

Fluoride content of commercially prepared strained fruit juices

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Abstract

The fluoride content of commercially prepared strained fruit juices was assessed using a fluoride ion-specific electrode in conjunction with a reference electrode. Most of the products contained less than 0.33 µg of fluoride per ml, but six of the 18 products contained more than 0.50 µg of fluoride per ml. When used in normal quantities, the fluoride content of commercially prepared strained fruit juices should not be a significant contributory factor to enamel fluorosis.

Introduction

Concern over the additive effects of fluoride received from various sources has prompted recent research in the field of dietary fluoride intake. This is especially evident in the area of infant nutrition.¹⁻⁵ These studies have indicated that human milk and cow's milk are low in fluoride content. Commercially available infant formulas, however, can provide fluoride in concentrations greater than 1.0 µg/ml. Studies which have analyzed solid infant foods have found with a few-exceptions low concentrations of fluoride. However, these foods can contribute substantially to the total fluoride intake of a small child, especially if considered on a milligrams of fluoride/body weight basis. To responsible dentists and pediatricians concerned with the possibility of fluorosis, these data cannot be ignored when fluoride supplementation is considered.

The purpose of this study is to document the dietary fluoride available to the infant via commercially prepared strained fruit juices from two major manufacturers.*

* Gerber Products Company, Fremont, Michigan; Heinz USA, Pittsburgh, Pennsylvania.

† Orion Research, Cambridge, Massachusetts.

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Materials and methods

The strained fruit juices analyzed were purchased in Iowa City, Iowa. Three cans of each product were analyzed for free ionic fluoride. Six products representative of the range of free ionic fluoride concentrations were further analyzed for the presence of a bound fluoride fraction.

Analysis of free ionic fluoride was carried out using a fluoride ion-specific electrode in conjunction with a reference electrode.† Samples and standard calibrating solutions were buffered 1:1 with total ionic strength activity buffer. The lower limit of accuracy of this technique was determined to be 0.10 µg of fluoride per ml. Bound fluoride ion determinations were accomplished using Wharton's modifications⁶ of the diffusion technique described by Singer and Armstrong.⁷ This procedure was used successfully to determine bound fluoride fractions in infant formulas.⁵

Results

Tables 1 and 2 list the free ionic fluoride concentrations found in products manufactured by Gerber and Heinz, respectively. The tables list the mean concentration from two analyses of each can, as well as a mean concentration from all three cans analyzed. The range of concentrations of all Gerber products analyzed was from less than 0.10–0.61 µg of fluoride per ml. The range of the average concentrations was from less than 0.10–0.59 µg/ml.

The range of concentrations of all Heinz products analyzed was from less than 0.10–1.40 µg of fluoride per ml. The range of the average concentrations was from less than 0.10–1.33 µg of fluoride per ml.

None of the six products selected for diffusion analysis demonstrated a bound fluoride fraction. This was not unexpected since fluoride generally binds to calcium or protein complexes not found in fruit juices.

Table 3 compares the mean fluoride concentrations between Gerber and Heinz juices of the same name.

In general, the Heinz products demonstrated slightly higher mean fluoride concentrations.

Discussion

Sources of Variation

Inspection of Tables 1 and 2 reveals the wide variation of fluoride concentrations found in these prod-

Table 1. Mean fluoride concentrations ($\mu\text{g/ml}$) found in Gerber strained fruit juices

Juice	Can 1 *	Can 2 *	Can 3 *	Mean
Apple	0.25	0.30	0.33	0.29
Apple-peach	0.28	0.36	0.28	0.31
Apple-grape	0.60	0.61	0.57	0.59
Apple-cherry	0.43	0.15	0.42	0.33
Apple-plum	0.46	0.20	0.24	0.30
Prune-orange	<0.10	0.13	0.11	<0.11†
Orange	0.27	0.10	0.36	0.24
Orange-Pineapple	0.13	0.10	0.13	0.12
Orange-apple	0.22	0.13	0.23	0.19
Mixed fruit	0.33	0.23	0.21	0.26
Orange-apricot	<0.10	<0.10	<0.10	<0.10†
Orange-apple-banana	<0.10	0.18	0.30	<0.19†

* Values given are means of duplicate analyses.

† One or more cans contained less than $0.10 \mu\text{g}$ of fluoride per ml, the lower limit of accuracy of the measurement technique.

Table 2. Mean fluoride concentrations ($\mu\text{g/ml}$) found in Heinz strained fruit juices

Juice	Can 1 *	Can 2 *	Can 3 *	Mean
Apple	1.25	1.35	1.40	1.33
Apple-grape	1.18	1.15	1.30	1.21
Apple-pineapple	0.72	0.70	0.16	0.53
Apple-apricot	0.88	0.42	0.45	0.58
Orange	<0.10	<0.10	<0.10	<0.10†
Orange-apple-banana	0.84	0.70	0.75	0.76

* Values given are means of duplicate analyses.

† One or more cans contained less than $0.10 \mu\text{g}$ of fluoride per ml, limit of accuracy of the measurement technique.

Table 3. Comparisons of mean fluoride concentrations ($\mu\text{g/ml}$) between Gerber and Heinz juices of the same name

Juice	Mean fluoride concentration	
	Gerber	Heinz
Apple	0.20	1.33
Apple-grape	0.59	1.21
Orange	0.24	<0.10*
Orange-apple-banana	<0.19*	0.76

* One or more cans contained less than $0.10 \mu\text{g}$ of fluoride per ml, the lower limit of accuracy of the measurement technique.

ucts. All of the Heinz strained juices, with the exception of orange, had fluoride concentrations greater than $0.50 \mu\text{g/ml}$. Two of them, apple and apple-grape, averaged over $1.20 \mu\text{g}$ of fluoride per ml. One can of apple-pineapple juice had a noticeably lower fluoride content ($0.16 \mu\text{g/ml}$) than its counterparts (0.72 and $0.70 \mu\text{g/ml}$, respectively).

The range of concentrations of the Gerber products was lower, with no juice containing more than $0.61 \mu\text{g}$ of fluoride per ml. Five of the 36 Gerber cans analyzed had less than $0.10 \mu\text{g}$ of fluoride per ml. Fluoride concentrations in the three cans of each product were relatively consistent, with the exceptions of apple-cherry, apple-plum, orange, orange-apple, and orange-apple-banana.

There are many potential sources of variation in the fluoride content of strained fruit juices. Some of them cannot be easily assessed, such as the type of soil in which the fruit was grown and contamination via fertilizers or air sources.

Personal communication with company officials at Heinz and Gerber revealed further potential sources of variation in fluoride content. The first of these is the fluoride concentration of the water used in processing the juices. Four of the five Heinz plants producing juices use city water which is optimally fluoridated. The same is true of Gerber plants. Each company has one plant using nonfluoridated well water.

A further source of variation is the use of fruit juice concentrates as opposed to single strength juices in some of the products. In general, combination products are made from concentrates. Orange and grape juices are generally used as single strength juices, except where orange is used in a combination. Thus, concentrates diluted with fluoridated water at the processing plant will provide more fluoride than single strength juices or concentrates diluted with nonfluoridated water. Nutritional information on the cans states whether concentrates were used in that product.

Implications for Fluoride Supplementation

The most important factors to consider in prescribing supplemental fluoride are the patient's age and the level of fluoride in the drinking water. However, data such as these suggest that downward revision of older supplementation schedules may be necessary to prevent fluorosis.^{8,9} Dietary intake of fluoride must be considered, especially for infants and small children whose low body weights increase the relative dose of fluoride.

The baby food manufacturers have taken steps to standardize the fluoride content of infant formulas. In 1979, water used in the manufacture of formula will contain less than $0.15 \mu\text{g}$ of fluoride per ml. This should result in an average of less than $0.1 \mu\text{g}$ of fluoride per liter for formula manufactured in this country.¹⁰ The

fluoride ingested from strained fruit juices should not account for a very significant portion of an infant's total fluoride intake. At the present time, the fluoride dosage schedule recommended by the American Dental Association remains the standard of the profession (Table 4).

Table 4. Current fluoride dosage recommendation*

F content in drinking water (ppm)	Daily dosage (F ion)		
	Birth-age 2 (mg)	Age 2-3 (mg)	Age 3-4 (mg)
<0.3	0.25	0.50	1.00
0.3-0.7	0	0.25	0.50
>0.7	Fluoride dietary supplements unnecessary		

* (Approved by the Council on Dental Therapeutics of the American Dental Association.) From Wei, S. H. Y.: "Fluoride supplementation," In *Pediatric Dental Care. An Update for the Dentist and for the Pediatrician*, New York: Medcom, Inc., 1978, p. 32.

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