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EFFECTS OF THREE EXTRACTION METHODS ON RECOVERY, QUALITY, STORAGE STABILITY AND FRYING CHARACTERISTICS OF COCONUT OIL

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By

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EFFECTS OF THREE EXTRACTION METHODS ON RECOVERY, QUALITY, STORAGE STABILITY, AND FRYING CHARACTERISTICS OF COCONUT OIL

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Chairman : Yaakob Bin Che Man, Ph.D

Faculty : Faculty of Food Science and Biotechnology

Three improved methods for coconut oil extraction using acetic acid, a baker's yeast, and mixed enzymes with respect to oil recovery, quality, storage stability, and frying characteristics were investigated. In the initial process, cream was separated from the coconut milk. Treatment of the cream with 0.1 - 0.4% acetic acid or 0.5 - 2 g baker's yeast for 10 - 14 hrs resulted in further separation of the cream into two phases; the upper phase containing oil-rich fraction and the lower phase consisting of aqueously fraction. The oil phase was finally boiled for 20 minutes to remove moisture. The other extraction method was based on the combined action of

cellulase, α-amylase, protease, and polygalacturonase at 0.1 to 1% on grated coconut meat at pH 4 to 8, 40° to 60°C for 30 minutes and centrifugation at 10,000 rpm.

Oil recovery by acetic acid treatment ranged from 58.25 to 61.02%. The quality of the oil extracted was characterised by the following : moisture content ranged from 0.13 to 0.20%, free fatty acid (FFA), 0.035 to 0.061%, peroxide value, 0.16 to 0.20 meq. oxygen/kg, anisidine value, 0.027 to 0.030 (1,000 x abs.), iodine value, 8.08 to 8.6, saponification value, 260 to 262, and the colour at 0.7 (Y + 5R). A similar result was obtained by baker's yeast treatment. The oil recovery by mixed enzymes treatment ranged from 53.26 to 73.83%. The quality of the oil was characterised by the following: moisture content, 0.11 %, FFA ranged from 0.051 to 0.054%, peroxide value, 0.016 to 0.018 meq. oxygen/kg, anisidine value, 0.026 to 0.028 (1,000 x abs.), iodine value, 8.1 to 8.4, saponification value, 260 to 262, and the colour at 0.6 (Y + 5R).

After three months' storage in polyethylene terephtalate (PET), opaque polyvinyl chloride (PVC) bottles, and cans at 25° and 40 °C, the extracted coconut oil from the three improved methods showed a high degree of stability against oxidation.

There was a slight increase in peroxide and anisidine values during storage, but these changes did not alter the quality characteristics of the oils.

Oils stored in PET bottles for three months at 40°C were shown to have excellent frying characteristics during repeated frying for five consecutive days using potato French fries. The FFA content was lower than 3%, and the smoke point was higher than the temperature used for frying operation. The potato fries were well accepted by the sensory panelists.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi syarat untuk mendapatkan Ijazah Master Sains.

KESAN TIGA KAEDAH PEMERAHAN KEATAS PENGHASILAN, KUALITI, KESTABILAN SEMASA PENYIMPANAN, DAN CIRI-CIRI PENGORENGAN MINYAK KELAPA

Oleh

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Tiga kaedah pemerahan minyak kelapa yang telah diperbaiki dengan menggunakan asetik asid, yis roti, dan campuran enzim dari segi penghasilan, kualiti dan kestabilan semasa penyimpanan dan ciri-ciri penggorengan telah dikaji. Pada awal proses, krim diasingkan daripada santan kelapa. Rawatan kepada krim pada paras 0.1 - 0.2% asid acetic atau 0.5 - 2 g yis roti menyebabkan pengasingan krim lebih lanjut kepada dua fasa; fasa atas mengandungi sebatian kaya dengan minyak dan fasa di bawah berupa bahagian berair. Fasa minyak pada akhirnya dimasak selama 20 minit untuk mengwapkan air yang dikandunginya. Kaedah lain yang digunakan berasaskan kepada gabungan aktiviti

daripada enzim selulase, α-amilase, protease, dan poligalakturonase pada paras 0.1 - 1% kepada kelapa parut pada pH 4 - 8, suhu 40° - 60°C selama 30 minit dan pengemparan pada 10,000 psm.

Penghasilan minyak dengan rawatan asid asetik mempunyai julat 58.25 - 61.02%. Kualiti minyak yang diperolehi mempunyai ciri-ciri berikut : kandungan lembaban berjulat 0.13 - 0.20%; asid lemak bebas (ALB), 0.035 - 0.062%, nilai peroksid, 0.16 - 0.20 meq. oksigen/kg; nilai anisidin, 0.027 - 0.030 (1,000 x abs.); nilai iodin, 8.08 - 8.6; nilai pensabunan, 260 - 262; dan warna pada 0.7 (Y + 5R). Hasilan seumpama itu juga diperolehi dengan rawatan yis roti. Penghasilan minyak berasaskan rawatan campuran ensim berjulat 53.26 - 73.83%. Kualiti daripada minyak yang diperolehi mempunyai ciri-ciri berikut : kandungan lembapan 0.11%; ALB, 0.051 - 0.054%; nilai peroksid, 0.016 - 0.018 meq. oksigen/kg; nilai anisidin, 0.026 0.028 (1,000 x abs.); iodin value, 8.1 - 8.4, nilai pensabunan, 260 - 262, dan warna pada 0.6 (Y + 5R).

Setelah disimpan selama tiga bulan dalam botol-botol polyethylene terephtalate (PET), polyethylene klorid (PVC) yang gelap, dan tin pada suhu 25° dan 40°C, minyak yang diperoleh dari tiga kaedah pemerahan yang diperbaiki menunjukkan kestabilan yang tinggi terhadap pengoksidaan. Didapati sedikit

kenaikan nilai pereoksid dan nilai anisidin selama penyimpanan, tetapi perubahan itu tidak mengubah ciri-ciri kualiti minyak.

Minyak kelapa yang telah disimpan di dalam botol PET pada suhu 40°C selama tiga bulan menunjukkan prestasi penggorengan yang baik semasa penggorengan berulang-ulang selama lima hari keatas kepingan ubi kentang. Kandungan ALB lebih rendah daripada 3% dan titik asap lebih tinggi daripada suhu yang digunakan dalam penggorengan. Kepingan ubi kentang yang telah digoreng diterima dengan baik oleh ahli panel.

CHAPTER I

INTRODUCTION

Coconut oil is the most valuable of coconut products. In 1974 it constituted about 6% of the total oils and fats entering the world market (Khera, 1978). Ten years later its share increased to a little over 10% (Thampan, 1984). Coconut oil ranks sixth in the world vegetable oil production and fourth in international edible oil trade (Robbelen *et al.*, 1989).

There are three processes available for coconut oil extraction i.e. wet processing, dry processing, and solvent extraction processing. Wet processing is a method for obtaining oil via the coconut milk route. This process can be carried out both by traditional method using common kitchen utensils and modern method using hydraulic press or screw press and centrifuge. However, until now there is no indication that the modern method is commercially successful (Child, 1974; Hagenmaier, 1980; Thampan, 1984).

Dry processing is a method for obtaining oil by extracting and purifying oil from copra or dried coconut meat. In standard milling process, copra with moisture content of 5-6% is cleaned, ground, and steamed for conditioning and then fed into either hydraulic or screw press for extraction of the oil.

The extracted oil is further refined by neutralisation, bleaching, and deodorisation.

Solvent extraction processing utilises an appropriate solvent such as benzene and n-hexane for extracting the oil. The oil recovery is very high, but due to high risk and investment involved, this method is very rarely applied.

Even though the more efficient and modern wet processes are available such as the Tropical Product Institute (TPI) process and the Modified Solvol (MS) process, the traditional wet processing of fresh coconut meat into oil is still practised in Malaysia, Indonesia, Thailand, the Philippines and many other coconut producing countries. There are slight process variations in various countries, which may result in oil of variable quality and quantity (Loo, 1982; Banzon and Velasco, 1982).

Generally, the oil recovered by traditional wet process is considerably low between 30 - 40% (Thieme, 1968). Moreover, the quality of oil is also poor due to the high moisture content, darker colour, and shorter shelf-life (Hagenmaier, 1980). This process is also energy and time consuming (Loo, 1982; Hagenmaier, 1980). However, the traditional process is easy to handle, the oil has a pleasant aroma and the free fatty acid (FFA) content is low (Loo, 1982).

To improve the quantity and quality of the oil extracted by the traditional method, alternative extraction methods using acetic acid, a baker's yeast, and mixed enzymes are investigated. The objectives of this study are: (1) to investigate the effect of acetic acid, a baker's yeast, and mixed enzymes on the quantity and quality of the coconut oil extracted, (2) to study their storage stability, and (3) to study the frying characteristics of the extracted oils.

CHAPTER II

LITERATURE REVIEW

Introduction

Coconut (*Cocos nucifera* L.) is one of the most useful trees in the world. It plays an important role in the daily life of the people living in the humid tropical regions (Ohler, 1984). In 1981, Asian countries produced 84% of the world coconut. The remaining 16% were almost equally distributed among other producing regions: Africa 4.1%, Oceania 6.2%, and Latin America, 5.7% (Ohler, 1984).

Statistical data issued by the Asian and Pacific Coconut Community (A.P.C.C.) showed that the hectarage of coconut area in Asian and Pacific countries in 1988 was 10,148,000 ha (A.P.C.C., 1989). The distribution of coconut area, coconut production, and coconut oil export in this area is presented in Table 1.

Botany

The coconut palm is tall and can reach a height of about 15-30 m when fully matured. It has a smooth, light grey stem rising from a swollen base and topped by a beautiful green crown of long pinnate leaves with heavy bunches of nuts growing from the leaf axils. It belongs to the family of the *palmae*.

Table 1

Coconut Area, Production, and Coconut Oil Export in Asian and Pacific Coconut Community Countries

Country	Area, ha	Production, tonnes copra equivalent	Coconut oil export, tonnes
I n d i a	1,429,000	1,129,000	-
Indonesia	3,444,000	2,053,000	306,647
Malaysia	289,000	130,000	55,005
P a l a u	14,000	14,000	5,000
Papua New Guinea	260,000	181,000	36,247
Philippines	3,360,000	1,849,000	792,880
Solomon Island	63,000	46,000	-
Sri Lanka	419,000	393,000	5,350
Thailand	407,000	294,000	-
Western Samoa	303,000	30,000	-

Source: Asian and Pacific Coconut Community Statistical Year Book (1989).

Within the tribe of Cocoidae, it is the sole species in the genus Cocos. Formerly, more than sixty species mostly from Central and South America, were included in the genus Cocos. Taxonomic studies and investigations of monocotyledon anatomy show Cocos nucifera to be monotypic. However, different varieties and cultivaars are recognised. These can be divided into two groups, the tall and dwarf coconuts (Ohler, 1984).