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INFLUENCE OF ARTIFICIAL DIET ON THE FATTY ACID COMPOSITION OF FRESHWATER FISH *CYPRINUS CARPIO* (COMMON CARP)

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ABSTRACT

The main aim of this present study is to improve the fatty acid content in freshwater fish *Cyprinus carpio* by means of providing manufactured feed. Four experimental diets were prepared with the use of vegetable proteins and different grades of fish oil (0%, 2.5 %, 5%, 7.5 %) respectively. Diet I considered as the control feed. After 30 days experimental study, fishes were analysed for fatty acid content. C18:2 *9 found as the primary monounsaturated fatty acid in all groups of experimental fishes. C18:2 *6 is the second high level fatty acid (PUFA) in all groups of fishes. PUFA show marked increase in Group II, III, IV fishes than control fishes. USFA/SFA value is above 0.35 is beneficial. Our study shows values 2.5, 2.3, 1.8 and 2.5 in four groups of fishes respectively. The present study concluded PUFA content improved in fresh water fish, *C.carpio* by manufactured feed.

Keywords: *C.carpio*, Fish oil, Manufactured feed, Fatty acid.

INTRODUCTION

In addition to agriculture, aquaculture is an important sector for providing the better nutrition for human population. Because it provides essential proteins and vitamins. In addition to this fish is also an important source of essential fatty acids. Of this Omega 3 fatty acid is essential polyunsaturated fatty acids (PUFA) which is mainly found in marine fishes. When compared to marine fishes freshwater fishes does not possess sufficient amount of Omega 3 fatty acids. The present study aimed to improve this essential fatty acid content in fresh water fish, *Cyprinus carpio* (Common carp), which in turn can be used to improve the human health. Fish is most widely accepted as a nutrient-rich food source because it is palatable, tender, and of high nutritive value. The nutrients derived from fish include vitamins, calcium, phosphorus and unsaturated fat. These nutrients when provided naturally or artificially in aquaculture enable the fish to grow adequately for the enhancement of health in humans [1]. When fishes are cultured in artificial environment, additional nutrients need to be supplied in the form of supplementary diet [2]. To meet animal protein needs in developing countries, increased efforts are being made to develop aquaculture on an intensive scale [3]. Generally, Lipids of marine fish species contain more highly unsaturated fatty acids with higher n-3/n-6 ratio than the freshwater fish species [8]. The main source of Omega 3 fatty acids are marine fishes such as salmon, tuna, mackerel etc. The availability of these marine fishes in non-coastal regions is uncommon.

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Inclusion of fish meal (5%) and fish oil (0.1%) in carp culture is very low [17] and therefore the substitution of fish meal and oil will be considerably easier than for carnivorous aquaculture [18]. It is a general rule that larval and juvenile fish as well as other animals, tend to have a higher requirement for n-3 LC-PUFA than later life stages [16]. The LC- PUFAs -DHA, EPA, and AA play very important physiological roles in fish larvae, although fish as all vertebrates are incapable of their de novo synthesis [16]. Fresh water fish seem to possess sufficient desaturase and elongase capability to produce AA, EPA and DHA from their shorter-chain precursors Linoleic acid (LA; 18:2n-6) and Linolenic acid (LNA; 18; 3n-3) if they are present in the diet [20].

MATERIALS AND METHODS

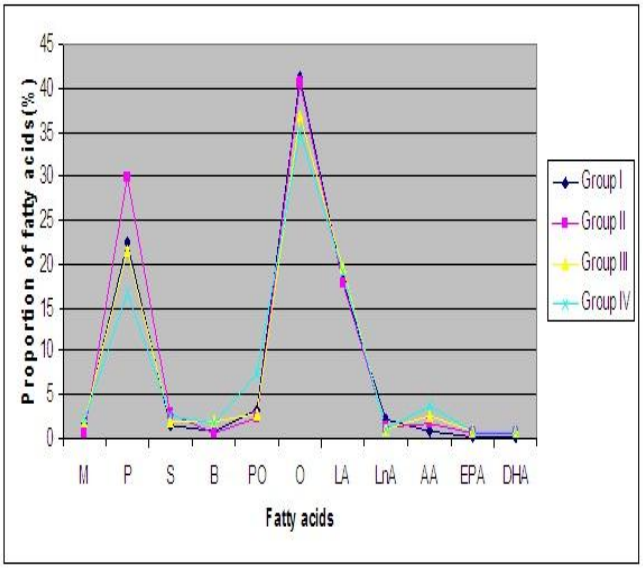
Preparation of manufactured feed

Manufactured artificial feeds are an important part of modern commercial aquaculture, providing the balanced nutrition needed by farmed fish. In the present study fish feeds are made by mixing together ingredients such as vegetable proteins (Soy flour 15%, Tapioca flour 4%, Maize flour 4%), vitamin, mineral mixture and binding agents such as wheat bran and rice bran. Water is added and the resulting paste is boiled for 10 minutes. Then fish oil is added and mixed well. Then it is extruded through holes in a metal plate. The diameter of the holes set the diameter of the pellets which can range from less than a millimeter to over a centimeter. As the feed is extruded in the form of nodules and it is sun dried to avoid fungal infection. The dried nodules are packed in air tight containers. By this method 4 types of feeds are prepared with different proportions of fish oil such as 0 %, 2.5 %, 5 % and 7.5 % in diet I , diet II, diet III and diet IV respectively. The experimental diets are analysed for fatty acid content as described by [4]. The fatty acid content in experimental feed is shown in Figure 1.

Experimental fish

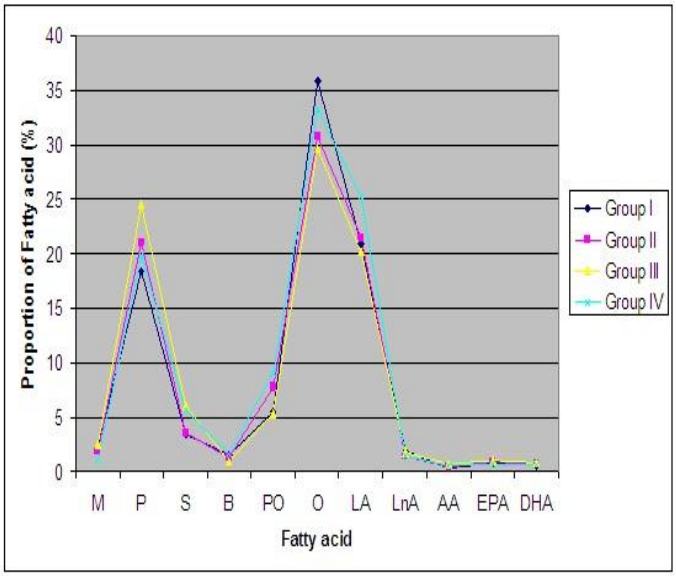
Cyprinus carpio (Common carp) was selected as an experimental fish. *C. carpio* belongs to the family cyprinidae, is commonly found fresh water fish. Because of their easy availability, and tolerance to low oxygen levels, *C. carpio* is mostly preferred rearing fish in pond culture. Fingerlings length from 3 to 5 cm was collected from Tamil Nadu Fisheries Development Corporation, Aliyar, Pollachi and Coimbatore District. Tamil Nadu, India. They were allowed to acclimatization for 2 weeks. Thereafter, they were divided in to 4 groups as I, II, III, IV each group containing 50 fishes. The group I maintained as the control. The duplicate of four groups of fishes fed experimental diet I, II, III, IV respectively. They were fed with 2 gm of manufactured feed daily at 8 a.m. This experiment was carried out for 30 days. After 30 days fish muscle were analysed for fatty acid content by Gas chromatographic analysis [4]. Fatty acid content in muscle of fishes shown in Figure 2.

Figure 1. Fatty acid content in manufactured feed



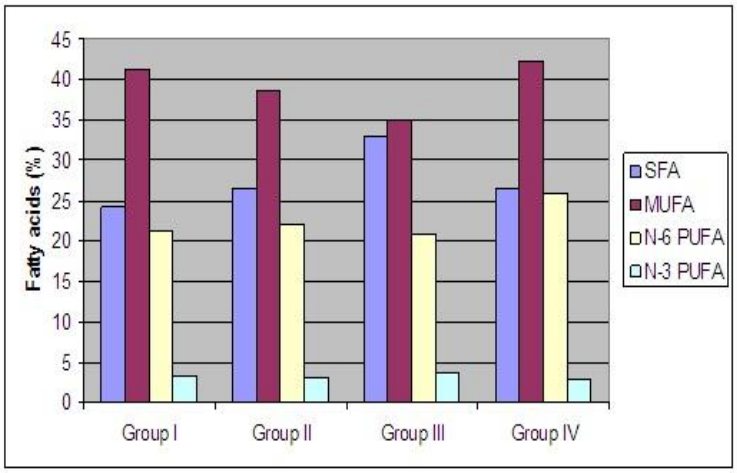
M-Myristic acid, P-Palmitic acid , S- Stearic acid, B-Behenic acid, PO- Palmitoleic acid, O-Oleic acid , LA-Linoleic acid, LnA- Linolenic acid, AA-Arachidonic acid, EPA- Eicosapentaenoic acid, DHA- Docossahexaenoic acid.

Figure 2. Fatty acid content in *C.carpio* muscles



M-Myristic acid, P-Palmitic acid , S- Stearic acid, B-Behenic acid, PO- Palmitoleic acid O-Oleic acid , LA-Linoleic acid, LnA- Linolenic acid, AA-Arachidonic acid, EPA- Eicosapentaenoic acid, DHA- Docossahexaenoic acid.

Figure 3. Fatty acid content in four groups of experimental fishes



SFA- Saturated Fatty acids, MUFA- Monounsaturated Fatty acids, N-6- Polyunsaturated Fatty acids, N-3- Polyunsaturated Fatty acids.

RESULTS

Feed analysis showed the different composition of fatty acids. There are 11 fatty acids found in the experimental diets. They are shown in the following Figure 1. The composition of fatty acids in four experimental feed found to be varied according to the ingredients used for preparation. Muscles of *C. carpio* found to have saturated fatty acids Myristic acid (C14: 0), Palmitic acid (C16: 0), and Stearic acid (C18: 0) found in *C.carpio* muscles. The principal fatty acid is Palmitic acid (C16: 0) in SFA. Their content are 18.33 %, 21.07 % 24.51 % and 19.85 % in four groups of experimental fishes respectively. Highest level of Palmitic acid (C16: 0) is found in fishes fed with diet III. Stearic acid (C18: 0) was the second highest SFA in experimental fishes (1.58 % - 2.88 %), high level found in fishes fed with diet II. Kalyoncu *et al.,* [10] studied the fatty acid profile in *C. carpio* captured in Ivriz dam lake, Turkey and found Stearic acid (C18: 0) was the second high saturated fatty acid in *C.carpio* muscles and found the same results in *C. carpio* muscles (4.30- 5.66 %). Myristic acid (C14: 0) is the third SFA present in carp. (1.09-2.45 %). In our experiment fishes fed with artificial diet the SFA content is 24.11 %, 26.56 % , 33.01 %, 26.59 % in four groups of experimental fishes respectively. Fatty acid content in muscles of *C. carpio* shown in Figure 2.

DISCUSSION

In the present study (MUFA) Oleic acid (C18: 1 *9) is the predominant fatty acid found in the muscles in all groups of experimental fishes. In the case of all freshwater fish, the major fatty acid among MUFA group was Oleic acid (20.7 – 42.7 %) [9]. This is in accordance with the result of Ugoala *et al.,* [18], Kolakowska *et al.,* [13] and Kminkova *et al.,* [12]. The content of Oleic acid was significantly higher in carp than in other fish species [9]. Oleic acid (C18:1 *9) 35.83 % is the highest level found in fishes fed with diet I. According to Kalyoncu *et al.,* [10], Oleic acid (C18:1 *9) was identified as a primary monounsaturated fatty acid in the carp for all seasons. The highest level of Oleic acid was found in summer 29.28 % [7]. Kolakowska *et al.,* [13] found similar results in carp. Guler *et al.,* [7] identified Oleic acid as the major fatty acid (15.1-20.3%) in carp. In our study MUFA Oleic acid (29.65% -35.83 %) content improved by providing artificial diet. Palmitoleic acid (C16:1 *9) is another MUFA found in carp muscles (5.36 – 9.05 %). Fishes fed with diet IV contain highest percentage of MUFA (42.23 %). PUFAs (Polyunsaturated fatty acids) n-3 and n-6 fatty acids found in fishes fed artificial diet. N-6 fatty acid include Linoleic acid (C18:2 * 6) and Arachidonic acid (20:4 *6) and N-3 fatty acid include Linolenic acid (C18:3 *3), EPA (C20:5 *3) and DHA (C22:6 *3). The percentage contents of n-6 PUFA in bream and carp were similar (10.5 % and 10.8 % respectively) [9,14]. Ozogul *et al.,* [14] found that n-6 PUFA values in tench (16.8 %) and carp (16.3 %). Greka and Dudek [5] reported n-6 PUFA for carp was 17.09 %. Our present study results showed that 20.86 – 25.89 %. Fishes fed with diet IV contain higher percentage of n-6 PUFA (25.89 %). C18:2 *6 is the second highest level of PUFA found in 4 groups of experimental fishes, (i.e.) 20.91 %, 21.53 %, 20.18 %, 25.24 %, 22.18 % in fishes fed with diet 1; diet II, diet III and Diet IV respectively. C18:2 *9 is found high level in fishes fed with diet IV. AA is another PUFA identified (0.36 – 0.68 %) and found high level in fishes fed with diet III. The main fatty acids of n-3 PUFA in muscle lipids of fish were DHA (0.60-0.85 %) and EPA (0.69 – 1.04 %). High content of EPA and DHA was found in carp fed with diet III 1.04 % and 0.85 % respectively. Fishes fed with diet IV contain high PUFAs (28.78 %). N-3 PUFA contents varied from 2.89 – 3.74 %. High levels of n-3 PUFA present in fishes (3.74 %) fed with diet III. There were no significant differences between the four groups of fishes at 0.05 levels. Joanna Luczнska *et al.,* [9] found that

n-3 PUFA in *C.carpio* is 4.7%. An increase in the human dietary n-3/n-6 fatty acid ratio is essential in the diet to help prevent coronary heart disease by reducing plasma lipids and to reduce cancer risk [11]. The ratio of n-3/n-6 accounted for 3.3 (Rainbow trout), 2.6 (Bream), 1.6 (Tench) and 0.4 (carp) respectively [9]. According to Koalkowska *et al.,* [13] the value in carp was 0.1, whereas in the case of Rainbow trout the n-3/n-6 ratio was 4.9. The present study reported the n-3/n-6 ratio 0.11 – 0.18 in four groups of experimental fishes. A high level of n-6 fatty acids lowered the n-3/n-6 ratio in summer in *S. luciperca* which was the freshwater fish [6]. Our present study coincides with the above study. The ratio of n-3/n-6 PUFAs in total lipids of freshwater fishes changes mostly between 0.5 and 3.8, whereas with marine fishes it is 4.7-14.4 [7]. Sakineh yeganeh *et al.*, [15] reported this ratio was more than 1 in the wild carp and less than 0.5 in the farmed carp.

CONCLUSION

MUFA found higher level in all experimental fishes. C18:1*9 is the predominant MUFA in all groups of fishes. C18:2 *6 (PUFA) was the second higher level of fatty acid in all groups of fishes. MUFAs and PUFAs found high level in fishes fed with diet IV. At the same time group IV fish contain higher n-6 PUFA than other fish groups whereas n-3 PUFA level increased in group III fishes. The ratio of unsaturated (USFA) Vs. saturated fatty acids is of great importance in edible fat. The value of more than 0.35 is usually believed to be beneficial [12]. In our study USFA Vs SFA values 2.6, 2.3, 1.7, 2.5 in four groups of experimental fishes respectively. The present study revealed the improvement of fatty acid contents in the muscles of *C. carpio* fed with artificial diet.

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