PALM MIXED-CAROTENE: NATURAL AND HEALTHY COLOURS

EATING WITH YOUR EYES ALONE MAY LINK TO NEGATIVE HEALTH EFFECTS IF ARTIFICIAL DYES ARE INVOLVED. NATURAL FOOD COLOURANTS NOT ONLY COLOUR FOOD NATURALLY, BUT ALSO HEALTHILY AND WITH ADDED NUTRITION. WHAT DOES NATURAL FOOD COLOURANT PALM MIXED-CAROTENE HAVE TO OFFER? BY CHEE YEN LAU, NUTRITIONIST, EXCELVITE, MALAYSIA

WHEN walking down any food aisle in supermarkets, one will see hundreds of colourful processed or fresh foods displayed on the shelves. Consumers “eat with their eyes first”. In fact, colour is an important characteristic of food and beverages as it not only predetermines a consumer’s perception of taste, palatability, quality of foods, but also ensures uniformity of the food from batch to batch.

Carotenoids are natural pigments widely available in fruits and vegetables. Carotenoid-containing plant extracts have been used for colouring foods for many decades and it is still practiced today. Beta-carotene is a member of the carotenoid family and it is commonly used as a colourant in food and beverages and as a good source of pro-vitamin A that helps to promote night vision and strengthen immunity.

Therefore, beta-carotene is commercially synthesised as an artificial colour additive and a nutritional dietary supplement ingredient. Unfortunately, studies have suggested that synthetic colourants or dyes cause attention deficit hyperactive disorder (ADHD) and that the synthetic and single form of beta-carotene also poses a health threat.

SYNTHETIC COLOURANTS ON HEALTH

The University of Southampton reported hyperactivity in young children (aged between three and nine years old) after consuming drinks mixed containing artificial food colourants in 2007. The European Food Safety Authority (EFSA) subsequently conducted safety tests on six synthetic food dyes—so called ‘Southampton Six Colours’—namely Tartrazine (E102), Sunset Yellow (E110), Allura Red (E129), Quinoline Yellow (E104), Ponceau 4R (E124) and Carmoisine (E122).

Following this Southampton Study, EFSA reviewed on a broader body of evidence and it proved that artificial food colourants caused children’s hyperactivity (ADHD). As a result, the European Union Parliament mandated warning labels on foods containing the Southampton six colours.

With this mandatory warning statement, almost all manufacturers and retailers have taken action to remove and replace the artificial colours with natural colouring agents,
i.e. replacing synthetic colourants such as Tartrazine and Sunset Yellow with natural colourants such as palm mixed-carotene.

Additionally, beta-carotene was sent into a tailspin following the publication of the Carotene and Retinol Efficacy Trial (CARET), Physicians’ Health Study (PHS), and Alpha-Tocopherol, Beta-Carotene Cancer Prevention (ATBC) studies which involved approximately 66,000 individuals on the negative effects of beta-carotene. Surprisingly, the results of these studies were contradictory to the anti-cancer properties hypothesised for beta-carotene.

The CARET study was prematurely terminated when lung cancer incidence rate and mortality increased in beta-carotene supplementation groups. The ATBC study also reported similar increase in lung cancer incidence with beta-carotene consumption. In addition, the PHS study found no beneficial effects—neither negative nor positive with beta-carotene supplementation. These three studies were carried out with only a single form of synthetic beta-carotene, commonly known as ‘nature-identical beta-carotene’, and it contains only trans-beta-carotene.

**CURRENT MARKET TREND**

Following the aforementioned negative results, instead of a single form of carotene (i.e. beta-carotene), researchers and dietary supplement companies started to explore in depth natural mixed carotenoids and their biological activities—either as a natural colourant for food or drinks, or as a natural pro-vitamin A in dietary supplement formulation.

To date, there is a significant number of published research works focusing on multi-carotenoid such as mixed-carotene (i.e. alpha-carotene and beta-carotene) in relation to heart health and longevity, or on lutein and zeaxanthin with vision health.

According to the latest Health and Diet Survey from the US Food and Drug Administration, half of the consumers read nutrition facts labels before making their purchasing decisions. Consumers these days tend to seek for authenticity in their food choices and hence, they are constantly sourcing for simple, natural, non-GMO or recognisable ingredients. This has led to the ‘Clean Label’ movement that is gaining momentum and has become more prominent in Europe, North America and Asia over the past decade.

**NATURAL FOOD COLOURANT PALM MIXED-CAROTENE & APPLICATIONS**

Palm fruits are the world’s richest natural plant source of carotenoids in terms of retinol (provitamin A) equivalent. Palm contains about 15 to 300 times as many retinol equivalents as carrots, leafy green vegetables, and tomatoes. Palm mixed-carotene possesses a mixture of alpha- and beta-carotene (which exist in both cis and trans forms), gamma-carotene, lycopene and other minor carotenoids.

An interesting fact is that the carotene composition in palm is similar to carrots, with approximately 33 percent alpha-carotene and 65 percent beta-carotene and about two percent of other carotenoids (e.g. y-carotene, lycopene). Hence, the unique mixture of palm mixed-carotene presents not only a single carotene, but also a wholesome array of carotenoids.

The carotenoid compounds of palm are responsible for the orangy-red colour to palm oil, and it is commercially available in various forms such as oil concentrate, powder and emulsion. These carotenoids are widely used as natural colourants for yellow to orange colours in the food and beverage industry in applications such as margarine, cheese, dairy, bakeries, confectionery, dietary supplement, animal feed additives and even cosmetics.

Not all beta-carotenens are equal. Generally, there are four types of beta-carotene sources available in the market. The summary of the comparison among all the commercial sources of beta-carotene are shown in the table below:

<table>
<thead>
<tr>
<th>Commercial Carotene Products</th>
<th>Palm Carotene Complex</th>
<th>Algae β-carotene</th>
<th>Fermentative β-carotene</th>
<th>Synthetic β-carotene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Crude palm oil (Elaeis guineensis)</td>
<td>Algae (D. salina)</td>
<td>Fungus (B. trispora)</td>
<td>Petroleum</td>
</tr>
<tr>
<td>Composition</td>
<td>33% α-carotene 65% β-carotene 2% other carotenoids (mixed-carotene complex)</td>
<td>&gt; 96% β-carotene (predominantly a single beta-carotene source)</td>
<td>&gt; 98% β-carotene (predominantly a single beta-carotene source)</td>
<td>100% β-carotene (single β-carotene source)</td>
</tr>
<tr>
<td>α-carotene</td>
<td>Highest level of α-carotene (33 to 35%)</td>
<td>Negligible level of α-carotene</td>
<td>Negligible level of α-carotene</td>
<td>No α-carotene</td>
</tr>
<tr>
<td>Cis and trans isomers</td>
<td>Cis and trans</td>
<td>Cis and trans</td>
<td>~ 100% trans</td>
<td>100% trans</td>
</tr>
<tr>
<td>Ratio &amp; Composition of Carrot Carotenoids</td>
<td>Similar</td>
<td>Different</td>
<td>Different</td>
<td>Different</td>
</tr>
</tbody>
</table>

Table 1: Comparison between Commercial Sources of Beta-Carotene
Alpha-carotene often coexists with beta-carotene in fruits and vegetables such as carrots and red palm fruits, and can be detected in blood and various tissues. A study from the University California Berkeley showed that alpha-carotene is a more potent antioxidant than beta-carotene, and cis-beta-carotene has been shown to possess higher antioxidant potency than trans-beta-carotene.

Another study also showed that alpha-carotene is a better antioxidant than beta-carotene, therefore it may be useful in limiting free radical-mediated peroxidative damage against membrane phospholipids in vivo.

In addition, palm mixed-carotene (a mixture of alpha-carotene, beta-carotene and lycopene) inhibited the development of colonic aberrant crypt foci (i.e. abnormal tube-like glands in the colon lining that may link to cancer development) but single beta-carotene did not. Hence, these various carotenoid isomers work synergistically in providing the beneficial health effects.

HEALTH BENEFITS OF NATURAL CAROTENOIDS

Carotenoids play an important role in the antioxidant defence system in humans. In fact, various cohort studies have revealed that carotenoids increase telomere length, and this is strongly associated with reduced risk of age-related diseases.

In addition, carotenoids ameliorate age-related macular degeneration (AMD), minimise risks of developing type 2 diabetes and increase bone mineral density through their potent antioxidative properties.

INCREASES TELOMERE LENGTH (PROMOTES LONGEVITY)

Telomeres are specialised structures at the end of the chromosomes to minimise the loss of human’s genetic data (i.e. telomere shortening) during cell division. Telomere shortening is associated with accelerated ageing and higher risk of cancer development and death.

In a study, 3,660 US adults aged 20 years and above were recruited. The concentration of plasma carotenoids (alpha-carotene, beta-carotene (trans + cis), beta-cryptoxanthin, combined lutein/zeaxanthin and trans-lycopene) were measured. DNA samples were extracted from whole blood and the leukocyte telomere length (T/S ratio) was determined.

The results show that blood alpha-carotene, beta-carotene (trans+ cis) and beta-cryptoxanthin were significantly associated with 1.76 percent, 2.22 percent and 2.02 percent longer telomeres respectively. Additionally, when compared to the lowest carotenoid (alpha-carotene, beta-carotene (trans+ cis) and beta-cryptoxanthin) quartiles, the highest carotenoid quartiles show a significant increase in telomere length of 5-8 percent.

Hence, it is suggested that high consumption of carotenoid-rich food increases telomere length this could potentially delay the ageing process and reduce risk of age-related illnesses.

MINIMISES RISK OF AGE-RELATED MACULAR DEGENERATION

Photo-oxidative stress is a phenomenon where reactive oxygen species (ROS) is produced when there is light exposure that may damage biomolecules (DNA, hormones, enzymes and minerals) in the eyes. AMD is an irreversible blindness due to photo-oxidative stress and it affects the macula lutea (maximal visual acuity) of the retina.

A recent study, published in Journal of the American Medical Association (JAMA), conducted a cohort study involving more than 100,000 subjects and followed up for up to 26 years. Plasma carotenoids were predicted from food intakes at baseline.

CAROTENOIDS PLAY AN IMPORTANT ROLE IN THE ANTIOXIDANT DEFENCE SYSTEM IN HUMANS WITH THEIR POTENT ANTIOXIDATIVE PROPERTIES.
PALM MIXED-CAROTENE COMPLEXES
FIT THE BILL WHERE CONSUMER,
RETAILER AND MANUFACTURER
DEMANDS FOR HEALTH, NATURAL AND
NUTRITION ARE CONCERNED.

It was found that high intake of carotenoids, particularly alpha-carotene, lutein and zeaxanthin is inversely associated with AMD. It is strongly believed that protection against photo-oxidative stress is related to the potent antioxidative properties of these macular carotenoids.

ATTENUATES RISK OF TYPE 2 DIABETES
Elevated levels of glucose or fatty acids induce production of free radicals and oxidative stress reactions, and diabetes occurs if increased plasma glucose or fatty acids persist in the long run.

In a study conducted in the Netherlands, a total of 37,846 men and women were recruited and followed up for a mean of 10 years. The participants’ dietary intakes of alpha-carotene, beta-carotene, beta-cryptoxanthin, lycopene, lutein and zeaxanthin, and sum of the carotenoids were assessed using food frequency questionnaire.

It was found that high intake of alpha-carotene and beta-carotene decreased the risks of type 2 diabetes among healthy men and women. Conversely, dietary intake of other individual carotenoids is not associated with diabetes risk.

In addition, another longitudinal cohort study demonstrates that long term high consumption of carotenoids especially pro-vitamin A carotenoids (alpha-carotene, beta-carotene and beta-cryptoxanthin) reduces the risk of type 2 diabetes.

A total of 1,073 males and females aged between 30 and 79 years were recruited in Mikkabi, Japan and they were followed up for 10 years. Serum carotenoids (alpha-carotene, betacarotene, beta-cryptoxanthin, zeaxanthin, lutein and lycopene) were analysed at the baseline and follow-up. Information on medical history, lifestyle, and estimated nutrient intake from diets were also assessed.

The results showed that high concentration of alpha-carotene, beta-cryptoxanthin and total provitamin A carotenoids (alpha-carotene, beta-carotene and beta-cryptoxanthin) reduced the risk of type 2 diabetes development significantly. Interestingly, the inverse association between serum carotenoid and risk of type 2 diabetes is not only observed in non-smokers and non-drinkers, but also in light drinkers.

INCREASES BONE DENSITY
In a cross-sectional study, 1,898 women and 933 men aged 50-75 years were recruited and the follow-up study was done after a mean interval of 3.1 years. Serum alpha-carotene, beta-cryptoxanthin, lycopene, zeaxanthin, and lutein in relation to bone mineral density (BMD) at different body areas were analysed.

The results demonstrated that high levels of alpha-carotene, lycopene and beta-cryptoxanthin are associated with increased BMD at most skeletal sites in women. Additionally, higher alpha-carotene level is significantly associated with higher BMD in total hip and its sub-regions. In fact, when comparing the highest and lowest intake of alpha-carotene among women, the increased mean BMD values were found at total hip, femur neck, and femur regions (i.e. trochanter and intertrochanter).

By contrast, high serum alpha-carotene is significantly associated with increased BMD at all sites except for lumbar spine in men. However, serum lutein and zeaxanthin showed no significant association with BMD in either sex.

This study showed that supplementation with a true natural mixed-carotene complex helps to support healthy bone function by improving bone mineral density.

CONCLUSION
In a nutshell, increased awareness among consumers and millennial health trends have increasingly led to the emphasis on the naturalness and nutritional values of the products. It eventually leads to an escalation of transparency in food or ingredient labelling in the market.

For this reason, consumers, retailers, and manufacturers have been progressively sourcing for natural food colourants—this is where palm mixed-carotene complexes fit the bill.

Palm mixed-carotene, apart from possessing a bouquet of mixed-carotenoids (alpha-, beta-carotene and lycopene) that function synergistically to confer unique health beneficial properties, is also a true natural food colourant with a valuable nutritional profile.