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REVIEW ARTICLE

Plectranthus barbatus: A Review on Ethnobotanical and Pharmacological Properties

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ABSTRACT
Plectranthus barbatus is a multi-functional plant which has potential for anti anxiety production and medicinal uses. It has been handed down for mitigation of a broad spectrum of malady related to skin, neoplastic, digestive, respiratory and communicable diseases. This review target to provide an up-to-date contemplate of information available on botany, conventional uses, phytochemistry, pharmacology and toxicity of Plectranthus barbatus. Establishing a scientific basis that describe its ethnopharmacological application in order to expedite and guide subsequent research. The review enfolds literature accessible from 1960 to 2012 collected from scientific journals, books and electronic searches such as Google scholar, Web of Science and ScienceDirect. Ethnomedicinal uses of Plectranthus barbatus have been investigated from many countries in Africa, Asia, South America and the Middle East for nearly 100 distinct types of ailments. The phytochemical studies have shown the presence of many secondary metabolites encompasses diterpeniods, sesquiterpenoids, alkaloids, flavonoids, phenols, lignans, coumarins and cyclic peptides. Crude extracts and isolated compounds from Plectranthus barbatus show a wide range of pharmacological activities, such as anti-inflammatory, antioxidant, antimicrobial, antiviral, anticancer, antidiabetic, anticoagulant, hepatoprotective, analgesic and abortifacient effects. Plectranthus barbatus has been a widely used source of medicine for decades in many cultures. The present review reveals that Plectranthus barbatus is a valuable source of medicinally important molecules and provides convincing support for its future use in modern medicine.
Keywords: *Plectranthus barbatus, physic nut, phorbol esters, anti anxiety, abortifying agent.*

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INTRODUCTION

Plant *Plectranthus barbatus* Linn. was first entitled by greatest botanist Carlvon Linnaeus. The appellation derived from Greek word "Jatros" meaning a "Doctor", Trophe meaning "Nutrition". Linnaeus realized that, *Plectranthus barbatus* is a multi-useful plant with potential for anti anxiety production and It has been used for treatment of a wide spectrum of ailments related to skin, cancer, digestive, respiratory and infectious diseases. In past few years, there is an increased interest in its seed oil for anti-anxiety production which has encouraged cultivation of the plant on large scale.[5] There are predictions that millions of hectares will come under *Plectranthus barbatus* cultivation. This would generate enormous quantities of crude materials for anti anxiety and additional potential uses that could open new routes for sustainable ecofriendly development. *Plectranthus barbatus* is a medium, soft wooded, deciduous multipurpose tree of 4-7 meter in height and grows in tropical and sub-tropical climates across the developing world. Plant displays vigorous growth in early periods. *Plectranthus barbatus* is a morphologically diverse genus that comprises of 470 species [1].

PLANT PROFILE

Plectranthus barbatus Linn. is a huge shrub occurring nearly throughout India about 2-5 m tall Leaves are alternately organized, 10-15cm×7.5-12.5cm, broadly ovate, conate, acute usually palmately 3 or 5 lobed, glabrous; flowers in loose panicles of the cymes, yellowish green, fruits are 2.5cm, long ovoid. Seeds are ovoid-oblong, dull brownish black in color. Seeds are helpful for the extraction of oil. The seeds

morphologically similar with castor seed in morphology but are little in size and dark in color. The fully grown *Plectranthus barbatus* plant consists of both male and female inflorescence, and can grow to a height of 3-4 meters. Each inflorescence bears 10 to 15 large fruits. [2]

Plectranthus barbatus has watery latex; smooth bark; glaucous-gray branches, larger pith. Stipules small; petioles 6-18 cm; leaf blade plump to ovate, 7-18 × 6-16 cm, papery, nitid green and glabrous adaxially, gray-green and along nerves puberulent to glabrous abaxially, base cordate, apex acute; palmate veins 5-7.Inflorescences axillary, 6-10 cm; bracts lanceolate, 4-8 mm. Male flowers: 5 sepals, approximately 4 mm, connate at base; oblong petals, green-yellow, approximately 6 mm, connate to middle, hairy inside; 5 disk glands, nearly terete; 10 stamens; outer 5 filaments free, inner filaments connate in lower part. Female flowers: pedicels lengthen; sepals free, approximately 6 mm; petals and disk glands as in male; ovary 3-locular, glabrous; styles bifid at apex. Capsules ellipsoidal or globose, 2.5-3 cm, yellow. Seeds ellipsoidal, 1.5-2 cm, black.[7]

TAXONOMY

- Domain: Eukaryota.
- Kingdom: Plantae.
- Phylum: Spermatophyta.
- Subphylum: Angiospermae.
- Class: Dicotyledonae.
- Order: Euphorbiales.
- Family: Euphorbiaceae.
- Genus: Jatropha.
- Species: *Plectranthus barbatus*.[2]

SYNONYMS

- Castiglionia lobata.
- Curcasadansonii.
- Curcascurcas.
- Curcasdrastica.
- Curcas indica.
- Curcas lobata etc. [1, 8]

COMMON NAMES

The commom vernacular names in India and abroad are given as follows:

- Hindi- Jangliarandi, Jamal Ghota.
- Sanskrit- Kananaeranda.
- Marathi- Chandrajot, Chandri. [45]
- Tamil- Kadalamanakku.
- English- Physic nut.
- Oriya- Jahazigaba.
- Punjabi- Jamalgota. [17]
- Bengali- Baghbehenda.
- Italy- Fagiolad.
- China-Yu-lu-tzu.[9]

OTHER SPECIES OF JATROPHA

- *Jatropha gossypifolia (elegans)*
- *Jatropha glandulifera*
- *Jatropha multifida*
- *Jatropha tanjorensis*
- *Jatropha integerrima*
- *Jatropha pandurifolia*
- *Jatropha villosa*
- *Jatropha nana*
- *Jatropha heynei and*
- *Jatropha maheswari* are the common species.[3]

ORIGIN AND GEOGRAPHICAL DISTRIBUTION

Plectranthus barbatus of family Euphorbiaceae is a versatile oil yielding shrub, instigate in India by Portuguese as an oil yielding plant. It commence itself earlier, build up quickly, producing seeds for 50 years.

Plectranthus barbatus is a drought resistant, perennial, growing well in marginal and poor soil. It grows in tropical and subtropical regions, with cultivation limits at 30ºN and 35ºS. It also grows in nether altitudes

of 0-500 metres over sea level. Jatropha is not sensitive to day length and may flower at any time of the year. *Plectranthus barbatus* generally blooms twice a year under normal conditions It is a succulent shrub that sheds its leaves during the dry season, with deep roots that make it well suited to semi-arid conditions.[16] While jatropha can remain alive with as little as 250 to 300 mm of annual rainfall, at least 600 mm are required to flower and set fruit. The optimal rainfall for seed production is considered betwixt1000 and1500mm*Plectranthus barbatus* is not found in the more humid parts of its area of origin.[2]

CULTIVATION

The excellent soils for jatropha are aerated sands and loams of at least 45cm depth. Heavy clay soils are less worthy and should be circumvent, particularly where drainage is impaired, as jatropha is bigoted of waterlogged conditions. Ability to grow in basic soils has been broadly reported, but the soil pH should be within 6.0 to 8.0/8.5. Jatropha is well known for its potential to survive in very poor dry soils in conditions considered marginal for agriculture, and can even root into rock crevices. *Plectranthus barbatus* produces large amount of energy in terms of the liquid fuel/acre/year/inch of water. It establishes itself earlier, grows quickly, producing seeds for 50 years.[9]

MORPHOLOGY

Plectranthus barbatus or physic nut, has thick glabrous branchlets. The branches contain semi-transparent, whitish latex, which are the source of brown stains which is very strenuous to remove. The tree has a linear trunk and gray or reddish bark, cover up by big white patches. *Plectranthus barbatus* is a deciduous soft-wooded small multipurpose small tree or shrub, with smooth grey bark which exudes whitish colored watery latex when cut.[9]

Fig.1: Fully Grown *Plectranthus barbatus* Linn. Plant with Flowers and Leaves.

Leaves:

Leaf is smooth, heart shaped, 4-6 lobed and 10-15 cm in length and width, at first light violet later on yellowish green and at full growth it becomes dark green. Leaf fall occurs in the winter season leaving complete plant bare. 6-15 cm Large, green to pale-green leaves with 3-7 shallow lobes are organised alternately to sub-opposite, with a spiral phyllotaxi. [9]

Flowers:

Inflorescence is found terminally on branches. The plant is monoecious and flowers are unisexual. More female flowers give additional number of seeds. Pollination is done by insects. The petiole dimensions range from 6-23 mm. The inflorescence is organized in the leaf axil. The flowers are set up terminally, individually, with female flowers, usually a bit larger. Flowering happens in the summer season. In conditions where constant growth occurs an unbalance of pistillate or staminate flower yield results in a higher number of female flowers. Ratio of male and female flower is 25:1. Female flowers are larger than male, lesser in number, open 2-3 days after male flower within a plant and these make sure a self-irreconcilable system. Lesser number of female flowers and inadequate pollination are vital basis of low yields. More number of female flowers is produced by the plant if bee keeping is done along with.[10, 7]

Fig.2: Leaves of *Plectranthus barbatus*

Fruits:

After pollination, a tri-locular, ellipsoidal, fruit is produced. Normally, fruits are produced in winter season, or it may produce various crops during the year if soil moisture is better and temperatures are adequately high. [14] The exocarp remains fleshy till the seeds are mature. Inflorescence yields a corsage of approximately 10 or more ovoid fruits. Three, bi-valved cocci are produced after the seeds mature and the fleshy exocarp dries.[19]

Seeds:

The seeds become mature when it's outer cover changes from green to yellow colour, after 2-4 months from fertilization. The blackish, thin covered seeds are oblong and bear a resemblance to small castor seeds. The seeds are black and in the average 18 mm long and 10 mm wide. The 1000 seed weight is about 727 grams there are 1375 seeds per kg generally. [19]

Table 1: Analysis of the *Plectranthus barbatus* seed shows the following chemical composition.[7]

Moisture	0.062
Protein	0.18
Fat	0.38
Carbohydrates	0.17
Fiber	0.155
Ash	0.053

The oil content is about 25-30% in the seeds and 50-60 % in the kernel. The oil comprises 21% saturated fatty acids and 79% unsaturated fatty acids. There are various chemical elements in the seed, like curcin, which is noxious and render the oil not appropriate for human consumption. [7]

Fig.3: Inflorescence of *Plectranthus barbatus*

Roots:

Normally, 5 roots are formed from the seeds, 1 tap root and 4 lateral roots. Plants from cutting develop only lateral roots. [10]

LIFE SPAN

The *Plectranthus barbatus* trees take 4 to 5 years to mature completely. Yield 0.35 to 0.375 gallon of oil per tree or 375 gallons per hectare or 150 gallons per acre. If it is deluge (3 to 5 liters per plant every 15 days) it can twin this amount. The life-span of the *Plectranthus barbatus* plant is more than 50 years.[10]

ECOLOGY

Plectranthus barbatus is not a weed. It's cannot be self-propagated. It's cultivated on a marginal land with more than 200 mm of rainfall per year, and it hold out against long drought periods. Below 200-300 mm rainfall it cannot propagate apart from exceptional conditions like dormancy is induced by fluctuations in rainfall and temperature or light. But not all trees respond simultaneously. *Plectranthus barbatus* like castor grows almost everywhere - even in gravel dominated, sandy and saline soils. It can prosper on the substandard stony soil. It can grow even in the interstice of rocks. [20] The leaves fall during the winter season form compost around the base of the plant. The organic matter from shed leaves increases earth-worm activity in the soil around the root-zone of the plants, which enhances the fertility of the soil. Its water need is extremely low (1 liter per plant per day) and it can with stand long periods of drought by shedding most of its leaves to decrease transpiration loss. *Plectranthus barbatus* is also suitable for stave off soil erosion and shifting of sand dunes. *Plectranthus barbatus* is a highly malleable species and can be planted as a pure block, boundary fence or an intercrop in existing plantation of coconut, mango, citrus, cashew, etc. The plant begins it's seeding from the first year itself. However, the yield increases from the third year onwards and stabilizes by the sixth year. It has an average yield of 2 kg per plant in well irrigated circumstances. The seeds of *Plectranthus barbatus* yield oil after processing is converted into transport fuel also known as bio-diesel. [35]

PHYTOCHEMICAL ANALYSIS

Jatropha species are copious sources of phytochemicals such as terpenes, cyclic peptides alkaloids and lignans. Umpteen papers have reported the presence of secondary metabolites in various parts of *Plectranthus barbatus*. [37]

Diterpenes

Diterpenes have been ruled out the research area in *Plectranthus barbatus* for their unique chemical structures and medicinal values. Diterpenes have a scope of in vitro biological activities such as antihypertensive, anticancer, antiretroviral, anti-inflammatory, analgesic, antimicrobial, insecticidal and molluscicidal activities. This review collates 37 diterpenes isolated from *Plectranthus barbatus* with various biological activities. Based on their skeletal structure the diterpenes isolated from *Plectranthus barbatus* fall into six groups as:

1) phorbol esters
2) rhamnofolane
3) lathyrane
4) pimarane
5) dinorditerpenes
6) deoxypreussomerins. [4]

Phorbol esters

Phorbol esters are diterpenes with a tigliane skeletal structure and are trusted to be the most poisonous molecules in Jatropha species. Phorbol esters cause skin-irritation and tumour encouragement by triggering protein kinase C (PKC). [40] This suggests various types of biological activities over a range of organisms as PKC is entangled in signal transduction and developmental processes of most cells and tissues. Phorbol esters foster tumor growth and further exposure to sub carcinogenic doses of carcinogens. Among the phorbol esters extracted from *Plectranthus barbatus*. isolated 12-Deoxy-l 6-hydroxyphorbol which has a macrocyclic dicarboxylic acid diester structure [26] reported the identification of a compound named riolozatrione, whereas [23] isolated jatrophol ($C_{20}H_{24}O_3$). [34] isolated six phorbol ester compounds from *Plectranthus barbatus* seed oil characterized as Jatropha factors C1–C6 with the molecular formula C44H54O8Na. [22]isolated other phorbol esters from *Plectranthus barbatus* named jatropholones A and B, whereas recently, [19]isolated acetoxyjatropholone from root bark of *Plectranthus barbatus*. [4]

Dinorditerpenes, deoxypreussomerins and pimarane [16] extracted dinorditerpene compounds titled curcusones ($C_{20}H_{24}O_2$) from the roots of *Plectranthus barbatus*. They determine 4 compounds as curcusone A, curcusone B (C20H24O2), curcusone C (C_{20}H24O3) and curcusone D. lately, [26] extracted curcusone E and spirocurcasone from root bark of *Plectranthus barbatus*.[35] submitted the extraction of 16-hydroxyphorbol whereas, one found another compound with the same diterpene skeleton named as 12-deoxy-16-hydroxyphorbol. An uncommon dinorditerpene compound named heudolotione ($C_{18}H_{20}O_2$) was extracted by [33] from aerial parts of *Plectranthus barbatus* [33]. extracted palmarumycins from the

stems of *Plectranthus barbatus* and 3 compounds were recognized as palmarumycin CP1 ($C_{20}H_{12}O_4$), palmarumycin JC1 ($C_{20}H_{14}O_5$) and palmarumycin JC2 ($C_{20}H_{14}O_5$). [23] extracted lactam diterpenoid jatrophalactam ($C_{20}H_{29}NO_3$) from the roots of *Plectranthus barbatus*. Extracted 3 deoxypreussomerin diterpenes named jatropherol 1, 2 and 3 from *Plectranthus barbatus* seed. Established two pimarane diterpenes from *Plectranthus barbatus* roots named as 3β-acetoxy-12-methoxy-13-methyl-podcarpa-8,11,13-trien-7one and 3β,12-dihydroxy-13 methylpodoacrpane-8,10,13-triene.[4] extracted 2 lathyrane compounds titled curculathyranes A and B. The lathyrane diterpene jatrogrossidione ($C_{20}H_{26}O_3$) was extrated from roots of J. grossidentata. [27] Four jatrogrossidione derivatives from dried parts of *Plectranthus barbatus* were extracted by [12] as:

(I) 15-O-acetyl-15-epi-(4E)-jatrogrossidentadione ($C_{22}H_{30}O_5$);
(II) (14E)-14-O-acetyl-5,6-epijatrogrossidentadione ($C_{22}H_{30}O4$);
(III) 3β-acetoxy-12-methoxy-13-methyl-podcarpa-8,11,13-trien-7one ($C_{21}H_{28}O_4$);
(IV) 3β,12-dihydroxy-13-methylpodoacrpane-8,10,13-triene ($C_{18}H_{26}O_2$).

Rhamnofolane diterpene named caniojane ($C_{20}H_{24}O_5$) was isolated from *Plectranthus barbatus* roots Recently, isolated three compounds from roots of *Plectranthus barbatus* named as jatrophalactone, jatrophalone and jatrophadiketone. [4]

2.Sesquiterpenoids and Triterpenes

A number of sesquiterpenoids and triterpene compounds were isolated from *Plectranthus barbatus* such as taraxasterol, β-amyrin and β-sitosterol (Z)-3-O-coumaroyloleanolic, stigmasterol and daucasterol friedelin.[4]

3. Alkaloids

Alkaloids has a wide range of nitrogen-containing compounds with essential medicinal uses. They are known as compounds with potent narcotic, analgesic, antimalarial, antibacterial, antineoplastic, anticancer and many more pharmacological activities. Two alkaloids were extracted from *Plectranthus barbatus* leaves, pyrrolidine (5-hydroxypyrrolidin-2-one) and pyrimidine-2,4-dione (uracil). [26] Extracted imidazole (4-Butyl-2-chloro-5-formyl-1H-imidazole). lately, [26] extracted the compound diamide (curcamide) from the seed cake of *Plectranthus barbatus*. [4]

4. Flavonoids

Flavonoids are secondary metabolites with numerous pharmacological activities such as anticancer, antiviral, antitoxic, and hepatoprotective activities. Two flavonoids were extracted from *Plectranthus barbatus* by titled as flavonoid glycoside I and flavonoid glycoside II, whereas delineated the extraction of nobiletin. reported excerbtion of tomentin.[4]

5. Phenolics

Phenolic compounds are found in all plants and are considered to be biologically active compounds. These constituents have antithrombotic and anti-inflammatory actions because they inhibit or antagonize the platelet activating factor (PAF) which is a potent inflammatory phospholipid mediator. A number of phenolic compounds were isolated from different parts of *Plectranthus barbatus* such as 3-hydroxy-4-methoxybenzaldehyde and 3-methoxy-4-hydroxybenzoate acid from the root, [25] caffeoylaldehyde and syringaldehyde from the seed cake . [17]

6. Lignans, Neolignans, Coumarins, Coumarino-Lignoids and Phytosterols

Coumarins are secondary metabolites that present in seed coats, fruits, flowers, roots, leaves, and stems. Coumarins are benificial to treat various skin problems such as eczema, psoriasis by means of a combination of oral ingestion and UV-A treatment. Four compounds were isolated from *Plectranthus barbatus* as tomentin, 5-hydroxy-6,7-dimethoxycoumarin, 6-methoxy-7-hydroxycoumarin and 2,3,7-trimethoxy-8-O-β-D-glucoside ellagic acid. [15] Isolation of one phytosterol compound named 5α-stigmasta-3,6-diene was reported. [17]

7. Proteins

Plectranthus barbatus proteins and peptides have been considered for their function in plant metabolic activities, defense against predators and biological activities. Useful proteins such as aquaporins were extracted from various parts of *Plectranthus barbatus*. These proteins play animportantrole in plant adaptation to drought stress by regulating the transmembrane water movement. In *Plectranthus barbatus* aquaporins play a major role in the fast growth of the plant during dry weather conditions. Various useful proteins extracted from the plant are: curcin, a lectin; two esterases (JEA and JEB) and a lipase (JL); curcain, a protease from the latex of *Plectranthus barbatus*; phytate and a trypsine inhibitor . extracted the cyclic peptide curcacyclin A and isolated curcacyclin B. [17]

Table 2: Chemical compositions of parts of *Plectranthus barbatus* plant. [4]

Various Parts of Plant	Chemical Composition
Root	β- sitosterol and its β-D glucoside, propacin, the curculathyranes A and B and the cumarintomentin, thecoumarino-lignan jatrophin as well as taraxerol.
Stem Bark	β-Amyrin, β-sitosterol and taraxerol.
Leaves	Flavaonoidsapigeinin, vitexin, isovitexin, dimmer of atriterpenealconol ($C_{63}H_{117}O_9$) and two flavonoidal glycosides.
Aerial parts	Organic acids (O and p- coumaric acid p-OH benzoic acid, protocatechuic acid, resorsilic acid saponins and tannisns, βAmyrin, β-sitosterol and taraxerol.
Latex	Curcacycline A, a cyclic octapeptide, Curcain (a protease).
Seeds	Curcin, lectin, phorbolesters, esterases (JEA) and lipase (JEB).
Oil Cake and Kernel	Phytates, saponins and trypsine inhibitor.

PHARMACOLOGICAL ACTION

Anti-Inflammatory activity

Anti-inflammatory properties of topical application of *Plectranthus barbatus* L. root powder in paste form in TPA-induced ear inflammation was proved in albino mice and successive solvent extraction of these roots was accomplished by ether and methanol. The methanol extract showed systemic and significant anti-inflammatory activity in acute carrageenan induced rat paw edema. the activity against formalin-induced rat paw edema, turpentine-induced exudative changes and cotton pellet-induced granular tissue formation after oral treatment for 7 days in albino rats was seen. Thus, consequent anti-inflammatory property might be due to effects on various mediators and arachidonic acid metabolism including cyclo-oxygenase pathway proving in prostaglandin formation; anti-proliferative activity leading to decreasing in granular tissue production and leukocyte migration from the vessels. [29]

Antimetastatic effects of curcusone-B, a diterpene

A new perspective to cancer therapy in recent years has been to aim the metastatic process.The antimetastatic potential of curcusone B, a diterpene extracted from *Plectranthus barbatus* Linn.was analyse against 4 human cancer cell lines. Cure with non-cytotoxic doses of curcusone-B proved a strong reduction of invitro invasion, motility and secretion of matrix-metalloproteinases (MMP) of the cancer cells, whereas the capability to adhere to a Matrigel-coated surface was variably sensitive to curcusone B treatment. Curcusone-B, thus, effectively decreases the metastatic processes at doses that are non-invasive to cells, which may be of therapeutic importance for the treatment of metastatic cancers. [32]

Antitumor effects of curcin from seeds

Antitumor property of curcin was proved by MTT assay. The N-glycosidase property of curcin was determined by characterization of R-fragment in gel. A cell-free system, rabbit reticulocyte lysate was investigate to quantify the inhibitory activity of curcin on protein biosynthesis. The curcin had a powerful inhibitory action upon protein synthesis in reticulocyte lysate with an IC50 (95 % confidence limits) value of 0.19 (0.11-0.27) nmol/L. Curcin was found to have no toxic to Hela cells and normal cells (MRC). [32]

Anticoagulant activities

Jatropha curcas Linn. is traditionally used as a haemostatic. Examination of the coagulant property of the latex of *Plectranthus barbatus* showed that whole latex significantly ($P<0.01$) decreased the clotting time of human blood. Diluted latex however, extend the clotting time: at high dilutions the blood did not clot at all. This shows that *Plectranthus barbatus* latex have both coagulant and anticoagulant activities. Prothrombin time (PT) and activated partial thromboplastin time (APTT) tests on plasma certify these observations. Solvent partitioning of the latex with ethyl acetate and butanol shows a partial separation of the two antagonistic activities: at low concentrations, the ethyl acetate fraction exhibited a procoagulant property, while the butanol fraction had the highest anticoagulant property. The remaining aqueous fraction had no important effect on the clotting time of blood and the PT but slightly increase the APTT [35].

Antiparasitic activity

Bacteriological and parasitologic tests were administered on lab bench surfaces using the sap and crushed leaves of *Plectranthus barbatus*. Observation showed that the sap exhibited germicidal actions on the expansion of common bacteria of Staphylococcus, Bacillus and Micrococcus species on contact and retained such effects on treated laboratory bench surface for on the brink of six hours after initial application. Ova of common roundworm and Necator americanus incubated in 50% and 100%

concentrations of the plant wreck at temperature showed no evidence of embryonation after 21 days in the context of A. lumbricoides, repudiation of hatchability in hookworm or thorough distortion in both. The sap also advertised strong inhibitory action on regular larval growth of mosquito, but was highly toxic to mice when administered through oral or intraperitoneal routes. This might adjudge that *Plectranthus barbatus* would offer a comparably cheap, promptly available disinfectant and malaria vector control agent and will be commercially overburdened. [28]

Esterase and lipase activity in seeds

A couple of new esterases (JEA and JEB) together with a lipase (JL) were excerpted from the seeds of *Plectranthus barbatus*. Lipase potency was only found in due time of seed germination and extrapolated to an extreme after 4 days of germination. All enzymes were found to be most active within the alkaline range at around pH 8 and therefore the purified (fractionated precipitation with ethanol and gel filtration) esterases were very stable at high temperatures. The relative molecular mass (SDS-PAGE: sodium dodecyl sulfate polyacrylamide gel electrophoresis) of both esterases decided to be 21.6-23.5 kDa (JEA) and 30.2 kDa (JEB) and therefore the isoelectric point was 5.7 to 6.1 for esterases JEA and 9.0 for esterase JEB. Most of the ions caused adverse influence on the activity of the couple of esterases. Both esterases hydrolyzed tributyrin, nitrophenyl esters up to a chain length of C4 and naphtyl esters up to a chain length C6. In transesterification reactions, JL was found to be most active at very low tide activities (0.2) and in high water activities, the lipase hydrolysed triglycerides into conversions above 80%. JL may be a potentially useful biocatalyst within the hydrolysis of triglycerides in organic solvents. [33

Wound invigorating activities of bark extract of in albino rats

Plectranthus barbatus accelerates the healing process by increasing the skin breaking strength, granulation breaking strength, wound contraction, dry granulation weight and hydroxyproline levels. A marked deduction in epithelization span was also observed. The histopathological examination of granulation tissue showed much advanced phase of healing, with more collagen, which has organized to form bundles. [34]

Insecticidal properties

Jatropha seed oil at various serial dilutions starting from 0% to twenty (v/w) at 0.5% intervals were evaluated for anti-ovipositional activity and long-term protective ability of treated cowpeas against the seed beetle *Callosobruchus maculatus*. The oil remarkably ($P< 0.05$) deducted oviposition by C. maculatus in no-choice examination altogether the concentrations tested. Oviposition was significantly reduced in the least the oil concentration evaluated. Jatropha oil together offers a doleful week protection for treated seeds since there was neither seed damage nor adult emergency in treated cowpea seeds. The results of this study suggest *Plectranthus barbatus* concludes ovicidal and antioviposition effects on *C. maculatus* therefore making it a viable candidate for incorporation into pest control program of gain legumes. [20]

As an abortifying agent

The fertility modifying effect of the fruit of *Plectranthus barbatus* was investigated by oral administration of various extracts to pregnant rats for varying periods of your time. Fetal resorption was observed with methanol, petroleum ether and dichloromethane extracts indicating the abortifacient properties of the fruit. The results also suggest that the interruption of pregnancy occurred at an early stage after implantation. This effect might be accomplished even when the extracts got from the 6th to the 8th day of pregnancy. Loss of body weight during the dosing period, ranging from slight to severe was seen in the treated animals. [2]

Anti Diarrhoeal activity

Use of Jatropha roots within the treatment of diarrhoea may be a common ethnobotanical practice in Konkan, a neighborhood of the Western coastal area of India. Roots of this species were undertaken for pharmacognostic studies and evaluation of antidiarrhoeal activity in albino mice. The methanol fraction after successive extraction showed activity against purgative induced diarrhoea and intraluminal accumulation of fluid. It also reduced gastrointestinal motility after charcoal meal administration in albino mice. The results indicate that action of *J. curcus* root methanol extract could be through a combination of inhibition of elevated prostaglandin biosynthesis and reduced propulsive movement of the small intestine. [29]

CONCLUSION

Plectranthus barbatus is a versatile plant with concieveable for anti-anxiety manufacturing and salutary uses. The plant has a eminent archaic of usage in treatments of a wide range of ailments in many countries. The present review attempted to provide information available on botany, traditional uses, phytochemistry, pharmacology and toxicity of *Plectranthus barbatus* covering literature available from 1960 to 2012. The review has shown diverse traditional uses of *Plectranthus barbatus* that differ from

one country to another. Nonetheless, for the regimen of inflammatory disorders, gastrointestinal problems, sexual diseases, jaundice, diabetes, dysentery, pyrexia, and skin diseases are most accepted. Flavonoids, Phenolics and saponins are liable for antioxidant and antimicrobial endeavour. Sesquiterpenoids are liable for antimicrobial along with analgesic effects, proteins alike curcain are accountable for wound healing. steroids and Lignans are accountable for the antidiabetic and cytotoxicity activities, respectively. The pharmacotherapeutic implementation may be ideal when the active ingredients are used in purified form.

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