LIPID PROFILES OF JUVENILE *Piaractus mesopotamicus* (TELEOSTEI: CHARACIDAE) FED DIETS OF VARYING POLYUNSATURATED FATTY ACID COMPOSITION

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Lipids play an important role in fish growth, since they are the most important source of energy and essential fatty acids (EFA). Studies undertaken with warmwater fish indicate that significant differences exist among species. Rainbow trout have requirements for *n*-3 fatty acids (FA), carp appear to require both *n*-3 and *n*-6 FA, tilapia seem to have at least an *n*-6 requirement and channel catfish grow well on diets containing both *n*-6 and high molecular weight *n*-3 FA (Stickney and Hardy, 1989).

Methods

Eighty *Piaractus mesopotamicus* juveniles were maintained for 12 months in earth ponds at the National Center of Tropical Fish Research, in Pirassununga, SP, Brazil. Four experimental diets were formulated by combining the same amounts of ingredients, differing by the addition of different oil sources. The control group had no oil added to the diet, the corn oil group had corn oil (48%

of 18:2 n-6, LA) added in the diet and the cod oil group had cod liver oil (7% of 20:5 n-3, EPA and 6% of 22:6 n-3, DHA). The forth group, corn + cod group, had both oils added in the diet. In the same day, 10 fish were sacrificed and are the initial group.

Animals from each group were weighed and lipid storage organs were collected for determination of lipid classes and FA. The tissue samples were frozen at -80^0C with prior addition of 0.01% of BHT to avoid oxidation. Tissues were extracted according to Folch et al., (1957). Lipid classes were analyzed by thin layer chromatography with flame ionization detection using a MARK V Iatroscan (Parrish, 1987). Fatty acid methyl esters were prepared by transesterification with methanolic sulphuric acid and the analyses were performed on a Shimadzu GC-17 with a mass spectrometer. Data were treated with ANOVA and means were compared by Student-Newman-Keuls ($P<0.05$).

Results and Discussion

After 12 months, animals fed the cod oil diet had higher final weight than the other groups. When corn and cod oil are added together, the final weight was still higher than control and corn oil group (Table 1).

The main lipid classes in the white muscle are triacylglycerol (TG), phospholipids (PL) and sterols (ST). The data show that the cod oil group has the highest total lipid content and the other groups do not differ from the initial group. Analyzing the main lipid classes can be observed that the higher total lipids values in that group must be due to higher TG values. In contrast, the control group has the highest phospholipid content, higher than all the other groups (Table 1).
The lipid content in the liver is higher than in the white muscle but the main lipid classes are the same. However, in the liver the distribution of total and neutral lipids is different from the muscle. Neutral lipids are not so much higher than polar lipids, as observed in the white muscle and this is due to the higher phospholipid content in the liver. The sterol content in the liver is also higher than in white muscle and in the former, the diet combining corn and cod oil results in lower sterol values when compared with the initial group. In addition, the corn oil and cod oil groups have lower phospholipids values when compared to control group (Table 1).

The FA composition of the adipose tissue samples reflects the composition of the diets, where animals fed the cod liver oil diet have the higher values of *n-3*

FA, mainly the essentials, DHA and EPA. Animals fed the corn oil diet have the higher values of the essential *n-6* FA arachidonic acid (20:4 *n-6*, AA), when compared with the initial and cod oil groups. In the white muscle samples, the higher *n-6* FA were found in the corn oil group and the same is observed for AA. DHA values are not altered among the different groups, but fish from the cod liver oil group had more EPA than the other groups. All the experimental groups have lower amounts of saturated FA compared to the initial group and no PUFA are observed in that group (Table 2).

The *n-3* FA profile in the cod liver oil, results in a faster growth in *P.mesopotamicus*. They accumulate a higher amount of TG in the muscle, and EPA can be accumulated in that organ in higher amounts than in the other groups but the same does not occur with DHA. The animals are also elongating 18:2 *n-6* (LA) to the essential 20:4 *n-6* (AA), because the corn and corn + cod oil groups have higher amounts of this EFA when compared to the initial group. Interestingly, the higher lipid accumulation in the muscle of the cod oil group is not associated with an increase in sterols, which is important for human consumption, since the major sterol in fish is cholesterol.

References

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Table 1. Final weight and lipid class composition of *Piaractus mesopotamicus* fed different diets (mean)

	Initial	***Control***	***Corn Oil***	***Cod Oil***	***Corn+Cod Oil***
Weight (g)	468	788	824	1375	1043
Lipid Class - muscle					
TL ($mg.g^{-1}$)	19.4	25.3	18.3	34.0	14.0
NL (%)	73.1	73.0	76.7	85.5	78.7
PL (%)	26.9	27.1	23.3	14.5	21.3
TG ($mg.g^{-1}$)	12.4	17.3	12.8	27.1	10.5
ST ($mg.g^{-1}$)	0.38	0.40	0.34	0.61	0.25
PHOS ($mg.g^{-1}$)	4.1	5.9	3.6	4.3	2.4
Lipid Class – liver					
TL ($mg.g^{-1}$)	35.9	53.9	50.6	40.9	38.4
NL (%)	56.9	62.4	66.7	57.7	58.8
PL (%)	43.1	37.6	33.3	42.3	41.2
TG ($mg.g^{-1}$)	15.4	27.8	21.1	12.3	11.4
ST ($mg.g^{-1}$)	2.66	2.26	2.39	2.34	1.98
PHOS ($mg.g^{-1}$)	13.8	17.7	12.0	11.0	13.9

TL - total lipids; NL - neutral lipids; PL - polar lipids; TG - triacylglycerol; ST - sterol; PHOS - phospholipids

Table 2. Fatty acid composition (%) of *Piaractus mesopotamicus* fed different diets (mean)

Adipose	***Initial***	***Control***	***Corn Oil***	***Cod Oil***	***Corn+Cod***
SAT	32.2	32.1	31.6	30.5	31.9
MUFA	49.2	50.5	50.7	48.7	47.6
PUFA	15.8	12.8	15.2	15.2	16.3
n-3	1.2	1.9	1.7	4.6	2.7
n-6	14.6	10.9	13.8	10.5	13.6
n-3/n-6	0.08	0.18	0.12	0.46	0.20
DHA	0.36	0.20	0.43	1.83	0.65
EPA	0.10	0	0.39	1.07	0.75
AA	0.40	0.95	0.80	0.56	0.94
Muscle	***Initial***	***Control***	***Corn Oil***	***Cod Oil***	***Corn+Cod Oil***
SAT	62.6	39.2	35.7	38.7	38.1
MUFA	43.5	45.8	48.7	47.7	43.6
PUFA	0	9.8	14.5	12.1	13.5
n-3	0	2.4	1.7	2.8	3.0
n-6	0	8.6	13.0	10.7	11.7
n-3/n-6	0	0.33	0.14	0.26	0.28
DHA	0	3.23	1.58	2.22	1.91
EPA	0	0.26	0.26	0.95	0.51
AA	0	1.55	2.01	0.31	0.99

SAT – Saturated Fatty Acid; MUFA – Monounsaturated fatty Acid; PUFA – Polyunsaturated fatty acid; DHA – docosahaexanoic acid (22:6 *n-3*); EPA – eicosapentaenoic acid (20:5 *n-3*); AA – arachidonic acid (20:4 *n-6*)