SIGNIFICANCE OF CHEWING-STICKS (MISWAKS) IN ORAL HYGIENE FROM A PHARMACOLOGICAL VIEW-POINT

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Abstract

The rate of caries has long been observed to be very low in the users of chewing-sticks even when they consume high carbohydrate diets. Recent researches have revealed that the chewing-sticks help in cleaning the teeth not simply due to mechanical removal of plaque but also due to their chemical constituents that possess the properties of whitening the teeth, protecting them from decay and removing the tartar. In addition, they stimulate the gingiva and heal spongy and bleeding gums. Large amounts of fluoride, silicone and resins have been reported to be present in many chewing-sticks which not only help in cleaning the teeth but also exert strong anticariogenic effect. Some commonly used chewing-sticks have also been shown to possess antimicrobial property due to the presence of antibiotics and/or other chemo-thcrapeutic agents. In addition some essential oils and other ingredients of the chewing-sticks have been reported to promote the healing of inflamed gums, alleviate tooth-ache and check bleeding from spongy gums. Some constituents of the chewing-sticks like fluoride and essential oils are already being incorporated into the tooth-pastes. More recently two new tooth-pastes have been manufactured which contain extracts of Salvadora and Neem, the popular chewing-sticks. Further studies on chewing-sticks are expected to reveal many more pharmacologically potent substances which would prove very effective in further promoting dental health and oral hygiene. Anatomically most of the popular chewing-sticks have been found to be well suited to their role as fine natural tooth-brushes.
Holy Prophet, Hazrat Muhammad (Peace be upon Him) has said that "Miswak is an implement for the cleaning of teeth and pleases Allah". Many other similar injunctions clearly show Islam's deep concern in oral hygiene. The chewing-sticks as an implement to clean the teeth which still remain very cheap and practical means of maintaining oral hygiene in masses, was highly recommended by the Apostle of Allah (Peace be upon Him) about fourteen hundred years ago.

Introduction

Chewing-stick as a means of teeth-cleaning has been used by many cultures of the world since antiquity. The practice is still continued by many individuals in many parts of the globe despite many conveniences in the use of modern tooth-brushes. The plants commonly used for making chewing-sticks are very carefully selected for such properties as foaminess, hardness and taste. Consequently, certain species have become more popular than others. MacGregor (1963) reported the incidence of caries and other dental diseases to be low amongst the users of chewing-sticks, despite intake of carbohydrate rich diet and lack of modern dental prophylactic regimens in such populations. The tooth-loss has also been found to be minimal in the populations in countries where such natural implements are used (Elvin-Lewis et al., 1974).
Phytochemical and pharmacological studies have demonstrated the presence of very useful ingredients in ideal medicinal combinations in some of the popular chewing-sticks (Elvin-Lewis, 1980). In this paper, an attempt has been made to present some observations and pharmacological data available on chewing-sticks to show a correlation between the traditional practice and its scientific basis.

Chewing-Sticks Employed in Various Countries

The chewing sticks used for cleaning teeth in various parts of the world, alongwith their claimed medicinal actions and the major chemical constituents present in them, have been listed in alphabetical order in Table. I.

Table I: Some Chewing Stick used for Cleaning Teeth in Various Countries*

Name of Plant	Part Used	Country where Used	Medicinal Uses/Actions	Major Active Constituent(s)
Acacia arabica (Kikar)	Twig	Pakistan, Africa	Dysentery, oral wounds, tradcho-ma, toothache, venereal diseases.	Anthraquinones, tannin, inor-ganic salts, gum.
Acacia modesta (Phulai)	Twig	Pakistan, India	Astringent, antiseptic; cures oral infections, toothache.	Anthraquinone, tanninn gum.
Acacia speciosa (Shirin)	Twig	Pakistan, India	Astringent, ophthalmia, haemo-static; cures piles, spongy-gums etc.	Anthraquinone, tannin, gum.
Achyranthes aspera (Rough chaff tree, Latjira)	Branch, root	Arabia, Paama	Emetric, useful in a hydropho-bia, snakebite, scorpionstings.	Alkaline salts.
Adina microcepala	Twig	Africa	Oral infections.	Alkaloid *mitraphyline*.
Aegle marmelos (Bengal quince, Bel)	Twig	Pakistan, India	Dysentery, diarrhoea, febrifuge, antibillious.	Volatile oils, tanning, inorganic salts.
Alchornea cordifolia	Root, Stem	W. Africa	Purgative, diuretic, antipyretic, cures dysentery, oral wounds, toothache, etc.	Tannin.
Allanblackia floribunda (Tallow tree)	Root	W. Africa	Analgesic (dental), dysentery.	Essential oil.
Alnus glutinosa (Black alder)	Bark	England	Inflammed gums, toothache.	———
Antidesma venosum	Twig	Nigeria	Laxative, antipruritic, vermifuge.	———
Azadirachta indica (Neem, Nim)	Twig	Asia	Antipyretic, antiseptic, tonic; cures, skin infections.	Alkaloid margosine, resin, gum
Baphia nitida	Stem	W. Africa	Purgative; useful in dysentery, ringworms.	Red dye isosantaline.
Betual lenta	Twig	U.S.A.	Antiseptic, disinfectant, anti-rheumatic.	Tannin, essential oil.
Capparis aphylla (Caper plant, Khirar)	Root	Pakistan, India, Africa	Astringent, expectorant laxative, antirheumatic.	Alkaloid, caparic acid.
Carapa procera	Twig	W. Africa	Laxative, antipyretic, ophthal-mia, dermatitis.	Alkaloid *carapin* and *tulukunin*, bitter.
Cassia auriculata (Tanners cassia, Tarwar)	Twig	India, Ceylon	Ophthalmia, heart diseases, dia-betes.	Tannin in organic, salts etc.
Citrus aurantifolis (Kagzi Lemon)	Twig	W. Africa, India	Dysentery, fever, oral infections, ophthalmia.	Essential oils, resins, tannin, bitter princip.
Cornus florida (Dog wood)	Twig	Eastern U.S.A.	Astringent, dentifrice, febrifuge, conditioner gum.	Bitter principle.
Dalbergia sissoo (Black-wood, Shisham, Tali)	Twig	Pakistan, India	Astringent, Antibacterial, haemo static, gonorrhoea.	Essential oil.
Daniellia oliverae	Twig	Ghana	Evacuant, antipruritic, antisep-tic, venereal disease.	Resin, essential oil.
Diospyros barteri	Stem	W. Africa	Antibacterial, styptic, astringent, antipyretic, sore throat, stomati-tis.	Alkaloid *scopolin*, antibacterial agent, tannin, saponin naph-thaquinones, fluoride and sili-cone.
Diospyros embryopteris (Wild mangosteen, Taindu)	Bark	Bengal, India, Pakistan	Antibacterial, styptic, astringent, antipyretic, sore-throat, stomati-tis.	Antibacterial agent, alkaloid *scopolin*, tannin, saponin, naph-thaquinones, fluoride and sili-cone.
Diospyros lycioides	Root	Zambia	Antibarterial.	Similar to above.
Diospyros tricolor	Stem	W. Africa	Anticarcinogenic.	Diosquinone and as given above.
Eugenia coronata	Twig	Ghana	Spongy-gums, dysentery.	Tannin.
Fagara zanthoxyloides	Stem	W. Africa	Dysentery, fever, antiseptic in oral infections, ophthalmia, anti-cariogenic.	Alkaloid *starine*, resin, essential oil.
Garcinia kola	Root	W. Africa	Dysentery, head-ache, malignant tumors, respiratory diseases, wounds, laxative.	Tannin, reducing sugar, fluo-ride and silicone.
Garcinia mangostana (Mangosteen, Mangustan	Twig	W. Africa, India	Dysentery, diarrhoea, antiseptic, disinfectant.	Fluoride, mangostin, resin, tan-nin, ambeisiasin.
Gaultheria fragrantissima (Indian winter-green)	Root	Nepal, Burma, Ceylon, India	Dysentery, diarrhoea, antiseptic, *disinfectant*.	Volatile oil, methylsalicylate, e, arbutin, ericolin, resin.
Gaultheria procumbens	Root	U.S.A.	Analgesic; useful in rheumatism, dysentery, toothache.	Methyle salicylate.
Glycosmis pentaphylla Stem (Ban nimbu)	Stem	India, Pakistan	Fever, liver disease, anthelmintic, skin diseases.	———
Glyphara brevis	Twig	W. Africa	Antipyretic, laxative, wounds, respiratory diseases.	———
Gouania lupuloides (Chaw stick)	Stem	Africa, West Indies	Inflammed spongy gums, denti-frice.	Toothwash ingredient in Jamai-ca.
Jatropha curcas (Jangli erandi Rattanjot)	Stem	India	Purgative, antirheumatic, styptic cures inflammed, bleeding gums.	Tannin, saponin, *curcin*, *caseine*, salts jatrophic acid.
Juglans regia (Wall-nut, *Akhroot*)	Stem Bark	Pakistan	Anthelmintic, antiseptic, astring-ent.	Nucin, Juglandic acid, resin, alkaloid *bartsiam*.
Mangifera indica (Mango, Aam)	Twig	Panama, India, Pakistan	Astringent, styptic, bronchitis, toothache.	Tannin, bitter gum, resin.
Massularia acuminata	Stem	South Nigeria	Dysentery, anticariogenic, oph-thalmia.	Fluoride (?).
Newbouldia laevis	Twig	Nigeria	Stomach pains, diarrhoea, tooth-ache.	Essential oil (?), tannin.
Parinari curratellifolia	Twig	W. Africa	Antimalarial, cardiac stimulant, ope-diseases.	Tannin, antimalarial.
Paullinia pinnata	Root	Tropical Africa	Dysentery, leprosy, jaundice, oral wounds, aphrodisiac.	
Pongamia glabra (Indian beech, *Sukhchain*)	Twig	India, Pakistan, Ceylon	Antiseptic, stimulant healing ac-tion, skin diseases, anthelmintic.	Pongamicoil, bitter alkaloid, resin, mucilage.
Populus cupkratica (Safeda)	Twig	U.S.A., India, Pakistan	Vermifuge, colds.	Essential oil, glucoside, sali-cin, populin, chrysin.
Rhus cotinus	Twig	Tanzania	Antiseptic; used for gargles and mouthwash.	Tennin, essential oil.
Rhus glabra	Twig	U.S.A.	Anticariogenic	Same as above.
Rumex crispus (Sour dock, Hummaz; Chukkah)	Root	India, Pakistan	Spongy gums, chronic, dysen-tery analgesic (dental), astring-ent.	Rumicin, lapathin, tannin, Cal-cium oxalate, emodin, essential oil, mucilage.
Salvadora persica (Toothbrush tree, chhottipilu Khabhar)	Root, Twig	Pakistan, India, East Africa	Diuretic, gastric sedative, hook-worm, venereal disease, antisep-tic, stimulate gums.	Alkaloid *salvadorine* resin, tri-methylamine, large amounts of salts containing chlorine.
Sassafras albidum (Sassafras)	Twig	U.S.A.	Antiseptic, disinfectant, tonic, antirheumatic.	Safrole, essential oil, alkaline ash, bitter principle.
Stercospermum kunthianum	Stem	W. Africa	Wounds, dysentery, respiratory disease.	Alkaline ash, bitter principle.
Waltheria indica	Root	Ghana	Cough, dysentery, fever, oph-thalmia, wounds, styptic.	Tannin, mucilage, sugar.
Tamarindus indica (Imli)	Twig	W. Africa, India	Dysentery, laxative, fever, lep-rosy, ophthalmia, tonic.	Tannin, organic acids, gums, pectin, invert sugar.
Vernonia amygdalina	Root, Stem	W. Africa	Appetizer, diuretic, evacuant, infections.	
Waltheria indica	Root	Ghana	Cough, dysentery, fever, oph-thalmia, styptic.	Tannin, mucilage, sugar.
Vitex simplicifolia	Stem	Nigeria	Antipyretic, toothache, skin in-fection.	Alkaloid, essential oil.
Zanthoxylum alatum (Timber, Tejbal)	Woody bark	Himalaya, Bhutan, Kashmir	Fever, cholera, liver diseases, antiseptic, deodorant.	Alkaloid, essential oil, resin.

*Compiled from the data of Nadkarni, 1954; Said, 1969; Mirza and Chaghtai, 1975; Lewis and Elvin-Lewis, 1977.

Technique of using chewing-sticks

The stick is at first thoroughly washed with water and then chewed on the top to macerate it so that the end becomes frayed and brush-like. Using it as a brush, the teeth are cleaned with it. Care is taken to clean both the inner as well as-outer surface of the teeth. Usually, this procedure take from 5-10 minutes but the stick is sometimes chewed for several hours after brushing is completed. Many muslims use chewing-sticks at least 5 times a day i.e., before every prayer (Salat).

Lewis and Elvin-Lewis (1977) reported that little or no plaques remained on the teeth after proper use of chewing-sticks. The gums, however, appeared pink and firm. Sometimes a mild transient inflammation of gums also occurred.

Chemical Constituents of Chewing-sticks

Some of the important constituents of the chewing-sticks are fluoride, silicone, alkaloids, essential oils (volatile oils), tannins, resins, gums, anthraquinones and related compounds (Table I). The beneficial effects of chewing-sticks in respect of oral hygiene and dental health are partly due to the mechanical action of the fibres and partly due to the pharmacological actions of the various chemical constituents contained therein. This is supported by the observations and research findings of various workers as outlined below:

1.Fluoride and Silicone

Chewing-sticks made from Diospyros, Gar-cinia and Gaultheria species have been found to be rich in fluoride and silicone (Kao and Li, 1968; Losee and Adkins, 1969). Fluoride has-been reported to exert anticariogenic action by (a) strengthening the apatite of teeth due to increased rate of maturation of the enamel surface (b) reducing enamel solubility, (c) favouring the formation of hydroxyl-apatite crystal structure during dissolution and remineralization of enamel, and (d) exerting an inhibitory effect on the growth of micro-organisms or their cariogenic potential by blocking their enzymes (Losee and Adkins, 1969; Peach, 1975). One of the chewing sticks, Diospyros tricolor, rich in fluoride, has been reported to reduce acid production without affecting the rate of growth of cariogenic bacteria (Elvin-Lewis et al., 1974). In addition to fluoride many of the chewing-sticks have been shown to contain silicone which also accounts for the low caries rate seen among the continuous users of such chewing-sticks (Farooqui and Strivastava, 1968).

2. Alkaloids

Many chewing-sticks particularly those belonging to the family Rutaceae contain alkaloids. The alkaloids usually have a bitter taste and exert different types of actions on body tissues. The Fagara species, for example contain alkaloid atarine, which possesses bactericidal, trypanocidal and antimalarial actions (Irvine, 1961). Some other alkaloids are known to exert vasoconstrictor or vasodilator and even analgesic actions (Elvin-Lewis, 1980). All these properties may positively contribute towards dental welfare.

3. Essential Oils

Many chewing sticks such as Aegles marmelos, Aza-dirachta indica, Daniellia oliverae, Fagara zanthoxyloides, Gaultheria procumbens, Pogamia pinnata, Populus euphratica, Rhus cotinus and Zanthoxylum alatum contain essential (volatile) oils which possess characteristic aroma. Many of them exert carminative, anti-septic and analgesic actions. Some of these oils are applied locally on carious teeth, infiammed gums or mucous membranes to relieve pain (Lewis and Elvin-Lewis, 1977).

4. Tannins and Resins

Tannins exert astringent or somewhat irritant action on the mucous membranes. Similarly, resins also possess irritant and many other varied pharmacological properties. They form a coat over the enamel and thus protect against tooth decay. Some of the plants which are known to contain tannins and/or resins are Alchornea cordifolia, Cassia auriculata, Euclea multiflora Garcinia kola, Garcinia mangostana, fatropha curcas, funglans regia, parinari curatellifolia, Rhus curcas, Waltheria indica, and Zanthoylum alatum (Nadkarni, 1954; Lewis and Elvin-Lewis, 1977).

5.Anthraquinones and Related Compounds

Some of the chewing-sticks such as those made from Diospyros barteri, Acacia modesta, Acacia arabica are known to contain anthraquin-ones and/or related compounds (Nadkarni, 1954). These substances exert antibacterial, antidysen-teric and mild laxative effect in different doses. It is possible that continuous use of such chewing-sticks may, in addition to contributing towards oral hygiene, also improve appetite and regulate the peristaltic movements.

Some Pharmacological Properties of Chewing-sticks

1. Antibacterial Effect

Many studies have indicated that certain chewing-sticks possess antibacterial properties and can thus reduce the growth rate and production of acid in cultures of cariogenic bacteria (El-Said et al., 1971; Buadu and Boakye-Yiadom, 1973; Elvin-Lewis et al., 1974; Boakye-Yiadom and Konning, 1976; Manley et al., 1975). Diospyros loureiriana contains an antibiotic while some other type of antibacterial agents are present in plants such as Adina microcephala, Alchornea cordifolia, Azadirachta indica, Citrus aurantifolia, Diospyros bacteri, Fagara zanthoxy-loides, Garcinia kola, Mangifera indica, Mussaendra acuminata, Paullinia pinnata, Tamarindus indica, Vernonia amygdalina, Vitex simplicifolia, and Waltherai indica. The active ingredients in many of these plants have not yet been indentified or isolated. However, in Garcinia morella, broad spectrum activity has been associated with antibiotics Morellin and Gutifferin (Korzybski et al., 1967).

2. Anti-Inflammatory Effect on Gums

It is well known that inflammation of gums occurs quite often during tooth brushing. However, many of the chewing-sticks such as Alnus glutinosa, Antidesma venosum, Azadirachta indica, Dialium guineense, Glycosmia pentaphylla, Gouania lupuloides and Parinari curatellifolia contain substances which possess strong anti-inflammatory effect on gums.

3. Analgesic (Dental) Effect

Extracts of certain plants have been found to be effective in relieving toothache. Local analgesic and anaesthetic properties have been demonstrated in many species of the Acacia, Alchornea, Fagara and Zanthoxylum, which are, therefore, used in various preparations to alleviate toothache (Lewis and Elvin-Lewis, 1977). The active principles in many of these plants have not yet been isolated.

4. Anticarcinogenic and Antineoplastic Effect

The anticarcinogenic and antineoplastic activities have been shown in sticks from Dialium guiveense, Diospyros tricolor, Fagara zanthoxy-loides, Garcinia kola, Massularia acuminata and Rhus glabra. The widely used Diospyros species contain metabolites which exert antineoplastic effects (Thomas, 1971). Extract of Fagara macrophylla is scheduled for pharmacological trial in the cancer chemotherapeutic research programme of U.S. National Institute of Health. Thus, it is possible that regular use of such chewing-sticks may help in reducing the incidence of neoplasms especially in the oral cavity.

Use of Plant Extracts in the manufacture of Tooth-pastes

Commercial tooth-pastes incorporate hydro-philic colloidal binders to stabilize the formulation and to prevent the separation of solid and liquid phases during storage. Some of these are gum arabica, gum karaya, gum tragacanth and mucilages from algae. Volatile oils' extracted from spearmint, caraway, peppermint, cinnamon, sweet orange, cloves, anise, nutmeg, eucalyptus and wintergreen are used as flavouring agents. It is noteworthy that many of these plants have been selected empirically as chewing-sticks by the indigenous populations. Some of the popular chewing-sticks contain a combination of substances which have been recently exploited and made use of in the manufacture of tooth pastes.

Sarakan Tooth-Paste

It is manufactured by M/s Sarakan Ltd Backenham, U.K. It contains stem and/or root material of Salvadora persica (Tooth-Brush tree) locally known as Chhotta-Pilu. This species has long been used as tooth brush tree in Saudi Arabia, Africa, Sudan, Iraq and Indo-Pakistan. Recent researches have proved the efficacy of this plant as a dentifrice. Its root-bark contains about 27% ash, large amounts of chlorine

and trimethylamine, an alkaloid and resin. It also contains silica, sulphur, vitamin C and negligible amounts of tannins and saponins. Its high chloride content imparts dentifrice properties to aid in removing tartar and other stains from teeth mechanically. The silica helps in tooth-whitening by its mechanical action. The resin may form a coat over the enamel and thus protect the tooth from decay. The trimethylamine has a stimulatory effect on the gums. Vitamin C helps in the healing and repair of tissues. The presence of sulphur compounds and possibly its alkaloid gives it antibacterial property. Anatomically, Salvador a persica is well suited to its role as tooth brush. The large amounts of intraxylary phloem and the widely spaced, thick walled fibre in the pericycle of the root allow the spongy wood to be easily crushed by the teeth. It can also be easily softened by water, if dried. The xylem contains numerous thick-walled vessels and fibres characteristic of a good chewing-stick. These cells produce the fibre-like quality of wood (Farooqui and Strivas-tava, 1968).

Neem Tooth-Paste: (M/s Calcutta Chemical,
Calcutta) and Nimodent Tooth-Powder: (Hamdard Laboratories, Karachi)

The oil of Azadirachta indica, so called "Neem" has been reported to exert anti-inflammatory and wound-healing properties and is especially used to treat skin infections. In recent trials carried out in U.S.A. and elsewhere, the usefulness of the neem tooth-paste in the treatment of gingivitis has been demonstrated (Rathje, 1971).

Discussion

In Pakistan and many countries of Asia and Africa, a great majority of the population still lives in the rural areas which fortunately also abound in plants and vegetation. For most of them, use of chewing-sticks is the only method employed for cleaning teeth and maintaining oral hygiene. The modern tooth-brushes and tooth-pastes are seldom used. It is, therefore, important that a traditional practice so common in a large percentage of our population should be further thoroughly investigated on modern scientific lines. Pharmacological investigations of chewing-sticks commonly used in this country should be made to identify their active principles (antibiotics, anti-inflammatory and healing agents etc.) that could be usefully employed in the development of future dentifrices for the benefit of all.

Islam constitutes a complete, all-embracing and comprehensive way of life, obviously it could not leave the importance of oral hygiene unemphasized. Quran Says:

"In it are men who love to purify themselves. And Allah loves those who purify themselves" (Chapter XI-Immunity-108). Holy Prophet of Islam (Peace be upon Him) has been quoted as saying: "Cleanliness is half of faith" (Al-Tibrani), "If I had not found it hard for my followers or the people, I would have ordered them to clean their teeth with chewing-stick (Miswak) for every prayer", "Chewing-stick is a purification for the mouth and it is a way of seeking Allah's pleasure", and "I have told you repeatedly to use Miswak" (Al-Bukhari). Whenever the Apostle of Allah (Peace be upon Him) entered the house, he used chewing-stick (Miswak) first of all and whenever the Messenger of Allah (Peace be upon Him) got up for Tahajjud prayer, he cleaned his mouth with chewing-stick (Al-Muslim). He also said "You shall clean your mouth, for this is a means of praising Allah" and "I am ordered (By Allah) to use the Miswak so that I take it as if it has been written for me (as a special commandment)". The belief of the Prophet (Peace be upon Him) regarding good oral hygiene was so profound that he requested his wife to prepare his miswak on his death-bed.

In the light of these and many other similar injunctions it becomes apparent that Islam lays emphasis on regular cleaning of teeth and other structures in the mouth by using Miswak (Chewing-stick). Although the use of "Miswak" might have evolved in various cultures independent of each other, the influence of Islam on the spread and use of this implement of teeth-cleaning in different parts of the world is significant as it was almost completely ignored when the Holy Prophet Muhammad (Peace be upon Him) started his mission (Elvin-Lewis, 1980). Indeed, it was due to Holy Prophet's (Peace be upon

Him) deep concern in oral hygiene that the Muslims took so avidly to Miswak. Recent researches prove that regular use of Miswak remains even today an extremely effective, cheap and practical means of achieving oral hygiene.

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