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Fluoride content of several brands of teas and juices found in Brazil and risk of dental fluorosis

CONTEÚDO DE FLÚOR EM DIVERSAS MARCAS DE CHÁS E SUCOS ENCONTRADOS NO BRASIL E RISCO DE FLUOROSE DENTAL

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Given that increasing numbers of people are consuming beverages instead of water, fluoride (F) intake should not be determined solely upon the concentration of the drinking water, but should also consider the amount of different beverages consumed and their fluoride content. The aim of this study was to evaluate the fluoride content of (A) 12 infusion black tea (*Camellia sinensis);* (B) 15 ready-to-drink teas; (C) 10 powdered juices; (D) 3 powdered tea-containing juices; and (E) 4 ready-to-drink juices found in Brazil. Samples of A were prepared by infusion of a bag in 80mL of boiling deionized water, for 3 minutes. Powdered juices were prepared with deionized water, following the manufacturer's instructions. F analysis was made in triplicate using the ion-specific electrode (Orion 96-09). The mean F concentration ± SD (amplitude; unit mg/mL) were 2.57±0.99 (1.07-3.99); 0.37±0.20 (0.08-0.81); 0.02±0.05 (0-0.03); 1.10±0.15 (0.99-1.22); 0.30±0.18 (0.12-0.52), for A, B, C, D and E, respectively. All the A, 2 of the B and all of the D samples showed a F concentration higher than 0.7 µg/mL. Regarding the juices, only the D could significantly contribute to the daily maximum recommended F intake (0.07 mg/Kg body weight). However, if the other juices were reconstituted with fluoridated water they could also contribute. It was concluded that some products analyzed may be important contributors to the total daily F intake. Their consumption by children at the age of risk to dental fluorosis should be avoided. The [F] in these products should be informed on their labels.

UNITERMS: Fluoride; Dental fluorosis; Tea; Juice.

INTRODUCTION

Since the 1940's, the prevalence of dental fluorosis has increased, concomitant with a reduction in dental decay. These changes have been attributed in part to the widespread use of systemic and topical fluorides. Various sources of increased systemic fluoride exposure have been investigated.

It has long been accepted that fluoride accumulates in the leaves of the tea plant *Camellia sinensis*. In addition it is known that some of this fluoride is released into the infusion, which is drunk as tea. The exact concentration of fluoride in a cup of tea and the effects of this fluoride have been the subject of many international studies[1,4,6,7].

Increasing consumption of beverages as a replacement for water has made the fluoride content in beverages an important issue. Few studies have investigated fluoride exposures from infused tea, juices and from tea and juice-flavored manufactured drinks. Fluoride ingestion from these beverages by children may be a substantial factor in the development of fluorosis. Thus, the aim of the present study was to evaluate the fluoride content of several infusion teas, ready-to-drink teas, powdered juices, powdered tea-containing juices and ready-to-drink fruit juices found in Brazil.

MATERIAL AND METHODS

Sampling

Twelve samples of infusion black tea (*Camellia sinensis* - A); 15 samples of ready-to-drink teas (B); 10 samples of powdered juices (C); 3 samples of powdered tea-containing juices (D); and 4 samples of ready-to-drink juices, from different brands (E) (Table 1) were purchased in Bauru, São Paulo, Brazil. The products were chosen because they are the most consumed by infants and young children. Brand name, food type, flavor, container size, batch number, and manufacturer's name were recorded for each product studied (Table 1).

TABLE 1 - Teas and juices analysed

Beverage type	Product name (flavor)	Manufacturer	Production site
Infused black tea	Castellari (black tea)	Effem Brasil	São Caetano do Sul
	Leão (black tea)	Leão Júnior	Curitiba
	Royal blend (black tea)	Fleischmann e Royal	Jundiaí
	Lin Tea (black tea)	Unilever Bestfoods Brasil	Pouso Alegre
	Oetker (black tea)	Oetker Produtos Alimentícios	São Paulo
	Apichá (black tea, vanilla, cocconut, almond, tangerine, damask, ginseng)	Api-Nutri	Campinas
Mate and black ready-to-drink ice-tea	Ice tea Lipton (Light peach, diet lemon, peach, lemon)	Pomar	Araguari/Jundiaí
	Nestea (peach, lemon)	Coca Cola/Nestlé	Ribeirão Preto
	Santal (peach, lemon, red fruits, lemon mate)	Parmalat	Jundiaí
	Leão (peach, diet lemon, natural)	Leão Júnior	Curitiba
	Leãozinho (peach, strawberry)	Leão Júnior	Americana
Powdered juice	Sukest (grape,guarana)	Sukest	Bauru
	Frisco (grape)	Unilever Best Foods	Goiânia
	Mid (grape)	Ajinomoto	Limeira
	Fresh (grape, guarana)	Kraft Foods Brasil	Curitiba
	Suks (grape)	Sukest	Bauru
	Tang (grape)	Kraft Foods Brasil	Curitiba
	Ki-suco (grape)	Kraft Foods Brasil	Curitiba
Powdered tea-containing juice	Cligth (italian grape)	Kraft Foods Brasil	Curitiba
Ready-to-drink juice	Cligth (peach, lemon, apple)	Kraft Lacta Suchard Brasil	São Paulo/Curitiba
	Del Valle (grape)	Sucos Del Valle Brasil	Americana
	Del Valle Kids (grape)	Sucos Del Valle Brasil	Americana
	Santal (grape)	Parmalat	Jundiaí
	Kapo (grape)	Cia. de Bebidas Ipiranga	Ribeirão Preto

Preparation and fluoride analysis

The products were opened on the day of the analysis. The black teas were prepared by infusion of a bag in 80 mL of boiling deionized water, for 3 minutes. The powdered juices were prepared with deionized water, following the manufacturer's instructions.

Fluoride analysis

Fluoride was analyzed using the ion-specific electrode (Orion Research, Cambridge, MA, USA, model 9609), after sample buffering with an equal volume of TISAB II. A set of standards (containing 0.1, 0.2, 0.4, 0.8 and 1.6 ppm fluoride) was prepared, using serial dilution from a 100 ppm NaF stock solution (Orion). The millivoltage potentials were converted to μg F/mL using a standard curve with a coefficient correlation of $r \geq 0.992$. The mean reproducibility of the readings, based on the triplicate samples, was 99.4 percent.

RESULTS

Table 2 shows the F concentration determined for all the products. F concentration is expressed as mg/mL. Mean F concentration ± SD (amplitude, n) were 2.57 ± 0.99 (1.07-3.99, n=12), 0.37 ± 0.20 (0.08-0.81, n=15), 0.02 ± 0.05 (0-0.03, n=10), 1.10 ± 0.15 (0.99-1.22, n=3), 0.30 ± 0.18 (0.12-0.52, n=4), for A, B, C, D and E, respectively. All the A, 2 of the B and all of the D samples showed a F concentration higher than 0.7 μg/mL.

TABLE 2 - Fluoride concentration (g/mL) of teas and juices

Beverages	F concentration (μg/mL)	Beverages	F concentration (μg/mL)
Castellari (black tea)*	2.94	Leão (peach)**	0.44
Leão (black tea)*	1.49	Leão (diet lemo)**	0.44
Royal blend (black tea)*	1.21	Leão (natural)**	0.43
Lintea (black tea)*	1.07	Leãozinho (peach)**	0.09
Oetker (black tea)*	2.95	Leãozinho (strawberry)**	0.81
Apichá black tea*	3.99	Sukest (grape)***	0
Apichá vanilla*	3.12	Sukest (guarana)***	0.15
Apichá cocconut*	3.05	Frisco (grape)***	0
Apichá almond*	2.42	Mid (grape)***	0
Apichá tangerine*	3.37	Fresh (grape)***	0
Apichá damask*	3.56	Fresh (guarana)***	0
Apichá ginseng*	1.64	Suks (grape)***	0.03
Ice tea Lipton (light peach)**	0.26	Tang (grape)***	0
Ice tea Lipton (diet lemon)**	0.39	Ki-suco (grape)***	0
Ice tea Lipton (peach)**	0.17	Cligth (italian grape)***	0
Ice tea Lipton (lemon)**	0.19	Cligth (peach tea)****	0.99
Nestea (peach)*a*	0.71	Cligth (lemon tea)****	1.21
Nestea (lemon)**	0.57	Cligth (apple tea)****	0.98
Santal (peach)**	0.24	Del Valle (grape)*****	0.52
Santal (lemon)**	0.34	Del Valle Kids (grape)*****	0.34
Santal (red fruits)**	0.38	Santal (grape)*****	0.20
Santal (lemon mate)**	0.10	Kapo (grape)*****	0.12

*Infusion black tea
**Ready-to-drink teas
***Powdered juices
****Powdered tea-containing juices
*****Ready-to-drink juices

DISCUSSION

Given that increasing numbers of people are consuming beverages instead of water, fluoride intake should not be determined solely upon the concentration of the drinking water, but should also consider the amount of different beverages consumed and their fluoride content.

Tea and juices are a pleasant, popular, socially accepted, economical, and safe drink that is enjoyed everyday by hundreds of millions of people across all continents. Tea also provides a dietary source of biologically active compounds that help prevent a wide variety of diseases, and either is used as a calm and painkiller agent in childhood.

It is considered that the optimal range of fluoride intake is 0.05-0.07 mg F/kg body weight/day[1,5]. Most of the products we analyzed had high F concentration. All of the A, 2 of the B and all of the D samples showed a F concentration higher than 0.7 mg/mL. The F concentration found in A (Table 2) are consistent with the reports of Chan; Koh[3] and of Pang; Phillips; Bawden[8], who found F concentrations between 0.34 and 3.71 ppm (in caffeinated tea infusions) and between 2.00 and 3.00 ppm, respectively. The F concentrations in juices (Table 2) are within the same range as those reported by Pang; Phillips; Bawden[8] (0.1-1.7 ppm), by Heintze; Bastos[6] (0.06 ppm) and by Bastos et al. [1] (0.1-0.5 ppm or more, being the highest values for the guarana and grape powdered juices).

The amount of F in these products we analyzed suggests that they may significantly contribute to the daily fluoride intake. For the highest F concentration found (black tea Apichá, 3.99 μg F/mL), when only 200 mL are consumed just once a day, this may provide up to 100% of the upper limit of the ranges of estimates believed to be associated with increased risk of enamel fluorosis (0.07 mg F/kg body weight/day) for a 2-year-old child, that weighs around 12 kg[2,5], having a estimated fluoride intake of 0.80 mg. In addition, the level of fluoride may be much higher, when fluoridated water is used to reconstitute the product.

For the grape fruit juices, the mean F concentration found were lower than the one reported by Stannard; Shim; Kritsineli; Labropoulou; Tsamtsouris[10], who found that 42% of the samples had more than 1 ppm F. The authors had already observed that when the juices were made with grapes separated from the skin, they did not contain any fluoride. Since it is a common practice to use fluoride-containing insecticide in growing grapes, it is believed that contamination of these juices occurred. Washing the grape skins also produced appreciable quantities of fluoride.

This work was carried out in an attempt to establish the significance of F in tea and juices, considering the daily F intake. The most popular teas and juices in Brazil are not readily available in other countries and, therefore, Brazilian data might not be assumed to be similar to those in foreign studies. Despite some researches identify teas as a caries preventive agent among schoolchildren[9,13,11], future research is needed to define the actual magnitude of health benefits, establish the safe range of tea and some juices consumption associated with these benefits, and elucidate potential mechanisms of action. By identifying potential sources of high F ingestion, recommendations can be made to reduce consumption from these sources in patients who may be at risk of dental fluorosis. It is recommended that a research project be carried out to analyze the bioavailability of F from teas and juices available on the Brazilian market.[12]

CONCLUSIONS

It was concluded that some products analyzed may be important contributors to the total daily F intake. Their consumption by children at the age of risk to dental fluorosis should be avoided.

RESUMO

Considerando-se que um grande número de pessoas está consumindo bebidas industrializadas ao invés de água, a ingestão de flúor não pode ser determinada apenas pela sua concentração na água, devendo-se considerar a diversidade de bebidas industrializadas consumidas e sua concentração de F. O objetivo deste estudo foi avaliar o conteúdo de flúor em (A) 12 chás pretos para infusão (*Camellia sinensis);* (B) 15 chás industrializados prontos para o consumo; (C) 10 sucos em pó; (D) 3 sucos em pó contendo chá; e (E) 4 sucos industrializados prontos para o consumo encontrados no Brasil. As amostras A foram preparadas por infusão do sachê em 80mL de água deionizada fervente, por 3 minutos. Os sucos em pó foram preparados com água deionizada, seguindo as recomendações dos fabricantes. As análises do teor de F foram feitas em triplicata com o uso de eletrodo íon específico (Orion 96-09). As concentrações médias de F ± DP (amplitude; unidade

mg/mL) foram 2,57±0,99 (1,07-3,99); 0,37±0,20 (0,08-0,81); 0,02±0,05 (0-0,03); 1,10±0,15 (0,99-1,22); 0,30±0,18 (0,12-0,52), para A, B, C, D e E, respectivamente. Todas as amostras A, 2 amostras B e todas as amostras D apresentaram uma concentração de F maior que 0,7 µg/mL. Para os sucos, apenas os D poderiam contribuir significantemente para a ingestão diária máxima de F recomendada (0,07 mg/Kg peso). Entretanto, os outros sucos, se reconstituídos com água fluoretada, também poderão contribuir para a ingestão diária máxima de F. Concluiu-se que muitos dos produtos analisados podem ser importantes contribuintes para a ingestão diária total de F, e o seu consumo por crianças na faixa etária de risco para fluorose dental deve ser evitado. A concentração de F presente nestes produtos deveria ser informada em seus rótulos.

UNITERMOS: Flúor; Fluorose dental; Chá; Suco.

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