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ORIGINAL ARTICLE

Temperature responds mass culture of Zooplanktons in small ponds

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ABSTRACT
The zooplanktons are small creatures without receptors and digestive system, but popular as live feed for adult and contain also needs for the small larvae of all fishes. The present research was conducted to estimate temperature response upon the population density in the commercial culture with cow dung medium. There results showed optimum temperature as 27^{0}C and mortality exceeding after 35^{0}C in cultured tanks. One way ANOVA showed significant differences in their density 0.5 level of confidence at low and high temperatures.
Keywords: *Aquaculture, live feed, zooplankton, temperature, mass culture*

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INTRODUCTION

The live feed enhances high survival of hatching stages is emerging as a new technique in fish culture ponds because such feed providing enriched nutrients to developing fishes. In this series, Zooplankton has potential as natural diet for larval and adult fishes. Their mass culture emerged also in modern aquaculture in tropical countries with earlier better experiences from temperate zones of the world in which copepod and cladocerans are more prominent with maximum survival and high population density in surprisingly short time period and also economic with waste excreta of animals.

This was experienced that rotifer [9], copepod [10] and cladocera [11] utilize algae and animal wastes as their feed and temperature is more effective for their life history which can enhance production during mass culture. The earlier researches evidenced that temperature plays a major role in population dynamics more than predation rate of fishes [4, 5]. There is lack of literature about role of zooplanktons in fish hatchery and so intensive research should be emphasized on their cultural aspects and response to climatic factors on population structure. Their culture can definitely promote hatchery system of important fish species with enriched nutrients. The present study will establish temperature effect upon mass culture of live feed in cow dung fertilized medium.

MATERIAL AND METHODS

The rotifer, copepod and cladocera species (*Brachionus angularis*, *Mesocyclopus hyalinus* and *Daphnia carinata*) collected from local pond were sieved through mesh filters and separated using dissection microscope. There cow dung stored in a plastic container after removal of moisture for fertilizing zooplankton culture medium. This manure was micronized by grinding and dissolved in water to get stock suspension for mass culture medium. The zooplankton species were cultured in 100 liter tanks for 30 days under different salinity value and medium was fertilized with stock solution at a rate of 500 ppm for two species (*Daphnia carinata* and *Mesocyclopus hyalinus*). Mass culture experiments were conducted in triplicate for each species of zooplankton. The medium was continuously aerated to maintain DO of 2.0 to 4.0 mg/L, algae were introduced 24 h after preparation of culture media an maintained between 7.8 and 8.3. The initial density maintained as100 ind/L in each tank and culture media mixed on alternate days during culture period with 30% water exchange in each week. The culture tanks were covered with

mosquito net to avoid mosquito larvae in culture. The mass culture experiments were conducted by maintaining water temperature at 26 ±1 ºC and at 32±1 ºC, respectively to quantify population density of cultured species, culture medium was thoroughly mixed and 1 L of sample was drawn from the culture medium. Subsamples of 100 ml and then 10 ml were drawn from these samples. All stages of zooplankton were counted under a binocular microscope using Sedge-wick Rafter cell. Triplicate of each sample was analyzed to determine the population of *B. angularis*, *M. hyalinus* and *D. carinata*. Experimental data was statistically analyzed for ANOVA using SPSS software ver.

RESULTS

The water parameters of medium of zooplankton during culture at 26±1 ºC and 32±1 ºC temperatures showed less variation (Table 1), while population density always progressive for studied zooplanktons and peak value ultimately obtained in last 21st day and thereafter maintained only in 4th week and decreased during 5th week of experimentation.

Table1: Water quality during mass culture of zooplanktons at low and high temperatures

Water parameters	Low Temp (26±1^{0}C)			High Temp (32±1^{0}C)		
	B. plicatus	*M. hyalinus*	*D. carinata*	*B. plicatus*	*M. hyalinus*	*D. carinata*
Water temp (^{0}C)	24-26	21-25	23-25	28-31	28-31	28-31
pH	7.6-8.1	7.7-8	7.9-8.2	7.9-8.2	7.7-8	7.8-8.2
Salinity (ppt)	16-20	3.5-6	16-19	14-21	2-4	16-24
DO (mg/dl)	2.3-3.80	2-4	2-4	3-4	2.5-3.8	2-4
Nitrite (mg/l)	.4-4.5	.03-.10	.08-.70	.04-.08	.03-.08	.03-.07
Nitrate (mg/l)	4-110	1-75	2-85	1-3	1-19	1-9
Ammonia (mg/l)	10-20	6-14	8-14	4-8	2-5	5-7
Phoshphate (mg/l)	4-7	2-4	3-7	3-5	1-3	1-5

There higher temperature showed only 50 percent rotifer and copepod compared to high density in low temperature, whereas again increase only in 2nd week but declined surprisingly during next weeks in comparison to high density throughout in the case of low temperature in increasing pattern of population structure (Table 2).

Table 2: Zooplankton density during low and high temperatures

Water parameters	Low Temp (26±1^{0}C)			High Temp (32±1^{0}C)		
	B. angularis	*M. hyalinus*	*D. carinata*	*B. angularis*	*M. hyalinus*	*D. carinata*
Ist week	1260±246	226±120	1258±476	1848±231	532±117	696±87
2nd week	8330±944	1835±413	6036±1378	8824±1430	897±284	5594±836
3rd week	26260±3500	7956±507	11386±2172	5493±871	486±41	1307±193
4th week	24846±2460	3643±206	7138±923	3420±411	613±142	498±137
5th week	10820±1470	.2430±262	.2957±152	.1806±173	.213±41	.2532±412

Also, the body size was larger in low temperature rather than high temperature provided during the experimentation (Table 3), while that of *D. dcarinata* it was 84±12 µm and 78±09 µm, respectively.

Table 3: Body size of cultured zooplanktons at low and high temperatures

Zooplankton species	Low temp culture media		High temp culture media	
	Length(µm)	Width(µm)	Length (µm)	Width (µm)
B.angularis adult	192±18	112±12	150±9	93±16
D. carinata adult	470±54	342±62	509±37	410±70
D.carinata neonate	150±24	118±16	146±17	113±15
M. hyalinus male	716±17	170±9	662±18	168±6
M. hyalinus female	832±16	278±7	806±23	231±7
M. hyalinus neonate	241±12	118±7	237±27	103±9
M.hyalinus copepodite	514±21	158±13	526±54	141±26

The egg diameter of *B. angularis* cultured at 26±1 ºC and 32±1 ºC was 85±14 µm and 80±09 µm, while length and width of adult *M. hyalinus* cultured at 26±1 ºC and 32±1 ºC did not show variation.

DISCUSSION

The present study showed variation related to the growth period, body size and population density in two different temperatures. There was more fast growth observed in the case of high temperature for all zooplankton groups, while peak density in the third week found in low temperature with consistent

increasing pattern indicating optimum larval growth in low winter season. The egg laying and hatching rate showed direct relation with increasing threshold and declines later. The past researches in laboratory conditions showed temperature response upon egg production and survival of zooplanktons [1]. However, the egg diameter in rotifer and copepod species showed lower temperature as better condition, but not significant in the case of low density culture.

The body size and temperature emerging as two important variables that is capable to respond all biological rates and periods, so it is important to correlate these variables [6]. There is optimum growth experienced in the case of rotifer and copepod under low temperature rather than in high temperature culture. However, such variation is not persistent in the case of larval copepods cultured under different temperature regimes and also not a marked difference observed in the case of cladoceran larval and adult stages. Thus, it may be emphasized that global warming ensures reduction in body size at increasing temperature to zooplanktons [5]. The earlier researches also evidenced about temperature effect upon community level might contribute to proportional small sized individuals and a decrease in individual size at consequent life stages [2], and, also mean body size at the population level resulted due to co-acting environmental factors like food supply, competition, predation or parasitism [7]. Thus, it is possible that body size might be affected by different environmental variables.

The weekly analysis of zooplankton density cultured under two different temperatures showed varied population dynamics. It was noted that low temperature favored copepod and rotifer density than the cladoceran species might be due to higher parthenogenesis in rotifers and higher fecundity in copepods rather than cladocera species. However, culture at high temperature after first week showed maximum rotifer density than both copepod and cladocera species might be resulted due to differential temperature response on the reproductive response of zooplankton groups; but interestingly all zooplanktons were substantially increased their population after 2nd week of experimentation.

The peak density from second week in both temperatures ensured accelerative response of temperature on studied zooplanktons. The study confirmed that temperature exceed above 30 ºC is lethal for the mass culture of these species, while 25 ºC to 28 ºC temperature appeared to be suitable for the mass culture of all studied zooplankton groups and species. It is also noted that density of all the three species decreased from third week in high temperature culture and from fourth week in the case of low temperature culture. The earlier studies proposed 25-30^{0}C as optimum water temperature for zooplankton groups [8, 9], however differential temperature requirement for different strains of copepod, cladocera and rotifer were reported [3].

CONCLUSION

This study confirmed that cow dung is more suitable manure when mixed with algae promote mass culture of the rotifer, cladoceran and copepods species. The cultured zooplankton can be harvested and used in larval rearing after second week. Temperature have definite response on the density and population structure of studied zooplankton species and temperature of 26 to 28 °C may be ideal for the culture of these species.

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