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A nutritional evaluation of some soft drinks as supply sources for vitamin C

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Abstract

A novel index (designated PAIM), in which nutritional losses as a result of cooking and practical intake in a typical meal were considered, was applied to the evaluation of ascorbic acid content in several commercially available soft drinks. This index successfully enabled a comparative examination between various foods and drinks as supply sources of ascorbic acids. Employing this index, in the seven soft drinks tested, two products were assessed as effective sources for ascorbic acid affording values nearly satisfying the daily recommended dietary allowance; furthermore, the remaining five products were superior to some foods after cooking. These results suggested that soft drinks might be regarded as an off-handed optional source of ascorbic acid.

Key words: vitamin C, soft drink, ascorbic acid, dehydroascorbic acid

Introduction

Ascorbic acid is a well known vitamin displaying effects of melanin synthesis inhibition and collagenization promotion as well as antitumor and antianemia activity[1]. In particular, benefits of ascorbic acid as a cosmetic material have received much focus recently in Japan, partially due to information appearing in various mass media. In this situation, the recommended dietary allowance of ascorbic acid in Japan was changed to 100 mg/day from 50 mg/day[2,3] for healthy persons over the age of 18 years. This value was determined by the Resources Council, Science and Technology Agency of Japan in 2000. Moreover, since many foods and drinks in Japan are currently supplemented with ascorbic acid as a food additive due to its antioxidant effect, the consumer appears to be interested with respect to whether the quantities of ascorbic acid supplements are exhibited accurately on product packages.

In this study, ascorbic acid analyses were conducted using several soft drinks available commercially. Results were compared with the values indicated on the drink packages or with a commonly utilized food composition table[2,4] to confirm the accuracy of the food display. Furthermore, several foods were selected for their abundance of ascorbic acid; subsequently, effectiveness of the soft drinks as supply sources of ascorbic acid was evaluated via comparison of the acquired data with ascorbic acid contents of the selected foods.

Materials and Methods

■ Soft drinks

Seven kinds of soft drinks including three fruit juices, Aserola-drink® (Nichirei), Tropicana® (Kirin Beverage), Chelate-lemon® (Pokka), two

vegetable juices, Kagome-tomato-juice® (Kagome) and Jujitsu-yasai® (Itoen), one fermented lactic drink, Vitamin-parlor® (Takara), and one green tea, Ohi-ocha® (Itoen), were examined in this study. These soft drinks were purchased from a grocery store in Higashi-Matsuyama City, Saitama Prefecture, Japan in November 2001. All soft drinks were canned (volume, 190 to 250 ml), with the exception of Chelate-lemon®, which was packaged in a paper container.

■ Analysis of ascorbic acids

Two types of ascorbic acid, the reduced (L-ascorbic acid, AsA) and oxidized (L-dehydroascorbic acid, DAsA) forms, were analyzed for the testing targets. First, DAsA content was quantified according to the hydrazine method[5]. Subsequently, total content of ascorbic acid was determined following oxidation of the sample via addition of 0.01% indophenol (2,6-dichloroindophenol sodium) and incubation at 50°C for 90 min. AsA content was calculated by subtracting the DAsA content from the total content determined.

■ Ascorbic acid content of reference foods

According to the report of Koike *et al.* (1999)[6], nine reference foods were selected due to their richness of ascorbic acid as follows: potato (*Solanum tuberosum*), lotus (*Nelumbo nucifera*), broccoli (*Brassica oleracea var. italica*), rape flower (*Brassica campestris*), spinach (*Spinacia oleracea*), lemon (*Citrus limon*), strawberry (*Fragaria ananassa*), navel orange (*Citrus sinensis var. brasiliensis*) and kiwi fruit (*Actinidia chinensis*). In these reference foods, four fruits (*i.e.*, lemon, strawberry, navel orange and kiwi fruit) were regarded as foods edible freshly, whereas potato and the four vegetables (*i.e.*, lotus, broccoli, rape flower and spinach) were regarded as foods edible after cooking, *e.g.*, boiling. The remaining ascorbic acid values of each reference food were calculated based on a food composition table[4]. Using calculated values of the remaining ascorbic acid, PAIM (practically possible ascorbic acid intake in a meal) values were then determined based on the assumption that these foods in masses of 100, 50, 25, 50, 50, 12, 100, 150 and 120 g would be included in a meal consisting of potato, lotus, broccoli, rape flower, spinach, lemon, strawberry, navel orange and kiwi fruit, respectively[6-8]. The determined PAIM values were equivalent to an index utilized to evaluate the effectiveness as a supply source of ascorbic acid.

Results and Discussion

In the present study, ascorbic acid content in several soft drinks was assayed by the hydrazine method to confirm accuracy of food display. Findings suggested that most of the soft drinks tested contained total ascorbic acid levels approximately equal to values described on the label of each drink package or food composition table (Fig. 1). However, total ascorbic acid content of a green tea product, Ohi-ocha®, exhibited a value 3.2 times

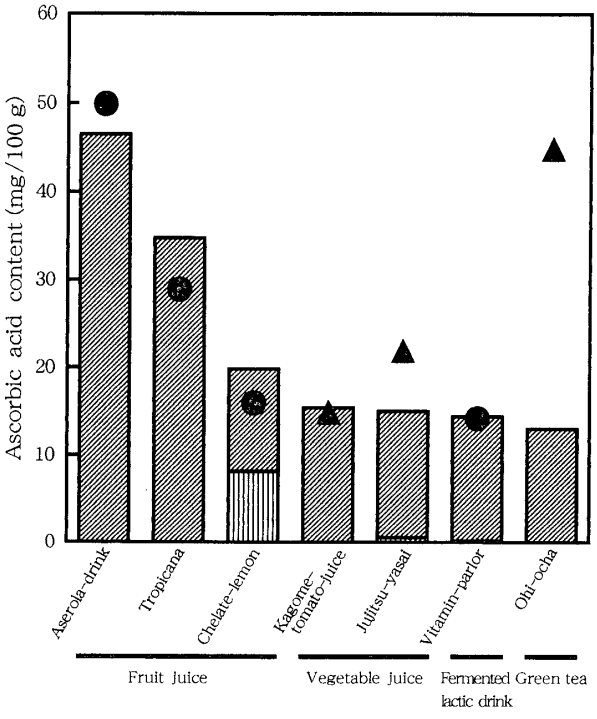

Fig. 1. The determined ascorbic acid contents of soft drinks and their indicated values. Symbols: ▨, L-ascorbic acid (reduced form, AsA); ▥, L-dehydroascorbic acid (oxidized form, DAsA); ●, total ascorbic acid content indicated in the package; ▲, total ascorbic acid content indicated in a food composition table.

lower than the value described in the food composition table (Fig. 1). This contradiction observed in the green tea may be attributable to either natural variation of raw material or intentional alteration of product composition by the manufacturer. In actuality, the green tea product has been modified frequently in the past several years and the latest data from the company revealed that this product contained ascorbic acid levels of 24 mg/100 mg (personal communication), which agreed more closely with our data.

Furthermore, individual analyses for the two forms of ascorbic acid were performed, indicating that most of the ascorbic acid in the tested soft drinks occurred in the reduced form (AsA); in contrast, a fruit drink, Chelate-lemon®, included the oxidized form (DAsA) of ascorbic acid in excess of 40% (Fig. 1). All experiments for ascorbic acid quantification were completed prior to product consumption deadlines; moreover, tests were conducted with sufficient care to prevent air oxidation of AsA. However, it was noted that the Chelate-lemon® was packed in a cylindrical container lacking an interior metallic film lining. Therefore, these results may suggest that metallic packaging is extremely effective in terms of prevention of oxidation of ascorbic acid in soft drink products.

Finally, a novel index value, designated as PAIM (practically possible ascorbic acid intake in a meal), was introduced into the evaluation of effectiveness as supply sources for ascorbic acid. Consequently, we confirmed that the foods edible after cooking (potato, lotus, broccoli, rape flower and spinach) were not effective as supply sources despite the abundance of ascorbic acid contained in the fresh food (Fig. 2). Lemon also exhibited lower PAIM values due to a smaller edible amount, whereas other fruits, namely strawberry, navel orange and kiwi fruit, appeared to be excellent supply sources of ascorbic acid (Fig. 2).

On the other hand, the seven soft drinks tested were separable into two groups characterized by lower (Chelate-lemon®, Kagome-tomato-juice®, Jujitsu-yasai®, Vitamin-parlor® and Ohi-ocha®) and higher (Aserola-drink® and Tropicana®) ascorbic acid levels in comparisons employing the PAIM value. Even the drinks belonging to the lower group were found to be superior to the foods edible after cooking as supply sources; the values corresponded to 1/3 - 1/4 of the recommended dietary allowance (Fig. 2). Moreover, the drinks of the higher group appeared to be excellent supply sources of ascorbic acid; these products were comparable to navel orange or kiwi fruit with the values closely approaching the daily recommended dietary allowance (Fig. 2).

In general, soft drinks can be readily consumed

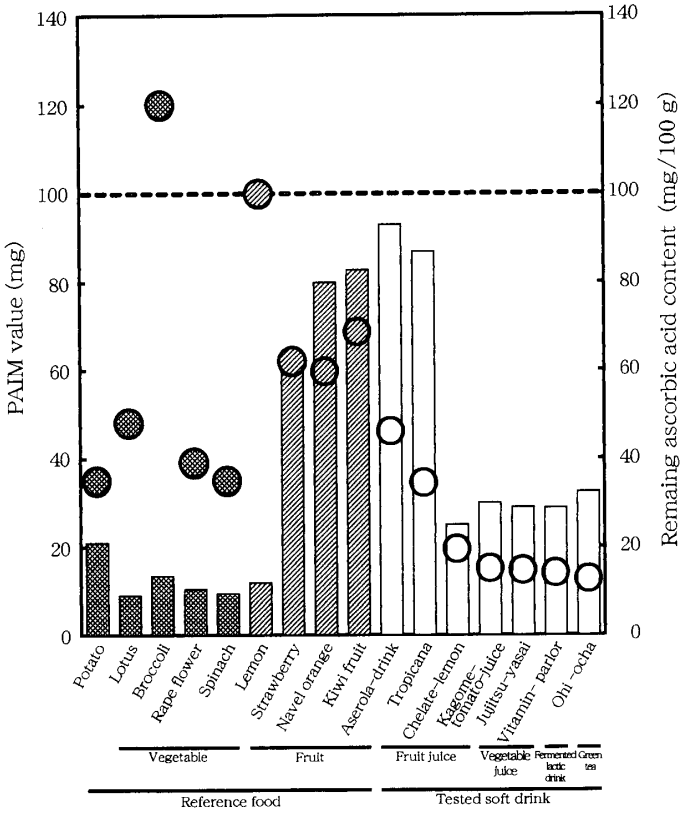

Fig. 2. The PAIM (practically possible ascorbic acid intake in a meal) values and the remaining ascorbic acid contents of reference foods and tested soft drinks. The bars indicate the PAIM values, the circles show the remaining ascorbic acid contents, and then a dotted line is the recommended dietary allowance of ascorbic acid. Symbols: ▒, reference foods edible after cooking; ▨, reference foods edible freshly; □, tested soft drinks.

at any time without concern regarding storage. Some soft drinks include other vitamins and minerals. Hence, effective utilization of soft drinks as an off-handed supply source of vitamin C may be considered.

References

1) Itokawa Y. (1998): A guidebook for basic knowledge and nutritional practice; The newest vitamin learning. Footwork Shuppan, Tokyo, pp. 88-93 (in Japanese).
2) Standard tables of food composition in Japan (2000): Fifth revised edition (ed. by Resources Council, Science and Technology Agency, Japan). Printing Bureau, Ministry of Finance, Japan, Tokyo, (in Japanese).
3) The Japanese recommended dietary allowance-dietary reference intakes (1999): Sixth revision (ed. by Ministry of Health and Welfare, Japan). Dai-ichi Shuppan Publishing Co. LTD., Tokyo, (in Japanese).
4) Component tables of processed foods commercially available (1995): Seventh revised edition (ed. by Y.Kagawa). Kagawa Nutrition University Publishing Division, Tokyo, (in Japanese).
5) Kurata T. and M.Otsuka (1996): New method for food analysis (ed. by Japanese Society of Food Science and Technology). Korin Publishing Co. LTD., Tokyo, pp. 444-447 (in Japanese).
6) Koike G., K.Nishimura, M.Miura and E.Ogiwara (1993): Taking vitamin C by meal; For beauty and health. Kagawa Nutrition University Publishing Division, Tokyo, pp. 4-9 (in Japanese).
7) Inoue Y. (1998): A book for understanding the vitamin. Nihonbungeisha, Tokyo, (in Japanese).
8) Takeuchi F. (1995): A caloric guidebook for home-made side dishes (ed. by Y.Kagawa). Kagawa Nutrition University Publishing Division,Tokyo, (in Japanese).