



UNIVERSITI PUTRA MALAYSIA

**QUALITY CHARACTERISTICS OF BANANA CHIPS AND OILS
AFTER DEEP FAT FRYING**

WANNA AMMAWATH

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DEEP FAT FRYING**

By

WANNA AMMAWATH

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirement for the Degree of Master of Science**

August 2002



Dedicated to
My husband and my son
for their love,
patience
and understanding

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

**QUALITY CHARACTERISTIC OF BANANA CHIPS AND OILS AFTER
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August 2002

Chairman: Professor Yaakob B. Che Man, Ph.D.

Faculty: Food Science and Biotechnology

Banana chips prepared from *Pisang Abu* and *Pisang Nangka* at 'green' and 'trace of yellow' stages of ripeness were studied. The results showed that *Abu* had higher carbohydrate content than *Nangka* at both stages of maturities. The fruits were peeled, sliced and deep-fried in refined, bleached and deodorised (RBD) palm olein at 180 ± 5 °C for 3 min. The moisture content and water activity (a_w) of *Abu* chips were lower than those of *Nangka*. Sensory evaluation showed that chips prepared from *Abu* at both stages of ripeness were better in all characteristics. The *Abu* was selected and used in the subsequent study. The effects of deep-fat-frying in RBD palm olein and soybean oil were studied. Before the frying process, the *Abu* banana was subjected to three different pretreatment methods as follows: (i) peeled and sliced banana (control), (ii) blanched whole green banana in water at 70 °C for 20 min and (iii) whole banana soaked sodium chloride (NaCl) solution for 30 min. RBD palm olein was shown to be more stable to oxidation than soybean oil while

there was no difference in the different pretreatment methods in both oils. The result also indicated that banana soaked in NaCl solution and fried in RBD palm olein presented better sensory score in colour, flavour, odour, texture and overall acceptance attributes while the texture of control banana fried in RBD palm olein showed better crispness than the other samples.

Storage study using four types of packaging materials namely, laminated aluminium foil (LAF), oriented polypropylene (OPP), polypropylene (PP), and low density polyethylene (LDPE) was also conducted. The parameter determined were moisture content, water activity (a_w), thiobarbituric acid reaction substances (TBARS), crispness, colour and sensory properties of banana chips. The results showed that samples packed in LAF gave lower moisture content, a_w and TBARS values and higher in sensory score on crispness, colour and rancid-odour descriptors than the other three samples during 8 weeks storage times. It was clear that the most notable changes during storage were samples packed in LDPE which gave the lowest score in crispness and product colour.

The changes in quality of RBD palm olein with added α -tocopherol, oleoresin rosemary and their combination during deep-fat frying were also studied. The finding of this study reveals that RBD palm olein with added antioxidant showed significantly ($P < 0.05$) lower in peroxide value, anisidine value, totox value, $E^{1\%}_{1cm}$ at 232 nm and 268 nm, free fatty acid and viscosity. In general oleoresin rosemary was more effective in retarding oxidative deterioration after 5 days of frying

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**CIRI-CIRI KUALITI KEREPEK PISANG DAN MINYAK SELEPAS
PENGGORENGAN MINYAK PENUH**

Oleh

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Kerepek pisang telah disediakan daripada pisang Abu dan pisang Nangka pada peringkat hijau dan permulaan warna kuning. Keputusan Kajian menunjukkan bahawa pisang Abu mengandungi kandungan karbohidrat yang lebih tinggi jika dibandingkan dengan pisang Nangka pada kedua-dua peringkat kematangan. Buah pisang telah dikopek, dilayang nipis-nipis dan digoreng dalam minyak sawit olein pada suhu 180 ± 5 °C selama 3 min. Kandungan air dan aktiviti air (a_w) kerepek pisang Abu telah didapati lebih rendah berbanding dengan kerepek pisang Nangka. Selain itu, kerepek pisang Abu pada peringkat hijau telah didapati paling rangup. Keputusan penilaian deria telah menunjukkan bahawa kerepek yang disediakan daripada pisang Abu pada kedua-dua peringkat kematangan mempunyai ciri-ciri deria yang lebih baik jika dibandingkan dengan kerepek daripada pisang Nangka. Oleh kerana itu, pisang Abu telah dipilih dalam kajian-kajian seterusnya. Kualiti kerepek pisang, minyak sawit olein dan minyak kacang soya telah dikaji. Sebelum proses penggorengan, pisang Abu telah melalui tiga kaedah pra-rawatan yang

berbeza. Kaedah-kaedah pra-rawatan merangkumi: mengopek dan memotong kepingan pisang (kawalan); mencelur pisang dalam air pada suhu 70 °C selama 20 min; merendamkan pisang dalam larutan natrium klorida (NaCl) selama 30 min. Keputusan kajian menunjukkan bahawa minyak sawit olein didapati lebih stabil terhadap proses pengoksidaan jika dibandingkan dengan minyak kacang soya. Manakala kaedah-kaedah pra-rawatan yang berbeza tidak menunjukkan perbezaan yang bererti pada kedua-dua jenis minyak masak. Hasil kajian juga menunjukkan bahawa pisang yang direndam dalam larutan NaCl dan digoreng dalam minyak sawit olein mempunyai nilai deria yang lebih baik manakala teksur pisang dari pra-rawatan kawalan menunjukkan nilai kerangupan yang lebih baik daripada sampel-sampel lain.

Kajian penyimpanan dengan menggunakan empat jenis bahan pembungkusan yang berlainan iaitu foil aluminium berlapis (LAF), polipropilen “oriented” (OPP), polipropilen (PP) dan polietilen berketumpatan rendah (LDPE) telah dijalankan. Kandungan lembapan a_w , bahan tindak balas asid tiobarbiturik (TBARS), kerangupan, warna dan ciri-ciri deria kerepek pisang telah dikaji. Keputusan menunjukkan bahawa sampel yang dibungkus dalam LAF dan disimpan selama 8 minggu, menunjukkan kandungan lembapan, a_w dan nilai TBARS yang lebih rendah dan mempunyai nilai deria yang lebih tinggi berbanding dengan sampel yang disimpan dalam tiga jenis bahan pembungkus yang berlainan. Kesan yang paling ketara adalah sampel yang dibungkus dalam LDPE di mana sampel telah menunjukkan nilai kerangupan dan warna produk yang paling rendah.

Perubahan-perubahan minyak sawit olein dengan penambahan α -tokoferol, oleoresin rosemary dan kombinasi mereka semasa proses penggorengan juga telah dikaji. Hasil kajian menunjukkan bahawa minyak sawit olein yang ditambah antioksidan mempunyai nilai peroksida, nilai anisidin, nilai totox, $E^{1\%}_{1cm}$ pada 232 nm dan 268 nm, asid lemak bebas dan kelikatan yang lebih rendah secara bererti ($P < 0.05$). Secara keseluruhannya, oleoresin rosemary telah didapati lebih berkesan dalam menghalang proses pengoksidaan selepas penggorengan selama 5 hari.

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CHAPTER I

GENERAL INTRODUCTION

The banana industry in Malaysia is facing a serious problem of Fusarium Wilt disease which attacks various parts of the trees, causing them to die (Zainun *et al.*, 1997) This problem carried a decreased in the production of banana from 238,376 tonnes in 1996 to 211,577 tonnes in 1998 as reported by Major Agricultural Commodities, in Malaysia Agricultural Directory and Index 2001/02 (2001). While there are basically two main types of banana, are the cooking and the dessert varieties. Among the cultivars that can be eaten fresh are *Pisang Mas*, *Pisang Rastali*, *Pisang Berangan* and *Pisang Embun*, which are popular for export but they are promed to the Fusarium Wilt desease. The cultivars for cooking such as *Pisang Nangka* and *Pisang Abu* (Zainun *et al.*, 1997) are resistant to Fusarium Wilt and there is considerable field resistance to Bacterial Wilt (Stover, 1972). To revive the banana industry, disease tolerant from the cooking varieties could be planted and processed in to banana chips, which have potential for export.

There has been considerable interest in developing a market for banana chips as a snack item by deep-frying unripe bananas as in other deep-fried products (Noor and Augustin, 1984). During handling of unripe bananas, the enzyme can cause browning and the oil absorption by the product can cause oxidation.

In deep-fat frying, the oil is used over and over again, moisture and air are mixed into the hot oil, hence substantial quantities of heated fat are absorbed into the fried foods. Under these conditions, the major deteriorative reaction in frying oils and fried foods are often resulted in a significant loss of quality (Alexander, 1978). Lipid oxidation can lead to the changes in functional, sensory, nutritive value and even the safety of fried foods. Antioxidants are added to fats and oils, and foods containing fats to inhibit the development of off-flavours arising from the oxidation of unsaturated fatty acids.

The quality of the oil used in deep-fat frying contributes to the quality of the fried chips. Oxidative and chemical changes in frying fats during use are characterised by a decrease in the total unsaturation of the fat with increases in free fatty acid content, foaming, colour, viscosity, polar and polymeric materials (Min and Lee, 1996). The oxidative degradation of polyunsaturated fatty acids, contributes significantly to the shelf life of product. In addition, lipid oxidation products seem to be directly involved in the development of a number of diseases including coronary artery disease, atherosclerosis, cancer and the aging process (Lawson, 1995a).

Preservation of food products with additives is an ancient practice. In particular, antioxidants are principal ingredients that protect food quality by retarding oxidative breakdown of lipids. However, the commercial use of synthetic antioxidants is strictly controlled and increasing consumer awareness of food

additives and safety has prompted increased interest in the use of natural antioxidants as alternatives to synthetic compound (Che Man and Jailong, 1999).

In the processing of deep-fat-fried banana chips, the packaging is important to preserve the quality (Callegarin *et al.*, 1997). This kind of snack food has the high content of oil and need to remain moisture low to be crisp and tasty (Jenkins and Harrington, 1991). For prolonging the shelf-life of this product, the essential functions of packaging materials are required to protect moisture absorption, rancidity, loss of odour or entry of foreign odours (Sacharow and Griffin, 1980).

The aims of this project were to study the effect of variety and stage of maturities of banana, pretreatment methods, antioxidants and packaging materials on changes in physicochemical characteristics of oils during frying and quality characteristics of banana chips. The specific objective of the study outlined as follows:

1. To compare the quality characteristics of deep-fried banana chips from two banana varieties and two stages of maturity of raw bananas.
2. To determine the effect of different pretreatment methods on oils and banana chips.
3. To assess the effect of antioxidants on the quality of deep-fried banana chips and repeated frying oil.
4. To investigate the effect of packaging materials on storage stability of deep-fried banana chips.

CHAPTER II

LITERATURE REVIEW

Banana

Variety of Banana

Commercial banana is a giant, perennial, herbaceous monocotyledon propagated vegetatively belonging to the family *Musaceae* genus *Musa*. The banana (English) has various names: bananier (French), pisang (Malaysia, Indonesian), kluai (Thailand), chuoi (Vietnam), xiang jiao (Chinese) according to Nakasone and Paul (1998). The banana is important in the humid tropical lowlands. The edible cultivars are derived from two wild species namely, *Musa acuminata colla* and *Musa balbisiana colla*. They belong to various genomic groupings AA/AAA, AB, AAB, ABB, ABBB, BB/BBB depending on whether the clones are pure *acuminata* or *balbisiana*, diploid characterised by vigorous growth and large bunch size (Hassan and Pantastico, 1990).

Pisang Abu

Pisang Abu (Malaysia ABB group) is a vigorous clone easily distinguished by the widely spaced hands of large, angular, spreading, nearly straight fruits, starchy at ripeness; the peduncle is conspicuously long and the bunch is pendulous;