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EFFECTS OF WASHING WITH POTASSIUM AND SODIUM HYDROXIDE MIXTURES IN THE DEVELOPMENT OF RANCIDITY IN BLACK TILAPIA (*OREOCHROMIS MOSSAMBICUS*) FILLETS AND THE FRYING OIL

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By

ANIDA YUSOFF

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

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Dedicated to my beloved…….
Parents …mak, abah..
Sisters ….Along, Nyah…
Twin sister …..Ya
and
Brother…Aliff

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

EFFECTS OF WASHING WITH POTASSIUM AND SODIUM HYDROXIDE MIXTURES IN THE DEVELOPMENT OF RANCIDITY IN BLACK TILAPIA (*OREOCHROMIS MOSSAMBICUS*) FILLETS AND THE FRYING OIL

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Faculty : Food Science and Biotechnology

A study was carried out to determine the effectiveness of potassium hydroxide (KOH) and sodium hydroxide (NaOH) in removing the earthy flavor and odor in black tilapia (*Oreochromis mossambicus*) muscle. Four different mixtures of KOH and NaOH were also prepared, each in three different ratios. The range of concentration used were 0.05 – 0.54N for individual KOH and NaOH washing solutions and between 0.054N to 0.216N for the mix solution. Their effects on frying of treated breaded fillets on the rancidity development and physico-chemical changes in refined bleached and deodorized (RBD) palm olein, the frying oil used was also carried out. Washing treatment with either KOH or NaOH solution was found to affect the rancidity development of the muscle. PV and TBARS values were significantly increased ($p<0.05$) in all treatments. The absorbance for hydroperoxides at 1745 cm^{-1} using Fourier Transform Infrared (FTIR) spectroscopy for oil extracted from all treated fillets also increased. The correlation coefficients (R^2) between absorbance versus PV for KOH and NaOH were 0.8467 and 0.6651, respectively. Fatty acids composition and

fatty acids ratios ($C_{18:1}+C_{18.2}$)/$C_{16:0}$ and $C_{18.2}/C_{16\,0}$ showed a decreasing trend in total unsaturated fatty acids with increasing concentration of washing solutions. Nineteen triglycerides were determined and only four were detected in the samples. The percentage of tripetroselinin and triolein decreased while trilaurin increased with increasing concentration of both KOH and NaOH. Sensory evaluation for odor, texture and acceptability indicated that panelists have more preferences for samples treated with less than 0.36N for both alkalies. The rancid odor was detected at TBARS value of 17 μmol malonaldehyde/kg and the PV at 20 meq hydroperoxide/kg oil. PV was found to be highest in samples washed in mixture of 0.108N KOH and 0.162N NaOH. TBARS and FFA values were highest in samples washed in mixture of 0.162N KOH and 0.108N NaOH and mixture of 0.108N KOH and 0.162N NaOH, respectively. Nonetheless, sensory evaluation indicated no significant difference ($p>0.05$) among all samples. There were significant differences ($p<0.05$) in PV, IV, AnV and totox values between control and treatments during 5 consecutive days of frying. However, there was no significant difference ($p>0.05$) in FFA and ratio of $C_{18.2}/C_{16:0}$ between control and treatments during frying. Instrumental color determination showed increases in red (R) and yellow (Y) values of the frying oil, thus, indicating darkening of the oil. For fried breaded fillets, TBARS values increased and significant differences ($p<0.05$) were obtained between control and treatments. No significant different ($p>0.05$) in organoleptic quality of fried fillets between control and treatments. The amount of alkaline contaminant materials (ACM) were significantly ($p<0.05$) increased during 5 consecutive days of frying. Washing treatments did not seem to affect the ACM content.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PEMBASUHAN MENGGUNAKAN CAMPURAN KALIUM DAN NATRIUM HIDROKSIDA KE ATAS PERUBAHAN KETENGIKAN DALAM FILET IKAN TILAPIA (*OREOCHROMIS MOSSAMBICUS*) DAN MINYAK PENGGORENGAN

Oleh

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Januari 2003

Pengerusi : Professor Madya Dr. Jamilah Bakar, Ph.D.

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Satu kajian telah dijalankan untuk menyelidik keberkesanan penggunaan kalium (KOH) dan natrium hidroksida (NaOH) secara individu dan campuran keduanya dalam penyahbauan dan citarasa lumpur di dalam filet ikan tilapia (*Oreochromis mossambicus*). Empat larutan campuran KOH dan NaOH digunakan pada nisbah yang berlainan. Kepekatan yang digunakan adalah antara 0.05 – 0.54N bagi setiap larutan individu dan bagi larutan campuran, kepekatan adalah antara 0.054N dan 0.216N. Kesan rawatan terhadap perubahan ketengikan dan fiziko kimia di dalam filet goreng bersalut dan minyak gorengan yang digunakan juga telah dijalankan. Kaedah pembasuhan sama ada menggunakan KOH atau NaOH telah menunjukkan kesan terhadap ketengikan dalam isi ikan. Peningkatan yang ketara ($p<0.05$) bagi nilai peroksida (PV) dan asid tiobarbiturik (TBARS) telah diperolehi dalam semua rawatan. Nilai penyerapan hidroperoksida pada 1745 cm^{-1} menggunakan Fourier Transform Infrared (FTIR) spektroskopi bagi minyak yang diekstrak dari filet yang dirawat juga

meningkat. Pekali perkaitan (R^2) bagi nilai penyerapan melawan PV adalah 0.8467 bagi larutan KOH dan 0.6651 bagi larutan NaOH. Komposisi asid lemak dan nisbah asid lemak ($C_{18:1}+C_{18:2}/C_{16:0}$) dan ($C_{18:2}/C_{16:0}$) telah menunjukkan nilai yang menurun bagi jumlah asid lemak tak tepu dengan peningkatan kepekatan larutan pembasuh. Sembilan belas trigliserida telah diuji tetapi hanya empat dapat dikesan di dalam sampel. Peratus tripetroselinin dan triolein berkurang dengan peningkatan kepekatan larutan pembasuh. Manakala, trilaurin telah bertambah bagi kedua-dua larutan pembasuh. Ujian penilaian deria bagi bau, tekstur dan penerimaan di atas filet telah menunjukan bahawa ahli panel menyukai sampel yang dirawat dengan alkali pada kepekatan kurang dari 0.36N bagi kedua-dua NaOH dan KOH. Bau ketengikan diperolehi pada nilai TBARS 17 µmol MA/kg dan PV pada 20 meq hidroperoksida/kg minyak. PV adalah tertinggi bagi campuran basuhan 0.108N KOH dan 0.162N NaOH. Nilai TBARS dan asid lemak bebas (FFA) adalah tertinggi dalam sampel yang dibasuh dengan larutan campuran 0.162N KOH dan 0.108N NaOH dan larutan campuran 0.108N KOH dan 0.162N NaOH. Bagaimanapun, tiada perbezaan yang ketara ($p>0.05$) diperolehi dalam semua sampel bagi penilaian deria. Terdapat perbezaan yang ketara ($p<0.05$) dalam PV, nilai iodin (IV), nilai anisidin (AnV) dan nilai totox antara kawalan dan sampel rawatan sepanjang 5 hari penggorengan berturut-turut. Tiada perbezaan yang ketara ($p>0.05$) dalam FFA dan nisbah asid lemak ($C_{18:2}/C_{16:0}$) antara kawalan dan sampel rawatan semasa penggorengan. Pengukuran warna menunjukkan peningkatan dalam nilai merah (R) dan kuning (Y) bagi minyak goreng yang menandakan berlaku penghitaman dalam warna minyak kelapa sawit semasa penggorengan. Bagi filet bersalut yang digoreng, nilai TBARS menunjukkan peningkatan dan perbezaan yang ketara ($p<0.05$) di antara

kawalan dan sampel rawatan. Tiada perbezaan yang ketara ($p>0.05$) antara kawalan dan sampel rawatan dari aspek deria bagi gorengan filet bersalut. Kandungan kontaminasi alkali (ACM) dalam minyak menunjukkan peningkatan yang ketara ($p<0.05$) sepanjang 5 hari penggorengan berturut-turut bagi semua minyak goreng, rawatan pembasuhan tidak memberi kesan ke atas kandungan ACM.

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LIST OF ABBREVIATIONS

ACM	-	Alkaline contaminant material
ACS	-	American Chemical Society
ANOVA	-	Analysis of Variance
AnV	-	Anisidine Value
cm	-	centimeter
FFA	-	Free Fatty Acid
FTIR	-	Fourier Transform Infra-red
g	-	gram
i.d	-	inner diameter
IV	-	Iodine Value
KOH	-	Potassium hydroxide
Meq	-	milliequalent
mL	-	milliliter
N	-	normality
NaOH	-	Sodium hydroxide
nm	-	nanometer
PV	-	Peroxide Value
RBD	-	Refined, Bleached and Deodorized
rpm	-	revolution per minute
SAS	-	Statistical Analysis System
TBARS	-	Thiobarbituric Acid Reactive Substances
w/v	-	weight/volume

%	-	percentage
μ	-	micro

CHAPTER I

GENERAL INTRODUCTION

Depletion of many ocean fish species has resulted in the use of lesser known fish (NAS, 1978). However, successful marketing of those fish for commercial purposes depends on consumer acceptance of their sensory properties such as flavor and textural characteristics. Flavor and flavor characteristics are concluded as the most important determinant of consumer acceptability (Connell and Howgate, 1971; Hamilton and Bennett, 1983 & 1984; Wesson *et al*., 1979; Sawyer *et al*., 1988). However, for fish with mild flavor, i.e those which exhibited low to moderate intensity of fishy and/or oxidized flavors, texture is more important (Wesson *et al*., 1979; Sawyer *et al*., 1988). A serious and frequent problem in intensive fish culture is the absorption of objectionable flavor compounds by fish from the culture environment which will contribute to the earthy odor and flavor (Johnsen, 1989). The fish readily absorb organic compounds through their gills and skin as well as from the digestive tract.

Many studies have been conducted to remove the earthy odor and flavor in fish. The treatments for removing muddy flavor and odor of black tilapia involved chemical and physiological approaches. Several traditional methods which assist in removing the muddy flavor and odor in tilapia include the washing with tamarind pulp and lemon juice or mixture of tamarind pulp, *Garcinia pyrifera* (asam gelugor), guava leaves, flour, "lambanog", salt and lemon grass (Jamilah and Siti Aini, 1997; Mabesa *et al*., 1989; Rohani and Yunus, 1994; Anon, 1991). However,