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Fatty Acids Composition of Indian Mackerel *Rastrilliger kanagurta* under Different Cooking Methods

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Abstract: Analysis of fatty acid (FA) compositions in marine fish under cooking methods to promote understanding of potential relationship between fish and health of human nutrition. This study was carried out to determine the fatty acid compositions in Indian mackerel (*Rastrilliger kanagurta*) were compared at two cooking methods viz., fry and gravy. Saturated fatty acids accounting for 30.05–43.27% followed by mono unsaturated (15.19–21.88%) and poly unsaturated (27.53 - 39.44%). The percentage of omega-3 fatty acids in gravy fish had little increased (0.21–0.42%). The palmitic acid and oleic acid were present larger proportion in raw fish (28.94%) and fried fish (29.72) respectively. Fatty acid composition did not present wide variation due to frying and gravy method, indicating that the cooking methods used did not interfere heavily in fatty acids composition.

Key words: Cooking methods, fatty acid and omega-3 fatty acid

INTRODUCTION

Fish is a major source of food to man kind. It provides a significant amount of poly unsaturated fatty acids intake in the diet of a large proportion of people in the developing countries. The good taste of fish flesh comes from their fat contents. The important of these fats of organisms comes from highly unsaturated fats, which they contain (Ackman *et al*., 1989; Gibson, 1988; Megali *et al.,* 1990).The nutritional importance of fish consumption is in great extent associated with the content of Omega-3 fatty acids (ω-3FAs), and Omega-6 fatty acids (ω-FAs) (Hege *et al*., 2005).

Fish lipids have been intensely investigated since their protective effect on cardiovascular diseases was first studied. Fish oils are rich in long-chain polyunsaturated fatty acids (LC-PUFA), namely Ecosapentaenoic (EPA) and docosahexaenoic (DHA), which reduce some risk factors associated with arteriosclerosis (Calder, 2004). Polyunsaturated fatty acids ω -3 (PUFA ω -3) plays a role in preventing Heart disease and has anti-inflammatory and anti-thrombosis effects (Connor, 2000). Also, ω -3 and ω -6 polyunsaturated fatty acids are considered essential but since they cannot be synthesized in the human body, they must be obtained through diet (Mahan and Escott-Stump, 2005).

Omega-3 fatty acids are unique long-chain polyunsaturated fatty acids (PUFA's). There are three types of Omega-3 fatty acids, and each type differs in its chemical structure and physiological role.

Along the east coast of India *Rastrelliger kanagurta* is the most popular fish species used as the food (Lakshman *et al*., 1999). Method of preparation before consumption is different from those of other part of world. The gravy (gravy and fried) as well as raw fish were analyzed for fatty acid and discussed in this paper.

Many studies analyzed the profile of fatty acid in marine raw fish; however, fish is usually consumed after the frozen storage and/or after some type culinary preparation. According to the (Silva *et al*., 1993), some factors such as lipid contents, cooking temperature, species size and surface contents can affect lipid composition in the fish after cooking. Additional data are certainly needed of this subject, since most fish are consumed gravy in many ways.

The main aim of the present study is to obtain information on the fatty acids composition levels of *Rastrilliger kanagurta*. Since some of the fatty acids are essential in the human nutrition and any changes which may take place during processing. A more specific objective was to observe the increasing and decreasing essential fatty acids levels due to different cooking methods (gravy and fried).

MATERIALS AND METHODS

In this present study, the fishes (*Rastrilliger kanagurta*) were collected from local fisher man from parangipettai coast, Tamilnadu (Lat: 11.50º N; Lon: 79.77º E). This is commonly available to customers. Immediately after collection, these fishes were washed with distilled water and taken in to the laboratory. The length and weight measurements were also taken out, the fishes were identified using with FAO manual. The same length and weight size groups were selected for this fatty acid analysis.

Sample preparation and analysis of fatty acids methyl esters (fames): For fatty acids analysis, each fish specimens were beheaded washed manually. These samples were gravy (gravy and fried). The gravy was prepared with different ingredients. The preparation and

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analysis of fatty acids methyl esters (FAMEs) from these fish tissue were performed according to the method described by (Anon., 2000). 50mg of tissue sample were added to 1ml of 1.2M NaOH in 50% aqueous methanol with glass bead (3mm dia) in a screw-cap tube and then incubated at 100º C for 30 minuets in a water bath. Then saponified sample were cooled at room temperature for 30 min, they were acidified and methylated by adding 2ml 54% 6N HCl in 46% aqueous methanol and incubated at 80º C for 10 minuets in water bath. After rapid cooling, methylated FAs were extracted with1.25ml of 50% methy-tert butyl ether (MTBE) in hexane. Each sample was mixed for 10 minuets a bottom phase removed with a Pasteur pipette. Top phase was washed with 3ml 0.3M NaOH. After mixing for 5 minuets the top phase was removed for analysis, following the base wash step , the FAME'S were cleared in anhydrous sodium sulphate and then transferred into GC vials for analysis, FAME were separated by gas chromatograph (HP 6890 N, Agilent technologies, USA) in Centre of Advanced study in Marine Biology, Annamalai University. FAME'S profiles of the tissue were identified by comparing the commercial Eukary data base with MIS software package. (MIS ver. no 3.8 microbial id, Newark, Delaware).

RESULTS

Table 1 shows the percentage of each fatty acid in raw, fried and gravy fish. Twenty nine fatty acids were identified in this fish with saturated fatty acids accounting for 30.05–43.27%. Palmitic acid (16:0) was the fatty acid, which is present in the largest proportion in the range of 23.53–28.94%.This was true for all the fish species examined (Hege *et al*., 2005), followed by the stearic acid in the range of 4.75–11.36%.

In comparing all the three samples, the results indicate that gravy and frying had little effect on the fatty acids composition. The observed difference was reduced. There was an increase in the percentage of alfalinolenic acid (18:3 ω-3) and Docosahexaenoic acid (22:6 ω-3) after cooking process. Conversely, significantly lower level of omega-3 and omega-6 fatty acids were found in fried fish. The palm oil used for frying, it contains 44–54% of 12:0 fatty acid and also high quantities of the 14:0 and 18:1 series (Matilda *et al.,* 1991).

These fatty acids masked the fatty acid pattern in the fried samples as judged by the high percentage of unidentified acids. The levels of 14:0 (Fatty acid) and 18:1 (Fatty acid) were also higher in the fried fish than in the fresh. In view of the above the fried fish cannot be a good source of the omega-3and omega-6 fatty acids which have an important role in combating coronary heart disease (Dyerberg and Bang., 1979; Bang *et al*., 1980) and protection against breast cancer (Kaizer *et al*., 1989). However, if there is a need to increase the energy density of a diet, then fried fish could make an important impact.

The total omega-3 fatty acids (15–64%) were found to be higher in gravy fish than that of raw and fried fish.

Table 1: (%) Fatty Acids Composition of Rastrelliger Kanagurta in Edible Tisssue (With Different Cooking Methods)

Fatty acids	Raw fish	Fried Fish	Gravy Fish
Saturated fatty acids(SAF)			
12:0	0.46	0.40	0.21
14:0	1.01	0.82	0.83
15:0	0.60	0.39	0.36
16:0	28.94	26.50	23.53
17:0	0.60	-	0.37
18:0	11.36	5.16	4.75
19:0	0.14	-	-
22:0	-	0.33	0.12
24:0	0.16	0.14	0.09
Sum of Saturated fatty acids(SAF)	**43.27**	**33.74**	**30.05**
Monounsaturated fattyacids(MUFA)			
14:1 ω5c	-	-	0.11
16:1 ω7c	6.16	6.55	12.53
16:1 ω5c	0.19	0.51	0.72
17:1 ω8c	0.35	0.19	0.49
18:1 ω9c	11.40	29.72	-
20:1 ω9c	2.17	0.17	0.19
22:1 ω9c alcohol	0.41	0.22	0.16
24:1 ω9cnervonic	1.01	0.39	0.36
24:1 ω6c	-	0.03	0.01
24:1 ω3c	0.19	0.11	0.62
Sum of Monounsaturatedfattyacids (MUFA)	**21.88**	**37.89**	**15.19**
Polyunsaturated fatty acids(PUFA)			
18:2 ω6c	0.72	13.67	0.91
18:2 ω3c	3.12	0.28	1.20
18:3 ω6c	0.37	0.57	0.68
18:4 ω3c	0.45	0.67	0.66
20:4 ω6c	23.74	5.89	12.50
20:3 ω6c	2.66	1.21	0.53
20:2 ω6c	0.23	1.62	1.31
20:5 ω3c	3.25	0.87	6.67
22:3ω3c	0.04	0.09	0.12
22:4 ω6c	0.43	0.02	0.33
22:5 ω3c	1.17	0.11	0.09
22:6 ω3c	3.17	2.12	4.82
Sum of Polyunsaturated fatty acids	**39.44**	**27.53**	**32.77**
Branched			
16:ISO	0.17	-	0.15
17:0ANTEISO	0.12	-	-
19:0 ISO	0.58	-	0.31
22:0 3OH	-	0.28	-
C2 N alcohol	0.40	-	-
Unknown			
Unknown 21.252"C"	0.47	-	-
Unknown 24.407"b"	0.08	-	-
Unknown 25.052	0.63	-	0.74
Sum Of unknown and others	**2.45**	**0.28**	**1.20**

The high level of polyunsaturated fatty acid, especially 20:4 ω-6 in fish is most probably due to lower oxygen solubility in warmer water (Smith *et al.,* 1980).

Of the 29 fatty acids identified in these three analyzed fishes, the following presented the highest percentage : palmitic acid (16:0), stearic acid (18:0) and arachidonic acid (20:4 ω-6) in both raw and gravy fish (Table 1).

DISCUSSION

The high value of unidentified acid obtained from raw fish remains observe. Further more, the raw and fried had more amounts of saturated fatty acids but different proportions of the monounsaturated and polyunsaturated fatty acids are present. Normally, one would expect high levels of omega-6 fatty acids in raw fish .These were, however about the more or less similar as those of gravy fish. Significant differences were also observed in percentage of palmitoleic acids (16:1 ω-7) that increased in gravy fish sample.

Table 2: Percentage composition of ω-3 and ω-6 fatty acids

S.NO	FISH	ALA	DHA	EPA	DST	DPA	SA	LA	GLA	ARA	DGLA	EDA	DST
1	RAW	3.12	3.17	3.25	0.04	1.17	0.45	0.72	0.37	23.74	2.66	0.23	0.43
2	FRIED	0.59	2.12	0.87	0.09	0.11	0.67	13.67	0.57	5.89	1.21	1.62	0.02
3	GRAVY	4.15	4.82	6.67	0.12	0.09	0.66	0.91	0.68	12.50	0.53	1.31	0.33

ALA-Alfalinolenic acids, DHA-Docosahexaenoic acids, EPA-Eicosapentaenoic, DTA-Docosatrienoicacid, DPA- Docosapentaenoic, SA-stearidonicacid, LA-linoleic acids, GLA-Gammalinolenicacid, ARA-Arachidonic acids, DGLA-Dihomogammalinolenicacid, EDA-Eicosadienoicacid, DST-Docosatetraenoicacid

Table 3: omega -3: omega- 6 fatty acids in ratio

FISH	OMEGA-3:OMEGA -6
RAW	0.401
FRIED FISH	0.193
GRAVY	1.01

In contrast, there was an increase in the percentage of cis-9-octadecenoic acid (oleic acid) in fried fish (29.72%).Among omega-6 fatty acids, the Arachidonic acid (20:3 ω-6), Dihomogammalinolenic acid (20:3 ω-6) and Docosatetraenoic acid (22:4 ω-6) were identified in higher proportion in raw fish than the fried and gravy fish. The linoleic acid (18:2 ω-6) was found to be higher in fried fish (13.67%).

The total omega-6 fatty acids (16.27–28.15%) were found to be higher than that of omega-3 fatty acids (4.45–16.51%) in these fishes (Table 2).

Bowman and Rand (1980), reported that Arachidonic acid (20:4 ω-6) is precursor for prostaglandin and thromboxan which will influence the blood clot and its attachment due to the endothelial tissue during wound healing. Apart from that the acids also play a role in growth.

Totally six omega -3 fatty acids followed Stearidonic (18:4 ω-3) Eicsapentaenoic acid (20:5 ω-3), Docasapententaenoic acid (22:5 ω-3). Alfa linolenic acid (18:3 ω-3) and Docosahexaenoic acid (22:6 ω-3) were identified in this study compared with raw and fried fish the gravy fish had more amounts of omega-3 fatty acids.

Alfalinolenic acid (ALA), Eicosapentaenoic acid (EPA) and Docasahexaenoic acid of the gravy fish ranged from 4.15; 6.67 and 4.82% of the total fatty acids. The above three omega -3 fatty acids considered as medically important fatty acids (Ward and Ajaysing. 2005).

Piggott and Tucker (1990) suggested that ω-3: ω-6 ratio is better index in comparing relatives nutritional value of fish. This result indicates that the ω-3: ω-6, ratio of the raw and fried fish was less than 1 (Table 3).

Arachidonic acid (ARA) is the principle omega -3 fatty acid in the brain and together with Docosahexaenoic acid (DHA) is an important in the brain development of infants. While Gamma linolenic acid (GLA) is metabolic precursor to ARA, it conversion to ARA mediated by the enzyme -6 desaturase, is slow and this enzyme is present only in low level in humans. Hence it is considered preferable to feed ARA to humans rather than GLA. ARA is also a direct precursor of a number of Eicosanoids to regulating lipoprotein metabolism, blood rheology and leucocytes functions and platelets activation. Good nutritional sources of ARA are animal livers and yolk (Ward and Ajaysing., 2005).

In this present study we investigated more amount of ARA in raw fish (23.74%) followed by fried fish (5.89%) and gravy fish (12.50%). Linoleic acid (LA) is the most abundant PUFA in the human skin. Among other things, it plays vital role preserving our epidermal water barriers. This result revealed that more amount of linoleic acid fried fish(13.67%).Deficiency in this essential fatty acids (EFA) results in scaly skin and excessive water loss (Ziboh *et al.,*2000).

The other omega-3fattyacids such as stearidonic acid(SA) and Docosatrienoic acid(DTA) are plays an important role in the biological effects, antiarrhythmic, anti-inflammatory responses (Penny *et al.*, 2002), Docosatrieonic acid (DTA) was found in raw fish (0.04%), fried fish(0.09%) and gravy fish(0.12%).

A number of factors can influence in fish fatty acid composition, such as water temperature, time of capture, salinity and feed type. Therefore, this factor must be considered when analyzing differences among studies (Fátima *et al.*, 2007). This result showed that high content of medically important omega3 essentially in raw fish as well as gravy fish.

The raw fish had higher amount of ALA (3.21%), EPA (3.25%) and DHA (3.17%) then that of fried fish ALA (0.59%), EPA (0.87%) and DHA (2.12%). This result was confirmed by several other studies food some tissue of different fish (Silversand *et al.*, 1996; Sergiusz Czesny *et al.*, 2000)

CONCLUSION

Fish is a major source of essential fatty acids and it also contains protein, carbohydrates, lipids, vitamins and trace minerals. Fish is widely consumed in many part of the world by human because it has highly polyunsaturated fatty acids especially omega-3 fatty acids known to support the good health.

Some factors, such as lipid contents, cooking temperature, species size and surface contact can affect lipid composition in fish after cooking, in additional data are certainly needed on this subject, since most fish are consumed gravy in many ways.

According to this way, the main objective of this study was to evaluate the fatty acid profile of common edible Indian fish *Rastrilleger kanagurta* under different cooking method. After gravy using frying and gravy methods, the fish showed a fatty acid profile had little variation when compared with raw fish. The results were discussed with previous studies. Since data related to the effects of different cooking methods on the lipid composition of edible fishes are scarce in the literature. Currently, there has been very limited research on this subject. In addition very few reports was found in the literature concerning in the fatty acid composition of this

cooking method. Therefore, in this study we identified fattyacid composition of Indian mackerel under different cooking process.

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REFERENCES

Ackman, R.G and W.M.N. Ratnayake, 1989. Fish Oils, Seal Oils, Esters and Acids Are all from of Omega-3 Intake Equal. In: Heath Effects of Fish Oils. Derleyen and R.K. Chandra, (Eds.). Arts Biomedical Publisher and Distributors, Newfoundland, pp: 373-393.

Anon., 2000. Sherlock Microbial Identification System. Version 4 MIS Operating Manual, Newark, DE, USA.

Bang H.O., J. Dyerberg and H.M. Sinclair, 1980. The composition of the Eskimo food in North Greenland. Am. J. Clin. Nutr., 33: 2657-2661.

Bowman, W.C. and M.J. Rand, 1980. Text Book of Pharmacology. (2nd Edn.).Oxford, U.K: Black well Scientific Publication.

Calder, P.C., 2004. Long-chain n 3 fatty acids and cardiovascular disease: further evidence and insights. Nutr. Res., 24:761-772

Connor, W.E., 2000. Importance of n _ 3 fatty acids in health and disease. Am. J. Clin. Nutr., 71(Suppl.): 171S-175S.

Dyerberg, J. and H.O. Bang, 1979. Haemostatic function and platelet polyunsaturated fatty acids in Eskimos. Lancet, 2(8140): 433-435.

Fátima A.F. de C., M.P.S. Helena, M.C. Flávia, M.B.C. Neuza, T.C.S. Marco, S. Ana Lúcia, C.C.F. Sylvia do, 2007. Fatty acid composition of three freshwater fishes under different storage and cooking processes. 103(4):1080-1090

Gibson, R.A., 1988. The effect of diets containing fish and fish oils on disease risk factors in humans. J. Med., 18: 713-731.

Hege M.W.O., I.S. Stoaknes, J.F. Remme, M. Kierstad and M. Synnes, 2005. Proximate composition, fatty acids and lipid class composition of the muscle from deep sea teleost and elasmobranch 437., Comp. Biochem. Physiol., Part B, 140(3): 437-443.

Kaizer, L., N.F. Boyd, V. Kriukov. and D. Tritchler, 1989. Fish consumption and breast cancer risk: An ecological study. Nutr.cancer, 12: 61-68.

Lakshmanan, R., V. RAO. Venugopal, D.R.B.Y.K. Bongirwar, 1999. Stability of lipids of Indian mackerel to gamma irradiation. J. Food Lipids, 6(4): 277-285.

Magali,C., C. Prancose, P. Henri, P. Anne and P. Marin,1990. Effect of salmon oil and corn oil on plasma lipid level and hepato biliary cholesterol metabolism in rats. Acta Biochemical. Biophy., 1046: 40-45.

Mahan, L.K. and S. Escott-Stump, 2005. Krause: alimentos, nutric¸a˜o & dietoterapia, 11th ed. Sa˜o Paulo, pp: 1280.

Matilda, S.A., K. Jjulshamn and O. Lie, 1991. Effect of local processing methods (cooking, frying and smoking) on three fish species from ghana: part I. proximate composition, fatty acids, minerals, trace elements and vitamins. J. Food Chem., 40: 309-321.

Penny, M. Kris-Etherton, S.H. William and J.A. Lawrence, 2002. Fish consumption. fish oil, omega-3 fatty acid and cardiovascular disease. Circulation, Arlington, v. 106: 2747-2757.

Piggot, G.M and B.W. Tucker, 1990. Effects of Technology on Nutrition. Marcel Decker, Inc., Newyork, USA.

Sergiusz, C., D. Konrad, E.C. James, V. E. Joel and D. Serge, 2000. Discrimination of wild and domestic origin of sturgeon ova based on lipids and fatty acid analysis. J. Aqua Culture, 189:145-157.

Silva, S.M., C.S. da., E.K. Kuga, and J.M. Filho, 1993. Efeito do processamento sobre a´cidos graxos polinsaturados da frac¸a˜o lipı´dica da sardinha (Sardinella brasiliensis) e da tainha (Mugil cephalus).Revista de Farma´ cia e Bioquı´mica da Universidade de Sa˜o Paulo, 29(1): 41-46.

Silversand, C., B. Norberg, C. Haux, 1996. Fatty acid composition of ovulated eggs from wild and cultured turbot (*S.* maximus) in relation to yolk and oil globule lipids. Mar. Biol., 125: 269-278

Smith, M.W and N.G.A. Miller, 1980. In: Animals and Environmental Fitnes. R. Giles, (Ed.). Pergamon press Oxford. U.K.

Ward, O.P and Ajaysing, 2005. Omega3\6 fatty acid: Alternative sources of production. Press Biochemistry, 40: 3627-3652.

Ziboh,V.A., C.C. Miller and Choy, 2000. Metabolism of polyunsaturated fatty acids by skin epidermal enzyme: generation of anti inflammatory and anti proliferative metabolites. Am. J. Clin. Nutr., 71(supply): 361-369s.