OPEN ACCESS Freely available online

Fisheries and Aquaculture Journal

Research Article

Effect of Water Physico-Chemical Characteristics on *Myxobolus tilapiae*, A Myxosporean Parasite of The Fish *Oreochromis niloticus* at MAPE Dam in Adamawa Region of Cameroon

Fonkwa Georges[1,3,4*], Kouam K Marc[2], Tchuinkam Timoléon[3], Tomedi Eyango Minette[1] and Tchoumboue[4]

[1]*Laboratory of Aquaculture and Demography of Aquatic Resources, Institute of Fisheries and Aquatic Sciences, Department of Aquaculture, University of Douala, P.O. Box 7236 Douala-Cameroon*

[2]*Physiology and Animal Health Research Unit, Department of Animal Production, Faculty of Agronomy and Agricultural Science, University of Dschang, P.O. Box 118, Dschang-Cameroon*

[3]*Vector Borne Diseases Laboratory of the Applied Biology and Ecology Research Unit, Department of Animal Biology, Faculty of Science, University of Dschang P.O. Box 67, Dschang-Cameroon*

[4]*Applied Hydrobiology and Ichthyology Research Unit, Department of Animal Production, Faculty of Agronomy and Agricultural Science, University of Dschang, P.O. Box 222, Dschang-Cameroon*

ABSTRACT

The effect of water physico-chemical characteristics on *Myxobolus tilapiae* loads and prevalence was investigated from May 2016 to May 2017 in 350 specimens of *Oreochromis niloticus* captured in MAPE dam, Adamawa region of Cameroon. The spores load and the fish condition factor were negatively correlated (r=-0.37; P<0.05). No significant (P>0.05) correlation was observed between the prevalence of *Myxobolus tilapiae* and water temperature, pH and nitrate concentration. However, the prevalence was significantly and positively correlated with the carbonate hardness (r= +0.14; P<0.001), and negatively correlated (r=-0.17; P<0.001) with water transparency. The optimum characteristics of water regarding transparency and carbonate hardness for reduced *M. tilapiae* infection and *O. niloticus* productivity need to be determined.

Keywords: *Myxobolus tilapiae*; Water physico-chemical characteristics; *Oreochromis niloticus*; MAPE dam; Cameroon

INTRODUCTION

Fish represents nearly 51% of animal proteins intake in Africa [1]. Unfortunately, fish production is impeded by many challenges, some of which are the deleterious effects of pathogens particularly Myxosporeans [2]. The world of Myxosporeans fauna is composed of about 2180 species gathered within 62 genera among which the genus *Myxobolus* Bütschli, 1882 is the most abundant with 792 species [2]. *Myxobolus tilapiae* is one of the *Myxobolus* species infecting various organs in *O. niloticus*.

In a given habitat, factors that influence the fish parasites fauna are both endogenous and exogenous [3]. Among the exogenous factors, water physico-chemical characteristics are important because its modification can disrupt the host - parasite equilibrium. As a result, fish not only stress but water can become more conducible to epizootics leading to massive fish deaths and important economic losses [4]. Thus, a better understanding and adequate monitoring of water physico-chemical characteristics can help interrupting *Myxobolus tilapiae* life cycle since effective drugs against Myxosporeans are unavailable [5]. The study aimed at assessing the correlation

***Correspondence to:** Fonkwa Georges, Laboratory of Aquaculture and Demography of Aquatic Resources, Institute of Fisheries and Aquatic Sciences, Department of Aquaculture, University of Douala, P.O. Box 7236 Douala-Cameroon, Tel: (+237)674298924; E-mail: fonkwageorges@gmail.com

Received: May 27, 2020; **Accepted:** July 29, 2020; **Published:** August 05, 2020

Citation: Fonkwa G, Kouam KM, Tchuinkam T, Tomedi EM, Tchoumboue. (2020) Effect of water physico-chemical characteristics on *Myxobolus tilapiae*, a Myxosporean parasite of the fish *Oreochromis niloticus* at MAPE dam in Adamawa region of Cameroon. Fish Aqua J 11:278. doi: 10.35248/2150-3508.20.11.278

between *Myxobolus tilapiae* loads as well as prevalence and the water physico-chemical characteristics in *Oreochromis niloticus*.

MATERIALS AND METHODS

Study area

Fish were sampled in MAPE dam, Bankim subdivision (6°00'-6°20' NL/11°20'-11°40' EL), Mayo-Banyo Division, Region of Adamawa – Cameroon (Figure 1). The average altitude is about 724m and the soil is a mixture of clay and sand. The climate is of tropical Sudano-Guinean type with two seasons: a long rainy season running from March to November and a short dry season from November to March. The annual average temperature is about 23°C and the rainfall varies between 1500 mm and 2000 mm [6].

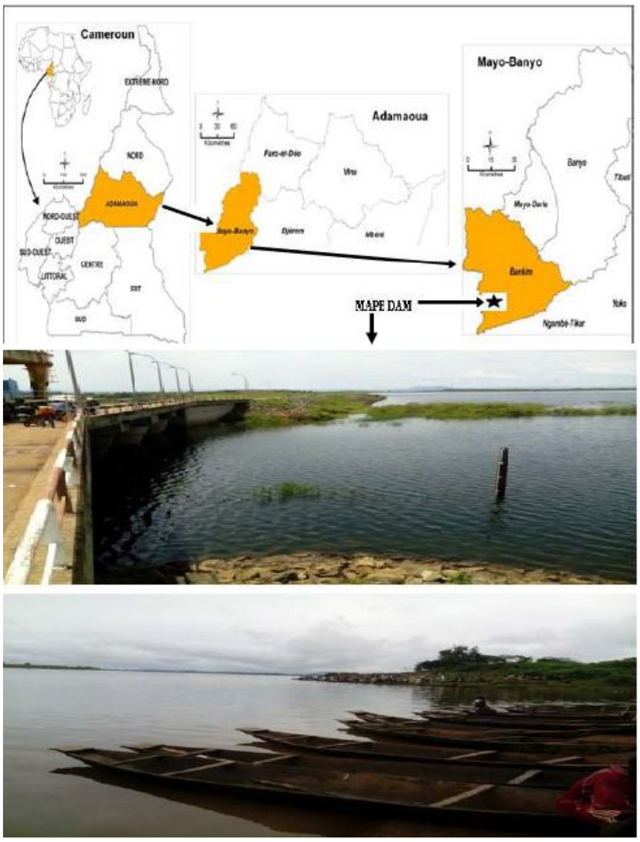

Figure 1: Cameroon map showing the study area.

Fish and water sampling

A total of 350 fish specimens of *Oreochromis niloticus* (Figure 2) was harvested monthly from fishermen during the study period from May 2016 to May 2017. They were captured both at day and night using fish nets and fishing canes. Fish specimens were immediately stored at 10% formalin solution and transported to the laboratory for examination. During field collection of fish, water was equally sampled and analyzed in situ thrice a month between 8 and 9: am according to Rodier *et al.* [7]. The water physico-chemical characteristics as well as quantification materials are summarized in Table 1.

Table 1: Water physico-chemical characteristics quantification and materials.

Physico-chemical characteristics	Units	Materials
Temperature	°C	Mercury thermometer
Transparency	cm	Secchi disc (30cm diameter)
pH	/	Portable pH- meter
Carbonate hardness	mg /l	Test strips
Nitrates	mg/l	Test strips

Figure 2: Photograph of host specimens (bar: 13 cm).

Identification of Myxosporeans

Fish were identified as described by Stiassny et al. [8] and examined according to Abakar [9]. Thus, standard and total lengths were measured to the closest millimeter using a slide caliper of stainless brand. Fish were weighed using Sartorius electronic scale of 0.01 g accuracy and were sex-determined after dissection. The condition factor (K) was calculated using the following formula by Charles and Alan [10]:

$$K = \frac{Fish\ body\ weight\ (g)}{[Total\ length]^3\ (cm)} \times 100$$

The condition factor expresses the health status or the well-being of fish at a given time [11]. As the animal grows, its condition factor or welfare increases [12]. The fish's heath is good if k>1 and poor when k<1 [13]. The condition factor varies according to fish age, sex, season, the stage of development of the reproductive organs, the fullness of gut, type of food consumed, amount of fat reserve and degree of muscular development [10].

External organs (fins, skin, scales and eyes) and internal organs (gills, spleen, kidneys, intestines, gall bladder, stomach and gonads) were examined with naked eyes, and then with stereoscopic microscope using the 10X lens to look for the cysts. As for kidneys, spleen and gonads, three smears were made per organ (anterior, medium and posterior regions) and examined at a total magnification of 1000X with a light microscope for spores. For each smear, spores were counted in 40 microscope fields. Cysts were crushed between slide and cover glass in a drop of distilled water and their contents were identified with the light microscope using 100X lens. Spores were fixed using methanol, stained with May-Grünwald-Giemsa and snapped with digital camera (Canon Ixus brand). Species were identified according to Lom and Arthur (1989) [14].

Parasitological parameters studied

The prevalence (Pr) of infection expressed in percentage was monthly determined and defined as the number of host species infected by *Myxobolus tilapiae* during a given sampling month divided by the number examined [15]. The parasite load (spores or cysts load) was the sum total of spores or cysts harbored by the host during a given month of sampling.

Statistical analysis

The comparison of prevalence was performed using the Chi-square (X^2) test while the Spearman correlation coefficient was determined to look for a possible relationship between the parasitological parameters and the water physico-chemical characteristics. The error probability for analysis was $P<0.05$.

RESULTS

Results are illustrated in Figures 3-4 and Tables 2-3.

Table 2: Monthly variation of water physico-chemical characteristics from May 2016 to May 2017 presented as mean ± standard deviation.

Months	pH	Temperature (°C)	Transparency (cm)	Nitrates (mg/l)	Carbonate hardness (mg/l)
May-16	7.4 ± 0.1	22.0 ± 1.5	151.0 ± 2.3	10.2 ± 1.5	107.4 ± 8.9
Jun-16	8.2 ± 0.0	24.0 ± 2.2	149.0 ± 1.4	10.0 ± 0.5	110.9 ± 3.6
Jul-16	8.0 ± 0.6	21.0 ± 0.6	153.0 ± 5.7	10.0 ± 1.1	116.3 ± 7.2
Aug-16	8.9 ± 0.8	20.0 ± 1.6	148.0 ± 0.0	10.1 ± 0.9	80.5 ± 0.1
Sep-16	6.7 ± 0.4	23.0 ± 4.0	145.0 ± 7.1	7.5 ± 3.5	107.4 ± 0.0
Oct-16	6.4 ± 0. 2	27.0 ± 3.2	150.0 ± 1.2	5.0 ± 0.2	107.4 ± 7.2
Nov-16	6.6 ± 0.5	26.0 ± 1.8	185.0 ± 0.0	7.0 ± 1.5	143.2 ± 0 .0
Dec-16	6.2 ± 0.2	24.7 ± 1.9	146.0 ± 1.5	8.3 ± 2.9	89.5 ± 16.1
Jan-17	6.3 ± 0.2	22.0 ± 0.9	151.0 ± 2.1	10.0 ± 2.3	80.5 ± 10.7
Feb-17	6.6 ± 0.4	25.5 ± 2.5	160.0 ± 3.6	17.5 ± 3.5	53.7 ± 0.0
Mar-17	6.1 ± 0.0	25.5 ± 1.2	148.0 ± 1.3	5.0 ± 0.5	44.75 ± 3.6
Apr-17	6.5 ± 0.6	23.0 ± 0.3	150.0 ± 1.0	6.0 ± 1.2	71.6 ± 5.37
May-17	6.3 ± 0.7	24.0 ± 1.4	158.0 ± 2.5	7.5 ± 1.6	53.7 ± 1.8

Table 3: Correlation between the physico-chemical characteristics of water and *Myxobolus tilapiae* loads.

	Physico-chemical characteristics of water				
	pH	Temperature (°C)	Transparency (cm)	Nitrates (mg/l)	Carbonate hardness (mg/l)
r_1	-0.06	-0.09	-0.29	0.02	-0.03
P	0.734	0.654	0.142	0.909	0.881
r_2	0.03	-0.01	-0.08	0 .10	0.03
P	0.723	0.942	0.437	0.322	0.8

r_1 and r_2: correlation coefficients relevant to cyst and spore loads respectively; P: error probability

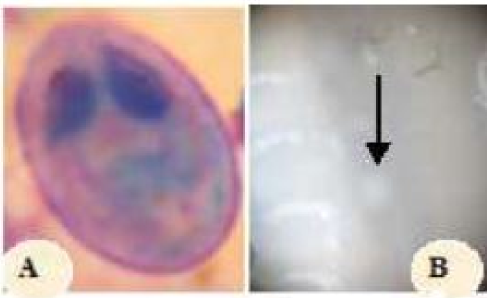

Figure 3: *Myxobolus tilapiae* spore and cyst micrographs. A: *Myxobolus tilapiae* stained spore (x1200) B: *Myxobolus tilapiae* cyst (white spot) imbedded in the gill filaments (x10).

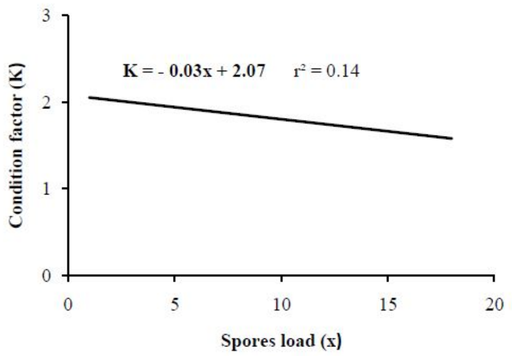

Figure 4: Regression line of O. *niloticus* condition factor (K) as a function of *Myxobolus tilapiae* spores load (x).

Monthly variation of water physico-chemical characteristics

The Monthly variation of water physico-chemical characteristics is summarized in Table 2.

Correlation between spores load and *O. niloticus* condition factor

The effect of *Myxobolus tilapiae* on O. *niloticus* health could be evaluated by calculating the correlation coefficient between the parasite load and the fish condition factor (K). The spores (Figure 3) load of *Myxobolus tilapiae* was negatively correlated (r=-0.37; P<0.05) with O. *niloticus* condition factor. The regression equation line (Fig. 4) according to the arbitrary adopted linear model was K=-0.03x+2.07 Where K and x stood for the condition factor and spores load respectively.

Correlation between the prevalence, parasite load and water physico-chemical characteristics

The prevalence varied with the physico-chemical characteristics of water but no significant correlation was noticed (P>0.05) with the temperature, pH and nitrates concentration. However, the prevalence was significantly and positively correlated with the carbonate hardness (r=+0.14; P<0.001), and negatively correlated (r=-0.17; P<0.001) with water transparency. The correlation coefficients between the physico-chemical characteristics of water and parasite loads (Table 3) were too low and insignificant (P>0.05).

DISCUSSION

The fluctuation of the water physico-chemical characteristics throughout the study period may be due to the fact that water was sampled during different seasons. In fact, the seasonal impact on these water characteristics is mostly due to variation in the weather characteristics (rain, sunshine regimen, temperature) which also affect the characteristics of water. The prevalence of *Myxobolus tilapiae* was significantly and negatively correlated (r=-0.17) with the transparency and positively correlated (r=+0.14) with carbonate hardness. The increase in the carbonate hardness probably affects the biology of oligochaetes (definitive hosts of M. *tilapiae*) by speeding up its proliferation in the water. The carbonates may equally encourage rapid planktons and algae growth. As spores are known to stick on planktons and algae, fish therefore easily get infected when feeding on these planktons and algae [9]. Probably the increase in water transparency reduces the extrusion of the polar capsule filament of the spore, thus prevents the parasite to anchor to the host tissue.

Nounagnon *et al.* [16] studied the correlations between the prevalence of gill's myxosporeans in *Tilapia zillii* and *Sarotherodon melanotheron melanotheron* from Lake Nokoué (Bénin). They observed that the prevalence of *Myxobolus dossoui*, *Myxobolus zillii* and *Myxobolus beninnensis* was not correlated with pH, salinity and water temperature. These results are in accordance with our own work. Anu [17] revealed that in aquaculture in Punja-India, the prevalence of Myxosporean infections significantly increased with the water temperature

Our result also agrees with the observations of Siau [18] in Tunisia who thought that myxosporean prevalence depends mainly on the host species, its size and origin and not on water pH and temperature. Martins et al. [19] showed that in fish ponds, water quality did not interfere with the prevalence of myxosporean parasites. The spores load of *Myxobolus tilapiae* was negatively correlated (r=-0.37; P<0.05) with O. *niloticus* condition factor showing that the higher the spores load, the less healthy were fish. *Myxobolus tilapiae* depressed the host health probably by destroying vital organs such as gills, kidneys, spleen and liver [20].

CONCLUSION

The prevalence of *Myxobolus tilapiae* was significantly and positively correlated with the carbonate hardness while negatively correlated with water transparency. Spores load was negatively correlated with the fish condition factor. Thus, M. *tilapiae* probably depressed O. *niloticus* health and its appearance in ponds should be controlled. It is necessary to look for an adequate monitoring of those water physico-chemical characteristics in order to interrupt the *Myxobolus tilapiae* life cycle.

REFERENCES

1. FAO. The state of world fisheries and aquaculture. Contributing to food security and nutrition for all. 2016;p:24.
2. Lom J, Diková I. Myxozoan genera : definition and notes on taxonomy, life-cycle terminology and pathogenic species. Folia Parasitol 2006;53:1 -36.
3. Renault T, Guichard B. Facteurs de risque d'apparition et d'émergence des maladies infectieuses en aquaculture. INRA prod. Anim 2007;20:219 -222.
4. Boungou M, Sinaré Y, Mano K, Kabré GB. Parasitic Copepods (Arthropoda, Crustacea, Copepoda) from fishes in Burkina Faso, Africa. Int J Fish Aquat Sci 2013;2:58-64.
5. Lekeufack Folefack GB, Fomena A. Structure et dynamique des infracommunautés de myxosporidies parasites de *Ctenopoma petherici* Günther, 1864 (Anabantidae), *Clarias pachynema* Boulenger, 1903 (Clariidae) et Hepsetus odoe (Bloch, 1794) (Hepsetidae) dans la rivière Sangé au Cameroun. Int J Biol Chem Sci 2013; 7:2301-2316.

6. Olivry JC. Fleuves et rivières du Cameroun. ORSTOM (edn). 1986;p:733.
7. Rodier J, Bernard L, Nicole M, Coll K. L'analyse de l'eau. 9e éd. Dunodparis 2009;p:1526.
8. Stiassny MLG, Teugels GG, Hopkins CD. Poissons d'eaux douces et saumâtres de la Basse Guinée, Ouest de l'Afrique Centrale. Collection faune et flore tropicales, IRD (éd.), Paris I 2007; p:797.
9. Abakar O. Les myxosporidies (Myxozoa : Myxosporea) parasites des poissons D'eau douce du Tchad : Faunistique et biologie des espèces inféodées à *Oreochromis niloticus* (Linné, 1758) et Sarotherodon gallilaeus (Linné, 1758) cichlidae. Thèse de Doctorat D'Etat. Université de Yaoundé I 2006; p:163.
10. Charles B, Alan B. Condition Factor, K, for Salmonid Fish. Fish Notes 1998; pp:440-454.
11. Lizama M.and Ambrosio AM. Condition factor in nine species of the Characidae family in the upper Parana river Floodlain, Braz J biol 2002 62:113-124.
12. Unlu E, Balci K. Observation on the reproduction of Leucius cephalusorientalis (Cyprinidae) in Savour stream (Turkey). Cybium1993 17:242-250.
13. Fulton T. (1902). Rate of growth of seas fishes. Sci Invest Fish Div Scot Rept 20.
14. Lom J, Arthur JR. A guideline for the preparation of species description in Myxosporea. J Fish Dis 1989;12:151-156.
15. Bush AO, Lafferty KD, Lotz JM, Shostak AW. Parasitology meets ecology on its own terms. J Parasitol 1997;83:575-583.
16. Nounagnon D, Adam Gbankoto EJ, Siko E, Christophe C, Florence V, Tareck R. Pattern and pathophysiological effects of myxosporean infection in the gills of Tilapia species (Telesotei: Cichlidae) from Bénin. Int J Multidiscip Res Dev 2016;4:1229-1238.
17. Anu K. Myxozoan parasitic infestation of aquaculture fishes in Punjab, India. 3rd World Conference on Parasitology & Pathogenesis. Chicago, USA. J Bacteriol Parasitol 2017;8:3.
18. Siau Y. Contribution à la connaissance des Myxosporidies .Etude de *Myxobolus exiguus* Thélohan, 1895. Thèse de Doctorat d'Etat U.S.T.L. Montpellier 1978;p:200.
19. Martins ML, Souza VN, Moraes JR, Moraes FR, Costa AJ. Comparative evaluation of the susceptibility of cultivated fishes to the natural infection with myxosporean parasites and tissue changes in the host. Rev Brasil Biol 1999;59:263-269.
20. Markiw ME, Wolf K. *Myxosoma cerebralis* (Myxozoa: Myxosporea) etiologic agent of Salmonid whirling disease requires tubificid worms (Annelida: Oligochaetea) in its life cycle. J Protozool 1983;30:561-564.