

An Insight on Traditional System of Medicine in Pharmaceutical Industry, with Pharmacological Profile Reporting on Devadaru and Indian Rhubarb: Vital to Pharmaceutical Research Endeavor

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Abstracts: The first record of practice of traditional medicine by humans comes from the tablet around 2600 B.C. old. The tablet mentions the significance and use of oils from *Cedrus species* (Cedar), *Cupressus sempervirens* (Cypress), *Glycyrrhiza glabra* (Licorice), etc. vital plants of that time. In recent times change in behavior of industry seems to take place, where they are now reverting back towards in traditional medicines and herbs. A quick show up of the present scenario indicates a surge in, the Global herbal supplements and remedies market, reaching to Rs. 9315 crores, comparatively in lead is the Indian Herbal Market with extreme growth expectations to Rs. 14,500 crore (2015). Herbal exports project market size of Rs. 9000 crores by 2015. However, Chinese herbal medicinal market poses big threat, so urgent need is required to build regulated traditional medicine practice in par with international standards. Realizing this fact, the review puts light on traditional system of medicine scenario in India, hurdles and ways to overcome them, along with description upon two essential herbs *Cedrus deodara* and *Operculina turpethum*, as an example to justify potential and expertise India could achieve in Drug Industry in coming future.

INTRODUCTION

Traditional system of medicine has been in use by *Homo sapiens* since years, man started learning from the nature and depending upon the nature for his mundane actions. Gradually and slowly a fundamental knowledge (in other words traditional system of medicines) got developed via accidental experiments or chance discoveries. The first record of practice of traditional medicine by humans comes from the tablet around 2600 B.C. old. The tablet mentions the significance and use of oils from *Cedrus species* (cedar), *Cupressus sempervirens* (cypress), *Glycyrrhiza glabra* (licorice), *Commiphora species* (myrrh), and *Papaver somniferum* (poppy juice).^[1] This is soul base for the development of Ayurveda, complementary or non-conventional system of medicines. This signifies the supremacy of traditional medicines in medical industry. Therefore, in conducting research on traditional system of medicines these valuable expertise (available through texts, such as *Materia medica*) shall be respected and given due consideration by the pharmaceutical giants looking for alternative to hold market in the time of dyeing blockbuster molecule model era (*Loss of profits due patent upliftment from Lipitor*). Recognizing such importance of these technical proficiency, due considerations are not given in many countries except, European Union, which has lately set up a regulation body to control the production and practices of herbal medicines and technical expertise. On shifting the whole prototype model being followed by pharmaceuticals, in the direction, of herbal leads i.e. isolating and refining valuable phytoconstituents, a profit earning endeavor would get established to serve mankind in better way at economical reach for the needy ones, at faster rate due faster regulatory clearance because of low incidence of adverse reactions. Moreover more than 80 % of the population residing in India and Asian block 'prefer'

traditional medicines for their primary healthcare needs. This gives another advantage for pharmaceutical giants as the degree of acceptability is already established and drugs launched over-the-counter would be highly successful drive. Considering the vital importance for the profitable drug lead sources, two plants *Cedrus deodara*, *Operculina turpethum*, holding apex position in Ayurvedic practices, have been selected. A light on pharmacological actions hypothesis based on present phytoconstituents The present review is an attempt to develop a concise understanding of the explored pharmacological potential in these plants along with hypothesis and setting platform for think process while selecting plant for animal experimentation.^[2-3]

Pharmaceutical Industry and Herbal Medicine

Global pharmaceutical market is forecasted to grow at a CAGR (compounded annual growth rate) of 9 % by 2015 compared to 6.5 % during the 2012-2013. Factors dominating the drive are low cost innovative drugs being launched currently, increasing per capita income and rising awareness of diseases and alternative medicines. Compared to Global pharmaceutical market, Indian pharmaceutical market is forecasted to grow at a CAGR of 15.9 % between 2010 and 2015, doubling in five years to whopping Rs.119677 crore.

Global herbal supplements and remedies market would reach upto Rs. 9315 crores by 2015. Major manufacturers of herbal supplements and remedies have their set ups in developing countries, including India, so high growth opportunity lies for Nutraceutical Industry in India. Indian Herbal Market is registering an extremely increase in growth, with projected size to reach to Rs. 14,500 crore in 2015 with exports to Rs. 9000 crores at annual growth rate of approximately 25 % (Associated Chambers of Commerce and Industries of India).^[5-7]

Plants render an enormous opportunity for pharmaceuticals to explore potential prospective leads for target diseases. It's estimated that approximately 5-15 % of

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Table 1: *Cedrus deodara* (Roxb.) Loud

Scientific Classification	
Kingdom	Plantae
Division	Pinophyta
Class	Pinopsida
Order	Pinales
Family	Pinaceae
Genus	Cedrus
Species	<i>C.deodara</i>

Table 2: *Operculina turpethum* (Nishotra) [50]

Scientific Classification	
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Solanales
Family	Convolvulaceae
Genus	<i>Operculina</i>
Species	<i>Turpethum</i>

total 250,000 species have been systematically investigated, and yet the potential plants which could prove to be prospective novel drug leads, still needs to be explored and unveiled. [8] An annual report published by the Ministry of environment and forests, government of India, for financial year 2009-2010, mentions around 960 plants being in use via trades. [9] The increasing interest or heave towards herbal medicines can be visualized with increase in production of herbal drugs of worth US \$ 813.5 million (Rs. 4000 crores) through 1650 herbal formulation, being sold in Indian markets. *Emblica officinalis* Gaertn. (Phyllanthaceae; amla) is the highest consumed botanical drug in herbal medicinal market in India, whereas isabgol (Psyllium husk), senna (leaves and pods), henna (leaves and powder) and myrobalans account for almost 70 % of total exports of raw drugs from India. A survey has reported that three of the ten most widely soldherbal medicines in developing countries like *Allium sativum*, *Aloe barbedensis* and *Panax* species; are grown in India. All these facts just focuses upon the richness India holds, even after being ruled by Britain for 200 years, India still is Golden Bird, now in terms of pharmaceutical raw input and its diversification. [10-12]

The biggest issues for herbal medicine not so widely commercialized are, Quality, as there is lack of scientific and technical know-how with farmers growing these valuable medicinal plants. The care needed to preserve the vital medicinal elements in these plants is unknown widely, plus scarcity of proper storage facilities, leading to wastage and diversification to other commercial crops.

Apart from these other issues which come in between herbal leads being accepted, are consumer perception (changing now in urban areas) and regulation guidelines. Though WHO has set up guidelines to regulate every aspect of traditional medicines, but very few companies and governments across globe have come forward to support it. Metal impurities are the major concern for the lower efficacy and some reported adverse effects in herbal medicines. For Indian herbal market, Chinese herbal

medicinal market poses big threat, though India lies ahead in the use of medicinal plants by 7000 compared to 5000 by Chinese. But, Chinese traditional system of medicines has established itself well in the international market. A new ray of hope lies ahead in the growth scenario for the Indian traditional medicines, as Indian government has now started supporting Indian traditional system of medicines, whether it's Ayurveda, Unani, Sidha or Homeopathic through setting up of central research laboratories like, Central drug research institute, Central Institute of Medicinal and Aromatic plants and national botanical research institutes, backed by scientific expertise and qualified manforce. [13]

SWOT ANALYSIS OF SETTING UP TRADITIONAL MEDICINE BASE COMMERCIALY BY PHARMACEUTICAL BIG-WIGS IN INDIA

Botany and Morphology of Selected Plants

Cedrus deodara

Cedrus or true *Cedars* are valuable timber trees and prominent specimen plantings in the urban landscape. The true *Cedars* consist of four main species of tall, oleoresin-rich, monoecious, coniferous, evergreen trees. [16-19] The *Cedars* are geographically restricted in the highest mountain ranges in between the 15° W and 80° E and 30° to 40° N. Its mainly restricted to areas from 1) Atlas mountains of North Africa, in northern Morocco and northern Algeria; 2) Turkey, the mountains on Cyprus and along the eastern border of the Mediteranean sea in Syria and Lebanon; and 3) the Hindu kush, karokoram and Indian Himalayas. [19] *Cedrus deodara* also known as Deodar, Himalayan *Cedar*, or Deodar in Sanskrit and Xue in Chinese, are evergreen coniferous trees reaching 40 m to 50 m tall.

Traditional Significance

Cedars have been addressed as "*devadaru*"; meaning wood of gods, Hindus have been worshiping it as a devine tree. Forests full of '*devadaru*' have been an attraction for

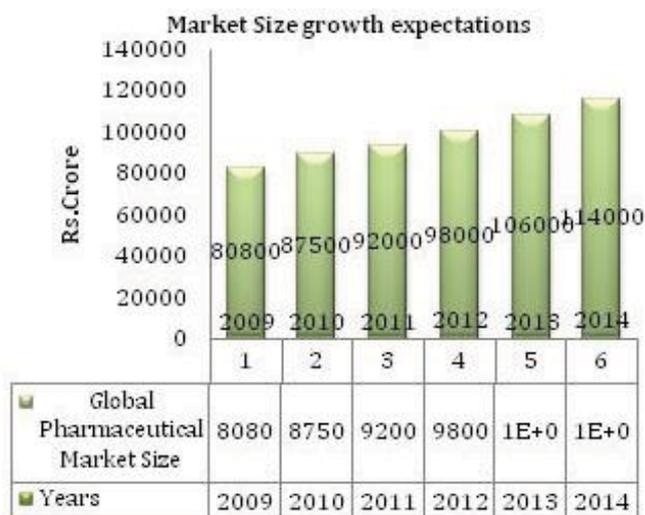


Figure 1: Global market size expectation for 2015

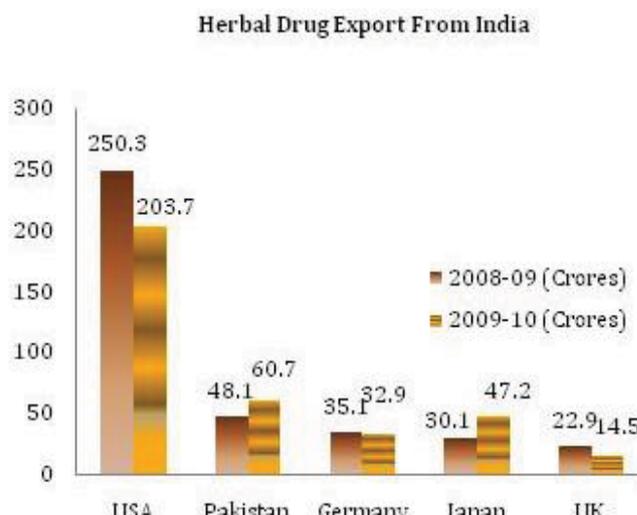


Figure 2: Herbal drug exports from india in fiscal year 2008-09 to 2009-10 [4]

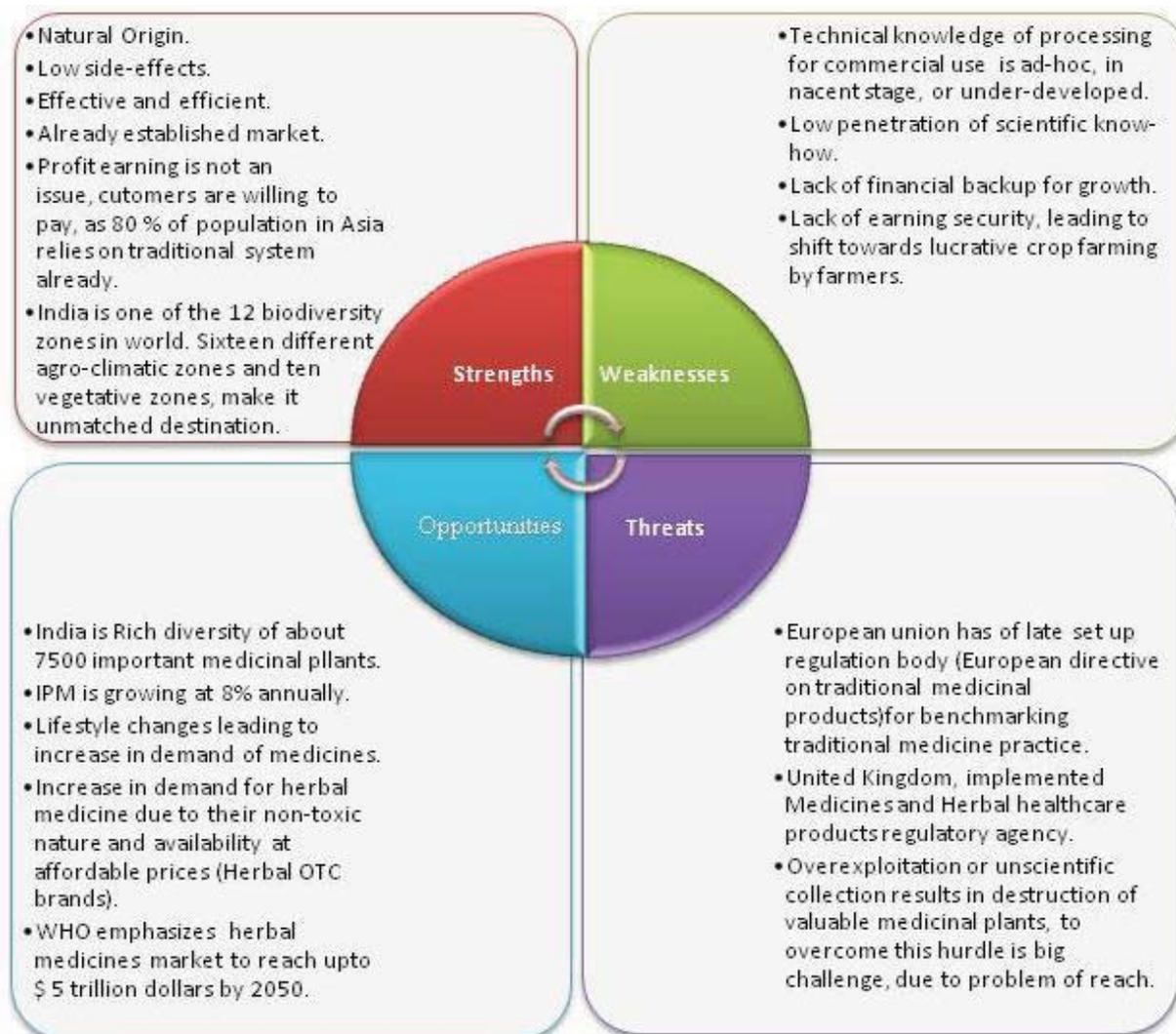


Figure 3: SWOT analysis of traditional system of medicine and challenges for commercializing

Indian sages and their families, who have dedicated their lives to the God Shiva.

Cedrus deodara has been given National tree of Pakistan status. [20]

A survey carried out on investigation of *Cedrus deodara* (Roxb.) loud. by (Slathia et al., 2007), found following observations, Deodara wood baskets or bins are extensively used by farmers to keep their paddy and wheat grains. The



Figure 4: *Cedrus deodara* gold needle leaves

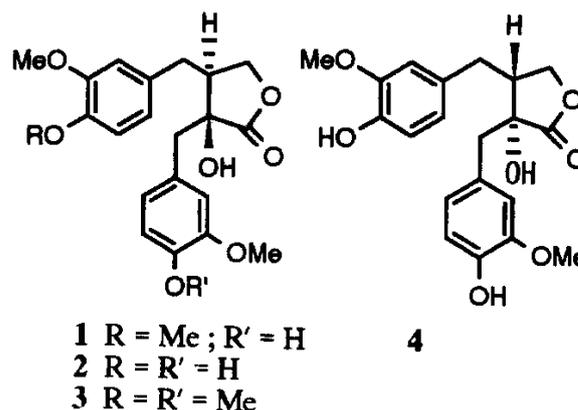
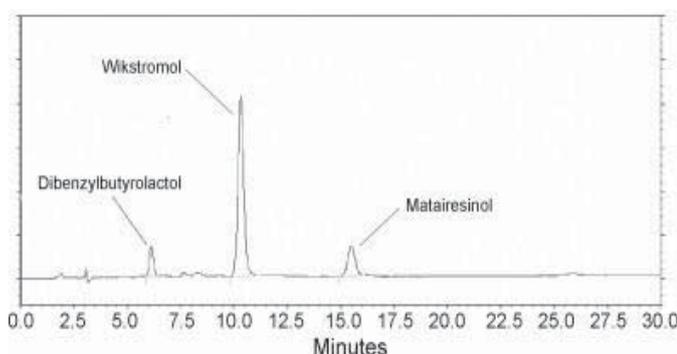


Figure 5: Wikstromol



(a) wikstromol; (b) matairesinol; (c) dibenzylbutyrolactol
Figure 6: Chromatographic representation: Lignans

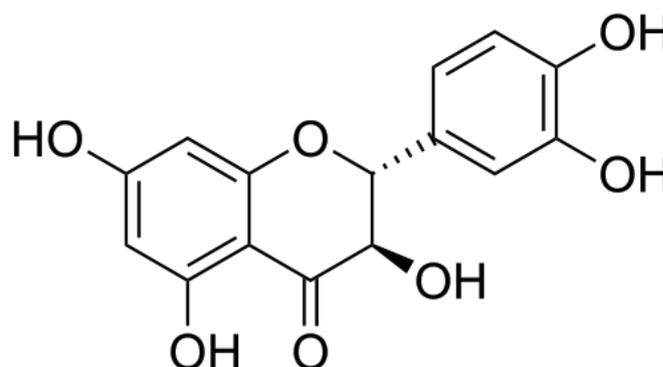


Figure 7: Taxifolin structure

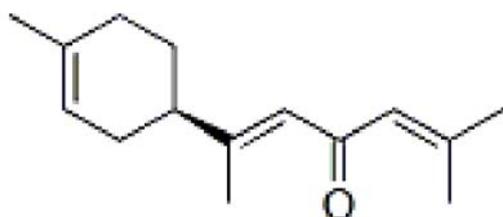


Figure 8: Atlantone structure



Figure 9: *Operculina turpethum* (Nishotra)

deodara bin help in preserving the paddy and wheat grains from insect and pest damage, due to already known property of insecticidal activity in deodara part of traditional practice. It is used as weedicides for paddies stored. The volatile oil separated from the deodara woods, are coated over maize seeds before sowing them, to prevent them from insect infestations, thus increasing productivity. One thing important shall not be missed is, that, such techniques are group of many ways for producing organic farms. Other extension of its vitality is projected by farmers using the volatile oil, diluted with water or hukka water as outer skin ointment to ward off ticks. [21]

Botanical Classification

Scientific classification of *Cedrus deodara* (Roxb.) Loud is given in Table 1.

Morphology

The habit of deodara tree is completely pyramidal when young, with gracefully pendulous branches. [22-23] It can attain a height of 15 to 50 meters upon maturity. [24] It is distinguished from other species by drooping leader and longer leaves that are 2 to 6 cm in length. [19]

There are many cultivars of deodar *Cedar*, but two cultivars mainly Shalimar and Kashmiri are the gems of *Cedar* family. [20, 23] The Kashmiri form is hardy, tolerating winter's upto -30°C , characterized by its silver green foliage. The cultivar Shalimar represents blue green leaf color and is the hardest cultivar planted in the United States. [26]

- **Leaf:** Evergreen needles, dark green but may have some silvery bloom giving them a blue-green color; 1 to 2 inches long, sharp pointed; occur singly on new

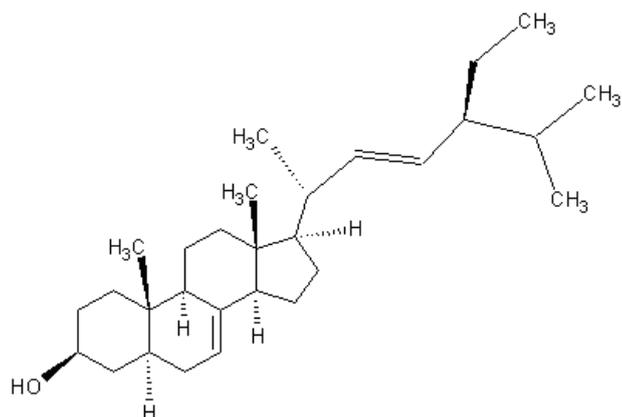


Figure 10: α -spinasteryl

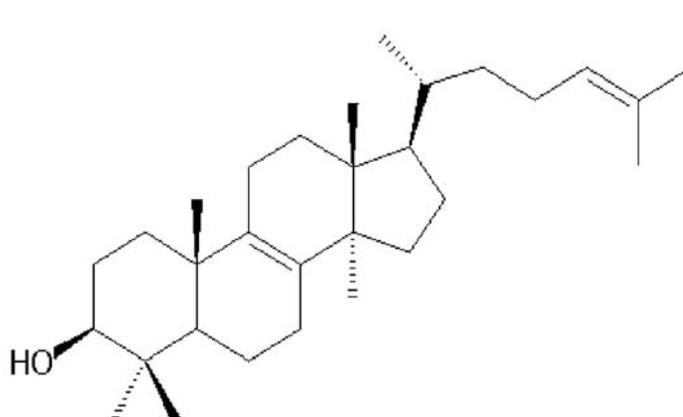


Figure 11: Lanosterol 1

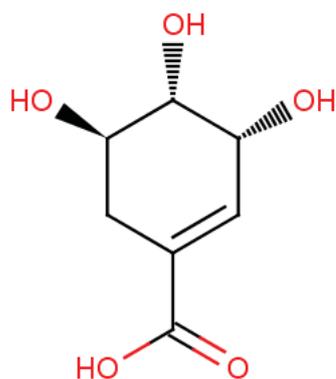


Figure 12: Shikimic acid vital antibacterial adjunct

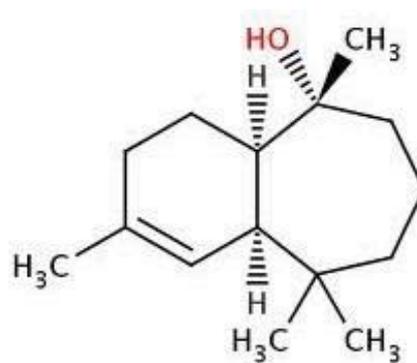
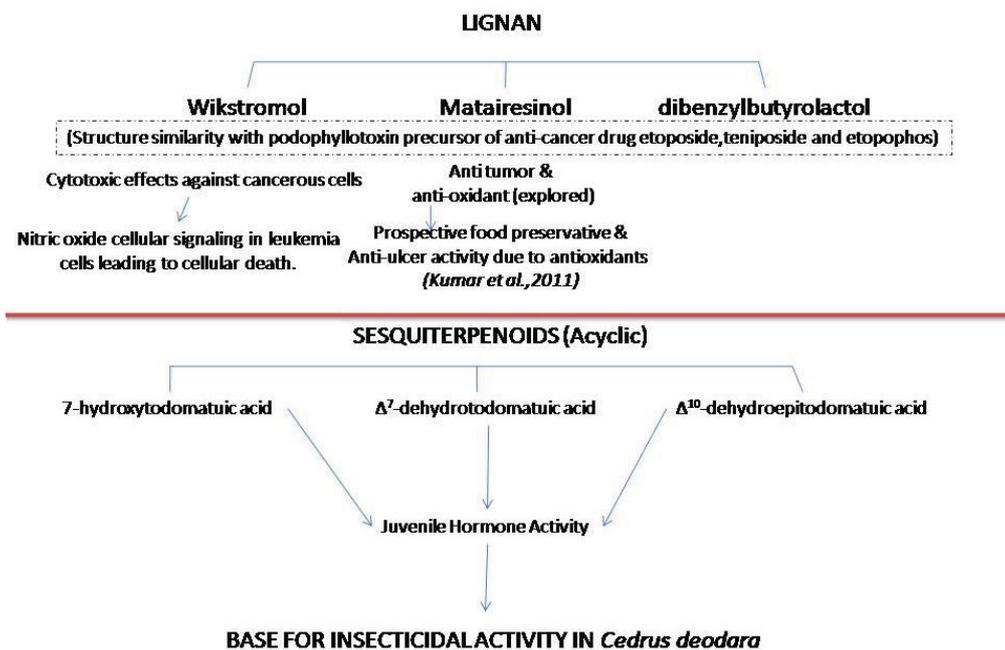


Figure 13: Himachalol



(Sachin et al., 2007)

Figure 14: Lignan and sesquiterpenes significance [35]

- growth and than later on spur shoots; remaining on the tree for 3 to 6 years.
- Flower:** Monoecious; male cones 2 to 3 inches long on the lower parts of crown; female cones erect, purplish, occur on upper portions of crown.
- Fruit:** Upright cones, 3 to 4 inches long and 3 inches across; deciduous scales; initially green and purplish, then later turning a reddish brown when mature, usually resinous.
- Twig:** Slender, with numerous short spur shoots, branches droop with age; buds are very small and round.

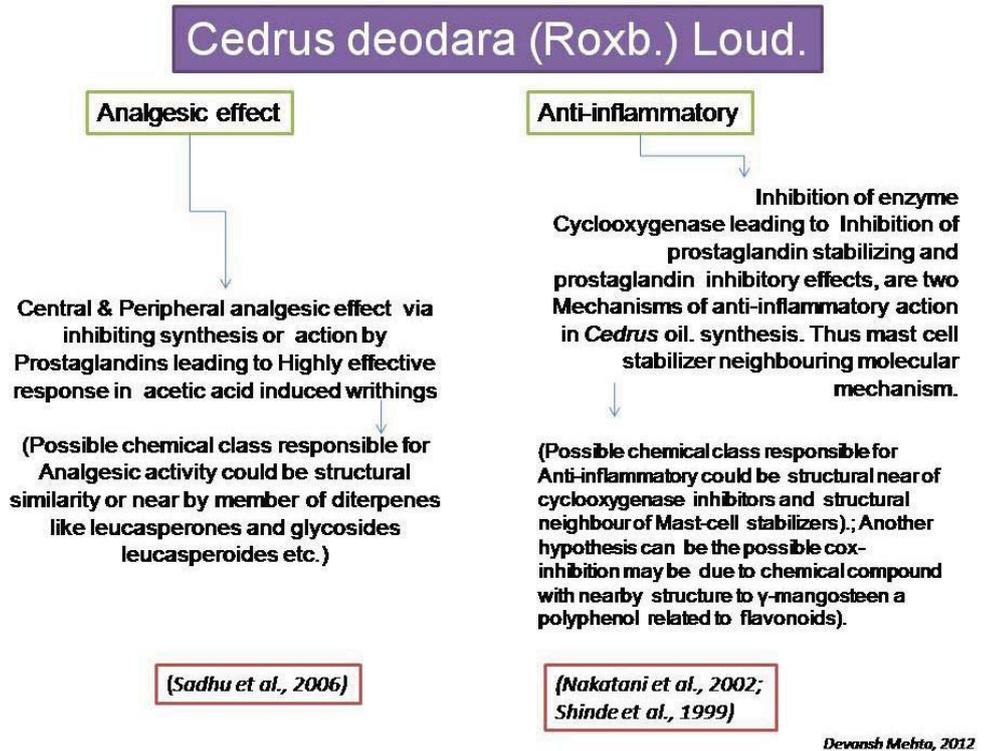


Figure 15: *Cedrus deodara* analgesic and anti-inflammatory mechanism of action [69-70]

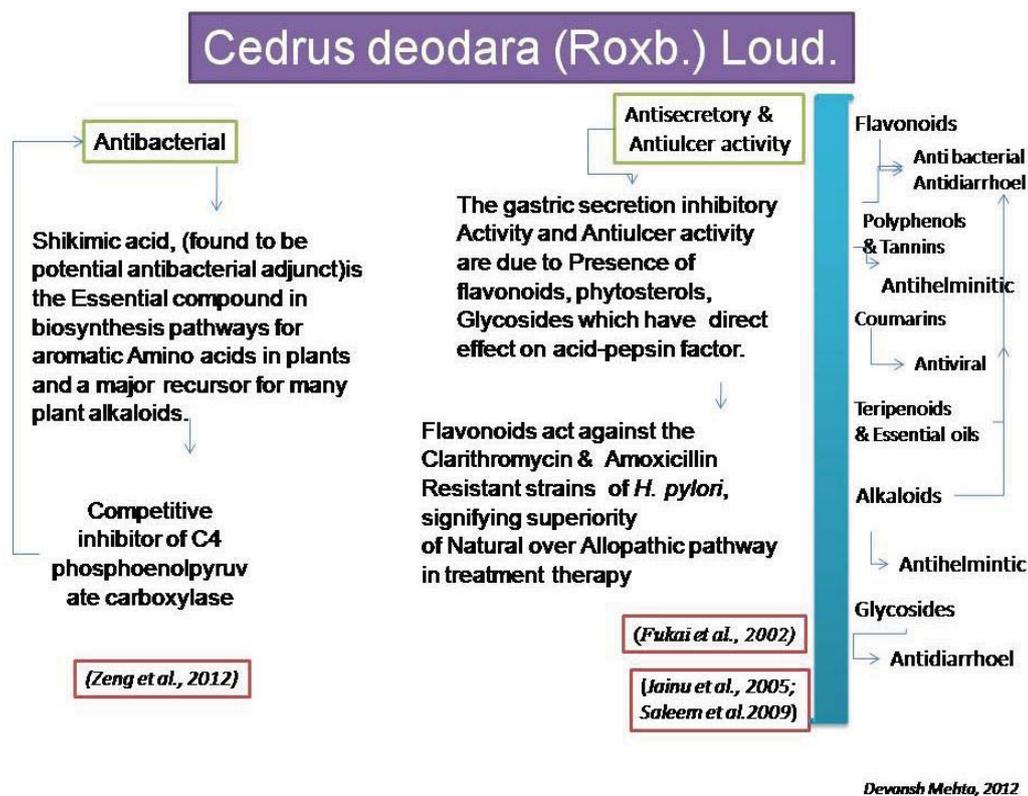


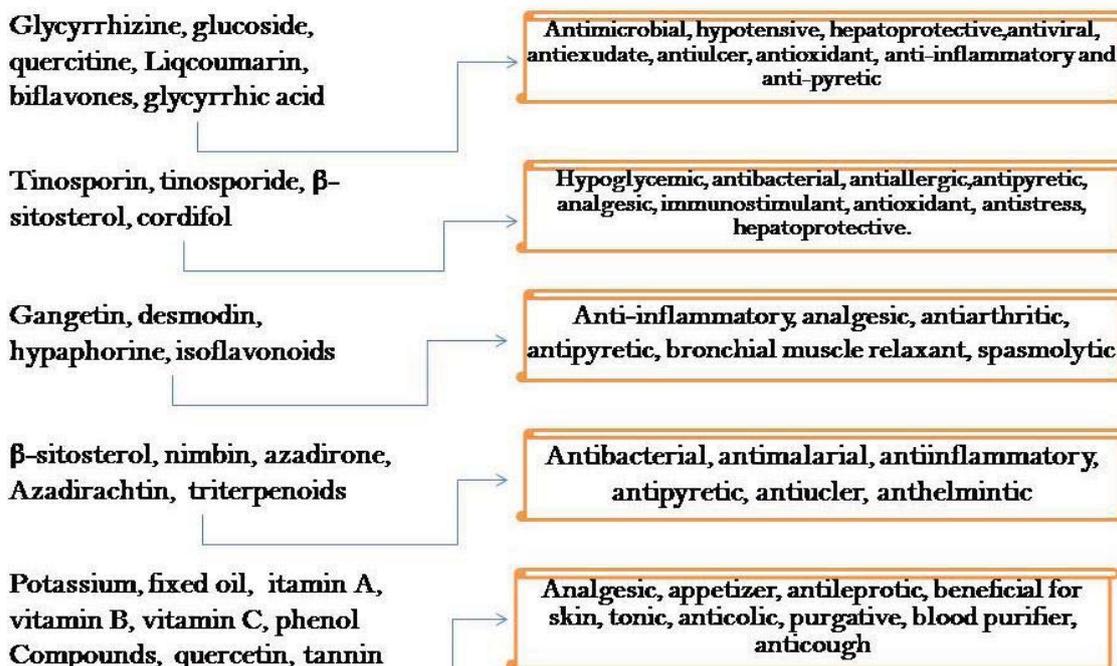
Figure 16: *Cedrus deodara* antibacterial, antisecretory & antiulcer mechanism of action

- **Bark:** Initially smooth and gray-brown, later developing short furrows with scaly ridge tops.
- **Form:** Young trees have a broad pyramidal crown that becomes wider with age; branch tips and leaders droop and have a fine texture. In the landscape it can reach 80 feet tall but becomes much taller in its native range. [27]

Phytoconstituents

Main phytoconstituents present in the oil of wood, are, wikstromal [28-29], matairesonil, [30] dibenzylbutyrolactol [lignans, sesquiterpenes LII, [32], isohimachalone, β -himachalene, [33] glycosides, [34-35], sesquiterpene alcohols (himachol, allohimacholol, isocentdarol, himadarol,

Phytoconstituents and their Prospective Activity



(Guata et al., 2009)

Figure 17: Phytoconstituents and their pharmacological actions

centdarol), ^[36] berating, isopimpillin, 1,4-diaryl butane, *meso - seco - isolariciresinol*, cedrusinin, benzofuranoid neolignan, ^[37] deodaron, cedeodarin, , atlone, deodarin, deodardionne, α -himachalene, α -pinene, β -pinene, myrcene, derin (6-methyl-dihydromyricetin), taxifolin, cedeodarin (6-methyltaxifolin), dihydromyricetin and cedrinolide, isopimaric acid, limonene-8-carboxylic acid, geronic acid, and 4-acetylcyclohex-1-ene-1-carboxylic acid, cedeodarin (6-methyltaxifolin), dihydromyricetin, cedrin (6-methyl-dihydromyricetin), cedrinolide, oxidohmachaline (sesquiterpene LIV), C₁₁ mono-carboxylic acid (nor-sesquiterpenes), sesquiterpene diosphenol, *cis-atlantone* and *trans-atlantone* (sesquiterpenes XLVII), some natural antioxidants, 10-nonacosanol (1), dibutyl phthalate (2), protocatechuic acid (3), phthalic acid bis-(2-ethylhexyl) ester (4), (E)-1-O-p-coumaroyl-beta-D-glucopyranoside (5), 5-p-trans-coumaroylguinic acid (6), Isocentdarol, 2-(3'-methoxy-4'-hydroxyphenyl) - 3 - hydroxymethy) - 2, 3 -dihydro-7-hydroxybenzofuran-5-*n*-propranol, Cedrusin, Cedrusinin, dihydrobenzofuran, neolignans, tetrahydrofuran lignin, phenyl tetralin lignin, dihydroflavonol glucoside, α -terpenol, linalool, limonene, anethole, caryophyllene and eugenol, 9-hydroxy dodecanoic acid (I) ethyl laurate (II), ethyl stearate (III), 3beta-hydroxy-oleanolic acid methyl ester (IV), beta-sitosterol (V), shikimic acid (VI), methylconiferin (VII), ferulic acid beta-glucoside (VIII). ^[38-47]

Operculina turpethum

Operculina turpethum commonly known as turpeth, fue vao, and St. Thomas lidpod; is perennial herbaceous, hairy

vine wood also known as wood rose commonly found in India. Mainly inhabits north circars and Deccan regions upto 3000 ft.

Common Names

- Indian Jalap
- St. Thomas lidpod
- Transparent wood rose
- Turpeth root
- White day glory
- Nisoth (Hindi)
- Panila
- Pithori
- Aluthi gida (Kannada)
- Bangada balli
- Bilitigade
- Devadanti
- Nagadanti
- Trivrutt (Marathi)
- Nishotra (Sanskrit)
- Dudhkalmi (Bangladesh)

The genus *Operculina* of family *Convolvulaceae* is major and important plant among Angiosperms. The plant has around 41 species, of which 13 have been accepted as specific scientific plants. The thirteen scientific named species of *Operculina* are *Operculina ampliata* (Choisy) House, *Operculina aurea* (Kellogg ex Curran) House, *Operculina codonantha* (Benth.) Heller f., *Operculina grandiflora* (Jacq.) House, *Operculina hamitonii* (G. Don) DF. Austin and Staples, *Operculina macrocarpa* (Linn.) Urb,

Operculina palmeri (S.watson) House, *Operculina pinnatifida* (Kunth) O'Donell, *Operculina pteripes* (G.Don) O'Donell, *Operculina rhodocalyx* (A.Gray) House, *Operculina sericanth* (Miq.) Ooststr, *Operculina triquetra* (Vahl.) J.F.Macbr., *Operculina turpethum* (L.) Silva Manso [48-49]

Botanical Classification

Botanical Classification is given in Table 2.

Morphology

Nishotra contains a large stout twinning perennial herb (creeper) with sap. Its white flowers are funnel shaped in bunches. Its leaves are egg shaped (oval) and heart shaped, 2 to 5 inch. in length. Its fruits are roundish with usually four-seeds to each, half or three forth in diameter. The herb has many branched root and quadrangular, winged stems It is also called as Indian rhubarb or Indian jalap because of its purgative characteristic. The plant bears fruits and flowers, from March to December.

The dried roots of the plant constitute the drug. There are two varieties of *Nishotra* with either white or black tuberous roots. The bark of *Nishotra* contains a glycoside resin, which has insoluble glycoside turpethin. [51]

Traditional Use

Charaka and Sushruta prescribed *Nishotra* internally as purgative in acute constipation, for intestinal paralysis and abdominal swellings, externally as a paint for malignant ulcers, as an ingredient ointment for fistulas. It's used as medicated ointment for cleansing of ulcers. Charaka and Sushruta also prescribed *Nishotra* powder, mixed with *Zingiber officinale* (Shunthi) in anaemia, jaundice and inflammations. It has also been used for dropsidal effects. [52]

Chemical Constituents

Operculina contains resins upto (9-10 %) in roots, Glycosides turpethin, alpha and beta turpethin, coumarin, scopoletin, glucose, rhamnose and fucose. It has β -sitosterol, betulin, lupeol, terpenoid cycloartenol, lanosta-5-ene, 2, 4-methylene- δ -5-lanosterol, Vitamin C, Chlorogenic acid, caffeic acid, quercetin, reutin, *N*-p-coumaryl tyramine, daucosterol, 2-hydroxybenzoic acid, 22, 23-dihydro- α -spinasteryl- β -D glucoside (H-1), salicylic acid, 12-hydroxy fatty acids, turpethic acids A- C, dammrane-type saponins, operculinosides A-D.

A qualitative analysis of the stem part of plant *Operculina turpethum* reveals the presence of Alkaloids, Saponins, Phytosterols, Phenols, Flavanoids, Cardiac glycosides, Proanthocyanidin (Sharma et al., 2012) [53-57]

PHARMACOLOGICAL SIGNIFICANCE (REPORTED)

Cedrus deodara

- **Analgesic Activity:** (Shinde et al., 1999) carried out studies on *Cedrus deodara* (Roxb.) loud. wood oil. The volatile oil was extracted by steam distillation and finally emulsifying with acacia and tragacanth mixture after drying over with anhydrous sodium sulphate. The analgesic activity was investigated using albino rats of

wistar strain. The analgesic acid activity was tested via two animal models i. Hot-plate method, ii. Acetic acid induced writhings. The response time in hotplate method was improved as well as blocked abdominal constriction due to antagonizing the effect of prostaglandin by volatile oil present in *Cedrus deodara*. The exact chemical constituents depicting this activity is hypothesized to be of same class or structure closer to diterpenes like leucasperones A(1) and B(2) and leucasperols A(3) and B (4) along with structure similarities to glycosides leucasperoides A,B and C(5-7). [58]

- **Anti-inflammatory Activity:** (Shinde et al., 1999) studied the potential anti-inflammatory activity in the male albino rats of wistar strain using doses of 50 and 100 mg/kg. The Carrageenan-induced pedal edema in rats was taken as study model. The time course of edema development in carrageenan-induced paw edema model in rats is generally represented by a biphasic curve. The first phase occurs within hour of injection and is partly due to the trauma of injection. The next phase is due to prostaglandins PGE₂ in inflammation. [59-60]
- **Antiarthritis /Rheumatoid Arthritis Activity;** (Shinde et al., 1999) studied the effective inhibition of polyarthritis phase in adjuvant induced animal models due to oil from the plant *Cedrus deodara*. [61-62]
- **Antibacterial Activity:** (Zeng et al., 2012) studied antibacterial activity in the water extract from pine needles of *Cedrus deodara* against five food born bacteria *Escherichia coli*, *Proteus vulgaris*, *staphylococcus aureus*, *Bacillus subtilis* and *Bacillus cereus*. The antibacterial activity was found to be significant with Shikimic acid playing the lead role as antibacterial adjunct. The water extract of *Cedrus deodara*, showed more potent antibacterial activity against *S.aureus*, *B.subtilis* and *B.cereus*, signaling high potency against Gram positive bacteria's. The antibacterial activity is due to lysis of bacterial structure and changes in cellular composition.
- **Antiseptic Activity:** The antiseptic activity was confirmed by test carried out by (Zeng et al., 2012) using tomato fruit juice by incubating the 25 ml of aliquot fresh tomato juice with the water extract of *Cedrus deodara* against the standard Sodium benzoate, to check for the bacterial growth. The test results were found to be zero bacterial growth in presence of water extract confirming the prospective hypothesis of potential antiseptic activity present in the plant. [63-64]
- **Antispasmodic:** (Kar et al., 1975) had investigated the antispasmodic activity in the wood of *Cedrus deodara* and found Himachalol as the major antispasmodic constituent. The antispasmodic activity was similar to that of pipavarine. [65]
- **Anti Gastric-secretory and Antiulcer Activity:** (Kumar et al., 2011) studied and evaluated the gastric antisecretory and antiulcer activity of *Cedrus deodara*. The volatile oils were extracted by steam distillation of *Cedrus deodara* using *Pylorus-ligation* and *Ethanol induced ulcer* models. The results showed positive antisecretory activity due to decreased gastric volume, total acidity, free acidity, and increase in ph of gastric fluid. [66]

- **Antioxidant Activity:** (Zeng et al., 2012) confirmed the antioxidant activity in *Cedrus deodara* by free radical scavenging activity in oils present in *Cedrus deodara* mainly α -terpenol, linalool, limonene, anethole, caryophyllene and eugenol. [67]

(Saxena et al., 2010) investigated the antioxidant potential of three natural antioxidants present in the *Cedrus deodara*, mainly curcumin, silymarin, and acteoside on AP9-cd induced cytotoxicity in human leukemia HL-60 cells. Thus the result signifies important role of natural antioxidant and on the whole; curcumin, silymarin and acteoside, in increasing the anticancer activity of AP9-cd and thus act as potential anti-neoplastic drug lead. [68]

- **Immunomodulatory Activity:** (Shinde et al., 1999) found *Cedrus deodara* oil effective in inhibiting neutrophil adhesion to nylon fibers, indicating inhibition of process of margination in the blood vessels. It also significantly inhibited Type III hypersensitivity reaction and Type IV reaction i.e. delayed type hypersensitivity reaction induced by sheep erythrocytes and oxazolone, indicating an inhibitory effect on humoral and cell-mediated immune responses. [69]

- **Antiproliferation Activity–Cancer Killer:** (Saab et al., 2011) found antiproliferative activity against leukaemia cells activity in the phytoconstituents present in *Cedrus* oil. It in investigation significantly inhibited proliferation of K562 cell line. The important phytoconstituents exhibiting this potential is atlantica. The mechanism of action can be related to the chemicals having neighbouring chemical structure to atlantica. [70]

(Sharma et al., 2008) studied apoptosis activity by a synergistic lignin composition from *Cedrus deodara* in human cancer cells. It found the inhibitory effect on AP9-cd infected cell lines. Thus, controlled cancer effectively, it can be effective in tumour suppression cases. [71]

- **Antiobesity Effect Leading to Antihyperlipidemic Activity:** (Patil et al., 2011) studied the significant decreasing effect of *Cedrus deodara* oil extracts on serum glucose, total cholesterol, and triglycerides, low density lipoprotein, and very low density lipoproteins and significantly increased the levels of High density lipoproteins. Thus it will be effective in controlling obesity and controlling cholesterol. [72]

- **Veterinary Use: Antisarcoptes Activity:** (Sharma et al., 1997) studied inhibitory effect of oil of *Cedrus deodara* against the *Sarcoptes mites* in lambs. The investigation was carried forward using 24 lambs, comparing to standard benzyl benzoate. Erythrocyte and leucocyte counts were significantly improved in the oil of *Cedrus* extract treated groups compared to standard. Thus *Cedrus deodara* was found effective in controlling sarcoptic mange in sheep. [73]

Cedrus deodara main activities explored, is briefed via pictorial representation Figure 14, Figure 15, Figure 16,

Operculina turpethum

- **Antioxidant, Free Radical Scavenging Activity, Protective Effect in Breast Cancer:** (Anbuselvan et al., 2007) studied the antioxidant effect of methanolic

extract of the plant *Operculina turpethum* against free radical scavenging of reactive oxygen species (ROS) directly or indirectly involved in multistage carcinogenesis. The extract showed remarkable reduction in lipid peroxidation and antioxidant levels such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and non-enzymatic antioxidants like glutathione (GSH), ascorbic acid (vitamin C) and α -tocopherol (Vitamin E) were markedly increased. This gives a clear indication the effectiveness of *Operculina turpethum* in preventing degradation of normal cells due to tumor cells and effective in 7, 12 dimethylbenz (a) anthracene (DMBA) induced breast cancer. [71]

- **Antiinflammatory Activity:** (Rajshekhar et al., 2006) evaluated the anti-inflammatory activity in the formalin induced paw edema model, and found effective reduction in inflammation by 36.45 %, possibly due to blocking the action of prostaglandins or arresting its synthesis. [72]

- **Cytotoxic Activity:** (Krishnarajua et al., 2005) carried out Brine shrimp (*Artemia salina*) lethality bioassay to investigate the cytotoxicity of aqueous extract of *Operculina turpethum*. The extract showed moderate brine shrimp lethality and the LC₅₀ value was found to be 81 (lower than 100). The significant lethality is an indicative of the presence of the cytotoxic components in the herb. [73]

- **Antidiabetic Activity:** (Pulpaka et al. 2011) investigated the antidiabetic potential in methanolic extract of the plant *Operculina turpethum* against streptozotocin induced diabetes mellitus models. The doses of 50 mg/kg and 100 mg/kg of methanolic extract were effective in reducing the fasting blood glucose levels, justifying the importance of *Operculina turpethum* to the diabetic patients.

- **Liver Toxicity Attenuation Activity:** (Ahmad et al., 2009) investigated the attenuation potential of *Operculina turpethum* against *N*-nitrosodimethylamine induced toxic liver injury and clastogenicity in rats. *Operculina turpethum* was found to significantly reduced the concentration of micronuclei count, liver function enzyme, serum hydroxyproline levels and LDH isoenzyme 4 and 5. Thus arresting the fibrogenesis completely. Thus *Operculina turpethum* extracts could be used as a hepatoprotective agent in many cases of liver toxicity, liver cirrhosis, and Alcoholic cirrhosis. [75]

- **Insecticidal and Pesticidal Activity:** (Haque et al., 2000) studied the development-inhibiting activity of some tropical plants and found *Operculina turpethum* effective against *Sitophilus zeamais* at lower dose of 0.05 %. [76]

(Sindhu ZUD et al., 2012) studied the effectiveness of tick control in the extracts of the plant *Operculina turpethum* showed growth arrest in the growth of three tick species. Out of which highest effectiveness was noted against *Acacia nilotica* i.e. (29) % w/v/. [77]

PHYTOCHEMICAL CONSTITUENTS AND THEIR PHARMACOLOGY

Unexplored Pharmacological Actions (Hypothesis) *Cedrus deodara*

It is hypothesized that *Cedrus deodara* shall be investigated for its proficiency in Cardiac segment as a potential,

- Antihypertensive
- Antiarrhythmic
- Antianginal
- Potent Cardio-tonic
- Efficiency as opening the blockage specially in case of Myo-cardial infarction
- As prospective lead for Diabetic nephropathy and neuropathy.
- Due to presence of significant volatile oils its effectiveness in depression and antianxiety shall also be explored (*Inference based on the phytoconstituents present in the plant.*)

Operculina turpethum

Due to scarcity of pharmacological activities being explored till date, therefore it possess, wide significance of testing its proficiency in areas of other ailments. Based on the inference from the phytoconstituents possessed in the plant, following hypothetical pharmacological actions are present in the plant, such as,

- Cardio-tonic
- Nerve tonic
- Memory enhancer
- Potent Nootropic action
- Effective wound healing potential

Organic Farming

Both plants possess insecticidal and pesticidal properties, which is backed by its historical use in our traditional practices to preserve crops (e.g. *Cedrus deodara* baskets for keeping paddy crops by farmers in Jammu's Doda district).

These plants shall be excellent replacements for the fungicides, insecticides and pesticides, in preserving our crops and thus potential Organic farming ingredient preventing crops from getting damage by insects and pests.

CONCLUSION

The present review is an effort to attract attention towards importance of medicinal plants in research activity and to drive the decision makers working in pharmaceutical giants, to utilize the rich diversity of Indian herbs. Making it worlds powerful and biggest pharmaceutical Industry based on natural resources, thus, transforming the Indian pharmaceutical Model to an more efficient and effective one, allowing reach of medicines at affordable prices for the people residing into deep rural sectors of Asian and African subcontinent. This would help in strengthening our foreign direct investment and making pharmaceutical industry of India as biggest sector in world with highest employability including the farmers. This would on the whole lead to rise in agricultural sector of our country. Driving the growth of agricultural sector, would being farmers a better life, making them leave the days of misery and thus reducing the factor leading to farmer suicide (Recent case of Vidharba region, in Maharashtra).

Thus traditional medicines and commercial exploitation of it is one of the ways to bring cheers to Agricultural sector and to the farmers.

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