

Fluoride Levels in Organic Apple Juices Before and After Dilution

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INTRODUCTION

Fluoride has been a topic of debate within the health community for over a century. While fluoridated water remains the primary source of fluoride intake, other foods and beverages can also contribute to overall exposure.¹ Organic fruit juices are widely consumed, particularly among children, and are often perceived as a healthier alternative to conventional beverages. As juice consumption begins early in life and can be frequent, it may represent an additional source of fluoride intake. Moreover, variations in agricultural practices, water sources, and processing methods may influence fluoride content in organic juices. Understanding fluoride levels in these beverages is essential for evaluating total dietary exposure and its potential health implications in pediatric populations.

Table 1: Daily tolerable intake levels for fluoride.

Age	Male	Female
0-6 months	0.7 mg	0.7 mg
7-12 months	0.9 mg	0.9 mg
1-3 years	1.3 mg	1.3 mg
4-8 years	2.2 mg	2.2 mg

Source: CDC⁴



Figure 1: Patient with mild fluorosis.

OBJECTIVE

This study aimed to evaluate fluoride concentration and pH in organic apple juice brands before and after dilution with 50% water and estimated daily fluoride intake.

MATERIAL AND METHODS

Fluoride concentrations in 4 organic juices were determined using an ORION fluoride ion-selective electrode (Thermo Fisher Scientific, Waltham, MA, USA). The electrode was calibrated using a series of five standard fluoride solutions (0.125 - 5 ppm) (Thermo Fisher Scientific) in the presence of Total Ionic Strength Adjustment Buffer II, (TISAB II - Thermo Fisher Scientific). Then, 30 mL of the samples were mixed with 30 mL of TISAB II. The mixture was gently stirred, and the fluoride concentration was measured. The pH of each sample was also measured using a pH meter (Thermo Fisher Scientific). All measurements were performed in triplicate. The estimated daily intake (EDI) for patients was calculated assuming a daily consumption volume of 120 mL (4 oz). Measurements were redone after juices were diluted 1:1 in water.

The percentage contribution to daily upper limit (%UL) was also calculated. Data was descriptively analyzed.



Figure 2: Juice brands tested

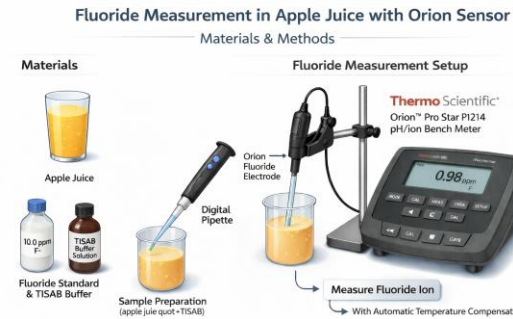


Figure 3: Schematic image showing the preparation and analysis of the samples.

RESULTS

The pH of apple juice samples ranged from 3.85 (0.02) to 4.44 (0.02), while tap water had a pH of 7.67 (0.2). Fluoride concentrations in undiluted juices ranged from 0.06 (0.02) to 0.14 (0.01) mg/L and increased to 0.56 (0.03)–0.63 (0.08) mg/L following dilution. Tap water contained 1.1 (0.07) mg/L fluoride. EDI values ranged from 0.01–0.03 mg/day for undiluted samples and 0.07–0.08 mg/day for diluted samples. The percentage of UL for children aged 1–3 years ranged from 0.6–1.3% (undiluted) and 5.2–5.8% (diluted), and for children aged 4–8 years ranged from 0.3–0.7% (undiluted) and 3.1–3.4% (diluted).

DISCUSSION

Apple juice samples were acidic. Fluoride concentrations in juices were relatively low compared to tap water, though levels increased after dilution, due to the fluoride from water. EDI values remained low across all samples, contributing less than 6% of the tolerable upper intake level (UL) for children. Overall, these findings suggest that apple juice is a minor contributor to fluoride exposure in children, especially when compared to fluoridated drinking water.

CONCLUSIONS

Fluoride concentrations in undiluted juices ranged from 0.06 to 0.14 ppm. Organic apple juices contained low levels of fluoride, and estimated daily intake remained well below established pediatric ULs. Dilution with tap water resulted in increased fluoride concentrations.



Figure 4: Average pH of different products.

Figure 5: Amount of fluoride in each product (ugF/g).

Figure 6: Estimate daily intake of fluoride (mg/day), considering 120 mL of juice.

Table 2. % of upper limit daily intake for fluoride for patients aged 1-8 years of age.

Group	%UL 1-3 yo	%UL 4-8 yo
Juicy Juice	0.58	0.35
Lakewood	0.79	0.47
365	1.26	0.74
Honest	0.57	0.34
Juicy Juice + water	5.20	3.07
Lakewood + water	5.55	3.28
365 + water	5.81	3.43
Honest + water	5.25	3.10
Water	10.92	6.45

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