



ORIGINAL ARTICLE

Total and soluble fluoride concentration present in various commercial brands of children toothpastes available in Saudi Arabia – A pilot study



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Abstract Objective: The aim of this pilot study was to perform chemical analysis and investigate the total and soluble fluoride concentrations in various brands of children toothpastes.

Materials and methods: Three samples of five different commercial brands of children toothpastes were collected and divided into five groups; group A – Biorepair Oral Care toothpaste containing no fluoride (control), group B – Signal Kids Strawberry toothpaste having 500 ppm fluoride, group C – Aquafresh Milk Teeth toothpaste having 500 ppm fluoride, group D – Aquafresh Little Teeth toothpaste having 500 ppm fluoride, and group E – Siwak F Junior having 400 ppm F. The total fluoride (TF) and total soluble fluoride (TSF) concentration of the toothpastes was determined using fluoride ion selective electrode. Data were analysed using Paired sample *t*-test.

Results: The measured TF values were inconsistent with that of the declared concentrations by the manufacturers. Mean TF found in the toothpastes ranged between 2.37 and 515.74 ppm whereas, the mean TSF ranged between 2.00 and 503.4 ppm. For two groups, TF was more than the declared TF whereas for the other three groups, it was less than the declared concentration. All the differences between the declared and observed TF concentration were statistically significant ($p < .05$) except for one group. All the toothpastes demonstrated mean TSF slightly lower than their respective observed mean TF concentrations.

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Conclusion: The analysis of TF and TSF concentrations revealed variations from the labelled claims. Therefore, some of the toothpastes may have doubtful anti-caries effectiveness owing to deficiency of total and soluble fluoride.

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1. Introduction

Dental caries involves loss of tooth structure as a result of acid attacks by cariogenic bacteria in the oral cavity after they ferment dietary carbohydrates (Featherstone, 2008). The use of fluoride based interventions has reduced the incidence of early childhood caries (Ammari et al., 2007). Fluoride (F^-) is an ion which replaces hydroxyl (OH^-) ion in the apatite structure of enamel and converts hydroxyapatite into fluorapatite, which is more resistant against dental caries (Mohammed et al., 2014). This F-OH exchange decreases the enamel's surface solubility thus making it stronger against acid attacks (Abou Neel et al., 2016).

Fluoride is commonly incorporated in toothpastes, gels, and mouthwashes for the prevention of caries (Ullah and Zafar, 2015). The relationship between fluoride and prevention of caries has been studied extensively in the literature previously (Somaraj et al., 2017; Clark and Slayton, 2014). In general, greater the concentration of fluoride incorporated in the toothpaste, higher will be the probability of caries prevention (Walsh et al., 2010). However, to be effectively anticariogenic, the formulation of toothpaste should be such that it provides sufficient soluble fluoride to enhance remineralization (Cury and Tenuta, 2008). The bioavailability of fluoride in toothpaste depends on the type of fluoride compound and abrasive present in the formulation (Cury et al., 2010). Three of the most common fluoride compounds added to a toothpaste are sodium fluoride (NaF), sodium monofluorophosphate (MFP), and strontium fluoride (SrF_2) whereas, most commonly used abrasives in toothpastes are silica, calcium carbonate, dicalcium phosphate dehydrate, calcium glycerophosphate, and tricalcium phosphate (Volpe, 1982).

Fewer researches are available worldwide which showed a difference between the declared and real concentration of fluoride present in children's toothpaste (Thakkar et al., 2015). Therefore, the aim of the study was to assess total fluoride (TF) and total soluble fluoride (TSF) existing in children toothpastes available in the markets of Saudi Arabia.

2. Materials and methods

The ethical approval (Ref: EA 2,016017) was obtained from the Scientific Research Unit of College of Dentistry, Imam AbdulRahman Bin Faisal University.

2.1. Toothpaste selection

Randomly selected, children toothpastes of different brands were divided into five groups

Group A: Biorepair Oral Care toothpaste containing no fluoride.

Group B: Signal Kids Strawberry toothpaste having 500 ppm fluoride.

Group C: Aquafresh Milk Teeth toothpaste having 500 ppm fluoride.

Group D: Aquafresh Little Teeth toothpaste having 500 ppm fluoride.

Group E: Siwak F Junior having 400 ppm F.

2.2. Preparation of measurement apparatus

The details of active ingredients, expiry date, and abrasive in the toothpaste were noted. All the toothpastes were given codes to permit blind analysis of total fluoride (TF) and total soluble fluoride (TSF) concentration by direct potentiometry and the samples were run in triplicate. A multimeter (VWR® symphony™, United States) was first prepared with an assembled fluoride ion selective electrode (Orion 9609BN, 710A meter, South Burlington, VT, USA) as an indicator electrode and a reference electrode (silver – silver chloride or double junction). A working solution of fluoride concentration varying from 10^{-1} to 10^{-7} M was prepared from a stock solution of 0.1 M sodium fluoride (NaF). Each standard solution with known volume of 0.1 M NaF was then mixed with 25.0 mL of total ionic strength adjustment buffer (TISAB) solution and diluted up to the mark into a 100 mL plastic volumetric flask. The solution was transferred to a plastic beaker for analysis. The whole process was repeated with the remaining concentration. A previously cleaned and dry indicator and reference electrode were inserted into the solution and swirled gently. The potential difference on the multimeter was recorded after the reading was stabilized. The electrodes were removed and gently swiped with a soft tissue, dried, and left in the air during analysis.

2.3. Analysis of total fluoride concentration (TF)

One gram of toothpaste was weighed in a clean and dry 100 mL beaker and the reading was recorded. After weighing the toothpaste, 25 mL of water and 25 mL of TISAB solution were poured into the beaker along with the toothpaste. The solution was boiled in a hot plate for 5 min to ensure thorough mixing of toothpaste in the solution. The solution was cooled and then stirred for 10 min to obtain a homogenous mixture. This mixed solution was then poured into a 100 mL plastic volumetric flask and diluted up to the mark. Afterwards, it was transferred to a plastic beaker for quantitative analysis.

2.4. Analysis of total soluble fluoride concentration (TSF)

The same steps for the preparation and calculation of TF were repeated except that before reading the potential difference,

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