

GROWTH OF *Daphnia magna* (CRUSTACEA: CLADOCERA) UNDER DIFFERENT DIET CONDITIONS

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ABSTRACT

Samples of *Daphnia magna* were collected from a ponds in Basrah. A successful culture was built in the laboratory using glass aquarium. The animals were fed on a diet of sheep manure, yeast and wheat bran under laboratory conditions. The results of this study indicate that the sheep manure seems to be the best diet for this species. The mean lengths of adults were 3.80, 3.42 and 3.21 mm. in sheep manure, yeast and wheat bran respectively. The maximum life span were 69, 47 and 40 days respectively. The number of preadult instars was between 4 – 7 while that of the adult seems to be about 10 instars. The duration of each instar was 2 – 5 days.

INTRODUCTION

It is a common knowledge that the group Cladocera plays an important role in the aquatic food chain as food for fish and other organisms. *Daphnia* also known as water fleas due to their jerky swimming movements are widely distributed (cosmopolitan) and easily to culture, as most *Daphnia* are females because the reproduce parthenogenetic and produce live young regularly if adequate food is present. Daphnids have a relatively short life span (about 8 weeks) and mature within 6 to 8 days after leaving the brood pouch, (TenBerge 1978). The genus *Daphnia* is the most important among zooplankton having about 30 species over the world. The approximately length of *D. magna* ranging between 0.7-1.0 mm. at birth and 2.3 - 6.0 mm. for adult, (Gulati 1978). *Daphnia magna* can be easily cultured if suitable water conditions and food are provided (Adema 1978).

In Iraq many cladoceran species were listed from several parts (Gurney, 1921; Mohammad, 1965; Khalaf and Smirnov, 1979; Khalaf and Shihab, 1979; Mohammad, 1979; Mangalo and Akbar, 1986c; Mangalo and Akbar, 1988; Ajeel *et al.* 2001; Ajeel, 2003). But there is little information concerning biological aspects for some of cladoceran.

However Khalaf *et al.*(1977a, b) studied egg production, rat of growth, life span and number of instars of the cladoceran *Simocephalus vetulus* under different diet conditions. And Shihab (1977) has investigated the

relationship between some environmental factors and the growth, reproduction and longevity of *Moina micrura*. Moreover Lazim (1977) studied a bio-ecological on *Daphnia lumholtzi*. And Lazim and Zaki (1986) studied life span, instar duration, growth and reproduction in *Scapholebris kingi*. While Mangalo and Akbar (1986b) studied size and reproduction in natural population of *Moina affinis* in Diyala river. Also Mangalo and Akbar (1986a) studied seasonal variation in brood size and body length of *Bosmina longirostris* in Diyala river. In Basrah Ajeel *et al.* (2000 a,b) studied population dynamics of the *D. magna* and *S. vetulus*, these animals were fed on *Chlorella vulgaris*.

The aim of the present study is to investigate the effect of three different types of diet on length, life span, number and duration of instars in *D. magna*.

MATERIALS AND METHODS

Samples of *Daphnia magna* were collected from a ponds in Basrah, (Fig.1) using a plankton net of a mesh-size 0.090mm. A successful culture was built in the laboratory using glass aquarium. The animals were fed on a diet of sheep manure, Yeast and wheat bran (Needham *et al.*1959). The gravid females were isolated from the stock culture using a pipette and placed in beaker 1 liter filled with filtered pond water and left for 24 hours to give birth of newly hatched nauplii, then the mothers were picked up and returned to the glass aquarium. The newly hatched nauplii (first stage) were separated and placed each in a beaker 100ml. The young's were fed with one of the following diets, sheep manure 200 mg/L.; yeast 15 mg/L. and wheat bran 150 mg/L. twenty replicates of each type of diet were made. The animals were examined daily at laboratory temperature and their lengths were measured with an ocular micrometer fitted in the eye piece of the compound microscope, observed the molts cycle as well the time of death of each animal in order to estimate the life span. The water of each replicate was changed weekly to avoid any shortage of food or oxygen depletion.



Fig. (1): Map of lower Mesopotamia showing the sampling station.

RESULTS

The relation between mean length and time is given in Fig. 2. The growth rate is high when the animals are young and becomes low when it's older. The maximum length attained by the adults was 4.08, 3.81 and 3.3 mm., however the mean lengths were 3.80, 3.42 and 3.21 mm. For those animals fed with sheep manure, yeast and wheat bran respectively.

The length of the newly hatched of *D. magna* was ranged between 0.52 – 0.87 mm. And the mean length was 0.65 mm. This value was based on the measurements of thirty newly hatched nauplii. Table (1) show the mean length and instar duration of *D. magna* under different diet conditions.

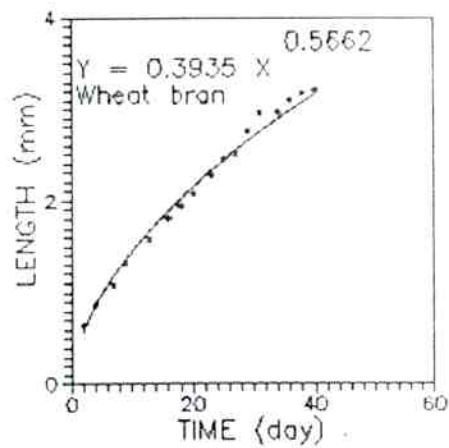
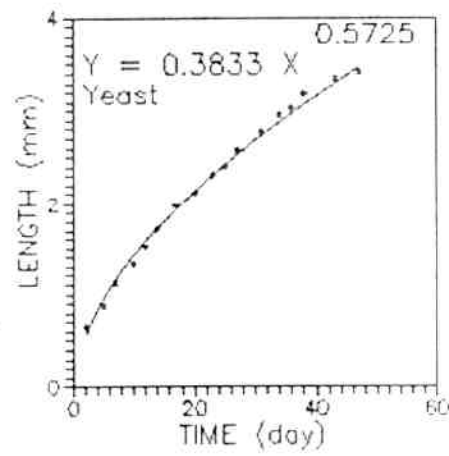
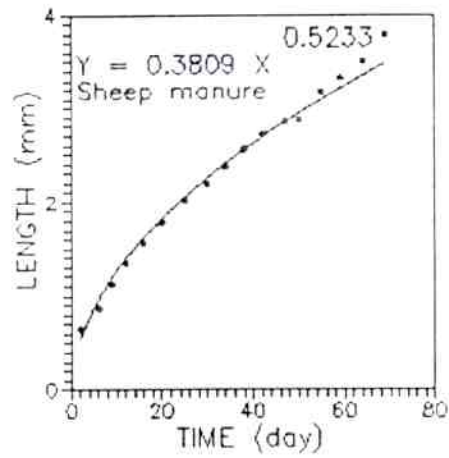


Fig.2: The relations between mean length(mm) and time (day)

The maximum length attained by the adults was 4.08, 3.81 and 3.3 mm., however the mean lengths were 3.80, 3.42 and 3.21 mm. For those animals fed with sheep manure, yeast and wheat bran respectively.

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Table (1): Mean length and instar duration of *D. magna* under different diet conditions.

Number of instar	Sheep manure		Yeast		Wheat bran	
	Mean length mm.	Duration of each instar	Mean length mm.	Duration of each instar	Mean length mm.	Duration of each instar
1	0.65	2	0.65	2	0.65	2
2	0.87	4	0.88	3	0.87	2
3	1.12	3	1.12	2	1.08	3
4	1.35	3	1.33	3	1.32	2
5	1.56	4	1.52	2	1.58	4
6	1.79	4	1.72	2	1.81	3
7	2.02	5	1.98	3	1.95	2
8	2.19	5	2.12	3	2.08	2
9	2.37	4	2.31	3	2.27	3
10	2.56	4	2.41	2	2.45	2
11	2.72	4	2.58	2	2.50	2
12	2.86	5	2.77	4	2.75	2
13	2.87	3	2.96	3	2.96	2
14	3.18	5	3.04	2	2.98	3
15	3.33	4	3.19	2	3.10	2
16	3.51	5	3.36	5	3.18	2
17	3.80	5	3.42	4	3.21	2
		69		47		40

The number of preadult instars was between 4 – 7 while that of the adult seems to be about 10 instars. The maximum life spans were 69, 47 and 40 days in sheep manure, yeast and wheat bran respectively. The duration of the preadult instars were 12 days in sheep manure and 15 days in yeast and wheat bran.

The maximum number of newly hatched nauplii were 29, 22 and 16 in sheep manure, yeast and wheat bran respectively.

DISCUSSION

In *Daphnia* the growth is a discontinuous process for increase in length only occurs immediately after molting when the integument is still soft. The increase in size occurs very rapidly and it takes less than a minute (Green 1956).

The *Daphnia magna* has a 14 – 17 instars, 4 – 7 preadult instars and 10 adult instars, the duration of the adult instars are longer than preadult instar. Similar finding have been reported in Cladocera by (Navaneethakrishnan and Michael 1971, Murugan and Sivaramkrishnan 1973, Khalaf *et al.*, 1977a). The duration of the instars in cladocerans are usually longer in the low temperature than in high temperatures (Brown, 1927; Macarthur and Baillie 1929). However Murugan (1975) pointed that the duration of preadult and adult instars of *Moina micrura* was constant duration (24h.) While Novaneethakrishnan *et al.* (1971) did not find such a constancy as well on *Daphnia carinata*. Also the relationship was noted for other related species such as *D. pulex*, *D. magna* and *D. longispina* (Anderson *et al.*, 1937; Anderson and Jenkins 1942; Ingle *et al.*, 1937). In the present study it was found that the life span varies according to the type of the diet. Table (2) show the comparison between the present study and the other studies for the preadult instars of the cladocerans. The life span ranged between 40 days for those animals fed with wheat bran and 69 days for those animals fed with sheep manure at laboratory temperature ($18\pm 4^{\circ}\text{C}$). These findings are in agreement with Robertson (1988) who found that the total life span of *D. magna* was 40 days at 30°C and 60 days at 25°C .

Table (2): The comparison for the number of preadult instars for the some species of *Daphnia*

Species	Number of preadult instars	References
<i>Daphnia magna</i>	5 – 8	Anderson (1932)
<i>D. magna</i>	4 – 6	Anderson and Jenkins(1942)
<i>D. magna</i>	4 – 6	Pennak (1978)
<i>D. magna</i>	7	Ajeel, <i>et al.</i> (2000)
<i>D. magna</i>	4 – 7	Present study
<i>D. carinata</i>	4	Agar (1930)
<i>D. lumholtzi</i>	6	Lazem (1977)
<i>D. pulex</i>	4 – 5	Pennak (1978)
<i>D. rosea</i>	4	Pennak (1978)
<i>D. gibba</i>	4	Hart (1987)

The mean lengths were 3.80, 3.42 and 3.21 mm. for those animals fed with sheep manure, yeast and wheat bran respectively. This is in agreement with the findings of the Kryvichkova and Sladeczek (1969) who working on *D. pulex* have reported that daphnids fed with algae attained 2.9 mm. while those fed with yeast attained 2.4 mm.

Nevertheless differences in the other factors such as the amount and the type of the food or genetic factors also must be taken in account on the account in this aspect as it is reported that these factors influenced on the instar duration and the life span of the cladocerans (Kryutchkova and Sladeczek 1969). The total life span of different species of *Daphnia* are shown in Table (3). Since the rate of growth was affected by the type of the diet, it was found that the time required to reach adult stage and be able to produce egg was also affected. In the present study the growth rate in *D. magna* is very gradual in reproduction phase though it is rapid in the preadult phase, these findings are in agreement with Lazim (1977) who reported that rapid preadult growth seems to be a common feature for cladoceran. A similar results has been observed in *D. pulex* (Buikema 1973) and *D. hyalina* (Vijverberg 1976).

Table (3): Comparison of the effect of temperature on the life span of some species of *Daphnia*.

Species	Life span (day)	Temperature (°C)	References
<i>Daphnia magna</i>	29	28	Macarthur and Baillie (1929)
<i>D. magna</i>	44.7	18	Macarthur and Baillie (1929)
<i>D. magna</i>	108	8	Macarthur and Baillie (1929)
<i>D. magna</i>	39 – 41	25	Anderson and Jenkins (1942)
<i>D. magna</i>	40	30	Robertson (1988)
<i>D. magna</i>	60	25	Robertson (1988)
<i>D. magna</i>	80	20	Robertson (1988)
<i>D. magna</i>	100	15	Robertson (1988)
<i>D. magna</i>	72	14.5 – 21.5	Ajeel, <i>et al.</i> (2000)
<i>D. magna</i>	40 - 69	18 ± 4	Present study
<i>D. lumholtzi</i>	11 – 15	35	Lazem (1977)
<i>D. lumholtzi</i>	11 – 19	30	Lazem (1977)
<i>D. lumholtzi</i>	18 – 35	25	Lazem (1977)
<i>D. lumholtzi</i>	34 – 61	18	Lazem (1977)
<i>D. pulex</i>	50	30	Robertson (1988)
<i>D. pulex</i>	70	25	Robertson (1988)
<i>D. pulex</i>	90	20	Robertson (1988)
<i>D. pulex</i>	110	15	Robertson (1988)

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نمو الحيوان القشري *Daphnia magna* تحت ظروف غذائية مختلفة

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الخلاصة

جمعت عينات الـ *Daphnia magna* من بركة في البصرة وتم زراعتها في المختبر في أحواض زجاجية وتم تغذيتها على ثلاثة أنواع مختلفة من الغذاء ، سماء الأغنام و الخميرة و نخالة الحنطة تحت درجة حرارة المختبر. وقد أظهرت النتائج إن سماء الأغنام هو أفضل غذاء لهذا النوع حيث سجل معدل الطول الكلي للحيوان 3.80 و 3.42 و 3.21 ملم في سماء الأغنام والخميرة ونخالة الحنطة على التوالي. أما فترة الحياة فقد بلغت 69 و 47 و 40 يوم على التوالي. وكان عدد الأطوار قبل البلوغ 4 - 7 أطوار أما عددها بعد البلوغ فكان 10 أطوار وإن الفترة الزمنية للأطوار كانت 2 - 5 أيام.