Enrichment of Fruit Products and Fruit Juices

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Since fruits are the primary source of ascorbic acid in the diet, the enrichment of these food products has logically been concerned principally with this vitamin. A large variety of fruit drinks and beverages are now available to the consumer as substitutes for fresh citrus juices, and most of these have been nutritionally standardized to provide an adequate source of ascorbic acid. The nutritional and technological aspects of ascorbic acid enrichment of fruit products are reviewed. The additional benefits imparted to fruits due to the antioxidant properties of ascorbic acid are also pointed out. Some fruits are also a source of provitamin A due to their carotenoid content. β-Carotene and β-apo-8′-carotenal have therefore been used to provide both color and vitamin A value to fruit beverages. The development of suitable market forms of carotenoids and the technology of their use as colors and nutrients are discussed.

Prior to any agriculture, man undoubtedly lived on meat, wild fruit and berries, and possibly tubers of plants. Fruits, therefore, were consumed by man before vegetables and cereal grains became available and were his primary source of vitamin A and ascorbic acid. Today, the primary value placed on fruit in the diet is as a source of ascorbic acid. Fruits, however, in addition to supplying vitamin A and a small amount of B vitamins, are unique in that they supply considerable quantities of potassium and very small amounts of sodium. For this reason, they have been of value in low sodium diets for treatment of hypertension and producing favorable acid-base equilibria.

Over the years, many special physiological and therapeutic properties have been attributed to fruit, and special diets have been built around them. Magee (1951) has reviewed the therapeutic values of fruit and fruit juices, and Charley (1952) has discussed the history and folklore of soft drinks and fruit juices.

PATTERN OF CONSUMPTION OF FRUIT PRODUCTS

The pattern of the consumption of fruit products in the United States has shown a gradual change over the years. The consumption of whole fresh fruit has shown a decline which is correlated with the advent of canned fruits and juices, and more recently by the availability of frozen products. These changes in the consumption of fruits and fruit products are shown in Table I. Although not shown in the table, the over-all per capita consumption of all fruits has held fairly constant over the years. Another aspect of fruit consumption, not shown in Table I, is the phenomenal rise in the consumption of fruit drinks of many blends and varieties consumed as thirst quenchers as well as substitutes for fruit juices at breakfast and luncheon. The tremendous growth in the production of these products is shown in Figure 1.

In 1957 and again in 1959, the American Can Co. conducted a market survey of the pattern of summer servings of fruit and vegetable juices and drinks in the United States. This survey noted the growth in fruit drinks just in this two-year period. The over-all use of juices and juice drinks in both surveys was found to be the highest in homes where children were present, particularly teenagers (Table II). The use profile of various types of fruit juices and drinks is shown in Table III. Fruit drinks are used primarily as thirst satisfiers but their use at breakfast, luncheon, and dinner is also considerable.

The relative consumption of the various varieties of fruit juices and drinks depends on the type of pack. In the case of the frozen juice concentrates, orange juice claims about 75% of the market with the remaining percentage consisting primarily of grapefruit, orange-grapefruit, and pineapple. The consumption of single-strength fruit juices is more diverse (Table IV) with the pattern changing considerably in the case of the ready-to-serve fruit drinks (Table V). The principal purpose of these tables is to emphasize the variety of fruit juices and drinks consumed by the American public and thus to provide a basis for the rationale of enrichment of fruit products.

Table I. Per Capita Consumption of Fruit Products, Pounds[a]

Year	Fresh Fruits	Canned Fruits	Canned Fruit Juices	Frozen Fruits	Frozen Juices
1910	134.7	3.6	0.47	...	...
1915	154.5	5.6	0.61	...	...
1920	142.6	9.4	0.59	...	...
1925	132.2	11.1	0.16	...	...
1930	129.9	12.8	0.33	...	...
1935	133.2	13.4	1.99	...	...
1940	139.1	19.1	7.23	1.28	...
1945	139.9	14.4	10.94	2.31	...
1950	108.6	22.0	13.38	2.76	5.12
1955	98.9	22.6	12.88	3.78	15.81
1960	94.5	22.6	12.93	3.50	17.48
1965	82.9	23.6	11.06	3.70	15.49

[a] U.S. Department of Agriculture (1966).

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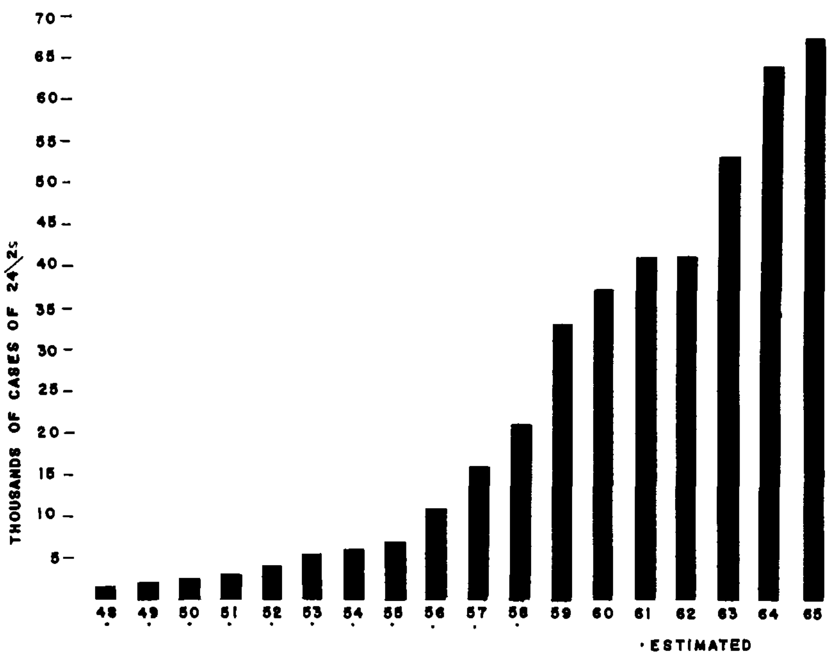

Figure 1. U.S. packs of juice drinks and concentrates

Data from *Canner/Packer* (1966)

Table II. Weekly Servings per 100 Families of Fruit Juices and Drinks[a]

	Drinks		Juices	
	1957	1959	1957	1959
Families with				
School children	465	635	934	935
Pre-school only	384	607	885	893
No children	252	320	866	855

[a] American Can Co. (1959).

Table III. Use Profile of Fruit Juices and Drinks, Per Cent[a]

	Breakfast	Luncheon-Dinner	Thirst Satisfier
Fruit juices			
Home prepared	69.4	7.2	23.4
Chilled in cartons	58.3	9.2	32.5
Concentrated	57.4	10.3	32.3
Single strength	53.7	14.8	31.5
Vegetable juices	48.7	29.7	21.6
Fruit drinks			
Ready-to-serve	25.4	20.1	54.5
Concentrated	9.7	27.6	62.7

[a] American Can Co. (1959).

Table IV. Per Cent of Total Single-Strength Fruit Juice Servings in 1959[a]

Juice	Per Cent
Orange	19.1
Pineapple	18.5
Grapefruit	15.6
Prune	12.1
Orange-grapefruit	11.9
Apple	11.8
Fruit nectars	5.4
All others	5.6

[a] American Can Co. (1959).

Table V. Per Cent of Ready-to-Serve Fruit Drink Servings in 1959[a]

Drink	Per Cent
Grape	28.4
Pineapple-grapefruit	20.4
Orange	17.5
Tropical fruit punch	16.2
Pineapple-orange	5.4
Orange-apricot	3.7
Other pineapple combinations	1.8
Lemon-lime	1.8
Grape-apple	1.8
Orange-apple	1.6
Orange-lemon	1.4

[a] American Can Co. (1959).

ENRICHMENT OF FRUIT PRODUCTS

Fruit juices and drinks are the primary fruit products which are enriched today. Frozen fruits are often enriched with ascorbic acid, but usually the primary purpose is to prevent undesirable browning reactions and off-flavor development. Fresh fruits for obvious reasons are not suitable vehicles for enrichment. By far the most common nutrient for fruit product enrichment is vitamin C, and to a lesser extent, vitamin A, usually in the form of β-carotene, which also supplies color. A few juices such as grape juice and drinks, frozen fruit drink concentrates, and fruit beverage powders are enriched with B vitamins.

Fruit products, however, cannot be enriched indiscriminately because some fruit products are controlled by the Standards of Identity (U.S. Department of Health, Education and Welfare, 1964). Examples of fruit juices which cannot now be enriched are shown in Table VI. Considerable promotional effort was expended in the late 1950's to amend the Standard of Identity for tomato juice to allow enrichment with ascorbic acid, but the effort was not successful. In 1964, the Food and Drug Administration proposed Definitions and Standards of Identity for fruit-flavored noncarbonated beverages, but to date these regulations have not been finalized. In 1966, the Standards of Identity for prune juice were amended to allow the addition of ascorbic acid at a level of not less than 30 mg. or more than 50 mg. per 6 fluid ounces as an optional ingredient.

The basic philosophy behind fruit enrichment is to standardize vitamin levels so that the various types of fruit juices, drinks, etc., are nutritionally interchangeable. This principle as well as other principles which guide the supplementation of foods with vitamins was reviewed by Harris (1959).

ASCORBIC ACID

Fruit Juices and Drinks. The commercial enrichment of fruit products has been practiced for about 25 years, and a voluminous literature has accumulated concerning the ascorbic acid content of fruit products and enrichment practices. Therefore, this article does not attempt a complete review of the literature concerning this subject. Bauernfeind (1953) covers the use of ascorbic acid in food processing up to 1953, and there have been many journal articles published since that time concerning various aspects of ascorbic acid in fruits.

The ascorbic acid enrichment of fruit juices and drinks has a sound nutritional basis and therefore has become accepted as common practice. Most juices and drinks, unless Standards of Identity do not permit, are enriched to provide 30 mg. of ascorbic acid per 4- or 6-ounce serving, the minimum daily requirement for adults in one serving.

Modern processing and canning techniques of both single-strength and frozen concentrate fruit juices is effective in preserving the natural ascorbic acid content; for juices which have an adequate ascorbic acid content, enrichment is usually not necessary. There can be a considerable varietal and seasonal variation, however, even in fruits which are considered good sources of ascorbic acid, so it is not always possible to guarantee that a standard serving will provide the MDR for ascorbic acid. Since the average consumer tends to use fruit juices interchangeably to provide variety in the diet, ascorbic acid intake would be extremely variable. The average amount of ascorbic acid contained in a 4-ounce serving of various fruit juices is shown in Table VII, which illustrates this point. Of the fruit juices listed, only grapefruit, tangerine, and orange juice could potentially supply 30 mg. of ascorbic acid in a 4-ounce serving.

All of these data clearly indicate the sound nutritional basis for standardizing the ascorbic acid content of fruit juices and drinks, so that regardless of consumer preference, an adequate intake of ascorbic acid is provided. This practice has been carried on commercially for some time, and the literature is replete with reports concerning the technology of ascorbic acid enrichment of fruit juices and blends and the stability of both natural and added ascorbic acid in various fruit products (Bauernfeind, 1953; Brody and Bedrosian, 1961; Curl and Talburt, 1954; Feaster *et al.*, 1950; Fitting and Miller, 1960; Huggart *et al.*, 1954; Lamb, 1946; Lamden *et al.*, 1960; Pelletier and Morrison, 1965; Robinson *et al.*, 1945; Ross, 1944; Strachan, 1942). On the basis of experience, it is usually anticipated that juices to which 40 to 50 mg. of ascorbic acid are added per 4 fluid ounces will contain 30 to 40 mg. after processing and market storage.

In general, ascorbic acid is most stable in low pH frozen concentrates and juices such as orange, grapefruit, and orange-grapefruit blends. Other fruit beverages can be variable, so that experience in manufacture with a particular juice or drink dictates the overages which are necessary to meet label claim after processing and storage. Proper processing, minimum inclusion of air, and lowest

Table VI. Juices Which May Not Be Enriched under Present FDA Standards of Identity (21 CFR)

Sections	Product
27.105–27.115	Orange juice
27.54 –27.57	Pineapple juice
27.101–27.102	Frozen concentrate for lemonade
53.1–53.5	Tomato juice

Table VII. Ascorbic Acid Supplied by 4 Ounces of Various Canned Fruit Juices[a]

Fruit	Ascorbic Acid, Mg.
Apple	1.5
Apricot nectar	1.5
Pineapple	10
Tomato	20
Tangerine	32
Grapefruit	34
Orange and grapefruit	48
Orange	53

[a] Burton (1965).

possible iron and copper content all contribute to good retention of ascorbic acid as well as flavor. This can be achieved in practice by the use of stainless steel or glass-lined equipment and mixing which does not incorporate air during processing. Deaeration of the juice before pasteurizing is recommended. The enrichment of fruit juices and drinks does not affect the appearance, taste, or odor of the product. Ascorbic acid, however, does retard the development of oxidized flavor resulting from the introduction of air during processing. Although ascorbic acid improves nutritional value, it will not upgrade color, odor, or flavor.

Considerable published data as well as a large amount of practical data collected in the author's laboratories over the past years confirm the stability of ascorbic acid in fruit juices and drinks. Recently, however, Pelletier and Morrison (1965) examined the content and stability of ascorbic acid in fruit drinks picked up on the retail market in Ottawa, Canada, and their results were not favorable. Thirteen of 20 liquid fruit drink samples which they examined were below label claims for ascorbic acid when assayed initially, and the values dropped steadily when the products were opened and kept under conditions of normal use. There was also marked variability among different batches of the same product. These findings indicate that some manufacturers appear to be lacking in their manufacturing control or are not adding sufficient excesses to cover losses on storage. This is not excusable, because there is adequate information on the processing and overage requirements for practically all types of fruit drinks manufactured. This publication hopefully will encourage corrections of these shortcomings.

In addition to conventional fruit juices and drinks, dry fruit-flavored beverage powders are easily fortified with ascorbic acid by dry blending with the other ingredients. The storage life of ascorbic acid in such dry blends is excellent as long as the product is protected from humidity. Many carbonated beverages are also enriched with ascorbic acid and sufficient excess of ascorbic acid is added to react with the head-space oxygen remaining in the bottle. Theoretically, 3.3 mg. of ascorbic acid will react with 1 ml. of air. The addition of sufficient excess of ascorbic acid to combine with the dissolved and head-space oxygen is an economical means of prolonging shelf life of the beverage.

The enrichment of fruit juices, drinks, and beverages has therefore become a standard practice. From an economic point of view, the present bulk price of ascorbic acid (about $1.86 per pound) provides nutritional insurance at an extremely small cost.

Frozen Fruits. The addition of ascorbic acid to frozen fruits has been common practice for some time, but in this case its primary role is as an antioxidant to retard discoloration and flavor loss. Ascorbic acid is an ideal food antioxidant with the advantages that it is a natural constituent of many foods, is easily detected, is economical to use, and provides nutritional value as well. As an antioxidant, it works by blocking the normal enzymatic oxidation of oxidizable tannins and polyphenols present in fresh fruits. As long as ascorbic acid is present, the fruit is protected, but when the ascorbic acid supply is exhausted, browning will take place.

Fruits with a low natural ascorbic acid content benefit most by ascorbic acid addition. Such fruits include apples, apricots, bananas, nectarines, peaches, pears, and plums. Certain varieties of strawberries, cherries, and pineapple with intermediate natural levels of ascorbic acid can also benefit. This practice will not, however, upgrade quality or cover poor processing techniques. The levels of ascorbic acid used in frozen fruit packs range between 150 and 250 mg. per pound of finished pack. Table VIII shows the effect of processing on the ascorbic acid content of two frozen fruits. Not only have the flavor and color been protected, but there has been a considerable improvement in nutritional value. Further details concerning the processing of frozen fruit are given by Bauernfeind (1953).

VITAMINS

Provitamin A (Carotenoids). The carotenoids are widely distributed throughout the plant kingdom and are responsible for the color of many fruits and vegetables. Of the over 100 different carotenoids which are known, only a few have provitamin A activity, the most important being β-carotene, which is primarily responsible for the provitamin A content of fruits. Except where the color of the carotenoids is obscured by the bright reds and blues of the anthocyanin pigments, the depth of the yellow to orange color of the fruit is a good indicator of the carotenoid content and the vitamin A value of the fruit. Bauernfeind (1958) reviewed the carotenoids in fruits, juices, and concentrates. Later, Bauernfeind *et al.* (1962) discussed the specific use of β-carotene as a color and nutrient in juices and beverages, and more recently Borenstein and Bunnell (1966) discussed the uses of carotenoids in food processing.

As is the case with the ascorbic acid content of fruits, there can be a large variation in the amount of provitamin A supplied by different fruits, as well as a considerable variation in the provitamin A content of any single fruit depending on season, degree of ripeness, soil conditions, etc.; consequently, interchanging fruit in the diet can result in a wide variation in provitamin A intake (Table IX). Peaches, nectarines, and apricots are the richest sources, which correlates well with their deep yellow to orange color. Table IX also shows the average amount of provitamin A

Table VIII. Effect of Method of Processing on Ascorbic Acid Content of Frozen Fruits[a]

Method of Processing		Total Ascorbic Acid: Apricots	Peaches
No ascorbic acid added	Average	8.6	11.2
	Max.	12.3	11.2
	Min.	6.1	11.2
Ascorbic acid added	Average	65.3	41.3
	Max.	100.3	76.1
	Min.	30.3	24.3

[a] Burger *et al.* (1956).

Table IX. Provitamin A Content of Fresh Fruits and Canned Juices[a]

Fruit	Fresh Fruit, I.U./100 Grams	Canned Juice, I.U./4 Ounces
Pears	20	...
Strawberries	60	...
Pineapple	70	100
Raspberries, red	130	...
Bananas	190	...
Oranges	200	125
Plums	300	...
Tangerines	420	515
Tomatoes	900	1270
Peaches	1330	...
Nectarines	1650	...
Apricots	2700	1385

[a] U.S. Department of Agriculture (1966).

supplied by a 4-ounce serving of various canned fruit juices.

The philosophy of nutritional interchangeability, which forms the basis for the present enrichment of fruit juices and drinks with ascorbic acid, could therefore also apply to vitamin A. While fruit can supply significant quantities of provitamin A depending on dietary habits, significant (but variable) quantities are also supplied by vegetables, butter, and margarine. Vegetables can be a very variable source of provitamin A for the same reasons as enumerated for fruit. Butter also can vary in vitamin A value depending on the season of the year. Therefore, margarine which is standardized to provide a definite amount of vitamin A is the only reliable and consistent source of this vitamin in the food groups mentioned.

While it is sound nutritional practice to supply the MDR for ascorbic acid in a 4- to 6-ounce serving of fruit juice or drink, it is not necessary to supply the complete MDR for vitamin A in a single serving of a fruit juice or drink, since some vitamin A would be supplied by other items in the average diet. However, special beverage and cereal products on the market today are designed to supply the MDR of many of the vitamins.

According to the National Research Council in its publication "Recommended Dietary Allowances" (1964), the average American diet is considered to provide about two thirds of its vitamin A activity as carotene and one third as preformed vitamin A. If we assume that half the provitamin A comes from fruit, then a level of 1200 to 1500 I.U. (30 to 37.5% MDR) of vitamin A activity per serving would not be unreasonable.

Fruit products can be enriched with vitamin A by the use of the commercially available carotenoids, β-carotene and β-apo-8′-carotenal, or preformed vitamin A such as vitamin A palmitate. β-Carotene and β-apo-8′-carotenal have vitamin A activity of 1,666,000 and 1,200,000 I.U. per gram, respectively.

The provitamin A compounds, β-carotene and β-apo-8′-carotenal, as a source of vitamin A also supply color. β-Carotene provides a yellow to yellow-orange color and β-apo-8′-carotenal a deep orange. Both compounds are approved by the FDA as color additives, so they can also be used without certification as sources of color only.

Because the pure crystalline carotenoids are unstable and difficult to handle, special market forms are commercially available which simplify their use. Since the carotenoids are primarily oil-soluble colors, special techniques had to be developed to enable their use in water-based food products. The development and use of water-dispersible β-carotene products were described by Bunnell *et al.* (1958) and of β-apo-8′-carotenal by Bauernfeind and Bunnell (1962). These products are also described in the patent literature (Bauernfeind and Bunnell, 1958; Mueller and Tamm, 1963). There are a variety of commercial carotenoid market forms available for the food processor for beverage use. All show excellent stability characteristics (Bauernfeind and Bunnell, 1962; Bunnell *et al.*, 1958).

With proper processing, β-carotene is stable in fruit juices and blends. Typical stability data obtained with a canned citrus beverage enriched with β-carotene are shown in Table X. The type of can lining has no effect on the β-carotene stability, which indicates that β-carotene is not particularly sensitive to metals. The level of fortification used in this study contributes 1120 I.U. of provitamin A per 4 fluid ounces as well as strengthening the natural orange color of the beverage. Although β-carotene is sensitive to light in the presence of oxygen, if all dissolved and headspace oxygen is removed by the use of ascorbic acid, exposure to sunlight has little destructive effect (Table XI). Strictly from a color viewpoint, β-carotene has advantages over some of the FDC dyes in that it is not affected by the reducing action of ascorbic acid. In contrast to

Table X. Stability of β-Carotene in Canned Citrus Beverage[a]

Sample	Storage Period, Months	Temp., °F.	Total Carotenoids	
			Mg./4 fluid ounces	Retention, %
Enamel-lined cans	Initial		0.66	98
	2	86	0.66	98
	2	98	0.62	92
	6	75	0.60	89
Plain tin cans	Initial		0.65	96
	2	86	0.69	100
	2	98	0.64	94
	6	75	0.61	91

[a] Bunnell *et al.* (1958).

Table XI. β-Carotene and Ascorbic Acid Stability in Carbonated Orange Beverage[a]

Storage Condition	Carotene, Mg./29 Ounces	Ascorbic Acid, Mg./29 Ounces
Initial	7.62	...
1 month, direct sun	6.78	90
1 month, south window	7.18	90
1 month, 86° F.	7.68	93
1 month, 104° F.	7.50	87
2 months, direct sun	6.24	102
2 months, room temp./75° F.	7.18	...
2 months, 86° F.	7.18	...

[a] Bunnell *et al.* (1958).

these results, the same ascorbic acid fortified beverage with FDC dyes faded after two days of exposure to sunlight.

Vitamin A. In the case of fruit products which are not naturally yellow or orange—e.g., apple, grape—or where no additional color is desired, commercial forms of vitamin A are available which are adapted for use in water-based food products. Alternately, if desired by the food processor, the color can be supplied by an FDC certified color and the vitamin A by vitamin A palmitate. Vitamin A palmitate for use in water-based foods is commercially available in the form of gelatin-sugar or acacia beadlets which contain the vitamin A in the form of finely emulsified droplets sealed in the dry matrix. These can be reconstituted in water to yield an emulsion. Also available is a liquid emulsion of vitamin A in a gum acacia base, or emulsions can be prepared by the food processor to suit his own needs. All these market forms contain food-acceptable antioxidants to protect the vitamin A against oxidation, and their stability characteristics are excellent.

The beadlet forms of vitamin A (40- to 60-mesh) are essentially white in color and lend themselves well to use in beverage powder mixes which are reconstituted in water before using. The stability of the vitamin A in these dry beverage mixes is excellent. After reconstitution, the beverage may be stored for reasonable periods of time with good retention of vitamin A. Tests on a typical orange-flavored beverage powder enriched with ascorbic acid and vitamin A in the form of a water-dispersible beadlet showed negligible losses in potency of vitamin A or C after 12 weeks of storage at 45° C. or 6 months at room temperature. The reconstituted beverage also showed no loss of vitamin A or C after 3 days of storage at 40° F.

Vitamin A may also be used to enrich frozen beverage concentrates with good storage stability. Tests should be performed, however, to determine the best form of vitamin A to use for the particular product. Some form of a liquid emulsion of vitamin A containing food-approved antioxidants is usually preferred for this application.

Vitamin B Complex. Although fruit are not considered good sources of the various B vitamins, they do supply small amounts of these vitamins and thus make a contribution to our over-all dietary intake of these nutrients. The B-vitamin content of 4-ounce servings of a variety of fruit juices is shown in Table XII. The vitamin B_6 level in pineapple juice shown in this table is considerably less than the range of 0.23 to 0.54 mg. per 100 grams reported by Teply *et al.* (1953).

The fortification of fruit juices and blends with B vitamins has not been so widely practiced as ascorbic acid and provitamin A. Grape and grape-apple blend fruit drinks have been marketed which have been fortified with thiamine and riboflavin. There is no stability problem associated with the vitamins in these fruit drinks. B-vitamins have also been used to enrich various frozen drink concentrates and beverage powders without difficulty.

Although not as yet applied to any extent with fruit drinks, the concept of supplying a considerable fraction of the minimum daily requirements of the essential vitamins in a breakfast food has been applied with breakfast cereals and instant breakfast beverages. For the juice, toast, and coffee breakfast common among weight watchers, the concept of a vitamin-balanced fruit drink might find a rational nutritional application.

FUTURE OF FRUIT PRODUCT ENRICHMENT

On June 20, 1962, the United States Food and Drug Administration published proposed regulations concerning dietary supplements, vitamin-enriched foods, and foods for special dietary use. Numerous comments were received by the Food and Drug Administration concerning

Table XII. Average B Vitamin Content of Some Fruit Juices (Mg. per 4 ounces)

Juice	Thiamine	Riboflavin	Niacin	Pyridoxine	Pantothenic Acid
Grape[a]	0.24	0.03	0.25	0.03	0.05
Grapefruit[a]	0.06	0.01	0.32	0.02	0.20
Lemon[a]	0.04	0.02	0.15	0.05	0.11
Orange[a]	0.11	0.02	0.41	0.04	0.19
Orange-grapefruit[a]	0.08	0.01	0.39	0.03	0.19
Pineapple[a]	0.08	0.02	0.31	0.09	0.16
Apple[b]	0.02	0.03	Trace	0.04[c]	...
Tomato[b]	0.05	0.03	0.80	0.19[c]	...
Prune[b]	0.03	0.08	0.40	...	...
Tangerine[b]	0.06	0.03	0.20	...	...

[a] Frozen (Burger *et al.*, 1956).
[b] Canned (Burton, 1965).
[c] Teply *et al.* (1953).

these regulations, and a revised version was re-issued on June 18, 1966. As a result of additional comments and objections, these proposed regulations will be subjected to a hearing in the near future. In the case of fruit juices and drinks, fortification with ascorbic acid only would be allowed under the proposed regulations. The extent to which vitamin enrichment may be applied to fruit products as well as other foods in the future, therefore, depends on the outcome of the hearings regarding the proposed regulations and their final content when issued.

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