants are incomparable resources of Siddha. From thousands of years, medicinal plants provide a great hope to curing diseases. This review spotlights the effort on anti-tubercular plants, which are various source of literature. This paper provides the plant description, chemical constituents, evidence based pharmacological activity. This will motivate and provide a way for further researches on medicinal plants, possess potent anti- tuberculosis activity.

Keywords: Tuberculosis, Anti-tubercular activity, Medicinal plants, Siddha.

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INTRODUCTION

Tuberculosis is a highly infectious disease caused by bacteria Mycobacterium tuberculosis. It is chiefly an opportunistic infection of poor community and 98% of mortality rate occurring in developing countries[1]. Hence, most important cause for death in throughout the world[2].

The development of science and community health of this disease was and evidence that it belongs to the very distant part[3]. Each year about 8 million new cases and 2 million deaths occur in worldwide[4]. In 1993, the WHO announced it to be global emergency[1].

Tuberculosis is a serious health problem due to various types of resistance[5]. Increased resistance has become a global concern[2]. So many research groups are pay particular attention and discovering novel anti-tuberculosis agents which provides greater effectiveness, less toxicity and particular mechanism of action. Anti-tuberculosis drugs are of two groups – first line and second line drugs. These drugs are two edged sword[6]. Here second line drugs have more adverse effect than the other[7]. The adverse effect of anti-tuberculosis drugs is given in table below [8-10]. Apart from adverse effect, there is always a possibility of "relapse tuberculosis" due to discontinuation of chemotherapy[11].

Crude materials are the source of natural products they have effectiveness against various diseases and used for many periods of practical experiences. Despite, many efficacious medicines, including Morphine, Digitoxin, Aspirin, and Atropine were developed from natural products[12].

India is one of the few countries in the world which has incomparable resources of medicinal plants and huge widespread information of herbal medicine for various diseases [13], [14]. Medicinal plants provide a great hope to realize the needs and used for curing diseases for thousands and thousands of years. Only a few plant species have been thoroughly examined for their medicinal properties [15].

Table: Adverse effects of Anti-TB drugs [8-10]

Drugs	Adverse effect
Isoniazid	Skin rash, hepatitis
Rifampicin	Hepatitis, Thrombocytopenic purpura
Pyrazinamide	Arthralgia, Hepatitis
Streptomycin	Vestibular and auditory nerve and Renal damage
Ethambutol	Retro bulbar neuritis, Ocular side effects
Thioacetazone	Skin rash, Exfoliative dermatitis
Kanamycin	Vertigo, Auditory nerve damage, Nephrotoxicity
Ethionamide	Hepatotoxicity
Cycloserine	Depression, psychosis, Convulsions

Hence, by elongate our wide description into plant kingdom, we could get a remarkable solution towards the acquirement of the enfeeble disease "A New phyto-look to the old killer" [16].

A brief description of anti-tubercular plants in Siddha:

Piper nigrum

Taxonomical classification:

Kingdom	:	Plantae
Class	:	Equisetopsida
Sub class	:	Magnoliidae
Super order	:	Magnolianae
Order	:	Piperales
Family	:	Piperaceae
Genus	:	*Piper*
Species	:	*P. nigrum*

Plant description:

Piper nigrum (Black pepper) plant is a flowering woody perennial climbing vine that belongs to Piperaceae family. Pepper plants easily grow in the shade on supporting trees, trellises or poles up to maximum height of 13 feet or 4 meters and roots may come out from leaf nodes if vine touch to the ground. The plants have heart shape alternate leaves with typically large size of 5-10 cm in length and 3-6 cm across, with 5 to 7 prominent palmate veins. The flowers are small, monoecious with separate male and female flowers but may be polygamous which contain both male and female flowers. The small flowers are borne on pendulous spikes at the leaf nodes that are nearly as long as the leaves. The length of spikes goes up to 7-15 cm. The black pepper's fruits are small (3 to 4 mm in diameter) called a drupe and the dried unripe fruits of *Piper nigrum* are known as a peppercorn. The fully mature fruits are dark red in colour and approximately 5 mm in diameter. A fruit contains a single seed. The plants bear fruits from 4th or 5th year, and continue to bear fruits up to seven years. A single stem contains 20-30 spikes of fruits. The collected spikes are sun dried to separate the peppercorns from the spikes. The fresh harvested unripe green fruits may freeze-dry to make green pepper. The fresh harvested unripe green fruits may sun-dried to make black pepper. The red skin of the ripen fruits is removed and the stony seeds are sun-dried to make white pepper [17].

Chemical composition:

The phytochemical investigations of *P. nigrum* revealed that it contains variety of

phytochemicals. Piperine was the first pharmacologically active compound isolated from different members of Piperaceae family. Many investigators isolated different types of compounds viz Phenolics, flavonoids, alkaloids, amides and steroids, lignans, neolignans, terpenes, chalcones etc and many other compounds. Some of the compounds are Brachyamide B, Dihydro-pipericide, (2E,4E)-N-Eicosadienoyl-pereridine, N-trans-Feruloyltryamine, N-Formylpiperidine, Guineensine, pentadienoyl as piperidine, (2E,4E)Nisobuty- ldecadienamid, isobutyl-eicosadienamide, Tricholein, Trichostachine, isobutyl-eicosatrienamide, Isobutyl-octadienamide, Piperamide, Piperamine, Piperettine, Pipericide, Piperine, Piperolein B, Sarmentine, Sarmentosine, Retrofractamide . The different pharmacological activities were reported due to the presence of these phytochemicals. Piperine reported to have four isomers viz; Piperine, Isopiperine, Chavicine and Isochavicine. Among all isolated compounds isolated from P. nigrum. Piperine, pipene, piperamide and piperamine were found to possess diverse pharmacological activities [18].

Pharmacological activities:

Anti-tuberculosis activity of *Piper nigrum* against *Mycobacterium tuberculosis* in $H_{37}Rv$ using Microplate Alomar Blue Assay possess activity against organism has proved [19].

Glycyrrhiza glabra

Taxonomical classification

Kingdom	:	Plantae
Division	:	Magnoliophyta
Order	:	Fabales
Family	:	Fabaceae
Genus	:	*Glycyrrhiza*
Species	:	*G. glabra*

Plant description:

The liquorice shrub is a member of the pea family and grows in subtropical climates in rich soil to a height of four or five feet. It has oval leaflets, white to purplish flower clusters, and flat pods. Below ground, the liquorice plant has an extensive root system with a main taproot and numerous runners. The main taproot, which is harvested for medicinal use, is soft, fibrous, and has a bright yellow interior. Glycyrrhiza is derived from the ancient Greek term glykos, meaning sweet, and rhiza, meaning root [20]. *Glycyrrhiza glabra* Linn (Fam. Leguminosae) consists of dried, unpeeled, stolon and root .The plant is a tall perennial herb, upto 2 m high found cultivated in Europe. Persia, Afghanistan and too little extent in some parts of India [21]. In India the plant

is cultivated in Punjab and sub Himalayantract [22]. The plant is meant to hold glycyrrhizin, glycyrrhizic acid, glycyrrhetinic acid, asparagine, sugars, resin and starch as main constituents. *G.glabra* or liquorice has been known in pharmacy for thousands of years. In old Chinese pharmacy, it was considered to belong to the drug of first class and to it was ascribed the property of rejuvenating those who consume it for long periods. It was used to allay thirst, feverishness, pain, cough and distress of breathing. For many centuries China has used large quantities of liquorice, and, many preparations of it are still in Chinese apothecary shops. In ancient Egypt, Greece and Rome Glycyrrhiza was also frequently used. Liquorice is referred to by Theophrastus. It is interesting to find that even to this day liquorice is maintaining its place in medicine and pharmacy [23].Liquorice continues to be used as a pharmacological agent as well as an ingredient in tobacco and confectionery throughout India in the East and West. Studies over the past 50 years have yielded information which has prompted new interest in the pharmacological and physiological effects of this plant. This research has revealed that the chemical structure of one of the principle agents in the root of the liquorice plant is a glycoside of a triterpene called glycyrrhetinic acid. Originally its structure and activity were thought to be similar to adrenal steroid hormones such as aldosterone and cortisol, since ingestion of liquorice mimicked hyperaldosteronism and was suggested as a treatment for Addison's disease[24].

Chemical constituents:

A number of components have been isolated from liquorice, including a water-soluble, biologically active complex that accounts for 40-50 percentage of total dry material weight. This complex composed of triterpene, saponins, flavonoids, polysaccharides, pectins, simple sugars, amino acids, mineral salts, and various other substances. Glycyrrhizin, a triterpenoid compound, accounts for the sweet taste of liquorice root. This compound represents a mixture of potassium-calcium-magnesium salts of glycyrrhizic acid that varies within a 2-25 percent range. Among the natural saponins, glycyrrhizic acid is a molecule composed of a hydrophilic part, two molecules of glucuronic acid, and a hydrophobic fragment, glycyrrhetic acid. The yellow colour of liquorice is due to the flavonoid content of the plant, which includes liquiritin, isoliquiritin (a chalcone), and other compounds. The isoflavones glabridin and hispaglabridins A and B have significant antioxidant activity, and both glabridin and glabrene possess estrogen-like activity [25, 26].

Pharmacological activities:

Anti-tuberculosis activity of *Glycyrrhiza glabra* against Mycobacterium tuberculosis in $H_{37}Rv$

using Microplate Alomar Blue Assay possess activity against organism has proved [19].

Lawsonia inermis

Taxonomical classification

Kingdom	:	Plantae
Class	:	Angiosperms
Sub class	:	Eudicots
Super order	:	Rosids
Order	:	Myrtales
Family	:	Lythraceae
Genus	:	*Lawsonia*
Species	:	*L.inermis*

Plant descriptions:

Botanical description it is much branched, deciduous, glabrous, sometime spine scent shrub or small tree with greyish brown bark, attaining a height of 2.4-5 m. It is cultivated as a hedge plant throughout India, and as a commercial crop in certain states of India for its dye [27]. Leaves are 1.3-3.2 by 0.6-1.6 cm, elliptic or broadly lanceolate, acute or obtuse, often mucronulate, base tapering; petioles very short. Flowers are numerous, less than 1.3 cm. across fragrant, white or rose-coloured, in large terminal pyramidal panicled cymes; pedicels short, slender. Calyx 3-5 mm, long broadly campanulate; lobes 2.5-3 mm, long, sub orbicular or subreniform, undulate. Stamens, inserted in pairs on the calyx-tube. Capsules 6 mm, diameter; slightly veined outside, supported by the persistent calyx and tipped with the style [28]. Seed capsules are red, globose, about the size of a pea, with numerous tiny pyramidal, brown pitted seeds.

Chemical constituents:

Leaves:

2-Hydroxy-1, 4-napthoquinone (HNQ; Lawsone) is the principle natural dye contained at 1.0-1 .4 % in the leaves of Henna [29]. Other related compounds present in the leaves are: 1,4dihydroxynaphthalene.1,4naphthoquinone, 1, 2-dihydroxy-glucoyloxynaphthalene and 2-hydroxy-1, 4-diglucosyloxynaphthalene. Flavonoids (luteolins, apigenin, and their glycosides). Coumarins (esculetin, fraxetin, scopletin). Steroids (βsitosterol). The leaves of *Lawsonia inermis* also reported to contain soluble matter tannin, Gallic acid, glucose, mannitol, fat, resin and mucilage [30].

Pharmacological activities:

The tuberculostatic activity of henna was tested in-vitro and in-vivo. On Lowenstein Jensen

medium, the growth of Tubercle bacilli from sputum and of Mycobacterium tuberculosis $H_{37}Rv$ was inhibited by 6 μg/ml of the herb. In vivo studies on guinea pigs and mice showed that the herb at a dose of 5 mg/kg body weight led to a significant resolution of experimental tuberculosis following infection with *Mycobacterium tuberculosis* $H_{37}Rv$[31].

Taxus baccata

Taxonomical classification

Kingdom : Plantae

Class : Pinosida

Order : Pinales

Family : Taxaceae

Genus : *Taxus*

Species : *T. baccata*

Plant description:

Dioecious shrubs or small trees to 15(25) m tall and 50(140) cm breath. Bole straight to contorted, fluted; crown open-conical. Bark scaly, outer scales purplish to purplish brown, inner ones reddish to reddish purple, scales varying widely in size (2-50 mm wide). Branches ascendant to drooping. First-year shoots green, entirely covered by recurrent leaf bases; older twigs red-brown, resembling bark by the third year. Foliage buds inconspicuous, arising terminally or at the adaxial base of a leaf. Leaves green, linear, acute, mucronate, 8-35 mm long, 1-3 mm wide, pliable, often falcate, with a narrow median ridge on the upper surface and stomata in two yellow-green (not glaucous) bands of 5-8 lines on the lower surface, whorled but appearing 2-ranked, with a short (c. 1 mm) petiole and a 5-8 mm long decurrent leaf base; cuticular papillae are present along stomata bands and epidermal cells as viewed in cross section of leaf are mostly taller than wide. Pollen cones solitary or clustered, adaxial on year-old shoots, buds globose, green, ca. 1.5 mm diameter. Seed ovoid, 2-4-angled, 5-6.5 mm, maturing late summer-fall, enclosed in a red aril ca. 10 mm diameter. Wood hard and heavy, about 640 kg/m^3.

Chemical constituents:

The main constituent taxal is present in all parts of the plant especially in leaves, roots and bark of the plant. Taxanes are the most important group of chemical constituents and until now 4 different taxane compounds have been found,all of which are diterpenoid structures. Aamond them three most important members are taxol, cephaslomannine and 10-deacetyl baccatin. In all species, which little variations, taxol occurs from 0.007% to 0.01%. It is mainly obtained from stem bark of t. brevifolia. But the method of isolation is tedious and like vinca, yields are also

less.it needs at least 60 years old 3-4 trees to get 1gm of taxol. Yields 50-150 mg of taxol are obtained from 1 kg dried yew bark. About 10 kg bark is available from an average tree. The most potent compounds include taxol (containing a rare oxetane ring and amide side chain), cephalo mannine (0.031%), baccatin-III (0.084%), and and10-deacetyl baccatin III [32].

Pharmacological activities:

Anti-tuberculosis activity of *Taxus baccata* in susceptible strain *M. tuberculosis* $H_{37}Rv$ using Lowenstein Jensen medium evaluated by percentage of inhibition, calculated by mean reduction in number of colonies on extract containing as compared to extract free controls.

Aqueous extract of the *Taxus baccata* leaves at concentration from 2%, 4%, 6% were tested in vitro for their activity against one MDR isolated reference. Inhibition percentage of this plant is 100%. These plants extract showed promising quantifiable antimicrobial activity against MDR *M. tuberculosis* [33].

Andrographis paniculata

Taxonomical classification

Kingdom	:	Plantae
Division	:	Angiospermae
Class	:	Dicotyledoneae
Order	:	Tubiflorae
Family	:	Acanthaceae
Genus	:	*Andrographis*
Species	:	*A. paniculata*

Plant description:

Andrographis paniculata is an annual, branched, herbaceous plant erecting to a height of 30-110 cm in moist shady places. The stem is acutely quadrangular; much branched and can be broken easily due to its fragile texture. Leaves are simple, opposite, glabrous, lanceolate, 2-12 cm long, 1-3 cm wide with acute entire margin. Inflorescence is terminal and axillary in panicle, 10-30 mm long with small bract and short pedicel. The flowers possess calyx with 5 sepals which are small and linear. Corolla tubes are narrow, about 6 mm long, bilabiate, upper lip oblong, white with a yellowish top, whereas the lower tips are broadly cuneate, 3-lobed, white with violet markings. Stamens 2, inserted in the throat, anther basally bearded. Ovary superior, 2-celled with exerted style. Capsule of the herb is erect, linear-oblong, 1-2 cm long, compressed, longitudinally furrowed on broad faces with thin glandular hairs. Seeds are very small [34].

Chemical constitution

Andrographolide is a colourless or light yellow crystal compound with a very bitter taste [35]. Deng et al. reported that there are four lactones in *Andrographis paniculata* viz., (1) 14-deoxyandrographolide, which was also identified by Sangalungkarn et al. [36] and Garcia et al. [37] (2) andrographolide, (3) neoandrographolide (a non-bitter, C 3 O glucoside derivative of the major constituent andrographolide) and (4) 14-deoxy-11, 12-di-dehydro-andrographolide which were also identified by Dhammaupakorn et al. [38]. Andrographolide and total lactone are the common names used in clinics for the active ingredients [39]. The other medicinal chemical principles are diterpenoid viz. 14-deoxyandrographolide, -19β-D-glucoside which has been isolated from the leaves [40].

Pharmacological activities:

Anti-tuberculosis activity of *Andrographis paniculata* in susceptible strain *M. tuberculosis* H_{37}Rv using Lowenstein Jensen medium evaluated by percentage of inhibition, calculated by mean reduction in number of colonies on extract containing as compared to extract free controls. Aqueous extract of the *Andrographis paniculata* leaves at concentration from 2%, 4%, 6% were tested in vitro for their activity against one MDR isolated reference. Inhibition percentage of this plant is 46%. These plants extract showed promising quantifiable antimicrobial activity against MDR *M. tuberculosis* [33].

6.*Adhatoda vasica*

Taxonomical classification

Kingdom	:	Plantae
Order	:	Laminales
Family	:	Acanthaceae
Genus	:	*Justicia*
Species	:	*J. adhatoda*

Plant description:

Adhatoda vasica Nees. Belongs to the medicinal family Acanthaceae. It is an evergreen shrub of 1-3 feet in height with many long opposite branches. Leaves are large and lance-shaped. Stem herbaceous above and woody below. Leaves opposite and exstipulate. Flower spikes or panicles, small irregular zygomorphic, bisexual, and hypogynous [41]. It has capsular four seeded fruits. The flowers are either white or purple in colour. Its trade name Vasaka is based on Sanskrit name [42]. Inflorescences in axillary spicate cymes, densely flowered; peduncles short; bracts broadly ovate, foliaceous. The leaves, flowers, fruit and roots are extensively used for treating cold

cough, whooping cough, chronic bronchitis and asthma, as sedative, expectorant and anti-spasmodic[43].

Chemical constituent:

The vast variety of pharmacological uses of Adhatoda is believed to be the result of its rich concentration of alkaloids [44]. The prominent alkaloid found in Adhatoda leaves is the quinazoline alkaloid known as vasicine [45]. In addition to vasicine, the leaves and roots of Adhatoda contain the alkaloids l-vasicinone, deoxyvasicine, maiontone, vasicinolone and vasicinol [46]. Research indicates that these chemicals are responsible for Adhatodabronchodilatoreffect [47].

Pharmacological activities:

A chemical constituent of Adhatoda alkaloids, vasicine, produces bromhexine and ambroxol – two widely-used mucolytic. Both of these chemicals have a pH-dependent growth inhibitory effect on Mycobacterium tuberculosis. Indirect effects of Adhatoda on tuberculosis include increased lysozyme and rifampicin levels in bronchial secretions, lung tissue and sputum, suggesting that it may play an important adjunctive role in the treatment of tuberculosis [48].

Aloe vera

Taxonomical classification

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Monocotyledons
Subclass	:	Liliidae
Order	:	Liliales
Family	:	Liliaceae
Genus	:	*Aloe*
Species	:	*A. Vera*

Plant description:

Aloe vera plant has triangular, fleshy leaves with serrated edges, yellow tubular flowers and fruits containing numerous seeds. Leaf is mainly composed of three layers. An inner layer is a clear gel, which contains 99% water and rest is made of glucomannans, amino acids, sterols lipids, and vitamins. The middle layer contains latex which is the bitter yellow sap and contains anthraquinones glycosides and other phytoconstituents. Rind is the outer thickest layer of *Aloe vera* leaves and which is having protective function and also synthesizes carbohydrates and proteins vascular bundles are present inside the rind which is responsible for transportation of

substances such as water (xylem) and starch (phloem) [49].

Chemical constituent:

Aloe vera contains more than 75 potentially active constituents such as anthraquinones glycosides, vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids [50].

a. Anthraquinones:*Aloe vera* contains 12 anthraquinones, which are phenolic compound. These anthraquinones acts as laxatives. Aloin and emodin act as analgesics, antibacterial and antivirals. *Aloe vera* also contains aloetic acid, mucopolysaccharides, glucosamines, saponins, choline and chrysamminic acid.

b. Vitamins:*Aloe vera* contains vitamin A (beta-carotene), vitamin C and vitamin E, which are having antioxidant property. It also contains vitamin B12, folic acid and choline. Antioxidant neutralizes free radicals.

c. Enzymes:*Aloe vera* contains eight enzymes: aliiase, alkaline phosphatase, amylase, bradykinase, carboxypeptidase, catalase, cellulase, lipase, and peroxidase. Bradykinase helps to reduce excessive inflammation when applied topically, while others help in the breakdown of sugars and fats.

d. Others: It contains 20 of the 22 human required amino acids and 7 of the 8 essential amino acids. It also contains salicylic acid that possesses anti-inflammatory and antibacterial properties. Lignin, an inert substance, when included in topical preparations, enhances penetrative effect of the other ingredients into the skin.

Pharmacological activities:

Anti-tuberculosis activity of *Aloe vera* in susceptible strain *M. tuberculosis* H37Rv using Lowenstein Jensen medium evaluated by percentage of inhibition, calculated by mean reduction in number of colonies on extract containing as compared to extract free controls.

Aqueous extract of the *Aloe vera* leaves at concentration from 2%, 4%, 6% were tested in vitro for their activity against one MDR isolated reference. Inhibition percentage of this plant is 51%. These plants extract showed promising quantifiable antimicrobial activity against MDR *M. tuberculosis* [33].

Piper longum

Taxonomical classification:

Kingdom : Plantae

Subclass : Magnoliids

Order : Piperales

Family : Piperaceae

Genus : *Piper*

Species : *longum*

Plant description:

It is having slender, aromatic, perennial climber, with woody roots and numerous wide ovate, cordate leaves. The inflorescence is a cylindrical, pedunculate spike, the female flower is up to 2.5 cm long and 4-5 mm in diameter but the male flower is larger and slender. The fruits are small, ovoid berries, shiny blackish green, embedded in fleshy spikes [51].

Chemical constituent:

Piperine is the major and active constituent of long pepper (*Piper longum*). The piperine content is 3-5% (on dry weight basis) in *P. longum*. The fruit of *P. longum* contains a large number of alkaloids and related compounds, the most abundant of which is piperine, together with methyl piperine, iperonaline, piperettine, asarinine, pellitorine, piperundecalidine, piperlongumine, piperlonguminine, refractomide A, pregumidiene, brachystamide, brachystamide-A, brachystine, pipercide, piperderidine, longamide and tetrahydropiperine, terahydro piperlongumine, dehydropipernonaline piperidine, piperine, terahydropiperlongumine and trimethoxy cinnamoyl-piperidine and piperlongumine have been found in the root of *P. longum*[52-54] .

Pharmacological activity:

Bioactivity guided fractionation concludes that Piperine is the only active ingredients in various fractions of fruit extract evaluated for antibacterial activity. Fraction having piperine has significant activity against multi drug resistant strains of Mycobacterium spp. than other purified fractions of fruit extract. The current finding encourages us to develop new alternative medicine that includes piperine alone and/or in combination with other drugs to fight against the drug resistance among Mycobacterial strains [55].

Withania somnifera

Taxonomical classification:

Kingdom : Plantae

Division : Angiosperms

Class : Eudicots

Order : Solanales

Family : Solanaceae

Genus : *Withania*

Species : *sominifera*

Plant description:

Withania somnifera is an evergreen, erect, branching, tomentose shrub, 30-150 cm in height. Leaves are simple, ovate, glabrous, and up to 10 cm long. Flowers are greenish or lurid yellow, small about 1 cm long; few flowers (usually about 5) born together in axillary, umbellate cymes (short axillary clusters). Fruits are globose berries, 6 mm in diameter, orange red when mature, enclosed in the inflated and membranous persistent calyx. Seeds are yellow, reniform and 2.5 mm in diameter [56].

Chemical constituent:

The roots are reported to contain alkaloids, amino acids, steroids, volatile oil, starch, reducing sugars, glycosides, hentriacontane, dulcitol, withaniol, an acid (m.p. 280-283^0 decomp.), and a neutral compound (m.p. 294-296^0). The total alkaloidal content of the Indian roots has been reported to vary between 0.13 and 0.31 percent, though much higher yields (up to 4.3%) have been recorded elsewhere [57].

Many biochemically heterogeneous alkaloids have been reported in the roots. Basic alkaloids include cuscohygrine, anahygrine, tropine, pseudotropine, anaferine, isopelletierine, withananine, with ananinine, pseudo-withanine, somnine, somniferine, somniferinine. Neutral alkaloids include 3tropyltigloate and an unidentified alkaloid. Other alkaloids include withanine, with asomnine, and visamine. Withanine is sedative and hypnotic. Withasomnine has been separated from the roots of the plant grown in West Germany. Visamine is a new alkaloid which has been separated from the roots of the plant grown in Soviet Union. It prolonged hexanal-induced sleeping time and showed hypothermic and nicotinolytic effects in mice[58] (Rastogi et al., 1998).The free amino acids identified in the root includeaspartic acid, glycine, tyrosine, alanine, proline, tryptophan, glutamic acid, and cysteine[59].

Pharmacological activity:

The view of percent inhibition for aqueous extracts showed that *W. somnifera* has exposed substantial reduction in the growth of Mycobacterium activity and is a prospect for future curative intrusions. It could be seen that *W. somnifera* has shown considerable activity against *M.Tuberculosis*. Aqueous extract of *W. somnifera* (0.01-1.0 mg/mL) had significant effect against *M. tuberculosis* [60].

Zingiber officinalis

Taxonomical classification:

Kingdom : Plantae

Division : Tracheophyta

Class : Magnoliosida

Order : Zingiberales

Family : Zingiberaceae

Genus : *Zingiber*

Species : *officinalis*

Plant description:

The ginger plant is an erect perennial growing from one to three feet in height. The stem is surrounded by the sheathing bases of the two-ranked leaves. A club-like spike of yellowish, purple-lipped flowers have showy greenish yellow bracts beneath. Unfortunately, ginger rarely flowers in cultivation. The ginger of commerce consists of the thick scaly rhizomes (underground stems) of the plant. They branch with thick thumb-like protrusions, thus individual divisions of the rhizome are known as "hands."[61]. Rhizomes are 7-15 cm long and 1-1.5 cm broad and laterally compressed. The branches arise obliquely from the rhizome are about 1-3 cm long and terminate in depress scars or in undeveloped buds. The outer surface is buff- coloured and longitudinally striated or fibrous [62] .Fractured surface shows a narrow cortex, a well-marked endodermis and a wide stele [63].

Chemical constituent:

The pungency of ginger is due to gingerol, an oily liquid consisting of homologous phenols. It is formed in the plant from phenylalanine, malonate and hexonate [64]. In the fresh ginger rhizome, the gingerols were identified as the major active components and gingerol [5-hydroxy-1-(4-hydroxy-3-methoxy phenyl) decan-3-one] is the most abundant constituent in the gingerol series. The powdered rhizome contains 3-6% fatty oil, 9% protein, 60-70% carbohydrates, 3-8% crude fiber, about 8% ash, 9-12% water and 2-3% volatile oil. The volatile oil consists of mainly mono and sesquiterpenes; camphene, betaphellandrene, curcumene, cineole, geranylacetate, terphineol, terpenes, borneol, geraniol, limonene, linalool, alpha-zingiberene (30-70%), beta-sesquiphellandrene (15-20%), betabisabolene (10-15%) and alpha-farmesene. In dried ginger powder, shogaol a dehydrated product of gingerol is a predominant pungent constituent up to biosynthesis [65]. It also contains acrid resinous substances (5-8%). Ginger contains up to three percent of a fragrant essential oil whose main constituents are sesquiterpenoids, with (-)-zingiberene as the main component. Smaller amounts of other sesquiterpenoids (β-sesquiphellandrene, bisabolene and farnesene) and a small monoterpenoid fraction (β-phelladrene, cineol, and citral) have also been identified [66]. Amadaldehyde is a novel compound has been isolated from the ginger extract [67]. Other pungent principles of the rhizomes are

paradols, gingerdiols, gingerdiacetates, gingerdiones, 6-gingersulfonic acid, gingerenones etc. The rhizome also contains diterpenes and gingerglycolipids A, B and C [68]

Pharmacological activity:

Ingenol and [6]–shogaol, isolated from ginger rhizome, demonstrated antiviral activity.32 [10]-gingerol has been reported as active inhibitor of *M. avium* and *M. tuberculosis* in vitro. Gingerol and related compounds have been investigated for antimicrobial activities. [6]- Gingerol and [12]-gingerol, isolated from ginger rhizome, demonstrated antibacterial activity against periodontal bacteria [69].

CONCLUSION:

In all over the world, requirement of phytopharmaceuticals is increased, because of side effect and many unwanted adverse effects of synthetic drugs. This review about anti-tubercular medicinal plant makes an effort to compile of some scientific account of anti-tubercular plants. Many phyto constituent are intent in anti-tubercular activity like alkaloids, flavonoids, tannins, triterpene, Quinone and etc., the inhibitory effect of some plant extracts provide their medicinal use. The investigation provides enlightenment for further research.

REFERENCE:

1. Sharma SK, Mohan A. ‘‘Multidrug-resistant tuberculosis’’. Indian J Med Res. 2004; 120: 354-376
2. Parekh J, Chanda SV. In vitro Antimicrobial Activity and Phytochemical Analysis of Some Indian Medicinal Plants. Turk J Biol. 2007; 31: 53-58.
3. Godreuil S, Tazi L, Banuls AL. ‘‘Pulmonary Tuberculosis and Mycobacterium Tuberculosis: Modern Molecular Epidemiology and Perspectives’’. Encyclopedia of Infectious Diseases: Modern Methodologies 2007; 1: 1-29.
4. Kishore PV, Palaian S, Paudel R, Mishra P, Prabhu M, Shankar PR. ‘‘Drug induced hepatitis with anti-tubercular chemotherapy: Challenges and difficulties in treatment’’. Kathmandu University Medical Journal 2007; 5(2): 256-260
5. Stokstad E. Drug-resistant TB on the rise. Science 2000; 287:2391
6. Johnson R, Elizabeth MS, Louw GE, Warren RM, Helden PDV and Victor TC. ‘‘Drug Resistance in Mycobacterium tuberculosis’’. Curr. Issues Mol. Biol. 2006; 8: 97–112
7. Zaleskis R. ‘‘Adverse Effects of Ant tuberculosis Chemotherapy’’. European respiratory disease 2006; 47-49.

8. Ghosh S, Malik SK, Gupta A, Chaudhary R. ‘‘A prospective, observational cohort study to elicit adverse effects of anti-tuberculosis drugs among patient treated for active tuberculosis’’. The Pharma Research (T. Ph. Res.) 2010; 3: 10-16. 9.
9. NaharBL, Mosharrof Hossain AKM, Islam MM and Saha DR. ‘‘A comparative study on the adverse effects of two anti-tuberculosis drugs regimen in initial two-month treatment period’’. Bangladesh J Pharmacol 2006; 1: 51-57. 10.
10. Yee D, Valiquette C, Pelletier M, Parisien I, Rocher I and Menzies D. ‘‘Incidence of Serious Side Effects from First-Line Anti-tuberculosis Drugs among Patients Treated for ActiveTuberculosis’’. Am J Respir Crit Care Med. 2003; 167: 1472–1477.
11. Swain, B., Mishra, S., Pattnaik, K., Pattnaik, D. and Dutta, P. 2001. Tuberculosis of Calcaneum: A case report. Ind. J. Tub. 48(4): 209-210
12. Kurokawa M, Shimizu T, Watanabe W, Shirak K. ‘‘Development of New Antiviral Agents from Natural Products’’. The Open Antimicrobial Agents Journal, 2010, 2:49-57.
13. Gupta AK, Tandon N, editors.4. Reviews of Indian medicinal plants. New Delhi, India: Indian Council of Medical Research; 2004.
14. Sharma SK. 5. Medicinal plants used in Ayurveda. New Delhi, India: National Academy of Ayurveda, Ministry of Health and Family Welfare, Government of India; 1998
15. Heinrich M, Gibbons S. Ethnopharmacology in drug 3. Discovery: an analysis of its role and potential contribution. J Pharm Pharmacol 2001; 53: 425-32.
16. Sivarajan, V.V. and Balachandran, I. 1994. Ayurvedic drugs and their plant sources. Oxford and IBH Publishing, New Delhi, p. 891.
17. Jaramillo, M.Alejandra; Manos (2000). “Phylogeny and pattern of floral Diversity in the Genus Piper (Piperaceae)”. American journal of Botany.88 (4):706-16. Doi: 10.2307/2657072.
18. Parmar VS, Jain SC, Bisht KS, Jain R, Taneja P, Jha A, et al.(1997) Phytochemistry of the genus Piper. Phytochemistry46:597-673.
19. Anti-tubercular activity and phyto chemical screening of selected medicinal plants. http://dr.doi.org/10.13005/ojc/310176
20. Olukoga A, Donaldson D. Historical perspectives on health. The history of liquorice: the plant, its extract, cultivation, and commercialisation and etymology. J R Soc Health 1998; 118:300-304.
21. Ayurvedic pharmacopoeia of India Part-I vol.I, 168-169.

22. Warrier PK, NambiarVPK, and Ramakutty C.Indian medicinal plants: Orient Longman, Madras, 1994:3(84).
23. Chopra's indigenous drugs of India. Academic publishers Kolkata, Second edition, 1994 page-184-186.
24. Conn. J.W... Rower, D.R. And Cohen, E.L. (1968) J. Am. Med. Assoc. 205: 80-84.
25. Obolentseva GV, Litvinenko VI, Ammosov AS, et al. Pharmacological and therapeutic properties of liquorice preparations (a review). Pharm Chem J. 1999; 33:24-31.
26. Yamamura Y, Kawakami J, Santa T, et al. Pharmacokinetic profile of glycyrrhizin in healthy volunteers by a new high performance liquid chromatographic method. J Pharm Sci 1992; 81:1042-1046.
27. Nadkarni K.M. (1982). Indian Materia Medica, Vol. 1. Popular Book Depot, Bombay, India, 730-73.
28. Sukh Dev (2006). A selection of prime Ayurvedic Plant Drugs, Ancient- modern concordance. Anamaya Publishers, New Delhi, 276-279.
29. Kirkland D. and Marzin D. (2003). An assessment of the genotoxicity of 2-hydroxy1, 4-naphthoquinone, the natural dye ingredient of Henna. Mutation Research, 537: 183-199.
30. Nayak B.S., Isitor G., Davis E.M. and Pillai G.K. (2007). The evidence based wound healing activity of Lawsonia inermis Linn. Phytotherapy Research, 21: 827-831
31. Sharma V.K. (1990). Tuberculostatic activity of henna Lawsonia inermis Linn. Tubercle, 71: 293-296.
32. An overview of taxus Volume 3, Issue 29, June, 2015, 01-07 ISSN: 2320 – 4230.
33. Effect of selective medicinal plants against multi drug resistance Mycobacterium tuberculosis strains 4(3): 812-817 July 2013.
34. Niranjan A, Tewari SK, Lehri A (2010) Biological activities of Kalmegh (Andrographis paniculata Nees) and its active principles-A review. Ind J Nat Prod Resour 1: 125-135.
35. SCHRI (1973) Sichuan Chinese Herb Research Institute. Review of chemical studies on A. paniculata. Journal of New Medicinal and New Drugs 23-30.
36. Tang, W, Eisenbrand G (1992) Chinese drugs of plant origin: chemistry, pharmacology and use in traditional and modern medicine. Springer-Verlag, Germany.
37. Sangalungkarn V, Thummauppakorn P, Kittiyanee U, Chaichantipyuth C (1990) the effect of andrographolide, neoandrographolide and 14-deoxy-11, 12- dedehydro-andrographolide on the intestinal motility of white rat. Journal of Pharmaceutical Sciences 15: 5-7.

38. Garcia LL, Kintanar QL, Fojus FR, Sison FM, Chua NG, et.al. (1980) Pharmacologic studies on the leaves of Andrographis paniculata Nees plant grown in the Philippines. Acta Medica Philippina 16: 59-68.
39. [No authors listed] (1978) the promotion and development of traditional medicine: report of a WHO meeting. World Health Organ Tech Rep Ser: 1-41.
40. Jarukamjorn K, Nemoto N (2008) Pharmacological aspects of Andrographis paniculata on Health and its Major Diterpenoid Constituent Andrographolide. Jounal of Health Science 54(4):370-381.
41. Shinwari ZK, Shah M. The Ethnobotany of Kharan district, Balochistan, Pakistan. Proc Sym Med Pl 1995; 12:35-38.
42. Kumar KPS, Debjit B, Chiranjib PT, Rakesh K. Indian traditional herbs Adhatoda vasica and its Medicinal application. J Chem Pharm Res 2010; 2(1):240-245.
43. Pandita K, Bhatia MS, Thappa RK, Agarwal SG, Dhar KL, Atal CK. Seasonal variation of alkaloids of Adhatoda vasica and detection of glycosides and N-oxides of vasicine and vasicinone. Planta Medica 1983; 48:81-82.
44. Shrivastava N, Shrivastava A, Banerjee A, Nivsakar M, Anti-ulcer activity of Adhatoda vasica Nees. J Herb Pharmacother 2006; 6(2):43-9.
45. Dhar KL, Jain MP, Koul SK, Atal CK. Vasicol, a new alkaloid from Adhatoda vasica. Phytochemistry 1981; 20(2):319.
46. Jain MP, Sharma VK. Phytochemical investigation of roots of Adhatoda vasica. Planta Medica 1982; 46:250.
47. Bhalla HL, Nimbkar AY. Preformulation studies III. Vasicinone, a bronchodilatory alkaloid from Adhatoda vasica Nees (absorption, potency and toxicity studies). Drug Dev Indian Pharm 1982; 8(6):833.
48. Grange JM, Snell NJC. Activity of bromhexine and ambroxol, semi-synthetic derivatives of vasicine from the Indian shrub Adhatoda vasica, against Mycobacterium tuberculosis in vitro. Journal of Ethnopharmacology 1996; 50(1):49.
49. Tyler V. The honest herbal: A sensible guide to the use of herbs and related remedies. Binghamton, New York: Pharmaceutical Products Press; 1993
50. Shelton RM. Aloe vera. Its chemical and therapeutic properties. Int J Dermato, 1991; 30(10): 679-83.
51. Williamsons, Piper longum,Major herbs of Ayurveda, 1st Edn, and Dabur research foundation, Dabur Ayurvet Limited, Elsevier health science, 2002, pp. 225-227.

52. Parmar VS, Jain SC, Gupta S, Polyphenols and alkaloids from Piper species.Phytochem, 49(4), 1998, 1069-1071.
53. Tabuneng W, Bando H, Amiya T, Studies on the constituents of the crude drug Piper Longi Fructus. Chem and Pharma Bull, 31(10), 1983, 3562-3565.
54. Shankaracharya NB, Rao LJ, Naik JP, Nagalakshmi S, Characterization of chemical constituents of Indian Long Pepper, J Food Sci Tech, 34(1), 1997, 73-75.
55. Anti-mycobacterial activity of piper longum l. fruit extracts against multi drug resistant mycobacterium spp.Vol 3, No 3 (2011)http://dx.doi.org/10.5138/ijpm.v3i3.361
56. Anonymous. The Unani Pharmacopoeia of India. Part I, Vol. I, Depatt. Of AYUSH, Ministry of Health & Family Welfare, Govt. of India, New Delhi (2007) 7-8.
57. Anonymous. The Wealth of India. Vol. X (Sp-W), Publications and Information Directorate, Council of Scientific and Industrial Research (CSIR), New Delhi (1982) 580-585
58. Rastogi RP and Mehrotra BN. Compendium of Indian Medicinal Plants. 2nd Reprint, Central Drug Research Institute, Lucknow and National Institute of Science Communication, Council of Scientific and Industrial Research, New Delhi (1998) Vol. 1: 434-436; Vol. 2: 708-710; Vol. 3: 682-684; Vol. 4: 765-766; Vol. 5: 889-891; Vol. 6: 148.
59. Khare CP. Indian Medicinal Plants–An Illustrated Dictionary. First Indian Reprint, Springer (India) Pvt. Ltd., New Delhi (2007) 717718.
60. Anti-mycobacterial activity of Withania somnifera and Pueraria tuberos against Mycobacterium tuberculosis H_{37}Rv.Vol. 1(4) September 2012ISSN: 2278-5213.
61. Bisset NG and Wichtl M, Herbal Drugs and Phytopharmaceuticals, Medpharm Scientific Publishers: (1994).
62. Evans WC. Trease and Evans Pharmacognosy, 16th Edn, Saunders Elsevier: 289-292, (2002).
63. Ali M. Text book of Pharmacognosy, 2nd Edn, CBS publishers and Distributors: 258262, (1998).
64. Evans WC. Trease and Evans Pharmacognosy, 16th Edn, Saunders Elsevier: 289-292, (2002).
65. Mustafa T, Srivastava KC and Jensen KB, Drug Development Report: Pharmacology of ginger, Zingiber officinale. J Drug Dev, 6 (24): (1993).

66. McGee and Harold. On Food and Cooking: The Science and Lore of the Kitchen, 2nd Edn. Scribner: 425-426, (2004).
67. Policegoudra RS, Rehna K, Rao LJ, Aradhya SM, Antimicrobial, antioxidant, cytotoxicity and platelet aggregation inhibitory activity of a novel molecule isolated and characterized from mango ginger (Curcuma amada Roxb.) rhizome. Journal of Bioscience, 35(2): 231-40, (2010).
68. Anonymous. Indian Herbal Pharmacopoeia, Vol 2, Indian Drug Manufacturer's Association and Regional Research Laboratory: 163-173, (1999).
69. Miri P, Bae J and Lee DS. Antibacterial activity of [10]-gingerol and [12]-gingerol isolated from gingerrhizome against periodontal bacteria. Phytothery Res. 2008; 22:1446-1449