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Effect of salinity and pH on hatchability and survival of the snails *Lymnaea auricularia*

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Abstract

The hatchability of eggs and the fecundity and survival of adult of *Lymnaea auricularia* snails was investigated in different pH and salinities.

The current study showed that egg masses and hatchlings to be considerably more sensitive to salinity than the adult snails, while PH concentration unaffected on the hatching of eggs in all groups.

The results revealed that *L. auricularia* snails remain alive in all concentrations and survival of these hatchlings was adversely affected by salinities as low as 0.5% and a salinity of 2.5 % was lethal within 10 weeks. In contrast, adult survival was has no effected in all concentrations of PH and all snails are survived up to 10 weeks.

Key words: Salinity , pH , *Lymnaea auricularia*

1- Introduction

Basommatophoran pulmonate gastropod molluscs are not only of a malacological interest, but also of a great parasitological importance because of the very numerous helminthes species they transmit. Freshwater snails of the family Lymnaeidae (Rafinesque, 1815) are, besides planorbids, those known to be involved in a greater number of helminthes life cycles.

They are utilized as intermediate hosts by numerous digenean trematode species (mainly as first intermediate hosts, or as second intermediate hosts as for instance in echinostomatids) and, although less frequently, by nematodes, mainly Protostrongylidae and hymenolepidid cestodes (Bargues *et al.* , 2001).

In recent years, the interest in lymnaeidae has markedly increased due to the detection of human fascioliasis endemics, ranging from low to very high prevalences and with global estimates of up to 17 million people infected (Mas-Coma *et al*., 1999a,b, 2000,2001, 2003, 2004a,b).

Lymnaea spp. , the snail intermediate hosts of *Fasciola* belong to the phylum Mollusca, Class Gastropoda , Subclass Pulmonata, Order Basmmatophora, Family lymnaeidae and genus *Lymnaea* (Osama, 2009).There are many physico-chemical factors influence the distribution and occurrence of this snails hosts in their habitats such as: chloride (Cl), ions of Bicarbonate (HCO3), Magnesium (Mg), Sulphate (SO4), Nitrates (NO3) and Calcium (Ca) (Raut, 1996). Some authors studied the effects of these factors on the biology of medically important snails. Noland and Carriker (1946) reported on the effect of hydrogen ion concentration and salinity of water on extruding response and survival of *Lymnaea stagnalis* the vector snail of *F . hepatica* . Kendall (1953) studied the effect of salinity, PH and other factors on some aquatic vector snails . Spronk *et al*. (1971) tested the effects of some medium factors on the fecundity of *Lymnaea stagnalis* under laboratory conditions. Elida *et al*. (1984) evaluated the influence of salinity and temperature on certain biological aspects of *L. stagnalis*. Marion *et al*. (2005) studied the resistance effect of pH on the rate of myosin head detachment in molluscan catch muscle in Austria, to drought under laboratory and natural conditions.

The breeding of *Lymnaea* spp. under laboratory conditions is difficult , since suitable condition must be provided for their growth.Several methods had been used to cultivate these snail (Neda *et al* ., 1999). In Iraq the snail *L. auricularia* is spreading in the provinces of Central and South and considered an intermediate host for *F. gigeantica* parasite (Al-Mashhadani 1970).

L. auricularia remains an essential link in the *F. gigeantica* life cycle. its ecology, bionomics and population dynamics is required for a proper understanding of *Fasciola* transmission. This knowledge is vital before control programmes are planned against disease vectors. .

This study is therefore, designed to assess the effect of pH and NaCl on the rates of hatching, maturation and survival of *L. auircularia*.

2- Materials and Methods

This work was carried out during May- July, 2009 at the parasitology researches laboratory ,Education College, Basrah University, Basrah provenance Iraq.

The snail were collected from Al-sweab region north of Basrah provenance. The snail were carefully brought to the laboratory, They were released into an aquarium 30 x 20 x 60 cm, containing tap water. The snails were regularly supplied with baby foods. The snails started egg-laying within a few days. The egg capsules were collected daily from the aquarium, and kept in a glass jar (capacity 1000 ml) containing tap water. In each glass jar 5-9 egg capsules deposited within a 24 hr period, water was changed regularly with fresh tap water. Through regular observation newly hatched (zero-day-old) snails were taken daily from the jars. These newly hatched snails were placed in a plastic container (41 capacities) containing tap water. The containers were kept at 25 ± 1°C temperatures in order to study the effect of different levels of pH, viz. group A(pH4), group B(pH 5), group C(pH 7) ,group D(pH 8) and control group in the culture water and four different grades of salinity viz. group E (0.5%), group F (1.5%), group G (2%) , group H (2.5%) NaCl and control group have been used in the life-cycle parameters viz. the growth rates, the age of attainment of sexual maturity, the duration of reproductive period, the rate of egg production, the death rate and the life span of the snails was reported regularly .The percentage rate of survival was calculated according to Neda et al,(1999) by using :

Rate of survival (%)= No.of surviving snails \ Initial no.of snails x 100

3-Results

Egg hatchability and hatchling survival

All eggs were hatch in all pH groups but there were differences in the time of hatching (Table 1). Eggs of *L. auricularia* failed to hatch in salinities of groups F, G and H with partial embryonic develop-ment occurring only in group E (63.5%) compared with the control (38.4%). The different test salinities are recorded in Table (1). Thus, with increasing salinity there were a progressive and significant reduction in both the rate of hatching and the mean percentage egg hatching with the most noticeable reduction occurring at group F.

Snails survival

The results of the current study showed that the pH groups A,B,C,D have a clear impact on survival rates of the snails after 10 weeks and the snails in group C (78%) were more resistant than

group D (65%), group B (47%) and group A (10.5%), respectively compared with the group of control (65%), Table (2) showed effect of the salinity (0.5, 1.5, 2 and 2.5 g\L) on the snails survival, which were 100%,50%,60% and 0%, respectively compared with the control.

Egg-laying, in groups A and B, began 18-24 days after hatching. The size of the newly snails hatched ranged from 4.90 to 5.60 mm in length. The individual egg masses observed varied from 2 to 6.5 mm in length and from 1.0 to 4.0mm in width, and contained 2-22 eggs. The sizes of the egg masses and the number of eggs within each egg mass increased with the growth of the snails. Groups C and D did not lay egg masses until 24- 35 days .While it was occurring in groups E and F at 21 – 24 days . The size of the snails at the time of hatching ranged from 4.25 to 5.12 mm in length. The individual egg masses observed varied from 3.5 to 7.5 mm in length and from 2 to 4.0 mm in width, and contained 10-32 eggs. Groups G and H did not lay egg masses to the end of the experiment.

Table-1: The percentage of egg masses hatched of *L. auricularia* under the influence of different concentrations of pH and salinity

Weeks	Group A	Group B	Group C	Group D	Group E	Group F	Group G	Group H	Control
0	0	0	0	0	0	0	0	0	0
1	90.4	89.4	0	55.5	0	0	0	0	38.4
2	-	-	90	45.5	20.4	0	0	0	-
3	-	-	-	-	36.3	0	0	0	-
4	-	-	-	-	6.8	0	0	0	-

Table- 2: The numbers (between percentages) of survival of *L. auricularia* under the influence of different concentrations of pH and salinity

Weeks	Group A	Group B	Group C	Group D	Group E	Group F	Group G	Group H	Control
0	100%(19)	100%(17)	100%(18)	100%(17)	100%(10)	100%(10)	100%(10)	100%(10)	100% (15)
1	79%(15)	83%(14)	89%(16)	88%(15)	100%(10)	90%(9)	100%(10)	100%(10)	93%(14)
2	58%(11)	76%(13)	83%(15)	82%(14)	100%(10)	90%(9)	100%(10)	100%(10)	93%(14)
3	58%(11)	70.5%(12)	83%(15)	82%(14)	100%(10)	90%(9)	100%(10)	100%(10)	93%(14)
4	58%(11)	70.5%(12)	83%(15)	76%(13)	100%(10)	90%(9)	80%(8)	100%(10)	93%(14)
5	58%(11)	70.5%(12)	83%(15)	76%(13)	100%(10)	90%(9)	80%(8)	70%(7)	87%(13)
6	58%(11)	65%(11)	78%(14)	70.5%(12)	100%(10)	50%(5)	80%(8)	50%(5)	70.5%(12)
7	21%(4)	53%(9)	78%(14)	65%(11)	100%(10)	50%(5)	80%(8)	50%(5)	65%(11)
8	10.5%(2)	47%(8)	78%(14)	65%(11)	100%(10)	50%(5)	60%(6)	50%(5)	65%(11)
9	10.5%(2)	47%(8)	78%(14)	65%(11)	100%(10)	50%(5)	60%(6)	0%(0)	65%(11)

4- **Discussion**

Raut (1996) referred to the pH and salinity as an important limiting factors and one which has received scant attention from investigators. The situation has changed little since then and this present investigation has attempted to elucidate the influence of pH and salinity on the local species, *L . auricularia* in Iraq. Increasing of salinity in rivers and wetlands is a serious environmental problem on all inhabited continents (Williams, 1987), and is likely to affect aquatic organisms (Hart *et al.*, 1990, 1991). Recently, there has been interest in the lethal effects of high salinity on freshwater macro- invertebrates (Kefford and Nugegoda 2005). It is apparent from the present study that salinity and hydrogen ion concentration all have affected the hatching of eggs , survival of juvenile and adult snails of *L. auricularia*.

The present study indicated that the optimal concentration of hydrogen ion was pH 8, which recorded the highest rate of hatching, while decreased the quarterly of the hatch at the top and lower than the optimum value for the hydrogen ion concentration (Table1), and this agree with Raut (1996) and comparable to what Raut *et al*, (1992) found that the concentration of optimization of *L . auricularia* was 7.7, while salinity seems to have more effect on hatching of eggs than survival of snails. The hatching rate decreased as there was an increase in salinity concentration up to 0.5% (group E) at which none of the eggs hatched. This is in closed agreement with the results of Raut (1996) who studied the survival of *Lymnaea* and clams,

respectively, and increasing salinity reduced the rate of hatching and percentage of egg hatching. The egg masses exposed to sodium chloride solution, ranging from 1 to 2.5 g\L, did not show any kind of abnormality in their capsules, in the process of hatching, and in development. According to Mohamed *et al*, (1986) who studied the effects of salinity on the clams and *Bulinus*, that as the *Bulinus* spp. progressed from dilute to a more saline environment, there was a loss of water,similary, the egg masses of *L . auricularia* might lose their water contents as the concentration of salinity increased. (Table 1).

The study also showed that the best concentration of hydrogen ion was pH 7 followed by pH 8 and the group of control, respectively.Recording for as long as the life of the snails , While the shortened period of life at the lowest concentration of this groups.(Table 2).

The present results (Table 2) represented that *L . auricularia* has a great resistance to salinity increase, since it remained alive at 2.5‰ NaCl concentration and 50% mortality occurred. This result was in accordance with that of Donnelly *et al*. (1983) who reported that the survival of adult *B. africanus* was unaffected in salinities > 3·5 ‰ while further increases in salinity resulted in significant reductions in the survival up to a lethal salinity which caused 100% mortality within 24 hours. The results on the survival of adult *L . auricularia* are in general agreement with those of Raut (1996) on *L . stagnalis*. In contrast, Metz (1973) demonstrated a marked increase at salinity tolerance of the local *B. pfellfferi* with survival up to 26 days in 8.75 %.However; Diaw *et al.* (1989) reported that the variations in some abiotic factors like the temperature and the pH of water do not seem to have a strong influence on the ecology while rainfall has a great importance on the distribution and the density of mollusks. The variation in the salinity of water bodies has direct effects on the prevalence of parasites transmitted by snails living in such water bodies(Donnelly et al ., 1983) , Rogowski and Stockwell (2006) in their study on the relationship between salinity, snails, parasites and white sands pupfish (*Cyprinodon tularosa*) in New Mexico State, reported that at the high salinity sites, spring snails were absent and pupfish trematode abundance was much lower, and fish condition was intermediate . The body fluids of freshwater pulmonates are hypertonic to the external environment (Ports &Parry, 1964; vanardt, 1979a) and their survival depends largely on their osmotic and ionic regulatory abilities.

However, not much is known of the mechanisms available for osmoregulation in the Basommatophora (Vanardt, 1979b). According to the present results on the survival of adult *L . auricularia* it would appear that these snails were capable of successful hyperosmotic regulation in the lower salinities and pH up to a concentration of 2.5% and pH 4 at which stage the iso-osmotic point is probably approached.

An important aspect of the fecundity of pulmonate snails in brackish water is their ability to lay eggs. It is clear from the results of this study and others that oviposition can occur in salinities from 0.5 – 1 g\L and pH from 7-8 (Cnsrnin & Bower, 1971; Styczynska-Jurewicz, t972; Metz, 1973). However, it has been suggested that these salinities and PH exert a retarding effect on fecundity by decreasing the number of egg masses per snail as opposed to the number of eggs per mass (Metz, 1973).

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تأثير الملوحة وايون الهيدروجين على فقس وبقاء قواقع *Lymnaea auricullaria* المضيف المتوسط لطفيلي *Fasciola gigeantica* في العراق.

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الخلاصة

تم في الدراسة الحالية دراسة تأثير الملوحة وايون الهيدروجين على فقس وبقاء وخصوبة قواقع *Lymnaea auricullaria*.اظهرت الدراسة الحالية ان للملوحة تأثير على فقس كتل البيوض اكثر من تأثيرها على القواقع البالغة، بينما لم يلاحظ أي تأثير لايون الهيدروجين على عملية الفقس ولجميع المجاميع. كذلك بينت الدراسة الحالية عدم وجود أي تأثير لايون الهيدروجين في بقاء القواقع على قيد الحياة ، بينما لوحظ تأثير اختلاف تراكيز الملوحة على بقائها بين تركيز 0.5% و 2.5% اذ ماتت جميع قواقع المجموعة (H) بعد مرور 10 اسابيع من بدء التجربة، في حين عاشت جميع القواقع المعرضة لباقي التراكيز وتراكيز ايون الهيدروجين للفترة نفسها.