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RESEARCHARTICLE

COMPARISON OF SURVIVAL AND GROWTH RATES OF DIPLOID BROWNTROUT EGGS AFTER APPLIED TEMPERATURE SHOCKS

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ABSTRACT

In this study, we compared to survival and growth rates of brown trout eggs afterhocks at different temperature. In this study, four temperatures and a control group were used. Eggs fertilized by milt of male fish were shocked for 7 minutes in the batches provided to 24±0.1˚C, 26±0.1˚C, 28±0.1˚C and 30±0.1˚C by aquarium heaters. The survival rates of eggs from fertilization to hatching were determined as 81,7% for the control group (9.6˚C), 72,5% for 24˚C, 70,1% for 26˚C and 39,7% for 28˚C, and 29,8% for 30˚C. The difference between groups was statistically significant (P<0.05). All of groups applied heat shocks were 100% diploid. No significant differences between groups with regard to weight gain (WG) and feed conversion rates (FCR), specific growth rates (SGR) of fry at the end of the 150-days experiment were determined. However, WG, FCR and SGR rates of fish shocked in 26˚C were found to be higher than that the other groups (P>0.05). Finally, the heat shock applied in 26˚C may be important for the optimal development in brown trout.

INTRODUCTION

Brown trout, *Salmotrutta* fario, which belongs to the Salmonidae family, is a fish species located in the stream ecotype. Rainbow trout are one of the species reared the mostextensively in Turkeyand the World.The most important reason for the choice of rainbow trout for rearing shows a good growth performance as well as short duration of incubation period. Whereas, brown trout are the most important reasons not be considered for rearing duetoshow the performance of the slow development and the long duration of the incubation period and the adaptation to environmental conditions of these fish. Whereas, there are effects of many environmental factors (oxygen, temperature, pH, hardness, etc.) on the development of trout reared in culture conditions.One of these environmental factors is temperature. Temperature has a significant impact on the development of brown trout from hatching to first feeding and it is important for determination of optimal growth (Ojanguren and Brana, 2003; Ojanguren *et al*., 1999; Beer and Anderson, 2001; Killeen *et al*., 1999) of fish. Watertemperatures the mostappropriatefordevelopment of browntroutareranges 8-14° C (Elliott, 1981; Crisp, 1993) from fertilization to hatching and from hatching to first feeding (Ojanguren and Brana, 2003). Eggsincubated at lowtemperatureshave a bigadvantage at time of hatching, (Einum and Fleming, 2000). Hot shock application is a method widely used for the production of triploid. There is no available information about whether there is any effect on growth of diploid brown troutof heat shock. Therefore, the hot shock applied to fish eggs is necessary to know whether this is related with optimum growth temperature or not. If we can provide the optimal development by applying hot shock to fish eggs, more rapid growth of the brown trout will be provided and brown trout will be an alternative to the rainbow trout in terms of rearing. In this study, diploid brown trout eggs of applications shock in different temperatures were investigated to effects on survival and growth rates. This is first study evaluated effect on development of diploid fish of heat shock.

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MATERIALS AND METHODS

Fertilizing, hot shock and incubation

Eggs taken from a female fish were divided to five groups and were used 60cc (659 pieces) for every groups (three replication), Eggs fertilized by milt of male fish were shocked for 7 minutes in five different water batches provided to 24±0.1^{0}C, 26±0.1^{0}C, 28±0.1^{0}C and 30±0.1^{0}C by aquarium heaters. Immediately after the temperature shock, eggs were taken to incubators spawn (with five divisions) placed on the fiberglass tanks of 310lt. Incubation water used for eggs is an artesian water, having 9.6mg/L dissolved oxygen, 7.2-7.6 pH, 9.6^{0}C temperature, 1L/s flow rate (Diaz *et al*., 1993).

Determination of survival rates of eggs

The death eggs, having a white color, and not fertilized eggs were removed and counted daily from experimental groups (24, 26, 28, 30^{0}C) and the control (K) during the 42 days of incubation period. The fertilization, embryo and eyed rations of eggs were calculated by using values obtained at end of experiment (Suziki and Fukude, 1971).

Determination of Triploid

Triploidrates in groups (TR) weredeterminedbymeasurementof thecellular size of erythrocytes. Forthispurpose, blood samples were collected with a syringe from the heart of 30 fryforeverygroup. Then, the cellular size of erythrocytes in blood was measured by auto-analyzer Beckman coulter LH750 (Benfey *et al*., 1984; CrozierandMoffett, 1989).

Feed conversation and specific growth rates of groups

Following of hatchery period, fry were freely fed with commercial trout feed (150, and 300 µ) up to 0.4g. Then, fish taken randomly from each group (enough number fish) were fed in controlled manner. Fish reached to weigh 0.4g weighed with a sensitive scale in every 15 days throughout 150 days and amounts of the daily feed given to fish at the end of weighing were determined. Throughout experiment, fish were fed with commercial trout feed (500µ, 800µ and 1mm). FCR and SGR of groups were calculated according to values obtained at the end of experiment. SGR was calculated as SGR = $[(\ln R_2-\ln R_1)/(F_2-F_1)]$ X 100where R2 and R1were fish weights at times F_2 and F_1, and (F_2-F_1) were the numberof days between weightings. FCR for the groups was calculated as FCR =(R)/(Y2 – Y1) where R was the amount of food consumed by the groups between weight measurements, Y2was the final groups weight and Y1 was the initial groups weight.

Statistical Analyses

The rates of fertilization, hatchingandeyedstageand the specificgrowthratesandfeedconversionrateswerecalculated. All data obtainedfrom the studywereanalyzedusing a one-wayanalysiswith the SPP (StatisticsPackage Program), version 11.5, followedby the LSD'smultiple range test todetermine significant differences between groups (Yanık *et al.,* 2002).

RESULTS

The average size of erythrocytes in all groups wasequaled. No an important different between the cellular size of erythrocytes in all groups wasdetermined, andshockedall groups were 100% diploid (respectively). The survival rates of eggs from fertilization to eyed stage in all groups were in the range of 29.8–81.7% (Table 1). The eggs shocked 28 and 30^{0}C were lower survival rates when compared to other groups and these temperatures werecaused to more lethal effect on eggs. There was significantly difference between the groups in terms of survival rates ($P<0.05$).The weight gain and feed conversion rate, specific growth rate of the diploid brown trout were showed in Table 2. The initial average weights of the all groups were qualed. At the end of experiment, the average weight and feed conversion rate and specific growth rate of fish shocked in 26^{0}C were found to be higher than those other groups (Table 2). 26^{0}Cwas notstatistically significant when compared to Control and 24^{0}C. But, it was statistically significant when compared to 28 and 30^{0}C.

Table 1. Comparison of survival rates from fertilization to hatching between groups

^{0}C	DR	ER	SER	YSR	TR
Control	99,8±3,2 ^{a}	94,6±4,0 ^{a}	88,3±6,5^a	81,7±11,3 ^{a}	-
24^{0}C	94,7±3,6 ^{a}	86,5±5,7^a	79,1±8,6^a	72,5±16,2^a	-
26^{0}C	91,7±3,9 ^{a}	84,7± 10,2^a	78,3±14,6^a	70,1±19,2^a	-
28^{0}C	87,4±6,3^{ab}	73,1±15,2^b	59,6±18,5^b	39,7±25,2^b	-
30^{0}C	83,1±7,9 ^{b}	68,4±17,8 ^{b}	47,2±20,6^b	29,8±32,1^b	-

Results were given as means and %. Control group was compared with 24, 26, 28, 30^{0}C in terms of survival rates. DR, fertilization rate; ER, embryo rate; SER, Stained eye rate; YSR, yolk-sac rates; TR, triploidy rate

Table 2. Comparison of FW, FCR and SGR of groups (24, 26, 28, 30^{0}C)after 150 days

^{0}C	FW	SGR	FCR
Control	6,08±0,6^a	1,10^a	1,66±0,07^a
24^{0}C	6,37±0,7^a	1,16^a	1,60±0,05^a
26^{0}C	8,31±1,1^a	1.40^a	1,52±0,01^a
28^{0}C	5,09±0,2^b	0.98^a	1,78±0,10^a
30^{0}C	4,91±0,4^b	0,93^a	1.90±0,13^a

Results were given as mean±SD. Control group was compared with 24, 26, 28, 30^{0}C in terms of growth. FW, final weight; SGR, specific growth rate; FCR, feed conversion rate.

DISCUSSION

The survival rate of the eggs in controlgroupwasfoundto be higherthanthose of the other groups. The increasedtemperatures between groups wereled to increase of egg deaths. However, nonnegative effects on brook trout and brown trout of longer shock temperatures on survival rates were reported before (Quillet *et al*., 1991; Dube *et al*., 1991). Moffett and Crozier (1995) and Karataş (2009) reported that the increased shocks levels were led to decrease survival rates of eggs. Weobservedthatheatshocksappliedfor 7 minledtoincrease in mortality rate of eggsdepending on temperature(Table 1).The optimal thermal shocks for salmonids such as Caspian Salmon 26^{0}C, 10 min, 40 min post-fertilization (Kalbassi *et al*., 2009), rainbow trout 28–29^{0}C post-fertilization (Scheerer and Thorgaard, 1983), brook trout 28^{0}C, 10 min, 10 min post-fertilization (Dube *et al*., 1991), andbrown trout 28C, 10 min, 10 min post-fertilization (Scheerer and Thorgaard, 1983) or 29^{0}C, 10 min, 5 or 45 min post-fertilization (Araiand Wilkins, 1987) were determined.

In the present study, notriploidy in heat shocks applied to all groups were determined. Probably, the heat shock applied immediately after the fertilization may be considered the prevent formation of triploid. The only diploid individuals in shocks between 2 and 10 min have been determined (Chourrout, 1986) (Respectively). The development of group shocked 26^{0}C was higher when compared to the other groups even though statistically insignificant. There is no available information about whether there is any effect on development

of diploid brown trout obtained by heat shock. For this study, the optimal development temperature of diploid brown trout might be 26^0C. The development of groups of shocked in 28 and 30^0C was found to be lower than that the control group. Increased shock levels (28 and 30^0C) may lead to slowing down of development. The optimal temperature for growth of brown trout was reported as 17 °C (Ojangurenet, 2001). The optimal temperature for growth of brown trout in the present study was extremely found higher from the literature. This difference between same species could be closely related to method. The FCR and SGR of fish shocked in 26^0C were better than that the other groups even though statistically insignificant. FCR and SGR ratesof groups shocked in 28 and 30^0C were in accordance with the findings of Kocaman *et al*. (2006) but, were lower than the values reported by Kızak *et al*. (2011) and Hisar *et al*. (2003).

Conclusion

Heat shock could be had a significant impact on the development of diploid brown trout and brown troutcould be reared an alternativespeciestorainbowtrout.Production of brown trout could be increased. Further prospective and longitudinal studies with large cases are needed to investigate the effects on the development of diploid brown trout of heat shocks.

Note: This study was presented FABA 2013

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