



AVOIDING PERCHLORATE EXPOSURES FROM FRESH FRUITS AND VEGETABLES: AT WHAT COSTS?

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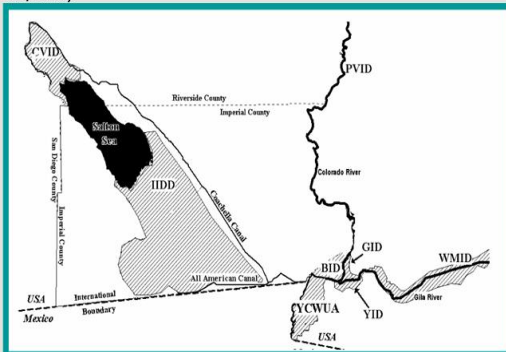
ABSTRACT

Perchlorate residues have been detected in fruits and vegetables grown in the Colorado River Basin (CRB) and in water and milk samples collected from multiple regions the US, raising concerns about the safety of the food supply. At high doses, perchlorate interferes with iodide uptake by the thyroid gland and disrupts its physiological functions. Excessive exposures of expectant mothers may affect the fetus and newborn and result in effects such as delayed development and decreased learning capability. Since the thyroid plays a major role in proper development in addition to metabolism in children, their exposure to perchlorate is also of potential concern. While avoidance of foods likely to be contaminated with perchlorate could result in decreased perchlorate exposures, these foods are major sources of calcium, vitamins A and D, antioxidants and water-soluble vitamins. We use food consumption data from surveys conducted by USDA and CDC to compare the nutrient profile of consumers of foods that may be contaminated with perchlorate to that of non-consumers of these foods. We assess the nutritional benefits associated with consuming these foods and risk associated with avoiding them, and compare these risks to the risks of exposure to perchlorate.

DATA SOURCES

>Samples of milk and 23 agricultural commodities were collected between 2003 and 2006. All samples were taken from the Lower Colorado River area. This includes the Imperial and Coachella Valleys in southern California, the irrigated Colorado River flood plain near Bard CA, and Yuma AZ, and a segment of the Gila flood plain irrigated with Colorado River water (Figure 1).

Figure 1. Lower Colorado River region including Coachella and Imperial Valley of California, Lower Colorado River Valley of California and Arizona, and Gila River Valleys of Arizona (Sanchez et al., 2005)



- >Food consumption data from USDA's 1994-98 Continuing Survey of Food Intakes by Individuals (CSFII) were used. The survey includes more than 20,000 participants with 2-day dietary recall information.
- >Data compiled in USDA's Nutrient Database were used to estimate the nutrient content of foods.
- >Agricultural production statistics were used to estimate the fraction of the food supply grown in the CRB.

METHODS

- >As previously reported (Sanchez et al., 2006) freeze-dried samples were analyzed by ion chromatography with conductivity detection (IC-CD) or ion chromatography tandem mass spectrometry (IC/MS/MS).
- >DEEM™ a dietary exposure assessment model was used to estimate distributions of 2-day average perchlorate intakes for the US population.
- >The Food Analysis and Residue Evaluation program (FARE™) was used to estimate nutrient intakes.

RESULTS

Detected perchlorate concentrations

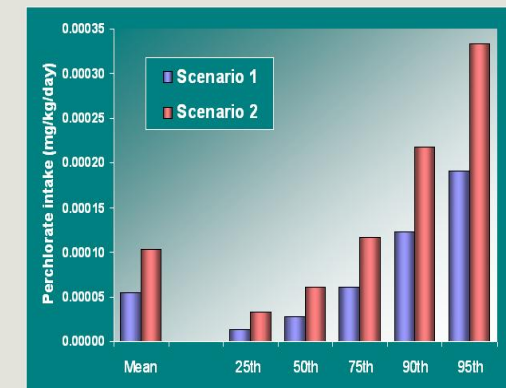
Table 1 lists the crops included in the assessment, the detected concentrations, and the fraction of the total US crop grown in the CRB region. Non-detects were assigned a value of LOD/2.

Table 1. Summary of the perchlorate concentrations (µg/L for milk and µg/kg fw for the remaining commodities.)

Crop	n	Range	Mean	% of total US crop
Broccoli	55	(3.5 - 106.9)	23.8	18.0%
Cabbage	19	(4.6 - 63.2)	18.5	4.6%
Carrots	30	(10.4 - 53.9)	28.8	28.0%
Cauliflower	38	(0.2 - 40.7)	12.5	25.6%
Celery	9	(7.1 - 41.6)	17.8	4.3%
Dates	29	(68.6 - 274)	138.4	100.0%
Durum wheat	48	(6.3 - 160)	16.7	7.5%
Eggplants	3	(8.6 - 18.1)	12.3	13.8%
Grapefruits	15	(0.6 - 16.2)	3.3	3.1%
Grapes	15	(21.1 - 87.3)	30.8	7.4%
Green Beans	4	(18.8 - 92.7)	44.9	1.3%
Lemons	33	(0.6 - 14.8)	2.3	32.1%
Lettuce, head	144	(5 - 47)	13.1	32.9%
Lettuce, leaf	104	(5 - 24.5)	38.3	45.8%
Melons	51	(6.4 - 34.4)	14.3	15.2%
Milk	40	(0.9 - 24.9)	6.6	NA
Onions	21	(6 - 28)	12.4	5.4%
Oranges	21	(0.2 - 19.2)	5.5	0.5%
Pepper	26	(3.8 - 72.6)	18	10.6%
Spinach	16	(14.2 - 608.5)	211.3	15.2%
Squash	14	(7.9 - 23.9)	16.1	0.3%
Sweet com	18	(13.4 - 39.3)	24.2	5.4%
Tomatoes	13	(6.2 - 24.7)	11.2	0.03%
Watermelons	21	(1.1 - 71.4)	12	4.7%

Estimated dietary perchlorate exposure

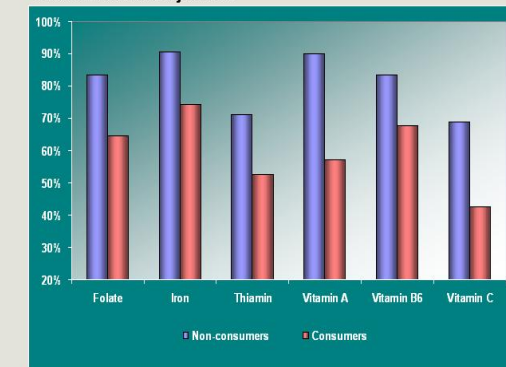
- >Scenario 1 (realistic): Crops grown in CRB region are distributed nationally and people living in CRB get their fruits and vegetables from CRB region as well as other areas in US (Figure 2)
- >Scenario 2 (unlikely, upper bound): Crops grown in CRB region remain in the CRB and people living in CRB get their fruits and vegetables from CRB region only (Figure 2)



Estimated nutrient intakes

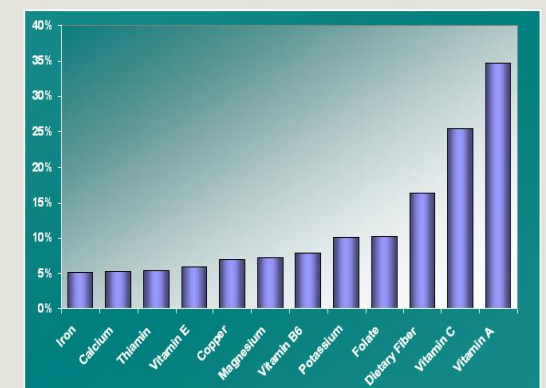
- >People who avoid potentially contaminated crops increase their likelihood of not meeting Recommended Daily Values (Figure 3)

Figure 3. Percent of adults (18+ years) not meeting the Recommended Daily Values



Estimated nutrient intakes (Cont'd)

- >Consumers of foods with potential perchlorate contamination get a significant amount of their nutrients from these foods (Figure 4)
- 35% of their Vitamin A
- 16% of their dietary fiber
- 25% of their Vitamin C
- 10% of their folate and



DISCUSSION AND CONCLUSIONS

- >The mean and 95th percentile of the distribution of estimated perchlorate intakes are 0.000054 mg/kg/day and 0.000191 mg/kg/day respectively, well below the RfD of 0.0007/mg/kg/day set by the NAS (NAS, 2005).
- >Even when we make the unrealistic assumption that only crops from contaminated areas are consumed (Scenario 2), estimated perchlorate intakes are still below the NAS RfD.
- >Consumers of crops that may contain perchlorate residues get a significant fraction of their nutrients from these foods.
- >Excluding fruits and vegetables from the diet to "avoid" perchlorate exposures could result in nutrient deficiencies

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