

Role of Herbs and Their Uses in Dentistry

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Abstract

The value of chewing sticks is believed to be in their mechanical cleansing action, they are also found to be effective in reducing plaque and gingival inflammation. However, gingival recession may be a consequence of their usage. They also possess antimicrobial activity, the bacteria which seems to be affected are streptococci, staphylococcus aureus, bacteroides gingivalis and bacteroides melanogenicus. The *Salvadora persica* mouth rinse has a significant antiplaque effect, however mouth rinse containing herbal extracts *Juniperus communis*, *Urtica dioica* and *Achillaca millifolium* does not have any effect on plaque growth and gingival health. The *Sanguinaria* containing dentifrice, herbal based tooth paste *Paradontox* and tooth paste containing neem seems to be effective in the control of plaque and gingivitis. The *Sanguinaria* extract tooth paste and oral rinse when used together has shown to control and reduce plaque and gingivitis. The *Acacia* gum has an inhibitory effect on early plaque formation and also exhibits antimicrobial property on *P.gingivalis* and *P.intermedia*. Future studies should be focused on chemical nature and mode of action of active constituents of these plants. This paper is aimed at reviewing, various herbal extracts and their effects on periodontal diseases.

Key Words: Herbs, Dentistry, Ayurveda, Chewing Stick

Introduction:

As we approach in the era of 21st century, it is appropriate to have a glance on advances made in personal oral hygiene. Dental caries, gingivitis & periodontal disease are the three most common chronic human diseases. Their prevalence is undoubtedly higher than in prehistoric times. Is this a "tribute" to progress in oral hygiene products? Realistically, the diseases are kept at bay by personal and professional oral hygiene - in spite of a pathogenic diet and lifestyles and numerous iatrogenic factors.¹

The history of dental sciences in ancient India takes us back to remote antiquity. Dental sciences in India are as old as the Vedas and Puranas. Ayurveda is the name which the ancient Indians gave to their sciences of medicine. Ayur means life and Veda is to know or attain. Hence, Ayurveda is the science by the

knowledge of which life expectancy can be prolonged or its nature is understood.

Diseases of the oral cavity were known to the Indians since ancient times and much was written about them by Sushruta, Charaka and Vagbhatta. Even in ancient times, Indians never liked to use the brushes made of animal hairs. They considered such brushes rather barbaric and unhygienic. They used to use wooden twigs called "datun". The wood of the twig always varied according to the time of the year and of course, the users temperament. Similarly, the length of the twig ideally about 6 inches but also varied according to the users choice. One end of the twig, crushed, liberating an extract being bitter but having astringent quality. The crushed end resembling like a brush was being used for cleaning the teeth. Aromatic herbs and spices were used for rinsing the mouth.

Both medical and religious beliefs have done much to focus the attention of the Indian on his teeth. Maintenance of oral hygiene as part of daily ritual for Indians who considered the mouth to be the gateway to the body and therefore insisted that it should be kept scrupulously clean.

Relation between plaque and periodontal disease is an established fact. The mechanical plaque removal is undoubtedly the best approach for its elimination.

In recent years, attempts have been rightly made to test the plants and plant products for their effectiveness. Various time tested Japanese and Chinese plants have been evaluated for their specific antiplaque properties. Extensive studies have also been conducted on blood root plant (*Sanguinaria*) for its effect on bacterial plaque.

Use of plants and herbs for dental care is very common in indigenous systems of medicine and plants like *Acacia* and *Azadirachta indica* have been demonstrated to possess antiplaque properties.²⁻³

In many African countries the ready availability of plant materials has led to the use of chewing sticks. Also these chewing sticks are widely used in Nigeria, and Asia, and in many Asian societies chewing sticks still remain the only method used to clean the teeth. Among the various tree twigs, African chewing sticks have been suggested to have an antiseptic activity, may control the formation and activity of dental plaque and therefore reduce the incidence of gingivitis.⁴ Also, the aqueous extracts of Nigerian chewing sticks showed significant in vitro anti-plaque activity.⁵ Nigerian chewing sticks derived from African plants were found to play an important role in restricting plaque accumulations and caries incidence.⁶

Both the twigs and oil of *Azadirachta indica* have been reported to contain substances with broad-spectrum antimicrobial activity and when incorporated into a dentifrice reduces gingival irritation. *Bridelia ferruginea* split-stem with lime juice is used in the topical treatment of acute necrotizing ulcerative gingivitis in children.⁷

The combined use of the sanguinarine-containing tooth paste and oral rinse has resulted in

controlling and reducing plaque and gingival inflammation in an orthodontic population.⁸

The gum of *Acacia Arabica* has been studied for its effect on plaque and gingivitis and has been found to have the potential to inhibit early plaque inhibition⁹ and its action on suspected periodontal pathogens like *P.gingivalis* and *p.intermedia* has been suggested to be of clinical value.¹⁰

Herbal based tooth paste composed of Camomile, Echinacea, Sage, Myrrh, Rhatany and Peppermint oil has been found to be as effective as the conventionally formulated dentifrice in the control of plaque and gingivitis.¹¹

Neem extract incorporated into toothpaste was beneficial in improving the oral health of population who were otherwise using natural products like mango leaf, cashew leaf, wood ash, charcoal powder.¹²

Neem tooth paste and Nimodent tooth powder uses *Azadirachta indica* (Neem) as an active ingredient and has been reported to exert anti-inflammatory and wound healing properties.¹³

Action of Various Herbal Extracts On Plaque:

Chewing Sticks:

Wolinsky LE, Sote EO (1983)⁵ studied eight varieties of commonly used chewing sticks from Nigeria, among which *serindeia Warnecki* inhibited the growth and adherence of *streptococcus mutans* comparable to that of 10⁻⁴M Chlorhexidine. *Anoigeissus Schimperii* was also a strong inhibitor of bacterial growth (26%) when added at a concentration of 1%. *Fagara Xanthoxyloides*, on the other hand showed no significant reduction in bacterial growth or adherence. The remaining plant extracts showed varying degrees of inhibition to growth and adherence. The extract of *prosopsis Africana*, *garcina kola* and *pseudocedrela Kotschy* caused a large reduction in the in vitro binding of *streptococcus mutans* to the glass surface without greatly affecting the growth of the organism as determined by pH and total growth. Because of the inhibition noted with *Serindeia Warnecki*, experiments varying the

concentration of this plant extract from 0 to 10% (w/v) were undertaken. These experiments revealed a dramatic reduction in growth inhibition at levels below 1%. They concluded that, several of these aqueous extracts of Nigerian chewing sticks showed significant in vitro anti-plaque activity.

Wolinsky LE, Sote EO (1984)⁶ conducted a study to determine the chemical nature of the active chewing sticks components and to examine the effects of these compounds on in vitro plaque development. Aqueous extracts, 1% (w/v) of Nigerian chewing sticks derived from African plants was found to effectively inhibit the attachment of streptococcus mutans to glass or saliva-coated hydroxyl-apatite beads. It was shown that the active compounds in these extracts interfere with binding of the bacteria, resulting in reduced adherence. Chemical and spectral analysis of the active constituent from *Serindeia Warnecki* showed this material to have the characteristics of a high molecular weight polyphenolic tannin. 1% aqueous solutions of tannic acid was also shown to promote similar invitro adherence inhibition as the tannin-like substance from *serindeia warnecki*. The results concluded that chewing stick constituents appear to play an important role in restricting plaque accumulations and caries incidence.

Wolinsky LE, Mania S, Nachnani S, Ling S (1996)¹⁴ investigated the inhibitory effects of aqueous extracts derived from the bark-containing sticks (Neem stick) upon bacterial growth, adhesion to hydroxyapatite crystals and production of insoluble glucan, which may affect invitro formation of plaque. Neem stick extracts were screened for minimal bacterial growth inhibition (MIC) against a panel of streptococci. No inhibition of bacterial growth was observed among the streptococcal strains tested in the presence of ≤ 320 mg/ml of the neem stick extract. The pre-treatment of streptococcus sanguis with the neem stick extract or the gallotannin enriched extract from *Mellaphis chinensis* at 250 mg/ml resulted in a significant inhibition of the bacterial adhesion to saliva-conditioned hydroxyapatite. Prior treatment of saliva conditioned hydroxyapatite with neem stick or galatannin rich extract prior to exposure to bacteria

yielded significant reductions in bacterial adhesion. Incubation of oral streptococci with the neem extract resulted in a microscopically observable bacterial aggregation. The data suggest that neem stick extract can reduce the ability of some streptococci to colonize tooth surfaces.

Paste:

Gazi MI, Lambourne A, Chagla AH (1987)¹⁵ conducted a single blind crossover study and measured the effect of mouthrinse made from tooth paste containing *Salvadora Persica* on plaque formation and gingivitis and compared the results with the known antiplaque agent chlorhexidine. Gingival index, bleeding point index, patient hygiene performance index and modified Quigley-Hein plaque index were recorded. Both treatments reduced the gingival and bleeding point indices and the plaque scores. The only significant difference between the two treatments was a lower modified Quigley-Hein plaque index shown by chlorhexidine. Both treatments showed a quantitative reduction in plaque bacterial growth but *Salvadora Persica* showed a significant reduction of the gram negative rods. When *Salvadora persica* toothpaste, was used as a mouthrinse without a toothbrush exhibited some features comparable to those of chlorhexidine, it was concluded that general public would accept it for daily use with a toothbrush would prove atleast as effective as chlorhexidine in reducing plaque and gingivitis.

Gingivitis:

Chewing Stick:

Cyril OE, Rosemary CA (1985)⁷ examined some of the properties of chewing sticks in relation to oral hygiene, with special reference to conditions in Africa. They reported that both the twigs and oil of *Azadirachta indica* contain substances with broad-spectrum antimicrobial activity and when incorporated into a dentifrice reduces gingival irritation. The cooled liquid obtained from boiling the bark *Bridelia Ferruginea* with lime juice is used in the topical treatment of acute necrotizing ulcerative

gingivitis in children. They also stated that the main advantage of chewing sticks in developing countries is their low price and in poor countries tooth brushes are often incorrectly used, usually with contaminated water.

Plaque and Gingivitis:

Paste:

Mallatt ME, Beiswanger BB, Drook CA, Stookey GK, Jackson RD, Bricker SL (1989)¹⁶ this study was conducted to evaluate the effects of a Sanguinaria – containing dentifrice on the prevention of dental plaque formation and gingivitis. A total of 59 young adults, either performed supervised brushing with a 0.075% Sanguinaria – 0.05% Zinc chloride (Via-dent) a 0.24% sodium fluoride dentifrice, or rinsed daily with a 0.05% sodium fluoride solution. Clinical evaluations for plaque and gingivitis were performed after 7, 14 and 21 days. Results showed that after 7, 14 and 21 days both groups using dentifrices had significantly less plaque and gingivitis than the group using the rinse, and there were no significant differences between the two groups using either Sanguinaria –ZnCl₂ or the NaF dentifrices.

Mullaly BH, James JA, Coulter WA, Lindne GJ (1995)¹¹ compared the efficacy of a herbal based product, paradontax to an accepted conventionally formulated toothpaste in the control of plaque and gingivitis. 70 subjects with gingivitis completed the 6 week study. At baseline, both groups were balanced for the parameters: plaque index, gingival index, bleeding on probing and gingival crevicular flow. At the end of the trial, results showed that there were reductions within both groups but no significant difference noted. It was concluded that the herbal based toothpaste was as effective as the conventionally formulated dentifrice in the control of plaque and gingivitis.

Subraya B. et al (2000)¹² evaluated whether the oral health of natural product users improved, primarily in terms of reduction in plaque formation and secondarily in terms of gingivitis. Three month clinical studies were conducted on a population of

natural product users, to determine the effect of brushing with two low cost chalk based toothpastes containing Neem extracts, on plaque and gingivitis.

The fluoridate and non-fluoridated toothpastes were tested in two phases. In the first phase, the experimental tooth paste contained 1000 ppm fluoride and in the second phase the same formulation was used. A control or no treatment population who used non-conventional dentifrices like Mango and Cashew leaf, Charcoal and Ash as routine method of oral hygiene, was used in both the phases of the study. Subjects underwent a baseline assessment for plaque and gingivitis and were assigned to either experimental group which received the test tooth paste and a soft toothbrush and instructions on brushing technique, or the control group. At the end of 3 months, there was a significant reduction in plaque and gingivitis for subjects using both the experimental tooth pastes without fluoride and with fluoride. Results concluded that the use of low cost tooth pastes containing Neem extract proved to be beneficial in improving the oral health of population, otherwise using natural products.

Oral Rinse:

Vander Weijden GA, Timmer CJ, Timmerman MF, Reijerse E, Mantel MS, Van der Velden U (1998)¹⁷ conducted a invitro study to establish the inhibiting effect of a herbal extract mixture on a selected number of micro-organisms and to test in vivo the effect of a mouth wash containing 6.3 mg/ml herbal extract mixture on plaque and gingivitis. The herbal extract was a mixture of : Juniperus Communis (Juniper), Urtica dioca (nettle), Achillaea millefolium (Yarrow) ; 1:1:1. The invitro effect of pure herbal extract mixture on acid production of streptococcus mutans was tested and the minimum inhibitory concentration (MIC) of S.mutans, S.mitis, A.viscosus, A.naeslundii, A.actinomyetemcomitans, P.intermedia, C.rectus, F.nucleatum and Veillonella parvula were tested. The MIC-values for A.viscosus and P.gingivalis were 100 mg/ml. The MIC-values for A.naeslundii and A.actinomyetemcomitans were considerably lower (10 mg/ml). s.mitis was the most

susceptible of the tested organisms to the extract with a MIC value of 1 mg/ml. *S.mutans*, *C.rectus*, *V.parvula* and *F.nucleatum* were not influenced by the extracts. There was no difference observed when the two test groups and one control group were asked to rinse with 10 ml of mouth wash twice a day for 3 months. They concluded that the mixture when used in a mouth rinse has no effect on plaque growth and gingival health.

Paste and Oral Rinse:

Robert AM, James EM, John CG (1988)¹⁸ conducted a double blind clinical trial to test the effectiveness of Sanguinaria – extract mouthrinse and tooth paste in maintaining gingival health and controlling plaque for patients with fixed appliances. 50 subjects fully banded or bonded in both arches were randomly assigned to either an active or placebo product. Plaque and gingivitis were scored on the Ramfjord teeth. Active group showed a 41% decrease in plaque and a 52% decrease in gingivitis. The control group showed an 18% increase in plaque and a 16% decrease in gingivitis. They concluded that the best results appear to be associated with the combined use of mouthrinse and tooth paste – combined with good brushing, flossing, and oral irrigation can help patients maintain better gingival health throughout fixed appliance therapy.

Hannah FF, Johnson FD, Kuftinec MM (1989)⁸ This study was conducted to evaluate over a 6 month period the effectiveness of Sanguinaria-containing tooth paste and oral rinse in controlling plaque accumulation, inflammation of gingiva and sulcular bleeding. 24 subjects were randomly assigned to the active treatment (Viadent tooth paste and oral rinse) or the placebo treatment. The Sanguinaria regimen reduced plaque by 57%, gingival inflammation by 60% and sulcular bleeding by 45% from baseline compared with placebo group reductions of 27% (Plaque) and 21% (gingival inflammation) and an increase of 30% in bleeding index. Results demonstrated that the combined use of the Sanguinaria-containing tooth paste and oral rinse

controls and reduces plaque and gingival inflammation in an orthodontic population.

Gum:

Gazi MI (1990)⁹ conducted a 2 blind crossover trials to evaluate the antiplaque potential of Acacia gum compared with sugar free gum. In trial 1, the mean gingival and plaque scores were lower after 7 days of using Acacia. Compared with sugar free gum but the differences were insignificant. In trial 2, daily photographic assessment of erythrocin-stained plaque showed lower scores after Acacia gum compared with sugar-free gum. The total differences in scores for each day from each individual between the 2 treatments was highly significant. He concluded that Acacia gum appeared to have the potential to inhibit early plaque formation.

Periodontal Status:

Chewing Sticks:

Mohamed AE, Hassan AS, Abdullah R, (1991)¹⁹ examined the relationship between chewing sticks (Miswak) and gingival recession. Gingival recession was measured on the midfacial surfaces of the incisors, canines and premolars in 238 patients. All patients were interviewed previously regarding their oral hygiene habits and use of Miswak. Patients were divided into 3 groups, namely Miswak group, toothbrush group and Miswak / tooth brush group. The Miswak users had significantly more sites with gingival recession than did the toothbrush users. It was concluded that the Miswak should be considered as a possible factor in gingival recession.

Darout IA, Albandar JM, Skaug N. (2000)²⁰ assessed and compared the periodontal status of adult Sudanese habitual Arak and toothbrush users. Community Periodontal Index (CPI) was used to score the gingival bleeding, supragingival dental calculus and probing pocket depth of index teeth of each sextant. In addition, the attachment level also was measured. Study population comprised Arak users (109) and tooth brush users (104). The results concluded that the periodontal status of Arak users in

this Sudanese population is better than that of toothbrush users, suggesting that the efficacy of Arak use for oral hygiene in this group is comparable or slightly better than a toothbrush. Given the availability and low cost of Arak, it should be recommended for use in motivated persons in developing countries.

Almas K. (2001)²¹ studied the effect of aqueous extracts of Arak on healthy and periodontally involved human dentin with scanning electron microscopy invitro. 25% aqueous extract of freshly prepared Arak solution was used for the study. Soaking the healthy and periodontally diseased root dentin in Arak extract resulted in partially removal of smear layer and occlusion of dentinal tubules was observed in specimens burnished with Arak solution. This study concluded that further research is needed to evaluate the effect of aqueous Arak extract on human dentin at higher concentrations.

Plaque, Gingivitis and Periodontal Status: Chewing Sticks:

Mohamed AE, Abdullah R, Hassan AS (1990)²² examined the relationship between Miswak and Periodontal health. 23 patients were examined and plaque, gingival inflammation, pocket depths, attachment loss and gingival recession were recorded. Patients were divided into 3 groups – a Mishwak group, a tooth brush group and a Miswak tooth brush group. Results revealed no differences in plaque scores between Miswak and toothbrush users. This demonstrated that Miswak users were able to control plaque as effectively as those subjects who used a toothbrush, and it was concluded that chemical effect of Miswak combined with the mechanical action of its fibres may have beneficial action.

Periodontal Pathogens: Chewing Sticks:

Akpata ES and Akinrimisi EO (1977)⁴ in this study the antibacterial activity of aqueous, isobutanol and benzene extracts of five popular African chewing sticks namely Fagara Zanthoxyloides Cam,

Massularia acuminata Bullock Hoyle, Vernonia amygdalina, Garcinia Kola Heckel El. Guttiferae and Anogeissus Schimperi Hochst extracts and Dalz was studied. The isobutanol extract produced the greatest antimicrobial activity and the benzene extract the least. Streptococci were the most sensitive to the extracts, while E.coli was the most resistant. It was suggested that the regular use of the African chewing stick, acting as an antiseptic, may control the formation and activity of dental plaque and therefore reduce the incidence of gingivitis.

Asuquo BI, Montefiore D. (1977)²³ investigated the possible antibacterial properties of chewing sticks like pseudocedreal kotschyi, Mezoneuron benthamianum, Fagana zanthoxyloides, Terminalia glaucescens. Anogeissus leiocarpus, Prosopsis Africana, Vernonia amygdalina, Nauclea latifolia commonly used in the Western states of Nigeria and considered whether there is any evidence that such activity if present could be of significance in the prevention of caries or periodontal disease. Results showed that only Terminalia glaucescens had marked antibacterial activity and was limited to staphylococcus aureus only. It was concluded that chewing sticks are of value for their mechanical cleansing action, their ready availability and low price, rather than a consequence of any special antibacterial activity of them.

Rotimi VO, Laughon Be, Bartlett JG, Mosadomi HA (1988)²⁴ conducted an in vitro study to find out the activities of extracts of 9 different Nigerian chewing sticks (NCS) against Bacteroides gingivalis and Bacteroides melaninogenicus. There was remarkable reduction in the growth of both organisms in the first 6 hours of incubation by all the extracts. All the extracts, except A leiocarpus and N.latifolia were effective in killing the organisms after 24 hours of exposure. Results demonstrated that eight of the nine Nigerian chewing sticks possess significant antimicrobial action against B. gingivalis and B. melaninogenicus. All the extracts, except that of A. leiocarpus, showed no evidence of acute toxicity to adult mice. Results of acute toxicity testing showed that most of the NCS were nontoxic. The A. leiocarpus extract was very toxic parentally, but this

may not be relevant since it was not acutely toxic by oral administration. They hypothesized that the ingredients in these chewing sticks produce the antimicrobial action and the toxic effect of *A.leiocardus* extract.

Taha AL, Hani A (1995)²⁵ tested the antibacterial activity of Arak chewing sticks on some oral aerobic and anaerobic bacteria. 3 methods of antibacterial activity were carried out – streaked plate method, ditch plate method and tube dilution test for minimum inhibitory concentration. Results noted a considerable antibacterial effect of the extract of different bacteria. The most sensitive microorganisms were staphylococcus aureus and streptococcus mutans. The most resistant microorganisms were candida and enterobacteria. Extract had a drastic effect on the growth of staphylococcus aureus with minimum inhibitory concentration values of 69 mg/100 cc. It was concluded that using chewing sticks twice a day on a regular basis reduced the incidence of gingivitis and possibly dental caries.

Almas K. (1999)²¹ conducted a study in Saudi Arabia to compare the effectiveness of antibacterial activity of Neem (*Azadirachta indica*) and Arak (*Salvadora Persica*) chewing sticks aqueous extracts at various concentrations of 1%, 5%, 10% and 50%. The microbial inhibition was measured using blood agar and ditch method. Data suggested that both chewing stick extracts are effective at 50% concentration on *S. mutans* and *S. faecalis*. It was concluded that chewing sticks are recommended as oral hygiene tools for health promotion in developing countries.

Gum:

Clark DT, Gazi MI, Cox SW, Eley BM, Tinsley GF (1993)¹⁰ conducted an invitro study to assess the antibacterial activity of acacia gum on *Actinobacillus actinomycetem comitans*, *Capnocytophaga* spp, *P. gingivalis*, *P. intermedia* and *T. denticola*. Growth of *P.gingivalis* and *P.intermedia* cultures on the agar was inhibited by whole gum sonicate at concentrations of 0.5 – 1.0% w/v. Enzyme activities were determined

and found to be reduced in the presence of 0.5% w/v gum sonicate, with trypsin like activities of *P.gingivalis* and *P.intermedia* proving most sensitive. There was no growth inhibition of *A. actinomycetemcomitans* or *capnocytophaga* spp by acacia. They concluded that the action of acacia gum against suspected periodontal pathogens and their enzymes may be of clinical value.

Conclusion:

Most commonly used herbal extracts are from herbal plants like *Salvadora Persica*, *Azadirachta indica*, *Acacia* gum, *Sanguinaria* etc, in form of chewing sticks, tooth pastes, mouth rinses and chewing gums which have demonstrated antiplaque, anticariogenic and antibacterial actions.

The use of these herbal extracts in the form of chewing sticks, tooth pastes, mouth rinses and gum is entirely consistent with the primary health care approach principles and in particular that of a focus on prevention, community participation and the use of appropriate technology. By using this the notion of self reliance can be encouraged in poor and developing countries. They are available locally in most rural areas of poor countries and it does not need technology or expertise or extra resources to manufacture it. It can be used by both children and adults. Thus it is appropriate for many societies. There is a need to develop an effective cleaning technique and to motivate individuals to take the responsibility for their health themselves. The use or rather reuse of these products as a tool for oral hygiene in any dental health programme or on a wide scale public programme is essential. Future studies should be focused on chemical nature and mode of action of active constituents of these plants.

References:

1. Fischman S. The history of oral hygiene products: How far have we come in 6000 years. *Periodontology* 2000 Vol 15 1987, 7-14.
2. Dr.Srikanth C, Dr.Swathi Rawal and Dr. Mehta DS. An insight into history of dentistry in ancient India. *JIDA* 1999 July-September; 70 : 59-60.
3. Shikha T, Mehrotra KK, Saimbi CS, Nigam SK. Role of Himalayan plants in dentistry and their effect on dental plaque. *JIDA* 1999 Jan ; 70 : 12-14.
4. Akpata ES, Akinrimisi EO, Lagos. Antibacterial activity of extracts from some African chewing sticks. *Oral Surg* 1977 November; 44 : 717-722.
5. Wolinsky LE, Sote EO. Inhibiting effect of aqueous extracts of eight Nigerian chewing sticks on bacterial properties favouring plaque formation. *Caries Res* 1983 ; 17 : 253-257.
6. Wolinsky LE, Sote EO. Isolation of natural plaque-inhibiting substances from Nigerian chewing sticks. *Caries Res* 1984 ; 18 : 216-225.
7. Cyril OE, Rosemary CA. The chewing stick in oral health care. *World Health Forum* 1985 ; 6 : 232-234.
8. Hannah JJ, Johnson JD, Kuftinec MM. Long term clinical evaluation of tooth paste and oral rinse containing *Sanguinaria* extract in controlling plaque, gingival inflammation, and sulcular bleeding during orthodontic treatment. *Am J Orthod Dentofac Orthop* 1989 ; 96 : 199-207.
9. Gazi MI. The finding of antiplaque features in *Acacia Arabica* type of chewing gum. *J Clin Periodontol* 1991 ; 18 : 75-77.
10. Clark DT, Gazi MI, Cox SW, Eey BM, Tinsley GF. The effects of *Acacia Arabica* gum on the in vitro growth and protease activities of periodontopathic bacteria. *J Clin Periodontol* 1993 ; 20 : 238-243.
11. Mullaly BH, James JA, Coulter WA, Linden GJ. The efficacy of a herbal based toothpaste on the control of plaque and gingivitis. *J Clin Periodontol* 1995 ; 22 : 686-689.
12. Subraya B. et al. the effect of low cost chalk based dentifrices containing neem extract, on plaque and gingivitis, amongst users of natural products. *JIDA* 2000 September ; 71 : 229-232.
13. Akhtar MS, Ajmal M. significance of chewing – sticks (Miswaks) in oral hygiene from a pharmacological view point. *J.P.M.A.* 1981 ; 89-95.
14. Wolinsky LE, Mania S, Nachnani S, Ling S. The inhibiting effect of aqueous *azadirachta indica* (neem) extract upon bacterial properties influencing in vitro plaque formation. *J Dent Res* 1996 February; 75 (2) : 816-822.
15. Gazi MI, Lambourne A, Chagla AH. The antiplaque effect of toothpaste containing *salvadora persica* compared with chlorhexidine gluconate. *Clinical Preventive Dentistry* 1987 November-December; 9 (6) : 3-8.
16. Mallatt ME, Beiswanger BB, Drook CA, Stookey GK, Jackson RD, Bricker SL. Clinical effect of a *Sanguinaria* dentifrice on plaque and gingivitis in adults. *J Periodontol* 1989 ; 60 : 91-95.
17. Van der Weijden GA, Timmer C, Timmerman MF, Reijerse E, Mantel MS, Van der Velden U. The effect of herbal extracts in an experimental mouthrinse on established plaque and gingivitis. *J Clin Periodontol* 1998 ; 25 : 399-403.
18. Miller RA, Meiver JE, Gunsolley JC. Effects of *sanguinaria* extract on plaque retention and gingival health. *J Clin Orthod* 1988 ; 22 :304-307.
19. Mohamed AE, Abdullah R, Hassan AS. The relationship between chewing sticks (Miswak) and periodontal health. III relationship to gingival recession. *Quintessence International* 1991 ; 21 (1) : 61-64.

20. Darout IA, Albandar JM, Skaug N. Periodontal status of adult Sudanese habitual users of miswak chewing sticks or toothbrushes ACTA Odontol Scand 2000 ; 58 : 25-30.
21. Almas K. The effects of extracts of chewing sticks (*salvadora persica*) on healthy and periodotally involved human dentine : A SEM Study. IJDR 2001 July-Sept ; 12 (3) : 127-132.
22. Mohamed AE, Abdullah R, Hasssan AS. The relationship between chewing sticks (miswak) and periodontal health. II relationship to plaque, gingivitis, pocket depth and attachment loss. Quintessence International 1990 ; 21 (12) : 1019-1022.
23. Asquo BI, Montefiore D. Preliminary studies on the anti-bacterial properties of chewing sticks. Journal of Dentistry 1977 ; 5 (2) : 123-127.
24. Rotimi VO, Laughan BE, Bartlett JG, Mosadomi HA. Activities of Nigerian chewing stick extracts against *bacteroides gingivalis* and *bacteroides melaninogenicus*. Antimicrob Agents Chemother 1988 ; 32 : 598-600.
25. Taha AI, Hani A. The effect of the extract of the miswak (chewing sticks) used in Jordan and the middle East on oral bacteria. International Dental Journal 1995 ; 45 : 216-222.

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