UDC (UDK) 639.21:597.552.512(496.5)

Enton SPAHO,
Rigerta SADIKAJ, Dritan ARAPI[1]

SOME CHARACTERISTIC OF WATER THAT SUPPLY THE CULTIVATION PLANT OF TROUT (*ONCORHYNCHUS MYKISS*, WALBAUM, 1792)

SUMMARY

This study is focused in some aspects of intensive cultivation of trout (*Oncorhynchus mykiss*) in plants with concrete canals of type *race ways*. The aim of this study is to analyze some practics of troutculture in Albania focusing in aspects of plants and to interfere over some elements of technology with the scoupe of optimisation of production. The study will propose some teorical solutions which will orientate the control of environmental parameters in systems of treatments of trouts.

The study is realized in the plant of trout cultivation in Verdove (Pogradec), during 2010 and 2011. It has incorporated one cycle of trout treatment for consumption. The density of stock was 215 individuals/m^3. During the growth cycle was provide a survival from 85%. In the end of cultivation, the average weight of one trout was 250 g. The minimal value of concentration of ammonia was in January 48 μg/l and the maximal value was in May 92 μg/l.

Key words: cultivation, trout, race ways, environmental parameters, production

INTRODUCTION

Aquaculture is one of the sectors of food industry that demonstrates the most rapid progress. Aquaculture fulfills all the demands for ictic products in conditions when wild fish reserves demonstrate continuous deduction (Sala et al, 2001). On the other side modern aquaculture guarantees for consumers healthy products due to the integration of advanced methods in the treatment of sicknesses (Lovell, 1998) and the application of diets that favour the growing of fish that do not damage the consumers (Zhu et al, 2001). Very important are also the achievements in the implementation of the measures that hamper the pollution and the development of new technologies which allow the application of the high density in the cultivation process (Summerfelt et al, 2001).

The main scope of intensive aquaculture which operates at high density is to guarantee the growth of *"the capacity of the load"* of the plant. In aquaculture the capacity of the load is determined in terms of weight per unit of the surface or

[1] Enton SPAHO, Agricultural University of Tirana, Agricultural and Environmental Faculty, Tirana; Rigerta SADIKAJ (corresponding author: rsadikaj@hotmail.com), Dritan ARAPI, University of Tirana, Faculty of Natural Sciences, Tirana, Albania

weight per unit of the volume (Soderberg, 1995). The maximum value of the density depend on the type and the size of the fish, on the type of the cultivation system and on the quantity and quality of the water that supply the plant (Westers, 1981). The improvement of the growth indicators of salmonides during the cultivation in high density in attained due to the guarantee of the quality of water in all the phases of the production process. Studies on the spatial and time changes of physical and chemical features of water that is used in intensive aquaculture which is practiced in ponds of the type *raceways* guarantee essential information on the execution of the best managerial options (Moogouei et al, 2010).

MATERIAL AND METHODS

The study is realized in the plant of trout cultivation in Verdove (Pogradec), during 2010 and 2011. It has included a full cycle of the training of the trout for consumption and also that of the clutch of reproducers.

The evaluation of the quantity of the water flows and the time interval for the filling of a pond with water - The value of the water flow is measured in the main channel of the supply of the plant. For the determination of this indicator is used the expression:

$$V = [(m * K) / t] * S$$

in which: V = the volume of the water that passes in the supply channel per unit of time, m = the distance selected of the flow of water within which the calculations are made, t= the time interval that a swimming object needs to pass the distance “m”, K = 0.85, S = the surface of the transverse cut of the water flow.

The time interval necessary to fill with water a pond where the training of fish is made during the cultivation is determined by the formula:

$$t = v/\mathrm{V}$$

in which: t = the time of the filling of the pond with water, V = the level of the water flow; v = the predicted volume of the water in the pond.

The determination of the concentration of the oxygen dissolved in water - The content of the oxygen dissolved in water and the temperature has been measured with a digital oxymeter YSI-85. Measurements have been made to the water which has immediately entered in the cultivation plant and in the water that comes out of the ponds. The measurements have been made twice during 24 hours.

The analysis of the content of the dissociated ammonia (N-NH3) in the water of the ponds of cultivation - The Nesslet method has been used for the evaluation of the content of the ammonia. The formation of the yellow colour during the reaction among the ammonia ions and the reaction of Nessler s helped by a polivinilic agent. The concentration of nitrogen of ammonia is determined by the intensity of the colour with spectrophotometer at the length of the wave which is 425 nm.

RESULTS AND DISCUSSION

The dynamics of the water flow in the ponds of the plant of Verdoves

In the figure 1 and 2 has been presented the change of the level of the water supply in the pond of the treatment of the remount of reproducers and also in the pond of the treatment of fish for fattening depending on the progressive growth of the individual weight (Wg) of the trout.

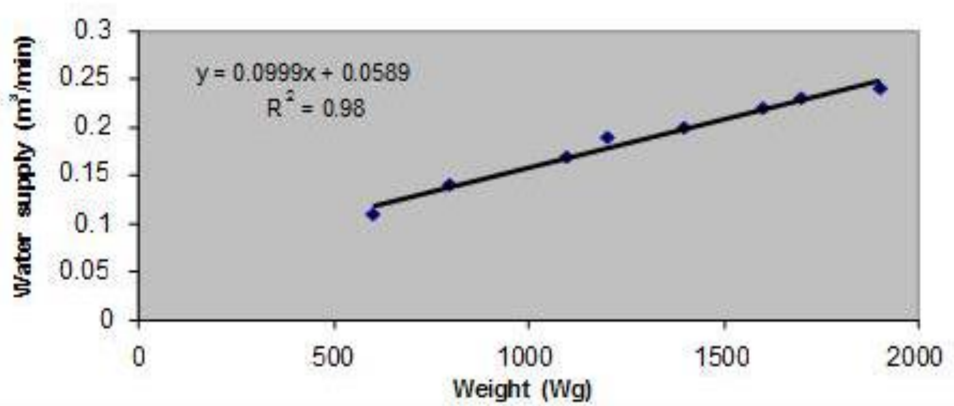

Figure 1. The change of the level of the water supply (m^3/min) in the pond of the treatment of the reproducers depending on the progressive growth of the individual weight (Wg) of the trout.

The initial level of the water flow of the treatment of the training of the remount and reproducers has been 0.11 m^3/min. If we accept an optimal depth of water of 0.7m, depth which is necessary to guarantee the fulfillment of the tendencies of trout reproducers in order to go away from the sun ray, then the volume of water in the pond with the surface 50 m^2 will be 35m^3.

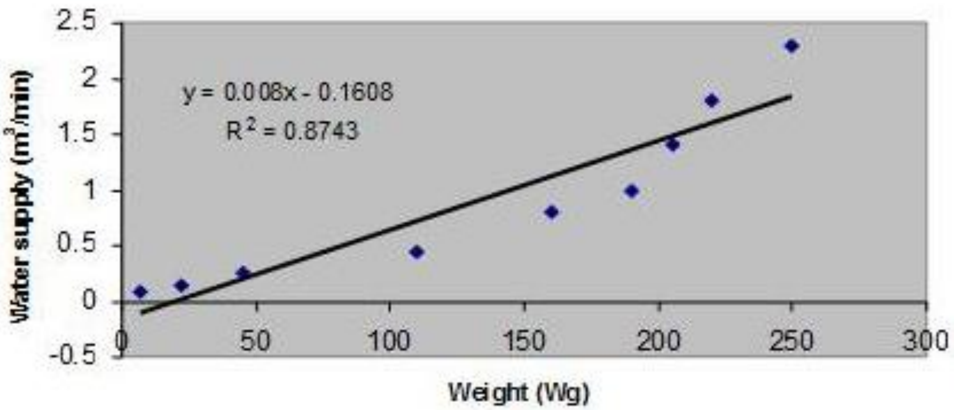

Figure 2. The change of the level of the water supply (m^3/min) in the pond of the treatment of fish for fattening depending on the progressive growth of the individual weight (Wg) of the trout.

By putting the values of the indicators in the formula (2) presented methodically, we determine the time of the filling of the water pond: $t = 35/0.11 \approx 320$ minutes or 5.3 hours.

In one of the four ponds for the treatment of the trout for fattening, the initial flow level was 0.08 m^3/min. The surface of the pond was 75 m^2, the depth of the water 0.7 m while the general volume that circulates in the pond was 52.5 m^3. Based on these data the necessary time for the filling of the ponds with water where the trout will be used for fattening will be: $t = 52.5/0.08 \approx 656$ minutes or 11 hours

The time interval necessary for the fulfilment of the ponds with water is an indicator that is advised to be used for determining the number of the full water changes during 24 hours. In this exact case 4.5 full exchanges of water in the remount pond have been guaranteed and 2.2 water exchanges in one of the ponds for the treatment of the trout for fattening. These figures answer to the values of the optimal water exchanges, which are determined even from several data of literature (Tarkulvichea et al, 2010).

The same reasoning can be made even for the eternal levels of water feeds in two categories of ponds. The necessary time for the filling of the ponds with water and the corresponding values of the water exchanges during 24 hours have resulted as below:

●for the reproduction pond:

-time interval for the water filling: $t \approx 146$ minutes or 2.4 hours

-number of full water exchanges in 24 hours: 10

●for the pond of the treatment of the trout for fattening:

-time interval for the water filling: $t \approx 23$ minutes or 0.4 hours

- number of full water exchanges in 24 hours: 60

From the review of the diagrams in the Figures No.1 and No.2 and also the figures that have resulted from the calculations can be noted that the water volume that enters in ponds grows compared to the augmentation of ichtiomass. In fact the water flow per unit of ichtiomass has changed very little.

The figures that result from these calculations show that during the period of the treatment of the remount, the reproducers and the trout that are cultivated for fattening have been guaranteed the water flow of 1.0-1.2 l/min per 1 kg of fish.

The water temperature and the content of the dissolved oxygen

The results of the study of the dynamics of the water temperature and the concentration of the dissolved oxygen in water, in one of the four ponds where the growing trout are treated and in the reproduction pond we have presented in the diagrams of the figures 3 and 4.

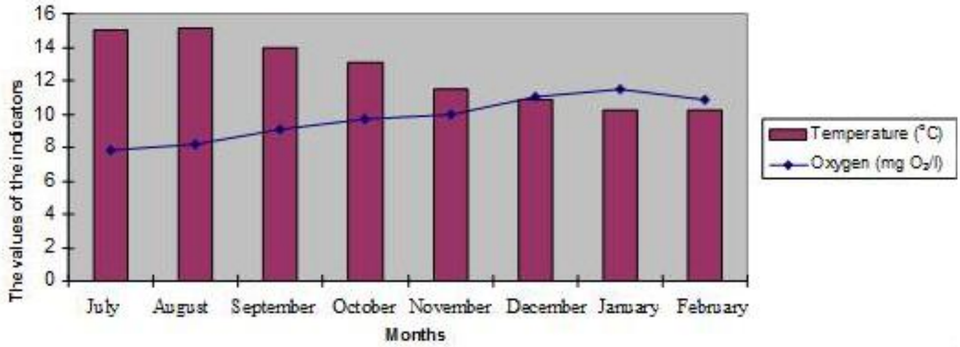

Figure 3. The change of the values of the water temperature (°C) and the content of the oxygen dissolved (mgO_2/l) in the water that furnishes one of the ponds for the treatment of the growing trout.

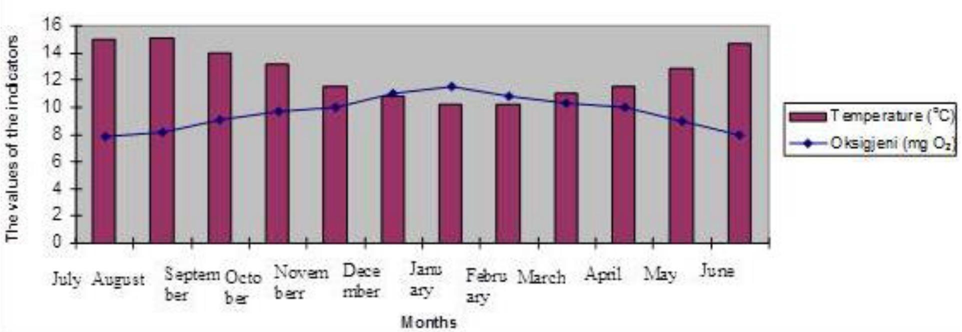

Figure 4. The change of the values of the water temperature (°C) and the content of the oxygen dissolved (mgO_2/l) in the water that furnishes the remount treatment ponds and the reproducers of the “rainbow” trout

In the diagram of the figure 5 we have illustrated the character of the attachment between temperature and concentration of the dissolved oxygen.

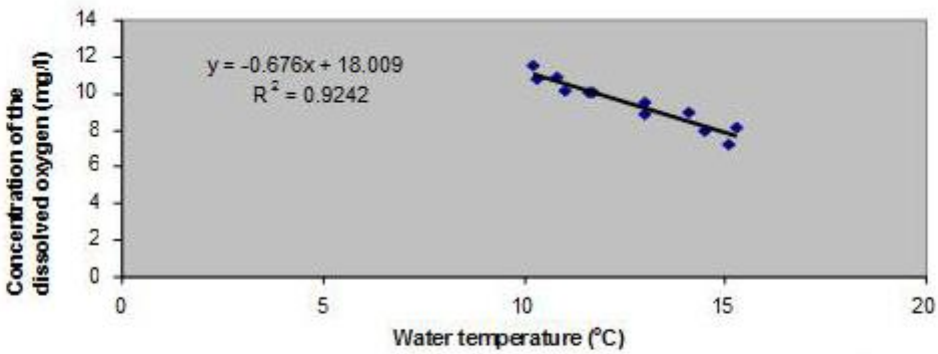

Figure 5. The regression of the attachment through the temperature (ºC) and the concentration of the dissolved oxygen (mg O_2/l) in the water that furnishes the pond for the treatment of the reproducers (r = 0.961)

In tables 1 and 2 we have listed the results of the analysis of the content of the oxygen in the water that enters in the plant ponds of Verdova and the water that is discharged from them and the oxygen consumption values calculated, respectively in one of the ponds of the treatment of the growing trout and in the pond of the keeping of the reproducers.

By concentrating in the dynamics of the values of the water temperature that furnishes the plant of Verdova we admit that the interval of their fluctuation, from the minimal values of 9.9°C up to the maximal value of 15.3°C (M ± m equal to 12.55±1.867), is within the accepted limits for the growth of the fish of the Salmonidae family.

We have found strong negative correlation (r =0.961) through the content of the oxygen dissolved and the water temperature.

Table 1. The oxygen consumption values by a population of "rainbow" trout respectively in one of the ponds of the treatment of the growing trout

Months	Concentration of O_2 in the supply water (mg/l)	Concentration of O_2 discharged water (mg/l)	Consumption of O_2 (mg/l)
July	7.8	2.07	5.73
August	8.2	1.90	6.30
September	9.1	2.68	6.42
October	9.7	3.00	6.70
November	10.0	3.90	6.10
December	11.0	4.07	6.93
January	11.5	5.00	6.31
February	10.8	4.39	6.50
M ± m	9.76±1.331	3.38±1.129	6.37±0.365

Table 2. The oxygen consumption values by a population of "rainbow" trout in one of the ponds of the keeping of the reproducers

Months	Concentration of O_2 in the supply water (mg/l)	Concentration of O_2 discharged water (mg/l)	Consumption of O_2 (mg/l)
December	10.86	4.84	6.02
January	11.50	5.19	6.31
February	10.80	3.46	7.34
March	10.20	3.19	7.01
April	10.10	2.72	7.38
May	8.90	2.16	7.23
June	8.10	2.07	6.74
July	7.26	1.80	5.46
Agust	8.12	1.97	6.15
September	9.10	2.49	6.61
October	9.52	2.64	6.88
November	10.09	3.78	6.31
M ± m	9.54±1.283	3.026±1.110	6.62±0.589

The content of the oxygen dissolved in the water that furnishes one of the four ponds for the treatment of the growing trout has been the minimal value of 7.8 mg/l up to the minimal value of 11.5 mg/l (M ± m equal to 9.76±1.331 mg/l). In the water that furnished the pond where the remount and reproducers were kept, the extreme borders of the content of the dissolved oxygen were 7.2 mg/l and 11.5 mg/l (M ± m equal to 9.54±1.283 mg/l).

The dynamics of the concentration of the dissociated ammonia (NH3)

In the diagrams of the figures 6 and 7 we have presented the dynamics of the concentration of the free ammonia in the water of the pond of the treatment of the remount and the reproducers and in the water of one of the ponds for the treatment of the growing trout.

Figure 6. The dynamics of values of the concentration of the free ammonia (NH3 µg/l) in the water of reproducers pond.

Based on the dynamics of the values of the concentration of this parameter we can make these evaluations: the average value of the concentration of the free ammonia during the yearly period of the treatment of the remount and reproducers has been 71.083±13.433 µg/l. The minimal value in January has been (48 µg/l) while the maximal value in May has been (92 µg/l). In the pond of the treatment of the growing trout, the average value of the indicator studied was 57.125 ±10.453 µg/l. The minimal value of 40 µg/l belonged to January while the maximal value of 72 µg/l is determined in October.

Figure 7. The dynamics of values of the concentration of the free ammonia (NH3 µg/l) in the water of one of the treatment ponds for the growing trout.

The average value (M±m µg/l) of the content of the free ammonia (NH3) in the pond of the treatment of the trout has been smaller compared to the pond of the treatment of the remount and the reproducers. It seems as if there is a contradichtion with the ichtiomasses correlation, the quantity of food spent and the level of ammonia excreted. In fact the most frequent water exchange in the pond for the treatment of the growing trout might have been one of the factors which has guaranteed the dilution of the free ammonia concentration and keeping it in low levels compared to those that are present in the pond of the reproducers.

The decrease of the concentration of free ammonia in the summer has been caused by the growth of the values of the water temperature and the stabilization of the values of pH in the easily basic direction (7.4 – 7.6). The decrease of the concentration of ammonia in the winter can be related to the lower excretion of this subject from the fish as a consequence of a reduction of the norm of food.

CONCLUSIONS

The time interval necessary for the fulfilment of the ponds with water is an indicator that is advised to be used for determining the number of the full water changes during 24 hours. In this exact case 4.5 full exchanges of water in the remount pond have been guaranteed and 2.2 water exchanges in one of the ponds for the treatment of the trout for fattening. These figures answer to the values of the optimal water exchanges, which are determined even from several data of literature.

The water volume that enters in ponds grows compared to the augmentation of ichtiomass. In fact the water flow per unit of ichtiomass has changed very little.

During the period of the treatment of the remount, the reproducers and the trout that are cultivated for fattening have been guaranteed the water flow of 1.0-1.2 l/min per 1 kg of fish.

This level of water supply must be considered optimal not only for the fact that it is within the allowed norms of technology of trout culture but also because it guarantees the fulfilment of the requests of special phases of the growth of the type *Oncorhynchus mykiss* for the oxygen which favours the self-cleaning of the ponds and the timely removal of the nitrous catabolite.

Based on the results of this study, we think that the calculation procedure of levels of water supply can be used depending on the progressive augmentation of ichtiomasess not only for the ponds of the type “*race ways*” but also for all categories of the structures of the keeping of the fish cultivated.

The interval of the temperatures of water that supply the plant of Verdoves fluctuation, from the minimal values of 9.9°C up to the maximal value of 15.3°C (M ± m equal to 12.55±1.867).These values are within the accepted limits for the growth of the fish of the Salmonidae family. We have found strong negative correlation (r =0.961) through the content of the oxygen dissolved and the water temperature.

The content of the oxygen dissolved in the water that furnishes one of the four ponds for the treatment of the growing trout has been the minimal value of 7.8 mg/l up to the minimal value of 11.5 mg/l (M ± m equal to 9.76±1.331 mg/l). In the water that furnished the pond where the remount and reproducers were kept, the extreme borders of the content of the dissolved oxygen were 7.2 mg/l and 11.5 mg/l (M ± m equal to 9.54±1.283 mg/l). These figures accord with the technical values that are determined for the water resources which can be used for the furnishing of the plants of the troutculture.

The average value of the concentration of the free ammonia during the yearly period of the treatment of the remount and reproducers has been 71.083±13.433 μg/l. The minimal value in January has been (48 μg/l) while the maximal value in May has been (92 μg/l). In the pond of the treatment of the growing trout, the average value of the indicator studied was 57.125 ±10.453 μg/l. The minimal value of 40 μg/l belonged to January while the maximal value of 72 μg/l is determined in October.

The average value (M±m μg/l) of the content of the free ammonia (NH3) in the pond of the treatment of the trout has been smaller compared to the pond of the treatment of the remount and the reproducers. The reason has been the difference in the number of water exchanges in 24 hours.

The decrease of the concentration of free ammonia in the summer has been caused by the growth of the values of the water temperature and the stabilization of the values of pH in the easily basic direction (7.4 – 7.6). The decrease of the concentration of ammonia in the winter can be related to the lower excretion of this subject from the fish as a consequence of a reduction of the norm of food.

We can advice the periodical monitoring of the dynamics of the extremity of nitrous catabolits in order to judge on the intensity of the getting of the food, the opportunity of the existence of sterogen situations and the food quality.

REFERENCES

Lovell, T. (1998): Nutrition and Feeding in Fish-Second Edition. *Kluwer Academic Publishers*, London, U.K. 267pp.

Moogouei, R., Karbassi. A.R., Monavari, S.M., Rabani, M., Taheri Mirghaed, A. (2010): Effect of the selected physico-chemical parameters on growth of rainbow trout (*Oncorhynchus mykiss*) in raceway system in Iran. Iranian *Journal of Fisheries Sciences*, 9 (2) 245-254.

Sala, E., Ballesteros, E., Starr, R. M. (2001): Rapid decline of Nasssau grouper spawning aggregations in Belize. *Fisheries* 26:23-30.

Soderberg, R.W. (1995): Flowing water fish culture. *Lewis Publishers*, Boca Ration, FL.147p

Summerfelt, S. T., Williams, J. B., Tsukuda S. (2001): Controlled systems: water reuse and recirculation. Pages 285-397 in G. A. Wedemeyer, ed. Fish hatchery management, second edition. *American Fisheries Society*, Bethesda,Maryland.

Tarkulvichean, S., Pavinee, P., Sasitorn, S., Sumate, T., Warinthorn, S. (2010): Wastewater from a trout farm for rice cultivation: case study in Chiang Mai Province, Thailand. *Asian J. Energy Env*. 2010, 11(02), 69-76.

Westers, H. (1981): Fish culture manual for the State of Michigan. Principles of intensive fish-culture. Mich. Dept. Nat. Res., Lansing, MI.101 p.

Zhu, S., Chen, S., Hardy, R. W., Barrows, T. (2001): Digestibility, growth and excretion response of rainbow trout (*Oncorhynchus mykiss* Walbaum) to feeds of different ingredient particle sizes. *Aquaculture Research* 32:885-893.

WHO (2007): Food safety and food borne illness. Fact sheet N237 available at: /http: //www. WHO. Int/ mediacntre/ fact sheet/fs237/en/index.htm//.

Enton SPAHO,
Rigerta SADIKAJ, Dritan ARAPI

NEKE KARAKTERISTIKE VODE KOJOM SE SNABDIJEVA UZGAJILIŠTE KALIFORNIJSKE PASTRMKE (ONCORHYNCHUS MYKISS, WALBAUM, 1792)

SAŽETAK

Ova studija je fokusirana na neke aspekte intenzivnog uzgoja pastrmki (*Oncorhinchus mikiss)* u objektima sa betonskim kanalima odnosno pastrmskim ribnjacima sa sistemima za protok vode (*raceways*). Cilj ove studije je analiza prakse uzgajanja pastrmke u Albaniji, s posebnim osvrtom na vrste objekata i povezanost nekih elemenata tehnologije sa obimom i optimizacijom proizvodnje. Studija će predložiti neka teorijska rješenja koja mogu usmjeriti kontrolu ekoloških parametara u sistemima uzgoja kalifornijske pastrmke.

Studija je realizovana u uzgajalištu pastrmki u Verdove (Pogradec), tokom 2010 i 2011. Studijom je obuhvaćen jedan ciklus uzgoja pastrmke za krajnju potrošnju. Gustina jata bila je 215/m³. Tokom ciklusa obezbjeđen je opstanak od 85%. Na kraju uzgoja, prosječna težina jedne pastrmke bila je 250 grama. Minimalna vrijednost koncentracije amonijaka bila je u januaru i to 48 mg/l, a maksimalna vijrednost bila je u maju i to 92 g/l.

Ključne riječi: uzgoj, pastrmka, pastrmski ribnjak, ekološki parametri, proizvodnja