DEVELOPMENT OF MARGARINE USING VIRGIN COCONUT OIL

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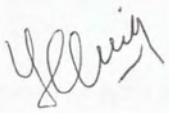

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ABSTRACT

This study was carried out to develop margarine using virgin coconut oil (VCO) mixed with hard fats palm stearin (PS). Five formulations were developed with different ratios of oil blending. The ratios utilized were 35VCO: 65PS, 45VCO: 55PS, 55VCO: 45PS, 65VCO: 35PS and 75VCO:25PS. Hedonic test was performed and formulation F5 was chosen as the best formulation. Formulation F5 with 75% virgin coconut oil and 25% palm stearin had the highest mean score for almost all the attributes being tested such as glossiness, taste, saltiness, texture and overall acceptance. Moisture content determination was conducted upon this formulation and was found to contain $11.25 \pm 0.10\%$ moisture. Iodine value of this sample was $37.89 \pm 0.10\%$. Peroxide value results showed that there was an increase in the value during the six weeks of the storage period. The total plate count, total yeast and mold count was 6.24×10^5 cfu/ml and 3.10×10^3 cfu/ml, respectively. Texture profile analysis (TPA) results showed that towards eight weeks, the product became harder. Consumer test showed high market potential whereby 88% of respondents were willing to buy this product if it is marketed. In conclusion, the development of this virgin coconut oil margarine was a success due to the fact that it was widely accepted by consumers.

ABSTRAK

Pembangunan Marjerin Minyak Kelapa Dara

Kajian ini dijalankan untuk menghasilkan marjerin yang terdiri daripada minyak kelapa dara (VCO) dan dicampur dengan palm stearin (PS) yang bersifat keras semula jadi. Sebanyak lima formulasi dibangunkan dengan campuran minyak kelapa dara dan palm stearin pada nisbah yang berbeza. Nisbah yang digunakan ialah 35VCO: 65PS, 45VCO: 55PS, 55VCO: 45PS, 65VCO: 35PS dan 75VCO:25PS. Ujian Hedonik dijalankan dan formulasi F5 telah dipilih sebagai formulasi terbaik. Formulasi F5 dengan campuran 75% minyak kelapa dara dan 25% palm stearin mempunyai min skor yang tertinggi dalam hampir semua atribut yang diuji, termasuk kekilatan, rasa, kemasinan, tekstur dan penerimaan keseluruhan. Penentuan kandungan kelembapan telah dijalankan ke atas formulasi ini dan dilihat bahawa sampel ini mengandungi 11.25$\pm$ 0.10% kelembapan. Nilai iodin bagi sampel ini ialah 37.89 $\pm$ 0.10%. Nilai peroksida menunjukkan peningkatan sepanjang tempoh penyimpanan selama enam minggu. Jumlah kiraan plat adalah 6.24 x 10^5 cfu/ml manakala jumlah kiraan kulat dan yis adalah sebanyak 3.10 x 10^3 cfu/ml. Analisis tekstur profil (TPA) bagi tekstur (kebolehsapuan) marjerin sepanjang lapan minggu menunjukkan marjerin semakin keras. Ujian pengguna menunjukkan potensi pasaran yang tinggi dengan 88% responden menyatakan bahawa mereka akan membeli produk ini sekiranya produk ini dipasarkan. Kesimpulannya, pembangunan marjerin minyak kelapa dara ini adalah berjaya kerana produk ini luas diterima oleh pengguna.

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LIST OF ABBREVIATIONS

AOAC	Association of Official Analytical Chemists
ANOVA	Analysis of Variance
SPSS	Statistical Programme for Social Science
MAG	Monoacylglycerol
DAG	Diacylglycerol
TFA	Trans Fatty Acid
MCFA	Medium Chain Fatty Acid
FFA	Free Fatty Acid
GAE	Gallic Acid Equivalents
VCO	Virgin Coconut Oil
RBD	Refined, Bleached and De-odourised
RBDCO	Refined, Bleached and Deodorized Coconut Oil
HDL	High Density Lipoprotein
LDL	Low Density Lipoprotein
VLDL	Very Low Density Lipoprotein
FDA	Food and Drug Administration
USDA	United States Department of Agriculture
SSMP	Sekolah Sains Makanan dan Pemakanan
SFC	Solid Fat Content
SMP	Slip Melting Point
SFI	Solid Fat Index
NMR	Nuclear Magnetic Resonance
GRAS	Generally Recognized As Safe
EDTA	Ethylenediaminetetraacetic Acid

IV	Iodine Value
PV	Peroxide Value
HDP	Heavy Duty Platform
SR	Spreadability Rig
TPC	Total Plate Count
PDA	Potato Dextrose Agar
PCA	Plate Count Agar

LIST OF UNITS

°C	degrees Celsius
°F	degrees Fahrenheit
mm	millimeter
μm	micrometer
g	gram
ml	milliliter
min	minutes
N	normality
kPa	kilopascal
ppm	parts per million
psi	per square inch
Bar	unit of pressure equals to 100 kilopascals
G	unit of acceleration
meq	milliequivalents
cfu	colony forming unit

LIST OF SYMBOLS

α	alpha
β	beta
β'	beta prime
%	percent
$<$	less than
$>$	more than
$\leq$	less than or equal to
$\geq$	more than or equal to

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CHAPTER 1

INTRODUCTION

1.1 Background

Margarine is a flavored food product containing 80% fat. It is made by blending selected fats and oils with other ingredients and is fortified with vitamin A to produce a table, cooking, or baking fat product that serves the purpose of dairy butter but is different in composition and can be varied for different applications (Riepma, 1970). Margarine and table spreads are water-in-oil emulsions. The aqueous phase consists of water, salt, and preservatives (Faur, 1996). The oil phase, which contributes to the polymorphic behavior of margarine, is a blend of oils and fats (Chrysam, 1996). Lecithin, distilled MAG, and distilled DAG are common emulsifiers added to the fat phase together with flavoring agents, antioxidants, and coloring agents.

Commercially available margarines are prepared by using hydrogenated fat. Oils suitable for margarine production can be prepared by co randomization of fat blends such as palm oil, coconut oil, and other similar oils (Wai-Lin, 2002). Physical blends, interestified mixtures of coconut oil and palm oil are used as margarine base/shortenings (Barison, 1996). It has been reported that palm oil tends to crystallize in the β' forms desirable for shortenings and have been used along with other oils (Ramli *et al.*, 2008).

Margarine was developed to fill both an economic and a nutritional need when it was first made as a butter substitute. Its growth in popularity has occurred because it can be physically altered to perform in many varied applications. Over 10 different types of margarines are produced today, including regular, whipped, soft tub, liquid, diet, spread, *trans*-fatty-acid-free, no fat, restaurant, baker's, and specialty, all of which are packaged in as many different packages. These

margarines are made from a variety of fats and oils, including soybean, cottonseed, palm, corn, canola, safflower, sunflower, lard, and tallow (Laia *et al.,* 2000). Margarine products cater to the requirements of all the different consumers: retail, foodservice, and food processor.

Most margarines are prepared from partial hydrogenation where trans fatty acid (TFA) formation is inevitable. Several studies with conflicting results have been reported on the health effects of trans fatty acids; although these studies are still controversial, trans fatty acids are associated with coronary heart disease (Willett and Ascherio, 1994; Lichtenstein, 1993; Mensink and Katan, 1990). Similarly, TFA has a negative impact on plasma lipoprotein profile by lowering high-density lipoprotein cholesterol and raising low-density lipoprotein cholesterol (Mensink and Katan, 1990). Fats, such as palm stearin and lauric oils, have been used to produce zero-trans margarine (Kok *et al.*, 1999).

The Philippine National Standard for Virgin Coconut Oil (VCO) (PNS/BAFPS 22:2004/ICS 67.2000.10) officially defines VCO as oil obtained from the fresh, mature kernel (meat) of the coconut by mechanical or natural means, with or without the use of heat, without undergoing chemical refining, bleaching or de-odourising, and which does not lead to the alteration of the nature of the oil. VCO is suitable for human consumption without the need for further processing. VCO consists mainly of medium-chain triglycerides, which are resistant to peroxidation. The saturated fatty acids in VCO are distinct from animal fats, the latter consisting mainly of long-chain saturated fatty acids (Bawalan and Chapman, 2006).

VCO is the purest form of coconut oil, essentially water-clear or colourless. It contains natural Vitamin E and has not undergone any hydrolytic and atmospheric oxidation as demonstrated by its very low, free fatty acid (FFA) content (even without refining) and low peroxide value. It has a fresh coconut aroma that can be mild to intense depending on the oil extraction process used (Dayrit, 2003).

VCO differs greatly from traditionally produced, copra-derived coconut oil, which must undergo chemical refining, bleaching, and de-odourisation processes to make it suitable for human consumption (Bawalan, and Chapman, 2006). RBD (refined, bleached, and de-odourised) coconut oil made from copra, is yellow in colour, odourless, tasteless, and does not contain natural Vitamin E, since this is removed when the oil is subjected to high temperature and various chemical processes (Dolendo, 1967).

The degree of saturation and length of the carbon chain of the fatty acids comprising a particular fat or oil determines its properties, corresponding uses, and its effects on human health. The more saturated the fat and the longer the chain, the harder the fat and the higher the melting point (Fife, 2001). Coconut oil is unique amid fats and oils, as it contains the highest percentage of medium-chain fatty acids (MCFA) with a carbon chain length of 8 to 12 carbon atoms. VCO behaves and metabolises differently in the human body to other saturated and unsaturated fats or oils. MCFA in coconut oil is about 64%, with lauric fatty acid (C12) as the highest ranging from 47 to 53% depending on the coconut variety (Bawalan and Chapman, 2006).

The most significant physical property of coconut oil is that unlike most fats, it does not exhibit gradual softening with increasing temperature, but passes rather abruptly from a brittle solid to a liquid within a narrow temperature range. Coconut oil is liquid at 27 °C or higher and solidifies at about 22 °C when it has the consistency of butter in temperate countries (Hagenmaier, 1980).

Coconut oil has been used for centuries as a vital source of food for health and general well being in traditional communities of tropical regions. Recent research verifies traditional beliefs that the coconut palm is the Tree of Life, and that, just like any other pure, whole food, coconuts and virgin coconut oil have a significant role to play in a well balanced and nutritious diet (Kabara, 2000). Abandoning unhealthy lifestyles and reverting to natural foods can help to reverse many of the diseases that have manifested in our bodies through the highly refined diet of our modern society.

Research shows that VCO generally creates a more favorable HDL/LDL ratio. This oil has antiviral, antibacterial, and antiprotozoal properties and, like all whole foods, contains nutrients for a healthy body (Fife, 2004). In terms of benefits to human health, the development of margarine using VCO will gain potential in the current market and in the food industry. Besides that, research utilizing VCO in margarine is currently very limited. Therefore, it has to be researched and developed on to widen the variety of margarine products in the market. Thus, the purpose of this research is to develop margarine using VCO.

1.2 Objectives

a) To develop margarine using virgin coconut oil with the best formulation chosen though a sensory test.

b) To determine the moisture content upon the best formulation chosen.

c) To determine the shelf life of the margarine through chemical tests, physical tests, and microbiological tests.

d) To determine the consumers' acceptance level towards the newly developed product.

CHAPTER 2

LITERATURE REVIEW

2.1 Margarine

Margarine is a butter substitute as it resembles butter in appearance, character, texture, and composition (De man *et al.,* 1991). Margarine was originally developed in 1869 as an alternative to butter which was in short supply and expensive (Chrysam, 1996). The first margarines were made from animal fats, but today most margarines are formulated from vegetable oils. The product range now includes table margarines, bakery margarines, and specialized puff pastry margarines and has now been extended to various low calorie spreads which essentially contain much higher levels of water and lower levels of fat than those legally required in margarines.

Table margarines fall into two main types: packet margarines which are designed to be spreadable at ambient temperature, and tub margarines which are spreadable on removal from the refrigerator, at a temperature of 5-10°C. Typical solid fat content (SFC) curves for the two types show much lower SFC in the tub margarines. When packet margarines are intended for use in a tropical climate, with ambient temperatures around 30°C, higher solid contents are required (Rasid *et al.*, 1996).

2.1.1 Margarine Development

Margarine was developed in 1869 after a prize was offered by Emperor Louis Napoleon III of France for an inexpensive butter substitute. Butter production was lagging far behind demand because of a short supply of milk in all of Western Europe. Large population shifts from farms to factories during the Industrial Revolution had created a demand for butter that the milk supply could not meet, which caused butter prices to escalate. Attempts had been made to create a

butterlike food for years, but a French chemist won the prize the first year it was offered. Hippolyte Mege-Mouries obtained French Patent Number 86480 for his development, which he named "oleomargarine", a combination of the Greek word for "pearl-like" (because it had a pearly luster when crystallized) and the fat source, oleo oil, derived from beef fat (Melnick, 1968).

During the late nineteenth century, some margarines were prepared from lard or unfractionated beef suet to which liquid oils such as cottonseed or peanut were added to reduce the melting point of the blend. In the early 1900s, some 100% vegetable oil margarines were formulated with coconut and palm-kernel oils (Clayton, 1920). During the 1920s, margarine quality was improved considerably. Hydrogenated vegetable oils were used to a greater extent but initially as blends with animal fats, then coconut oil came into wide use and accounted for about half of the oil used for margarine. Coconut oil offered several advantages over oleo oil and the blends that had been used. It could be hydrogenated and processed into firm margarine with the solid and stable shape associated with tablespreads but still melt sharply in the mouth more like butter, whereas oleo oil margarines had high melting points with poor get-away in the mouth. Coconut oil became the preferred margarine source oil and accounted for about 45% of the total margarine fat requirements in 1920 (Stuyvenberg, 1969).

An important milestone for margarine was the promulgation of the Definition and Standard of Identity for Oleomargarine by the U.S. Food and Drug Administration (FDA) in 1941. Further recognition of the food value of margarine was the U.S. Department of Agriculture's (USDA) classification of margarine as one of the items in its Basic Seven food groups. This recognition gave margarine an official identity of its own and removed the "imitation butter" stigma from the product (Chrysam, 1996).

2.1.2 Product Characteristics

The consumer-directed functional aspects of spreads and margarines, which primarily depend on fat level, type of fat, and stability of the emulsion, are spreadability, oiliness, and melting properties.

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