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Comparative analysis of Omega-3 polyunsaturated fatty acid profile of 2 common fish of upper Ganga

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Abstract

Fish is a high-protein, low-fat food that provides enormous health benefits. In this study, the ω- 3 polyunsaturated fatty acids composition in common food fishes of Upper Ganga Catla-catla and Labeo rohita are compared. Fishes are rich sources of ω- 3 fatty acids especially, Eicosapentaenoic acid (EPA) & Docosahexaenoic acid (DHA). The total PUFA amount in Catla-catla 31.9 and L.Rohita 22.5.In case of SFA content, Catla-catla is on 20.6 while L.Rohita contains 73.6.If we compare amount of MUFA of 2 fishes then the results are as follows Catla-catla is on 47.3 while L.Rohita contains 10.4. Fish oils is critical to normal eye and vision development besides providing energy for the central nervous system. Fish oils also increases memory power. The disease such as asthma, diabetes, psoriasis, thyrotoxicosis, multiple sclerosis etc. can also be moderated by ω-3 fatty acids. A person can expect good health if he or she consumes 0.5 -1g of ω–3 PUFA/day. Hence, regular consumption of these Indian food fishes may alleviate diseases/disorders related to malnutrition.

Keywords: catla-catla, labeo rohita, eicosapentaenoic acid (EPA) & docosahexaenoic acid (DHA), PUFA

Introduction

Subsequently 1961, the average annual increase in global apparent food fish consumption (3.2 percent) has outstripped population growth (1.6 percent) and exceeded consumption of meat from all terrestrial animals, combined (2.8 percent) and individually (bovine, ovine, pig, other), excluding poultry (4.9 percent). In per capita terms, food fish consumption has grown from 9.0 kg in 1961 to 20.2 kg in 2015, at an average rate of about 1.5 percent per year(1). The extension in consumption has been driven not only by increased production, but also by a mixture of many other factors, including reduced wastage, better utilization, improved dispersal channels and growing demand, linked with population growth, rising incomes and urbanization.

Europe, Japan and the United States of America together accounted for 47 percent of the world's total food fish feeding in 1961 but only about 20 percent in 2015. Of the global total of 149 million tonnes in 2015, Asia consumed more than two-thirds (106 million tonnes at 24.0 kg per capita). Oceania and Africa consumed the lowest share (2). The shift is the result of physical changes in the sector and in particular the growing role of Asian countries in fish production, as well as a significant gap between the economic growth rates of the world's more mature fish markets and those of many gradually important emerging markets around the world, particularly in Asia(3). Fish is a high-protein, low-fat food that provides a range of health profits. White-fleshed fish, in particular, is lower in fat than any other source of animal protein, and oily fish are high in omega-3 fatty acids, or the "good" fats. Since the human body can't make substantial amounts of these essential nutrients, fish are an important part of the diet (4). Fatty acids play crucial role in maintaining health and cellular functions. The preventive effect of ω-3 fatty acids on coronary heart disease is based upon hundreds of experiments in animals, humans, tissue culture studies, and even clinical trials(5). Further studies have shown that the kind of fat the consumed contained large quantities of ω-3 fatty acids: EPA (20:5) and DHA (22:6). Moreover, deficiencies of these fatty acids lead to a host of symptoms and disorders. Among the long chain omega- (ω-) 3 fatty acids (LC-PUFA), docosahexaenoic acid (DHA) is the principal PUFA constituent of brain neurons, retinal cells, and primary structural constituent of skin, sperm, and testicles (6). Apart from being an important mechanical component of cellular membranes, it performs varieties of functions in a number of cellular processes like transport of neurotransmitters and amino acids and modulates the functioning of ion channels and responses of retinal pigments. DHA has been shown to be particularly important for fatal brain development, optimal development of motor skills and visual acuity in infants, lipid metabolism in children and adults, and cognitive support in the elderly (16). DHA along with eicosapentaenoic acid (EPA) play important role in stopping atherosclerosis, dementia, rheumatoid arthritis, diseases of old age like Alzheimer's disease (AD), and age related macular degeneration (AMD)(7) . Cardiovascular disease (CVD) is the important cause of mortality in many economically developed countries and DHA plays an significant role in preventing CVDs9 (18). Fish is an important constituent of human diet in most parts of the world and plays an important role as a source of health friendly fatty acids. The nutrients in fish include PUFA, especially the ω-3 PUFA, DHA, and EPA , proteins, amino acids, and micronutrients (minerals and vitamins). Besides, unlike other animal proteins, fish has the unique advantage that there are many fish species available (8). Fish is one of the economy sources of quality animal proteins and plays a great role in satisfying the protein requirement in the developing and under developed countries of the world. Fish is also well-thought-out as a health food owing to its oil which is rich in PUFA.

Sample Collection

Four of fresh water fishes were collected *Schizothorax plagiostomus, Cyprinus carpio specularis, Cyprinus carpio communis, Catla-catla***.** Four samples of similar body weight and length for all analyzed fish species were collected from fish market located at Dehradun, India. Prior to analysis, about 25 g of fish muscle tissue was separated for the determination of protein moisture, ash and fat composition (9).

Methods

The following parameters were determined for above mentioned fishes which include 3 different types of Fatty acids- *1) Saturated fatty acids (SFA) 2) Monounsaturated fatty acids (MUFA) 3) Polyunsaturated fatty acid (PUFA)* by using the standard methods.Fatty Acid Analysis Fatty acids methyl esters (FAMEs) were obtained by the method of Metcalfe *et al*., (1966) with slight modifications (Sankar *et al*., 2010) (10). A fraction of the lipid extract was saponified with 0.5N NaOH in methanol followed by methylation in 14% boron trifluoride in methanol (BF3/MeOH). Methyl esters of the fatty acids thus obtained were separated by gas chromatography [Thermo Trace GC Ultra] equipped with a capillary column [30m long and 0.25mm diameter] and a flame ionization detector. The carrier gas was nitrogen and the flow rate was 0.8ml/min initial temperature was set as 110°Cand was increased 2.7°C/min until a temperature of 250°C was obtained. Injector and Detector temperature was kept at 260°C and 275°C respectively. Fatty acids separated were identified by the comparison of retention times those obtained by the separation of a mixture of standard fatty acids (11). Measurement of peak areas and data processing were carried out by Thermo Chromcard software. Individual fatty acids were expressed as a percentage of total fatty acids (12).

Result and Conclusion

Table 1: *Saturated fatty acids (SFA)*

Fatty acids (%)	*C. catla*	*L. rohita*
Saturated fatty acids (SFA)		
C4:0-C5:0	----	----
C6:0	----	0.0 ± 0.0^{a}
C8:0	----	-----
C10:0	----	0.0 ± 0.0^{a}
C11:0	-----	0.0 ± 0.0^{a}
C12:0	0.2 ± 0.0^{a}	0.2 ± 0.0^{a}
C13:0	0.2 ± 0.0^{a}	0.3 ± 0.0^{a}
C14:0	----	1.9 ± 0.3^{a}
C15:0	----	-----
C16:0	----	59.7 ± 9.8^{a}
C17:0	----	1.9 ± 0.5^{a}
C18:0	14.2 ± 4.6^{a}	5.3 ± 1.2^{b}
C20:0	0.5 ± 0.0^{a}	0.2 ± 0.0^{a}
C21:0	1.0 ± 0.2^{a}	3.3 ± 0.9^{b}
C22:0	0.9 ± 0.1^{a}	0.2 ± 0.0^{b}
C23:0	3.6 ± 1.0^{a}	0.3 ± 0.0^{b}
C24:0	----	----
∑SFA	20.6	73.3

Table 2: *Monounsaturated fatty acids (MUFA)*

Fatty acids (%)	*C. catla*	*L. rohita*
Monounsaturated fatty acids (MUFA)		
C14:1	0.2 ± 0.0^{a}	0.0 ± 0.0^{b}
C15:1	-----	0.0 ± 0.0^{a}
C16:1	2.6 ± 0.9^{a}	----
C 17:1	2.7 ± 0.8^{a}	0.5 ± 0.0^{b}
C 18:1	41.0 ± 8.9^{a}	9.5 ± 2.3^{b}
C 20:1	0.8 ± 0.0^{a}	0.3 ± 0.0^{b}
C 21:1	1.0 ± 0.2^{a}	3.3 ± 0.9^{b}
C 22:1	-----	------
C 24:1	------	-------
MUFA	47.3	**10.4**

Table 3: *Polyunsaturated fatty acids (PUFA)*

C18:2 *ω*-6	**6.7 ± 2.3^{a}**	**7.6 ± 2.1^{b}**
C20:2 *ω*-6	10.9 ± 2.6^{a}	6.3 ± 1.9^{b}
C20:3 *ω*-6	-----	0.2 ± 0.0^{a}
C20:3 *ω*-3	0.7 ± 0.1^{a}	0.0 ± 0.0^{b}
C20:4 *ω*-6	0.5 ± 0.0^{a}	6.3 ± 2.3^{b}
C20:5 *ω*-3 (EPA)	6.8 ± 1.2^{a}	0.9 ± 0.1^{b}
C22:6 *ω*-3 (DHA)	4.7 ± 0.9^{a}	0.4 ± 0.0^{b}
∑PUFA	31.9	22.5
∑*ω*-3	22.7	7.8
∑*ω*-6	9.3	14.7
ω-3/*ω*-6	2.4	0.5

The total PUFA amount in Catla-catla 31.9 and L. Rohita 22.5.In case of SFA content, Catla-catla is on 20.6 while L. Rohita contains 73.6.If we compare amount of MUFA of 2 fishes then the results are as follows Catla-catla is on 47.3(13) while L. Rohita contains 10.4. Fish oils is critical to normal eye and vision development besides providing energy for the central nervous system. Fish oils also increases memory power (14). The disease such as asthma, diabetes, psoriasis, thyrotoxicosis, multiple sclerosis etc. can also be moderated by ω-3 fatty acids. A person can expect good health if he or she consumes 0.5 -1g of ω–3 PUFA/day. Hence, regular consumption of these Indian food fishes may alleviate diseases/disorders related to malnutrition. (15)

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