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Short Communication

Comparative study of fluoride in *Alcornea cordifolia* and commercial toothpastes

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Fluoride was extracted from *Alcornea cordifolia* plant using sohxlet extractor. The fluoride content was determined by using a fluoride ion selective electrode. The fluoride content was found to be about 10% of that present in commercial toothpastes. The hard stem of the plant contained a higher amount of fluoride than the tender stem. Hence, the hard stem is a cheap source of fluoride when compared to commercial toothpastes.

Key words: *Alcornea cordifolia*, fluoride, toothpaste.

INTRODUCTION

The presence of fluoride in tooth pastes has been associated with the prevention of tooth decay. Before the advent of commercial toothpastes, the major process of cleaning the teeth was by chewing a stick. *Alcornea cordifolia* is the most widely chewed tooth-cleaning stick and has continued to be used despite availability of varieties of commercial tooth pastes. This paper reports the analysis of *cordifolia* for fluoride and its percentage composition.

A similar research was carried out on dental chewing stick plants in Bangladesh (Fazlul et al., 2007). The amount of fluorine, sodium and magnesium in those plants were determined using proton induced gamma emission. They found out that the concentration of fluorine, sodium and magnesium in the chewing sticks they worked on justified their use by the natives as chewing sticks and was an economical way of dental care. Their result could also be used in evaluating the chewing sticks in dental and oral health.

Excess fluoride intake has been found to cause fluorosis in animals (Krook and Justus, 2006; Justus and Krook, 2006) and reduced intelligence in children (Li et al., 1995; Ziang et al., 2005). Hence it is necessary to estimate the amount of fluoride in the local chewing sticks so as to assess its impact on humans.

Posada et al. (2000) studied the release of fluoride from resin-modified glass ionomer cement after recharging it with sodium fluoride solution and toothpastes and found that there was an improvement in the fluoride release that could prevent tooth decay. The importance of addition of 10% zinc sulphate ($ZnSO_4$) to a conventional glass ionomer and resin glass ionomer on their solubility and flexural strength was studied by Osinaga et al. (2003). They reported that there was an increase in fluoride release accompanied by inhibition of microorganism growth without significant effect on the solubility and flexural strength of the materials studied.

Recently, antibacterial properties of the extract of the leaves of *A. cordifolia was* reported (George et al., 2010). The extracts were found to inhibit the activities of *Staphlococcus aureus, Escherichia coli, Pseudomonas aeraginoso, Candida albican* and *Trichophyton violaceum.*

EXPERIMENTAL

Materials

Tender and hard stems of *A. cordifolia* were obtained from the University of Ibadan campus. The two commercial tooth pastes used were colgate and flourish. Sodium fluoride solutions of different concentrations were used as standards. Glacial acetic acid, sodium chloride and cyclohexylene dinitrotetra- acetic acid were used to prepare ionic strength adjustment buffer.

Table 1. Average pH and corresponding fluoride ion concentration in various samples.

Sample	pH	pH reading (mv)	Concentration of fluoride (ppm)
Extract from tender stem	3.0	178	7.1×10^{-3}
Extract from hard stem	3.20	190	8.6×10^{-3}
Colgate tooth paste	4.45	263.50	70.0×10^{-3}
Flourish tooth paste	4.70	278.00	75.0×10^{-3}

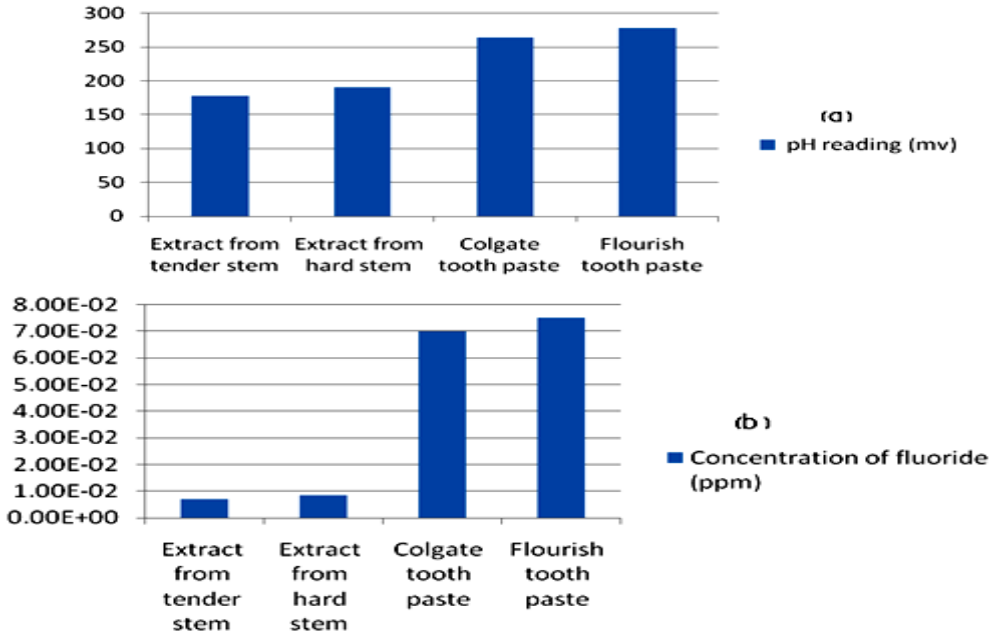

Figure 1. Plot of (a) average pH and (b) corresponding fluoride concentration for various samples.

Extraction of fluoride

750 g of *A. cordifolia* hard stem was placed in a sohxlet extractor and the contents extracted into distilled water for 6 h. The extract was subsequently concentrated to about half the volume by distillation. Same extraction procedure was used for the tender stem.

Qualitative analysis

Preliminary test for fluoride in *A. cordifolia* was carried out by drop-wise addition of concentrated sulphuric acid to the extract. An oily film was obtained. The oily film was probably hydrogen fluoride.

$$MF_2 + H_2SO_4 \rightarrow MSO_4 + 2HF$$

Confirmatory test involved mixing a small quantity of the extract in a crucible with three times its bulk of ignited silica. The solution was transferred into a test tube and concentrated sulphuric acid, and twice the amount of silica was added dropwise. The mixture was gently heated over a burner for 2 to 3 min. A white film of silicic acid formed confirmed the presence of fluoride (Vogel, 2000).

$$MF_2 + H_2SO_4 \rightarrow MSO_4 + 2HF$$

$$SiO_2 + 4HF \rightarrow SiF_4 + 2H_2O$$

$$3SiF_4 + 4H_2O \rightarrow H_4SiO_4 + 2H_2(SiF_6)$$

Quantitative analysis

Fluoride ion selective electrode and a calomel reference electrode were used. Standard solutions of sodium fluoride were prepared and the potential measurements were carried out to obtain a calibration curve. The electrode response was Nerstian over a wide range of concentration of the standard solutions. This was followed by measuring the potential of the extract. The fluoride contents in colgate and flourish tooth pastes were similarly determined. The pH reading in millivolts was obtained by using a conversion factor of 1 pH unit equal to 59.2 mV at 25°C and 0 pH was taken as 0 mV (Vogel, 2000).

RESULTS AND DISCUSSION

Qualitative analysis showed that the extract contained fluoride which was responsible for the oily appearance of the test tube resulting from the reaction between concen-

trated sulphuric acid and the fluoride. The oily film is hydrogen fluoride. The presence of fluoride was further confirmed by the formation of a white film of silicic acid formed as a result of the reaction between ignited silica and the hydrogen fluoride librated from the extract by dropwise addition of concentrated sulphuric acid.

The average fluoride concentrations obtained in the *A. cordifolia* extract and in the commercial tooth pastes are as presented in Table 1 and Figure 1a and b. The results showed almost equal amount of fluoride content in the tender and hard stem of *A. cordifolia* (7.1 to 8.6 x 10^{-3} ppm) which was about 10% of the amount present in the commercial toothpastes (Figure 1b). The two commercial toothpastes contained almost the same amount (70.0 to 75.0 x 10^{-3} ppm).

Studies have shown that fluoride content higher than 1.5 µg/g is harmful to human (Yadav et al., 2007). The presence and low content of fluoride in *A. cordifolia* both justified the choice of the plant as suitable tooth cleaning agent in the form of chewing stick as it is being used.

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