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Research Article

Fatty Acid Profile Investigation of Blue Whiting Fish (*Micromesistius poutassou*) Flesh from Agbalata Market Badagry, Lagos West, Nigeria

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Abstract

Fish meat possesses high nutritional value and is therefore a particularly recommended dietary component. Fish tissue is known as the main source for long chain polyunsaturated fatty acids (PUFAs) supply, which positively influence human health. These PUFAs favorably improve lipid profiles and reduce the risk of coronary heart diseases (CHD). Thus, this study was carried out to determine the fatty acid composition in the flesh of Blue whiting fish (*Micromesistius poutassou*) brought from Badagry market, Lagos west, Nigeria using gas chromatographic method. A total of twelve different fatty acids were obtained in the muscle of Blue whiting fish. The composition of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) was found to be 18.8%, 38.2% and 21.5%, respectively. Palmitic acid (C16:0) and erucic acid (C22:1w9) were identified as the major SFA and MUFA respectively. Docosahexaenoic acid (C22:6w3) and eicopentaenoic acid (C20:5w3) had the highest levels amongst the PUFAs. Results show that blue whiting fish is a good source of omega-3 fatty acids.

Keywords blue whiting fish, fatty acid composition, monounsaturated fatty acids, polyunsaturated fatty acids, saturated fatty acids

Introduction

Sea foods play important roles in human nutrition as a source of digestible animal proteins, lipids, healthful polyunsaturated fatty acids (PUFAs), minerals and vitamins that support the biochemical processes of the human body (Alasalvar et al., 2011). Most of these constituents are economically important for human nutrition because of their high nutritional quality. The lipid fraction of fish are rich sources of long chain n-3PUFA especially, α-linoleic acid (C18:3, ALA), eicosapentaenoic (C20; 5, EPA) and docosahexaenoic acid (C22:6w3, DHA) (Holub and Holub, 2004; Lecerf 2007; DeFilippis et al., 2010). Kris-Etherton et al (2002) revealed the effect of these fatty acids on blood pressure, arrhythmia (abnormal heartbeats),and hypotriglyceridemia. Arachidonic (C20:4n-6) acid and its parent fatty acid, linoleic acid (C18:2n-6) also drew consideration (Glogowski and Ciereszko 2001). Due to inability of human body to synthesize EPA and DHA, its constant supply through food is a prerequisite (Lecerf, 2007).

Blue whiting fish (*Micromesistius poutassou*) is a typical pelagic, lean fish species, widely distributed in the North East Atlantic region. It belongs to the Gadidae family along with the cod and haddock and feeds mostly on small fish and cephalopods (Cohen et al.,1990).The fish popularly called *Panla*, is consumed in Western Nigeria and other parts of the country. It has been recognized as a readily available and nutritious marine fish that can be obtained fresh from almost all the fish markets along the Lagos coastal line.

In terms of data on blue whiting fish, limited investigations have been performed on the fatty acid profile of blue whiting fish purchased from Badagry market. Such information would aid food scientists and nutritionists in dietary formulation,processing and product development (Ackman, 1989). Thus, the study was carried out to

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determine the fatty acid profile of blue whiting fish, a widely eaten fish amongst the people of Western Nigeria.

Materials and methods

Description of the study area

Agbalata market, Badagry is situated in a coastal town, southwest local government area in lagos state. Badagry is situated between Metropolitan Lagos, and the border Benin republic at Seme. Its geographical coordinates are 6^o 25' 0" North, 2^o 53' 0" East.

Sampling

Fresh fish samples were purchased from fishmongers at Agbalata market, Badagry, Lagos. They were transported aseptically in an insulated ice bag to the Nigerian Institute for Oceanography and Marine Research, Victoria Island Lagos laboratory for analysis.

Sample preparation

The fish samples were thoroughly washed under a flowing tap to remove any adhering contaminants and drained. They were then dissected with a knife and the intestines, guts and bones were removed. The muscle samples were homogenized in a mortar and pestle until a uniform mixture (homogenized) was obtained. Samples from the homogenate were taken for analysis.

Fatty acid analysis

Lipids were extracted from the fillets of the fish samples according to the method of Bligh and Dyer (1959). Saponification was done to convert fats to free fatty acids that led to formation of methyl esters. The resulting fatty acids methyl esters (FAME) were subjected to GC-MS analysis for the identification and quantification of fatty acids.

Statistical analyses

The descriptive statistics (mean, standard deviation, range) were conducted while statistical significance of differences ($P<0.05$) was determined by analysis of variance (ANOVA) with SPSS version10 (Duncan, 1955).

Results

In the present study, the profiles and percentage composition of 12 different fatty acids in Blue whiting fish are presented in Table 1.The sequence of the fatty acids are ordered according to their chromatographic retention times and values are given as weight percentages of the total acid methyl esters. Results showed that *M. poutassou* was composed of 18.82 % saturated fatty acids (SFA), 38.19 % monounsaturated fatty acids (MUFA) and 21.5 % polyunsaturated fatty acids (PUFA) (Figure 1). Palmitic acid (C16:0) and erucic acid (C22:1w9) were identified as the major SFA and MUFA respectively. Palmitic acid contributed 61.1 % of the SFAs while erucic acid provided 44.9 % of the MUFAs in the flesh of Blue whiting fish. Docosahexaenoic acid (C22:6w3, DHA) was the dominant PUFA closely followed by eicopentaenoic acid (C20:5w3, EPA).The percentages of docosahexaenoic (DHA) and eicopentaenoic (EPA) acids were 10.7% and 7.4% respectively in the PUFAs as shown in Table 1.

Discussion

The PUFA contents were much higher (21.59%) than the saturated fatty acids (18.82%) in blue whiting fish but lower than the monounsaturated fatty acids content which was 38.19 % as shown in Table 1.These results were similar to that reported by Osman et al (2001). The trend was different when compared to a study reported by Suriah et al (1995) in fresh water fish, where the concentrations of MUFA were higher than SFA and PUFA content. The difference can be attributed to the fact that freshwater fish feed largely on vegetation and plant materials, whereas marine fish feed on stable diet mainly zooplanktons which are rich in PUFA (Osman et al., 2001).

Total SFA content of blue whiting fish lipids was 18.82% (Table 1). Palmitic acid (C16:0) was the predominant saturated fatty acid (11.5%), followed by myristic acid (C14:0) with 5.09%. The least occurring fatty acids amongst the SFA was found to be stearic acid (2.26%). Several authors reported the abundance of palmitic acid (C16:0) as a saturated fatty acid in different fish species (Alasalvar et al., 2002; Celik and Gokce, 2003; Sengor et al 2003; Wheeler and Morrissey, 2003; De Silva et al., 2004; Rossano et al., 2005; Bayir et

al., 2006; Senso et al., 2007). Ackman (1988) observed that palmitic acid (C16:0) was a key metabolite in fish whose level was not influenced by diet. Level of palmitic acid in blue whiting fish was found to be lower than that of Atlantic bonito and mackerel (1.97 and 1.77 mg/100g) (Saglik and Imre, 2001) and both cultured and wild sea bass (20.5 % and 22.6 %) (Alasalvar et al., 2002). However, the amount of C16:0 in blue whiting is higher than that of catfish and mudskipper (8.5 % and 9.94 % respectively as reported by Eboh et al., 2006.

Table 1. Fatty Acid Composition of Blue Whiting Fish (*M. poutassou*)

Fatty Acid	% Composition
C14:0 Myristic Acid	5.1 %
C16:0 Palmitic Acid	11.5 %
C18:0 Stearic Acid	2.3 %
Total SFA	**18.8 %**
C16:1 n-7 Palmitoleic Acid	4.5 %
C18:1 n-9 Oleic Acid	0.5 %
C20:1 n-9 Eicosenoic Acid	13.8 %
C22:1 n-9 Erucic Acid	17.2 %
C24:1 n-9 Nervonic Acid	2.1 %
Total MUFA	**38.2 %**
C20:4n-3Eicosatetraenoic Acid (EFA)	1.2 %
C20:5n-3 Eicopentaenoic Acid (EPA)	7.4 %
C21:5n-3 Heneicopentaenoic Acid (HPA)	2.4 %
C22:6n-3Docosahexaenoic Acid (DHA)	10.7 %
Total PUFA	**21.6 %**

Total MUFA content of lipids in blue whiting was 38.19 % and erucic acid (C22:1 n-9) was identified as the main monounsaturated fatty acid (about 44.9 % of total MUFA). This was followed by eicosenoic acid (C20:1,n-9), palmitoleic acid (C16:1,n-7), nervonic acid (C24:1 n-9) and oleic acid (C18:1 n-9).The monounsaturated fatty acids (MUFA) content of M.poutassou were mainly omega-9 fatty acids except palmitoleic acid which is an omega-7 fatty acid.

Total PUFA content of blue whiting lipids was 21.59 % with docosahexaenoic (DHA, C22:6n-3) and eicopentaenoic (EPA, C20:5n-3) contents of the fish as 10.7 % and 7.37 % respectively (Table 1). Fish is known to be a rich source of the unique unsaturated fatty acids of the omega-3 family including both docosahexaenoic and eicopentaenoic. It may be due to the efficiency of fishes being at converting the ALA to the EPA and DHA omega-3 fatty acids than mammals (Gao et al., 2012).

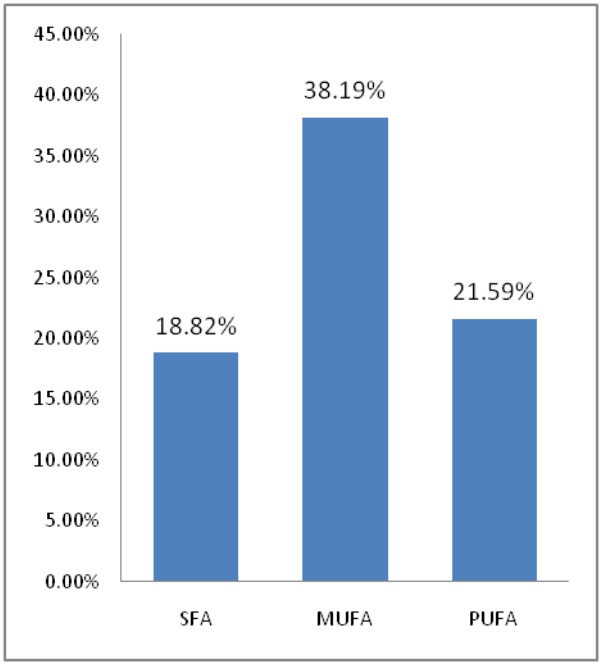

Figure 1. % Composition of Fatty Acids Present in Blue Whiting Fish

Polyunsaturated fatty acids (PUFA) especially omega-3 fatty and omega-6 fatty acids have been considered essential fatty acids and have been shown to have curative and preventive effects of cardiovascular diseases and neurodevelopment in infants and fat glycemic control (Conner, 1997). Moreover, detailed research has shown the decreased risk of arrhythmias (abnormal hearts), which can lead to sudden death. Omega-3 fatty acids also reduce triglyceride levels, slow down growth rate of atherosclerotic plaque and lower blood pressure.

These omega-3 fatty acids accumulate in seafood via food chain. These fatty acids synthesized by various forms of sea algae and then consumed by plankton and other small marine animals, are essential for ocean life. A major reason for their critical importance in marine physiology

may be their ability to remain fluid at cold temperature (Gordon and Ratliff, 1992).

Table 2. Comparison of omega-3 and omega-9 fatty acids values of Blue Whiting Fish

Fatty Acid Parameter	Value
∑SFA	18.82 %
∑MUFA	38.19 %
∑PUFA	21.59 %
∑n-3	21.59 %
∑n-9	33.65 %
PUFA/SFA	1.15
n-3/n-9	0.64

The percentage composition of DHA and EPA in blue whiting fish is similar to that obtained in some other fishes. Bayir et al. (2006) reported the DHA and EPA values in some marine fishes in Turkish waters to be 12.15 % and 6.18 % for bluefish; 20.55 % and 8.74 % for gilthead sea bream; 28.85 % and 11.68 % for achovy; 10.57 % and 7.48 % for horsemackerel; 22.71 % and 8.7 % for grey mullet; 19.61 % and 8.21 % for atlantic bonito; 12.7 % and 10.22 % for mackerel; 34.92 % and 6.14 % for garfish respectively.

The results of this study showed that the flesh of *M. poutassou* contains omega-3 and omega-9 fatty acids, while omega-6 fatty acids were not detected in the muscle of the fish. This could be due to the fact that blue whiting is a marine fish, and hence richer in omega-3 fatty acids while their freshwater counterparts are rich in omega-6 fatty acids (Mnari et al., 2007, Ahmed Louly et al., 2011) and marine fish feed on stable diet mainly zooplanktons which are rich in PUFA (Osman et al., 2001).

Ratio of Polyunsaturated Fatty Acid to Saturated Fatty Acids

Wood et al. (2008) recommended the ratio of polyunsaturated fatty acids to saturated fatty acids (PUFA/SFA) should be above 0.4. Ratios exceeding 0.50 have been shown to lower blood cholesterol (Gurr,1984).Blue whiting fish had a favorable PUFA /SFA ratio of 1.15 (Table 2). Thus lipids from blue whiting fish could be useful in the lowering of cholesterol in the blood Wood et al., (2008) also reported that since some meats of terrestrial farmed animals naturally have a PUFA/SFA ratio of around 0.1 that has been implicated in causing the imbalanced fatty acid intake of today's consumers. Fish lipids are particularly rich in polyunsaturated fatty acids (PUFA) that are only slowly synthesized in humans, which is the main difference between meat of fish and meat of farmed terrestrial animals (Vadau et al.,2008).

Conclusion

The fatty acid components of blue whiting fish (*Micromesistius poutassou)*obtained in this study suggested that it is a desirable item in the human diet, especially when levels of DHA and EPA are considered for the maintenance of human health. It is definitely a rich source of omega-3 fatty acids.

References

C. Alasalvar, K.D.A. Talyor, E. Zubcov, F. Shahidi, M. Alexis **(2002)**. Differentiation Of Cultured and Wild Sea bass (Dicentrarchuslabrax):Total Lipid Content, Fatty Acid and Trace Mineral Composition. Food Chem., **79:** 145-150.

C. Alasalvar, K. Miyashita, F. Shahidi, U. Wanasundra **(2011)**. Handbook of Seafood Quality, Safety and Health Applications. New Delhi: Blackwell Publishing Ltd: pp.13-29.

A.W.O.A. Louly, E.M. Gaydou, M.V.O. El-Kebir, **(2011)**. Muscle Lipids and Fatty acid profiles of three edible fishes from the Mauritanian coast: Ephinephelus aenus, Cephalopholis taeniops and Serranus sciba. J. Food Chem., **124:** 24-28.

R.G. Ackman **(1988)**. Concerns for Utilization of Marine Lipids and oils. Food Tech., **42:**151-155.

R.G. Ackman **(1989)**. Fatty Acids. In Ackman RG (Ed), Marine Biogenic Lipids, Fats and Oils (pp 145-178).CRC Press. Boca Rato.

A. Bayir, H.I. Haliloglu, A.N. Sirkecioglu, N.M. Aras **(2006)**. Fatty acid Composition of Some Selected Marine Fish Species Living Turkish Waters. J. Sci. Food Agric., **86:**163-168.

E.G. Bligh and W.J. Dyer **(1959)**. A rapid method of total lipid extraction. Can. J. Biochem. Phys., **37:** 911-917.

M.Celik, and M.A. Gokce **(2003)**. Cukurova (Adana) Bolgesi'nden Bes Ayri Tilapia

TurununYag Asidi Iceriklerinin Tespiti. Turk. J. Vet. Anim. Sci., **27:** 75-79.

D.M. Cohen, T. Inada, T. Iwamato, N. Scialaba **(1990)**. FAO species catalogue. Vol.10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis. 10(125).

W.E. Conner **(1997)**. The beneficial effect of omega-3 fatty acids in cardiovascular diseases and neurodevelopment. Curr. Opin. Lipidol., **8:** 1-3.

A.P. DeFilippis, M. Blaha, T.A. Jacobson **(2010)**. Omega-3 fatty acids for cardiovascular disease prevention. Curr. Treat. Options Cardiovasc. Med., **12:** 365-380.

S.S. DeSilva, R,M, Gunasekera, B.A. Ingram, **(2004)**. Performance of Intensively Farmed Murray Cod Maccullochella peeliipeelii (Mitchell) Fed Newly Formulated vs. Currently Used Commercial Diets , and a Comparison of Filled Composition of Farmed and wild fish. Aquacult. Res., **35:** 1039-1052.

D.B. Duncan **(1995).** New multiple range and multiple F-tests. Biometrics, **11:** 1-42.

L. Eboh, H.D. Mepba, M.B. Ekpo **(2006)**. Heavy metal contaminant and processing effects on the composition, storage stability and fatty acid profiles of five common commercially available fish species in Oron Local Government, Nigeria. Food Chem., **97:** 490-497.

F. Gao, A.Y. Taha, K. Ma, L. Chang, D. Kiesewetter, S.I. Rapoport **(2012)**."Aging decreases rate of docosahexaenoic acid synthesis-secretion from circulating unesterified α-linoleic acid by rat liver" . Postag. Leukotr. Essen. fatty acids, **75:** 213-217.

J. Glogowski and A. Ciereszko **(2001)**. Why we should increase fish consumption, especially that of Rainbow Trout Magazine Przemysl Rybn. **2:** 95-102 (In Polish, with English abstract).

D.T. Gordon and V. Ratliff **(1992)**. The Implications of Omega-3 Fatty Acids In Human Health, in Martins, R.E. Flicks eds, Advances in Seafood Biochemistry Consumption and Quality 69-98. Technomic Publishing Co. Inc. Gogus, A.K. and Kolsarici,N. (1992). Su UrunleriTeknolojisi. A.U. ZiraatFak. Yay: 1243, Ankara, Turkey.

M.I. Gurr **(1984)**. Roles of Fat and nutrition :In Fats in Health and Diseases, Elsevier Applied Science Publishers, Barking, Essex, UK,

D.J. Holub and B.J. Holub **(2004)**. Omega-3 fatty acids from fish oils and cardiovascular disease-Molec. Cell. Biochem., **263:** 217-225.

P.M. Kris-Etherton, W.S. Harris, L.J. Appel **(2002)**. AHA Scientific statement: Fish Consumption, fish oil, omega-3 fatty acids and cardiovascular disease. Circulation, **106:** 2747-2757.

J.M. Lecerf **(2007)**. Produits de la peche et acidesgras omega-3.Interet en prevention cardio-vasculaire. Phytotherapie, **5:** 14-21.

A. Mnari and I. Bouhle **(2007)**. Fatty acids in muscle and liver of Tunisian Wild and Farmed Gilthead Sea Bream Sparus aurata. Food Chem., **100:** 1393-1397.

H. Osman, A. Suriah, C. Law **(2001)**. Fatty acid composition and cholesterol content of selected marine fish in Malaysian waters. Food Chem., **73:** 55-60.

R. Rossano, M.A. Caggiano, L. Mastrangelo, R. Di-Lauro, N. Ungaro, M. Ettore, P. Riccio **(2005)**. Proteins, Fatty Acids, and Nutritional Value in the muscle of the Fish Species Mora moro (Risso,1810). Mol. Nut. Food Res., **49:** 926-931.

S. Saglik and S. Imre **(2001)**. N-3-Fatty acids in some fish species from Turkey. J. Food Sci., **66:** 210-212.

G.F. Sengor, O. Ozden, N. Erkan, M. Tuter, H.A. Aksoy **(2003)**. Fatty Acid Composition of Flathead Grey Mullet (Mugilcephalus) (L.1758) Fillet, Raw, and Beeswaxed Caviar Oils. Turk. J. Fish. Aquat. Sci. **3:** 93-96.

L. Sensor, M.D. Suarez, T. Ruiz-Cara, M. Garcia-Gallego **(2007)**. Possible effects of Harvesting Seasoned and Chilled Storage on the Fatty Acid Profile of the Filled of Farmed Gilthead Sea Bream (Sparus aurata). Food Chem., **101:** 298-307.

A.R. Suriah, T.S. Huah, O. Hassan, N.M. Daud **(1995)**. Fatty acid composition of some Malaysian fresh water fish. Food Chem., **54:** 45-49.

V.V. Vladau, I. Bud, R. Stefan **(2008)**. Nutritive value of fish meat comparative to some animal meat. Bulletin of University of Agricultural

Sciences and Veterinary Medicine. Animal Sciences and Bio technologies, **65:** 301-305.

S.C. Wheeler and T.C. Morrissey **(2003)**. Quantification and Distribution of Lipid Moisture, and fatty Acids of West Coast Albacore Tuna (Thunnus alalunga). Journal of Aquatic Food Product Technology, **12:** 3-16.

J.D. Wood, M. Enser, A.V. Fisher, G.R. Nute, P.R. Sheard, R.I. Richardson, S.I. Huges, F.M. Whittington **(2008)**. Fat deposition, fatty acid composition and meat quality: A review. Meat Sci., **78:** 343-358.