RESEARCH ARTICLE

Assessment of fluoride content of selected chewing sticks used in Nigeria
Taiwo Juliana Obontu, Mustafa Musiliyu Oladipupo, Denloye Obafunke Olufunlayo

Abstract

Introduction: In developing countries majority of the population, especially the rural population use chewing sticks to maintain oral hygiene. Fluoride if present in chewing sticks will confer similar protection against dental caries as fluoride dentifrice. Objective: To determine the fluoride content of commonly used chewing sticks in Nigeria. Materials and Methods: Fluoride was determined in 1 gram of each identified plant material commonly used as chewing sticks, by reading it on Atomic Absorption Spectrometer (AAS) at 286.5(µm) wave-length, after dissolving it with 25ml of 10% perchloric acid and 25ml of 10% nitric acid and filtered. Results: Fluoride was detected in all the chewing sticks with mean concentrations of 0.012% - 0.407% (54ppm – 1845ppm). The chewing stick from Zanthoxylum Zanthoxyloides has the highest mean concentration of fluoride (1845ppm), whilst the chewing stick from Mangifera Indica has the least fluoride (54ppm). Conclusion: Chewing stick from Zanthoxylum Zanthoxyloides has fluoride concentration slightly higher than regular toothpastes. If properly and regularly used it is likely to confer maximum anti-caries effect in users and deserves to be listed under home based topical fluoride products. Fluoride in chewing sticks has great public health implications for oral health community programmes for the prevention of caries in rural areas in developing countries. In developing countries where there have been cases of fluorosis in some communities, it is imperative to examine the other hidden sources of fluoride which evolve around the lifestyle of the people in the community and which could contribute to their total daily consumption of fluoride.

Keywords: Chewing Sticks; Fluoride; Caries; Dental Fluorosis.

Introduction

Chewing sticks are commonly used as oral hygiene tools in various parts of the world. A study on properties of some chewing sticks used in Ghana stated that they vary in taste sensation, from a tingling peppery taste, through bitter taste to numbness (1). In spite of a widespread use of toothbrushes and toothpastes, tooth cleaning method using chewing sticks prepared from twigs, stems, or roots of various plant species has been in practice for many years in Asia, Africa, the Middle East and America (2). Chewing sticks also play important role in socio economic life of West Africans by providing employment for peasants in both urban and rural areas (3).

Almas and Al Lafi (4) noted that the chewing stick constitutes one of the plant medicines derived from the forest which is widely used for dental care throughout the West Africa sub region. A study demonstrated fewer carious lesions in Africans who use chewing sticks than those using toothbrushes (5). This was supported by Hollist’s (6) observation of the chewing sticks being used to cure different oral diseases in Nigeria such as toothache, acute ulcerative gingivitis, periodontitis, mouth ulcer, black tongue, thrush and tonsillitis. Medicinal properties associated with gum healing, analgesic, antisickling, haemostatic and astringent as well as antimicrobial and plaque inhibiting effect, has been attributed to chewing sticks (7,8). From Enwonwu’s (9) study the
chewing stick in addition to providing mechanical stimulation of the gums, destroys microbes and therefore leads to production of strong teeth in Africans who use it.

According to Djossou (10), the functional justification of vegetable toothbrush is related to its four roles: cleaning of the surfaces of the teeth (mechanical action), gingival massage (activation of blood circulation, oral asepsis (phytotherapy) and stimulation of periodontal structure. These suggest that plants used as chewing sticks have phytochemical properties still not justified by pharmacists.

Fluoride therapy has been the cornerstone of caries preventive strategies since the introduction of water fluoridation scheme, over five decades ago (11). Fluoride has been administered in various ways to prevent caries, systemic fluoridation, involving the intake of fluoride orally either as fluoridated drinking water, fluoride supplements or fluoride tablets, have yielded a reduction in caries prevalence in deciduous teeth by 40-49% and in permanent teeth by 50-59% (12).

Topical fluoridation, the method by which fluoride products are applied directly to the teeth surfaces either in the clinic or at home, resulted in the reduction in caries prevalence by 30% (12). Fluoride administered in dentifrices is the commonest form of topical fluoride used worldwide. The sharp decline in the prevalence of dental caries in developed countries is attributed to the common use of dentifrice world wide (13). The benefit of fluoride in reducing caries experience is throughout life (14).

Although dentifrices are widely used in the world, in developing countries, majority of the population especially the rural population, use chewing sticks to maintain oral hygiene. Fluoride if present in chewing sticks will confer similar protection against dental caries as fluoride dentifrice. However, there is limited scientific information on fluoride content of such natural and herbal products in peer reviewed dental literature. Hence the objective of the present study was to investigate the fluoride content of commonly used chewing sticks in Nigeria.

**Materials and Methods**

The plant materials (stems) were collected from Forestry Research Institute, Jericho area in Ibadan. These plants were identified in Forest Herbarium Ibadan (F.H.I.) listed in Holmgren et al (15). The stems were sun-dried for seven days, then ground by electric grinder. The chewing sticks were tested separately. One gram of each sample was carefully weighed into different clean and dry 250ml beakers and labelled with the names of the chewing sticks. To each beaker 25ml of 10% perchloric acid and 25ml of 10% nitric acid were added and mixed thoroughly to dissolve it. They were filtered and read on Atomic Absorption Spectrometer (AAS) at 286.5 (µm) wave length. For each sample a confirmatory test was carried out. Table 1 illustrates the scientific names, local names, family and place of collection of the various chewing sticks used for the study. The results obtained were expressed in percentages. Using the sodium fluoride conversion chart, the percentage fluoride values obtained were converted to parts per million (ppm) (16).
TABLE 1: List of chewing stick plants with their local and scientific names.

<table>
<thead>
<tr>
<th>Sample code</th>
<th>Scientific names</th>
<th>Family</th>
<th>Local Names</th>
<th>Place of collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Masularia acuminate</td>
<td>Rubiaceae</td>
<td>Pako Ijebu</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>B</td>
<td>Zanthoxylum zanthoxyloides</td>
<td>Rutaceae</td>
<td>Orin ata</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>C</td>
<td>Terminalia glycosides</td>
<td>Combretaceae</td>
<td>Orin idi</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>D</td>
<td>Alchornea laxiflora</td>
<td>Euphorbiaceae</td>
<td>Pepe</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>E</td>
<td>Anogeissus leocarpus</td>
<td>Combretaceae</td>
<td>Ayin</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>F</td>
<td>Azadirachta indica</td>
<td>Meliaceae</td>
<td>Dongoyaro</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>G</td>
<td>Psidium guajava</td>
<td>Mytaceae</td>
<td>Guofa</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>H</td>
<td>Vernonia amygdalina</td>
<td>Asteraceae</td>
<td>Ewuro</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>I</td>
<td>Mangifera indica</td>
<td>Anacardiaceae</td>
<td>Mangoro</td>
<td>FRIN Compound</td>
</tr>
<tr>
<td>J</td>
<td>Jatropha mutifida</td>
<td>Euphorbiaceae</td>
<td>Ogege</td>
<td>FRIN Compound</td>
</tr>
</tbody>
</table>

Results

Fluoride was detected in all the chewing sticks used for the study but the mean concentrations varied (0.012% – 0.407%) (54ppm-1845ppm). Table 2 illustrates the concentration of fluoride in the various chewing sticks used in the study, expressed in percentages and parts per million (ppm). The chewing stick Zanthoxylum Zanthoxyloides had the highest mean concentration of fluoride (0.407%) (1845ppm) whilst Mangifera Indica had the least mean concentration of fluoride (0.012%) (54ppm).

Discussion

The use of fluoride in various forms is recognized as the most important factor responsible for the decrease in dental caries in many developed countries (12). Fluoride also plays a significant role in the prevention and repair of erosion of enamel (17). Water fluoridation was listed as one of the ten greatest public health achievements of the 20th century (16). The use of fluoride toothpaste, mouth rinses, gels or varnishes reduces dental caries in children and adolescents (18) Many toothpastes nowadays contain 0.31% (1450ppm) fluoride in the form of sodium fluoride or sodium monofluorophosphate (16). Majority of dentifrice studies (clinical trials) included paste containing 1000ppm fluoride either as 0.76% sodium monofluorophosphate or 0.24% sodium fluoride or 0.4% stannous fluoride, which demonstrated significant caries prevention activity (12) In some studies low fluoride test toothpaste 0.209% and 0.06% (550ppm) fluoride exhibited similar anticaries activity as higher (1055ppm) fluoride toothpaste in 2 year old children (19). Koch G. et al (20) in comparing 250ppm sodium fluoride toothpaste to 1000ppm sodium fluoride and 1000ppm monofluorophosphate toothpastes did not find any statistical difference between the low fluoride toothpaste and the high fluoride toothpaste in their caries prevention activity. Another study by Winter G.B. et al (21) concluded that regular use of low fluoride toothpaste was as effective in controlling caries as 1000ppm fluoride toothpaste.
TABLE 2: Percentages of fluoride content in some Nigerian chewing sticks

<table>
<thead>
<tr>
<th>Sl / No.</th>
<th>Type of chewing stick</th>
<th>Fluoride concentration (1) Test %</th>
<th>Fluoride concentration (2) Test %</th>
<th>Mean fluoride Concentration %</th>
<th>Mean fluoride Concentration in Parts per million (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>0.081</td>
<td>0.080</td>
<td>0.0805</td>
<td>365</td>
</tr>
<tr>
<td>2</td>
<td>B*</td>
<td>0.404</td>
<td>0.410</td>
<td>0.407</td>
<td>1845</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>0.075</td>
<td>0.075</td>
<td>0.075</td>
<td>338</td>
</tr>
<tr>
<td>4</td>
<td>D</td>
<td>0.077</td>
<td>0.077</td>
<td>0.077</td>
<td>347</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
<td>0.087</td>
<td>0.085</td>
<td>0.0860</td>
<td>383</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>0.0595</td>
<td>0.595</td>
<td>0.0595</td>
<td>270</td>
</tr>
<tr>
<td>7</td>
<td>G</td>
<td>0.049</td>
<td>0.049</td>
<td>0.049</td>
<td>221</td>
</tr>
<tr>
<td>8</td>
<td>H</td>
<td>0.067</td>
<td>0.0690</td>
<td>0.068</td>
<td>306</td>
</tr>
<tr>
<td>9</td>
<td>I</td>
<td>0.0117</td>
<td>0.0176</td>
<td>0.01165</td>
<td>54</td>
</tr>
<tr>
<td>10</td>
<td>J</td>
<td>0.063</td>
<td>0.063</td>
<td>0.063</td>
<td>287</td>
</tr>
</tbody>
</table>

*The chewing stick Zanthoxylum Zanthoxyloides has the highest concentration of Fluoride, 1845ppm.

The results obtained in this study demonstrated that one gram of ground sample of each of the chewing sticks after processing them as stated in the methodology yielded 0.012% to 0.4% (54ppm – 1845ppm), fluoride, confirming the findings of Adekola et al (22). This implies that all the chewing sticks used in this study contain varying concentrations of fluoride capable of exhibiting varying anti-caries properties. Zanthoxylum Zanthoxyloides from the Rubiaceae plant family demonstrated the highest concentration of fluoride (1845ppm), higher than that found in regular toothpaste commonly used. Zanthoxylum Zanthoxyloides if properly and regularly used is likely to confer maximum anti-caries effect in users just like any over the counter topical fluoride and deserve to be listed under home based topical fluoride products.

Previous studies have demonstrated the low prevalence of caries in developing countries especially in the less developed regions (23, 24). In the study of the same population of the elderly, majority of them confirmed the use of the chewing stick as their main method of maintaining oral hygiene (25). Taiwo et al (23) demonstrated that the elderly in South East Local Government Area in Ibadan had low prevalence of caries whilst cervical caries was almost non-existent despite marked recession and majority of these elderly use chewing sticks.

However, a study in Bangladesh did not find fluoride in the most popular chewing stick (Joytun miswaks) and many of the chewing sticks studied did not contain appreciable amount of fluoride (26).

Chewing sticks have been in use from time memorial and are still in use today in many developing countries because of religious or cultural traditions as well as easy availability, low cost and simplicity (26). Apart from the above findings, properties of chewing sticks include the following depending on the type of chewing stick (27- 29):

- Mechanical effects (massage of the gingiva)
- Release of beneficial chemicals
• Stimulation of salivation, resulting in a cleansing effect
• Plaque inhibiting effect
• Astringent effect on the mucosa membrane, reducing clinically detectable gingivitis.
• Tannin in some chewing stick inhibit the action of glucosyl transferase, reducing plaque and gingivitis
• Some chewing sticks contain resin which forms a layer over the enamel protecting it against caries
• Some chewing sticks contain alkaloids which exert a bacteriocidal effect in the oral cavity.
• Some chewing sticks possess essential volatile oils which give aroma and exert antiseptic effect.
• Some have a mild bitter taste stimulating salivary flow and has both cleansing and antiseptic effect.
• Chewing sticks contain Vitamin C which is an antioxidant
• Some of them contain sodium bicarbonate which have a mild abrasive effect
• Some of them have a high concentration of chloride, inhibiting calculus formation and results in removal of stains from the teeth.
• Some of them contain calcium which facilitates remineralization of the tooth.

(27,28, 29)

Baeshen H and Birkled D (30) in comparing NaF impregnated fresh and old chewing sticks (miswak), recommended 0.1% to 0.5% NaF in a day in chewing sticks, as safe products for the prevention of caries, which can be used widely in countries or communities where chewing sticks are commonly used. The fluoride content in chewing stick from Zanthoxylum Zanthoxyloides is within the safe concentrations recommended by Baeshe H. et al (30).

From the above findings, it is obvious that people using these chewing sticks have been experiencing the effect of fluoride on their dentition long before fluoride was discovered. This could explain partly the low caries prevalence in these areas.

Normally those who use the chewing sticks for oral hygiene chew them over a longer period, an hour or more, in fact they chew them while they are carrying out their house chores and the saliva produced during chewing is sometimes swallowed. Thus apart from the topical effect fluoride in chewing sticks has, it also has a systemic effect which could also be beneficial to their users.

The public health implications of this study is that fluoride in chewing sticks has great implications for oral health community programmes, for the prevention of caries in rural areas especially in communities which do not have access to community water supply, where water fluoridation and fluoride supplement programmes are not feasible. Secondly, they can be used to improve oral health for people in confinement such as prison inmates or motherless children’s homes, old people’s homes etc. Thirdly in some developing countries there has been evidence of fluorosis without evidence of high concentration of fluoride in their sources of drinking water. In such cases it is imperative to investigate other hidden sources of fluoride which evolve around the lifestyle of the...
people in such communities and which could contribute to their total daily consumption of fluoride.

Finally with global warming, deforestation and desert encroachment in Africa and other places in the world, how long will the culture of the chewing stick be sustained?

**Conclusion**

The above chewing sticks contain varying concentration of fluoride capable of conferring some protection against caries. Zanthoxylum zanthoxyloides contains a little more fluoride than the regular toothpastes and is capable of exerting the same anticaries effect as all other over the counter topical fluoride. Magifera indica (mango) from the family of Anacardiaceae contains the least fluoride. It is recommended that oral health should be incorporated into public health programmes and in communities where chewing sticks are commonly used the proper use of Zanthoxylum Zanthoxyloides should be encouraged for oral hygiene practices where people will be informed on their benefits especially in remote areas in developing countries as well as people in confinement. Fluoride should be incorporated into chewing sticks like magifera indica which do not have adequate fluoride to increase fluoride concentration to a safe level to facilitate the prevention of caries. Nigeria should borrow a leaf from Ghana and make chewing sponge (i.e. the roots or stems of such plants are beaten with a stick or mortar to form sponge) for children, making it easy for even the 5 year old child to chew, to promote oral hygiene in children in rural areas or children in confinement.

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**Conflict of Interest:**
The author(s) declared no conflict of interests.

**Source of Funding:** Nil.

**References**


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