Does Green Tea (Camellia sinensis) Powder Extract Contain Fluoride?

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Green tea being a rich source of fluoride, may provide anti-caries benefits when incorporated in toothpaste formulation.
Aim: To estimate the concentration of fluoride in dry green tea extract.
Methods: Prior to the estimation of fluoride in the sample, the dry green tea extract powder was tested for its physical characteristics, analytical characteristics, active ingredients and contaminants. Microbial assay was done for quantifying E. Coli, yeast and Salmonella. Fluoride estimation was done by IS 3025 P 60 method.
Results: Fluoride was not detected in the dry powder extract of green tea dry extract powder.
Conclusion: Green tea powder extract incorporated in herbal toothpastes cannot be read as a natural substitute of fluoride in toothpaste.

Keywords: Fluoride; herbal dentifrice; green tea.

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1. INTRODUCTION

Tea is the richest vegetarian source of fluoride [1]. It is considered as oral health-friendly because of the anti-caries benefits of its fluoride content. Green tea is increasingly consumed globally and is widely promoted as a wellness drink owing to its antioxidant and cancer-preventive effects [2]. Green tea (*Camellia sinensis*) is also reported to be rich in fluorides, ranging from 7 ppm- 25 ppm in one green tea brew, and with lesser concentration of tannins as compared to black tea, is more favourable for incorporation in oral pharmaceutical products [3]. But the release of fluoride from tea depends on various factors viz. hardness, acidity of the medium, method and duration of brewing etc. Majority of the pertinent studies in the literature have thrown light on fluoride released from tea as in beverage preparations. Concentration of fluoride released from powdered tea leaves have been reported only from studies where subsequently the dry powder was treated with artificial gastric acids and intestinal secretions [4].

Recently, the go-natural drive in oral health care products, has led to a surge in the availability of many non-fluoridated herbal toothpaste formulations containing green tea, with claims of cavity protection benefits. This might have left the consumers with the notion of green tea as a natural substitute for fluorides.

Hence, the authors conducted a study to estimate the concentration of fluoride in dry green tea extract, which is usually incorporated in the dentifrice-formulations.

2. METHODS

The present study is a laboratory-based investigation. The dry green tea extract used in the present study was procured from Arjuna Naturals Ltd., Kerala, India. The extract was analysed for purity at the same laboratory. Fluoride assessment was not done by the laboratory of Arjuna Naturals Ltd., as it was not included as part of their analysis protocol.

Hence, fluoride estimation was conducted at Met Chem Laboratory (A Government Recognized Laboratory), Vadodara, Gujarat, India. The sample was tested by IS 3025 P 60 method [5]. The principle behind the analysis is that the colour (red to yellow with increasing concentration of fluoride) obtained with zirconium alizarin reagent is matched against that produced with a series of standard fluoride solutions.

3. RESULTS

The details of analysis of purity of the green tea powder extract and fluoride estimation result are described in Table 1. The fluoride estimation test was negative, i.e. fluoride was not detected in the given sample of green tea powder extract.

4. DISCUSSION

Globally there has been a shift in consumer preferences from chemical-based products towards chemical-free products, powering the demand for herbal products, including toothpastes. Increased share of India in the Asia Pacific herbal products market, strengthening of the AYUSH at government and policy levels and positive forecast in consumer demand have propelled the increased availability of herbal toothpaste to the consumers. Key players in the herbal toothpaste market are Patanjali, Ayurved, Dabur India, VICCO, Colgate-Palmolive, Amway, Himalaya Wellness, Leverayush, Amorepacific, Glaxo-Smithkline plc and Procter&Gamble. These products do not contain fluoride from chemical source [6].

However, it has not been clear if inclusion of green tea as an ingredient in some of these formulations can additionally bestow anti-caries benefits, green tea being a rich source of fluoride. It was needed to clarify to the consumer, whether the anti-caries benefit claimed by the herbal toothpaste, be attributed to the presence of green tea. Hence, the present investigation was conducted to estimate the fluoride content of green tea powder (dry extract), the form in which it is incorporated in herbal toothpaste.

IS 3025 P 60 method used in this study for the estimation of fluoride is suitable for estimation of fluoride and can detect a minimum level of 0.05 mg/F in the sample [5].

In the present study, fluoride was not detected in the given dry powder sample for assay. Release of fluoride for topical effect is said to largely depend on physical and chemical treatments during the processing and preparation. Hence, the release of fluoride is maximum when consumed in beverage form, wherein the brewing or infusion time, method of brewing and hardness of water are considered as the most important factors [4,7].
Table 1. Analysis of green tea (Camellia sinensis) extract powder

| Description          | Specification     | Result       | Method                  |
|----------------------|-------------------|--------------|-------------------------|
| **Physical Characteristics** |                   |              |                         |
| Colour               | Pale green to brownish green | Complies     | Visual                  |
| Appearance           | Powder             | Complies     | Visual                  |
| Flavour              | Bitter tea flavour | Complies     | Organoleptic            |
| Odour                | Characteristic     | Complies     | Organoleptic            |
| **Analytical Characteristics** |                   |              |                         |
| Herb extract ratio   | 10:1               | Complies     | In- house specification |
| Solubility (in alcohol) | Soluble          | Complies     | IP                      |
| (in water)           | Soluble with turbidity | Complies     | IP                      |
| Moisture             | NMT 5%             | 1.3%         | USP 37<921>             |
| Extraction solvent   | Ethyl acetate/ alcohol | Complies     | IP                      |
| Residual Solvent     | NMT 5000 ppm       | Complies     | USP 37<467>             |
| Tap Density (Gm/Ml)  | >0.50              | 0.83         | USP 37<616>             |
| Bulk Density (Gm/Ml) | >0.30              | 0.58         | USP 37<616>             |
| Excipients           | None               | Complies     | In- house specification |
| Carrier used         | None               | Complies     | In- house specification |
| Particle size        | 100% thru 30#      |              | USP 37<786>             |
| **Contaminants**     |                   |              |                         |
| Heavy metals         | NMT 10 ppm         | Complies     | ICP-MS                  |
| Lead                 | NMT 3 ppm          | Complies     | ICP-MS                  |
| Arsenic              | NMT 1 ppm          | Complies     | ICP-MS                  |
| Cadmium              | NMT 1 ppm          | Complies     | ICP-MS                  |
| Mercury              | NMT 0.1 ppm        | Complies     | ICP-MS                  |
| **Microbial assay**  |                   |              |                         |
| Total plate count    | NMT 10000 cfu/g    | 30 cfu/g     | AOAC,BAM                |
| Yeast and mould      | NMT 1000 cfu/g     | Complies     | AOAC,BAM                |
| Salmonella           | Absent/ 25 g       | Complies     | AOAC,BAM                |
| E. Coli              | Absent/ 10 g       | Complies     | AOAC,BAM                |
| **Assay for Actives**|                   |              |                         |
| Total polyphenol     | NLT 60%            | 63.7%        | Spectrophotometer       |
| EGCG Content         | NLT 20%            | 26.4%        | HPLC                    |
| Caffeine Content     | NMT 10%            | 8.3%         | HPLC                    |
| **Fluoride Content**| Not Detected       | Not Detected | IS 3025 P 60            |

It is important to note that in the present study, the solvent used in the extract preparation process was ethyl alcohol/acetate as per the specifications of the vendor. In a previous research study, as well, it was reported that there was no significant fluoride content observed on both methanolic extract of green tea and ethyl acetate extract of green tea in all samples assayed by the investigators [8].

The fact that fluoride was not detected in the sample of green tea powder extract sample in the present study does not imply that green tea incorporated in the dentifrices have no anti-caries effects. Clinical study conducted by Prabakar J et al (2018) [9] have reported that there has been a reduction in S. mutans among patients using green tea containing dentifrices. The plausible anti caries mechanism of green tea has been explained as due to inhibition of glucosyltransferase and amylase enzymes by the active ingredients of green tea, and inhibition of S. mutans colonization by preventing microbial adhesion to enamel surface [10-12]. In a study conducted by Srinidhi PB et al (2014) [13], it was found that green tea increased salivary pH significantly more than black tea in both caries active and caries free individuals. This also supports that green tea has a caries protective effect.

5. CONCLUSION

In a nutshell, it can be concluded that in the present study, no fluoride was detected in green tea dry extract; however green tea incorporated in dentifrice should be considered beneficial to oral health irrespective of local release of fluoride, owing to its anti-oxidant properties, desirable influence on salivary pH and antibacterial effects. Use of green tea extract containing dentifrice may be effective in plaque control and conferring caries-protection.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our
area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Study was approved by the institutional ethics committee (Ref. SVIEC/ON/Dent/RP/18009).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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