Carotenoids in Human Blood Plasma after Ingesting Paprika Juice

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We investigated the presence of different carotenoids in male human subject after the ingestion of paprika juice, and identified capsanthin, capsanthone, cucurbitaxanthin A, 11-cis-capsanthin, lutein and zeaxanthin in the human plasma. These results suggest that capsanthone and 11-cis-capsanthin might be as important as capsanthin for human health.

Key words: carotenoid; capsanthin; capsanthone; cucurbitaxanthin A; 11-cis-capsanthin

Dietary carotenoids play an important role in the prevention of cancer. Epidemiological studies have revealed a correlation between the risk of cancer, the dietary intake of carotenoids and their concentration in blood plasma. Different carotenoids present in common foods are accumulated in tissues and blood plasma. Khachik has identified about 20 carotenoids in human plasma. Many previous studies have suggested that β-carotene plays an important role in the chemoprevention of cancer. However, some recent studies have indicated that some other carotenoids possess equivalent or superior anti-tumour activity compared with that of β-carotene. To clarify the bioavailability of carotenoids other than β-carotene, Oshima et al. have studied the accumulation and clearance of capsanthin, a major carotenoid of capsicum (about 35% of total carotenoids) in blood plasma after the ingestion of paprika juice by human male. These studies have revealed that dietary capsanthin was absorbed into the body and distributed to plasma lipoproteins. The concentration of other carotenoids present in paprika juice such as zeaxanthin, lutein, cryptoxanthin and β-carotene was also increased in the blood plasma. These studies also showed that capsanthin disappeared from the plasma at a faster rate than lycopene. However, some of the compounds present in blood plasma after the ingestion of paprika juice were not identified. The objective of this study is to identify those hitherto unidentified carotenoids.

Diets. Paprika was purchased from local distributors. The juice, which was the source of dietary capsanthin, was made from the paprika by using an electrical juicer. The concentration of carotenoids in the paprika juice was determined by the same method as that used for the plasma carotenoids and is described later. In this study, 200 g of paprika juice was diluted with water (adjusted to 2 mg/100 g of capsanthin) and regularly ingested by subject with the daily diet three times a day for three days (diet 1). The same subject ingested 300 g of concentrated paprika juice (equivalent to a dose of 10 mg of capsanthin) in a single dosage for the purpose of elucidating the relative changes of capsanthin and other carotenoid levels in the blood plasma after the ingestion (diet 2). Its taste was acceptable.

Sample preparation. Blood samples were drawn at specific intervals during a 7-day period. The samples were collected from the subjects into test tubes containing disodium EDTA, and plasma fractions were prepared by immediate centrifugation at 1087 × g for 20 min. The plasma carotenoids were extracted by hexane-acetone-ethanol-toluene (10:7:6:7).

Analyses. Plasma carotenoids were determined by HPLC with a GL-PACK Lichrospher RP-18-5 column (ϕ4.6 mm × 250 mm), using a mobile phase of MeOH-MeCN-CH3Cl-H2O (10:7:2:3.3) at 1.0 ml/min and detection at 452 nm by a photodiode array detector.

We reinvestigated the presence of different carotenoids after the ingestion of paprika juice by male subject (diet 1). These studies resulted in the identification of capsanthone, cucurbitaxanthin A, and 11-cis-capsanthin (tR: 18.1, 21.2 and 24.2 min) in the human plasma. The identification of these carotenoids was based on a data comparison of UV-visible and tR by HPLC with those of authentic samples (Fig. 2). The existence of a capsanthin cis isomer other than 11-cis-capsanthin was suggested in the plasma. All these compounds were also present in a paprika paste extract. Previous studies have indicated that capsanthin was retained in human blood plasma for a

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shorter time than some other carotenoids such as lycopene. The results obtained in this study indicate that capsanthin was oxidized in the blood to capsanthone and isomerised to its geometrical isomer, cis-capsanthin. These products may be retained in the blood for a longer period. After a single ingestion of paprika juice (diet 2), the decrease in the amount of capsanthin was accompanied by a simultaneous increase in the amount of capsanthone. As shown in Fig. 3, the concentration of capsanthin started decreasing after 7 hours and reached zero after 10 hours, while capsanthone, which was not observed within the first 7 hours, started increasing after 7 hours and reached its maximum level after 10 hours. These results indicate that all of capsanthin was metabolised within 10 hours after ingestion. In view of these findings, it is suggested that not only capsanthin, but also its metabolites such as capsanthone and its geometrical isomers such as 11-cis-capsanthin may be equally important in preventing human diseases. We propose that these compounds should be subjects of further biological studies.

The oxidation of capsanthin is important to understand these results. Philip and Francis have reported that capsanthin was converted into capsanthone by Oppenauer oxidation." It has been assumed that lycopene and capsanthin were oxidized by an oxygenase or active oxygen in human plasma. Further studies on the metabolism of capsanthin in plasma are in progress.

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References


