Journal of Coastal Development
Volume 3, Number 3, June 2000 : 641-645

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

# THE STABILITY OF FATTY ACID OMEGA-3 OF SALTED MACKEREL IN VACUUM PACKING

*By: Widodo Farid Ma'ruf*

*Department of Fisheries, Faculty of Fisheries and Marine Sciences, Diponegoro University*

## ABSTRACT

*Salted fist, one of the products od processed fish,is produced by the application of high temperature so that its quality tends to decrease during storage . One of the factors contributing to quality deterioration is the chemical reaction involving lipids such as oxidation and hydrolysis. Oxidation is caused by the presence of and accelerated by other factors such as temperature. This reaction occurs easily in fatty acid omega-3, which is one of a number of unsaturated fatty acids Hydrolysis reaction is caused by lipase enzyme in fish body. Therefore, it is necessary to find an appropriate storage method to prevent lipid deterioration. This research applied low temperature to preserve salted fish. The study was aimed at investigating the influence of low temperature (4°C) as compared to ambient temperature on the stability of fatty acids omega-3 of salted mackerel fish wrapped in vacuum packing. Result showed that the omega-3 content in mackerel varied with different storage temperature and period.*

## I. INTRODUCTION

Unsaturated fatty acids as a component of lipid has a high economic value, especially those containing omega-3 (Ma'ruf, 1989). Omega-3 comprised in fatty acids C20:5 (EPA=Eucosapentanoic acids) and C22:6 (DHA=Decosaheksanoic acids) is important for health, especially with respect to its ability to prevent arterio sclerosis. However, due to the long chain of its double bonds, its stability is very vulnerable against temperature and storage time.

Mackerel (Rastrelliger sp.) is one of small pelagic fish that contain high level of fatty acids omega-3. Unfortunately, its processed product is commonly preserved in high temperature before being consumed. In small-scale industry, salted fish is commonly stored at low temperature (4°C) and in some particular communities it is even kept under ambient temperature. This study is therefore carried out to examine the quality of fatty acid omega-3 in salted fish commonly found in the market.

## II. MATERIALS AND METHODS

Raw material used was fresh mackerel (Rastrelliger sp.). The underlying consideration of selecting this fish was its availability, the fact that it is consumed by many people, and its high content of fatty acids omega-3. The weight of tested fish ranged between 100 and 110 g and length between 19.5 and 20.5 cm. Other materials used were industrial salt (NaCl) and clean freshwater. Variables measured included proximate analysis, organoleptic and relative percentage of fatty acids in the fish.

Laboratory works were conducted for the following parameters: water content, ash, protein and lipid content (using proximate analysis). Thiobarbituric acid (TBA) value was measured following Tarladgis method (Tarladgis et al., 1960). This study applied an experimental laboratory research with completely randomized design and split plot in time design (Sudjana, 1982).

The treatment was different storage time (0, 7, 14 and 21 days) and low

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

temperature storage s low as 4 C compared to ambient temperature one as high as 30 C. As the main plot was storage time and the sub-plot was storage at low temperature and ambient temperature.

## III. RESULT AND DISCUSSION

### 3.1. Proximate Analysis

Data of proximate analysis is seen in Table 1, 2 and 3.

Table 1. Result of proximate analysis of fresh mackerel

| Variable | Content (%) |
|---|---|
| Water | 70,25 ± 0,040* |
| Ash | 1,45 ± 0,035* |
| Fat | 9,48 ± 0,980* |
| Protein | 17,03 ± 0,140* |

Note*: Average of three replicates

Table 2. Result of proximate analysis of salted mackerel at the beginning of vacuum packing storage

| Variable | Content (%) |
|---|---|
| Water | 64,05 ± 0,14* |
| Ash | 1,98 ± 0,13* |
| Fat | 10,31 ± 0,16* |
| Protein | 22,45 ± 0,08* |

Note*: Average of three replicates

Table 3. Result of proximate analysis of salted mackerel at the end of vacuum packing storage ( 21 days)

| | Content (%) | |
|---|---|---|
| | Low temperature (4C) | Room temperature (30 C) |
| Water | 61,99 ± 0,93* | 61,01 ± 0,02* |
| Ash | 3,07 ± 0,11* | 3,00 ± 0,12* |
| Fat | 9,42 ± 0,23* | 7,11 ± 0,16* |
| Protein | 21,56 ± 0,02* | 22,71 ± 0,23* |

Note*: Average of three replicates

From Table 2 and 3 it is obvious that there is a decrease in fat content in salted fish stored at ambient temperature, whereas the fat content in fish stored at low temperature was relatively stable. This is assumed to be the result of hydrolysis reaction in fat caused by lipase enzyme activity in salted fish product. Lipase enzyme is able to hydrolyze triglycerides to produce free fatty acids and glycerol. The rate of hydrolysis and activity of lipase enzyme in the tissue is relatively slow in low temperature.

### 3.2. Fatty Acids

The result of observation on fatty acid content is shown in Table 4 and 5 below.

Table 4. Percentage of fatty acids omega-3 in salted mackerel during storage period

| Day | Percentage of Fatty Acid Omega-3 | |
|---|---|---|
| | Low temperature (4 C) | Room temperature (30C) |
| 0 | 18,780 ± 0,163 a | 18,780 ± 0,163 a |
| 7 | 19,663 ± 0,580 b | 16,996 ± 0,081 c |
| 14 | 18,385 ± 0,069 d | 16,625 ± 0,020 e |
| 21 | 18,030 ± 0,025 f | 15,331 ± 0,075 g |
| Average | 18,715 ± 0,608 h | 16,933 ± 1,233 I |

Note: The above value is the average of 3 replicate ± standard deviation.

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

Observation of table 4 makes it obvious that the percentage of fatty acids of fish stored at ambient temperature decreased more rapidly and in larger amount than that stored at low temperature. This is because the oxidation rate is faster in room temperature. It is also known that autoxidation process occurs more easily at room temperature or above (Keteren, 1986). At room temperature the induction phase is shorter so that the formation of peroxide as free radical is faster. The result of fatty acids analysis contained in salted mackerel is presented in Table 5.

Table 5. Percentage of fatty acids contained in salted mackerel (*Ratrelliger* sp) during storage in vacuum package (in %)

| Fatty acid | Storage time (day) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low temperature | | | | Room temperature | | | |
| | 0 | 7 | 14 | 21 | 0 | 7 | 14 | 21 |
| SFA | 40,87 | 39,70 | 39,61 | 38,89 | 40,87 | 42,14 | 42,42 | 43,04 |
| MUFA | 9,25 | 7,43 | 7,37 | 8,97 | 9,25 | 9,51 | 9,88 | 9,71 |
| PUFA | 23,35 | 24,36 | 23,58 | 23,07 | 23,35 | 21,33 | 21,31 | 19,58 |
| C"X" | 26,53 | 27,98 | 28,29 | 25,63 | 26,53 | 27,53 | 26,38 | 27,66 |

Notes:
SFA = Saturated Fatty Acid
PUFA = Polly Unsaturated Fatty Acid
MUFA = Mono Unsaturated Fatty Acid
C"X" = Unknown fatty acid

SFA comprises miristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), arachidic acid (C20:0) and bahenic acid (C22:0). Whereas MUFA comprises only oleic acid (C18:1). As for PUFA consists of C18:2, C18:3, C18:4 and omega-3 (C20:5 and C22:6).

In Table 5, it is shown that the percentage of SFA and MUFA of salted fish stored at room temperature were higher than that stored in low temperature. This is suspected to be caused by the addition of SFA and MUFA as a result of oxidation and hydrolysis of lipase against fat. On the other hand, storage in low temperature resulted in slow reaction so that the percentage of SFA and MUFA tend to decrease.

### 3.3. Thiobarbituric acid (TBA) Analysis

TBA analysis was carried out during storage period both at room and low temperature. This analysis was conducted to determine the deterioration of fat as a result of oxidation with malonaldehyde compound.

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

Table 6. Average of TBA values of salted mackerel stored in vacuum package

| Storage time (day) | TBA value* | |
|---|---|---|
| | Low temperature (4 C) | Room temperature (30 C) |
| 0 | 0,12 ± 0,014a | 0,12 ± 0,014a |
| 7 | 0,2 ± 0,060b | 2,71 ± 0,011c |
| 14 | 2,6 ± 0,040d | 5,3 ± 0,008e |
| 21 | 4,87 ± 0,110f | 6,1 ± 0,005g |
| Average | 1,95 ± 1,940h | 3,55 ± 2,347i |

Note *: mg malonaldehyde/kg sample

From statistical analysis it was found that low temperature and room temperature storage and storage period affect the fatty acid content of salted fish highly significantly. Higher temperature accelerates the formation of peroxide at the early stage of oxidation. Peroxide is one of lipid oxidizing agent that initiates oxidation process as soon as it is formed. Furthermore, the peroxide will be decomposed into several compounds such as aldehyde, ketone and acids. Some acids formed by this process are those with C1-C10 chains (Kren, 1975).

At low temperature TBA values from day 0 to day 7 were relatively stable. This indicates that oxidation process is slow due to the absence of accelerating factors such as high temperature, so that the formation of peroxide is also slow. After day 7 TBA value at low temperature storage tended to increase. This might indicate that the formed peroxide is just decomposed into malonealdehyde after going through a long induction phase due to lack of activating energy that support the formation of free radicals.

### 3.2. Organoleptic Test

Organoleptic test was conducted with score sheet (SII, 1990). The result is shown in Table 7 below.

Table 7. Result of organoleptic test on fresh mackerel as raw material for salted fish

| Specification | Panelist | | | | | | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| Eyes | 8 | 8 | 9 | 9 | 9 | 8 | 8 | 9 | 8 | 8 | 8,4 |
| Gill | 8 | 9 | 9 | 8 | 9 | 9 | 8 | 9 | 8 | 9 | 8,6 |
| Flesh and guts | 9 | 9 | 8 | 9 | 8 | 9 | 8 | 8 | 8 | 9 | 8,5 |
| Consistency | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 9 | 8,6 |
| Average | 8,3 | 8,5 | 8,8 | 8,8 | 8,8 | 8,8 | 8,3 | 9,5 | 8,5 | 8,8 | |

From Table 7 it could be seen that the tested mackerel was still in a good condition to be used as material for salted fish as seen in the higher organoleptic

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

scores compared to the standard (BBPMHP, 1995). The organoleptic score obtained during storage is presented in Table 8.

Table 8. Organoleptic score of salted mackerel during storage in vacuum condition

| Storage time (day) | Storage temperature | |
|---|---|---|
| | low | room |
| 0 | 8,29 - 8,58 | 8,29 - 8,58 |
| 7 | 7,82 - 8,24 | 6,38 - 6,79 |
| 14 | 6,83 - 7,58 | 3,46 - 4,00 |
| 21 | 6,62 - 7,18 | 1,81 - 2,36 |

Table 8 shows that the organoleptic scores of salted fish stored at low temperature decrease more slowly than that stored at room temperature.

## IV. CONCLUSION

Based on the result of the experiment it is concluded that there is a difference between the stability of fatty acid omega-3 in salted mackerel stored at low temperature and that of the same substance stored in room temperature. In addition, there are also differences in the stability of omega-3 in salted mackerel among different periods of low temperature storage (0,7,14 and 21 days).

## REFERENCES

Balai Bimbingan dan Pengujian Mutu Hasil Perikanan (BBPMHP). 1995.

Standar Pertanian Bidang Perikanan Petunjuk Pengujian Organoleptik. Departemen Pertanian.

Ketaren, S. 1986. Minyak dan Lemak Pangan. Universitas Indonesia, Jakarta.

Karel, M. 1975. Free Radicals in Low Moisture Systems In R. B. Duckworth (Eds): Water Relation of Food. Academic Press, London, New York, San Fransisco. pp.435-453

Ma'ruf, W.F. 1989. Chemical and Nutritional Evolution of Indonesian Dried–Salted *Rastrelliger*, PhD Thesis, Nottingham University, UK.

Sudjana, 1984. Metode Statistik. Edisi ketiga. Tarsito, Bandung.

Sunarya, 1887. Extraction and Storage Stability of Nutritionally Important Component of Shark Liver Oil. Thesis. Humberside College, UK.

Tarladgis, B.G., Watts, B.M., Younathan, M.T. & Dugan, L.R. 1960. A Distillation Method FOR The Quantitative Determination of Malonaldehyde in Rancid Foods. Journal of the American Oil Chemists Society, 37.pp.44-48