Assiut Journal of Agricultural Science, Vol 37, No 3 , 2006

Effect Of Grilling And Frying On The Stability Parameters Of Bolti And Mullet Fish Oils Stored At Chilling Temperatures.

Salatana Moemen Hussin*

*- Food Sci. and Technol. Dept., Fac. Agric., Omer EL-Mukhtar Univ., Libya.

Abstract: This study was conducted to figure out the effect of grilling (180^{o}C / 30 minutes) and frying (180^{o}C/20-30 minutes) on the fish oil stability. Two different fish species were employed in this study. The first one is Bolti (*oreochromis nilotion*), where the second is Mullet (*Mugil cephalus)*. Bolti fish was caught from two different types of water (farm and river water), where mullet fish was caught from (farm and marine water). Upon coughing, fish were stored at chilling temperatures (refrigeration, 4^{o}C and ice boxing 0^{o}C). Fish were subjected to two different heating treatments (grilling at 180^{o}C for 30 minutes and frying at 180^{o}C for 20 to 30 minutes). Oil was extracted from grilled and fried fresh and cold stored fish (refrigeration, 4^{o}C and ice boxing, 0^{o}C). Oxidative parameters (peroxide value, anisidine value, totox value, diene and thiobarbituric acid) as well as hydrolytic rancidity parameter (free fatty acids) were performed in the extracted oil. The obtained results revealed that: The effect of frying on the stability of oil extracted from fish was higher than that of grilling regardless to fish species. In addition, stability of oil extracted from river and marine water fish was relatively higher than that extracted from farm water fish. Storaging fish at chilling temperature (refrigeration, 4^{o}C and ice boxing 0^{o}C) improving the oxidative and hydrolytic rancidity parameters of the extractable oils upon subjecting fish to grilling and frying treatments. Grilling and frying times (about 30 minutes) was too short to effect the stability and safety of fish oils.

Key words: grilling, frying, bolti, mullet fish, stability parameters, oils, chilling.

Introduction

Most of polyunsaturated fatty acids have been carried out on fish oil (Kinsella *et al.,* 1990). But these studies do not usually take into account that the qualitative and quantitative fat composition of fish oil can greatly affected by the industrial processing (Varela *et al.,* 1990) and frying are typical methods of fish processing, science large percentage of the consumed fish are grilled and fried (Sanchez-Corcoles *et al.,* 1990). Deep oil frying enhances the sensory properties of fish ; however, repeated use of frying oils produces undesirable constitutes that may pose health hazards (Tyagi and Vasishtha, 1996). Furthermore , during deep frying, fats and oils are repeatedly used at elevated temperatures in the

presence of atmospheric oxygen and recive maximum oxidative and thermal abuse. In addition, interaction among components of fish and the culinary fat used take place as a function of frying (Nawar *et al.*, 1990). These exchanges and interactions would imply that the concentration of specific fatty acids in the fish, such as docosahexaenoic acid (DHA) and eicoasapentaenoic acid (EPA) deeply change. So, many chemical reactions like oxidation, polymerization, hydrolysis, isomerization and cycliyation occure during deep-fat frying or industrial processing of oil (Martin *et al.*, 1998). The work to be describe here was conduct to figure out the effect of grilling and deep frying on the oil stability parameters of different fresh, refrigerating (4^oC) and ice boxing (0^oC) Bolti and Mullet fish.

Materials and Methods

I-Materials:

Bolti fish(*Oreachromis niloticus*) were caught from two different water sources (farm of Edco and river water of Rosette), where Mullet fish *(Mugil cephalous)* were cought from fresh water (farm of Edco) and Marine water of Rosette city, El-Behera Governorate, Egypt in the early morning during September 2005. Upon coughing fish, they were transferred immediately in ice boxes to the laboratory of food sciences and Technology, Faculty of Agriculture (Saba-bacha), Alexandria University, where they were removed from the ice boxes, cleaned and washed with top water. Each type of fish was divided into 3 groups. The first one was assigned for control where the second stored at refrigeration temperature (4^oC) for 24 hours , while the third was kept in ice box (0^oC) for 24 hours.

II-Methods:

Fresh and chilled Bolti fish were prepared by removing scales and cleaned, then washed using tap water before subjecting to cooking procedures.

Whole Bolti and Mullet fish were subjected to grilling without removing the internal organs in a household oven on an aluminum rack 20 cm from the upper heating element set at 180^oC for 30 minutes. The internal temperature in the thicket portion of the grilled fish was measured using a thermometer model (Hanna instruments, USA) as outlined by Gall *et al.* (1983). Fish were also deep fried by immersing in sunflower oil at 180^oC for a time ranged from 20 to 30 minutes until the internal temperature of fish reached 71^oC as described by Gall *et al.* (1983). After cooking, fish samples were placed on a rack, covered and allowed to drain by gravity until they cooled to room temperature. Fish fillets were recovered after removing the bones. The cooked fillets were thoroughly ground and mixed, then kept in polyethylene bags until further

processing and analysis. Crude oil was extracted from fresh and cooked fish samples following the methods of Folch *et al.*(1957). The extractable crude oil was kept in glass bottles at room temperature until running the chemical analysis. Peroxide value was determined using the method of the AOAC (1995) and expressed as Meq/ Kg oil. Anisidine value was performed colorimetery as described by Egan *et al.*(1981) using spectrophotometer (model sapas Monaco 1900) and calculated based on the following equation:

$$\text{Anisidine value} = \frac{25(1.2A2 - A1)}{M}$$

Where :

A1 = the absorbance of oil solution

A2 = the absorbance of reaction products of oil and p-anisidin.

M = gram of oil present in 25 ml of tested solution.

Totox value was conducted following Rossell , (1982) Procedure and calculated using the next equation:

$$\text{Totox value} = \frac{Pv + An\ v}{2}$$

where:

PV = peroxide value

An v = Anisidine value

Conjugated dienes were carried out using the method of the AOAC (1995), where absorbance was carried out at 234 nm using (1 % oil solution in Octane). The free fatty acids were determined by titration with standard sodium hydroxide solution and calculated as oleic acid as given in the AOAC (1995) method. Thiobarbituric acid (TBA) was estimated using the method of Egan *et al*. (1981).

Results and Discussion

Effect of grilling and frying on the oil stability parameters of different fresh Bolti and Mullet fish*:*

Chemical parameters that reflect change in the oil stability of during frying include free fatty acids (FFA), polar compounds (PC), peroxide value and iodine value (Mazza and Qi, 1992). However, data given in Table (1) represent the effect of grilling and frying on the stability parameters of different fresh Bolti and Mullet fish oils . From these data it could be noted that, peroxide value of oil extracted from fish subjected to frying process was relatively higher than that of grilling treatment regardless to fish species. Moreover, peroxide values of River and Marine water fish oils were little bit higher than those of farm water fish oils regardless to the cooking treatments. Similar results were found elsewhere (Robertson and Morrison,1977 and Mazza and Qi,1992).

The tabulated data showed that , fish oil oxidation rancidity parameters (Anisidin and Totox values) were relatively higher in case of deep frying process than found in grilling

Process regardless to the fish species. Although the rate of oxidation is greatly accelerated at higher temperature , oxidative reactions which occur at higher temperature

Table(1): Effect of griliing (at 180^{o}C/30 min) and Frying (at 180^{o}C for 20 to30 min) on the oil stability parameters of different fresh Bolti and Mullet Fish.

Sample	Technincal Processing	Peroxide value	Anisidin value	Totox value	Free fatty acids	Dien value	T.B.A
Farm water Bolti Fish	Grilling	2.0	2.18	2.09	0.39	2.08	1.32
Farm water Mullet Fish	Grilling	2.20	1.23	1.71	0.56	1.24	1.61
River water Bolti Fish	Grilling	3.30	2.30	2.80	0.28	2.36	2.24
Marin water Mullet Fish	Grilling	2.40	1.93	2.16	0.21	1.44	1.59
Farm water Bolti Fish	Frying	2.50	2.60	2.55	0.90	1.74	3.24
Farm water Mullet Fish	Frying	2.51	2.66	2.58	0.75	2.23	2.75
River water Bolti Fish	Frying	3.50	3.67	3.58	0.14	1.91	3.60
Marin water Mullet Fish	Frying	3.0	3.23	3.11	1.28	1.28	2.0

may not follow precisely the same routs and mechanisms as the reaction at room temperature. Thus, differences in the stability of fats and oils often be come more apparent when the fats are used for frying or slow baking (Washington ,1988). Generally, all of the oil oxidative parameters values includeing diene and TBA of marine and river water fish were little bit higher than those of farm water fish. Boran *et al*.(2006) recorded the safe level of thiobarbituric acid should be in the range of 7– 8 mg malonaldehyde per Kg oil, which in turn support our findings. Moving to the hydrolytic rancidity parameter (free fatty acids), it could be noted that, values of farm water fish oils were higher than those of marine and river water fish oils regardless to the processing used. This could be related to the effect of the initial environmental conditions such as the salinity and pH of water on the activity of lypoletic enzymes. However, the obtained results were in line with those of Lake and Scholes (1997) who recommended the safe level of acid value to be not more than 0.6 mg KOH / gm sample. Tyagi and Vasishtha (1996) found that, the higher values of free fatty acids in fresh water fish during frying could be due to the higher initial concentration of free fatty acids in the original fish.

Effect of grilling and frying on the oil stability parameters of different chilled Bolti and Mullet fish:

Oxidative and hydrolytic stability parameters of oil extracted from fish (Bolti and Mullet) stored under chilling conditions (refrigeration,4^{o}C and ice boxing 0^{o}C) and subjected to different heating process (grilling and frying) are given in Tables (2 and 3). It could be noted from these tables that, either oxidative parameters (peroxide value, Anisidin value, Totox value and TBA) or hydrolytic rancidity parameters (free fatty acids) took the same trend as those found in case of oil extracted from fresh fish upon subjecting to grilling and frying. However, the effect of grilling and frying on the stability of oil extracted from different fish species stored at ice boxing temperature (0^{o}C) was lower than that stored under refrigeration temperature (4^{o}C) and both were lowered than that of fresh one, since storage at temperature not far above freezing, which include mechanical refrigeration and ice boxing slow down the enzymatic changes in fish oil considerably as reported by Frazier and Westhoff (1978). Moreover, stability of oils extracted from river and marine water fish were higher than those of farm water fish, regardless to fish species. Similar results were found elsewhere (Robertson and Morrison, 1977 and Mazza and Qi 1992).

Lake and Scholes (1997) recommended that the safe peroxide

value must to be not more than 10 Meq / Kg oil, this level is considered very high in comparing with our findings. So, double advantages can be recovered upon consumption grilled or fried fish, the first one is consuming products rich in higher quality proteins and essential fatty acids, where second one related to its safety for human consumption. Based on the aformentioned results, if fish will not be consumed freshly it can be strongly recommended to store fish immediately after catching at refrigeration temperatures for short time (24 hours) to keep it in good order and safe for human consumption.

Table(2): Effect of grilling and Frying on the oil stability parameters of different fresh Bolti and Mullet Fish stored at refrigeration temperature ($4^{o}C$) for 24 hours.

Sample	Technical Processing	Peroxid value	Anisidin value	Totox value	Free fatty acids	Dien value	T.B.A
Farm water Bolti Fish	Grilling	2.6	2.88	2.74	0.75	2.38	1.56
Farm water Mullet Fish	Grilling	2.80	2.95	2.87	0.86	2.44	1.73
River water Bolti Fish	Grilling	3.95	3.77	3.83	0.92	3.0	3.04
Marin water Mullet Fish	Grilling	4.57	4.75	4.66	1.20	1.36	2.55
Farm water Bolti Fish	Frying	3.60	3.77	3.68	1.30	2.50	3.97
Farm water Mullet Fish	Frying	4.22	4.78	4.50	0.93	2.66	3.81
River water Bolti Fish	Frying	4.33	5.82	4.72	0.89	2.74	4.75
Marin water Mullet Fish	Frying	4.97	5.46	5.21	1.79	2.88	3.23

Table(3): Effect of grilling and Frying on the oil stability parameters of different fresh Bolti and Mullet Fish stored at ice boxing temperature (0^{o}C) for 24 hours.

Sample	Technical Processing	Peroxide value	Anisidin value	Totox value	Freefatty acids	Dien value	T.B.A
Farm water Bolti Fish	Grilling	2.50	2.05	2.27	0.46	2.10	1.33
Farm water Mullet Fish	Grilling	2.80	1.44	2.12	0.77	2.24	1.21
River water Bolti Fish	Grilling	3.36	2.66	3.01	0.32	1.72	2.64
Marin water Mullet Fish	Grilling	2.70	2.33	2.51	0.35	1.63	1.88
Farm water Bolti Fish	Frying	2.70	3.13	2.91	0.69	2.39	3.44
Farm water Mullet Fish	Frying	3.28	3.24	3.26	0.85	2.58	3.27
River water Bolti Fish	Frying	3.62	4.34	3.98	1.60	1.46	4.12
Marin water Mullet Fish	Frying	3.48	3.44	3.46	0.63	2.38	2.35

References

AOAC, Association of Official Analytical Chemists (1995). Official Methods of Analysis of the Association of Official Analytical Chemists. Washington , DC.,USA.

Boran, G.; H. Karacam, and M. boran. (2006). Changes in the quality of fish oils due to storage temperature and time. Food chem.., 98(4); 693 – 698.

Egan, H.; R. S. Hirk and R. Sawyer. (1981). Pearsons Chemical Analysis of Food.8th Ed., Buler

and Tanner Ltd., Great Britian,pp413.

Folch, J.; M. Lees, and G.H. Saloamestanley. (1957). A simple methods for the isolation and purification of total lipids from animal tissue. J. Biol. chem., 226: 497-590.

Frazier, W. C. and D. C. Westhoff. (1978). Food Microbiology. Mc Graw-Hill Book Company, New York, USA.

Gall, K. L.; W. S. Otwell, J.A. Koburger, and H. Appledrf. (1983). Effect of four cooking methods on the proximate, minerals and fatty acid composition of fish fillets. J. Food Sci., 48: 1068-1078.

Kinsella, J. E.; B. Lokesh and R.A. Stone (1990). Dietary n-3 polyunsaturated fatty acids and amelioration of cardiovascular disease : possible mechanisms. Am. J. Clin. Nutr., 52:1-28.

Lake, R. J. and P. Scholes (1997). Quality and consumption of oxidized lipids Frying fats and oils in Zew Zealand. J.A.O.C.S., 74(9): 1065-1068.

Martin, S. J. C., M. Lavillonnire, and J. L. Sebedia (1998). Effect of Fatty acids positional distribution and Triacylglycerol composition on lipid By – products formation during heat treatment; III- Cyclic fatty acid monomers study. J.A.O.C.S., 75(12): 169-1696.

Mazza, G. and H. Qi. (1992). Effect of after – cooking darkening inhibitors on stability of frying oil and quality of French fries. J.A.O.C.S., 69(9): 846-853.

Nawar. W.; H. Hultin, Y. J. Li and Y.H. Xing (1990). Lipid oxidation in sea foods under conventional condition. Food Rev.Int., 6: 647- 660.

Robertson, A. J. and W.H. Morrison (1977). Effect of Heating and frying on sunflower oil stability. J.A.O.C.S., 54(2):78A-81A.

Rossell, J.B.(1982). Measurements of rancidity. In; Rancidity in Food. Hllinad, J. C. and Hamilton, R.J.(eds.). Applied Science Puplisheres, Barking Essex, England.

Sanchez-Corcoles, E.; A. Ros, J. L. Escolar and C. Garcia (1990). Fish consumption and cardiovascular risk factors with special reference to plasma lipids. Nutr.Clin. 10:170-174.

Tyagi, V. K. and A. K. Vasishtha (1996). Changes in the characteristics and Composition of oils during deep fat frying. J.A.O.C.S.,73(4): 499-506.

Varela, G., M. Perez, and B. Ruji-Rose (1990). Changes in the quantitative and culinary processing. Bibi. Nutr.Dieta, 46:104-106.

Washington, B. (1988). Food Fats and Oil. The Technical Committee of Shorting and Edible Oil. IAC 6th Ed., New York, USA.

تأثير الشوى و القلي على مقاييس الثبات لزيوت اسماك البلطي و البوري المخزن على درجات حرارة التبريد

سلطنة مؤمن حسين*

*- قسم علوم وتقنية الاغذية – كلية الزراعة – البيضاء - جامعة عمر المختار – الجماهيرية العربية الليبية الشعبية الاشتراكية العظمى.

أجرى هذا البحث بهدف دراسة تأثير معاملتي الشى و القلي على مقاييس الثبات لزيوت اسماك البلطي و البوري المحفوظة عل درجات حرارة التبريد (درجة حرارة الثلاجة 4 °م ودرجة حرارة الصندوق الثلجي الصفر المئوي) حيث تم الحصول على اسماك البلطي من مياه مزرعة ادكو ومياه نهر النيل لفرع رشيد . كما تم الحصول على اسماك البوري من مياه مزرعة ادكو و المياه المالحة لمدينة رشيد وقد تم ذلك في فصل الخريف سبتمبر (شهر الفاتح) لسنة 2005 م . بمجرد اصطياد الأسماك تم نقلها مباشرة إلى قسم علوم وتكنولوجيا الأغذية- كلية الزراعة- سابا باشا – جامعة الإسكندرية. حيث تم غسل الأسماك بالماء الجاري ثم حفظت هذه الأسماك على درجات حرارة التبريد (درجة حرارة الثلاجة 4 °م ودرجة حرارة الصندوق الثلجي الصفر المئوي) وقد تم تعريض الأسماك لمعاملتي الشى و القلي على درجة 180°م لمدة 30 دقيقة وبعدها استخلص الزيت حيث تم تقدير مقاييس أكسدة الزيوت (الرقم البيروكسيدى ورقم الانيسيدين ورقم التوتكس وقيمة الديين (الأحماض الدهنية المحتوية على رابطتين مزدوجتين) و قيمة حمض الثيوباربتيوريك وكذلك تم تقدير مقياس التزنخ التحللي لزيت الأسماك (الأحماض الدهنية الحرة) .

وقد أظهرت النتائج مايلى:

كان تأثير عملية القلي على مقاييس ثبات الدهن أعلى من تأثير عملية الشى مع ملاحظة أن الزيوت المستخلصة من اسماك مياه نهر النيل و المياه المالحة كانت أكثر ثباتا من تلك المستخلصة من اسماك مياه المزارع. ساعد حفظ الأسماك على حرارة التبريد (الثلاجة و الصندوق الثلجي) على تقليل تأثر زيوت الأسماك بمعاملة القلي و الشي حيث كانت قيم مقاييس ثبات الزيت المستخلص من الأسماك المحفوظة على درجة حرارة الصندوق الثلجي (صفر مئوي) أفضل من ذلك المستخلص من الأسماك المحفوظة على درجة حرارة الثلاجة (4°م). بصفة عامة ونظرا لقصر فترة التعرض لعملية القلي و الشى (حوالي 30 دقيقة) كانت زيوت الأسماك في حالة جيدة و أمنة وصالحة للاستخدام الادمى بدون مخاطر مما يدعو للتوصية بحفظ الأسماك التي لا تستهلك مباشرة كحفظ مؤقت لا يتعدى أيام على حرارة التبريد وخاصة على درجة حرارة الصندوق الثلجي (صفر مئوي).