UNIVERSITI PUTRA MALAYSIA

CAROTENE EXTRACTION FROM CRUDE PALM OIL USING SYNTHETIC ABSORBENTS

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By

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Degree of Master of Science in the Faculty of
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Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

CAROTENE EXTRACTION FROM CRUDE PALM OIL USING SYNTHETIC ADSORBENTS

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September 2000

Chairman : Assoc. Prof. Badlishah Sham Baharin, M.Sc.

Faculty : Food Science and Biotechnology

Crude palm oil (CPO) has the highest content of carotenoids (500 - 700 ppm), a precursor of vitamin A. The only commercially viable method, so far, is transesterification followed by phase separation. However, the edible oil used as raw material has to be converted to methyl ester, therefore destroying the oil into non-edible product.

The present study on carotene extraction from CPO focussed on adsorption using synthetic adsorbent followed by solvent extraction. By this method, the carotene can be recovered without destroying the oil therefore it can be used for food applications. The

objectives of this study were mainly to find out the suitable adsorption process that selectively extracts the carotene from CPO and to determine the effect on CPO quality after going through this process.

Based on the studies conducted, it was found that the synthetic adsorbent SP850, SP825, HP20, Relite Exa 32 and Relite Exa 50 were capable of adsorbing carotene from CPO. The percentage of carotene extracted varied from 10 to 80% with the carotene concentration ranging from 1000 to 20,000 ppm depending on the process conditions. Combinations of adsorbent HP 20 and SP 850 slightly increased the percentage of carotene extracted. Adsorbent/CPO ratio of 4 was most suitable for this process for optimum recovery and concentration of carotene. The minimum adsorption time required was 0.5 hr. The IPA extraction time was determined based on the final carotene concentration required. The suitable temperature for adsorption and solvent extraction process was at 40°C. There is no significant different on the percentage of carotene extracted and carotene concentration between with and without agitation during IPA extraction process.

The quality of CPO after going through the carotene extraction process slightly deteriorated in terms of moisture content, impurities, peroxide value (PV), anisidine value (AV), discriminant function (DF) and deterioration of bleachability index (DOBI). However, changes in the chemical properties of the oil such as triglyceride (TG)

carbon number and fatty acid composition (FAC) and it can be refined to produce refined bleached deodorized palm oil (RBDPO) that is able to meet Palm Oil Refinery Association of Malaysia (PORAM) standard specifications.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENGEKSTRAKAN KEROTIN DARIPADA MINYAK SAWIT MENTAH

OLEH

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Minyak sawit mentah (CPO) mengandungi *carotenoids* pemula untuk Vitamin A yang paling tinggi (500-700 ppm). Setakat ini hanya kaedah *transesterification* diikuti dengan pengasingan berperingkat telah dimajukan secara komersial. Walaubagaimanapun minyak yang digunakan sebagai bahan mentah akan diubah kepada *methyl ester*, mengakibatkan pemusnahan minyak kepada bahan bukan makanan.

Kajian pengekstrakan kerotin dari CPO ini menumpukan penggunaan bahan penjerap sintetik melalui proses penjerapan diikuti dengan pengekstrakan pelarut. Kaedah ini akan mengekstrak kerotin tanpa merosakkan minyak, oleh itu ianya boleh digunakan untuk

penggunaan bahan makanan. Tujuan utama kajian ini dijalankan adalah untuk menentukan sistem penjerapan yang sesuai dimana ianya akan menjerap hanya kerotin daripada CPO dan menentukan kesan ke atas kualiti CPO selepas menjalani proses tersebut.

Berdasarkan daripada kajian yang dijalankan, didapati bahan penjerap SP850, SP825, HP20, Relite Exa 32 dan Relite Exa 50 berkemampuan untuk menjerap kerotin dari CPO. Peratus pengekstrakan kerotin adalah diantara 10% hingga 80% dimana kepekatannya adalah diantara 1,000 hingga 20,000 ppm bergantung kepada keadaan proses. Peratus pengekstrakan kerotin bertambah sedikit dengan menggunakan gabungan bahan penjerap HP 20 dan SP 850. Nisbah bahan penjerap/CPO pada kadar 4 adalah keadaan prosess yang paling sesuai untuk mendapatkan kepekatan dan kadar peratusan pengekstrakan kerotin yang optimum. Masa penjerapan minima yang diperlukan adalah pada 0.5 jam. Masa pengekstrakan IPA ditentukan berdasarkan kepada kepekatan kerotin yang dikehendaki. Suhu yang sesuai bagi proses penjerapan dan pengekstrakan pelarut adalah pada 40^{o}C. Peratus pengekstrakan kerotin dan kepekatan kerotin tidak berubah samada dengan menggunakan pengacau atau tidak semasa proses pengekstrakan IPA.

Kualiti CPO selepas menjalani proses pengesktrakan kerotin didapati mengalami sedikit penurunan terutamanya kandungan kelembapan, bendasing, nilai pengoksidaan (PV), nilai anisidine (AV),

fungsi diskriminen (DF) dan indeks penurunan pelunturan (DOBI). Walaubagaimanapun tiada perubahan di dalam bahan-bahan kimia minyak itu seperti TG dan FAC, dan ianya boleh menjalani proses penjernihan untuk menghasilkan minyak tulin, terluntur dan ternyabau (RBDPO) yang memenuhi spesifikasi Piawaian Persatuan Pengilang-Pengilang Kelapa Sawit Malaysia (PORAM).

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I certify that an Examination Committee met on 22 September, 2000 to conduct the final examination of Razam Abd. Latip on his Master of Science thesis entitled "Carotene Extraction from Crude Palm Oil using Synthetic Adsorbents" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and was accepted as fulfillment of the requirements for the degree of Master of Science.

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

(RAZAM ABD. LATIP)

Date: 9.11.2000

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CHAPTER I

GENERAL INTRODUCTION

According to Goh (1991) palm oil is composed predominantly of triglycerides (TG) (and partial gylcerides), with minor constituents of carotenoids (mainly α- and β-carotene), tocopherols, tocotrienols, sterols (e.g. cholesterol), phospholipids, triterpenes phospholipids and aliphatic hydrocarbons. Carotenoids and vitamin E are the principal minor components (Ooi, 1995) and they are known to possess important nutritional and physiological properties.

According to Choo et al., (1989) the concentration of carotene in palm oil can range from 400 ppm to 4600 ppm, depending on the species of the palm fruit from which the oil is obtained. The commercial Malaysian crude palm oil (CPO) contains about 500 ppm to 700 ppm (Jacobsberg, 1974 and Goh et al., 1985) of carotenoids with α- and β-carotene formed up to 90% of the total carotenoids.

Carotenes, in particular β-carotene, are known for their pro-vitamins A activities as they can be transformed into Vitamin A *in vivo*. The vitamin A equivalents of α-, β- and γ-carotenes and β-zeacarotenes are 0.9, 1.67,