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MINERAL CONTENT OF CANNED GRAPEFRUIT JUICE[1]

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Abstract. **The mineral elements, Zn, Cu, Fe, P, Ca, Mg, K, and Na which are essential in human nutrition, of more than 200 samples of canned grapefruit juice were determined by atomic absorption spectroscopy, flame emission spectroscopy, or colorimetric analysis. Zn and Cu were found to be less than 1 ppm, and the range for Fe was between 1 and 7 ppm. The average P content was about 110 ppm. Ca and Mg generally varied between 50 to 180 ppm. The range for values of K in these grapefruit juice samples was about 1000 to 2000 ppm with the average around 1500 ppm, while those for Na had a much wider variation. Occasionally samples had abnormally high values of Na, nearly 10 times that of the mean of the majority of the samples.**

Canned grapefruit juice is one of the main grapefruit products of the Florida citrus industry. With increased use of this product by the consumers during the past few years (2), with the current interest in human nutrition and with the recently promulgated Nutrition Labeling regulations (11) by the US FDA (U.F. Food and Drug Administration), there is a need to accumulate more information on its mineral nutrient content. There have been relatively few references on the mineral constituents of grapefruit juice in the literature. Harding (4) compared the mineral compositions of the flesh of grapefruit on various rootstocks at different stages of maturity. Roberts and Gaddum (7) and McCance and Widdowson (5) showed representative values of inorganic constituents of citrus fruits including grapefruit flesh. Dawes (3) reported the mineral values of 17 grapefruit juice samples of New Zealand.

This paper reports the values of several nutritionally important elements in canned Florida grapefruit juice from a survey of over 200 samples. Included in the list of elements analyzed in addition to those of the USFDA nutrition labeling regulations (11) were K and Na.

Material and Methods

Sample Collection and Preparation

Canned grapefruit juice samples [all in 46 oz (1360 ml) cans] used in this study were collected from the supermarket grocery shelves in connection with a quality survey (10). Also included in these samples were canned grapefruit juice collected from several manufacturing plants and stored at ambient temperature. All together 206 samples, all ascertained to be produced in Florida, during the past 2 years (10) were analyzed for the various elements.

Sample preparations for the analysis was similar to that used for frozen concentrated orange juice (9) except that 50 ml of single strength juice was first evaporated to dryness on a water bath before ashing procedure began.

Atomic Absorption (AA) Spectroscopic and Photospectrometric Analysis

The analyses were carried out by the Soil Analytical Laboratory at the University of Florida, Gainesville on a Perkin Elmer Model 503 AA spectrophotometer using the parameters recommended by the instrument manufacturer for the various elements. K and Na were determined on the emission mode, while P was determined by a colorimetric procedure (1). Elements determined on the absorption mode were Fe, Cu, Zn, Ca, and Mg. For Ca, a dilution of 1 to 25 was found to be satisfactory. Lanthanum was added at 0.5% of the diluted sample to prevent interference to Ca determinations by P. For K and Mg, a dilution of 1 to 50 was used.

Appropriate standards for each element were made within the concentration range of the element in the samples. Occasionally in a few samples it was found necessary to further dilute the samples in order to fall within the range of the standards.

Results and Discussion

The mean, range, and standard deviation of the various elements analyzed in these samples are shown in Table 1. K is by far the most abundant inorganic constituent in grapefruit juice. The mean value of 1550 ppm is considerably lower than that reported by McCance and

Table 1. Inorganic constituents of canned Florida grapefruit juice.

Element	Range	Mean	Standard deviation
		Parts per million	
Element	Range	Mean	Standard deviation
Potassium	850-2100	1550	174
Sodium	2-56	6.7	7.8
	(2-9.7)*	(4.2)*	(1.5)*
Calcium	50-182	76.4	17.7
Magnesium	51-129	93.0	9.2
Phosphorus	68-176	110	15.9
Iron	0.7-7.6	2.3	1.7
Copper	0.2-1.2	0.37	0.11
Zinc	0.33-0.92	0.51	0.10

*Sodium values in parentheses were calculated by not considering any values greater than 10 ppm.

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Widdowson (5) for grapefruit flesh. Dawes (3) reported a max K value of 172 mg per 100 ml for New Zealand grapefruit juice, while the max K value of this study is 2100 ppm (210 mg/100 ml). Smith and Rasmussen (8) have shown that increasing rate of potash fertilization increases the K content of 'Marsh' grapefruit juice.

The average Na content in these samples was about 6.7 ppm. The concn range is extremely wide and the frequency distribution is shown in Fig. 1. Ninety per cent of all samples occurred below 10 ppm, and the average of these samples was 4.2 ppm (Table 1). Thirty percent of the samples was found to have between 3 and 4 ppm. High Na content in occasional samples could be caused by improper processing operation. This view is also shared by Nagy (6) who states that abnormally high levels of certain elements (e.g. Na, P, S) in citrus juices may have been due to processing conditions rather than to fruit's normal levels of these elements.

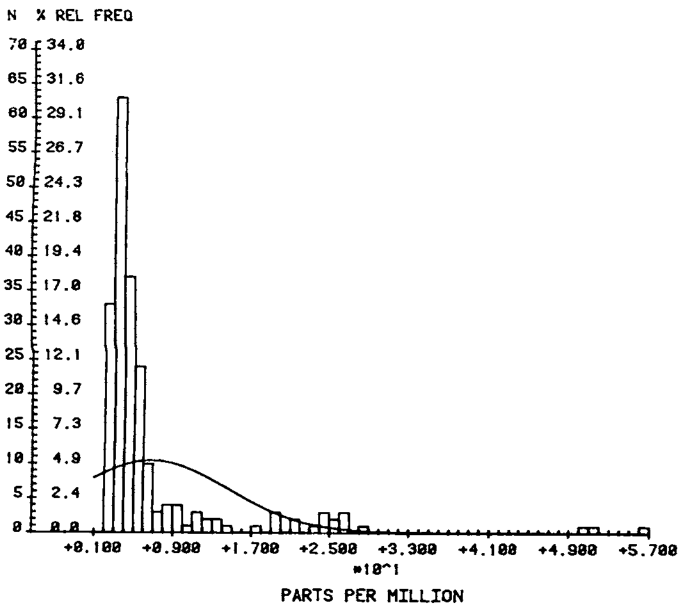

Fig. 1. Frequency and percent distribution of Sodium content found in canned grapefruit juice.

Among those elements that may be used for nutrition labeling, Ca averaged 76 ppm while Mg was found to be slightly higher. Ca had a much greater range than Mg. The individual samples of Ca varied from less than 5 ppm to as much as 18 ppm while the range of Mg of these grapefruit juice samples was only from 5 ppm to slightly over 10 ppm (Table 1). To be able to list an essential inorganic element in the USFDA nutrition label, it must be higher than 2% U.S. RDA in a serving (11) which is 6 fluid oz for citrus juices (9). The Ca content of these grapefruit juices when calculated on 6 fluid oz basis, was less than 1% U.S. RDA; and for Mg, about 3 to 4% U.S. RDA. The U.S. RDA for Ca and Mg are 1000 mg and 400 mg, respectively (11).

Among the other nutritionally essential inorganic elements, P averaged 110 ppm and Fe 2.3 ppm. Cu and Zn only averaged 0.37 ppm and .51 ppm, respectively. Although the P, Fe, and Cu contents in grapefruit juice are not very high, they are sufficient to comply to the min in a serving required for the nutrition labeling. The U.S. Recommended Daily Allowance (RDA) for P is 1000 mg and for Cu, only 2 mg (11). Zn content was less than 2% U.S. RDA per 6 fluid oz serving.

Conclusion

The most abundant inorganic constituent of canned Florida grapefruit juice is K, averaging 155 mg per 100 ml (1550 ppm). The average Na content was .67 mg per 100 ml (6.7 ppm), but 90% of the samples had Na content below 10 ppm. The average of these samples was 4.2 ppm. Some of the high Na samples were considered to be due to improper processing operation. Fe, Mg, Cu, and P occured in sufficient amounts to reach a 2% U.S. RDA in a 6 oz (177.7 ml) serving, the min that may be placed on a nutrition label. Ca and Zn were too low to reach this per cent.

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