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Straminipiles fungi growing on the alevins of the Nile tilapia in limnologically and trophically different water bodies

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The authors investigated the growth of straminipiles fungi on the alevins of Nile tilapia (*Oreochromis niloticus niloticus* L.) in water from eight limnologically and trophically different water bodies. Twenty-seven species were recorded. The largest number of species occurred on alevins in water from the Biala River and Fosa Pond (more biogenic), and the fewest in water from Dojlidy Pond and Lake Blizno (poor in biogenesis). The most commonly encountered species on Nile tilapia alevins were *Saprolegnia parasitica*, *Saprolegnia ferax*, *Achlya polyandra*, *Achlya oligocantha*, *Achlya prolifera*, *Leptomitus lacteus*, and *Pythium diclinum*. Amino acid, carbohydrate, and urease tests were used.

Key words: *Oreochromis niloticus*, alevins, straminipiles infections, hydrochemistry.

INTRODUCTION

The presence of wild fish production is stagnating, and the growth in overall fish production has come almost entirely from the global boom in aquaculture, especially in developing countries (Brown, 2000; van West, 2006). Over the past ten years, aquaculture production has increased, on average, by 11% per year (Delgado et al., 2003). In coming years, aquaculture will represent more than 30% of total fish production for consumption (FAO, 2012). In all hatcheries, the most important problem is aquatic fungi, especially straminipiles, growing on the fishes' eggs and young specimens (Dudka et al., 1989; Meyer, 1991; Hatai and Hoshiai, 1992; Czeczuga and Woronowicz, 1993).

The most common aquaculturally produced fish on the African continent for commercial use is the Nile tilapia (FAO-FIES, 2012), which has also been widely introduced for aquaculture on other continents (Stickney, 1986; ITIS, 2010). Thus, we decided to publish data covering the development of straminipiles fungi on the alevins of Nile tilapia from eight limnologically and trophically different water bodies.

MATERIALS AND METHODS

Short description of species

Nile tilapia, *Oreochromis niloticus niloticus* (Linnaeus, 1758) (Syn.: *L. niloticus* (Linnaeus, 1757); *Chromis niloticus* (Cuvier, 1817); *Chromis nilotica* (Cuvier, 1844); *Chromis guentheri* (Steindachner, 1864); *Tilapia nilotica, Tilapia calciati* (Gianferrari, 1924); *Tilapia nilotica nilotica* (van den Audenaerde, 1964); *Sartherodon niloticus* (Trewavas, 1978); *Oreochromis*

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niloticus (Trewavas, 1981), occur in Africa, the coastal rivers of Israel, the Nile from below the Albert Nile to the delta, and the Jebel Marra. In West Africa, its natural distribution covers the basins of the Niger, Bonue, Volta of Gambia, Senegal, and Chad, but the introduced specimens have been reported from the coastal basins. It has been widely introduced for aquaculture, with many existing strains (Lahuet, 1991). This fish occurs in a wide variety of freshwater habitats, such as rivers, lakes, sewage canals, and irrigation channels (Bailey, 1994; Skelton 2002). It feeds mainly on phytoplankton or benthic algae (ITIS, 2010). It is an oviparous species (Breder and Rosen, 1966), and they are maternal mouthbrooders (Trewavas, 1983). The extended temperature range is 8 to 42°C, and the natural temperature range is 13.5 to 33°C (ITIS, 2010).

Characteristics of water bodies

Water for the experiments was collected from eight limnologically and trophically different water bodies (two springs, two rivers, two ponds, and two lakes) located in the Northeastern region of Poland, Podlaskie District (53°07'N, 23°10'E- 53°13'N, 23°20'E):

i. Cypisek Spring, located in the South part of the Knyszynska Forest; limnocrenic type, 0.4 m width, 0.15 to 0.2 m depth, 0.6 l s^{-1} discharge.
ii. Jaroszowka Spring, located in the North part of Bialystok; limnocrenic type, 0.65 m width, 0.12 m depth, 2.4 l s^{-1} discharge.
iii. Biala River; 9.8 km length, 3.7 m width, 0.85 m depth; a left-bank tributary of the Suprasl River flowing through Bialystok.
iv. Suprasl River; 93.1 km length, 6.0 m width, 1.1 m depth; the largest right-bank tributary of the Middle Narew River, flowing through the Knyszynska forest.
v. Dojlidy Pond, located near Bialystok; 34.2 ha area, max depth 2.85 m. Its Southern shore borders coniferous woods, and its western part borders Bialystok.
vi. Fosa Pond, located in Branicki Park, Bialystok; 2.5 ha area, 1.75 m max depth. Swans breed and wild ducks colonies stay in this pond, as well as crucian carp.
vii. Lake Komosa; 12.1 ha area, 2.20 m max depth; surrounded densely by coniferous trees of the Knyszynska forest.
viii. Lake Blizno, located in Augustowska forest; 238.5 ha area, 28.8 m max depth.

Nineteen parameters of those water samples were determined (Table 1) according to the generally accepted methods (APHA, 2005).

Determining of straminipiles species

The investigated alevins (yolk-sac fry), covered with mycotic mycelia, were collected at the end of May from the hatchery of the Institute of Ichthyobiology and Aquaculture of the Polish Academy of Sciences in Golysz, Poland.

The following procedures were followed to determine the presence of straminipiles species on the investigated Nile tilapia alevins. Water samples (800 ml each) were placed in 1000 ml vessels, and 10 to 15 alevins were transferred to each vessel in accordance with general principles of culture (Watanabe, 2002). All the vessels were enclosed in Petri scales with the bed turned upside down to prevent possible airborne contamination by fungal spores. The vessels were stored at 15 ± 2°C, with access to daylight resembling natural conditions, and following the recommended instructions (Seymour and Fuller, 1987). Water analyses and experiments were carried out in three parallel repetitions.

The alevins in each vessel were observed every 3 to 4 days under a light microscope, and the presence of morphological structures (zoospores, antheridia, and oogonia) of aquatic fungi was recorded. Amino acid, carbohydrate, and urease tests were performed on the *Achlya, Aphanomyces, Leptolegnia, Pythium,* and *Saprolegnia* genera, according to Yuasa and Hatai (1996) and Kitancharoen and Hatai (1998). Yeast nitrogen base agar (YNB) (Difco) was used as the medium to culture the fungal isolates for the carbohydrate utilization test, and glucose yeast (GY) extract agar was used for the urease test. To prevent the growth of bacteria, ampicillin and streptomycin were applied. Basal medium was used in the amino acid assimilation test.

The medium preparation and indicator were the same as for the carbohydrate assimilation test. Bromothymol blue and phenol red were used as indicators and added to the YNB broth and GY broth, respectively. A change in the colour of the medium to pink or purple indicated a positive result, and a change to orange or yellow indicated a negative result. Those methods were described in detail in our previous paper (Czeczuga et al., 2011a). The experiments were carried out for one month. The straminipiles species were identified using the keys of Johnson et al. (2005) and Pystina (1998). The systematics of straminipiles species according to Dick (2001) were used in these experiments. The results were tested for significance using analysis of variance (ANOVA) and evaluated by Scheffé's test (Winer, 1997).

RESULTS

The chemical and physical parameters of the water used in the experiments are shown in Table 1. The most eutrophic was the water from the Biala River and Fosa Pond. Water from Lake Blizno and Dojlidy Pond had the lowest content of all forms of nitrogen, phosphates, sulphates, and chlorides. The highest levels of chemical oxygen demand (COD), chlorides, sulphates, and iron were also found in the Biala River and Fosa Pond.

Twenty-seven straminipiles species, including 22 belonging to Saprolegniales, four to Pythiales, and one to Leptomitales, were found growing on the Nile tilapia alevins (Table 2). The *Achlya*, *Pythium*, and *Saprolegnia* were the most prevalent genera. The most commonly encountered species were *Saprolegnia parasitica*, *Saprolegnia ferax*, *Achlya oligocantha*, *A. prolifera*, *Leptomitus lacteus*, and *Pythium diclinum*. The largest number of species occurred on Nile tilapia alevins in water from the Biala River and Fosa Pond (both more biogenic), and the smallest number were found in water from Dojlidy Pond and Lake Blizno (both poor in biogenesis). The results of amino acid, carbohydrate, and urease utilization are shown in Table 3. Six of the 12 amino acids tested-methionine, lysine, ornithine, phenylalanine, leucine, and glycine-could not be assimilated by the investigated straminipiles. All the stated species from the *Achlya*, *Aphanomyces*, *Leptolegnia*, and *Saprolegnia* genera assimilated glucose and starch, but they did not assimilate arabinose or salicin (except the species from the *Pythium* genus). Urease was assimilated by specimens from the *Leptolegnia, Pythium*, and *Saprolegnia* genera.

Table 1. Chemical and physical properties of water in particular water bodies (in mg L^{-1}).

Specification	Spring		River		Pond		Lake	
	Cypis	Jaroszówka	Biała	Supraśl	Dojlidy	Fosa	Blizno	Komosa
Temperature (°C)	14.5	10.2	16.8	15.2	15.8	18.0	12.6	14.9
pH	7.2	7.2	7.1	7.3	7.9	7.1	8.0	7.2
DO	16.4	11.8	8.2	18.6	9.4	6.4	16.5	14.8
BOD_5	2.6	3.6	10.8	4.2	9.7	12.8	2.8	5.1
COD (Oxidability)	9.9	4.8	16.8	11.2	15.8	20.2	4.2	9.0
CO_2	37.4	15.4	26.9	29.4	8.8	22.4	5.3	18.6
Alkalinity ($CaCO_3$ mval l^{-1})	4.6	3.9	4.3	3.6	3.2	5.8	2.5	3.8
$N-NH_3$	0.254	0.124	0.662	0.315	0.128	0.864	0.113	0.196
$N-NO_2$	0.015	0.013	0.128	0.037	0.008	0.114	0.003	0.018
$N-NO_3$	0.245	0.302	0.470	0.317	0.050	0.552	0.025	0.072
$P-PO_4$	0.920	0.974	1.820	1.020	0.242	3.598	0.140	0.706
Sulphates (SO_4)	36.8	121.0	73.2	50.4	45.7	85.1	14.1	40.6
Chlorides (Cl)	40.5	22.0	66.4	50.2	61.8	79.3	14.2	35.4
Total hardness (in Ca)	110.9	101.5	98.2	93.6	12.2	24.2	40.9	76.6
Total hardness (in Mg)	21.8	14.6	17.4	17.2	18.1	20.6	11.3	18.4
Fe	0.38	0.10	0.92	0.47	0.84	1.06	0.12	0.26
Dry residue	174.2	327.0	434.0	412.0	257.0	429.0	182.0	220.0
Dissolved solids	150.0	320.0	324.0	384.0	210.0	370.0	140.0	198.0
Suspended solids	24.2	7.0	110.0	28.0	47.0	59.0	42.0	22.0

DISCUSSION

In this study, 27 straminipiles fungal species belonging to eight genera were found to grow on the larvae of *O. niloticus* in water from eight limnologically and trophically different bodies of water in Northeastern Poland. The *Achlya*, *Pythium*, and *Saprolegnia* genera were the most prevalent.

The occurrence of zoosporic fungi has been investigated in bodies of water that are the areas of natural distribution of Nile tilapia on the African continent, mainly in the Northern part of the continent, especially in upper Egypt (Khallil et al., 1993) and lower Egypt (Ali, 2007, 2009). Zoosporic fungi were collected from accumulated rainfall water (El-Nagdy and Nasser, 2000), ponds in oases (El-Nagdy and Abdel-Hafez, 1990), the Nile River (El-Hissy et al., 1982), Nile Delta Region waters (El-Hissy and Khallil, 1989; Ali, 2007), Lake Nasser on the Aswan High Dam (El-Hissy et al., 2000), and other Egyptian lakes (Ali and Abdel-Raheem, 2003; El-Hissy et al., 2004), and fungal zoosporic species belonging to the *Saprolegnia*, *Pythium*, *Phytophthora*, and *Achlya* genera were found. Experimental transmission to two *Tilapia* species and the pathogenicity of some zoosporic fungi were investigated by El-Sharouny and Badram (1995), and 17 fungal species belonging to the *Saprolegnia, Achlya, Dictyuchus, Pythium, Allomyces*, and *Aphanomyces* genera were recorded in four organs of *Tilapia nilotica* and *Tilapia galilaela* from River Nile water. The most common were *S. ferax*, *Saprolegnia diclina, Achlya dubia, Achlya americana, Achlya racemosa, A. flagellata, Dictyuchus sterile, Pythium undulatum*, and *Aphanomyces sp.* Among the tested fungi, *S. parasitica, S. ferax*, and *A. racemosa* have been found to be the most infectious. Such species of zoosporic fungi as *Aphanomyces frigidophilus*, *Aphanomyces invadans*, *Dictyuchus pisci*, *Saprolegnia polymorpha*, *Scoliolegnia asterophora*, *P. diclinum*, and *L. lacteus* have not been recorded in bodies of water on the African continent.

The straminipiles species grows on the alevins of Nile tilapia in Polish waters and on the eggs of other fish species in Europe (Czeczuga and Muszynska, 1998) and Asia (Hussein et al., 2001). It is also worth noting that *A. invadans* occurs on the larvae of Nile tilapia in water from

Table 2. Straminipiles organisms recorded on the alevins of the Nile tilapia.

Taxa	Water bodies
Straminipiles	
Peronosporomycetes	
Saprolegniales	
Achlya americana Humphrey	Bi, K
A. androgyna (W.A. Archer) John et R.L.Seym.	Bi, J, K
A. bisexualis Coker et Couch	Bi, K, S
A. debaryana Humphrey	Bi, K, S
A. klebsiana Pieters	Bi, K, S
A. oligocantha de Bary	Bi, Bl, C, J, S
A. polyandra Hildebr.	Bi, Bl, C, J
A. prolifera Nees	Bi, Bl, C, J, S
Aphanomyces frigidophilus Kitanch. et Hatai	Bi, K, S
A. invadans Willoughby et al.	F
A. laevis de Bary	Bi, K
Dictyuchus monosporus Leitgeb	Bi, C, J, S
D. pisci Khulbe et Sati	Bi
Isoachlya curvata (Minden) Cejp	Bi, K
I. monilifera (de Bary) Kauf.	Bi, C, J, K, S
Saprolegnia anisospora de Bary	Bi
S. australis R.F. Elliott	Bi
S. diclina Humphrey	Bi, C, J, K
S. ferax (Gruith) Thur.	Bi, Bl, C, J, S
S. parasitica Coker	Bi, Bl, C, J, S
S. polymorpha Willoughby	Bi, K
Scoliolegnia asterophora (de Bary) M.W. Dick	Bi, K
Leptomitales	
Leptomitus lacteus (Roth.) C. Agardh	Bi, Bl, C, J, K, S
Pythiales	
Pythium debaryanum Hesse	Bi, K
P. diclinum Tokun	Bi, Bl, C, J, K, S
P. proliferum de Bary	Bi, S
P.ultimum Trow	Bi, C, J, K
Number of species in water from Spring Cypisek (C) – 11[a]	
Number of species in water from Spring Jaroszówka (J) – 12[a]	
Number of species in water from River Biała (Bi) –26[b]	
Number of species in water from River Supraśl (S) – 13[c]	
Number of species in water from Pond Dojlidy (D) – 9[c]	
Number of species in water from Pond Fosa (F) – 27[d]	
Number of species in water from Lake Blizno (Bl) – 7[e]	
Number of species in water from Lake Komosa (K) – 15[f]	
Number of species in water from springs – 11.5[a]	
Number of species in water from rivers – 19.5[b]	
Number of species in water from ponds – 18.0[b]	
Number of species in water from lakes – 11.0[c]	

Means with the same letter are not significantly different (p>0.05).

Fosa Pond; the *Aphanomyces sp.* has been reported to occur in some Egyptian lakes (El-Hissy et al., 2004). In some species of fish, it has been associated with skin lesions and mortality of the specimens. This phenomenon

Table 3. Amino acid, carbohydrate and urease assimilation by straminipiles isolated from alevins of Nile tilapia.

Species of genus	Amino acid	Carbohydrate	Urease
Achlya	Asp, Glu, Arg, Ala	Fru, Glu, Man, Raf, Suc, Mal, Lac, Mel, Cel, Tre, Sta, Dex, Rha, Gly	-
Aphanomyces	Glu, Ala, Cys	Glu, Sta	-
Leptolegnia	Asp, Glu, Ala	Fru, Glu, Man, Mal, Mel, Cel, Tre, Sta, Dex, Gly	+
Pythium	Ala, His	Fru, Glu, Man, Gal, Raf, Suc, Mal, Lac, Mel, Cel, Tre, Sta, Dex, Rha, Gly, Sal	+
Saprolegnia	Asp, Glu, Arg, Ala, His	Fru, Glu, Man, Mal, Cel, Tre, Sta, Dex, Gly	+

Abbreviations: Amino acids: Ala- Alanine, Arg- Arginine, Asp- Asparagine, Cys- Cysteine, Glu- Glutamine, His- Histidine, Carbohydrate: Fru- Fructose, Gal- Galactose, Glu- Glucose, Man- Mannose, Mal- Maltose, Mel- Melibiose, Cel- Cellobiose, Dex- Dextrin, Gly- Glycerol, Lac- Lactose, Rha- Rhamnose, Sal- Salicin, Raf- Rafinose, Sta- Starch, Suc- Sucrose, Tre- Trehalose. ”+” positive; “-“ negative.

was observed in two species of fish from an excavated earthen pond at the western shore of the Suez Canal, Egypt, during the winter of 1971 (Shaheen et al., 1999). According to Lilley et al. (2009), this invasive *Aphanomyces* infection of fish, reported by Shaheen et al. (1999), was caused by the *Aphanomyces invadans* species. It has also been observed in Poland, during autumn, on the skin and muscles of *Labeo bicolor* Smith specimens in water from Fosa Pond (Czeczuga et al., 2011c).

True fungi (Olufemi et al., 1983; Salem et al., 1989) and imperfect fungi (Lightner et al., 1988) also have been isolated from African specimens of the *Oreochromis* genus. Those isolated fungal species (from adult specimens of *Tilapia*) belonged to such genera as *Aspergillus, Fusarium, Mucor, Penicillium, Rhizopus, Scopulariopsis, Curvularia,* and *Paecilomyces*. Yeasts belonging to the *Candida, Rhodotorula,* and *Torulopsis* genera also have been isolated from adult specimens of the *Oreochromis* genus (Refai et al., 2010). The most predominant diseases of farmed *Tilapia* are aspergillomycosis (Marzouk et al., 2003) and zygomycosis (Wolf and Smith, 1999). Nile tilapia in aquaculture belong to parasite- and disease-resistant species (Kotusz, 2000). However, bacterial fin inflammation (rot fin) caused by protozoans from the *Trichodina* and *Chilodon* genera have been reported (Dykova, 2006), as well as some moulds, especially true fungi and straminipiles species (Marzouk et al., 2003; Refai et al., 2010).

We found the largest number of fungus species on the larvae of Nile tilapia in water from the Biala River and Fosa Pond (the most eutrophic of the bodies of water examined), while the number of isolated species of fungi was the lowest in water from Dojlidy Pond and Lake Blizno (the least abundant in biogenesis). We previously observed this type of phenomenon while studying the growth of fungi on the fillets of two species of piranhas (Czeczuga et al., 2010) and on the eggs of Acipenseridae fish species (Czeczuga et al., 2011b). *Saprolegnia* genus, similarly to *Achlya*, is generally thought to be an opportunistic pathogen that is saprotrophic and necrotrophic (Bruno and Wood, 1999). Opportunistic fungal specimens are very virulent and able to grow on dead plant fragments and cause primary infections in fish. Infections can take place on both eggs and fish. In the eggs, the disease is manifested by abundant cotton-like mycelial growth on the cells, resulting in death. In fish, the pathogen invades epidermal tissues (often beginning at the head or fins) and spreads to the entire surface of the body.

Occasionally, the hyphae penetrate into the muscles and blood vessels of infected fishes (Hatai and Hoshiai, 1992; van West, 2006). The most eutrophic water bodies are highly favourable environment for opportunistic species. Most dead plant fragments, on which opportunistic fungal species develop, occur in eutrophic bodies of water (Czeczuga et al., 2005b, 2007).

Owing to their rapid body weight growth, high tolerance of environmental conditions, and resistance to parasites and diseases, species of the Nile tilapia play an important role as a source of animal proteins, fats, and other biologically active substances, including carotenoids, which are important to human life. Carotenoids serve as a source of vitamin A, have antioxidant actions, play a cancer-protective role, and increase the immune response in mammals. They also may be significant against coronary heart disease (Czeczuga et al., 2013). Fish are not able to synthesise carotenoids *de novo*; therefore, those compounds have to be supplied in the diet. As shown in recent studies (Boonyaratpalin and Unprasert, 1989; Czeczuga et al., 2005a), specimens of Nile tilapia are rich in this pigment. Total content of carotenoids in particular body parts ranged from 0.216 µg g^{-1} (muscle) to 0.945 µg g^{-1} (liver) wet weight and included such important carotenoids as β- carotene, lutein, zeaxanthin, canthaxanthin, and astaxanthin (Britton and Khachik 2009).

In Nile tilapia, the considerable part of the carotenoid pool in the liver is transformed by oxidation and reduction into, i.a. vitamin A, and specifically, into three types of vitamin A (A_1, A_2 alcohol; A_1, A_2 aldehyde; and anhydro vitamin A_1 and A_2). In the Nile tilapia liver, the biotransformation into vitamin A involves not only α- and β-carotene, but also xanthophylls such as lutein, zeaxanthin, tanaxanthin, canthaxanthin, and astaxanthin (Katsuyama et al., 1987). Carotenoids are also important in resistance to fish infections. The immunity of a given population is also food-dependent (MacPhee et al., 1995), and it has been established that chitin (found in fish food) stimulates fish resistance (Sakai et al., 1992). The chitinous armours of crustaceans are known to be rich in carotenoids (Czeczuga and Czeczuga-Semeniuk, 1999). It is worth noting that fewer fungi were found on the eggs of *Coregonus alba* L., which contain a large amount of carotenoids, in comparison with eggs from the same lake but with fewer carotenoids (Czeczuga and Muszynska, 1998). This could explain why the fewest fungi were found growing on the eggs of *Coregonus lavaretus* L., which contain more carotenoids, compared with eggs with lower carotenoid amounts.

According to some authors (Soin, 1968; Karnaukhov, 1973; Latscha, 1990), carotenoids serve as a source of oxygen when oxygen is deficient, thereby ensuring better health of the eggs and enhancing their resistance to mycotic infections. Nile tilapia is known to be polyphagous (Kotusz, 2000; ITIS, 2010) under natural conditions; its food consists of algae (dominated by cyanobacteria), as well as periphyton and detritus. The fish also feeds on zooplankton and other aquatic invertebrates. Algae, especially cyanobacteria, as well as crustaceans and zooplankton, are rich in carotenoids. As is known, eutrophic bodies of water are more phyto- and zooplankton-rich than are oligotrophic bodies of water.

Chemotaxis-exhibiting zoospores found in water are particularly sensitive to asparagine and glutamine (Rand and Munden, 1993). Those two amino acids occur in large quantities in animals, including fish (Smith et al., 1985). All the stated species from the *Achlya, Leptolegnia*, and *Saprolegnia* genera growing on Nile tilapia larvae assimilated asparagine and glutamine, and the *Aphanomyces* species assimilated glutamine. Species of *Pythium* genus assimilated only alanine and histidine and all carbohydrates. These findings suggest that *Pythium* species prefers the plant substrate more than animal tissue. Four species of the *Pythium* genus growing on the Nile tilapia alevins are also common in Polish bodies of water (Czeczuga and Snarska, 2001), whereas they are quite rare on the eggs of freshwater fish (Czeczuga, 1996). Species from the *Aphanomyces* genus assimilated only glucose and starch and such amino acids as alanine, glutamine, and cysteine. We observed similar phenomena in our investigations on the occurrence of fungi on *Oncorhynchus gorbuscha* (Czeczuga et al., 2011a) and *O. tshawytscha* eggs (Czeczuga et al., 2012). It has also been observed on the eggs of other *Oncorhynchus* species (Kitancharoen and Hatai, 1998).

Conclusions

Examinations of the growth of straminipiles organisms on the alevins of Nile tilapia in eight different water bodies was performed, such as springs, rivers, ponds, and lakes. The investigations showed that:

i. The water most abundant in biogenesis was from the Biala River and Fosa Pond; the least abundant was water taken from Dojlidy Pond and Lake Blizno.
ii. Twenty-seven species of straminipiles organisms were found developing and growing on the alevins of Nile tilapia, 22 of which belonged to Saprolegniales, four to Pythiales, and one (*L. lacteus*) to Leptomitales. Most of the species were representatives of the *Achlya* and *Saprolegnia* genera. Two species that cause mass mortality of fishes in aquacultures, *A. invadans* and *S. parasitica* (Hatai and Hoshiai, 1992; Lilley et al., 2003), were found.
iii. The most frequently occurring species were *A. oligocantha*, *A. prolifera*, *Isoachlya monilifera*, *S. ferax, S. parasitica*, *L. lacteus*, and *P. diclinum.*
iv. The limnological type of the body of water does not influence the number of species occurring on the alevins of *Nile tilapia*; it depends on the trophicity.
v. The greatest number of straminipiles species on Nile tilapia alevins were found in water from the Biala River (26 species) and Fosa Pond (27) (more biogenic), and the lowest were found in water from Pond Dojlidy (9) and Lake Blizno (7) (both poor in biogenesis).

This finding can be explained by the fact that pathogenic Saprolegniales species belong to opportunistic organisms that are saprotrophic and necrotrophic (Bruno and Wood, 1999). Water rich in biogenesis is more abundant in dead organic material for saprotrophic organisms; therefore, it generates better development conditions for more Straminipiles species.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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