Food Choices and Nutrient Densities: What are the Realities of Food Types?

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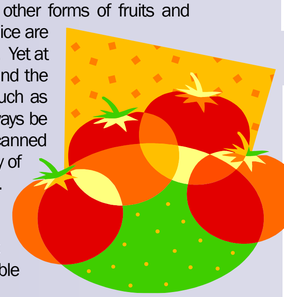
Promotion of fruit and vegetable consumption to the public usually focus on fresh produce and lay articles often promote "organic" or "raw" fruits and vegetables as the healthy choices. Underlying assumptions are that fresh and organic types provide more nutrients than frozen or canned forms. Little data support these claims but consumers may opt not to use other forms. This study examined current national nutrient databases to determine the amount and percent change in nutrient content from raw to frozen state, from fresh cooked, frozen cooked, and canned forms of 25 selected fruits and vegetables in 100 gram portions. Both gains and losses occur in individual nutrients in comparing one food form to another. More gains (20 nutrients) than losses (8 nutrients) occur with 100 g. of canned tomatoes compared to fresh cooked tomatoes. Gains include 200% in calcium and 104% in iron over fresh cooked form compared to losses for folate (41%), Vitamin A (84%), B_{12} (47%). These findings suggest that it is important to value all forms of fruits and vegetables for their nutrient contributions. Food availability, food accessibility, and food costs may limit individual ability to purchase certain types of foods. Health promotion campaigns need to incorporate all forms of fruits and vegetables in order to increase overall consumption of fruits and vegetables. Supported by USDA, ARS Project #6251-53000-004-00D.

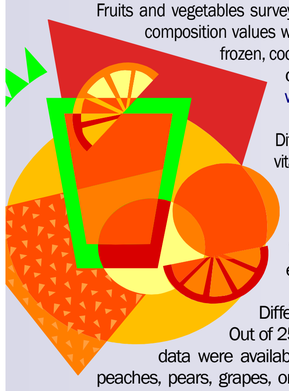
BACKGROUND

Promotion of fruit and vegetable consumption to the public such as the Five-A-Day program usually focuses on fresh produce. Consumers may have reasons for preferring "locally grown" or "organically grown" produce. Lay articles often promote "organic" or "raw" fruits and vegetables as the "healthy choices." While little data support these claims, consumers who do not have these foods readily available or who cannot afford these foods may opt to use little or no other forms of fruits and vegetables. Certain food items such as ready-to-drink refrigerated orange juice are promoted as superior to orange juice reconstituted from frozen concentrate. Yet at least one study that analyzed these two forms of orange juice actually found the frozen concentrate form to yield higher nutrients. As food constituents such as phytochemicals are analyzed, the fresh or freshly cooked form may not always be the best source. For example, the concentration of lycopene is highest in canned tomato sauce rather than in fresh raw or fresh cooked tomatoes. Availability of certain forms of fruits and vegetables in rural grocery stores is limited. Choices of fresh fruits and vegetables tend to be limited and of poorer quality in small/medium stores most commonly found in rural communities. Frozen food choices are also more limited and at greater risk of temperature abuse. Canned choices are more available and shelf stable but may not be promoted or regarded as desirable.



METHODS

A Food Store Survey (FSS) in the Lower Mississippi Delta (LMD) region examined the availability, quality, and price of fruits and vegetables through an actual in-store survey of 225 stores in Arkansas, Louisiana, and Mississippi.



Fruits and vegetables surveyed in the Lower Mississippi Delta Food Store Survey were reviewed if nutrient composition values were available for at least three forms of a given food: fresh, raw; fresh, cooked; frozen, cooked; and canned. Dried forms were also examined for fruits. Nutrient data were drawn from the USDA Standard Reference # 16. Available online at http://www.ars.usda.gov

Differences in nutrient content were calculated for 30 nutrients: 3 macronutrients, nine vitamins, and ten minerals/elements. Some vitamins were examined by more than one unit, e.g. Vitamin A (IU and RAE), Folate (mcg and DFE). Carbohydrates (total grams, total dietary fiber, sugars). Fatty acid differences were not examined due to low concentrations of fat in most fruits and vegetables. Minerals and trace elements were in mg except for Se (mcg). Ash and water content were examined due to changes from cooking and processing.

Differences were summarized by absolute change in units and in percent change. Out of 25 fruits and vegetables included in the Delta NIRI Food Store Survey, nutrient data were available for least three forms in 10 foods. Fruits examined included: apples, peaches, pears, grapes, orange juice. Vegetables included: potatoes, sweet potatoes, tomatoes (by menu categorization), snap beans, green peas, spinach, turnip greens, okra, and summer squash. Nutrient data were not available for canned forms of collard greens, broccoli, or strawberries.

Table 1. Actual values and per cent retained of selected nutrients in four forms of orange juice, each in 100 gram portion.

Fruit Juice (100g)	Orange Juice							
	Fresh	Frozen reconstituted	Percent Retained	Chilled	Percent Retained	Canned	Percent Retained	Average Percent Retained
Kcal	45	45	100%	44	98%	42	93%	97%
Calcium (mg)	11	9	82%	10	91%	8	73%	82%
Vitamin C (mg)	50	38.9	78%	32.9	66%	34.3	69%	71%
Thiamin (mg)	0.09	0.079	88%	0.11	122%	0.06	67%	92%
Riboflavin (mg)	0.03	0.018	60%	0.021	70%	0.028	93%	74%
Niacin (mg)	0.4	0.2	50%	0.28	70%	0.314	79%	66%
DFE (folate)	30	44	150%	18	60%	18	45%	85%
Vitamin A (RAE)	10	5	50%	4	40%	9	90%	60%
Vitamin E/A-toc (mg)	0.04	0.2	500%	Missing value	Missing value	0.2	500%	500%

Table 2. Actual values and per cent retained of selected nutrients of three forms of tomatoes, in each 100 gram portion.

Vegetable-Fruit (100g)	Tomatoes					
	Fresh	Fresh, Cooked	Percent Retained	Canned/NS	Percent Retained	Average Percent Retained
Kcal	18	18	100%	19	106%	103%
Calcium (mg)	10	11	110%	30	300%	205%
K+ (mg)	237	218	92%	227	96%	94%
Na+ (mg)	5	11	220%	10	200%	210%
Vit C (mg)	12.7	22.8	180%	14.2	112%	146%
Thiamin (mg)	0.037	0.036	97%	0.045	122%	110%
Folate (DFE)	15	13	87%	8	53%	70%
Vitamin A (RAE)	42	24	57%	7	17%	37%
Vitamin K (mg)	7.9	2.8	35%	3.2	41%	38%
Vitamin E/A-toc (mg)	0.54	0.56	104%	0.8	148%	126%

Table 3. Change in nutrient composition in 100 grams of pears and peaches; fresh, raw to canned in water forms.

Fruit (100g)	Pears			Peaches		
	Fresh	Canned, water	Percent Retained nutrients	Fresh	Canned, water	Percent Retained nutrients
Kcals	58	29	50%	39	24	62%
Sugars (g)	9.80	6.10	62%	8.39	4.81	57%
Calcium (mg)	9	4	44%	6	2	33%
K+ (mg)	119	53	45%	190	99	52%
Vitamin C (mg)	4.2	1.0	24%	6.6	2.9	44%
Folate (µg)	7	1	14%	4	3	75%
Vitamin A (RAE)	1	0	0%	16	27	169%
Vitamin E/A-Toc (mg)	0.12	0.08	67%	0.73	0.49	67%
Vitamin K (µg)	4.5	0.3	7%	2.6	1.7	65%

Table 4. Comparison of differences in selected nutrients in fresh cooked vs. frozen cooked forms of three varieties of greens.

Greens (100g)	Mustard			Collards			Turnip			Spinach			Average Percentage Retained for all Greens
	Fresh cooked	Frozen, cooked	Percent Retained nutrients	Fresh cooked	Frozen, cooked	Percent Retained Nutrients	Fresh cooked	Frozen, cooked	Percent Retained Nutrients	Fresh cooked	Frozen cooked	Percent Retained Nutrients	
Kcals	15	19	127%	26	36	138%	20	29	145%	23	32	139%	137%
Ca (mg)	74	101	136%	140	210	150%	137	152	111%	136	153	113%	128%
P (mg)	41	24	59%	30	27	90%	29	34	117%	56	50	89%	89%
K (mg)	202	139	69%	116	251	216%	203	224	110%	466	302	65%	115%
Vitamin C (mg)	25.3	13.8	55%	18.2	26.4	145%	27.4	21.8	80%	9.8	2.2	22%	76%
Thiamin (mg)	0.041	0.04	98%	0.04	0.047	118%	0.045	0.054	120%	0.095	0.078	82%	105%
Riboflavin (mg)	0.063	0.053	84%	0.106	0.115	108%	0.072	0.074	103%	0.236	0.176	75%	93%
Niacin (mg)	0.433	0.258	60%	0.575	0.635	110%	0.411	0.468	114%	0.49	0.439	90%	94%
Pantothenic (mg)	0.12	0.016	13%	0.218	0.115	53%	0.274	0.069	25%	0.145	0.075	52%	36%
Folate (µg)	73	70	96%	93	76	82%	118	39	33%	146	121	83%	74%
Vitamin A (RAE)	316	354	112%	406	575	142%	381	538	141%	524	603	115%	128%
Vitamin E (mg)	1.21	1.35	112%	0.88	1.25	142%	1.88	2.66	141%	2.08	3.54	170%	141%
Vitamin K (µg)	299.5	335.1	112%	440	623.2	142%	367.6	518.9	141%	493.6	540.7	110%	126%

CONCLUSIONS

Although flavor and texture may be more enticing in fresh raw or fresh cooked fruits and vegetables, only small differences may exist in changes in nutrients when the form of a food is changed through preparation or processing. Some nutrient values per 100 grams increase in value. If water is added in processing, mineral content may be increased. The largest changes are seen with the addition of salt to canned vegetables or ascorbic acid added to fruits to prevent discoloration in freezing or canning. The best choice for maximum nutrient content will vary with the specific nutrient and with the specific food.

For residents of rural areas with limited access to fresh fruits and vegetables in grocery stores, frozen or canned fruits and vegetables can contribute significant amounts of nutrients to their overall diets.