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

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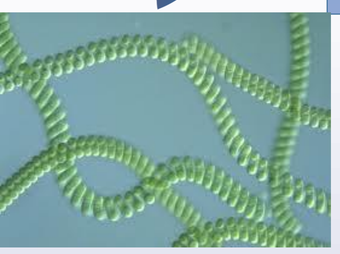

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Introduction

Spirulina is a protein source that have a high potential in formulation of fish feed, as reported by several authors. In contrast to other terrestrial plant protein, spirulina 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, with particular attention to the variation of fatty acid composition and to the antioxidant proprieties of spirulina, by 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 5.78 ±0.62 cm and 3.06 ± 1.26 g

5 diets (A, B, C, D E, Table 1) , 3 tanks/diet in RAS, 100 Fish /diet

Fish were measured at the beginning and at the end of trial

Feed ration 4% of body weight, corrected every 10 days

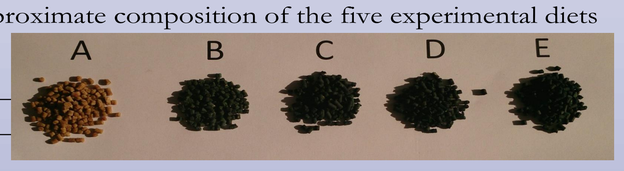
Proximate composition determination

DNA adducts measured by 8-OHdG ELISA Kit (JaICA)

Fatty acid analysis by GC

Statistical analyses by SPSS 22.0

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



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

Growth (table 2) did not appear to have been affected by dietary treatment. Fish fed with diet A presented an higher lipid content. Figure 1 shows the amount of DNA adducts (8-oxodGuo) while figure 2 shows the variation of polyunsaturated fatty acid concentration during the treatment.

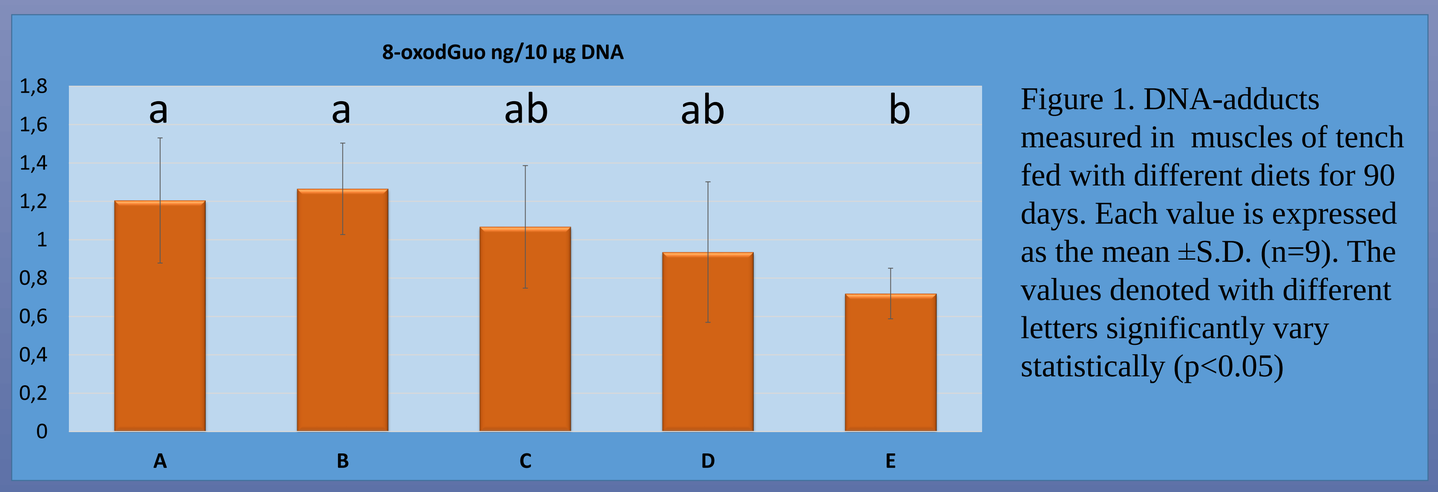


Figure 1. DNA-adducts measured in muscles of tench fed with different diets for 90 days. Each value is expressed as the mean ±S.D. (n=9). The values denoted with different letters significantly vary statistically ($p<0.05$)

Table 2. Survival, feed intake (FI), feed conversion rate (FCR) and specific growth rate (SGR) of the five experimental diets. (n= 60, 20 fish for 3 tanks).

	Diet				
	A	B	C	D	E
Overall survival	98.0	99.6	99.6	99.3	99.6
FI	12.11 ±0.46^{b}	11.10 ±0.14^{a}	10.66 ±0.75^{a}	10.49 ±0.08^{a}	10.54 ±0.49^{a}
FCR	3.96 ±0.79	3.06 ±0.60	3.87 ±1.09	4.57 ±1.08	5.14 ±1.18
SGR	0.68 ±0.17	0.96 ±0.21	0.78 ±0.26	0.62 ±0.10	0.55 ±0.15

Specific growth rate (SGR) was expressed as SGR = 100($\ln W_f$-ln W_i)$days^{-1}$ where Wf and Wi where final and initial weight. Feed conversion ratio (FCR) was expressed as FCR= $F(W_f-W_i)^{-1}$ where F is the amount of feed provided. Feed intake was calculated as FI= total feed fed/number of fish. Values are means ± SD; value in the same row having different superscripts are significantly different ($P>0.05$)

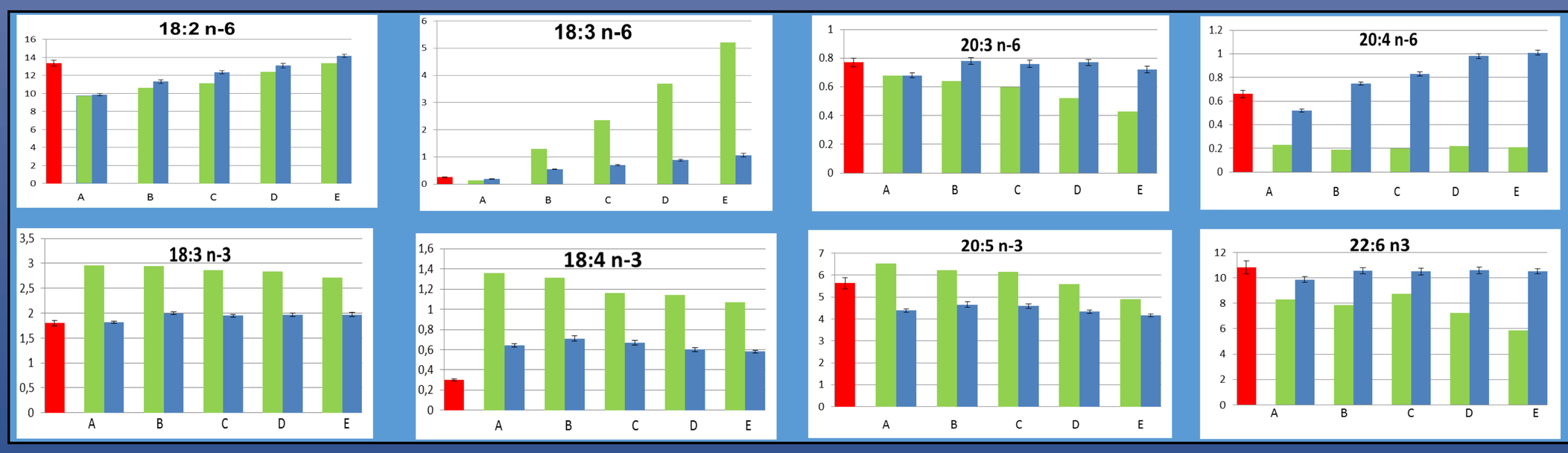


Figure 2 . Fatty acids composition (g/100g of fatty acids) of tench at the beginning of the trial (red bars), diets (green bars) and tench after 90 days of treatment (blue bars). Each value is expressed as the mean ±S.D. (n=9).

Conclusion

The results of the present trial demonstrated that it is feasible partially to 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 Linoleic Acid, introduced by spirulina meal. Spirulina showed in vivo antioxidant capacity, since fish fed with the highest amount of spirulina presented the lowest DNA adduct formation. Spirulina could be a valuable and sustainable source of protein for aqua feed, taking into account the cost of this ingredient, which could decrease in near future.