

Fluoride Intake from Milk and Plant-Based Alternatives

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INTRODUCTION

Fluoride has been a controversial subject within the health community for over 100 years. Although fluoridated water is the primary source of fluoride intake, other foods and beverages may also contribute to total daily exposure.¹ The American Academy of Pediatrics recommends the ingestion of up to 24 oz of milk daily, depending on a child's age.² As milk is a commonly consumed beverage in early childhood, it may represent a meaningful source of fluoride intake. Additionally, the increasing popularity of plant-based milk alternatives raises questions about their fluoride content and potential contribution to overall exposure. Understanding fluoride levels in both dairy and plant-based milks is important for assessing dietary intake and potential health implications in children.



Figure 1: Dean's Fluorosis Index: Very mild, mild, moderate and severe. Source: Fluoride Free Australia.³

Figure 2: Dental Growth and Development chart. Source: Modified from Fragelli, 2022.⁵

OBJECTIVE

This study aimed to estimate fluoride intake of dairy and plant-based milk products by identifying fluoride concentration and pH.

MATERIAL AND METHODS

Fluoride concentrations in 11 milk and plant-based alternatives 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 600 mL. The percentage contribution to daily upper limit (%UL) was also calculated. Data was descriptively analyzed.

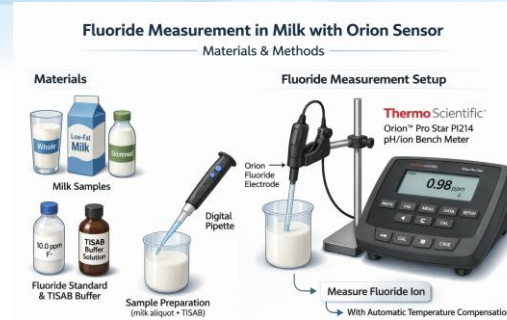


Figure 3: Schematic image showing the preparation and analysis of the samples.

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 4: Milk brands tested

RESULTS

All dairy milk products had pH 7(0.00), while the pH of the plant-based products varied from 5(0.09) to 8.4(0.02). Fluoride concentrations ranged from 0.01(0.01)–0.55(0.01) mg/L. EDI values ranged from 0.01–0.33 mg/day. %UL for children aged 1–3 years ranged from 1–25%, with oat and coconut products contributing the most to exposure. For children ages 4-8 years %UL ranged from 0.3-15%.

DISCUSSION

The results show a significant percentage of daily fluoride intake being consumed when drinking non-dairy milk products. Because of emerging popularity and increased options for non-dairy milk products, risk of fluorosis should be considered with greater precaution in children especially younger than 6 years old. A limitation of this study includes the daily intake being based on 20 oz for all age groups.

RESULTS

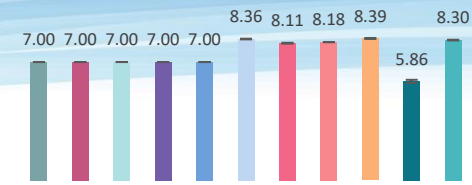


Figure 5: Average pH of different milk products.

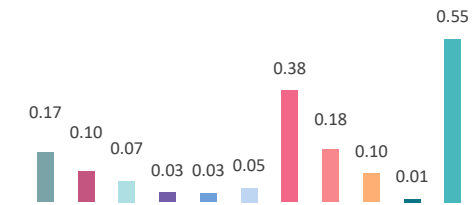


Figure 6: Amount of fluoride in each product (ugF/g).

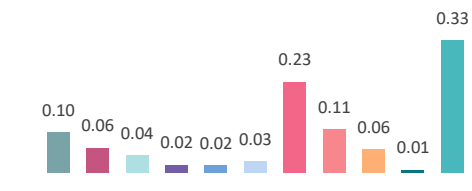


Figure 7: Estimated daily intake of fluoride (mg/day), considering 600 mL of milk.

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

Product	%UL 1-3 yo	%UL 4-8 yo
Kroger Whole Milk	7.78	4.60
Prairie Farms Whole Milk	4.73	2.80
Fairlife Whole Milk	3.29	1.94
Prairie Farms 2% Reduced Fat Milk	1.49	0.88
Kroger Skin Fat Free Milk	1.39	0.82
Silk Soy Milk	2.19	1.29
Chobani Oat Milk Original	17.39	10.28
Planet Oat Original	8.25	4.88
Almond Breeze Original	4.45	2.63
Simple Truth Creamy & Rich Coconut	0.50	0.29
Simple Truth Unsweetened Coconut	25.41	15.02

CONCLUSIONS

Variation in fluoride concentrations across milk types led to higher estimated intakes from plant-based products, with some exceeding 20% of the UL, suggesting implications for dietary fluoride monitoring in populations at risk for fluorosis.

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