FLUORIDE IN NEWER TEA COMMODITIES

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SUMMARY: The water-extractable fluoride content of nine packed teas, ten instant tea powders, and ten tea beverages manufactured in China, Japan, Taiwan, and the USA was determined by the fluoride ion specific electrode method. Among the black, green, and Oolong packed teas, the F content ranged from 41.5 to 212.4 mg F/kg tea. Among the instant tea powders, the range was broader: 25.9 to 631.3 mg F/kg tea, the latter in a black tea from Taiwan. The bottled and canned tea beverages had fluoride concentrations ranging from 0.20 to 1.80 mg F/L, with the highest in Oolong tea beverages. Chronic toxic levels of fluoride consumption from some of these tea products are possible. The packaging paper of packed teas and the addition of milk had no effect the fluoride concentrations in the infusions.

Keywords: Fluoride in tea; Fluorosis from tea; Instant tea; Packed tea; Powdered tea.

INTRODUCTION

Tea-consuming modalities have undergone considerable change in recent decades with the widespread availability of instant formulations such as packed tea, powdered tea, and bottled and canned tea beverages. Since tea is naturally rich in fluorine, the amount of fluoride consumed through these new tea modalities, especially by young children, is a matter of increasing concern for dental and other toxicity.[1,2] Although packed tea and instant tea powder account for about 30% of the total tea market,[3] their fluoride content has not been well studied. In this study we report the results of our measurements of the extractable fluoride in these newer tea products.

MATERIALS AND METHODS

Market samples of both Chinese and imported teas were studied, including nine packed teas, ten instant tea powders, and ten bottled and canned tea beverages. Six samples of traditional black tea, green tea, and Oolong tea served as controls for comparison.

For the packed teas, the paper packet wrapper was removed and the tea dried at 60 ºC for 5 hr in a desiccator. For the infusions, 2.00 g of the tea was heated in 100 mL of boiling deionized water for 10 min and filtered. For the instant tea powders, 2.00 g samples were dissolved in 200 mL of boiling deionized water and heated for 10 min. The bottled and canned tea beverages were sampled directly. For studying the influence of paper packaging materials, the infusions

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were prepared with the paper wrapper present or removed. The fluoride content of two black tea infusions was also examined after addition of milk and sugar.

Fluorine assays were conducted by the fluoride selective electrode method calibrated against a standard sodium fluoride solution in deionized water (10 μg F^-/mL), prepared by diluting solutions containing 0.2210 g NaF/100 mL (= 1 mg F^-/mL).[4,5] The fluoride content in the various teas was determined after addition of an equal volume of TISAB into the infusions, with some of the readings being checked for the recovery rate by addition of appropriate small amounts of the standard fluoride solution. The China National Research Center of Standard Material provided "Tea-tree-leaves (GBWO8513)" for quality control.

RESULTS

The fluoride contents of the various tea samples are listed below in Tables 1–5.

Table 1. The water-extractable fluoride content of packed teas (mg/kg)

Tea species	Sample No.	Nation where produced	Nation for source of tea	N (Number of determinations)	Mean±SE
Black teas	1	UK	China	5	41.5±0.01
	2	UK	India	8	110.4±0.01
	3	Japan	Japan	5	159.6±0.02
	4	China	China	4	76.5±0.03
Green teas	1	Japan	Japan	4	144.5±0.03
	2	China	China	4	212.4±0.01
	3	China	China	4	165.7±0.01
Oolong teas	1	Taiwan of China	Taiwan of China	4	136.7±0.02
	2	China	China	4	155.8±0.02

Table 2. The fluoride content of instant tea powders (mg/kg)

Tea species	Sample No.	Production sites	N	Mean±SE	Supplements
Black teas	1	China	4	151.0±0.02	
	2	Taiwan of China	4	631.3±0.02	
	3	China	4	56.4±0.02	Milk powder
Green teas	1	China	4	260.3±0.02	
	2	China	4	597.5±0.01	
	3	Japan	4	25.9±0.01	Special supplements
	4	Japan	4	75.2±0.01	Prepared directly from delicate leaves
Flower teas	1	China	4	196.3±0.01	
Oolong teas	1	China	4	248.2±0.02	
Tibetan Milk teas	1	China	4	389.2±0.01	

Table 3. The fluoride content of bottled and canned tea beverages (mg/L)

Tea beverage	Sample No.	Container	N	Mean±SE
Black tea	1	PVC bottle	4	0.69±0.02
	2	PVC bottle	4	0.85±0.01
	3	Aluminum can	4	1.29±0.01
Green tea	1	PVC bottle	4	0.28±0.01
	2	Aluminum can	4	0.67±0.01
	3	Paper box	4	0.67±0.01
	4	Aluminum can	4	0.20±0.01
Flower tea	1	PVC bottle	4	1.05±0.01
	2	PVC bottle	4	0.19±0.01
	3	Aluminum can	4	0.56±0.01
Oolong tea	1	PVC bottle	4	1.80±0.01
	2	PVC bottle	4	1.25±0.01
	3	PVC bottle	4	1.77±0.02

Table 4. Effect of packing paper on fluoride solubility of packed teas (mg/L)

Tea species	With paper package		Without paper package		P
	N	Mean±SE	N	Mean±SE	
Black tea No.1	5	42.1±0.01	5	42.4±0.04	>0.5
Black tea No. 2	5	110.8±0.01	5	111.4±0.02	>0.5

Table 5. Effect of milk supplement on black tea fluoride solubility (mg/kg)

Tea species	With milk		Without milk		P
	N	Mean±SE	N	Mean±SE	
Black tea No. 1	5	42.1±0.01	5	42.7±0.02	>0.5
Black tea No. 2	5	110.2±0.01	5	110.4±0.02	>0.5

DISCUSSION

Today, newer tea commodities in the form of various packed teas, instant teas, and bottled or canned teas find increasing favor among consumers as alternatives to the traditional modality of tea preparation by boiling and soaking in water. The fluoride content of ordinary tea commodities is usually not high enough to cause significant adverse health effects, since the delicate leaves used as raw materials in these tea species are generally relatively low in fluoride.[6] However, the extent to which the new forms of tea products manufactured through newly developed processes are safe has not yet been addressed.

Our experiments demonstrated that among the packed teas, instant tea powders, and bottled and/or canned teas, concerns about fluoride content need to be raised, which are closely related to the raw materials as well as the manufacturing processes. As seen in Table 1, among the black, green, and Oolong packed teas, the water extractable fluoride content ranged from 41.5 to 212.4 mg F/kg tea. Ordinary stick-shaped black tea commodities have water-extractable fluoride concentrations ranging from 97 to 148 mg F/kg tea.[6] Among the instant tea powders (Table 2), the range was broader: 25.9 to 631.3 mg F/kg tea, the latter in a black tea from Taiwan. The bottled and canned tea beverages (Table 3) had fluoride concentrations ranging from 0.20 to 1.80 mg F/L, with the highest in Oolong tea beverages. Chronic toxic levels of fluoride consumption from some of these newer tea commodities are therefore possible. It was also found (Tables 4 and 5)

that the packaging paper of packed teas and the addition of milk showed no effect the fluoride concentrations in the infusions.

Among the newer tea commodities it is difficult to determine whether their raw materials are exclusively the delicate tea leafs. Instant-tea powder manufacturing has a series of extraction, concentration, and evaporation steps in which the tea taste and color ingredients are pooled and concentrated, including their fluoride content.

Our findings suggest that the health safety problem of these newly marketed tea species warrants further attention. Appropriate regulation of the fluoride content of tea commodities should be an urgent matter for public food safety policy.

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