Journal of Multidisciplinary Engineering Science and Technology (JMEST)
ISSN: 2458-9403
Vol. 3 Issue 4, April - 2016

Results about the possibility of infection of carp (C.caprio), rainbow trout (O.mykiss) and koran (S.letnica) with Gyrodactylosis

Ani Vodica
Department of Animal Health,
Food Safety and Veterinary Institutes
Tirana, Albania
anivodica@hotmail.com

Vladimir Spaho
Department of Animal Production,
Agriculture University of Tirana
Tirana, Albania
vladimirspaho@gmail.com

***Abstract*—We have studied some indicators of infection caused by Gyrodactylus sp, the monogenetic of rainbow trout, koran and carp in order to prove the specificity parasitism of this parasite. The time from the introduction of the parasite in the test bathtub until the infection of the carp was longer compared of the infection time of the trouts. The presence of the parasites in koran was observed only for 12 days. The carp individuals from Prespa were infected by the parasite for 39 days and the duration of the presence of the parasite in the yearlings carp from Klos was 68 days. According to the data received was observed that the parasite burden in rainbow trout has been three times more pronounced compared to trout (t = 2.2; P <0.5). In the two different species of carp was observed that the parasites concentration in an individual of carp from Klosi was 1:56 times higher compared with carp from Prespa Lake. In this carp the period of stay of the parasites in affected fish was approximately 1.8 times shorter compared to carp from Klosi.**

Keywords—trout, koran, carp, parasites, helminthes.

I. INTRODUCTION

The specific parasitism of the monogenic helminthes is well known and has a great influence on the ecology and biology of their populations. 71% of 402 described species of genus Gyrodactylus are found in special host, while there are species such as *Gyrodactylus alviga* that has been found in 16 fish species [1]. Typical for the specific nature of the interaction parasites-type and host are *Gyrodactylus derjavini* in brown trout (*Salmo trutta*) and the species *G. salaris* in Atlantic salmon (*Salmo salar*). The brown trout may be also affected by *G.salaris*, as well as rainbow trout (*Oncorhynchus mykiss*) may be affected by *G.derjavini*, [12] but we have to mention that in all the cases the infection was lower. The Atlantic fish strains of Atlantic salmon are highly susceptible to infection with high values of mortality; meanwhile brown trout and *Thymallus thymallus* are parasite resistant [14]. The mechanisms that contribute in this specific relationship of attachment parasite/host are: the localization to the host, recognition, fixation, growth and reproduction. The response mechanisms of the host is what determine the host specificity, therefore at what level the fish is vulnerable, receptive or have a resistance against the parasite [1]. It is well-known the existence of some chemical factors, with special structure localized in host scales that define the specific parasitism of *Gyrodactylus sp* [4, 13]. The initial contact includes: the mechanoreceptors and chemoreceptors of the parasite interacting with the surface of the host and is a chemical reaction between host mucus and substances secreted by the parasite adhesion [19]. In this study we have proved the infection possibility of rainbow trout (*O.mykiss*), carp (*Cyprinus carpio*) and koran (*Salmo letnica*) with *Gyrodactylus sp*.

II. MATERIAL AND METHODS

The study was conducted in a rainbow trout farm (*O.mykiss*), located in the region of Pogradec, during the period April-July 2015. The test was conducted in a separate bathtub from the rest of the farm, guaranteeing an independently supply of water. In the study are included 43 yearlings fish 14 koran (*S.letnica*), 10 rainbow trout (*O. mykiss*) **free by the parasite**, 7 carp (*C.carpio*) taken from their natural habitats Prespa lake and 12 squamous (Hungarian) carp from the Klosi farm (Elbasan). The average weight of koran was 28.09 ± 2.605 (Var. % = 09.27) and of the rainbow trout 34.44 ± 4609 (Var. % = 13:38). The average weight of Prespa carp was 76.19 ± 10,053 (Var. % = 13:19) while for the "Hungarian" carp the weight was 197.01 ± 18146 (Var. % = 9.21). Before putting the individuals in the test bathtub they are controlled for the presence of ectoparasites. Together with the test fish in the bathtub were introduced 10 yearlings rainbow trout that were affected by *Gyrodactylus sp.* The control was conducted in anesthetized fish with MS 222. Two weeks before the test it was performed the examination of fish every two days (a total of seven examinations). In the other periods of the test the examinations were carried out at intervals of 3 to 15 days, increasing the range of examinations. The fish was observed in dissecting microscope and are controlled the cover scales, fins and gills. The parasites found were counted and some of them after being previously fixed in alcohol 70%, and mounted in ammonium picrate-glycerin. The identification of the

type of the parasite was done based on the determination keys [7]. It was applied the Kruskal-Wallis test to evaluate the differences in the average values of infection between the three types of the fish involved in the study. During the comparison, values of P < 0:05 were considered significant. The analyses are realized using GraphPad INSTAT 3.0 computer program. The evaluation of growth indicators is made on the basis of measurements performed with 15 days intervals. The fish have been collected with a hand net, weighted in Sartorius electronic scales (precision 0.01g), accurately was measured the zoological length (Lcm). The growth is estimated on the basis of the calculation of two parameters:
a) Intercept (b) of the Y axis in the regression equation of the weight: **W = a (t) + b.**

b) Condition factor:

$$K = \frac{W}{L^3} \text{ x100}$$

III. RESULTS AND DISCUSSIONS

According to the observation resulted that the yearlings of rainbow trout and koran manifested a same rhythm of parasites infection. The interval from the introduction of the parasites in the test bathtub until the carp infection was longer compared with the infection period of two species of trout. Also the carps have manifested specific features according to the infestation intervals; the wild carp of big Prespa resulted to be less attractive (the parasites appeared in the body surface 10 days after the beginning of the test) meanwhile in the "Hungarian" type of carp the helminthes was observed in the sixth day. This observation can prove the specificity of the parasite *Gyrodactylus sp.* It was observed that the invasion of the rainbow trout began four days after the beginning of the test, continued after the end of it (101 days, from 13 April to 22 July). Among the types included in the experiment koran manifested the shortest interval of the presence of *Gyrodactylus sp*. (only 12 days: from April 13 until April 24th). After this date none of the sampling was infected. Carp individuals from Prespa Lake infected by the parasite are found from 19 April until 28 may (39 days). For the cultivated carp of Klosi the period of presence of the helminthes was 68 days (15 April- 21 June). These values prove that *Gyrodactylus sp*, had a spontaneously elimination from yearlings wild carp in a shorter period compared with farmed carp. According to the fish control in the beginning of the infestation 53.8% of the parasites were found in the belly area, from pectoral fin to anal fin, 22.5% were fixed in the pelvic fin and the other part in different part of the body (caudal fin and gill cover). Such a spreading prove that in the beginning of the infection, the parasites are localized in the lower half of the body, mainly in the belly area and this is a indication of the way of the spreading of the parasites (the contact of the health fish with the bottom of the bathtub were are localized the detached parasites from the infested fish). This type of infection is not only common for the carp that is feed in the bottom but for the others types of tested fish too.

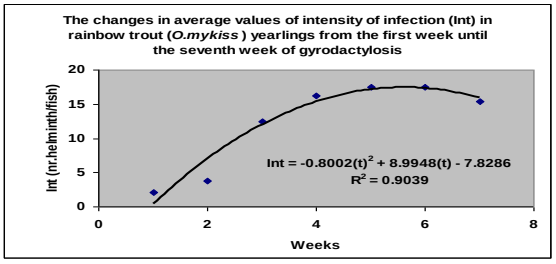

Fig. 1. Changes of the invasion values in rainbow trouts (O. mykiss)

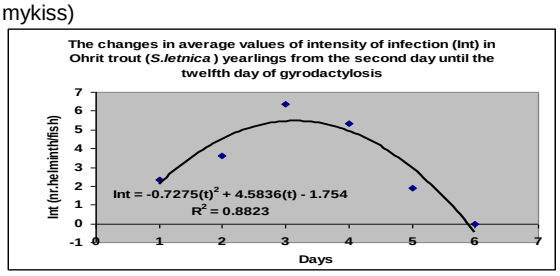

Fig. 2. Changes in the invasion values in Koran (S. letnica)

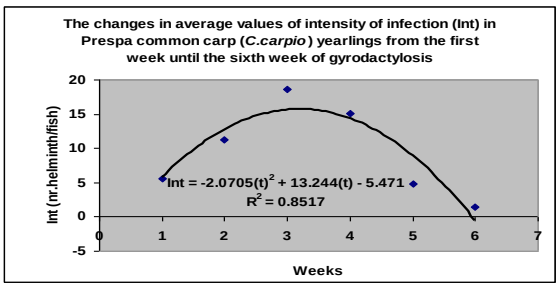

Fig. 3. Changes in the invasion values in yearlings Carp of Prespa (*C. carpio*)

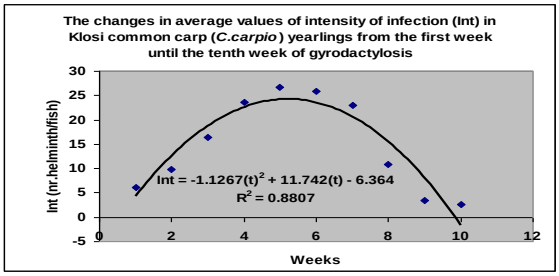

Fig. 4. Changes in the invasion values in Carp (C .carpio)

Comparing the values between the fish of the same family, we can prove that the gravity of Gyrodctylosis in rainbow touts was 3 times more pronounced compared with koran (t=2.2; P<0.5). In koran there is a very short interval of the presence of the parasite and it is observed a spontaneous elimination after the fixation of a small numbers of *Gyrodactylus sp*. So this endemic trout of Ohrid Lake it is not a host for *Gyrodactylus sp*. Comparing the values between the 2 types of Carp the concentration of the parasites in carp of Klosi was 1.56 times higher than in the Carp of Prespa. Also the period of stay of the parasites in the infected fish was 1.8 times shorter compared with carp from Klosi. This values prove that cultivated carp was more vulnerable compared with wild carp of Prespa lake. Considering as 100% the extension of the period

of parasite presence we have defined that the peak of the average value of the infection for the yearlings Koran was the 50% of this interval (day 6, M = 6.4 parasites/fish). This value was the same as in koran with peak of Gyrodactylosis (week 3, M=18.6 parasites/fish) in the yearlings of Prespa carp. In the farm carp of Klosi the peak of mean number of parasites in one fish (M=26.7) was observed in the 60% of the period of infection (week 6). Changes between mean number of the parasites in fish were observed between week 6 and 8 of infection ($t=6.6$; $P<0.05$) and between week VI and VIII ($t=8.1$; $P<0.05$). In the interval between week IV and VII of parasitism there was not observed a significant change in the main values of infection. For the carp of Klosi the intensity of the increase of the number of the parasites in the beginning of the infection was slower compared with the reduction of their number during the elimination. For the rainbow trout the period from the beginning of Gyrodactylosis until the moment of infection value stabilization was 7 weeks. The peak of the mean number of the parasites in one fish (17.5 individuals) was observed in the week 5. Are proved significant changes among the infection values for week V and VII ($t=2.1$ $P<0.5$) and for week III and IV ($t=2.4$; $P<0.5$). For weeks IV, V and VI the mean values didn't show any changes. For rainbow trout the intensity of increase of the number of the parasites in the beginning of the infection was higher compared with their reduction. According to the detail obtained during the study we can say that in the trout *Gyrodactylus sp*, is a preferred place to live compared with the carp, this is obvious if we find a temporary presence in carp and a spontaneous elimination from trout. According the variables studied for the evaluation of fish growth for koran is not observed a significant change in the index K values ($t=0.2$; $P>0.5$), but it is observed a significant change ($t=3.5$; $P<0.05$) for this value in the rainbow trout. Analyzing the infection, we can highlight four stages in the infection process: the fixation of the parasites, the increase of their number, the stage of relative sustainability of *Gyrodactylus sp*. and the stage of decrease of their number (rainbow trout) or spontaneous elimination (koran and carp). Changes in the infection values mainly affect the quantitative aspects and the changes in the peak time positions in the process of parasitism. The increase of the number of parasites immediately after his migration in a new host is related with the fact that only the matured parasites are capable to cause infection, the parasite transmission is undertaken by individuals with a functional male reproductive system, and the trigger for their migratory behaviour may be sexual maturation. [9]. Because of their direct life cycle and lack of a specialized transmission stage, *Gyrodactylus sp*. is reportedly capable of continuous transmission and able to infect new hosts at any time during their life cycle [3].More importance in the transmitted strategy of the parasites has the behaviour and the ecology of the host than the development stages of the parasite [2]. During the evaluation of parasite presence during the test we have found differences between 3 fish species. In the rainbow trout the parasite are fixed in the body surface of some fish in day IV and were present after the end of infection. The beginning of the parasites migration in koran was the same as in the rainbow trout but the presence of *Gyrodactylus sp*. in the last type lasted only 12 day. After this period was observed a spontaneous elimination from the fish in which they temporarily migrated. In the Prespa carp the parasites were observed on the tenth day of the test and after 39 days of presence were observed the spontaneous elimination. The parasites migration in individuals of Klosi carp began in the day six of the test, while their presence in the infected fish continued for 68 days, until the end of test we have not found parasites in this type of carp. The differences that we have found in two mentioned variables can serve as arguments to judge the character of association between host and parasite, with the aim to quantify the specific nature of the host tested in relation with *Gyrodactylus sp*. The specificity recognition of *Gyrodactylus sp*. is an opportunity to understand and to control the impacts caused by the parasite [18] The intervals of the parasites presence determine the specific host of G.salaris. The presence of *G. derjavini* in carp was six times longer than *G.salaris*. [5]. The first type may switch from rainbow trout to carp while the second type almost had no opportunities to create population in this fish. The performed experimentation determined that *G.salaris* preferentially colonized salmon, showed lower interest for rainbow trout and rejected carp. *Gyrodactylus derjavini* attached preferentially to rainbow trout when offered the choice between salmon, trout and carp. *Gyrodactylus derjavini* preferentially was attached to rainbow trout. The recognizing of the specificity of Gyrodactylus species is an opportunity to understand and control the impacts caused by the parasites. Commenting the results of our test, we judge that the rainbow trout was a typical obligator host for this parasite. Koran, that as rainbow trout is a Salmonidae, demonstrates the same initial features of infection with the trout but the presence of the parasites in the body surface was shorter in all the experiment. Apparently koran does not allow the parasite to establish stable populations and it pulls out spontaneously within a very short time from the start of migration in koran. This behaviour of koran can characterize it as "random host" for *Gyrodactylus sp*. The initial infection of carp, compared with two salmonids, does not justify the benthic behaviour of this type. The direct contact of the fish with parasites that are deposited at the bottom of the basin is one of the main ways for passage of Gyrodactylus in unaffected individuals. The fish species with high contact with parasites on the substrate (the carp) showed the lowest infection, so chemical factors play a major role in this process [5]. But the delays in the migration of parasites in individuals of both races of carp, compared with two species of salmonid, and the establishment of provisional parasite populations may be indicative of the fact that carp serve as an optional host for *Gyrodactylus sp*. We have to exclude the

possibility that we are dealing with the species *G.salaris*, for the fact that this type failed to create a sustainable population in carp. [5]. Also if we were dealing with this species we would expect a stable invasion in the Koran, since this salmon belongs to the genus Salmo as the Atlantic salmon (Salmo salar) that is considered a classic and typical host of *G. salaris*. Relations between the parasite and the host that we have included in the experiment prove that it is more likely that we are dealing with *G.derjavini.* Within 48 hours from the beginning of the experiment 91% of the *G.derjavini* parasites that were present migrated to rainbow trout, 7% to the carp and only 1% to salmon [5]. Besides that *G.derjavini* can pass from rainbow trout to carp. In our test resulted that for *Gyrodactylus sp*. the rainbow trout was the most attractive host.

IV. CONCLUSION

Parasites migration of *Gyrodactylus sp.* in yearling's rainbow trout and koran began four days after mixing the healthy fish with affected trout. The presence of the helminthes in koran continued for 12 days. After, occurred a spontaneous removal of them in these individuals. We have not proven a spontaneous elimination of the parasites in yearling's rainbow trout. The infection of yearlings carp from Prespa began ten days after mixing the healthy fish with the infected fish. This interval for the carp of Klosi was six days. The spontaneous eliminations of the parasites from carp of Prespa took place 39 days after, while in the carp of Klosi 68 days after. The Gyrodactylosis burden in rainbow trout has been three times more pronounced compared to trout ($t=2.2$; $P<0.5$). Most likely the fixation of a limit number of individuals of *Gyrodactylus sp*. in koran may be random and this endemic salmonid of Ohrid lake seems to not serve as a host for *Gyrodactylus sp*. Cultivated carp demonstrated the highest intensity of infection caused by *Gyrodactylus sp*. compared to wild individual's carp of Prespa.

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