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Research Article

Fatty acids composition of traditional salted-fermented and fresh tiger-fish in Sudan

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Abstract

The fatty acids composition of the salted-fermented fish product 'Feseekh' of the Nile tiger-fish (*Hydrocynus* spp.) was determined and compared with fresh fish. Fatty acids were analyzed as their methyl esters with gas chromatography-mass spectrometry (GC). Fermented fish contained significantly ($p<0.05$) lower amounts of total fatty acids (26.66 mg/g) compared to fresh fish (40.04mg/g). Palmitic acid (C16:0), Stearic acid (C18:0), palmitoleic acid (C16:1) and oleic acid (C18:1) were the most abundant fatty acids of both fermented and fresh fish. The most abundant polyunsaturated fatty acids were linoleic acid (C18:2n6), linolenic acid (C18:3n3). A significant decrease ($p<0.05$) in the content of Palmitic acid (C16:0) and oleic acid (C18:1) of the fermented fish compared to fresh fish was observed. The contents of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were (1.73 and 2.77mg/g) in fermented fish, respectively, compared to (1.46 and 2.28mg/g), respectively, in fresh fish. The ratio of DHA/EPA was1.6 in both fermented and fresh fish. Saturated fatty acids (SFA) were the most dominant class of fatty acids followed by monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). Saturated fatty acids formed higher percentage of total fatty acids (49.44%TFA) in fermented fish, compared to (46.04%TFA) in fresh fish. Both fermented and fresh fish contained higher amounts of N-3 fatty acids (8.63% and 8.34%TFA) compare to n-6 fatty acids (3.76% and 4.35%TFA) (giving n-6/n-3 ratio of 0.44 and 0.52, respectively. The present results indicated that 'Feseekh' is a good source of essential fatty acids for human, and with same level of DHA/EPA ratio can provide the daily requirement of DHA and EPA as fresh fish. However, traditional fermented fish products present health risk for human safety. Therefore, strict control measures is recommended for producers of fermented fish and good guidance should be provided for household producers in terms of their safety.

Keywords: DHA/EPA ratio, fatty acids, 'Feseekh', fermented fish, n-6/n-3 ratio.

INTRODUCTION

Fermentation is one of the oldest traditional technique of fish processing in many countries in Africa, Asia, Europe and Latin America[1,2,3]. It is not only extends the shelf-life but also enhances the flavor and nutritional quality of the product. Fermentation is often combined with salting and/or drying in order to reduce water activity and retard or eliminate the growth of proteolytic and putrefying bacteria[4]. The simplicity of the fermenting process, the low cost of production and the ease with which it combines with other preservation methods, has led to its popularity and extensive use. 'Fesiekh', the traditional name of salted-fermented fish product in Sudan, is prepared by salting and fermenting fresh fish in the absence of oxygen (anaerobic fermentation). In the making of fermented fish, known concentrations of salt are added to promote degradation of proteins and retard the growth of undesirable, microorganisms. During fermentation the fish flesh becomes very soft and the bones acquire the characteristic softness of cartilage when cooked.

Several studies have been carried out to study the bio-chemical pathways followed during the degradation process of fish salting and fermentation and identified the effect on some chemical changes of fish[5,6,7,8,9,10,11,12,13,14]. The effect of salting and fermentation on fatty acid composition of some fish was also determined[15,16,17,18,19]. Fermented fish has been proved to be a viable source of protein for the diet of fish[20,21,22,23]. Fermented fish could substantially increas the growth and quality of fish by accumulating more poly unsaturated fatty acid (PUFA) in fish flesh[24]. Considering fermented fish as

important nutritionally balanced and cost-effective alternative diets for humans and animals, there is a need for research effort to evaluate the fatty acid composition and profile of fermented fish. Therefore, the present study was carried out to investigate the fatty acids composition and profiles of salted-fermented product 'Fesiekh' of the Nile fish *Hydrocynus* species, and to compare the contents with that of fresh fish, to determine the effect of fermentation of these components.

MATERIALS AND METHODS

Sample collection and preparation:

Fermented and fresh specimens of the Nile tiger fish (*Hydrocynus* species) were purchased from the fish market in Khartoum. Fish samples were transported to the laboratory, gutted, prepared as a fillet, washed with fresh water and minced into fine particles and kept in separate glass containers for analysis.

Fatty acid analysis:

Lipid extraction was done according to the Bligh and Dyer method. Methyl esters were prepared by trans-methylation, using 2 M KOH in methanol and n-hexane, according to the method described by[25]. Fatty acids were analyzed as their methyl esters with a gas chromatography-mass spectrometry (GC-MS; Hewlett-Packard 5890 GC), according to the procedure of [26] and was identified by comparing their retention time with those of several commercial standard mixtures (Supelco, USA). The concentration of individual fatty acid was calculated using tricosanoic acid (C23:0) as internal standard and the result was expressed in mg/g wet weight and (%)/TFA.

RESULTS AND DISCUSSION

Fatty acid compositions of fermented and fresh fish are shown in (Table 1). Fermented fish contained significantly ($p<0.05$) lower amounts of total fatty acids (26.66 mg/g) compared to fresh fish (40.04mg/g). Eighty-two fatty acids with various chain lengths and saturation levels have been identified. Palmitic acid (C16:0), Stearic acid (C18:0), palmitoleic acid (C16:1) and oleic acid (C18:1) were the most abundant fatty acids of both fermented and fresh fish. The most abundant polyunsaturated fatty acids were linoleic acid (C18:2n6), linolenic acid (C18:3n3). There was a significant decrease ($p<0.05$) in the content of Palmitic acid (C16:0) and oleic acid (C18:1) of the fermented fish compared to fresh fish, but slight decrease was found in the remaining fatty acids. The contents of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) were slightly higher in fermented fish (1.73 and 2.77mg/g), respectively, compared to (1.46 and 2.28mg/g), respectively, in fresh fish. The ratio of DHA/EPA was1.6 in both fermented and fresh fish. Saturated fatty acids (SFA) were the most dominant class of fatty acids (Figure 1) followed by monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). Saturated fatty acids formed higher percentage of total fatty acids (49.44%TFA) in fermented fish (Figure 2), compared to (46.04%TFA) in fresh fish. Both fermented and fresh fish contained higher amounts of N-3 fatty acids (8.63% and 8.34%TFA) compare to n-6 fatty acids (3.76% and 4.35%TFA) (Figure 3), giving n-6/n-3 ratio of 0.44 and 0.52, respectively.

The decrease in free fatty acids (FFA) disagreed with[27] who showed a significant increase of Bouri Fish (*Mugil cephalus*) in Egypt after the salting and fermenting process, but the significant increase in C 16:0 and an increase in the ratio of USFA/SFA agreed with the findings. The increase in the ratio of USFA/SFA after the salting and fermenting process could be due to the increase of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in fermented fish. Fatty acid contents of some traditional fish and shrimp paste condiments of the Philippines was investigated[6]. The authors reported that the contents of polyunsaturated fatty acids, including DHA were not significantly different from that of fresh untreated shrimp fry. Fatty acid composition of fermented sardine fish sauce contained significantly ($p<0.05$) higher proportions in C14:0, C16:0, C18:1n9 trans, C18:2n6cis and C18:3n3[18]. The abundant fatty acids were C16:0, C18:0, C20:5n3 cis and C22:6 n3 similar to the present results in fermented fish. A great content of linoleic (C18:2n6) and docosahexanoic (C22:6n3) acids, which are considered as essential fatty acids for its beneficial effects for human health, have also been recorded in fermented fish. However, the ratio (0.26) of PUFA/USFA in fermented fish and (0.61) in fresh fish is lower than the ratio >0.90 observed by in fermented sardine fish sauce. The polyunsaturated fatty acid N-3 (PUFA-N-3) represented an average (65.5% and 56.9%PUFA) higher than (28.5% and 29.6% PUFA) of PUFA-N-6, in fermented and fresh fish, respectively, and C20:5n3 eicosapentaenoic ccid, (EPA) and C22:6n3 docosahexaenoic acid (DHA) were the most abundant PUFA-n3, which was similar to the results in fermented sardine fish sauce[18].

Table 1
The fatty acids composition (mg/g) and profiles (%/TFA) of fermented and fresh Nile tigerfish.

	Fermented fish		Fresh fish	
Fatty acids	mg/g	%	mg/g	%
Butyric acid C4:0	0.07	0.26	0.44	1.11
Caproic acid C6:0	0.05	0.17	0.11	0.27
Caprylic acid C8:0	0	0	0.06	0.15
Tridecanoic acid C13:0	0.29	1.08	0.1	0.26
Myristic acid C14:0	0.84	3.16	1.19	2.97
Pentadecanoic acid C15:0	0.11	0.42	0.16	0.4
Palmitic acid C16:0	8.08	30.32	10.35	25.84
Heptadecanoic acid C17:0	0.26	0.99	0.35	0.88
Stearic acid C18:0	3	11.24	3.98	9.95
Arachidic acid C20:0	0.07	0.25	0.12	0.27
Behenic acid C22:0	0.07	0.26	0.24	0.61
Tricosanoic acid C23:0	0.46	1.72	0.67	1.68
Lignoceric acid C24:0	0	0	0.67	1.67
Palmitoleic acid C16:1	2.23	8.36	3.29	8.22
Heptadecenoic acid C17:1	0.08	0.31	0.14	0.35
Elaidic acid C18:1n9t	0.04	0.14	0.18	0.46
Oleic acid C18:1n9c	7.36	27.59	11.77	29.39
Eicosenoic acid C20:1	0.15	0.56	0.35	0.88
Linolelaidic acid C18:2n6t	0.04	0.16	0	0
Linoleic acid C18:2n6c	0.82	3.07	1.51	3.78
Linolenic acid C18:3n6	0.04	0.16	0.1	0.25
Eicosatrienoic acid C20:3n6	0.1	0.37	0.13	0.33
Linolenic acid C18:3n3	1	3.77	1.49	3.73
Eicosatrienoic acid C20:3n3	0.1	0.37	0.35	0.88
Eicosapentaenoic C20:5n3(EPA)	0.46	1.73	0.58	1.46
Docosahexaenoic C22:6n3 (DHA)	0.74	2.77	0.91	2.28
Eicosadienoic acid C20:2	0.08	0.31	0.35	0.86
Docosadienoic acid C22:2	0.12	0.47	0.45	1.11
TFA	26.66		40.04	
SFA	13.29	49.44	18.43	46.04
USFA	13.37	50.14	21.6	53.96
MUFA	9.86	36.97	15.73	39.29
PUFA	3.51	13.17	5.87	14.67
N-6	1	3.76	1.74	4.35
N-3	2.3	8.63	3.34	8.34
N-6/N-3	0.44		0.52	
N-6/PUFA	28.5		29.6	
N-3/PUFA	65.5		56.9	

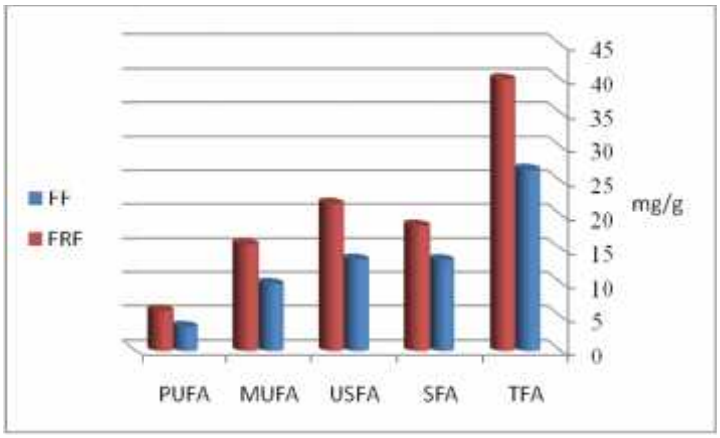

Figure 1
The contents (mg /g) of different groups of fatty acids in fermented (FF) and fresh (FRF) tiger fish.

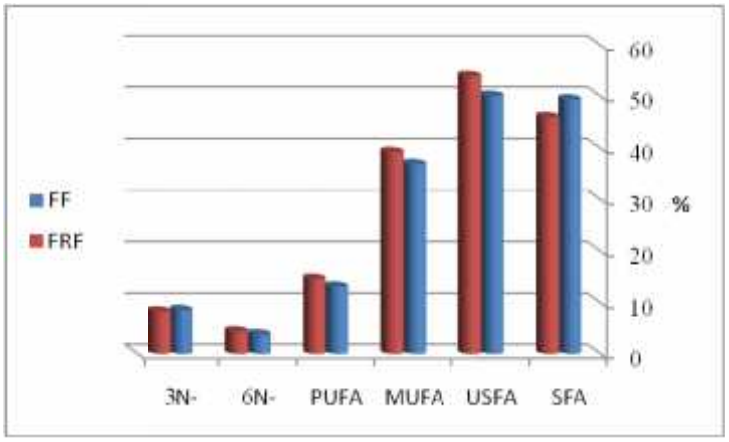

Figure 2
The percentage of different groups of fatty acids (%/TFA) in fermented (FF) and fresh tiger fish (FRF).

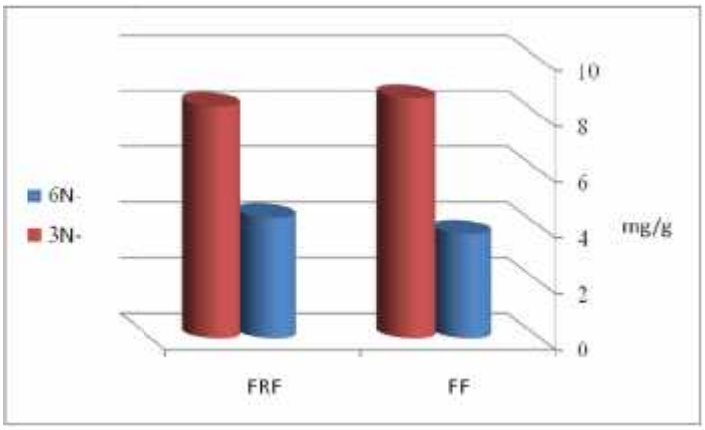

Figure 3
The contents (mg /g) of N-3 and N-6 polyunsaturated fatty acids in fermented (FF) and fresh (FRF) tiger fish

The fish fed with fermented fish was found to accumulate more N-3 fatty acids than N-6 fatty acids and increase N-3/N-6 ratio in return[24]. Improving the quality of fish by accumulating more N-3 PUFA in the flesh of the fish as well as increasing the N-3/N-6 ratio is beneficial for human health[28,29,30].

CONCLUSION

The present results indicated that 'Feseekh' is a good source of essential fatty acids for human, and with same level of DHA/EPA ratio can provide the daily requirement of DHA and EPA as fresh fish. The higher values of eicosapentaenoic, docosahexaenoic and n-3 series acids also make fermented fish more favorable for human consumption. Both products from local fish producers and household productions of traditional fermented fish products may present health risk for human safety. Therefore, strict control measures is recommended to be applied for producers and a good guidance should be provided for household producers.

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