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Current status of phytochemical and phytopharmacological study of some medicinal plants used by the tribes in Bangladesh: A review

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Abstract

Medicinal plants are emerging ever-increasing demand day by day because of their significant pharmacological values with low cost and less toxicity than the corresponding synthetic chemical entities. These plants have been used since very long times in the traditional folk medicine. Although various momentous advancement have been made in the medical and pharmaceutical sciences, yet the various tribes use the traditional plants as drug for remedial purposes worldwide till today. Enormous research papers are revealed of chemical profiling and pharmacological evaluation of medicinal plants. This comprehensive review is aimed to combine the phytochemical and phytopharmacological worth of medicinal plants used by various tribes in Bangladesh and to inspire advance research for the improvement of phytomedicine to combat various diseases.

Keywords: Medicinal plants, tribes, phytochemistry, phytopharmacology, Bangladesh

Introduction

Traditionally, plants are used by people in every country as natural remedy of various health disorders. Chemical compounds from plants are the basis of modern medicine and have been used for therapeutic purposes since the beginning of human era [63]. From that time, human being has been searching for recovery of new disease from plant sources [44]. The various group of chemical compounds found in plants are- essential oils, alkaloids, terpenoids, flavonoids, saponins, steroids, vitamins, amino acids, co-enzymes, minerals, phenolic compounds, sterols, organic acids etc. [31, 15]. A wide range of pharmacological effects that are exerted by these plants include- anticancer, antioxidant, hepatoprotective, anti-inflammatory, immunomodulatory, analgesic, antimicrobial, antiplatelet, antihyperlipidemic, adulticidal, melanin inhibitory, antidepressant, antiobesity, antiamebic, radioprotective, larvicidal, cardioprotective, antifungal, coronary vasodilation, antifertility, brain protective, cytoprotective, gastroprotective, laxative, estrogenic, diuretic and many others [26,14]. In Bangladesh, different tribes (Table 1) live in various regions [13, 4], who largely depend on plants' source for their remedy from various disease rather than synthetic medicine. For these reasons, this study was undertaken to focus into further studies of the pharmacological potential of these plant products and their biochemical effects on vital organs.

Table 1: Geographical distributions of the tribes live in Bangladesh

Tribes	Habitation
Sawntal	Rajshahi, Dinajpur, Rangpur, Jessore, Satkhira, Khulna, Gaibandha, Noagaon, Bogra, Sirajgonj, Chapainawabgonj, Natore, Sumangonj, Moulvibazar, Sylhet and Hobigonj districts ^[13]
Garos	Mymensingh, Jamalpur, Sherpur, Gazipur, Tangail, Netrokona, Sumangonj, Moulvibazar, Sylhet and Hobigonj districts ^[13]
Chakma	Bandarban, Rangamati, Khagrachari and Cox's Bazar (Teknaf) districts ^[13,4]
Marma	Bandarban, Rangamati, Khagrachari; and coastal area of Cox's Bazar and Patuakhali districts ^[13,4]
Tripura	Bandarban, Rangamati, Khagrachari, Noakhali, Comilla, Sylhet, Faridpur and Dhaka districts ^[13,4]

Phytochemical and Phytopharmacological aspects

Bangla name : Ashawagandha
Local name : Ashawagandha (Sawntal), Samidak (Chakma)
Botanical name : *Withania somnifera*
Family : Solanaceae

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Fig 1: *Withania somnifera*

Chemical constituents: Different parts of the plant contain different types of chemical entities. The main part reported in the literature review is the root that contain majority of the alkaloids, although other parts used are leaves, fruits, shoots, bark and stems [65]. More than 35 chemical compounds are reported in the studies. The biological activity is mainly due to the presence of alkaloids, steroidal lactone and saponins. The alkaloids present in the plant parts include isopellertierine, anferine, withanine (main), somniferine, somnine, somniferinine, withananine, pseudo-withanine, tropine, pseudo-tropine, 3- α -gloyloxytropine, choline, cuscohygrine, anahygrine, tropanol. Withanolides and withaferins are the major steroidal lactone. Among which withaferin-A and withanolides-D is mainly responsible for pharmacological activity. Other steroidal lactones are asitoinoside, withanolide-A, withanolide-B [37]. Some steroids i.e. cholesterol, β -sitosterol, stigmasterol, and kaempferol and quercetin flavanoids are also present [9].

Pharmacological effects: A number of research articles reveal that *W. somnifera* possess variety of pharmacological value. These include anti-inflammatory, anti-stress/anti-adaptogenic, antioxidant, and immunomodulatory, hemopoietic, rejuvenating, endocrine and cardiopulmonary effects [28]. Other articles suggest the evidence of effect on swimming performance, leukocytosis, and level of cortisol & ascorbic acid contents of adrenal glands. This plant also has effect on cognition, neurodegenerative diseases, GABA-mimetic neurodegeneration and neuroregeneration potential, anxiety, energy level and mitochondrial health [59]. Moreover, the anti-cancerous and anti-diabetic effect is reported by researchers [5].

Bangla name: Arhar
Local name: Adhaki (Sawntal), Cophlinc (Tripura), Dumorsomi (Chakma)
Botanical name: *Cajanus cajan*
Family: Fabaceae



Fig 2: *Cajanus cajan*

Chemical constituents: Flavonoids are the major constituents in *C. cajan* plant that lie highest concentration in leaves.

Seeds, roots, root's bark, etiolated stems and pod surface also contain various active chemical entities. The main flavonoids are flavones, isoflavones, flavonols, anthocyanidins, flavanones, isoflavanone and chalcone [39]. Some other compounds that are also present in leaves are hordenine, juliflorine, betulinic acid, stigmasterol, and β -sitosterol. The green seeds contain some nutrients such as protein, trypsin inhibitor, starch, soluble sugars, crude fiber, fat, calcium, magnesium, copper, zinc and iron [51].

Pharmacological effects: Along with the use of folk medicine, various scientific research shows the use of *C. cajan* as antimicrobial, antibacterial, hypocholesterolemic, antidiabetic, neuroactive, anticancer, hepatoprotective, anthelmintic, glycemic, lactating, analgesic and laxative agents [41]. The seeds can be eaten as a potential source of antioxidant and play a significant role in the minimizing of cellular damage [100]. The leaves are also used for the treatment of anemia, urinary tract infections, and yellow fever while some other plant parts are used for the remedy of coughs, bronchitis, pneumonia, dysentery and menstrual disorders [58].

Bangla name: Akanda
Local name: Ongar (Tripura & Chakma), Marufu (Marma), Arka (Sawntal)
Botanical name: *Calotropis gigantea*
Family: Asclepiadaceae



Fig 3: *Calotropis gigantea*

Chemical constituents: Cardenolides are the principal active species. Some proteinases, triterpenes esters are present in the latex while aerial parts and flowers contain flavonol and triterpenoids respectively [73]. "Mudarine" an active compound is found in leaves. Wide varieties of cardiac glycosides that also present are calotropogenin, calotropin, uscharin, calotoxi and calactin. Some other constituents are giganteol, isogiganteol, akundarin, α -amyrin, glutathione, asclepin [60]. Few alkaloids, flavonoids, tannin, phenolic compounds, steroids are present in methanolic extract of leaves whereas petroleum ether treated extract contain glycosides, saponins and fats & oils [62].

Pharmacological effects: *C. gigantea* is a multipotent medicinal plant. The antimicrobial effects of this plant is studied against a wide range of microorganisms including *E. coli*, *S. aureus*, *C. albicans*, *X. campestris* [11]. The antifungal activity against human pathogen is reported in study. This plant also possess antivenom, antioxidant, antidiarrheal, antiviral, anthelmintic, fibrinolytic, mosquitocidal and antitumor activity [1].

Bangla name: Apang
Local name: Apamarga (Sawntal), Chaikacrilu (Marma), Upalengra (Chakma)
Botanical name: *Achyranthes aspera*
Family: Amaranthaceae



Fig 4: *Achyranthes aspera*

Chemical effects: The seeds of the *A. aspera* are the main source of various saponins. The D-Glucuronic acid and D-Galactopyranosyl ester are isolated from saponin-A and saponin-B respectively from the seeds. A wide number of compounds like p-benzoquinone, hydroquinone, spathulenol, nerol, ionone, asarone and eugenol are present in leaves [48]. Other parts such as shoots contain ketones, long chain compounds and aliphatic alcohol, while stems contain pentatriacontane, 6-pentatriacontanone. Fruits contain saponin namely saponin-C and saponin-D. Moreover, carbohydrate, protein, phenols and some enzymes are present in gall & normal tissues [54].

Pharmacological effects: The most common activities that are known to possess by *A. aspera* plant include spermicidal, anti-parasitic hypoglycemic, cancer chemo-preventive, hepatoprotective, anti-inflammatory, anti-arthritic, anti-oxidant, nephro-protective, anti-depressant, cardiovascular, broncho-protective, anti-allergic and wound healing [18]. Some other valuable therapeutic uses are hypolipidemic, immunomodulatory, anti-microbial, analgesic-antipyretic and diuretic [49].

Bangla name: Nishinda
Local name: Indrani/ Nirgundi (Sawntal), Gaurabo (Chakma)
Botanical name: *Vitex negundo*
Family: Verbenaceae



Fig 5: *Vitex negundo*

Chemical constituents: Several compounds such as volatile oils, lignans, flavonoids, steroids and terpenes are common in various parts of the plant. Different solvent extract contain different specific chemical constituents i.e., negundoside, agnuside, vitegnoside are profound in methanolic extract [31]. Some common compounds are- 6'-p-hydroxybenzoyl musaenosidic acid, β -caryophyllene, sabinene, 4-terpineol, gamma-terpinene, caryophyllene oxide, n-hentriacontanol, β -sitosterol, p-hydroxybenzoic acid, protocatechuic acid, oleanolic acid, angusid, casticin, vitamin-C, nishindine,

gluco-nonitol, vitedoin-A; vitedoin-B, vitedoamine-A, β -sitosterol, p-hydroxybenzoic acid, 5-oxisophthalic acid, n-tritriacontane, n-hentriacontane, n-pentatriacontane, n-nonacosane, vitexin, isovitexin, negundin-A, negundin-B, vitrofolal-E, vitrofolal-F, acetyl oleanolic acid, sitosterol, δ -guaiene, guaia-3,7-dienecaryophyllene epoxide, ethyl-hexadecenoate, β -selinene, α -cedrene, germacrene D, hexadecanoic acid, p-cymene and valencene [27].

Pharmacological effects: Antiamnesic, antioxidant, antibacterial, phytopathogenic antibacterial, antifungal, anti-inflammatory, analgesic, reproductive potential, histomorphological, anticonvulsant, anxiolytic, antipyretic, cellular, cytotoxic against PANC-1 & a panel of 39 human cancer cell, antitussive, anti-snake venom, hepatoprotective, larvicidal and antihelminthic properties of *V. negundo* are well known [66]. In addition, some other pharmacological values that are found in independent research include antifeedent, antihyperpigmentation, CNS, antiadrenergic, antihistaminic and mosquito repellent activity [61].

Bangla name: Raktajoba/ Joba
Local name: Padmacharini (Sawntal), Hindumapangi (Marma), Ulphul (Chakma)
Botanical name: *Hibiscus rosa-sinensis*
Family: Malvaceae



Fig 6: *Hibiscus rosa-sinensis*

Chemical constituents: The chemical entities that are investigated in leaves are alkaloids, glucosides, reducing sugars, fatty materials, fatty alcohols, resins, sterols, sterculic acid, malvalic acid and hydrocarbon. In addition to sterculic acid, malvalic acid, stems contain teraxeryl acetate and β -sitosterol. Flowers are source of thiamine, riboflavin, niacin, ascorbic acid, apigenidin, citric acid, fructose, glucose, oxalic acid, pelargonidin, and quercetin. Roots reveal the presence of glycosides, tannins, phytosterol, fixed oils, fats, proteins, amino acids, flavonoids, saponins, gums and mucilages [43]. Some other compounds that also isolated are nitrogen, crude fiber, calcium, iron, phosphorous, quercetin-3,5-diglucoside; quercetin-3,7-diglucoside; cyaniding-3,5-diglucoside; glucose, fructose, carotene, undecanoic acid, tridecanoic acid, tricosanic acid, palmitic acid, octanoic acid, nonaolic acid, N-hexacosane, N-heptadecane, N-eicosane, margaric acid, lignoceric acid, lauric acid and catalase [20].

Pharmacological effects: Flowers and leaves of *H. rosa-sinensis* are used in various communities from ancient times. Diverse pharmacological and biological efficacies of this plant parts have been proved. These includes- antifertility, abortifacient, analgesic, anticonvulsive, anti-implantation, anti-inflammatory, anti-pyretic, anti-spasmodic, anti-ovulatory, antifungal, anti-viral, CNS-depressant, hypotensive, hypothermic, hair growth and Juvenile hormone

activity [20]. Some other significant effects are anti-tumoral, anti-convulsant, anti-diarrheal, anti-phlogistic, anti-diabetic, demulcent and laxative [35]. The benzene treated extract of flowers show estrogenic property [64], antioxidant and antibacterial efficacy [24].

Bangla name: Bel/ Bael
Local name: Sreephal (Sawntal), Wa-rai-ropand (Marma), Belgulu (Chakma)
Botanical name: *Aegle marmelos*
Family: Rutaceae



Fig 7: *Aegle marmelos*

Chemical constituents: *A. marmelos* fruit is the blessings of nature. The main part used is fruit, although other parts used include leaves, roots and seeds. The various parts contain a range of phytochemical. The fruit contains – marmelosin, luvangetin, auraptene, psoralen, marmelide, tannin and phenols. The compounds that are found in leaves include – aeglin, rutin, skimmianine, gamma-sitosterol, β -sitosterol, flavone, lupeol, cineol, citral, glycoside, hallordioli, mameline, euginol etc. Barks and roots have alkaloids, fagarine, marmin, fluroquinoline, halopins, coumarins and terpenes. Some other chemical constituents i.e., essential oil -D, limonene, cineol, citronellal, citrol, p-cymene, cuminaldehyde are also reported in seed [17]. Fruit contains some nutritional compounds as protein, fat, mineral, fibre, calcium, phosphorous, iron, carotene, thiamine, niacin, vitamin-C, potassium, and copper [57]. The ethanolic extract of fruit pulp contains coumarins glycoside, phenol, alkaloids, tannins, flavanoids, saponins and steroids [21].

Pharmacological effects: This plant parts have great potential to combat a variety of disorders like diarrhea, dysentery, constipation, cardio-protective, peptic ulcer and many others [17]. Pharmacological activities of leave are- contractile, anticonvulsant, antimicrofilarial, antidepressant & anxiolytic, analgesic, anti-inflammatory, antipyretic, antifertility, antiulcerative, antifungal, hepatoprotective, radioprotective, hypolipidemic and immunomodulatory. Antidiabetic property is shown by fruit pulp and seed extract [22, 36]. Antibacterial activity of ripe *A. marmelos* fruit is proved against micro-organisms *B. subtilis*, *S. flexineri*, *S. epidermis*, *S. aureus*, *E. coli*, and *P. aeruginosa* [10]. Anticancer, chemopreventive, antigenotoxic and diuretic activities are also demonstrated [46]. Moreover, the insecticidal property of leaves, antiproliferative activity of stem bark and antimalarial activity is also documented in various studies [52].

Bangla name: Keshraj
Local name: Vringoraja (Sawntal), Crongmai (Marma)
Botanical name: *Elipta alba*
Family: Asteraceae



Fig 8: *Elipta alba*

Chemical constituents: The different parts of *E. alba* contain a diverse group of phytochemicals. Active compounds are- coumetan, terpenoids & glycosides, alkaloids, saponins and volatile oils. Some other chemical constituents reported in individual parts of plant are- wedelolactone, desmethylwedelolactone, stigmaterol in leaves; sterols & ecliptalbine in seeds; hentriacontanol, heptacosanol, stigmaterol, ecliptal, eclalbatin in roots; wedelolactone in stems; β -amyrin & luteolin-7-O-glucoside, apigenin, cinnaroside, sulphur compounds, eclabasaponins I-VI in aerial parts and resin, ecliptine, reducing sugar, nicotine, stigmaterol, triterpenesaponin, eclalbatin, ursolic acid, oleanolic acid in whole plants [7]. Moreover hydrocarbons, triterpenes, thiopenes, sterols, flavanoids and miscellaneous are also isolated from *E. alba* [56].

Pharmacological effects: *E. alba* is an important medicinal plant. Studies demonstrate proteolytic, hemorrhagic, osteoblast differentiation and neuropharmacological effects. This plant is widely used in various hepatic disorders [23]. Other remarkable pharmacological properties of this plant are- analgesic, anti-aggression, anti-bacterial, anticancer, hair growth promotion, memory enhancement, anti-diabetic, anti-helminthic and anti-inflammatory [53]. Moreover, *E. alba* shows antihyperlipidemic, antioxidant, immunomodulatory [33] and anti-venom properties [68].

Bangla name: Gulanchi/ Katgolap
Local name: Devanganagalu (Sawntal), Gulochi (Tripura), Aangara (Marma)
Botanical name: *Plumeria rubra*
Family: Apocynaceae



Fig 9: *Plumeria rubra*

Chemical constituents: Compounds isolated from flower are- resin, quercetin, kaempferol and cyaniding diglycosides. Bark contains plumieride, resinic acid, fulvoplumerin, (E)-non-2-en-1-ol, limonene, phenyl acetaldehyde, n-tetradecanol, and gamma-elemene. Other compounds that present in leaves are plumeride, resinic acid, (Z)- β -farnesene- α -patchoulene, limonene, (E)- β - farnesene, α -copaene, phytol, lupeol nanoate, lupeol heptanoate, rubrinol glucoside, β -sitosterol- β -

D-glucoside and plumeiride coumarate [30]. Some phytoconstituents like allamcin, allamandin, 2, 5-dimethoxy-p-benzoquinone, 6-hydroxy-3-epioleanolic acid, and 3, 27-dihydroxyolean-12-ene are present in stems and barks [8]. In addition to these, *P. rubra* from various regions shows some other chemical entities such as- lauric acid, palmitic acid, myristic acid, linoleic acid, benzyl salicylates, benzyl benzoate, neryl phenylacetate, phenyl ethyl benzoate, linalool, geraniol, hydrocarbon, tricosane, citronellol, n-tetradecanol, butyl-oleate, butyl-palmitate, methyl-oleate, famesol, citral and many others [16]. Ursolic acid is also identified in *P. rubra* [55].

Pharmacological effects: The Ethanolic extract of *P. rubra* shows anti-cancer activity [47]. This plant also possess antifungal, antibacterial, antimicrobial, antialgal, larvicidal, molluscicidal, piscicidal, nematocidal, antioxidative, hypolipidemic, proteolytic, cytotoxic, abortifacient, anti-HIV, antipyretic, anti-inflammatory, anthelmintic and antiviral property [12, 67]. Moreover, the wound healing property of *P. rubra* is also well known [6].

Bangla name: Punarnava
Local name: Punarnava (Sawntal), Proynoya (Marma)
Botanical name: *Boerhaavia diffusa*
Family: Nyctaginaceae



Fig 10: *Boerhaavia diffusa*

Chemical constituents: *B. diffusa* is a familiar ethno-medicinal plant. A number of phytochemicals are identified and isolated from this plant. The chemical compounds isolated from entire plant are- alkaloids, phytosterols, lignans, rotenoids, xanthenes, and potassium salts of nitrates [50]. The whole plant contains 15 amino acids. Phytochemicals reported in the roots are- punarnavoside, boerhavone, isoflavones, trans-caftaric acid, rotenoids, boerhavine, liriodendrin, boerhavisterol, β -ecdysone, tricont-24-en-1-oic acid and boeradiffusene while flavonol and flavonoid glycoside present in leaves [32].

Pharmacological effects: *B. diffusa* is a valuable medicinal plant, each part having specific therapeutic applications. The important pharmacological effects are immunomodulatory, anticancer, anti-diabetic & hypoglycemic, antifibrinolytic, anti-inflammatory, diuretic & renal activity, hepatoprotective, antimicrobial, antifungal, antioxidant, spasmolytic, anti-asthmatic and anti-convulsant [41]. Other pharmacological activities exerted are anti-proliferative, anti-estrogenic, antitumor, analgesic, antiviral, anti-stress/ adaptogenic [29], antifertility, radioprotective, nitric oxide scavenging, growth inhibition of struvite crystals, anti-lymphoproliferative, insecticida [2], anti-nociceptive [34] and effect on semen & testicular morphology [98].

Conclusion

This review highlights the known phytochemical constituents and reported pharmacological findings of the above mentioned plants. The aim of this review is to preserve the knowledge of tribes towards the use of various plants and plant parts' for medicinal purposes. The presence of wide range of phytochemicals in these plants indicates the immense therapeutic efficacy as a potent phytomedicine, as they are comparatively safe, non-toxic and economical. Therefore, further research would bring about new era in the treatment of various complicated disorders by using these plants.

Conflict of interest

Authors have no conflict of interest regarding this study.

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