USE OF SPIRULINA (*Arthrospira platensis*) AS PROTEIN SOURCE FOR THE NUTRITION OF JUVENILE TENCH (*Tinca tinca*)

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Introduction

Spirulina is a protein source that have a high potential in formulation of fish feeding, as tested by several authors. Spirulina, in contrast to other protein terrestrial plant source, such as soybean meal, does not contain anti nutritional or toxic factors. Its composition include several nutrients, like antioxidants, vitamins and essential fatty acids. In our study we tested the growing response of tench to the substitution of fish meal with spirulina meal, focusing also to the variation of fatty acid profile and to the antioxidant proprieties of spirulina, using the formation of DNA adducts 8-oxo-7,8-dihydro-2′-deoxyguanosine (8-oxodGuo) as an indicator of oxidatively generated DNA damage.

Materials and methods

Juvenile tench, one summer old, provided by a local pond farmer were fed with isoproteic, isolipidic and isoenergetic diet, where the amount of fish meal was substituted with 5 levels of spirulina meal (0%, 25%, 50% 75% and 100% of substitution) (Table 1). After the acclimation fish were transferred to 15 cylindrical tanks of 400 l, three tanks per diet, l00 individuals per tank and fed for 90 days with the experimental diets. Fish were measured at the beginning and at the end of trial. The total biomass of each tank was measured every 10 days to correct the feed ration that was kept at the 4% of body weight. Proximate composition was performed on diet and on pool of three fish according the AOAC methods (1996) and fatty acids were determined by chromatographic analysis according to Christie (1982). 8-OHdG were determined using the an ELISA kit (8-OHdG check, Japan Institute for the Control of Aging, Shizuoka, Japan) from ten micrograms of cellular DNA isolated using the DNeasy tissue kit (QIAGEN, Germany).

Table 1 Diet formulation and proximate composition of the five experimental diets

	Replacement				
	0	0.25	0.5	0.75	1
Diet	A	B	C	D	E
Ingredients (g/kg)					
Fish meal (737 g CP/kg)	500	375	250	125	0
Spirulina meal (632 g CP/kg)	0	125	250	375	500
Soybean meal (432g CP/kg)	100	135	170	206	240
Wheat meal (91 g CP/kg)	250	215	180	144	110
Cod liver oil	120	110	105	95	90
Carboxymethylcellulose	10	20	25	35	40
Vitamin premix	20	20	20	20	20
Proximate composition (g/100g)					
Moisture	1.6	1.5	1.4	1.5	1.75
Crude Protein	44.16	45.05	45.11	46.06	45.95
Crude lipid	13.02	12.22	12.87	12.57	11.11
Nitrogen-free extract	29.2	30.49	31.59	32.28	34.5
Ash	12.02	10.74	9.03	7.59	6.69
Gross energy KJ $g^{-1\ h}$	17.45	17.53	17.94	18.11	17.90

Results

The growth rates of juvenile tench of this study resulted poor in all the diets treatment. Best growth results was found in group with the 25% of replacement of spirulina meal, with SGR (specific growth rate) of 0.96 and a FCR (feed conversion ratio) of 3.06. Our acceptable but not satisfying results could have been influenced by the high variability of growth that we observe in all fish groups as reported also by Wolnicki et al (2003).
Considering the fish body composition, tench fed with diet A, where no spirulina meal was used, showed a lipid content of fillet (15.5 g/100g) that was significantly higher in relation to other groups. Fatty acids found in fish partially respect the fatty acid composition of diets. Oleic acid (OA) increase its value in all groups. At the beginning of the trial the value of OA was 25.28 g/100g of total fatty acids, while at the end its amount increased in all groups, even if the amount of this fatty acid was lower than 25% in all diets.
The amount of linoleic acid (LA) and γ-linolenic acid (GLA) were strongly influenced by treatment. The higher value of LA was found in fish fed with diet E, 14.47 g/100g of total fatty acids, and this value decreased, following the presence of spirulina meal in feed, till the lowest value, 9.87 g/100g of total fatty acids, found in diet A, where no spirulina meal was used. The same trend was found following the presence of GLA, whose amount in groups was directly linked to the presence of spirulina meal in diets. n-3 fatty acids were almost constant in all fish, and they were not many influenced by diet. Docosahexaenoic acid (DHA) was the larger of this category, followed by eicosapentaenoic acid (EPA). The n-3/n-6 ratio in fish follow the trend of LA, but it was always greater than 1, even in fish of group E, which were fed by a diet where this value was 0.85. Stearidonic acid (SDA) increased in all groups compare to the fish at the beginning of trial although its value never reached the amount of this fatty acids in diets. EPA was found higher in diets respect to fish. Its value decrease also if it is compared to the value found in fish at beginning of trial. DHA value remains stable in fish, without following the presence of this fatty acid in the diets. DHA progressively decrease from diet A to diet E, and all values are lower in diets respects of fish. The n-3/n-6 ratio was influenced by the presence of different levels of LA. n-3 fatty acids tended to stay in a constant level, as reported by Turchini et al (2007) who gave diet with different lipid source to tench for 84 days. At the end of their trial they found that the n-3/n-6 ratio did not exceed a minimum level, whatever was the n-3/n-6 ratio of diet.

Conclusions

The results of the present trial shows that it is possible to partially replace fish meal with spirulina meal in the diet of juvenile tench, although the fatty acids profile of fish resulted affected by the presence of LA brought by spirulina meal. Spirulina could be a valuable and sustainable source of protein for aqua feeding taking to account the cost of this ingredients, which could decrease in near future.

References

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