SEASONAL VARIATIONS IN FATTY ACID COMPOSITION AND HEPATIC STATUS OF WILD EURASIAN PERCH (Perca fluviatilis) DURING A MATURATION CYCLE

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Introduction. At present in aquaculture, the lipid nutrition aspect of aquatic organisms is of main interest. The capacity of some fish species to use high-energy diet to meet optimum growth capacity and enhancing the protein sparing effect is well exploited. However, supply of such high-energy diets to coolwater fish species like Dicentrarchus labrax L., Psetta maxima L. can be deleterious. The most common effects are the diminution of growth performances and immune defences, the increase of sensitivity to rearing conditions, the accumulation of lipid in tissues and liver, and an increase of mortality rate. It is obvious that the capacity to use high-energy diets differ according to fish species, but the lipid metabolism is also involved in this capacity and mainly influenced by nutritional status and sexual maturation. One of interesting observation is that, according to Diaz (1999), disturbances of lipid metabolism appear when the natural capacity of lipid storage is overpassed. In wild Eurasian perch, it has been observed that energy is mainly stocked in perivisceral tissues and gonads according to season and needs. Females are single spawners with a group synchronous ovary development and energy needs are greater during vitellogenesis. Indeed, knowledge about liver stocking energy capacities, liver status and metabolism, during a reproduction cycle in the wild is scarce. The main objective of the study was to investigate the lipid content and fatty acid composition of target tissues and the hepatic status of Eurasian perch according to maturation cycle of adult wild fish.

Methods. Wild adult females of Eurasian perch were regularly captured from the Meuse river between August 2001 and July 2002. Back from the field, fish were killed with a blow to the head, weighed, dissected to measure the morphological parameters needed to determine the hepatosomatic (HSI) gonadosomatic (GSI) and liposomatic indexes (LSI) (fat around the digestive tract) and sexed. Maturation stages were determined by histological observations of gonads previously fixed in bouin. Samples of liver, gonad and fillet were stored at −80°C prior to lipid extraction. Total lipid of liver and gonad was extracted with chloroform/methanol (2:1, vol/vol) according to Folch et al. (1957), and the total lipid of muscles were extracted with chloroform / methanol / water (2:2:1.8, by vol) according to Bligh and Dyer (1959). The FA of total lipids were converted to methyl esters with BF₃-MeOH and FA separated and quantified by GC (GC trace, 2000; ThermoQuest, Carlo Erba, Italy) using a 30m X 0.32mm capillary column (FAME-Wax™; Restek Corporation, Bellefonte, PA). For each period, liver samples were fixed to produce electron micrographs. Sixty photographs from 3 females per period (3 x 20) were analysed and lipid droplets (LD), glycoegen (Gly), mitochondria (M) and rough endoplasmic reticulum (RER) were quantified by a soft imaging system (AnalySIS).

Results. Female GSI was very low (0.67%) during the resting period, from May to late August. It increased then progressively to reach a maximum of 27.8% in April, just before spawning (figure 1). On the other hand, LSI was low (0.46%) during exogenous vitellogenesis (from October to April) but significantly increased during the resting period (up to 1.62%). HSI did not differ significantly during the maturation cycle (1.1%).

![Figure 1. Seasonal variations of gonado- (GSI), hepatosomatic (HSI) and liposomatic indices (LSI) during the reproductive cycle of females of Eurasian perch. Maturity stages of ovary: SR: sexual resting; ENV: endogenous vitellogenesis; EXV: Exogenous vitellogenesis; OV: Ovulation and Spawning.](image)

In terms of total lipid contents (figure 2), muscles of Eurasian perch never exceeded 0.9%, while ovary displayed a significant decrease just after spawning. The lipid content of liver did not differ significantly along the maturation stage although a slight decrease can be observed until the spawning period. Fatty acid (FA) composition of tissues was relatively stable all year round. In muscle, quantity of n-6 polyunsaturated FA (PUFA) significantly increased.
in February, probably due to C18-2 (n-6) augmentation. In liver, content of C20-4 (n-6) (AA) decreased significantly during August. In ovary, content of C22-6 (n-3) (DHA) significantly decreased in June compared to March and April. It has been observed a transfer of C18:2 (n-6) and C18:3 (n-3) from the liver to the gonad and a bioconversion of the FA mainly in DHA.

Assuming that muscles represent 65% body weight (BW), the source of lipid in female perch is, in decreasing order of importance, perivisceral fats (0.95% BW), muscles (0.57% BW), gonads (0.30%) and liver (0.05% BW).

Figure 2. Seasonal variations of total lipid contents (%) in female Eurasian perch muscle, liver and gonad. Upper values indicate the number of fish used. Concerning the liver ultrastructure, the mean area of lipid droplets (area of LD/ number of LD) decreased from October to the spawning period in April (0.09 to 0.05\(\mu\)m\(^2\)) (figure 3) while it increased during the resting period. A decrease in glycogen storage was also noticed during the same period, the area of hepatocytes occupied by glycogen granules ranging from 15% in October to 7.9% in April. At the opposite, RER area increased but not significantly. Mitochondria area increased during the reproductive cycle (0.31\(\mu\)m\(^2\) in August to 0.83 \(\mu\)m\(^2\) in April) and decreased in June (0.48\(\mu\)m\(^2\)).

**Discussion.** During the sexual resting period, females accumulated energy as perivisceral fat and, to a lesser extend, into the liver. Size of LD was large and glycogen storage was maximum. Lipid content of ovary was low. A significant decrease of hepatic energy reserve (glycogen and LD) can be attributed to exogenous vitellogenesis. Protein synthesis and energy needs increased during vitellogenesis inducing an increase of RER and mitochondria. Physiological processes are focused to reach the maturation of ovary. In conclusion, general profiles of FA composition of tissues in perch match with the observations of previous researchers (Xu & Kestemont, 2002). Eurasian perch is characterized by a high content of C22:6 (n-3) (DHA) in liver, gonad and muscles (31.3; 22.8; 23.0%, respectively). During a whole annual cycle, the average lipid content of female liver never exceeds 4.3%.

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