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Review Article

ATIBALA: AN OVERVIEW

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ABSTRACT:

Abutilon indicum is known as 'Atibala' in Sanskrit. Literally, 'Ati' means very and 'Bala' means powerful, referring to the properties of this plant as very powerful. A. indicum is a hairy herb or under shrub distributed throughout the tropica. In traditional systems of medicine, various plant parts such as roots, leaves, flowers, bark, seeds, and stems have been used as antioxidant, demulcent, laxative, diuretic, analgesic, anti-inflammatory, and antiulcer. The present review is therefore an effort to give the detailed survey of literature on its pharamcognosy, phytochemistry as well as traditional and pharmacological uses.

Keywords: Abutilon indicum, Atibala, Indian mallow, Pharamcognosy, Phyto-chemistry, Pharmacology.

INTRODUCTION:

A. indicum (Linn) Sweet, is a hairy herb commonly known as 'Indian mallow' belonging to family Malvaceae. It is found abundantly in the hotter parts of India but it occurs throughout the tropica, subtropica, and Ceylon [1, 2]. In addition to 'Atibala' it is also known as Thuthi, Kanghi in Hindi, and Mudra in Marathi [3].

It grows as weed and found abundantly in wastelands from seashores 1,200 meters high in India and in sub Himalayan tracts. It is herbaceous, or shrubby, softly tomentose plant, stem is round, often tinged with purple color. The leaves are 9 by 5 cm up to petiolate, ovate to orbocular –cordate, acuminate, and toothed [4]. Flowers are borne solitary in long jointed and axilary pedicels. Calex lobes divided in the middle and apiculate. Corolla is yellow or orange yellow opens in the evening. Carpels are 15-20 in number. Fruits are hispid, scarcely longer than the calyx and awns are erect. Seeds are 3 -5, ovoid, kidney shaped, dark brown black, tuberceled or with minutely stelleate hairs. Tap roots, fairly long with a number of lateral branches: 1.5-2 cm in diameter, light brown, outer surface smooth with dot like lenticels. Bark thin and can easily peel off, it has feeble odor, astringent and bitter tastes [5].

It has a many medicinal properties and has been used by native peoples from all regions where it is found. The folk practitioner also use this plant for curing blood dysentery, fever, allergy and also aphrodisiac [6]. Bark is used in strangury and urinary complaints and is valued as a diuretic. Leaves are used for toothache, lumbago, piles and all kinds of inflammation. Decoction of leaves is used in bronchitis, catarrhal bilious diarrhoea, gonorrhoea and inflammation of bladder, and fevers. It is prescribed as a mouthwash in cases of tender gums and toothache. Seeds are tonic and Unani systems of medicine suggest its use in piles, chest troubles, bronchitis, and gonorrhea. Rectum of children's affected with thread worms are exposed to the smoke of seeds burned on charcoal. According to the Chinese in Hong Kong, the seeds are employed as an emollient and demulcent. Infusion of root is useful in fever as a cooling medicine, strangury, heamatouria, and also in leprosy. Root is used as a pulmonary sedative and diuretic. Porter Smith states that the entire plant and seeds are used as demulcent, lenitive, diuretic, and laxative [3].

It has been a reputed remedy in the Siddha systems of medicine for piles, jaundice, leprosy and ulcer [7]. In Vedic periods, the roots of the Bala plants i.e. Atibala (A. indicum Linn.), Mahabala (Sida rhombifolia Linn.), Bala (Sida cordifolia Linn.) and Bhumibala (Sida veronicaefolia Lam) were used to remove poison, vata – pitta diseases, heart problems, bily blood, eye diseases, and uterine disorders. Its seeds and roots both were used in

fever in the form of decoction i.e., powdered plant material dissolve in water or any other solvent [8] .

PHARMACOGNOSY:

The root of A. indicum is cylindrical 1.2-1.5 cm in diameter with smooth surface, having fragrance with saltish taste and yellow in color. The stem is 0.3-0.9 cm in diameter and yellow. The leaves are evergreen, stipulate, and cordate. The bark is flattened having hairy, yellow outer surface and inner surface is smooth. The fractures are fibrous. The flowers are yellow in color, pedicillate bisexual. The petiole is 1.5-7.0 cm long, yellowish brown in color, cylindrical with stellate hair. The lamina is crenate, reticulate, acute to acuminate, minutely stellate, dentate, dull green in color, hairy above and glaucous below. Glandular hairs are present while the texture is coriaceous. Fruit is a schizocarp while the seeds are furrowed, minute and glabrous [5, 9].

Microscopically the stem is undulate in outline with unicellular and multicellular hairsm which are blunt. The root is also undulate in outline, with secondary wood arranged in definite rings. Some giant unicellular hairs are also present. The leaves are dorsiventral and covered with flask shaped, stellate, pitcher glandular hairs. The epidermal cells have straight anticlinal walls while the stomata are anomocytic [9].

PHYTO-CHEMISTRY:

The knowledge of individual chemical constituents of a medicinal plant is essential for understanding pharmacological activity as well as potential toxicity and optimizing extraction procedures.

Leaves:

Leaves contain tannins, mucilage, traces of asparagin, organic acid and, ash of leaves contains alkaline sulphates, chlorides, magnesium phosphate and calcium carbonate [1]. Ethanolic extract contain 72% more quercetin than flowers [10]. Leaves also contains alkaloids, sterols, titerpenoids, glycosides [5] essential oils as well various amino acids [11]. Baxi et al isolated tocopherols and β – sitosterol from leaves [12].

Aerial parts

The aerial part of the plant on extraction with petroleum ether led to the isolation of n-alkane mixture, an alkanol fraction and β – sitosterol; fumaric, p-coumaric, vanillic, caffeic, and p-hydroxybenzoic, p - β -D-glucosyloxybenzoic acids, and gluco-vanilloyl glucose, fructose, aspartic acid, histidine, threonine, serine, and leucine. Galactose and galacturonic acids are present in mucilage fraction. Saponins, flavnoids, and alkaloids are present in shoot and flowers [13].

Roots

Roots contain asparagin [14]. Gallic acid [15] and Fixed oil were isolated from root [16]. Bhattacharjee reported presence of sterols, terpenoids, terpens, flavonoids, and steroids [17].

Flowers

Gossypetin-8 and 7-glucosides and cyanidin-3-rutinoside isolated from flower petals of A. indicum [18]. Two sesquiterpene lactones i.e alantolatone and isoalantolactone have been first time reported by Sharma et al [19]. Some flavonoids like luteolin, chrysoeriol, luteolin 7-O-β -glucopyranoside, chrysoeriol 7-O-β -glucopyranoside, apigenin 7-O-β -glucopyranoside, quercetin 3-O-β -glucopyranoside, quercetin 3-O-α-rhamnopyranosyl (1 - 6)-β -glucopyranoside, were isolated and identified [20]. Oil obtained from the flowering tops yielded geraniol, geraniol actate, α- pinene, borneol, and tetradecane [21].

Seeds

Seeds contain water soluble galactomannan contains D-galactose and D- mannose in 2:3 ratios. Acid catalysed fragamentation, periodate oxidation and methylation showed that the seed-gum has branched structure consisting of linear chain ß-D (1 4) linked mannopyranosyl units, some of which are substituted at ortho-6 by two α –D (1 6) galactopyranosyl units mutually linked glycosidically as end groups [22]. Chemical analysis of the seed oil showed the presence of stearic, linolenic, oleic, and palmitic acid [23]. Seeds were analyzed for the crude pentosan, protein, and water soluble mucilage

contents [24]. HBr reactive fatty acids viz, 12, 13-epoxyoleic (vernolic acid); 9, 10 methylene-heptadec-8-enoic (Malvalic acid) were identified in the seed oil [25]. Amino acid profile of seed proteins (31%) contains threonine, glycine, serine, glutamine, lysine, methionine, isoleucine, proline, alanine, cystenine, tyrosine, phenylalanine, leucine, aspargine, histidine, valine, argininine [26]. TLC-GLC studies of seed oil revealed the presence of high amount of unsaturated acids. Stearic acid and palmitic acid were the principal component from the saturated acids. Raffinose as a prime sugar component was found in seed [27] .

Fruits

Fruits contain flavanoids and alkaloids [28].

Whole plant:

Some flavonoids have been isolated from A. indicum like quercetin, kaemferol, gossypetin, and cyanidin glycosides [29]. The investigation on the chemical constituents of the whole plant has resulted in the isolation of two new compounds, abutilin A (1) and (R)-N-(1'-methoxycarbonyl-2'-phenylethyl)-4-hydroxybenzamide (2), as well as 28 known compounds [30]. β -sitosterol as a potential new mosquito larvicidal compound was isolated from petroleum ether extract [31]. The plant was found to contain gum resin and mucilage [32]. Tannins were not present in 50% ethanolic extract of the plant [33].

The essential oil of plant contains β -pienene, caryophyllene, caryophyllene oxide, 1, 8-cineole, ceraneol, ceranyl acetate, elemenes, eudesmol, and farnesol [34]. Preliminary phytochemical test shows the presence of glycosids, leucoanthocyanidin, saponins alkaloids cardiac glycosides, cyanogenetic tannins, and, phenolic compounds in the leaves, root, and stem [9].

PHARMACOLOGY:

a) Antioxidant and radical scavenging activity:

The roots and aerial parts were extracted in n-hexane, chloroform, butanol, and ethyl acetate, evaluated for their total phenolic content, total flavonoid content, total antioxidant capacity (TAC) and Trolox equivalent antioxidant capacity (TEAC), employing 2,2′-azinobis-3-ethylbenzotiazo-line-6-sulfonic acid (ABTS) and ferric reducing anti-oxidant power(FRAP). TEAC values ranged from 3.019 to 10.5 muM for n-hexane and butanol fractions using the ABTS assay. The FRAP assay showed reducing powers of the fractions in the order of butanol > ethyl acetate > chloroform > n-hexane and butanol > chloroform > hexane > ethyl acetate. By using the DPPH free radical assay $T_{(EC50)}$ and EC_{50} values were determined. The antioxidant/radical scavenging capacity of the extracts was found to be a dose-dependent activity. From this report one can conclude that plant is a potent source of natural antioxidant [35].

b) Antidiabetic activity:

The aqueous extract was administered to moderately diabetic rats at a dose of 0.5 and 1 g/kg body weight in an oral glucose tolerance test led to a significant reduction in plasma glucose levels in 30 minutes as compared with untreated rats ($P < 0.05$), and it was at a faster rate than the use of standard antidiabetic drug, i.e. glibenclamide. By using an everted intestinal sac inhibition of glucose absorption through the small intestine was investigated. The extract at concentrations of 0.156 to 5 mg/mL caused a reduction of glucose absorption in a dose response manner. The maximum response was noted at a dose of 2.5 mg/mL. From above observations one can predict that the aqueous extract of the A indicum plant has good antidiabetic property [36].

c) Antimalarial activity

Larvicidal activity of crude hexane, petroleum ether, ethyl acetate, acetone and methanol extracts of Abutilon indicum, were tested for their toxicity against the early fourth-instar larvae of Culex quinquefasciatus. All extracts showed moderate larvicidal effects after 24 h. Petroleum ether extract showed highest larval mortality. β -sitosterol isolated from plant was a potential new mosquito larvicidal compound with LC50 value of 11.49, 3.58 and 26.67 ppm against Aedes aegypti L, Anopheles stephensi Liston and Culex quinquefasciatus Say (Diptera: Culicidae), respectively [31].

d) Hepatoprotective activity

The aqueous leaf extract of A. indicum exhibited significant hepatoprotective activity in carbon tetrachloride- and paracetamol-induced hepatotoxicities in rats by reducing carbon tetrachloride- and paracetamol-

induced change in bio-chemical parameters like SGPT, SGOT, and ALKP by enzymatic examination. Hepatoprotective action was found may be due to interference of leaf extract with free-radical formation. Aqueous extract at a dose of 100 and 200 mg/kg body wt p.o showed hepatoprotective activity comparable to standard drug Silymarin (100 mg/kg body wt). LD50 value is more than the dose of 4 g/kg body wt in acute toxicity models [37].

e) Hypoglycemic activity

Alcohol and water extracts of A. indicum leaves at a dose of 400 mg/kg, p.o showed significant hypoglycemic effect in normal rats 4 hrs after administration (23.10% and 26.95%, respectively). When results were compared to standard drug Tolbutamide alcohol and water extracts showed weak activity while petroleum ether and chloroform extract did not showed significant hypoglycemic activity [6]

f) Analgesic activity

Isolated eugenol [4-allyl-2-methoxyphenol], from A. indicum was found to possess significant analgesic activity. At doses of 10, 30, and 50 mg/kg body weight, it exhibited 21.30 ($p < 0.05$), 42.25 ($p < 0.01$) and 92.96% ($p < 0.001$) inhibition of acetic acid induced writhing in mice. In the radiant heat method at a dose of 50 mg/kg body weight eugenol showed 33.40% ($p < 0.05$) prolongation of tail flicking time [38].

Fixed oil isolated from petroleum ether extract of the root showed dose –dependent analgesic activity in rats using analgesiometer and in mice against acetic acid induced writhing test. Fixed oil exhibited analgesic effect at a dose of 400mg/kg s.c. LD50 of the fixed oil in mice was 2357.9 mg/kg p.o and 933.3 mg/kg s.c No behavioral changes were observed in mice [16, 39]. Gallic acid in rat showed analgesic activity at dose of 0.1gm/kg i.p within 30-45 minutes of administration [15]. Central analgesic activity of fixed oil isolated from A. indicum tested on animal at doses of 400 and 600 mg/kg i.p by using tail flick response to radiant heat, acetic acid induced writhing, and tail clip method [40].

g) Estrogenic/antiestrogenic properties

Methanolic extracts of fruits at a dose of 100-500 mg/kg body weight caused suppression of uterine peroxidise enzyme activity. It was suggested that the uterine peroxidase assay could be utilized as a biochemical parameter in the screening of new antifertility agents for their estrogenic/antiestrogenic properties [41].

h) Immunomodulatory activity:

Essential oil from plant augments antibody in animals showing immunological value [11]. A. indicum was evaluated experimentally for its immunostimulant properties. The parameters included i) humoral antibody enhancing response of drug against killed salmonella typhi ‘O’ antigen in rabbits, ii) protective effect of drugs against Staphylococcus aureus (Coagulase positive) challenge in rabbits iii) direct antibacterial activity of drugs against Staphylococcus aureus on nutrient agar plate and iv) immunological changes in experimental animals following drug administration. Experimental studies in rabbits showed that the entire drug treated groups of animals showed a higher level of anti-salmonella typhi ‘O’ titers. The values of titers were statistically significant for 8^{th}, 16^{th}, and 24^{th} day, respectively when compared to the control group. Higher level of antibody titre was obtained on 24^{th} day of experiment. The protective effect of A. indicum against virulent staphylococcus aureus challenge in the rabbits showed highly significant survival period ($p<0.01$). The haematological values for total and differential leucocytes count and Haemoglobin percent did not shown any particular change. However a significant decrease in Erythrocyte Sedimentation Rate levels ($p<0.05$) following Staphylococcus aureus injection was noted in A. indicum treated animals. Histopathological studies of animals challenged with virulent staphylococcus aureus showed marked protection of tissue damage [42]. The use of A. indicum as an adjuvant in immunization programme has been advocated due to its immunomodulatory properties [43]. The whole fine powder of the plant at a dose of 500 mg/kg body weight, when compared to the control group showed statistically highly significant rise in modulatory behaviour in all the models [44].

i) Antimicrobial activity:

Essential oil obtained from whole plant exhibited antibacterial activity against Proteus vulgaris, Bacillus subtilis, Bacillus anthracisand while it was inactive against Salmonnella typhimurium, Salmonnella pullorum, and Klebsiella Species [45]. The aqueous extract of the whole plant at a concentration of 5-10 mg/ml showed in vitro antibacterial activity against E.Coli, Corynebacterium diptheriae, Streptococcus viridans, Salmonnela typhi , Shigella flexneri, Diplococcus pnumoniae, Salmonnela paratyphi A and B. The aqueous extract of plant was devoid of antimicrobial activity against Trichosporon cutaneum, Candida albicans, Candida tropicalis, Microsporum canis, Microsporum nanum, Microsporum gypseum, Piedraria hortae, Phialophora jeanselmei, Trichophyton mentagrophytes, Trichophyton rubrum, Madurella mycetomy, Histoplasma capsulatum, and Cryptococcusneo formans [46].

The 80% ethanolic extract of root was found to be devoid of any activity against Pseudomonas aeruginosa, Escherichia Coli, Staphylococcus aureus, and Klebsiella aerogenes, Benzene extract was active against Pseudomonas aeruginosa, Escherichia Coli, and Proteus species [47]. The hexane extract was active against Staphylococcus aureus, and Pseudomonas aeruginosa. The chloroform and ethyl acetate extract showed good activity against most of bacteria. The hexane extract showed activity against the fungi Aspergillus terreus, Aspergillus ochraceus, Aspergillus flavus, Aspergillus cardius, and Aspergillus oryzae. The methanolic extract was active against Aspergillus oryzae, Aspergillus ochraceus [48].

The aqueous residue of the leaves were devoid of any antibacterial activity against Aeromonas hydrophilla, Alkaligenes viscolactis, Staphylococcus pyrogenes, Escherichia Coli, Cytophaga species, Klebsiella aerogenes, Vibrio parahaemolytica, Pseudomonas aeruginosa, Vibrio damsela, Streptococcus pyrogens, and Bacillus cereus [49]. The 50% acetone extract of the seeds showed antifungal activity against the plant fungi Microsporum gypseum (5%) and Epidermophyton floccosum (20%) but was found to be inactive against Paecilomyces mentafrophytus [50].

Crude ethanol extract of A. indicum exhibits antimicrobial activity against the Gram negative organisms P. Aerugenosa, P. Vulgaris, E. Coli, S. Sonnie and Gram positive organisms such as B. Subtilis, B. Megatherium S. Leuka,S. Aureus with a maximum diameter of zone of inhibition ranging from 24.3 mm, 22.4 mm, 20.1 mm, 24.5 mm, 22.4 mm, 21.0 mm, 23.5 mm and 24.1 mm respectively in the agar-well diffusion method [51]. The ethanolic extract of the root was active against the fungi Aspergillus flavus, Aspergillus glaucus, Aspergillus ochraceus, Aspergillus oryzae, and Aspergillus cardius, Penicillium Species. Acetone was active extract against Aspergillus ochraceus [52].

j) Angiotensin Converting Enzyme (ACE) inhibitory activity

The root extract of A. indicum was found to inhibit ACE in water, acetone, ethanol (96%), by 18 %, 9 % 1 %, and respectively. Inhibition was measured from the enzymatic cleavage of the chromophore- fluorophore-laballed substrate dansyltriglycine into dansylglycine and diglycine. It reflects the use of plant in hypertension [53, 54].

k) Anti-inflammatory activity

Ethanol, chloroform, and aqueous extract (1, 5, 10, 20 mg/100ml) of leaves of A. indicum were screened for anti-inflammatory activity. Prevention of hypotonicity induced HRBC membrane lysis was taken as a measure of anti-inflammatory activity. All the extracts showed biphasic effect on HRBC membrane stabilization and have comparable activity to that of Diclofenac [55].

l) Miscellaneous:

Fixed oil showed depressant action on isolated frog's heart, and had no effect on isolated guinea pig ileum. It inhibits acetylcholine- induced contraction of isolated guinea pig ileum [39]. Fruit decoction mixed with ammonium chloride is given orally to treat hemorrhagic septicemia [51]. Whole plant extract of A. indicum is devoid of insecticidal properties [33]. Methanolic extract (0.1 mg/ml) of whole plant was screened for acetylcholinesterase inhibitor activity using Ellman's

colorimetric method in 96-welled micro plate. Extract showed 30.66% inhibitory activity. Acetylcholinesterase inhibitors have therapeutic applications in the treatment of Alzheimer's disease, senile dementia, myasthenia gravis, ataxia, and Parkinson's disease [56]. Ethanolic extracts of plant against a P_{388} Lymphocytic leukemia in mice in a preliminary biological screening showed anticancer activity [52]. Whole plant was screened for in-vitro anti-arthritic activity. The effect was observed on inhibition of protein denaturation, proteinase inhibition, and membrane stabilization at a dose of 100 and 200 mcg /ml. It showed significant protection against hypotonic saline induced RBC membrane damage, denaturation of proteins and possesses good anti-proteinase activity [57]. The leaf juice when mixed with jaggery is used for the treatment of snakebite as antidote [58]. The fruit is used to treat piles, gonorrhea and cough [59, 60].

Uses in Commercial Formulations

The plant has many Ayurvedic and commercial applications. The commercially available products are Atibalaghrit, Mahanarayan taila, Bala taila, and Mahavishgarbh taila [61, 62]. It also forms one of the ingredients of Chayvanprash Linctus, used as a general tonic for restoring strength and health and Garbha Cintamani Rasa, a classical Ayurvedic preparation which is used in puerperal complications [63] .

CONCLUSION

The extensive survey of literature revealed that A. indicum is an important plant of Ayurveda. It is being used since a long time in making ayurvedic drugs. Medicinally saponins possess hypoglycaemic and antifungal activities. Linoleic, oleic, palmitic, lauric, stearic, and other fatty acids found in the plant claims analgesic activities. β -sitosterol is reported to possess antipyretic actions and flavonoids having hypoglycaemic activities. Besides, the gum and resin obtained from the plant are used in rheumatism and show antiplasmitary reaction, which support the use of this plant for the various purposes since ancient times. Thus, the phytochemicals found therein possess various applications in the allopathic treatment for better drug rationale therapy.

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