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OPTIMIZATION OF PROCESSING PARAMETERS AND ACCELERATED SHELF LIFE OF KERISIK

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OPTIMIZATION OF PROCESSING PARAMETERS AND ACCELERATED SHELF LIFE OF *KERISIK*

By

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

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December 2014

Chair: Prof. Russly Bin A. Rahman, PhD
Faculty: Food Science and Technology

The study was conducted since there is no information about optimization of kerisik (roasted coconut paste) processing parameters and accelerated shelf life study of the optimized processing parameters of kerisik to date. Therefore, the objectives of the study were to use response surface methodology (RSM) to optimize roasting temperature and roasting time to produce kerisik and consequently to use accelerated shelf life study to determine the shelf life of the kerisik. The optimization of kerisik processing parameters such as roasting temperature (130-150 °C) and roasting time (210-240 minutes) was achieved by using central composite design (CCD) via Design Expert software. Responses measured were color (L and b values) and furan compound (measured at 280 and 290 nm). Subsequently, the kerisik were packed in nylon and polypropylene packaging films and then were stored at two storage temperatures namely 38 °C for 38 days and 48 °C for 30 days for each type of packaging film. The analyses for accelerated shelf life study included moisture content (%), total color different (TCDH), peroxide value (PV) (meq kg^{-1}), acid value and p-anisidine value. Accelerated shelf life study employed PV as it main parameter in shelf life estimation with PV of 10 meq per kg fat was considered as the threshold limit for oxidative rancidity. Result showed that the optimum processing conditions for kerisik (laboratory scale) by using oven were found to be 130 °C (roasting temperature) for 227 minutes (roasting time). Predicted value of responses (color and furan) obtained using model equations were in good agreement with the experimental values. L (lightness), b (yellowness) and furan measured at 280 and 290 nm were significantly affected by the processing parameters. Finally, the shelf life of kerisik in nylon packaging film was predicted to be 46-49 days and 41-43 days for kerisik in polypropylene film. Kerisik producers may consider the generated optimized processing parameters and accelerated shelf life information from this study for kerisik product development in order to find the best method to replace the conventional way of kerisik production.

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah sarjana sains

PENGOPTIMUMAN PARAMETER PEMPROSESAN DAN TEMPOH SIMPAN YANG DIPERCEPAT BAGI KERISIK

Oleh

NAEMAA BINTI MOHAMAD

Disember 2014

Pengerusi: Prof. Russly Bin A. Rahman, PhD
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Kajian ini dijalankan kerana masih tiada maklumat yang boleh didapati mengenai pengoptimuman parameter pemprosesan bagi kerisik dan kajian tempoh penyimpanan yang dipercepat bagi kerisik yang dihasilkan daripada proses pengoptimuman. Objektif-objektif bagi kajian ini adalah penggunaan kaedah rangsangan permukaan bagi proses pengoptimuman suhu pemanggangan dan masa pemanggangan bagi penghasilan kerisik dan seterusnya menggunakan kajian tempoh penyimpanan yang dipercepat bagi menentukan tempoh penyimpanan bagi kerisik yang dihasilkan. Pengoptimuman parameter pemprosesan bagi kerisik seperti suhu pemanggangan (130-150 °C) dan masa pemanggangan (210-240 minit) dicapai dengan menggunakan rekaan komposit tengah melalui perisian Design Expert. Respon-respon yang diuji adalah warna (nilai L dan b) dan kandungan furan (yang diukur pada 280 dan 290 nm). Kerisik dibungkus dalam plastik nylon dan plastik polypropylene disimpan pada dua suhu berbeza iaitu 38 °C selama 38 hari dan 48 °C selama 30 hari. Analisis yang dijalankan untuk kajian tempoh simpan yang dipercepat adalah kandungan kelembapan (%), perbezaan warna keseluruhan, nilai peroksida (meq kg^{-1}), nilai asid dan nilai p-anisidine. Had nilai peroksida 10 meq bagi setiap kg lemak telah dipilih sebagai parameter utama untuk penentuan jangka hayat kerisik. Suhu pemanggangan 130 °C dan masa pemanggangan 227 minit telah dipilih sebagai parameter yang optimum bagi pemprosesan kerisik dalam skala makmal. Nilai respon yang dijangka untuk warna dan furan didapati selari dengan nilai yang didapati daripada ujikaji di makmal. Parameter pemprosesan terbukti mempengaruhi nilai L, b dan furan yang diukur pada 280 dan 290 nm. Tempoh simpan bagi kerisik dalam plastik nylon didapati adalah selama 46-49 hari manakala 41-43 hari adalah tempoh simpan bagi kerisik dalam plastik polypropylene. Akhir sekali pengusaha kerisik boleh mempertimbang maklumat yang didapati daripada kajian ini bagi tujuan pembangunan produk kerisik dalam usaha mencari pendekatan terbaik bagi menggantikan cara lama dalam penghasilan kerisik.

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I certify that a Thesis Examination Committee has met on 19 December 2014 to conduct the final examination of Naemaa binti Mohamad on her thesis entitled "Optimization of Processing Parameters and Accelerated Shelf Life of *Kerisik*" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

°	Degree
µ	Micro
<	Less than
%	Percentage
AOCS	American Oil Chemists' Society
AV	Acid Value
ASLT	Accelerated Shelf Life Testing
b	Yellowness Value
° C	Degree Celcius
cc	Penetrant concentration
CDA	Conjugated Dienoic Acid
CL	Chemiluminescence
CODEX	Codex Alimentarius
CV	Coefficient of variation
DPPH	(2,2-diphenyl-1-picrylhydrazyl)
E_a	Activation Energy
FAMA	Federal Agricultural and Marketing Authority
FAOSTAT	Statistic from Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
FFA	Free Fatty Acid
g	Gram
HMF	Hydroxymethyl Furfural
in	Inch
IP	Induction Period

k	Rate Constant
k	Thermal conductivity value
K	Kelvin
k_{ref}	Rate Constant at Reference Temperature
kg	Kilogram
L	Lightness Value
m	Metre
meq	Milliequivalents
ml	Milliliter
mg	Milligram
MPa	Millipascal
O_2	Oxygen
OTR	Oxygen transmission rate
p	Probability
p-Av	Para-Anisidine Value
PV	Peroxide Value
R	Universal Gas Constant
RCP	Roasted Coconut Paste
RPM	Revolution Per Minute
RSM	Response Surface Methodology
T_{ref}	Reference Temperature
TBARS/TBA	Thiobarbituric Acid Reactive Substance
TCDH	Total Color Different
T_g	Glass transition temperature
T_m	Crystalline melting temperature
TOTOX	Total Antioxidant

W	Watt
WVTR	Water vapor transmission rate

CHAPTER ONE

INTRODUCTION

Coconut palm (*cocos nucifera* L.) is one of the important plantation crops in tropical countries owing to its various parts that possess multiple benefits both for human and stock usage (Chan and Elevitch, 2006 and Guarte et al., 1996). Coconut kernel and coconut oil are two products of coconut palm that were important in this study since kerisik (roasted coconut paste) was prepared from roasting of the grated coconut kernel and then the roasted grated coconut kernel was ground by mechanical action and producing oily paste. Coconut oil is believed to have many medicinal properties such as anticoagulant, antiviral and antiseptic effects (Mandal and Mandal, 2011). The low unsaturated fatty acids in coconut oil are proven to increase the oxidative stability of coconut oil against oxidation and therefore it is suitable to be used in many products with the objective to prolong the shelf life of the products that are using it as the ingredient (Guarte et al., 1996).

There is growing trend of making various food products from different kernel based of coconut for human consumption. A mature kernel inside the coconut nut can be used in various ways such as eaten raw or being processed. Usually the mature kernel would be dried and grated for the purpose to be used in many dishes and delicacies (Chan and Elevitch, 2006). In kerisik making for this study, it was important to be consistent in choosing the coconut based on basic requirements such as the coconut must be free from defects, free from damages and uniform in maturity (color index). Federal Agricultural and Marketing Authority (FAMA) standard has been used in the coconut selection for this study and the standards used are listed in table 1 to table 5. In summary, coconut grade number two (Table 1.1), medium size coconut (Table 1.2), all requirements listed in Table 1.3, coconut with maturity index 2 and 3 (Table 1.4) and coconut with acceptable quality in the market (Table 1.5) were selected to be used in this study (Federal Agricultural and Marketing Authority, 2011)

Table 1.1. Grade specification for coconut based on FAMA standard (Federal Agricultural and Marketing Authority, 2011)

Grade	Specification
Premium	1. Same variety and clean 2. Uniform in size (≤5%) and maturity (≤5%) 3. Free from defects (≤5%) 4. Free from damages (≤5%)
1	1. Same variety and clean 2. Uniform in size (≤10%) and maturity (≤5%) 3. Almost free from defects (≤5%) 4. Almost free from damages (≤10%)
2	1. Same variety and clean 2. Uniform in size (≤10%) and maturity (≤10%) 3. Rather free from defects (≤5%) 4. Rather free from damages (≤10%)

Table 1.2. Size classification for coconut based on FAMA standard (Federal Agricultural and Markething Authority, 2011)

Size	Code	Weight (g)
Extra large	XL	>2000
Large	L	>1500-2000
Medium	M	>1000-1500
Small	S	800-1000

Table 1.3. Minimum requirement for coconut based on FAMA standard (Federal Agricultural and Marketing Authority, 2011)

Requirements for coconut
1. Has reach maturity as required by market 2. Rather free from defects and fit for human consumption 3. Still has coconut husk on top of coconut shell 4. Clean

Table 1.4. Maturity index for coconut based on FAMA standard (Federal Agricultural and Marketing Authority, 2011)

Index	Description
1	1. Immature kernel 2. Light colored coconut shell 3. No sound produces when shaken
2	1. Mature kernel 2. Light brown colored coconut shell 3. Produces sloshing sound when shaken
3	1. Mature kernel 2. Light brown colored coconut shell 3. Produces sloshing sound when shaken 4. Budding
4	1. Too mature kernel 2. Dark brown colored coconut shell 3. No sound produces when shaken 4. Bud

Table 1.5. Qualities of coconut based on FAMA standard (Federal Agricultural and Marketing Authority, 2011)

Quality	Description
Best	1. Mature kernel 2. Clean 3. Free from defects and damages
Accepted in the market	1. Mature kernel 2. Clean 3. Minimum defects and rather free from damage
Not accepted in the market	1. Immature kernel 2. Dirty 3. Major defects (pests and diseases) and damages (mechanical damages that affecting quality and shelf life)

Kerisik is a semi convenient food product that usually being used in cooking. Semi convenient food products are to be used with raw or semi-cooked materials and followed by minimal preparations afterward. Minimal preparation includes heating in microwave or frying in wok or short cooking in a container which does not need a lot of time in preparing the meal. Thus kerisik is categorized under semi-prepared ingredient. The process to make kerisik is usually simple and does not need costly materials. Kerisik is being used in many dishes in Malaysia to add flavour. It can make dishes more tasty and appealing. It is specially prepared for dishes with beef,

chicken, fishes and seafood. Kerisik also suitable to be used in *kerabu* (salads) and *rendang* (spicy meat dish) served with aubergines or pineapple (Nazrul, 2010).
The fresh coconut kernel will first be grated by a coconut grinder. After that, the grated coconut kernel will be roasted until it turns crispy and flaky. Soon after it cooled, it will be blended until the fried grated coconut kernel particles become fine. At this level, the kerisik will excretes oil. Some manufacturers separate the oil from kerisik and the kerisik texture becomes harder than the kerisik which oil is not separated from the kerisik. It is depend on the consumer to choose which one they prefer (Mohammad, 2010).

The acceptable characteristics of kerisik include it must be in paste form, the color of the paste could vary from light brown to brown and have roasted or fried coconut aroma. The aroma of kerisik is unacceptable when burnt coconut aroma could be detected due to high temperature used during frying or roasting of grated coconut kernel, or the time taken to roast or fry the grated coconut kernel was too long. The grated coconut kernel will be heat treated by the action of toasting (Johan et al., 2007), frying (Hansen, 1993) or roasting (Tan, 2013). Afterward, to make the heat treated grated coconut kernel becomes an oily paste, it will be pounded in a mortar (Hansen, 1993) or ground (Tan, 2013). By varying the method to produce kerisik, the kerisik producers may increase the kerisik production by replacing the traditional way to produce kerisik that is time consuming and requires a lot of commitments with an easier method to produce the kerisik. Young generations nowadays prefer instant foods that are easy to prepare. Good response has been received from them towards convenience traditional food like kerisik and this trend could boost up the selling of the kerisik and benefiting small medium enterprise (Mohd et al., 2013).

Unfortunately most kerisik producers' lack of knowledge about the determination of optimum conditions for roasting the grated coconut kernel brought variation in quality of kerisik. By controlling the roasting parameters especially roasting temperature, the development of color and furan can be controlled (Beliz et al., 2009; Demir et al., 2002 and Özdemir and Devres, 2000). The maillard reaction happens by the interaction of carbonyls with amines during thermal processing (Eichner, 1981) and gives rise to brown pigments (Saklar et al., 2001) and these brown pigments increase as the browning and caramelization reactions progress (Moss and Otten, 1989; Mayer, 1985 and Buckholz et al., 1980). Several authors have found a good correlation between color parameters and the roasting process (Demir et al., 2002 and Saklar et al., 2001). Furan is considered as an undesirable compound (Ameur et al, 2006) that is produced due to thermal degradation of carbohydrates, pyrolysis of sugar at high temperature and oxidation of polyunsaturated fatty acids (Crews and Castle, 2007; Boekel, 1998 and Olano and Castro, 1996) and can be linked with color development as furan is considered a useful tool to evaluate browning reaction extension (Fallico et al., 2003).

No information exists about shelf life or the effects of storage temperature, packaging material and storage period on quality degradation of kerisik have been reported. Therefore, it is important to have an independent model that could

accurately predict the progress of chemical reaction occurring in a semi-solid phase during thermal processing and storage (Ahmed et al., 2004) to explain the effects of factors that might play major role in determining the shelf life of kerisik. Lipid oxidation is known as one of the factor that could affects foods shelf life. Hence peroxide value has been selected as the main indicator in this study to further understand about the quality degradation of kerisik. This is because, the mechanical actions such as grinding or pounding could increase kerisik susceptibility to oxidation. Thus, the control of roasting process is significant since both roasting temperature and roasting time could affect the product quality (Lee et al., 2010; Şimşek, 2007; Kahyaoglu and Kaya, 2006 and Özdemir and Devres, 2000).

Objectives of study

The scopes of the study were to establish the optimal processing conditions for kerisik and to determine its shelf life in different packaging materials using an accelerated shelf life testing (ASLT).

The specific objectives of this study were:

1. To optimize the roasting time and roasting temperature of kerisik production using response surface methodology (RSM).
2. To determine the shelf life of kerisik stored in different packaging materials (nylon and polypropylene films) and temperatures (38 and 48 °C) using accelerated shelf life testing (ASLT) method.

Limitation of study

There were some limitations in this study such as the study was done on specific characteristics of coconut kernels as specified in the introduction part and was purchased from pasar Sri Serdang, Malaysia. The equipments used were from the Faculty of Food Science and Technology, Universiti Putra Malaysia. Other limitations might include the collected data, data interpretations, software used and access to scientific literatures.

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