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A Comparative Study on the Effect of Different Salinities on the Survival, Growth, Life Span and Morphometric Characteristics Cyst of Two Parthenogenetic Species of *Artemia* (Gaav Khooni Wetlands of Isfahan, Ponds Around Lake Urmia) from Iran

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ABSTRACT

The identification of environmental conditions inducing different ecophysiological responses in the different strains and populations of the brine shrimp (*Artemia*) should improve the understanding of their biogeographic distribution. In the persent study, Nauplii from two Iranean brine shrimp parthenogenetic population, *Artemia* Gaav Khooni from wetlands of Isfahan and *Artemia* from ponds around lake Urmia, were grown up at three salinities (80, 120 and 150 ppt). The initial stocking density was 200 nauplii/litre in all the salinities tested. Shrimps were feeding, according to standard feeding table. On days 8th, 11th, 14th, 17th, 20th and 23th, the number of remaining than the frist day of culture, percentage survival was calculated at different salinities. The growth rate of shrimps also on days 8th, 11th, 14th, 17th, 20th and 23th of culture, by a microscope equipped with ocular micrometer and measured results were compared statistically. Salinity was proved to have significant impact on majority of the life span characters studied in this survey. The results shown, *Artemia* Gaav Khooni showed higher survival rates than brine shrimp of Urmia ponds (except in salinity 80 ppt). Also the best results shown for the life span factors in all three salinities was observed in brine shrimp of Gaav Khooni wetlands (especially in wetland natural salinity 120 ppt). But the best results for the growth factor in all three salinities was observed in brine shrimp of Urmia ponds. Too *Artemia* ponds around lake Urmia, from majority on the morphometric characteristics cyst larger size than *Artemia* Gaav Khooni. Therefore, from the persent study it could be confirmed that *Artemia* Gaav Khooni unlike most species than the decreas in salinity (optimal level) is also vulnerable.

Key words: *Artemia*, Gaav Khooni, survival, growth, morphometric characteristics cyst

INTRODUCTION

Artemia is a unique cosmopolition anostracan living in hypersaline and saline lake, ponds, lagoons and man-made salterns. It is characterized by communities with low species diversity and simple trophic structures compared to fresh and marine water environments (Persoone and Sorgeloos, 1980; Lenz, 1987). *Artemia* is very well adapted to the severe physiological demands imposed by these ecosystems. Covered by a nearly impenetrable exoskeleton and able to pump out

excess of salt, brine shrimp can tolerate the widest salinity range of any other multicellular organism. Due to its unique osmoregulatory capacity, *Artemia* is found in wide range of saline environments with salinity levels ranging from 10-340 g L^{-1} which are characterized by diverse chemical composition (Persoone and Sorgeloos, 1980; Agh, 2002).

The genus *Artemia* is comprised of a number of sexual species and numerous parthenogenetic populations (Browne *et al*., 1991). In the old world, five sexual species and many parthenogenetic populations were reported. One of the sexual species is *Artemia urmiana* from Lake Urmia (Iran). However, Iranian *Artemia* resources are not only limited to Urmia Lake. Due to the numerous salt water bodies, the presence of *Artemia* in different parts of the country seemed very likely (Agh *et al*., 2007).

Gaav Khooni Lake is situated 140 km south-east of Isfahan province. It is one of the rare wetlands of Central Iran and in this sense it plays a critical role for migratory and native birds. It is an internationally protected natural reserve. The Gaav Khooni Lake occupies the center of the Gaav Khooni region which extends over an area of 2800 km^2. The soil is salty throughout the region and a permanent salt crust covers large areas around lake. It is an almost permanent saline lake and its major water source is the River Zayandeh Roud. During the rainy season, many smaller lagoons and lakes with fluctuating salinity appear around the central lake. The average annual precipitation is 83 mm. The dry season lasts from late March until mid-October. The temperature in the region ranges from 6.6-37.48°C (Asri *et al*., 2002). Water salinity is usually above 120 g L^{-1}. Agh *et al*. (2007) reported the presence of a possible parthenogenetic *Artemia* population in the Gaav Khooni Lake at Isfahan (Central of Iran). Agh and Noori (1997) and Agh *et al*. (2002) also reported the presence of a morphologically distinctive parthenogenetic population in the small lagoons in the vicinity of Urmia lake. These lagoons are scattered at the periphery of the lake in both west and easte Azerbaijan. The size of the lagoons varies from a few square meters to maximum 10000 m^2 surface area and their depth is always less than 0.7 m. Therefore, these lagoons are considered as temporary small water catchments that are dried during early summer and fielld up again during winter rains. Water salinity in the lagoons ranges from 10-20 g L^{-1} in early spring and gradually rises to saturation level within about 10 weeks. Parthenogenetic females were observed at high densities with rare males seen only at the ratio of one male to 100 females in these lagoons (Agh and Noori, 1997; Abatzopoulos *et al*., 2006a).

There is considerable literature information on survival and growth of many parthenogenetic *Artemia* population (Vanhaecke *et al*., 1984; Wear and Haslett, 1986; Browne *et al*., 1984, 1991; Browne and Wanigasekera, 2000; Triantaphyllidis *et al*., 1995, 1997; Baxevanis *et al*., 2004; El-Bermawi *et al*., 2004; Abatzopoulos *et al*., 2003, 2006a; Agh *et al*., 2008). But, the effect of salinity on *Artemia* population in the Gaav Khooni Lake at Isfahan (Central of Iran) have been poorly examined or not studied at all was surveyed.

In this study, the effect of salinity on survival, growth, Life span and morphometric characteristics cyst of two parthenogenetic species of *Artemia* (Gaav Khooni wetlands of Isfahan, ponds around lake Urmia) from Iran was surveyed.

MATERIALS AND METHODS

Culture procedure: The origins of the *Artemia* cysts used in the experiment are as follows: (1) *Artemia parthenogenetica* from the Gaav Khooni wetlands at Isfahan, Iran; (2) *Artemia parthenogenetica* from the ponds around lake Urmia, Iran. In the laboratory, the *Artemia* cysts were seperated by Floatation Separation Method and Density Separation in Freshwater

(Stappen, 1996). The cysts were maintained under conditions of continuous illumination and aeration with Gaav Khooni wetland-water collected in the sampling station and was hatched at a constant temperature 23-25°C and salinity 33-35 ppt and pH was adjusted to 8.0 throughout hatching. After hatching, the nauplii were separated from their shells and from the unhatched cysts by the method described by Amat *et al.* (1994).

This step was then followed by transferring tree replicates of 200 actively moving nauplii from each population into 500 mL conical containers filled with 400 mL of filtered water with different salinities. Solutions of different salinities (80 ppt, 120 ppt and 150 ppt) were prepared using synthetic Gaav Khooni wetland-water and salt of Gaav Khooni wetland. The animals were cultured at 27±1°C under constant aeration. The salinity in each cone was checked daily in order to maintain salinities according to the experimental set up. 24 h after hatching, Larvae were fed daily with yeast-based diet Lansy PZ, 1.66 g L^{-1} (INVE Aquaculture NV, Belgium). Density of *Artemia* was adjusted to one animal per 2 mL at the beginning of the experiment but the density was gradually decreased to one animal per 3 mL on day 8 and per 4 mL on day 14 of growth.

Determination of survival and growth: Survival and total length were determined on days 8th, 11th, 14th, 17th, 20th and 23th, according to Triantaphyllidis *et al.* (1995). For determining the growth 10 animals from each replicate were measured from the most anterior part of the head up to the last abdominal segment (telson) using a light microscope equipped by ocular micrometer. measured results were compared statistically.

Life span characteristics: As animals attained maturity 30 adult parthenogenetic females from each population (from all salinities) were transferred into separate 50 mL falcon tubes in order to study their life cycle characteristics. The falcon tube were checked every day for the life span which were recorded separately. Finally the life span characteristics pre reproductive period, reproductive period, post reorodutive period and lifetime) were determined for each population according to Browne *et al.* (1984, 1991).

Morphometric characteristics cyst: For determining the average hydrated cysts, several gram of cysts from each population were transferred into a glass jar containing brine water (10 ppt). Cysts after adding 0.5 mL Logol 1% were placed at room temperature for 2 h. After 2 h, this process was repeated and were placed in the dark overnight. Then, the diameter of 300-400 number of cysts from each population was measured with using a stereomicroscope equipped with an acular micrometer. According to standard methods determined the average shelled cyst. For this purpose, hydrated cysts per gram, 7 mL of hypochlorite solution containing 5% active hypochlorite, 7 mL of fresh water and 0.15 g NaOH were poured into a cylindrical container cone. The mixture was aerated for 15-20 min. When the cysts changed color from brown to orange, they filtered and rinsed by a sive 100 μm. Then, according to above methods the diameter of 300-400 number of shelled cysts from each population was measured. Also, according to above methods, thickness of the chorion was computed.

Statistical analysis: Statistical analysis was performed using SPSS, version 17.0 for windows. The normality of distribution of variables was tested using Kolmogorov-Smirnov test. The homogeneity of variances was tested using the Levene's F-test. At the beginning of the experiment, possible differences in initial weight, length and body composition of animal were tested by one-way analysis of variance (ANOVA). The differences in the variables among the treatments were tested using one-way ANOVA at regular sampling dates. *Post hoc* comparisons between sample means

were tested by Tukey and LSD test. Data was expressed as Mean±Standard Error (S.E) and differences were considered statistically significant at $p<0.05$ level.

RESULTS

Survival: Records of the survival after 23 days of experiment indicate that in the majority of the cases survival decline in brine shrimp of Urmia ponds when salinity increases. Also, survival decline in *Artemia* Gaav Khooni when salinity increases but more than 120 ppt. Multifactor ANOVA test revealed that there were significant effects on survival by species and salinity as well as significant interaction among two variables ($p<0.05$) for all tests.

The *Artemia* Gaav Khooni had significantly higher survival at salinities 120 and 150 ppt compared to brine shrimp ponds. The brine shrimp ponds had significantly higher survival only at 80 ppt compared to the *Artemia* Gaav Khooni.

Maximum survival was observed in brine shrimp ponds at 80 ppt, significantly higher compared to the values obtained at other salinities at intrapopulation level ($p<0.05$) while minimum survival was observed in *Artemia* Gaav Khooni at 80 ppt.

The both asexual populations demonstrated significant differences in survival rate at all salinities (Table 1).

Growth: The results show that in the majority of the cases, the growth rate declines in the both populations when salinity increase. The maximum total length of brine shrimp ponds was significantly larger than *Artemia* Gaav khooni at all levels of salinity. No considerable differences were found in the total length of parthenogenetic strains at 80 and 120 ppt but the same were significantly different at 80 and 150 ppt (ANOVA, $p<0.05$).

Maximum total length was observed in brine shrimp ponds at 80 ppt while minimum growth was observed in *Artemia* Gaav khooni at 150 ppt (Table 2).

Pre reproductive period: The results show that in the average pre reproductive period increment in the both populations when salinity increase. No considerable differences were found in average pre reproductive period of parthenogenetic strains at 80 and 150 ppt but the same were significantly different at 120 ppt (ANOVA, $p<0.05$).

In fact the results show that in the average pre reproductive period considerable decline in the *Artemia* Gaav Khooni at 120 ppt was observed (Table 3).

Table 1: Comparison of two *Artemia* populations from different levels of salinity in terms of mean survival

	Salinity (ppt)		
Artemia species	80	120	150
Artemia Gaav Khooni	45.08±4.71^{a}	72.11±5.36^{b}	63.11±3.56^{db}
Artemia ponds	91.19±6.38^{c}	57.08±6.05^{d}	52.66±7.21^{db}

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

Table 2: Comparison of two different levels of salinity on *Artemia* population in terms of average growth (mm)

	Salinity (ppt)		
Artemia species	80	120	150
Artemia Gaav Khooni	6.539±0.51^{a}	5.675±0.68^{ab}	3.956±0.89^{b}
Artemia ponds	6.981±0.40^{a}	5.953±0.56^{ab}	4.458±0.72^{b}

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

Table 3: Comparison of two *Artemia* populations in different levels of salinity in terms of average pre reproductive period

	Salinity (ppt)		
Artemia species	80	120	150
Artemia Gaav Khooni	27.27±3.21^{a}	8.43±2.56^{b}	29.43±6.44^{ac}
Artemia ponds	27.43±2.78^{d}	27.93±3.99^{bd}	29.47±4.22^{acd}

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

Table 4: Comparison of two *Artemia* populations in different levels of salinity in terms of average reproductive period

	Salinity (ppt)		
Artemia species	80	120	150
Artemia Gaav Khooni	29.93±4.99^{a}	57.1±2.34^{b}	5.03±6.09^{e}
Artemia ponds	19.53±5.43^{d}	12.4±5.89^{ef}	9.03±7.09^{ef}

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

Reproductive period: The results show that in the average reproductive period declines in the both populations when salinity increases (except in *Artemia* Gaav Khooni at salinity 120 ppt). The *Artemia* Gaav Khooni had significantly higher average reproductive period at salinities 80 and 120 ppt compared to brine shrimp ponds. The brine shrimp ponds had significantly higher average reproductive period only at 150 ppt compared to *Artemia* Gaav Khooni. Maximum average reproductive period was observed in *Artemia* Gaav Khooni at 120 ppt, significantly higher compared to the values obtained at other salinities at intrapopulation level ($p<0.05$), also minimum average reproductive period was observed in *Artemia* Gaav Khooni at 150 ppt.

The interesting point in the results is that the average reproductive period was different from other treatments in *Artemia* Gaav Khooni at 120 ppt (Table 4).

Post reproductive period: Different results obtained in the average post reproductive period for each one population at all levels of salinity. No considerable differences were found in average post reproductive period of the brine shrimp ponds at all levels of salinity but the same were significantly different for the *Artemia* Gaav Khooni at 80 and 150 ppt and at 120 and 150 ppt (ANOVA, $p<0.05$). Maximum average post reproductive period was observed in *Artemia* Gaav Khooni at 120 ppt, also minimum average post reproductive period was observed in *Artemia* Gaav Khooni at 150 ppt.

The interesting point in the results is that the average post reproductive period was higher than other treatments at 120 ppt (Table 5).

Lifetime: The results show that in the average lifetime declines in the both populations when salinity increases (except in *Artemia* Gaav Khooni at salinity 120 ppt). The *Artemia* Gaav Khooni had significantly higher average lifetime at salinities 80 and 120 ppt compared to brine shrimp ponds. The brine shrimp ponds had significantly higher average lifetime only at 150 ppt compared to *Artemia* Gaav Khooni. Maximum lifetime was observed in *Artemia* Gaav Khooni at 120 ppt with an average of 69 days, significantly higher compared to the values obtained at other salinities at intrapopulation level ($p<0.05$), also minimum lifetime was observed in *Artemia* Gaav Khooni at 150 ppt with an average of 35 days (Table 6).

Morphometric characteristics cyst: In this survey determining average hydrated cysts, shelled cyst and thickness of the chorion for each one populations. Finally, the results show that in all

Table 5: Comparison of two *Artemia* populations in different levels of salinity in terms of average post reproductive period

	Salinity (ppt)		
Artemia species	80	120	150
Artemia Gaav Khooni	2.77±6.09[a]	3.00±5.00[ab]	0.53±7.83[c]
Artemia ponds	1.33±5.78[d]	1.87±6.21[bd]	1.60±6.88[d]

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

Table 6: Comparison of two *Artemia* populations in different levels of salinity in terms of average lifetime

	Salinity (ppt)		
Artemia species	80	120	150
Artemia Gaav Khooni	60.27±5.88[a]	68.6±5.21[ab]	35.00±8.99[c]
Artemia ponds	48.20±6.86[d]	42.5±6.09[d]	40.07±7.07[d]

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

Table 7: Comparison of two populations of *Artemia* cysts morphology

	Cysts (mmμ)		
Artemia species	Hydrated cyst	Shelled cyst	Chorionic
Artemia Gaav Khooni	235.475±12.98[a]	230.927±13.78[b]	4.547±6.99[c]
Artemia ponds	243.188±10.08[d]	237.927±9.88[e]	5.260±4.67[f]

Home of the table that have no common letters are statistically significant difference ($p<0.05$)

morphological characteristics of cysts, the brine shrimp ponds had significantly higher than the *Artemia* Gaav Khooni (ANOVA, $p<0.05$) (Table 7).

DISCUSSION

Survival: Although, thriving *Artemia* population are found in salinities as high as 340 ppt (Post and Youssef, 1997) its culture and maintenance in laboratory at salinities higher than 200 ppt has always been difficult (Wear and Haslett, 1986; Wear *et al*., 1986). Browne and Hoopes (1990) reported only 9% survival at 190 ppt and no survival at all at 230 ppt in a parthenogenetic *Artemia* from Salin de Giraud (France). Triantaphyllidis *et al*. (1995) reported over 80% mortality of both parthenogenetic *Artemia* from Tanggu area (China) and *A. franciscana* at 180 ppt at 25°C over a 23 days culture period. On the contrary, they reported above 75% survival for *A. franciscana* and higher than 50% survival for parthenogenetic *Artemia* at salinities lower than 100 ppt.

Browne and Wanigasekera (2000) reported an increase in survival of parthenogenetic *Artemia* from Margherita di Savoia (Italy) and *A. salina* when salinity of the culture medium was increased from 60 to 120 g L^{-1} at 15°C but this percentage sharply decreased in three other bisexual species (*A. sinica, A. franciscana* and *A. persimilis*). Inversely, at 24°C they got completely different results, obtaining significantly higher survival at higher salinity. El-Bermawi *et al*. (2004) observed similar results with parthenogenetic *Artemia* populations from Egypt. Contrary to these two findings, Triantaphyllidis *et al*. (1995) reported a steady decrease in survival in both parthenogenetic from Tanggu (China) and bisexual *A. franciscana* cultured in the range of 60 to 180 g L^{-1}. Triantaphyllidis *et al*. (1995) reported 70-80% survival for *A. franciscana* at 60 g L^{-1} but Browne and Wanigasekera (2000) observed only 16% survival for this species at the same salinity. Vanhaecke *et al*. (1984) reported high survivorship for *A. sinica* and *A. salina* at

60 g L^{-1}, whereas survival was zero for these two species at the same salinity in the experiments performed by Browne and Wanigasekera (2000). Browne and Wanigasekera (2000) claimed that differences in the culture conditions and intraspecies and population-dependent characteristics could be among the reasons for the different results obtained by different researchers.

Part of our experiments are in agreement with the findings of Triantaphyllidis *et al.* (1995), showing a constant decline in survival in brine shrimp of Urmia ponds when salinity increases. In present study we found survival percentages of both populations, that decreases in brine shrimp of Urmia ponds when salinity increases and also survival declines, in *Artemia* Gaav Khooni when salinity increases but more than 120 ppt. According to the results obtained in our study, *Artemia* Gaav Khooni higher survival than brine shrimp of Urmia ponds (except in salinity 80 ppt).

Also, high mortality was observed in *Artemia* Gaav Khooni at 80 ppt. Therefore from the persent study it could be confirmed that *Artemia* Gaav Khooni unlike most species than the decreas in salinity (optimal level) is also vulnerable. Different findings with different *Artemia* strains could be an indication for strain-specific adaptation patterns of various *Artemia* populations to diverse physical, chemical and biotic characteristics of their own biotopes.

Growth: According to Gilchrist (1960), Triantaphyllidis *et al.* (1995) and El-Bermawi *et al.* (2004), growth is inversely proportional to salinity. Triantaphyllidis *et al.* (1995) reported significant differences in the growth of *Artemia* especially in the parthenogenetic population from Tanggu (China) cultured at different salinities. According to their experiments maximum growth in *A. franciscana* was observed at 35 g L^{-1}, whereas growth in parthenogenetic *Artemia* showed no differences in 35, 60 and 100 g L^{-1}. But parthenogenetic *Artemia* at 180 g L^{-1} attained only 50% of the length of those at 35, 60 and 100 g L^{-1}. *A. franciscana* at 180 g L^{-1} achieved 60% of the length in comparison to animals grown at 35 g L^{-1}. El-Bermawi *et al.* (2004) did not observe big differences in growth of parthenogenetic and bisexual populations of *Artemia* from Egypt grown in the laboratory at salinities ranging from 35 to 200 g L^{-1}. Abatzopoulos *et al.* (2006b) found that growth rate of *A. urmiana* was not affected by the increase of salinity.

The present study confirms that growth rate in parthenogenetic *Artemia* populations from Iran is inversely proportional to salinity, supporting the findings of Gilchrist (1960), Triantaphyllidis *et al.* (1995), El-Bermawi *et al.* (2004) and Agh *et al.* (2007). The maximum total length of brine shrimp ponds was significantly larger than *Artemia* Gaav khooni at all levels of salinity. No considerable differences were found in the total length of parthenogenetic strains at 80 and 120 ppt but the same were significantly different at 80 and 150 ppt.

Our result agreement with the findings of Abatzopoulos *et al.* (2006b) it seems that performance of brine shrimp ponds and *Artemia* Gaav khooni are affected by different sources of brine water used for culture experiments. In present study we used diluted Gaav khooni wetland water adjusted to 80, 120 and 150 ppt throughout the experiment, whereas Abatzopoulos *et al.* (2006a) used artificially prepared D and K medium of 35, 50, 100, 140 and 180 ppt salinity in their experiments. Our results in combination with literature data suggest that adaptation to different salinities and growth rate are species specific and in addition dependent on the culture conditions.

Life span characteristics and morphometric characteristics cyst: A number of investigations have reported on effects of salinity on the reproductive and life span characteristics of *Artemia*. Gilchrist (1960), Dana and Lenz (1986) and Triantaphyllidis *et al.* (1995) who worked on *A. salina*, *A. franciscana* from Mono lake and Tanggu parthenogenetic *Artemia* and

A. franciscana from San Francisco Bay respectively, reported that maturation is achieved fastest at salinities lower than 100 g L^{-1} and much slower above 140 g L^{-1}. Abatzopoulos *et al.* (2003) reported faster maturity at 50 and 80 g L^{-1} in comparison to 120 g L^{-1} for a parthenogenetic *Artemia* from Megalon Embolon (Greece). Similarly Baxevanis *et al.* (2004) reported early maturation at 35 g L^{-1} in three parthenogenetic populations and at 80 g L^{-1} in the bisexual *A. salina* from Lake of Wadi El-Natrun, all from Egypt. It was found that this bisexual *Artemia* died before attaining maturity at 150 and 200 g L^{-1}. But Browne and Wanigasekera (2000) who performed the experiments at various combinations of temperature and salinity with five *Artemia* populations (one parthenogenetic and four bisexual) reported parthenogenetic *Artemia* from Margherita di Savoia (Italy) as a niche specialist attaining maturity and reproducing only at salinities higher than 120 g L^{-1} at 24°C. This *Artemia* was not able to reproduce at 60 g L^{-1} at 15°C or 30°C. According to their findings maturation time in all four bisexual populations was more temperature-dependent than salinity-dependent. Within different temperature treatments at lower salinity, maturity was achieved earlier than at higher salinities, except in *A. persimilis* which had the shortest maturation time (9.7 days) at 30°C at 180 g L^{-1} (Browne and Wanigasekera, 2000).

Our results also proved that early maturation is achieved by two asexual *Artemia* populations from Gaav Khooni wetlands of Isfahan and ponds around lake Urmia in low salinities.

Unlike findings of Triantaphyllidis *et al.* (1995) with Tanggu (China) parthenogenetic *Artemia* and *A. franciscana* from San Francisco Bay, we found significant differences in most of the life span characteristics of two asexual populations from Iran both at inter- and intrapopulation levels in all salinities. In accordance with findings of Baxevanis *et al.* (2004) on Egyptian sexual and asexual population, we also found significant differences in life span characteristics of Iranian parthenogenetic strains under function of different salinities.

The present study supports findings by many studies on the negative impact of salinity values above 120-140 g L^{-1} on reproductive and life span characteristics in many other *Artemia* species or strains (Vanhaecke *et al.*, 1984; Wear and Haslett, 1986; Triantaphyllidis *et al.*, 1995; Browne and Wanigasekera, 2000; Baxevanis and Abatzopoulos, 2004; Baxevanis *et al.*, 2004). In accordance with previous laboratory investigations on several *Artemia* species (Browne *et al.*, 1991; Triantaphyllidis *et al.*, 1995; Baxevanis *et al.*, 2004) it was found that the optimal range for life span of Iranian asexual strains of *Artemia* from region lies between 80 and 120 ppt (especially for *Artemia* Gaav Khooni at salinity 120 ppt).

Also, in this study survey determining morphological characteristics of cysts for each one populations. Finally, the results show that in all morphological characteristics of cysts, the brine shrimp ponds had significantly higher than the *Artemia* Gaav Khooni. Therefore from the persent study it could be confirmed that different findings with different *Artemia* strains could be an indication for strain-specific adaptation patterns of various *Artemia* populations to diverse physical, chemical and biotic characteristics of their own biotopes.

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