

# PROCESS FOR RECOVERY OF PALM CAROTENE CONCENTRATE

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**T**he orange red colour of crude palm oil is due to the presence of the natural colour pigment called carotenes. In fact, palm oil is one of the richest source of natural carotenes.

The major carotenes found in crude palm oil are the carotene (35%) and  $\beta$ -carotene (56%). The concentration of carotene in crude palm oil ranges from 500-700 ppm. Malaysia produced 8.3 million tonnes of palm oil in 1998 and the production is expected to increase in the near future. This translates into potential availability of more than 4000 tonnes of natural carotenes. In view of the economic value and nutritional importance of natural carotenes, PORIM has developed a process to extract these carotenes from palm oil (Ooi *et al.*, 1998).

## PRODUCTION TECHNOLOGY

The technology to recover carotenes from crude palm oil is a three-stage process. The three stages are:

- i. transesterification of palm oil into alkyl esters, distillation of alkyl esters to produce carotene concentrate and
- iii. purification of carotene concentrate.

The transesterification is carried out through a mild reaction. The results are that the carotenes, vitamin E and other minor components originally present in crude palm oil remain intact in the alkyl esters (Choo *et al.*, 1988). The reaction also produces glycerol, a co-product that can be easily separated. The carotene content of the esters is about 600ppm.

The second stage of the process is the distillation of the alkyl esters using short path distillation (Ooi *et al.*, 1998a; 1994). This process is carried out under vacuum of 10-20 mTorr and temperature of 160°C-180 °C. Under these conditions, the bulk of the esters

are removed and the carotenes concentrated in the other fraction. Most of the carotenes (more than 90%) are retained in the concentrate. The concentrate contains 2%-8% of carotenes. The by-product from this stage is the distilled methyl esters which can be used as oleochemical feedstock.

The last stage of the process involves the separation and purification of the carotene concentrate through column chromatography technique to give high carotene concentration fraction (Ooi *et al.*, 1998b). One important feature of this process is the use of shorter column as compared to normal chromatography. The carotene concentration of this fraction ranged from 80%-100%. This can then be diluted or formulated to various carotene products.

## ADVANTAGES OF THE PROCESS

1. Conversion of crude palm oil to methyl esters does not destroy the carotenes
2. Recovery of distilled methyl esters, one of the downstream products for the oleochemical industry.
3. Using short chromatography column for separation and purification stage reduces processing time.
4. The adsorbent can be recycled and reused.
5. Solvents used in the process can be recovered and reused.

## IMPORTANCE OF CAROTENES

Natural carotenes are gaining importance as nutritional supplement. Numerous studies have shown that various carotenes possess antioxidant and anti-cancer properties. Studies have also shown that increased carotene intake can reduce the risk of cancer growth and offer protection against some common diseases such as cardiovascular and degenerative diseases. One of the protective actions is through its

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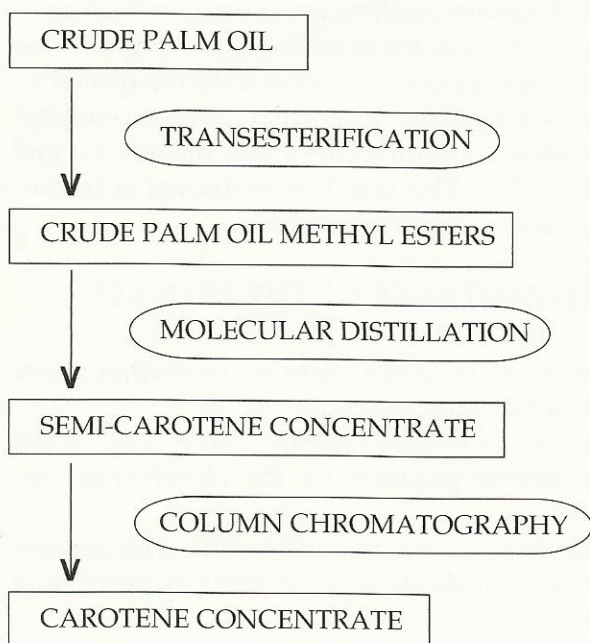




## CAROTENE COMPOSITION (%) OF CRUDE PALM OIL (CPO) AND CAROTENE CONCENTRATE (CaC)

Carotenes	CPO	CaC
Phytoene	1.3	2.8
Phytofluene	0.1	-
cis- $\beta$ -Carotene	0.7	2.1
$\beta$ -Carotene	56.0	47.4
$\alpha$ -Carotene	35.1	31.1
cis- $\alpha$ -Carotene	2.5	5.7
$\zeta$ -Carotene	0.7	0.8
$\delta$ -Carotene	0.3	0.8
$\gamma$ -Carotene	0.8	0.6
Neurosporene	0.3	1.0
cis-Neurosporene	-	0.4
$\alpha$ -Zeaxarotene	0.7	0.1
cis- $\alpha$ -Zeaxarotene	-	0.1
$\beta$ -Zeaxarotene	0.2	1.3
Lycopene	1.3	1.1
cis-Lycopene	-	2.2
Others	-	2.0
Concentration(%)	0.06	80.0

### CAROTENE RECOVERY PROCESS



antioxidant activity against cellular oxidation and singlet oxygen quencher.  $\beta$ -Carotene,  $\alpha$ -carotene, lycopene and phytoene, have been reported to possess anti-cancer properties (Norman and Tapan, 1988; Suda *et al.*, 1986; Mathews-Roth and Krinsky, 1987; Peto *et al.*, 1981; Santamaria and Bianchi, 1989; Bendich, 1990; 1989; Bianchi-Santamaria *et al.*, 1992).

### APPLICATION OF CAROTENE CONCENTRATE

1. Natural food colourant.
2. Nutritional supplement in the pharmaceutical industry.

## CONCLUSION

The technology for the recovery of palm carotene is available for transfer to the industry.

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