

Food Applications of Natural Carotene & Tocotrienol Rich Oils & Fats

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Introduction

Crude or Natural palm oil is a rich source of natural carotenes (500-700 ppm) [1] and vitamin E (600-1000 ppm) [2]. A patented, non-chemical and environmentally friendly process has been developed that retains more than 80% of the carotenes and vitamin E as tocopherols and tocotrienols, in the final products. Through a technology transfer agreement with Malaysian Palm Oil Board (MPOB), Carotino Sdn Bhd has commercialized this process. The manufacturing plant of Carotino Sdn Bhd in Pasir Gudang produces a wide range of Natural Carotene & Tocotrienol Rich Natural Carotene & Tocotrienol Rich Red Palm Oil products and the specifications of these products are shown in Table 1. The typical fatty acid compositions of the products are shown in Table 2.

Comment [MSOffice1]: Yap SC, Choo YM, Ooi CK, Ong ASH, Goh SH. Quantitative analysis of carotenes in the oil from different palm species. *Elaeis* 1991;3:309-18

Comment [MSOffice2]: Goh SH, Choo YM, Ong ASH. Minor constituents of palm oil. *J. Am. Oil Chem. Soc.* 1985; 62: 237-240

Product	FFA, %	M&I, %	IV	SMP, °C	Carotene, ppm	T+T3*, ppm
Oil	0.1 max	0.1 max	50-55	33-39	Approx 500	Approx 800
Olein	0.1 max	0.1 max	56 min	-	Approx 500	Approx 800
Stearin	0.1 max	0.1 max	31-40	44 min	Approx 250	Approx 450
Superolein	0.1 max	0.1 max	60 min	-	Approx 500	Approx 800
Midfraction	0.1 max	0.1 max	40-48	30-38	Approx 350	Approx 500

Table 1. Specifications of Natural Carotene & Tocotrienol Rich Red Palm Oil products.

* Tocopherols & Tocotrienols

Product	C12:0	C14:0	C16:0	C16:1	C18:0	C18:1	C18:2	C18:3	C20:0	C20:1
Oil	0.4	1.2	44.1	0.2	4.4	39.2	9.7	0.3	0.4	0.1
Olein	0.4	1.0	39.7	0.1	4.2	42.8	10.9	0.3	0.4	0.2
Stearin	0.1	1.3	53.0	0.1	5.3	30.7	8.7	0.3	0.4	0.1
Superolein	0.3	1.0	36.5	0.2	3.5	45.0	12.5	0.4	0.4	0.2
Midfraction	0.2	1.0	42.9	0.1	4.8	39.6	10.6	0.3	0.4	0.1

Table 2. Typical fatty acid compositions of Natural Carotene & Tocotrienol Rich Red Palm Oil products

These products meet all international specifications of refined oil except for color due to the presence of natural carotenes. A sensory evaluation showed that Natural Carotene & Tocotrienol Rich Red Palm Oil products are comparable to refined bleached and deodorized (RBD) palm oil products. [3]

Comment [MSOffice3]: Choo YM, Ma AN, Yap SC, Ooi CK, Basiron Y. Production and applications of deacidified and deodorized red palm oil. *Palm Oil Developments* 1993;19:30-4

Food Applications

A number of food applications have been commercialized with CAROTINO products in different parts of the world. An overview of some of these applications is:

Bakery Fats

Natural Carotene & Tocotrienol Rich Red Palm Oil based Shortenings & Margarine find excellent applications in the production of Trans Fatty Acid Free & Anti-Oxidant Rich Biscuits, Cookies, Crackers and a variety of Pastry Products. Tailor made formulations for specific applications have been developed and commercialized in many countries.

Natural colorant

It is only natural for Natural Carotene & Tocotrienol Rich Red Palm Oil to be used as a colorant. In this application, it plays a double role, that of the oil component as well as a coloring agent. The need to use an additional constituent as colorant is thus eliminated resulting in cost saving. Natural Carotene & Tocotrienol Rich Red Palm Oil can be used as a frying medium for potato chips for example, imparting a golden yellow color to the fried products. In margarine, Natural Carotene & Tocotrienol Rich Red Palm Oil gives the product a natural yellow color.

Functional Food

When Natural Carotene & Tocotrienol Rich Red Palm Oil is utilized as a component or an ingredient in the food industries, it converts a normal food product into a functional food. Here, Natural Carotene & Tocotrienol Rich Red Palm Oil acts as a carrier of pro-vitamin A and vitamin E to the consumer.

Substrate for Nutraceuticals

Natural Carotene & Tocotrienol Rich Red Palm Oil is rich in minor components such as carotenes, tocopherols, tocotrienols, squalene, sterols and coenzyme Q10. These components can be extracted, concentrated and packaged as nutraceuticals.

Animal Fat Replacement

In a time where globalization means comminuted meat products can be distributed anywhere in the world, availability of Red Palm Fat in the area of animal fat replacement is a good fortune. Red Palm Fat carries less microbial load and thus it is safer for consumption, it also reduces the cholesterol content of comminuted meat products. The fat does not require freezing cutting down storage costs. At the same time the final product becomes a functional food with the added carotenes and vitamin E.

Cooking/salad oil

Natural Carotene & Tocotrienol Rich Red Palm Oil based cooking/salad oil is marketed under the brand Carotino and is available in more than 10 countries worldwide. The cooking oil is endorsed by the Swiss Vitamin Institute for its contents of natural carotenes, tocopherols, tocotrienols and co-enzyme Q₁₀.

Nutritional and Medical Studies with Carotino Products

The nutritional and health impact of Natural Carotene & Tocotrienol Rich Red Palm Oil has been widely researched and much of the facts published are collected in a paper written by Dr D. Kritchevsky [5]. Some areas of the research are summarized in the following paragraphs.

Comment [MSOffice4]: Kritchevsky D. Impact of red palm oil on human nutrition and health. Food and Nutrition Bulletin 2000; Vol 21; No.2; 182-188.

To combat vitamin A deficiencies in children [6]

Dr Benade et al of The Medical Research Council of South Africa conducted a study to evaluate the effect of Natural Carotene & Tocotrienol Rich Red Palm Oil on the vitamin A status of primary schoolchildren. Four hundred 5- to 11-year-old children from an area where sub clinical vitamin A deficiency is prevalent underwent the 3-month trial. The children were randomly assigned to one of three groups; a group receiving a placebo biscuit, a group receiving a biscuit with synthetic β -carotene as a vitamin A fortificant and a group receiving a biscuit with Natural Carotene & Tocotrienol Rich Red Palm Oil as a source of natural β -carotene. After three months of intervention, the results showed Natural Carotene & Tocotrienol Rich Red Palm Oil based shortening used in biscuits effectively raised serum retinol concentrations.

Comment [MSOffice5]: M.E.van Stuijvenberg & A.J.S.Benade. South African experience with the use of red palm oil to improve the vitamin A status of primary schoolchildren. Food and Nutrition Bulletin, Vol 21, No.2, June 2000; 212-214.

To improve vitamin A status of lactating mothers and their infants [7]

This project was conducted to find a sustainable solution to vitamin A deficiency in Honduras. Dr Canfield et al supplemented groups of lactating mothers and their nursing infants with Natural Carotene & Tocotrienol Rich Red Palm Oil. Mothers who consumed Natural Carotene & Tocotrienol Rich Red Palm Oil had 2.1- and 2.5-fold increases in their serum and milk β -carotene concentrations respectively, and 2.8- and 3.2-fold increases in their serum and milk α -carotene concentrations respectively. Maternal supplementation with Natural Carotene & Tocotrienol Rich Red Palm Oil resulted in significant increases of infant serum retinol concentrations.

Comment [MSOffice6]: Canfield LM, Kaminsky RG. Red palm oil in the maternal diet improves the vitamin A status of lactating mothers and their infants. Food and Nutrition Bulletin 2000; Vol 21, No.2: 144-148

Atherosclerosis Reduction [8]

The effects of Natural Carotene & Tocotrienol Rich Red Palm Oil and RBD palm olein on experimental atherosclerosis in rabbits were compared by Dr Kritchevsky et al. Each group of 8 rabbits was fed a semi purified diet containing 0.2% cholesterol for 65 days. The rabbits fed with Natural Carotene & Tocotrienol Rich Red Palm Oil suffered significantly less severe atherosclerosis.

Comment [MSOffice7]: Kritchevsky D, tepper SA, Kuksis A. Effects of palm oil, randomized palm oil and red palm oil on experimental atherosclerosis. FASEB J. 1999; 13: A213.

Cancer Prevention and Control [9]

Dr Murakoshi et al found that palm carotenes, which consist of 60% beta-carotene, 30% alpha-carotene and 10% others, behave in a synergistic manner to inhibit carcinogenic activities in mouse carcinogenesis models. In their study on two-stage

Comment [MSOffice8]: Murakoshi M, Nishino H. Proceedings of the 1999 PORIM International Palm Oil Congress (Nutrition): 232

mouse lung and skin carcinogenesis, and mouse spontaneous liver carcinogenesis models, palm carotenes showed stronger inhibitory activity than alpha-carotene and beta-carotene individually.

Minor Components in Natural Carotene & Tocotrienol Rich Red Palm Oil

Minor components found in Natural Carotene & Tocotrienol Rich Red Palm Oil besides carotenes and vitamin E, which are gaining prominence are sterols and ubiquinones. Plant sterols or phytosterols are important because they have great potential in the pharmaceutical industry [10] and sitosterol is known to be hypocholesterolemic [11].

Sterol	Crude palm oil [12]	Red palm olein [13]
Cholesterol	2.7-13	6.6-11.5
Campesterol	46.4-150	76-83
Stigmasterol	26.3-65.7	59-64
Sitosterol	120-369.5	187-218
Unknown	2-21	<6
Total	210-620	325-365

Table 4. Sterol composition (ppm).

Ubiquinone-10 is better known as coenzyme Q₁₀. The quinol form of the compound has been shown to be even more potent as an antioxidant than vitamin E [14].

Ubiquinone	Crude palm oil [15]	Red palm olein [13]
Ubiquinone-10	10-80	18-25

Table 5. Ubiquinone content (ppm)

Crude palm oil contains 537-659 ppm of squalene while RBD palm oil still retains 478-791 ppm of squalene [16]. It follows that Natural Carotene & Tocotrienol Rich Red Palm Oil would retain similar or higher quantities of squalene than RBD palm oil and further work should be done to confirm it.

Conclusion

Natural Carotene & Tocotrienol Rich Natural Carotene & Tocotrienol Rich Red Palm Oil (CAROTINO) products find excellent applications in many Food Products. To Food manufacturers they offer the following unique advantages:

- i) A rich source of Natural Anti-Oxidants particularly Carotenoids & Tocotrienols
- ii) All products are Free from harmful Trans Fatty Acids and are GMO Free as well.
- iii) End Food Products can improve their Nutritional claims by highlighting the % RDA of Vitamin A (from Carotenoids) and Vitamin E.
- iv) The Nutritional & Medical benefits of CAROTINO supported by research can be used to drive the Ad & PR messages of end food products
- v) The presence of natural anti-oxidants would also improve the shelf life of the finished food Products.

Comment [MSOffice9]: Welzel P, Hobert K, Ponty A, Mikova T. Tetrahedron Lett. 1983; 24: 3199

Comment [MSOffice10]: Farquhar JW. Plant Sterols: Spiller GA (Ed). Their biological effects in humans. In: Handbook of lipids in human nutrition 1996: 101-105

Comment [MSOffice11]: Siew WL. Palm oil sterols. Palm Oil Developments 1990; 18: 23-4

Comment [MSOffice12]: Bonnie TYP, Choo YM. Valuable minor constituents of commercial red palm olein: carotenoids, vitamin E, ubiquinones and sterols. Proceedings of the 1999 PORIM International Palm Oil Congress (Chemistry and Technology): 97-108

Comment [MSOffice13]: Kagan V, Serbinova E, Packer L. Biochem. Biophys. Res. Comm. 1992; 16:851-857

Comment [MSOffice14]: Hamid AH, Choo YM, Goh SH, Khor HT. The ubiquinones of palm oil. In Nutrition, Lipids, Health, and Disease (Ong ASH, Nike E, Packer L, eds) 1995: 122-128

Comment [MSOffice15]: AB Gapor, M Sulong, Meriam H, Rokiah AHR. Palm squalene: a valuable component of palm oil. Proceedings of the 1999 PORIM International Palm Oil Congress

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