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QUALITY CHARACTERISTICS OF PALM OLEIN IN FRYING SYSTEMS

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QUALITY CHARACTERISTICS OF PALM OLEIN IN FRYING SYSTEMS

BY

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in the Faculty of Food Science and Technology, Universiti Pertanian Malaysia.

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Dedicated to My Late Parents

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TABLE OF CONTENTS

Page

Page

LIST OF TABLES

Table		Page
XIV	The Shelf-Life of Potato Chips Fried In Three Different Treatment of RBD Olein Systems Kept at 60°C .	143
XV	The Shelf-Life of Potato Chips Fried In Three Different Treatment of RBD Olein Systems Kept At Room Temperature	144

LIST OF FIGURES

LIST OF PLATES

An abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in partial fulfilment of the requirements for the Degree of Master of Science

QUALITY CHARACTERISTICS OF PALM

OLEIN IN FRYING SYSTEMS

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Faculty : Food Science and Technology

The changes in quality characteristics of refined bleached and deodorised palm olein (RBD olein) during heating and heating with intermittent frying for 5hr/day for 8 consecutive days in 4 different systems were studied. The systems studied included (1) static heating of RBD olein without antioxidant, (2) heating with intermittent frying using RBD olein without antioxidant, (3) heating with intermittent frying using RBD olein to which 200 ppm of tertiarybutylhydroquinone had been added prior to frying on the first day and (4) heating with intermittent frying using RBD olein which had tertiarybutylhydroquinone topped up to a level of 200 ppm at the start of each day. The evaluation of oil quality included assessment of colour, iodine value, fatty acid composition, C18:2 remaining (%), polar components, dielectric constant, acid

value, smoke point, polymers' content and uv absorbance at 232 nm and 268 nm. The results showed that oil deterioration increases with increases in heating and frying time. The useful frying life of RBD olein under these conditions is about 4 days when 27.0% polar components is taken as the accepted limit for frying oil. The addition of tertiarybutylhydroquinone has some protective effect on the oil. This is most evident in system 4. The only observed undesirable effect of tertiarybutylhydroquinone is that it caused darkening of the oil.

Analyses of quality parameters showed that there were good linear correlations between polar components, iodine value, C18:2 remaining (%) and dielectric constant. There were also significant correlations between polar components and polymers and between acid value and smoke point.

In addition to the quality changes in the oil the storage stability of fried potato chips was investigated. It was found that tertiarybutylhydroquinone has a good carry-through effect. The storage stability of chips depended on oil quality and the level of tertiarybutylhydroquinone in the frying medium at the time of frying.

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QUALITY CHARACTERISTICS OF PALM

OLEIN IN FRYING SYSTEMS

oleh

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Perubahan ciri-ciri kualiti pada olein kelapa sawit yang telah ditulinkan, nyahwarnakan dan nyahbaukan (RBD olein) semasa pamanasan dan pemanasan dengan penggorengan tidak berterusan untuk 5 jam/hari selama 8 hari berturutan dalam 4 sistem berbeza telah dikaji. Sistem-sistem yang dikaji termasuk (1) pemanasan statik RBD olein tanpa agen anti-pengoksidaan (2) pemanasan dengan penggorengan tidak berterusan dalam RBD olein tanpa agen anti-pengoksidaan (3) pemanasan dengan penggorengan tidak berterusan dalam RBD olein yang telah ditambah 200 bsj butilhidroquinontersier sebelum penggorengan pada hari pertama dan (4) pemanasan dengan penggorengan tidak berterusan dalam RBD olein yang ditambah butilhidroquinontersier kepada paras 200 bsj pada permulaan tiap-tiap hari. Penilaian kualiti minyak termasuk analisa warna, nilai iodin, komposisi asid

lemak, C18:2 tertinggal (%), komponen polar, angkatap dielektrik, nilai asid, takat asap, kandungan polimer, penyerapan uv pada 232 nm dan 268 nm. Keputusan menunjukkan bahawa kerosakan minyak meningkat dengan bertambahnya masa pemanasan dan penggorengan. Hayat penggorengan berguna RBD olein dibawah keadaan tersebut adalah 4 hari berasaskan kepada 27.0% komponen polar sebagai had penerimaan untuk minyak goreng. Penambahan butilhidroquinontersier mempunyai kesan perlindungan keatas minyak. Kesan ini sangat jelas dalam sistem 4. Kesan butilhidroquinontersier yang tidak diingini hanyalah ia boleh menyebabkan peningkatan kegelapan minyak.

Analisa parameter kualiti menunjukkan bahawa terdapat korelasi linear yang baik diantara komponen polar, nilai iodin, C18:2 tertinggal (%) dan angkatap dielektrik. Juga terdapat korelasi bererti diantara komponen polar dan kandungan polimer dan diantara nilai asid dan takat asap.

Selain daripada perubahan kualiti minyak, kestabilan kerepek ubi kentang semasa penstoran juga dikaji. Didapati bahawa butilhidroquinontersier mempunyai kesan "carry-through" yang baik. Kestabilan kerepek semasa penstoran bergantung kepada kualiti minyak dan paras butilhidroquinontersier dalam medium penggorengan pada masa penggorengan.

CHAPTER 1 INTRODUCTION

Deep-fat frying is one of the common methods use in food preparation: they prevent sticking, transfer heat from hot surface to the food, and also the absorbed oil add flavour to the fried products. Since the frying oils are absorbed by every piece of fried food, they should be considered an important part of the diet.

The important chemical changes which occur in fats during frying/heating are oxidation, hydrolysis, polymerisation and fission. Fats also decompose to form volatile monomeric and polymeric compounds. These deteriorative changes can limit the useful frying life of the oil and affect the safety, nutritional value and shelf-life of fried product and in addition the decomposition products themselves could be harmful.

Palm olein, a liquid fraction of palm oil is a common medium for deep-fat frying on industrial scale and is also a major edible oil produced in Malaysia. There is however insufficient information available on the quality characteristics changes in RBD olein during heating/frying operation and thus further assessment on the performance of RBD olein during deep-fat frying is of paramount importance.

The present study looked into the quality characteristics changes in RBD olein during heating and frying conditions. This study was also extended to look at the characteristics of the chips and the shelf-life of the fried product (potato chips) in an attempt to relate the stability of the fried product to the quality of the frying oil.

CHAPTER 2 LITERATURE REVIEW

All fats and oils belong to a group of substances called lipids. Natural fats and oils tend to be mixed triglycerides and each molecule contains more than one type of fatty acid.

Fats and oils are an important source of energy and more than 90% of the world production of fats and oils are in edible products (Formo, 1979a). According to Yusof Basiron and Malek Mansoor (1984) the current world consumption of edible oil is about 13.95 kg/capita and a total of 62.7 million tonnes of oils and fats are consumed per year. In the case of visible fats it has been forecasted that the demand may grow from about 34 million to about 56 million tonnes by the year 2000 (Berger, 1984a). Such a large demand would have a dynamic effect on the main products as another 22 million tonnes would be required in 15 year time. The current world index of oil production shows that palm oil is in the lead and Malaysia plays an important role to meet this demand. In fact, Malaysia is now the major producer and exporter of palm oil and kernel oil (Yusof Basiron and Malek Mansoor, 1984).

PALM OIL

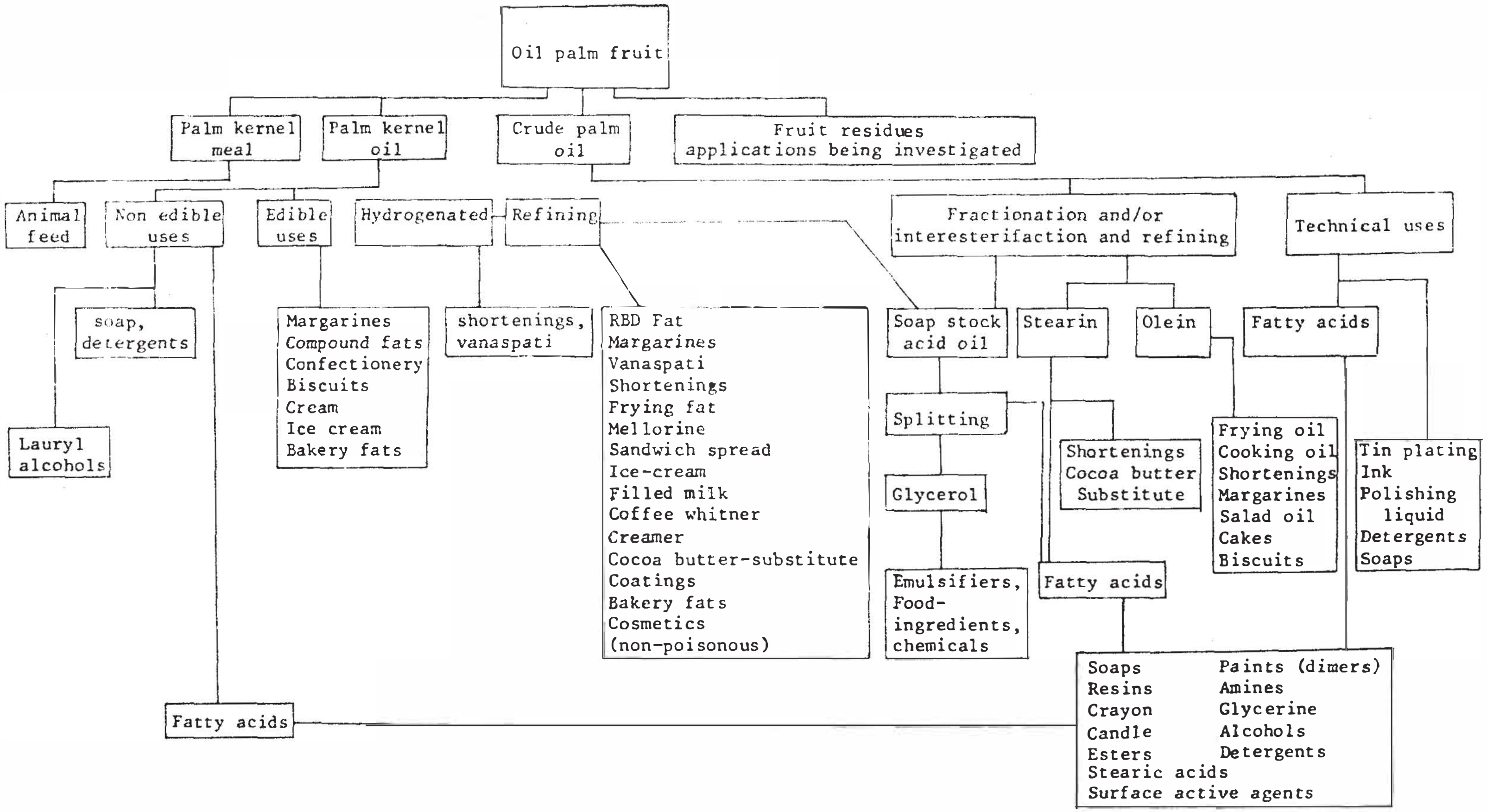
Palm oil is one of the most abundant and readily available among the edible fats and oils, and its dominant position is easily seen through the rapid increase in its market share of world export of oils and fats, from 2% in 1960 to 10% in 1970 and 16% in 1980 (Yusof Basiron and Malek Mansoor, 1984). Palm oil is obtained from the oil bearing cells in the mesocarp part of the oil palm fruit. The three genotype of considerable economic significance are dura, pisifera and tenera. In Malaysia, tenera, the hybrid form between dura and pisifera is the most commonly grown in oil palm plantations (Paranjothy and Rao, 1984).

Factors Influencing the Use of Palm Oil

Palm oil is the cheapest vegetable oil to produce and has the highest yield per hectare (Chin, 1983). The ready supply of quality controlled palm oil from Malaysia, the major exporter, at any required or regular intervals, enhances its position as a reliable source of vegetable oil in quantity (Moolayil, 1977). Palm oil is a good source of vitamin E and provitamin A (carotene) and has negligible cholesterol content. It is relatively stable. Further, the absence of long chain fatty acids allows for easier assimilation. Due to the nature of its wide range of fatty acids, it is very versatile. Its versatility coupled with modern technology has made palm oil suitable for a multitude of different applications (Figure 1). Although its inherent properties in its nature have somewhat limited its applications in cooler climates, some of these limitations have been overcome via fractionation, hydrogenation, interesterification, or a combination of these processes, as well as blending with other oils.

FIGURE 1

PALM OIL UTILISATION CHART (PORIM, 1979)



PALM OLEIN

Palm olein is the liquid fraction of palm oil obtained on fractionating palm oil. The process of fractionating palm oil was adopted with a view to diversifying the product range of palm oil and consequently serving a wider market. There are three different types of palm oil fractionation processes used on a large scale in Malaysia. In the dry process (e.g. Tirtiaux), oil is chilled to crystallise under standardised and controlled conditions of temperature and cooling, and subsequently filtered on a rotatory vacuum drum filter covered with a special synthetic cloth to separate the solid fraction (stearin) from the liquid fraction (olein). The detergent process (e.g. Lipofrac) uses an acqueous solution to render the separation of the olein from stearin and the function of the detergent is that of a surfactant to allow better separation of the solid and liquid fractions. Finally, a third type of fractionation process (e.g. Bernadini) makes use of a suitable solvent such as hexane, isopropyl alcohol, acetone, etc. to dissolve the oil before chilling. In the presence of solvent, large filtrable crystals are produced and viscosity of the liquid phase is reduced and this allows easier filtration. The solvent is removed by distillation and recycled back to the process.

Characteristics of Palm Olein

The general characteristics of palm olein produced in Malaysia vary slightly depending on the localities, the breed of oil palm trees grown, and the method by which they are produced. The data obtained on samples drawn from 18 refineries in Malaysia is shown in Table 2.1 (Tan, 1981). This data has been considered to be

TABLE I

GENERAL CHARACTERISTICS OF PALM OLEIN[a]

Identity Characteristics	Palm Olein Range Observed	Palm Olein Mean
Relative density, 40°C/water 25°C	0.9001 - 0.90028 n = 21	-
Refractive index, n_D 40°C	1.4586 - 1.4592 n = 21	-
Saponification value (mg KOH/g oil)	194 - 202	-
Cloud point °C (refined)	6.0 - 11.5	8.8
Fatty acid composition (%)		
C12 : 0	0.1 - 1.1	0.2
C14 : 0	0.9 - 1.4	1.0
C16 : 0	37.9 - 41.7	39.8
C16 : 1	0.1 - 0.4	0.2
C18 : 0	4.0 - 4.8	4.4
C18 : 1	40.7 - 43.9	42.5
C18 : 2	10.4 - 13.4	11.2
C18 : 3	0.1 - 0.6	0.4
C20 : 0	0.2 - 0.5	0.4
Iodine value (Wijs)	56.1 - 60.6	58.0
Slip melting point °C	19.4 - 23.5	21.6
Solid fat content 5°C	43.6 - 61.0	51.1
20°C	2.9 - 8.6	5.9

representative of the normal range of quality of palm olein produced locally.

It can be seen from Table I that the iodine values fall within a narrow range and this is confirmed by a small variation in the fatty acid composition.

FRYING

Deep-fat frying is one of the common methods used in the preparation of foods. Deep fried foods are one of the major items of the western as well as the eastern diets. In USA, a recent report states that more 300,000 tonnes/yr of oils and fats are used for frying doughnuts and potato products (Berger, 1984b). Canadian statistics show a similar trend with 54% increase in per capita of fats and oils from 10 kg/capita in 1950 to 19.5 kg/capita in 1975 (Stevenson et al., 1982). These increases were attributed to the significant increases in the use of fats and oils for cooking in the home, increase in the use of salad oils, shortenings and shortening oils and to the increase in fast food consumption. Some of the major types of fried foods manufactured on a large scale include fish in batter, fish fingers, meat balls, french fries, fried chicken, fried noodles and snack foods include potato crisps, doughnuts, corn chips and banana chips.

On a smaller scale, in many developing countries fried snack foods are made at street stalls and not in factories and statistics are not available. In India some 64 products and deep fried foods contribute more than 40% of the visible fat content in some Indian diets (Berger, 1984b).