Development of a National Fluoride Database

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USDA
Agricultural Research Service

Abstract

The Nutrient Data Laboratory (NDL) initiated development of a National Fluoride Database. This database is critical to a collaborative effort with the Nutrition Coordinating Center (NCC) at the University of Minnesota in support of work for the national Institute of Dental and Craniofacial Research, and the National Heart, Lung, and Blood Institute. The purpose is to estimate fluoride concentration, and evaluate fluoride variability, in drinking water, beverages and foods contributing to dietary fluoride. Objectives and statistically based sampling approaches [Table 1] were modeled after the National Food and Nutrient Analysis Program (NFNAP). Representative national sampling locations [Figure 1] have been determined which are consistent with current statistical sampling theory. The primary objective is to obtain an unbiased estimate of the mean fluoride content of water, beverages and foods consumed in the US, allowing a 10% error bound with 90% confidence. A secondary objective is to obtain useful estimates of sample to sample variability in fluoride content. Fluoride methodology [Table 5] has been validated and the data quality assurance measures [Table 6] have been established including the use of Certified Reference Materials and in-house control materials. Initial analyses have been determined by the College of Dentistry University of Iowa, working in cooperation with NDL, and by several collaborating labs. Precision and accuracy of these analyses have been reviewed. Data quality reviews will continue regularly as data are generated. Sample collection has been initiated [Table 2, Table 3 and Figure 2] with high priority and medium priority beverages and foods sampled through NFNAP. Non-fluoridated water sources, including bottled water and well water, will be included as samples. This comprehensive database will be released electronically at NDL's Web site at and will be adapted to support fluoride assessment methodology developed by NCC.

Table 1
Sampling Frame Development

- 2000 Census data
- 72 counties using Census regions and states
- 2 locations in each county
- 144 total locations across the U.S.

Figure 1
Sampled Counties Using Census State Frame

Table 2
Selection of Beverages and Foods

- NDL, ARS, USDA Key Foods method
- Based on published fluoride values and
- Continuing Survey on the Food Intakes of Individuals' (1994-6) reported intakes of foods and beverages
- Around 100 foods and beverages sampled
- The 13 beverages contributing 80% of dietary fluoride intake were considered high priority [Table 3]. Contribution from tap water includes only water from recipes and formulations.
- Around 60 archived samples of lower-level fluoride foods/beverages
- Around 2000 samples analyzed

Table 3

High Priority Beverage Samples for Fluoride Analysis.	
Sample Category	Sample Information
Waters	Tap (municipal)
Teas	Brewed at home
	Ready-to-drink
Carbonated beverages	Cola, Diet
	Non-cola, Diet
	Other
Beer/ales	Regular
	Light
Ready-to-drink Juices	Apple
	Grape
	Orange
Ready-to-drink Drinks	Fruit Drink (10% Juice)

Medium priority samples include Enriched White bread, Enriched Hamburger Rolls, Mozzarella Cheese, Frozen Dessert Novelties, and Whole Milk.

Table 4
Sample Receipt

Food and Laboratory Control Center (FALCC), Virginia Polytechnic Institute (VPI) and State University (SU)

- Verification of sample integrity and correct product
- Modifications of composites and workplans if necessary
- Log descriptive information into Sample Tracking and Composite Information Database (STACI)
- Assign sample number
- Implement protocols for representative sampling, homogenization and sample shipment

Table 5
Fluoride Analytical Methodology

- Direct analysis for clear beverages
  - Using an Ion Specific Electrode
  - Van Winkle et al., (1995) Water and formula fluoride concentrations: significance for infants fed formula. Pediatric Dentistry, **17**, 305
- Microdiffusion for solid samples & complex beverages
  - Taves, D. R., (1968) Separation of fluoride by rapid diffusion using hexamethyldisiloxane. Talanta **15**, 969-974

Analyses are being done by College of Dentistry, U of Iowa.

Table 6
Fluoride Quality Control

- Reference materials for direct analysis
  - NIST Freeze-dried Urine
    - Two different levels of fluoride – Values certified
  - Aqueous control produced by USDA
    - Concentration confirmed by four independent labs
- Reference material for microdiffusion
  - Freeze-dried Prawn from China
    - Concentration certified
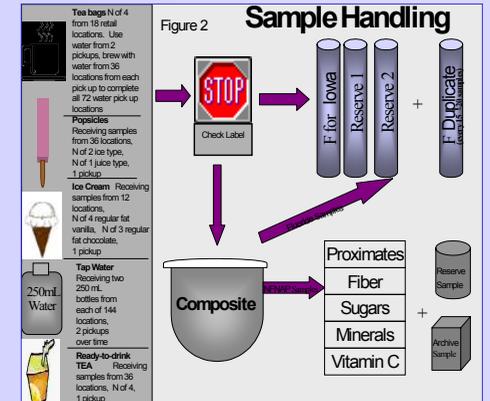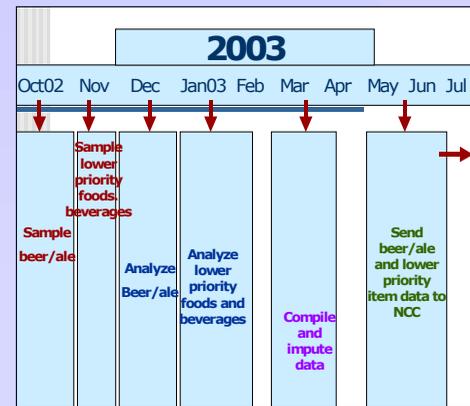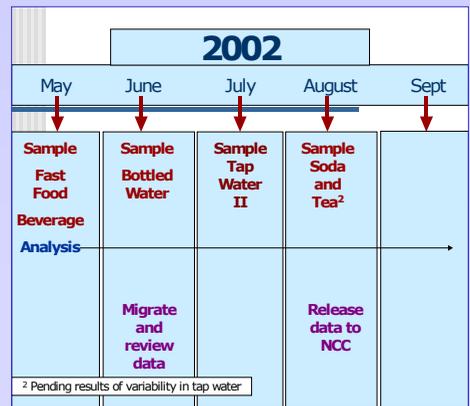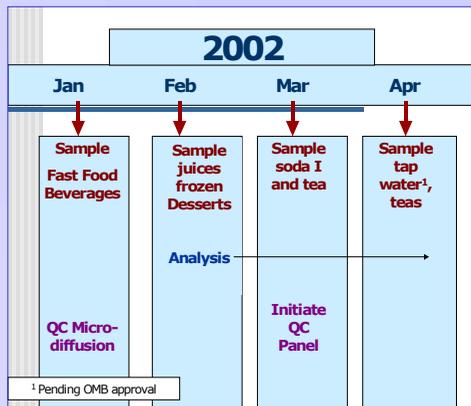
Figure 2
Sample Handling

Figure 3
Fluoride Project

Statistical Consultants

Nutrient Data Lab

Dissemination
- NCC Software Development
- USDA Web site

Superior Pickup

FALCC/FCL
(Sample prep and QC)

Primary Labs Minerals

U. of Iowa Fluoride

Sampling information
- Foods
- Sample Flow
- Data Flow

2002

Jan	Feb	Mar	Apr
Sample Fast Food Beverages	Sample juices frozen Desserts	Sample soda I and tea	Sample tap water[1], teas
	Analysis		
QC Micro-diffusion		Initiate QC Panel	

[1] Pending OMB approval

2002

May	June	July	August	Sept
Sample Fast Food Beverage Analysis	Sample Bottled Water	Sample Tap Water II	Sample Soda and Tea[2]	
	Migrate and review data		Release data to NCC	

[2] Pending results of variability in tap water

2003

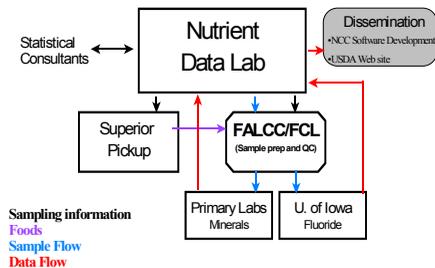| Oct02	Nov	Dec	Jan03	Feb	Mar	Apr	May	Jun	Jul
	Sample lower priority foods, beverages								
Sample beer/ale		Analyze Beer/ale	Analyze lower priority foods and beverages			Compile and impute data	Send beer/ale and lower priority item data to NCC		

Summary

- Data will be adapted to support fluoride assessment methodology developed by the Nutrition Coordinating Center.
- A new comprehensive database of the fluoride concentration and estimates of variability in beverages and foods consumed in the U.S. will be released on the Nutrient Data Laboratory Web site, www.nal.usda.gov/fnic/foodcomp, in 2003 – 2004.
- Data will be released according to the Nutrient Data Bank number for each food; the mean value (mg/100g), SEM and minimum and maximum values will be included.