Fluoride Content of Common Foods

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Introduction

Before many of the controversies surrounding fluoridation[8,9] of drinking water can be discussed intelligently, recent data regarding fluoride levels in commonly eaten foods needs to be available. The purpose of this study was to determine fluoride levels in foods found in the local community. This allows reasonable estimates to be made of total daily fluoride intake.

Determinations of fluoride content were made on over 180 different foods prepared in either the Manchester College cafeteria, local homes, local restaurants, or purchased from local stores. Also, the fluoride level in the local water supply was monitored daily for three weeks.

Experimental

A 5 to 25 gram sample of food was collected and sealed into a plastic bag and refrigerated for analysis as soon thereafter as possible. The solid or semi-solid samples were mixed in a blender to produce homogeneous samples. A portion was weighed to the nearest 0.01 gram and set to dry at 100°C for 24 hours and then reweighed for calculation of percentage water content. A 1.00 gram sample was weighed into a platinum crucible[1] two milliliters of 20 M NaOH added, the contents mixed and the sample left to dry for 2 hours at 150°C. At the end of this drying time, the sample was transferred to a cold muffle furnace; controls were set for the temperature to hold at 560°C, and the sample fused for 3 hours. After fusion and cooling, 5 ml of H_2O was added to dissolve the melt. It was sometimes necessary to break up the melt with a stainless steel spatula and use boiling water for dissolution. The solution was transferred to a styrofoam cup and the pH adjusted to approximately 6, using 8 M acetic acid. This was done dropwise to slow the evolution of CO_2 from the carbonates that had formed. The solution was filtered through medium porosity filter paper into a 25 ml volumetric flask containing 1.5 grams of TISAB [2]powder. After dilution, this solution was put into a plastic container for storage. Liquids such as coffee or wine were treated as received with TISAB and stored in plastic containers. Fluoride levels were determined using an Orion Specific Ion Fluoride Electrode[3].

Since no standard foods with known fluoride levels were available, multiple samples were run on a number of foods. In all cases, duplicates agreed within ± 5% at the .5 ppm[4] level, and a recovery of 90% of fluoride added to vegetable samples was found. Considering that some samples of the same food taken from different containers varied by a factor of two, the observed precision was quite acceptable.

Discussion and Results

The recent USDA listing (7) of recommended daily allowances (RDA) for fluoride indicates that from 1.5 to 4.0 mg of fluoride is the RDA. Previous studies (3,4,5) have found fluoride ingestion ranging from .18 to 5.4 mg. Questions have been raised concerning possible increases in fluoride levels in foods due to processing foods using fluoridated water or simply due to increased fluoride release from phosphate fertilizers(6). One previous study concluded saying ". . . the fluoride

content of the different food items which constitute the diets for infants from birth to 6 months is sufficient and that additional fluoride supplements would not be required(10)."

In this study, we calculated the daily intake of fluoride in North Manchester would typically be in the range of 1.5 mg depending upon the foods eaten (Table 1). The local water contains about .55 ppm of fluoride and a proposed addition of 0.45ppm fluoride would add about .5 mg to the daily intake of many local people.

TABLE 1. *Six representative meals and their fluoride content Amounts of foods correspond to listings in standard nutritional tables (2)*

Meal	Contents	Total mg fluoride
1	Orange juice, wheaties with whole milk, 2 slices white bread, 2 cups coffee	.44
2	2 eggs, 2 slices whole wheat bread, grape jelly, grapefruit juice, 1 glass 2% milk	.13
3	Swiss cheese sandwich, vegetable soup, 2% milk, water	.28
4	Hamburger with tomatoes and a bun, pepsi, french fries, water	.35
5	Fruit cocktail, beef barbecue, green beans, white bread, wine-catawba red, coffee, water	.41
6	Cottage cheese, apple sauce, pork chop, lima beans, white bread, mashed potatoes, tea-constant comment, water	.74

Floride levels in meat baby foods were high and a single jar of Gerbers' chicken baby food[5] would supply about .34 mg of fluoride. It is quite possible that the concern of Wiatrowski et al. as indicated above might be justified. However, levels in baby orange and apple juices were found to be below our detection limits of .01 ppm.

Only two of the wines tested, Lancers and Almaden Chenin Blanc, showed levels below .01 ppm. As indicated in table 2, the average fluoride content was moderately high. Two major wine producers were contacted and both[6] claim no addition of fluoride to their wines. The addition of sodium fluoride to retard enzymatic action was practiced in the past (9) but is not currently done. Of interest is that both grape juice and grape jelly showed fluoride levels of .6 and .21 ppm,

TABLE 2. *Food Categories and Fluoride Levels - Units are mg of Fluoride per 1000 grams of food as eaten (ppm)*[7]

CATEGORY	NUMBER OF SAMPLES	RANGE	AVERAGE ppm F
Vegetables	22	nil*-1.96	.25
Soups	17	nil-3.01	.26
Meats	13	nil-1.68	.40
Baby Foods	15	nil-2.73	.89
Wine	15	nil-2.80	.94
Yogurt	7	nil-.06	.01
Cereals (toasted)	5	.34-1.25	.84

* nil means below the detection limits of 0.01 ppm.

respectively. Perhaps there is a significant concentration of fluoride in grapes and this shows up in the wine. This certainly would be an interesting area to research further particularly since sampling is such a delightful task.

Vegetables showed relatively low fluoride levels with only brocolli showing significant levels (1.96 and .5 ppm). The canning liquid from two samples each of canned corn and green beans showed fluoride levels similar to those found in the local water supply although the corn and the beans in these cans had levels 5-10 times lower than the liquids. It is quite probable that the canning liquid reflected the fluoride levels in the water used in the canning process.

While coffee was found to provide no fluoride in addition to that in the water used for brewing, the same can not be said for tea. All solid tea samples showed high levels of fluoride. These would provide a range of fluoride levels in the tea as drunk since varying amounts of instant tea or variable brewing times can be used. But generally, tea was high in fluoride. One glass of instant tea could provide as much fluoride as one liter of water containing one ppm fluoride.

Summary

Significant amounts of fluoride can be obtained from foods eaten locally. However, no evidence was found that current fluoride levels are significantly different from those found as far back as 1966(6). Foods eaten in other communities within this region of the country would probably show fluoride levels similar to those in North Manchester. However, communities with fluoridated water might add up to a milligram of fluoride to the total daily intake making this intake around 2.5 mg of fluoride.

Notes

1. The procedure was a modification of that found in (1).
2. Total Ionic Strength Adjustment Buffer purchased from Fisher Scientific Co.
3. The electrode output was read on a Sargent Welch model LSX expanded scale pH meter.
4. Levels of fluoride reported in this paper will all be ppm (mg/l) of fluoride ion or total milligrams of fluoride ion. The fluoride levels of all foods will be reported as ppm of fluoride ion in the food as eaten or total mg of fluoride in the sample of the food.
5. A level of 2.73 ppm was found. For the 128 g contents of the jar, this would provide 0.34 mg of fluoride.
6. Great Western and Taylor, both in Hammondsport, New York, were contacted. Both of these companies produce wine in New York and California.
7. A complete listing of all foods and their fluoride content is available as a computer output from the first author. Data also may be obtained on a disk compatible with an Apple II computer.

Literature Cited

1. BAKER, R. L. 1972. Determination of Fluoride in Vegetation using the Specific Ion Electrode. Anal. Chem. 44:1326-1327.
2. CHURCH, C. F. and H. N. CHURCH. 1975. Food Values of Portions Commonly Used. J.B. Lippincott, Phil. 12th Edition.
3. FARKAS, C. S. 1975. Total Fluoride Intake and Fluoride Content of Common Foods: A review. Fluoride. 8:98-105.
4. JERARD, E. and P. PATRICK. 1973. Summing of Fluoride Exposures. Inter. J. Envir. Studies. 4:141-155.

5. KRAMER, L. et al. 1974. Dietary Fluoride in Different Areas in the U.S. Am. J. of Clin. Nutr. 27:590-594.
6. MARIER, J. R. and D. ROSE. 1966. The Fluoride Content of Some Foods and Beverages. J. of Food Science. 31:941-946.
7. National Academy of Science. 1980. Recommended Daily Allowences. U.S. Govt. Printing Office, Wash. D.C. Table II.
8. ROGOT, E. et. al. 1978. Trends in Urban Mortality in Relation to Fluoridation Status. Am.J. of Epidemiology. 107:104-112.
9. WALDBOTT, G. L. 1978. Fluoridation: the Great Dilemma. Coronado Press, Lawrence KS.
10. WIATROWSKI, E. et al. 1975. Dietary Fluoride Intake of Infants. Pediatrics. 55:517-522.