Palm Oil Carotenoids: of the Beta-Car

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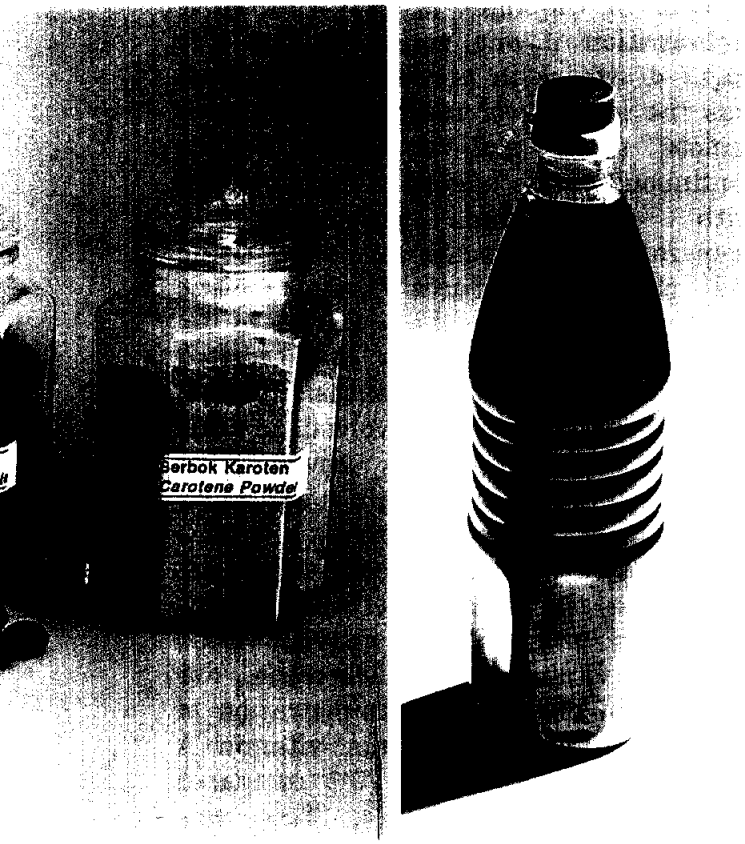
One of the most promising micronutrients recommended for optimum health has been sent into a tailspin by recent media and scientific reports. We have become rather familiar with eye-catching captions such as, "beta-carotene ineffective in forestalling cancer"; "beta-carotene takes a collective beating". To those who have been following the almost meteoric rise (and now fall) of beta-carotene as a nutrient par excellence, this news is both deeply disappointing and of a major concern. Nevertheless, the subject itself needs reexamination since the present debacle was precipitated by using commercially synthesised beta-carotene at relatively high doses with a view of ensuring maximum protection against carcinogenesis

Historically, beta-carotene's image has been projected to the forefront through indirect observations from several major population studies. Epidemiologists were thrilled by their observation that populations routinely consuming green leafy vegetables were better protected against certain types of cancers than those omitting them from their daily diets. The search for this anti-cancer component was narrowed down to the carotenoids and especially the beta-carotene isomer found in appreciable quantities in green leafy vegetables. Striking negative correlations with incidence and mortality from degenerative diseases including cancer was shown in populations whose green leafy vegetable intake was highest. Heartened by these findings several pharmaceutical giants set into motion to produce beta-carotene synthetically and soon health outlets worldwide were distributing these preparations to the public keen to extend their longevity.

The scientific community itself has often been divided over the many claims attached to the beta-carotene story. Many believed that a single compound such as beta-carotene could not possibly have all the therapeutical properties assigned to it. Several major trials were initiated and the results of these studies were largely contradictory to the anti-cancer properties hypothesised for beta-carotene. For example the Beta-Carotene Retinol Efficacy Trial (CARET), was an intervention trial in 18,000 men and

Are They the Saviour otene Debacle?



women smokers and asbestos workers who were regularly supplemented with beta-carotene and vitamin A. The study was prematurely terminated when increases in the incidence and mortality from lung cancer became obvious. A similar Finnish trial (Alpha-Tocopherol and Beta-Carotene, ATBC, study) in 29,000 men also reported increased incidences of lung cancer with beta-carotene consumption. In response to these findings two other major trials in the United States involving almost 66,000 men and women have been prematurely terminated. In contrast to the above American studies, a study in Linxian, China, involving 30,000 rural Chinese adults supplemented with beta-carotene, vitamin E and selenium resulted in 13% fewer cancer deaths.

Do these results sound the death knell for beta-carotene as nutrient supplements? We do not necessarily think so and the subject may have to be approached differently probably from a natural source. Carotenes are fat soluble pigments that are found in leaves, vegetables and fruits. Although more than 600 different carotenoids are known to exist in nature, nutritionally the most interesting isomers are the alpha- and beta-carotene. These isomers are converted to vitamin A in our body (provitamin A) which when deficient can result in night blindness. Traditionally we have been advised to consume regular portions of green leafy vegetables as part of our daily diet. Nevertheless, studies have shown that eating green leafy vegetables is not always a satisfactory method of overcoming night blindness induced by vitamin A deficiency. The concept of bioavailability (proportion of the nutrients consumed in the diet that is usable by the body) plays an important role here. In the case of carotenes in a mixed diet, six parts of carotene are equivalent to one part of retinol (Vitamin A content of foods is termed retinol equivalent).

Vitamin A deficiency is widespread in many parts of the developing world and as a result almost three million children are blind from this nutritional deficiency at any given time. Many different approaches, including supplementation with megadoses of Vitamin A have been attempted to overcome this problem. Although the use of vegetables rich in vitamin A and carotenes abound, there are tremendous difficulties in incorporating these into the diet, especially the diet of young weaning children. Studies in

several parts of the world have compared beta-carotene bioavailability either from vegetables or from specially made beta-carotene enriched wafers. In all cases the bioavailability of beta-carotene from the wafers was much higher. The lower bioavailabilty from vegetables has been suggested to result from the physical packing of the carotenes in these vegetables making them inaccessible to the digestive enzymes. Beta-carotene is normally organized in a pigment-protein complex within the chloroplast. Light cooking would increase bioavailability but extended heating could destroy the carotenoids or even transform them into isomers with lower provitamin A activity.

The scare brought about by the ineffectivness of commercial beta-carotene supplements in adults seems real enough for now. Nevertheless, are the children at risk of becoming blind to be left alone? From our point of view this need not be so; we may even have the antidote to these issues in the form of red palm oil. Crude palm oil is nature's richest source of carotenoids with concentrations in the order of 700–1000 ppm. This is about 30 times more than that present in carrots, for example. Moreover, it is well recognized that the carotenoids are most stable and best absorbed in the presence of fat which acts as the carrier. Not all the carotenoids in palm oil are beta-carotene (which accounts for only 55%) but it contains a bouquet of other carotenoids which have properties apart from their provitamin A activity. Alpha-carotene (35%), lycopene, phytoene and zeacarotene are the other major constituent carotenoids in palm oil.

Recent reports on the efficacy of red palm oil in overcoming vitamin A deficiency in children at risk is very encouraging. Studies in India have shown that a tablespoon of red palm oil (about five grammes) per day and administered for just twenty one days was sufficient to protect the child at risk from blindness for the next six months. This suggests that the provitamin A carotenoids in red palm oil are absorbed, stored and slowly converted to the active retinol equivalent at the demands of the child's metabolic process. This represents a great stride forward in the fight against vitamin A malnutrition if one considers that the major drawback in previous programmes was the logistics of reaching children in remote areas and ensuring that a continuous and adequate intervention with conventional provitamin A preparations was made available. Using red palm oil reduces these logistic nightmares since the child in a malnutritioned area needs to be visited only once every six months. Several international agencies involved in this uphill battle against unwarranted blindness induced by vitamin A deficiency are showing a keen interest in this development. Of course, these effects are related to the striking efficiency with which red palm oil can increase blood levels of vitamin A and carotene. For example in one study, administration of red palm oil caused serum vitamin A levels to be elevated by 70% compared with pre-treatment levels. This was significantly superior to either a vitamin A concentrate or a vegetable-based diet that caused only marginal increases (43% and 8% respectively) in serum vitamin A levels.

We think that there are very few doubts on the efficacy of red palm oil in the above-mentioned efforts to overcome vitamin A blindness in children. But what about adult requirements in light of the recent studies associating beta-carotene and its ineffectiveness in preventing cancer. Before proceeding, the reader may recall that the populations intervened in some of the studies quoted *i.e.* CARET (USA), ATBC (Finland), were already at high risk considering their habitual practise of excessive smoking or exposure to environmental asbestos (a known carcinogen). In these cases, beta-carotene

failed to overcome preconditioned risk factors for carcinogenesis. It did not provide a curative effect, something that is impossible to ascribe to this simple dietary micronutrient anyway. Moreover, the levels of beta-carotene "popping" may have been an important and influential factor. Beta-carotene has proven singlet oxygen quenching properties besides its antioxidant effects. Many of us forget that a biological antioxidant when present in excess "turns turtle" and can assume the role of a pro oxidant and thus become harmful. Oxidation of biological fluids and tissues has been hypothesised to increase risk factors associated with both coronary heart disease and cancer. Unfortunately, for the carotenes (beta-carotene included) and vitamin E, the experts are unable to recommend optimum levels for optimum nutrition. This is illustrated in the ATBC Finnish study in which the high dosage of beta-carotene caused the serum beta-carotene levels to increase by almost seventeen folds compared with the pre-treatment values. This high dosage of beta-carotene now seems unwarranted and may have been an important factor contributing to the observed higher cancer incidence and mortality in the beta-carotene treated group.

The beta-carotene anti-cancer hypothesis actually evolved on the basis that the consumption of vegetables high in carotenoids was protective against cancer incidence and development. But actual availability of the carotenoids from green leafy vegetables is very small indeed; such diets have been noted to increase serum beta-carotene levels by approximately 10%–15% only. Low but optimum level of carotenoids intake may be the clue. This fact holds much promise for red palm oil that usually contains about 500 mg carotenoids per kilogram oil (500 ppm). In Malaysia, for example, we consume about 50 g of dietary oil per day, mostly used as cooking oil. If this were derived totally from red palm oil, our diet will contain 15–20 mg of the bouquet of carotenoids present in red palm oil (subtracting for some losses during cooking); the amount of beta-carotene available would be approximately 9–12 mg. It is prudent for us to note here that in the Lixian study in China that reported fewer cancer deaths, the 30,000 subjects were administered beta-carotene preparations at a low-optimum dose of only 15 mg; provocative results that could be clinically tested!

Alpha-carotene is the other major carotenoid (38%) in red palm oil and modern technology permits its isolation and subsequent concentration for experimental purposes. Alpha-carotene too has provitamin A activity but its efficacy is much lower than beta-carotene. It often coexists with beta-carotene and can be detected in blood and various tissues. A recent animal study with alpha-carotene from palm oil demonstrated that it has potent inhibitory effects on the progression of certain types of cancers. Alpha-carotene (isolated from crude palm oil) but not beta-carotene inhibited liver carcinogenesis in the experimental mice. It was also more effective than beta-carotene in inhibiting chemically induced skin tumour progression. In similar studies the total bouquet of palm carotenes had greater inhibitory effects on skin and liver carcinogenesis than either the alpha- or beta-carotene alone. These results led the researchers to conclude that the natural carotenoids in palm oil have excellent chemopreventive activity and efforts should be directed at preserving these micronutrients in the oil.

The technology to produce these carotenoids containing red palm oil and olein on a commercial scale has already been made available to the industry by PORIM. If one considers the above nutritional arguments for red palm oil, it is easy to see that the product will have marketing advantages that could become a nightmare for the competition. We have not even mentioned the other important micronutrient – palm vitamin E (about

600 ppm) that is also a constituent of this oil. Palm vitamin E in the form of tocotrienols has been shown to have some exemplary nutritional properties including their ability to regulate cholesterol synthesis, and inhibit human mammary cancer cell proliferation. In red palm oil, Malaysia's golden oil has not only retained its distinct red colour (due to the carotenoids) but without the threatening disadvantages. ■

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