Effect of sex on the fillet quality of Nile tilapia fed varying lipid sources

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ABSTRACT - Effect of sex and three different oil supplementations on main production traits, and fatty acid composition of the fillet and gonads was investigated in Nile tilapia. Males and females had significantly different final weights owing to the occasional reproduction of fish. Diets had no significant effects on the main production traits. The percentage of ALA in the fillet was significantly higher in the males in all diets. Significant differences were found between the two sexes in the n-3 PUFA, resulting in a higher n-3/n-6 ratio in the males. MUFA and n-6 PUFA percentages and EPA/DHA ratio in the fillet were affected by the fat sources in the diet. The proportion of the main fatty acids showed significant changes in the gonads. Both sex and the diet had a significant effect on LA, AA, and DHA percentages. In case of EPA the males had significantly higher values than the females. ALA was affected by the different diets, the fillets of the LO group containing the highest percentage. Regarding the main FA groups, n-3 PUFA, n-6 PUFA, n-3/n-6 ratio and the DHA/EPA ratio were affected by sex and diets.

Key words: Nile tilapia, Fatty acids, Sex, Oil supplementation.

Introduction - Meat quality of fish depends firstly on feeding (Steffens, 1989), and secondarily on many different factors such as age, sex, diet, season. Akpinar et al. (2009) found quantitative differences between individual fatty acids in liver and muscle tissues in trout, depending on the sex. Caponio et al. (2004) reported that qualitative differences exist between sexes on sardines. The aim of our investigation was to evaluate the effect of sex and three different oils in feed on main production traits and meat quality, evaluating also the fatty acid composition of the fillet and gonads in Nile tilapia.

Materials and methods - The study was carried out in the Fish Laboratory of the Kaposvár University. Treatments were repeated in 3 tanks, with a stocking density of 65 fish per tank (11kg/m³). The experimental stock showed no signs of sexual maturity at the start of the 42 days feeding trial. The experimental feeds were supplemented with soybean oil (SO) and linseed oil (LO), the control diet contained fish oil (FO). Chemical and fatty acid composition of the feeds are shown in Table 1. At the end of the trial four fish (two males and two females) for each treatment were over-anaesthetised, dissected and the fillets and the gonads were subjected to the analysis of fatty acid profile. Tissue samples (muscle and
gonad) were extracted by the method of Folch et al. (1957). Gas liquid chromatography was performed on a Shimadzu 2100 apparatus. Results were evaluated by two-way ANOVA and treatment mean values were compared by Tukey’s test.

Results and conclusions - Main production traits were not significantly affected by the different fat sources of the diets. The low value of the specific growth rate (S.G.R.=0.7% day⁻¹) can be explained by the occasional reproduction of fish. Males and females had no

| Table 1. Proximate composition and most important fatty acids in the feeds. |
|---------------------------------------------------------------|
| Chemical composition | SO  | LO  | FO  | Fatty acids (%) | SO  | LO  | FO  |
|----------------------|-----|-----|-----|----------------|-----|-----|-----|
| Dry matter (DM; g/kg)| 871 | 867.6 | 867.2 | C18:2 n-6 (LA) | 23.10 | 30.09 | 19.08 |
| Crude ash (g/kg DM)  | 51.4 | 50.7 | 50.3 | C20:4 n-6 (AA) | 0.33 | 0.16 | 0.36 |
| Crude protein (g/kg DM) | 38.8 | 371.4 | 363.4 | C18:3 n-3(ALA) | 4.16 | 24.5 | 3.72 |
| Ether extract (g/kg DM) | 11.9 | 95.3 | 123.4 | C20:5 n-3 (EPA) | 4.64 | 1.37 | 5.20 |
| Crude fibre (g/kg DM) | 24.3 | 23.1 | 22.5 | C22:6 n-3 (DHA) | 8.43 | 2.95 | 9.27 |

| Table 2. Fatty acid composition (% of total fatty acids) of the fillets and gonads of tilapia fed different diets. |
|---------------------------------------------------------------|
| Fatty Acid | Organ (diet) | SO  | LO  | FO  |
|------------|-------------|-----|-----|-----|
| C18:2n-6  | fillet      | 15.8±0.02³³³ | 13.9±0.06²   | 13.7±1.00²   |
|            | gonad       | 13.3±0.03²天文 | 14.8±0.06¹天文 | 10.9±0.50¹天文 |
| C20:4n-6  | fillet      | 9.98±1.20²天文 | 3.90±0.36²   | 7.03±1.35¹天文 |
|            | gonad       | 10.7±0.10²天文 | 0.79±0.22²天文 | 4.51±0.03²天文 |
| C18:3n-3  | fillet      | 0.58±0.01¹天文 | 1.18±0.15¹天文 | 3.01±1.35¹天文 |
|            | gonad       | 0.58±0.01¹天文 | 1.18±0.15¹天文 | 3.01±1.35¹天文 |
| DHA/EPA    | fillet      | 23.1±0.46³天文 | 18.3±1.87³天文 | 27.3±4.70³天文 |
|            | gonad       | 23.1±0.46³天文 | 18.3±1.87³天文 | 27.3±4.70³天文 |
| SFA        | fillet      | 27.6±2.10³天文 | 28.9±0.37³天文 | 13.9±1.00³天文 |
|            | gonad       | 17.3±3.35³天文 | 17.3±3.35³天文 | 17.3±3.35³天文 |
| MUFA       | fillet      | 16.5±1.15³天文 | 17.6±3.52³天文 | 21.2±0.40³天文 |
|            | gonad       | 23.0±1.87³天文 | 18.3±1.87³天文 | 27.3±4.70³天文 |
| n-3 PUFA   | fillet      | 21.5±0.59³天文 | 19.9±0.85³天文 | 17.9±1.54³天文 |
|            | gonad       | 21.5±0.59³天文 | 19.9±0.85³天文 | 17.9±1.54³天文 |
| n-6 PUFA   | fillet      | 26.6±2.04³天文 | 21.1±0.27³天文 | 17.5±0.55³天文 |
|            | gonad       | 26.6±2.04³天文 | 21.1±0.27³天文 | 17.5±0.55³天文 |
| n-3/n-6    | fillet      | 0.86±0.00³天文 | 0.87±0.08³天文 | 1.26±0.20³天文 |
|            | gonad       | 0.86±0.00³天文 | 0.87±0.08³天文 | 1.26±0.20³天文 |

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significant differences in the initial body weight (168.3 vs 177.1g) while final weights (273.4 vs 187.3g) differed significantly (P<0.001). Males also showed significantly (P<0.001) higher fillet percentage than females (30.4 vs 27.4%). Different diets did not result in significant differences in the final body weight, fillet weight and fillet percentage.

Changes of the fatty acid profile of Tilapia tissues are shown in Table 2. The incidence of ALA in the fillet was higher in the males by all diets, however it was significant only in groups FO and LO, and the latter was higher than in fish fed other diets. Differences were found between the two sexes in the n-3 PUFA of FO and LO groups, resulting in a higher n-3/n-6 ratio in the males, but these were significant only in the FO group. In case of EPA, the males had generally higher values; however the difference was significant in the gonads of FO group. Fillet MUFA, was affected by the fat source in the diet. LA, AA, and DHA and the main FA groups, n-3 PUFA, n-6 PUFA, the n-3/n-6 ratio and the DHA/EPA ratio were affected by both treatments (sex and diets). In case of n-3/n-6 ratio the interaction of the two treatments was also significant. Similarly to the fillet, females had a higher MUFA incidence in the gonads; however it was significant only in the group FO.

The higher body weight and fillet incidence make the males of tilapia more advantageous in the aquaculture production. However, the maturation process results in marked differences between the two sexes in the fatty acid composition of fish fillet. The higher level of n-3 PUFA in the muscle of male fish than in that of females resulted also in Salmo trutta macrostigma (Akpinar et al., 2009), in Onchorhynchus mykiss (Görgün and Akpinar, 2007), and in Sardinia pilchardus (Caponio et al., 2004). A diet rich in n-3 fatty acids has a positive effect on cardio-circulatory pathologies and on many other human diseases. The optimal n-3/n-6 ratio is 1/1, whereas the western human diets provide a 1/15 ratio (Simopoulos, 2002). Tilapia fillets with 1/1.7-1/1.1 n-3/n-6 ratio offer a possibility to develop health protecting functional products.

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REFERENCES - Akpinar, M.A., Görgün, S., Akpinar, A.E., 2009. A comparative analysis of the fatty acid profiles in the liver and muscles of male and female Salmo trutta macrostigma. Food Chem. 112: 6-8. Caponio, F., Lestini, A., Summo, C., Bilancia, M.T., Laudadio, V., 2004. Chemical characteristics and lipid fraction quality of sardines (Sardina pilchardus W.): influence of sex and length. J. Appl. Ichthyol. 20: 530-535. Folch, J., Lees, M., Sloane-Stanley, G.H., 1957. A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226: 497-509. Görgün, S., Akpinar, M.A. 2007. Liver and muscle fatty acid composition of mature and immature rainbow trout (Onchorhynchus mykiss) fed two different diets. Biologia, Bratislava, 62: 351-355. Simopoulos, A.P., 2002 The importance of the ratio of omega-6/omega-3 essential fatty acids. Biomed Pharmacother 56: 365-379. Steffens, W., 1989. Principles of Fish Nutrition. John Wiley, New York.