

RESEARCH ARTICLE

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Salinity and Biology of Copepoda and Cladocera in Culture Medium under Lab Conditions

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ABSTRACT

The effect of different salinities (5, 10, 25 and 30 psu) has been investigated with salt-mixed freshwater on population growth and density of Copepoda and Cladocera in freshwater as they are unable to emigrate to escape the problem. The findings showed that there is a significant difference ($P < 0.05$) detected between the salinity treatment and it showed that difference in salinities give different effects on the population number of selected copepods cultured in the same temperature. Copepoda reared in 25 psu salinity showed the highest population density (mean of 3.7 ind/ml), but the most frequent population growth is showed in 35 psu. From this research, it can be concluded that 35 psu and temperature of 25°C is the optimum condition for the maximum production of a copepoda in the laboratory conditions. *Daphnia carinata* is used as a toxicological test species for water systems. The determined 45h-LC50 from studies salinities were 2.99, for sodium chloride solution. Survival and growth rate of daphnid was decreased with increasing salinity. The highest total reproduction ($95 \pm a$) neonates per female was achieved at 0.44% (LC10) for saline water over a period of 21 days.

Key words: Zooplanktons, Neonates, Aquaculture, Salinity, Water quality.

INTRODUCTION

Most aquatic organisms are specifically adapted for both saline and freshwater environment (Young, *et al.*, 1989). The local populations may do micro-evolutionary changes, increasing tolerance and acquires phenotypic plasticity due to salinity variation in many habitats (Hall and Burns 2002).

Freshwater invertebrates have lived with the low osmotic pressure of their present habitat. Thus any alteration in salinity due to rain water and local anthropogenic activities may lead effect on their biology.

Zooplankton plays an important role in the functioning of aquatic ecosystem are the major herbivores in many aquatic communities and also live feed for large crustaceans and fishes. The Copepoda and Cladoceran are very important components of zooplankton, usually restricted to freshwater environments (Arner and Koivisto, 1993) with salinity values lower than 1 g l^{-1} or conductivity values less than 500 ms cm^{-1} (Hebert, *et al.*, 2002). *Daphnia* have reduced their osmotic loads through the body salt content as major mechanism for osmoregulation in freshwater Cladocerans (Peters, 1987). The freshwater Cladocera that successfully colonize brackish environments are smaller in size and have a reduced reproduction (Arner and koivisto, 1993). This study was aimed to assess effect of salinity upon freshwater Zooplanktons.

MATERIALS AND METHODS

Experiments were carried out in glass Petridishes filled with 15 ml treated freshwater mixed with NaCl to prepare 5, 10, 25 and 35 psu salinity. Salinity in glass Petridishes was measured using a refractometer. *Daphnia carinata* and *Mesocyclopus hyalinus* has been cultured in the laboratory for about six months and the species has already adapted to its new environment. One gravid female was placed in each Petridishes. No aeration was

given to the culture as aeration will only increase evaporation. Two different sets of culture were maintained in two temperatures (21°C and 29.5°C) and a refrigerator temperature for 45 days. The temperature was measured everyday using a mercury thermometer.

Everyday each individual of copepods at all stages counted under a stereo microscope before being fed with Baker's yeast at 0.1 ml. Dead animals, molted exoskeleton and any debris were taken out from the culture using a wire loop. The data collected were analyzed using one way analysis of variance (ANOVA, treatment vs population).

RESULT AND OBSERVATIONS

A. Copepoda:

As for 5 psu salinity, the population density reached to 3.5 ind./ml at 4th week of culture. 10 psu salinity with 2.9 ind./ml in 2nd week (Fig.2) and 2.3 ind./ml for 35 psu at the 6th week (Fig.1).

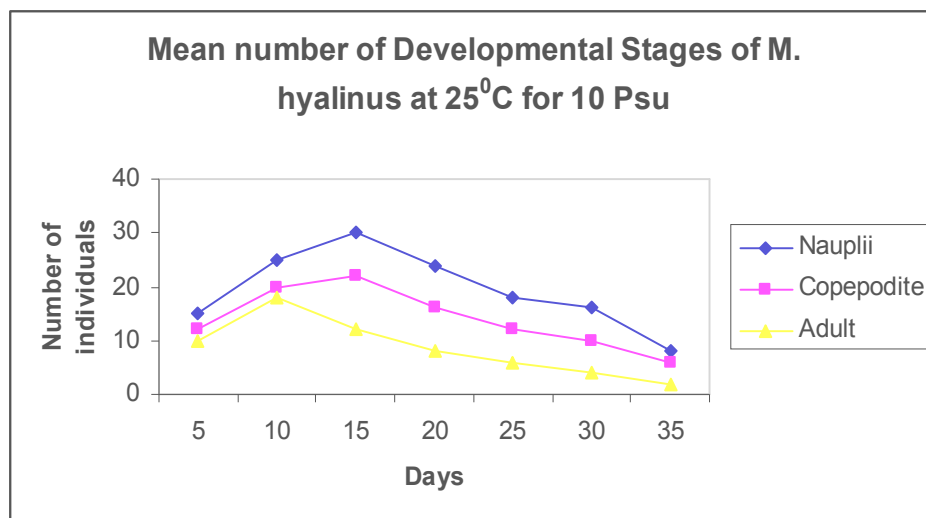


Fig. 1: Mean number of *M. hyalinus* at 25°C in 10 Psu salinity

The Copepoda cultured in 25 psu salinity showed the highest population density with 3 ind./ ml during the 4th week of culture (Fig.2).

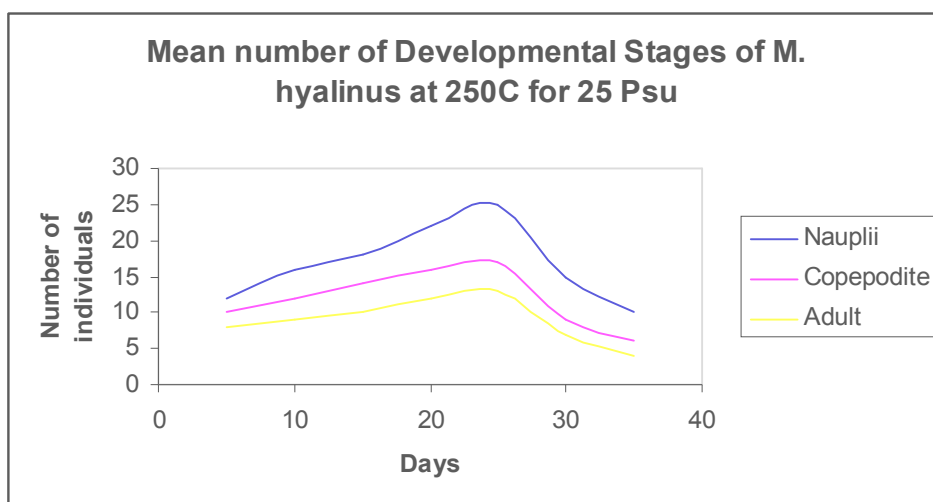


Fig. 2: Mean number of *M. hyalinus* stages at 25°C in 25 Psu salinity

The production of various life stages cultured in different salinities at 25°C showed maximum nauplii production for 5 psu, 10 psu, 25 psu, and 35 psu at day 5 and 27, 6 and 19, 7 and 27 and 9 and 37 respectively. It is interesting to note that in 35 psu, the nauplii survived until the 45th day. Gravid female occurred several times in the culture indicating the occurrence of several new generations throughout the study period. Gravid females were more frequent in 35 psu than other treatments although higher number was in 25 psu. They also occurred in shorter duration during the overall 10 first day of experiment suggesting the more favorable culture condition in the early period of the study.

B. Cladocera:

The effect of different sub-lethal concentrations of NaCl on survival rate of *Daphnia carinata* at the end of experiment, it was found that the survival rate decreased with increasing the culture period and also with increasing salt concentration. Groups of *Daphnia carinata* cultured in 0‰ showed the highest significant survival rate ($p < 0.01$) represented by 97% after 21 days, while the lowest survival rate ($p < 0.001$) for those cultured in the highest concentration, 2.66% represented by 43% after 21 days (Fig. 3).

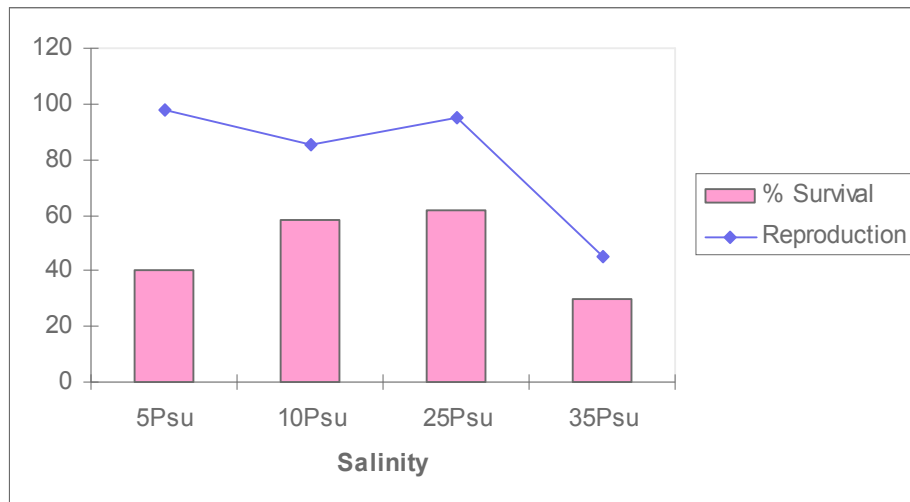


Fig. 3: Survival and reproduction of *D. carinata* in different salinity

This figure illustrates the effect of different concentrations of NaCl on growth rate of *Daphnia carinata* at the end of experiment. Generally it was found that the length of *D. carinata* increased with increasing period of culture for all concentrations.

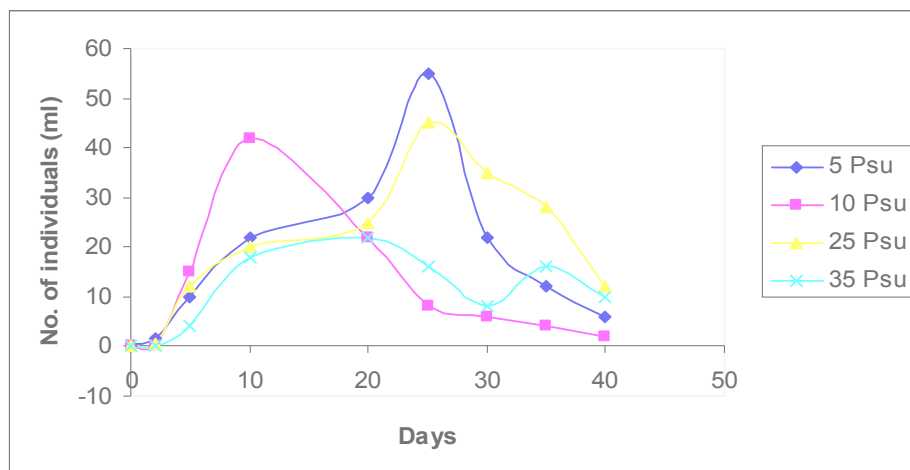


Fig. 4: Population density of *D. carinata* under different salinities with time in days

The lowest salt concentration ($p < 0.001$) showed more significant lengths as 3.74 mm, while the lowest significant ($p < 0.001$) lengths (3.38) were observed for groups cultured in the highest NaCl concentrations (2.66%) after 21 days. There were no significant differences ($p < 0.001$) between control and experimental groups cultured in different concentrations, respectively (Fig. 4).

DISCUSSION

Female are fertilized after the entry into adulthood and can produce several brood from one fertilization event. According to Hicks and Coull (1983), harpacticoid copepods need male once to produce multiple of egg. Therefore egg production is variable between samples. This significant difference could potentially due to the cannibalism activity performed by certain nauplii, copepodite and adults stages (Schipp, *et al.*, 1999).

The sharp decline of the number of nauplii could be explained due to food availability. Williams and Jones (1999) noted that in laboratory studies, offspring production generally declines with reduction in food supply below the optimal levels. Salinity level of 35 psu was found to provide the best condition for the development of Copepods is in agreement with Matias-Feraita, *et al.*, (2005) for a tropical species.

The results of this study showed that *M. hyalinus* species is more sensitive to the sudden change of temperature rather than salinity. The physiological response and tolerance towards temperature and salinity might be the reason for the different sensitivity to the two parameters is in accordance with Devreker, *et al.*, (2009).

The different species might have different thermal limit in term of reproductive response. This study confirmed the important role of temperature in copepod culture. We found that 26-30°C was the best range for nauplii production while 28-32°C was the best for fast maturation rate of nauplii. A study by Williams and Jones (1999) also noted that a benthic harpacticoid, *Tisbe battagliai* has their best temperature at 20°C, and increasing of temperature towards 25°C decreased the production rate in the case of salinity effect.

There is a non-linear survival response of *Mesocyclops hyalinus* to short term immersion of 24 hours in 3, 12 and 35 psu. Copepods that were transferred in the 12 psu showed the lowest survival rate. We also noted that exposure of low salinity in more than 24 hours for this species will only cause death, as what happened to *Euterina acutifrons* which survived only for 24 hours when transferred directly from 35 to 5psu seawater (William and Zones, 1999).

EFFECT OF SALINITY UPON CLADOCERA

The results of salinity effects upon *D. carinata* may capable to endure salinity upto slight level. The present study reveals LC 50 as 3.99 gl^{-1} indicated greater sensitivity of *D. carinata* with salinity in tropical freshwater ecosystem is in accordance with Arner and Koivisto (1993) for *D. magna*. Aladin (1991) described round nuchal organs in *D. magna* embryos, whose cytoplasm is capable of intensive cellular absorption of salt on account of high permeability to ions. The salinity may limit individual growth rates transferred from freshwater to a brackish environment as in agreement with *Daphnia carinata* (Hall and Burns 2002).

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