A review of two plants used in Bangladesh for toothache and general oral care

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Abstract

Because of the comparative unhygienic mode of living, which includes not taking proper care of the teeth and gums, toothache and gum diseases are common among the rural and tribal people of Bangladesh. In the absence of qualified dentists and dental diseases’ treatment, the people depend on traditional medicinal practitioners like folk and tribal medicinal practitioners, who in turn utilize various medicinal plants for treatment of tooth and gum problems. In this review, we discuss the traditional mode of use of two such plants, namely *Abutilon indicum* and *Acalypha indica*. At the same time, we review comparative ethnic uses in other parts of the world, and discuss the scientific validation of the uses along with potential for discovery of new drugs based on published scientific literature on the phytochemical content and pharmacological properties of the two plants. It is concluded that the two plants merit potential for further scientific research towards discovery of possible novel drugs, which can be effective against tooth and gum disorders.

Keywords: Abutilon indicum, Acalypha indica, toothache, gum disorders, traditional medicine

Running head: Plants for toothache and general oral care

Introduction

Oral diseases can be of many type; among them oral cancer, dental caries, and periodontal diseases constitute the major health problems according to recent reviews and reports [1-3]. A survey of dental health carried out in rural and urban areas of central and western Bangladesh found that except for the 6 year olds, less than 10% in all age groups had a healthy periodontium. In the 18 year olds, shallow pockets were found in 34% of the urban slum group and in 42% of the rural group [4]. Another survey on oral health of 12-year old children found frequent occurrences of poor oral hygiene and bleeding gingiva [5]. In a survey of 6-12 year old children in Bangladesh, it has been found that there is a significant correlation between incidence of dental caries (decayed teeth) and underweight of children [6]. Prevalence of dental caries was associated with lower height, weight and body mass index (BMI) among Bangladeshi children as observed in another
Prevalence of gingivitis and plaque accumulation has been observed to be remarkably high among slum dwellers of Bangladesh.

The scenario presented above for Bangladesh holds true for other countries, especially the under-developed countries. According to the World Health Organization (WHO), in most developing low-income countries, the prevalence of dental caries is high with 90% of the dental caries left untreated. An estimated 5 billion people suffer worldwide from dental caries or tooth decay.

Dental caries carry a high treatment cost. Although the cost may vary from country to country, just to cite one example, the treatment cost for dental caries for all children below 15 years age in Saudi Arabia (assuming that each child has 6 decayed teeth and the prevalence of dental caries is 84%) comes to 3.9 billion Saudi Riyals (1 Saudi Riyal = 0.27 US$).

The prevalence of dental caries in India is 50-60%. Dental caries is an infectious microbial disease leading to tooth loss and severe pain in the late stages. Thus prevention is better than treatment of dental caries. On the other hand, prevention means adoption of good oral hygiene measures necessitating regular brushing of teeth and washing of mouth after consumption of food, especially sweets. People in poor countries, either through lack of knowledge of how to maintain appropriate oral hygiene or because of their inability to purchase toothbrushes and toothpastes or because of absence of quality water fail to observe proper maintenance of their teeth and gums. At the same time, once any dental problem occurs, any proper dentist, doctor and even medicines are either not available or affordable.

To get out of this conundrum, people resort to traditional medicinal practitioners, who mostly use plants for both preventive and therapeutic purposes. Notably, the two major things to be used in case of for example occurrence of dental caries are use of anti-microbial substances and pain alleviating items.

**Overview of plants used against dental problems like toothache and bleeding from gums**

Plants form an important tool of traditional medicinal practitioners for maintaining oral hygiene and for treatment of various dental problems. In an ethnomedicinal survey carried out in Bargarh district in Odisha State, India, 57 plant species were documented to be used for dental and oral health care. Out of the 57 plant species, 24 were used exclusively for tooth stick, 24 for toothache due to caries, 16 for gum diseases, and 11 for pyorrhea. The Fabaceae and Moraceae families contributed the maximum number of plants with 5 species for each family. Small branches of *Abutilon indicum* were used as tooth brush and leaf paste was used for treatment of toothache. Small branches of *Achyranthes aspera* were also used as tooth brush; twig mixture was used as a wash for tooth pain. Dried root powder was used as tooth paste and for treatment of gum disorders. Cotton soaked in leaf extract was applied to aching tooth and for filling up cavities.

A review of plants used for oral health care showed that 120 species of plants are used throughout India for maintaining oral health and treatment of oral health disorders. It has been shown that a number of plants used for maintenance of oral hygiene contain phytochemicals, which are active against oral bacteria. To cite just one example, the plant *Piper cubeba* contains anti-bacterial components like artocarpesin, macelignan, catechol, and xanthohumol. The tribal population of Wayanad district, Kerala, India has been reported to use three plants for teeth cleansing, eight plants as remedy for dental caries or tooth decay, thirteen plants as remedy for toothache, and six plants as treatment for oral ulcers. Among the plants used are roots of *Areca catechu* (for oral
Traditional healers in Cameroon have been identified to use 52 plants of which 48 are used in the management of toothache, sore throat, mouth sores, abscess, broken tooth and jaw, tooth sensitivity, mouth thrush, dental caries, gingivitis, sinusitis, tonsillitis, xerostomia, oral syphilis, oral cancer, halitosis, and tooth bleeding. Four plants were used for dental extraction [16]. It may be noted that the majority of the people of Cameroon depend on traditional medicinal practitioners for their health care needs [17].

An ethnobotanical survey conducted among different tribal communities (Bhills, Gavits, Kokanis, Mavachis, Valvis, Pawras, Koknas, and Vasaves) of Nandurbar district of Maharashtra, India, revealed use of 20 plants for treatment of disorders of oral cavity, particularly tooth decay. The stems of Achyranthes aspera were used as tooth brush; ash of the plant was used as tooth powder and to relieve pyorrhea and tooth ache [18]. Sixty two medicinal plant species have been identified to be used by traditional healers in the Kadiogo Province of Burkina Faso for treatment of mainly gingivitis and toothache [19].

Seven plant species have been reported to be used in Shamdhara (Oghi), Mansehra, Pakistan for treatment of oral diseases like gum bleeding and toothache [20]. Eighty seven plant species have been reported to be used in northern India for dental problems with the largest number of plants being used in Himachal Pradesh. Among the various species, Acalypha indica whole plant was used for toothache, and leaves and roots of Achyranthes aspera were also used for the same purpose [21]. A. aspera was among the 13 plants reported to be used for treatment of dental caries by the Malayali tribals from Kolli Hills, India. Stem of the plant was used as tooth brush. Whole plant ash was used as tooth powder to cure pyorrhea, toothache, and gum bleeding [22]. The people of Dakshina Kannada, India use 32 plant species to maintain oral health and hygiene and as remedy for dental diseases. The seeds of Areca catechu are chewed with lime, betel leaf and tobacco to prevent tooth decay [23].

Streptococcus mutans is the most significant bacteria behind the development of dental caries. Among Indian plant species found to inhibit this bacteria are Curcuma longa, Spilanthes acmella, Piper cubeba, Morusalba, Prospopisspicigera, Trachispermum amni, Acacia nilotica, Drosera peltata, Azadirachta indica, Morinda citrifolia, and Cocos nucifera [24].

A number of plant species are also used by folk and tribal medicinal practitioners in Bangladesh to treat toothache and bleeding from gums. The Soren clan of the Santal tribe residing in Rajshahi district, Bangladesh use roots of Glycosmis pentaphylla in combination with garlic (Allium sativum) cloves and fruits of black pepper (Piper nigrum) for toothache. Stems of G. pentaphylla are used for brushing teeth [25]. Fruits of Averrhoa carambola are chewed to obtain relief from toothache by non-Garo folk medicinal practitioners (FMPs), and roots of Glycosmis pentaphylla are used by Garo tribal medicinal practitioners (TMPs) for pyorrhea and toothache in Tangail district, Bangladesh [26]. Stems of Amaranthus spinosus are used to brush teeth and gums to alleviate gum bleeds and toothache in Kurigram district, Bangladesh [27]. Crushed young leaves of Mangifera indica are advised to brush teeth to alleviate toothache by FMPs of Narayanganj district, Bangladesh [28]. The Bede community TMPs of Porabari village, Dhaka district, Bangladesh boils roots of Mimosa pudica and advises patients with toothache to gargle with the still warm water [29]. Paste of root of M. pudica is applied to painful tooth as treatment for toothache in Rangpur district, Bangladesh [30].

In Kishoreganj district, Bangladesh, paste of flowers of Spilanthes calva is applied to aching tooth to obtain relief from pain [31]. Leaves of S. calva or Polygonum
Hydropiper are used for treatment of toothache in Sylhet and Moulvibazar districts, Bangladesh [32]. In a number of ethnomedicinal surveys carried out by us over the last ten years (many of them still not published), it has been observed that more than thirty plant species are used in Bangladesh to treat tooth and gum disorders and oral lesions. The objective of the present report will be to discuss two of these plants used for treatment of toothache or other disorders affecting oral health with regard to their phytochemical constituents and potential for new drug discoveries from these plants. These two plant species are *Abutilon indicum* and *Acalypha indica*. It is obvious that to be good agents for preventing or curing toothache, dental caries or other periodontal diseases, a plant preferably should give both effects, namely anti-bacterial and analgesic as well as be non-toxic and bioavailable.

**Abutilon indicum**

Analgesic and anti-inflammatory effects of ethanol extract of the plant has been reported for carrageenan-induced hind paw edema model and formalin-induced paw licking and tail flick model in rodents [33]. Methanol extract of whole plant also reportedly gave analgesic activity as determined by Eddy’s hot plate method, and anti-inflammatory activity as determined by carrageenan-induced paw edema method in rodents [34].

Phytochemicals isolated from *A. indicum* whole plants include 1-methoxycarbonyl-carboline; 3-hydroxydamascone; 3-hydroxy-ionol; 3,7-dihydroxycromen-2-one; 4-hydroxyacetophenone; 4-hydroxybenzaldehyde; 4-hydroxybenzoic acid; 4-hydroxybenzoic acid ester; 4-hydroxyphenylacetic acid methyl ester; abutilin A; adenine; adenosine; aurantiacamide acetate; benzamide derivative; benzoic acid; coumaric acid; methylindole-3-carboxylate; n-(1’-methoxycarbonyl-2’-phenylethyl)-4-hydroxybenzamide; n-feruloyltirosine; *para*-coumaric acid; riboflavin; scoparone; scopoletin; sitosterol; stigmasterol; syringaldehyde; thymine; vanillic acid; vanillin; and (R)-N-(1’-methoxycarbonyl-2’-phenylethyl)-4-hydroxybenzamide [35]. The plant essential oil constituents are mainly, pinene, caryophyllyene, caryophyllene oxide, endesmol, farnesol, borneol, geraniol, geranyl acetate, elemene, and cineole [36]. Other compounds reported from the plant include p-hydroxybenzoic acid and sesquiterpene lactones including alantolactone and isoalantolactone [37]. From flowers, the reported compounds include luteolin, chrysosieriol, luteolin 7-O-glucopyranoside, apigenin 7-O-glucopyranoside, quercetin 3-O-□-glucopyranoside, and quercetin 3-O-□-rhamnopyranosyl□glucopyranoside [38]. Some of the compound structures are shown in Figure 1.

Volatiles such as eugenol [39], caryophyllene and caryophylline oxide [40], borneol [41], and geraniol [42] and flavonoids like luteolin, apigenin, and quercetin can act as analgesic and anti-inflammatory agents [43]; from that viewpoint, *A. indicum* has excellent potential to mitigate pain and inflammation from disorders like dental caries. Flavonoids like quercetin inhibit both cyclooxygenase and lipoygenase activities thus alleviating both pain and inflammation [44].

Ethanol extracts of leaves of *A. indicum* showed anti-bacterial activity against *Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumoniae, Pseudomonas aeruginosa, Escherichia coli*, and *Salmonella typhi* [45, 46]. In another study, ethanolic extract of leaves showed anti-bacterial activity against Gram positive organisms like *Bacillus subtilis, Staphylococcus aureus, Sarcina leuka* and *Bacillus megatherium*, and Gram negative organisms like *Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris* and *Shigella sonnei* [47]. Ethanol extract of whole plant was found to be active against various bacteria species like *Salmonella typhimurium, Proteus vulgaris, Shigella dysenteriae*, and a fungus, namely *Candida*.
Various solvent extracts of the leaves were found inhibitory against a number of bacterial species like *Bacillus cereus*, *Bacillus megatherium*, *Bacillus subtilis*, *Staphylococcus aureus*, *Sarcina lutea*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella paratyphi*, *Salmonella typhi*, *Shigella boydii*, *Shigella dysenteriae*, *Vibrio mimicus*, *Vibrio parahemolyticus*, and the fungal species *Candida albicans*, *Aspergillus niger*, and *Saccharomyces cerevisiae*. Ethnomedicinally, the leaves of the plant are used for mouth washes. The root of the plant is also used in ethnic medicine for treatment of gonorrhea and leprosy, while the fruits are used for coughs and gonorrhea. The ethnomedicinal uses also point to the anti-bacterial properties of various parts of the plant.

**Acalypha indica**

Decoction of this herbaceous plant is used for tooth disorders in Tamil Nadu, India. Traditional medicinal practitioners of Khulna City, Bangladesh administer either around 5g of dried plant or 6g of juice obtained from fresh plant for treatment of tooth diseases. Reported bioactive compounds from *A. indica* include 9-tricosene, phytol, dihydroactinidiolide, loliolide, docosanol, 1-eicosanol, 1-triacontanol, 3,7,11,15-tetramethyl-2-hexadecen-1-ol, octacosanol, 5,10-diohexy-2,3,7,8-tetrahydro-1H,6H-dipyrrrolo[1,2-a;1’,2’-d]pyrazine, tricosane, 9,12-octadecadienoic acid (Z,Z) methyl ester, hexanedioicacid bis(2-ethylhexyl) ester, the latter compound has anti-bacterial activity. Kaempferol, acalyphine, acalyphamide, 2-methylantraquinone, tri-O-methyl ellagic acid sitosterol, sitosterol glucoside, stigmasterol, and n-octacosanol have also been reported from the plant. Acalyphine can be used for the treatment of sore gums. Some of the compound structures are shown in Figure 2.

Hexane, chloroform, ethyl acetate and methanol extracts of leaves of *A. indica* reportedly demonstrated inhibitory activities against the Gram-positive microorganisms *Staphylococcus aureus*, *Staphylococcus epidermis*, *Bacillus cereus*, and *Streptococcus faecalis*, and the Gram-negative microorganisms *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus vulgaris*, and *Pseudomonas aeruginosa*. Methanol extract of whole plant showed inhibitory activity against *Salmonella typhimurium*, *Proteus vulgaris*, and *Shigella dysenteriae* and a fungal pathogen, *Candida albicans*. Petroleum ether extract of dried stem, bark and leaves was active against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli*. Ethyl acetate and hexane extracts of leaves and roots was found to inhibit the growth of *Bacillus subtilis*, *Staphylococcus aureus* and *Klebsiella pneumoniae*. Methanol extract of leaves inhibited the growth of bacteria causing nosocomial infections, the various bacterial species including *Staphylococcus aureus*, *Serratia marcescens*, *Escherichia coli*, *Salmonella typhi*, *Shigella flexneri*, *Klebsiella pneumoniae*, *Vibrio cholerae*, and *Pseudomonas aeruginosa*. Ethanol, methanol, acetone and chloroform extracts of the plant’s leaves were active against the bacterial species *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Staphylococcus aureus*, and the fungal species *Candida albicans*, *Aspergillus niger*, and *Candida kefyr*. Water and ethanol extract of the leaves were reportedly more active against the bacterial species *Escherichia coli*, *Salmonella enteritidis*, *Staphylococcus aureus*, and *Bacillus subtilis*, while chloroform extract of the leaves was more active against the fungal species *Candida albicans*, *Candida tropicalis*, *Microsporum canis*, and *Aspergillus fumigatus*. Methanolic extract of *A. indica* showed anti-inflammatory activity in carrageenan-induced rat paw edema and...
analgesic activity in acetic acid-induced writhing tests in mice \[66\]. From a number of compounds reportedly present in \textit{A. indica}, namely 2-methylanthaquinone, sitosterol, \textit{n}-octacosanol, and stigmasterol, 2-methylanthaquinone showed best docking store with cyclooxygenase 1 (COX 1) enzyme, which is responsible for synthesis of prostaglandins and causation of pain \[67\]. sitosterol and stigmasterol are also known for their anti-inflammatory and analgesic properties \[68, 69\]. Thus similar to \textit{A. indicum}, \textit{A. indica} also possess both anti-microbial and analgesic properties, which can be beneficial in alleviating pain and eradication of pathogenic microorganisms involved in oral disorders.

**Conclusion**

Our comprehensive literature review reveals that both \textit{A. indicum} and \textit{A. indica} have various bioactive phytoconstituents, many of which have been proven to have reported anti-inflammatory, analgesic and antibacterial properties. In ethnobotanical uses of extracts derived from these plants, it is likely that multiple constituents contribute to the observed benefits, perhaps with additivity and/or synergy. Future studies may look into concentration response of these known chemicals either single or in combination against suitable models of dental infection and toothache and identification of relevant targets or pathways.

**Data availability statement**

All data has been cited from published papers which have been abstracted in PubMed, SCOPUS and Google Scholar.

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**Conflicts of interest**

The authors declare that they do not have any conflicts of interest regarding publication of this paper.

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Legends Figure

1-Methoxycarbonyl-β-carboline

3 Hydroxy-β-damascone

3-Hydroxy-β-ionol

3,7-Dihydroxychromen-2-one

Scoparone

Scopoletin

Aurantiamide acetate

Alantolactone

Caryophyllene

Caryophyllene Oxide

Eugenol

Borneol

Geraniol

Luteolin

Apigenin

Quercetin

Figure 1. Selected phytochemicals isolated from various parts of *Abutilon indicum*
**Figure 2.** Selected phytochemicals isolated from various parts of *Acalypha indica*