Proximate composition and fatty acids profiles of *Artemia* cysts, and nauplii from different geographical regions of Iran

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Abstract

Artemia has been widely used in aquaculture as a suitable live food. The presence of highly unsaturated fatty acids is a key factor that determines the nutritional value and marketing of *Artemia* for shrimp, marine larvae, sturgeon and ornamental fish industries. To determine the variation in nutritional content in cysts, decapsulated cysts and nauplii of *Artemia* from three different biotopes of Iran, were tested for their protein, lipid, energy, and fatty acid profiles, particularly essential fatty acids. The cysts collected from Urmia, Maharlou and Meighan lakes, were rinsed, processed, decapsulated, hatched and then analyzed for proximate and fatty acid composition using standard methods. Statistical comparisons of the results revealed significant differences not only in proximate composition but also in fatty acid contents (p<0.05). The highest mean (±SD) level of protein (60.5±3.3 %), lipid (18.60±1.1%) and energy contents (5448.3±10.4 Kcal/kg) were observed in Instar I nauplii hatched from Urmia Lake cysts, Instar I nauplii hatched from Maharlou Lake cyst and Instar I nauplii hatched from Urmia Lake decapsulated cyst, respectively. The highest content of DHA (0.78 mg/g DW) was observed in nauplii of cysts from Urmia Lake; whereas, it was around zero in other samples. The highest level of EPA (24.24 mg/g DW) was measured in nauplii from Maharlou Lake decapsulated cysts and the lowest (0.24 mg/g DW) was observed in Urmia lake cysts. The results revealed that the nauplii from decapsulated cysts of Maharlou Lake *Artemia* contained significantly higher levels of EPA and n-3 HUFA compared to others. Therefore, it is recommended to use it in aquatic larviculture.

Keywords: *Artemia*, cyst, Decapsulated cyst, Nauplii, Nutritional value, Fatty Acid Profile

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Introduction

Although *Artemia* has been known for centuries, its uses in fish larviculture began in the 1930 (Lavens and Sorgeloos, 1996). There is an increasing demand for *Artemia* products that led to its huge supply from natural habitats and its culture in pools, ponds and salt water lakes. Because of their use in aquaculture and their direct impact on survival rates and growth of sensitive larval stages of shrimp and marine fish, *Artemia* cysts, decapsulated cysts and nauplii have been extensively studied as to their biochemical composition, especially the fatty acid profiles (Bengtson *et al*., 1991, Lavens and Sorgeloos, 1996). The level of essential fatty acids eicosa pentaenoic acid (20: 5⁻ώ3) and docosahexaenoic acid (22:6 ώ3) are a very important factor to determine the dietary value of *Artemia* for marine fish (Sargent *et al*., 1997), crustacean larvae (Kayama *et al*., 1980; Mourente and Rodriguez, 1997) and bivalves (Langdon and Waldock, 1981; Caers *et al*., 1998) feeding. However, their levels reveal a distinct variability among different *Artemia* populations even within the same strain and different sampling times depending their feeding regimes and climatological conditions (Leger *et al*., 1986;Lavens *et al*., 1989). Little work on this matter is carried out in Iran (Ahmadi *et al*., 1990; Agh and Hosseini Ghatre, 2002) and comparative studies on *Artemia* from different geographical regions are not available. The present study analyzed the proximate and fatty acid composition of some *Artemia* cysts and nauplii from different geographical regions in Iran.

Materials and methods

The geographical position and other specifications of study regions is shown in Table 1 and Fig.1. Water salinity was measured in all sampling areas by a refractometer ATAGO-Japan (Table 1). All cysts collected by a 100µ mesh size net sampler. After collection, cysts separated and purified from mud, algae and *Artemia* carcass.

Table 1: The specifications of sampling area.

Region	Position	Altitude from Sea level (m)	Situation	Area (Km^2)	Salinity (g/L)
Urmia Lake	37 ° 20' N 45° 40' E	1278	17 km East of Urmia	5750-6000	320
Maharlou Lake	29 ° 32' N 52° 42'E	1455- 2990	27 km South-East of Shiraz	216	250
Meighan Lake	34 ° 9'N 49° 55'E	1660	17 km North-East of Arak	545.3	96

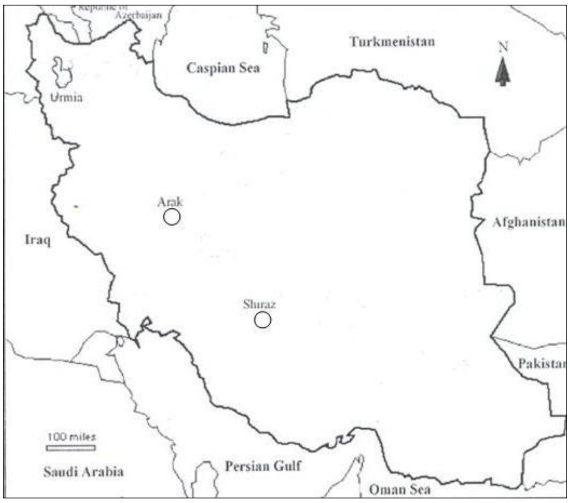

Figure 1: The geographical position of sampling areas.

Artemia cysts of 3 geographical regions in Iran (Urmia, Maharlou and Meighan lakes) were collected, hatched according to Sorgeloos *et al*. (1997). Moreover, some cysts were decapsulated according to Bruggeman *et al*. (1980). The nutritional composition of cysts, decapsulated cysts and Instar I nauplii were analyzed using Kjeldahl, Soxhlet and calorimetry methods (Hafezieh *et al*., 2010). Fatty acid profile of *Artemia* cyst, decapsulated cyst and newly hatched nauplii of each of the 3 *Artemia* populations was determined using capillary gas chromatography Agilent-6890–USA. Decapsulated cysts or Nauplii were homogenized, then lipid extraction, saponification and esterification were done according to Schauer *et al*. (1980) and Folch *et al*. (1957). Fatty acid methyl esters (FAME) were injected on a capillary column (30m fused silka, ID: 0.32 mm and layer thickness of 0.25µm). Peak identifications and quantification was done with reference standards. The results are presented as area–percent FAME composition and as mg FAMEg^{-1} dry weight. All data were statistically analyzed using Excel and SPSS v. 19. One Way ANOVA–Duncan test, after the normality's were stabilized by PP. Plot, SPSS V.

Results

Data on nutritional value including moisture, protein, lipid, carbon hydrate, calcium, phosphorus, ash, fiber and energy of *Artemia* cyst and nauplii hatched from decapsulated and non-decapsulated cysts from 3 geographical regions in Iran, are shown in Table 2. Fatty acid profiles of each sample (Area % and mg /g DW) are shown in Tables 6.

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Table 2: *Artemia* cyst composition analysis of three geographical regions in Iran (Mean ± SD).

Nutrients (%)	Region		
	Meighan Lake	**Maharlou Lake**	**Urmia Lake**
Moisture	0.1±0.001[c]	0.6±0.001[b]	2±0.001[a]
Protein	49.7±7.0[b]	58.6±8.1[a]	57.5±6.2[a]
Lipid	7.67±0.7	6.62±0.6	7.15±0.6
Carbon hydrate	28.13±3.1[a]	27.68±3.2[a]	24.25±2.7[b]
Calcium	1.3±0.5[a]	0.42±0.2[b]	0.35±0.2[b]
Phosphorus	0.43±0.1	0.46±0.1	0.4±0.1
Ash	11.6±1.1[a]	4.1±0.5[b]	3.6±0.4[b]
Fiber	2.8±0.5	2.4±0.4	2.5±0.4
Energy (Kcal/kg)	3803.5±10.4[b]	3953±11.1[a]	3977±11.8[a]

Different superscript letters in each row show significant differences ($p \leq 0.05$).

Table 3: Analyses of ingredients of Instar I nauplii hatched from *Artemia* cysts of three geographical regions in Iran (Mean ± SD).

Nutrients (%)	Region		
	Meighan Lake	**Maharlou Lake**	**Urmia Lake**
Moisture	1.7±0.9[b]	1.9±0.8[b]	2.7±0.7[a]
Protein	53.7±3.1[c]	57.7±2.0[b]	60.5±3.3[a]
Lipid	12.42±3.1[b]	18.60±1.1[a]	12.38±3.5[b]
Carbon Hydrate	24.38±6.5[a]	13.7±8.5[b]	21.85±6.3[a]
Calcium	0.35±0.1	0.46±0.1	0.58±0.1
Phosphorus	0.47±0.1	0.57±0.1	0.67±0.1
Ash	6.1±2.5[a]	6.1±2.5[a]	0.67±0.1[b]
Fiber	1.7±0.5	2±0.5	1.9±0.5
Energy (Kcal/kg)	4241±10.4[b]	4530±10.4[a]	4408.2±10.4[a]

Different superscript letters in each row show significant difference ($p \leq 0.05$).

Table 4: Analyses of *Artemia* decapsulated cyst composition of 3 geographical regions in Iran (Mean ± SD).

Nutrients (%)	Region		
	Meighan Lake	**Maharlou Lake**	**Urmia Lake**
Moisture	1.7±0.8[a]	0.5±0.1[b]	1.4±0.7[a]
Protein	51.7±3.0	52.5±3.0	50.7±2.0
Lipid	9.7±1.1[b]	9.34±1.2[b]	11.87±2.1[a]
Carbon Hydrate	29.9±1.0[a]	26.54±1.8[b]	28.73±2.1[a]
Calcium	0.45±0.1	0.42±0.1	0.32±0.1
Phosphorus	0.5±0.1	0.46±0.1	0.4±0.1
Ash	5.1±1.1	6.2±1.1	5.2±1.1
Fiber	1.9±0.6[a]	0.42±0.1[b]	2.1±0.5[a]
Energy (Kcal/kg)	4137±10.4[ab]	4002.2±10.4[b]	4245.5±10.4[a]

Different superscript letters in each row show significant difference ($p \leq 0.05$).

Table 5: Analyses of Instar I nauplii composition from decapsulated *Artemia* cyst of three geographical regions in Iran (Mean ± SD).

Nutrients (%)	Region		
	Meighan Lake	Maharlou Lake	Urmia Lake
Moisture	2±0.7	1.3±0.6	2±0.7
Protein	52.5±2.1[b]	56.8±1.1[a]	52.5±2.2[b]
Lipid	14.07±1.1[b]	16.62±2.1[a]	13.91±0.9[b]
Carbon Hydrate	25.23±3.1[ab]	23.18±2.1[b]	29.91±3.1[a]
Calcium	0.4±0.1	0.30±0.1	0.4±0.1
Phosphorus	0.58±0.1	0.62±0.1	0.58±0.1
Ash	5.1±1.1[a]	1±2.1[b]	0.58±0.1[b]
Fiber	1.1±0.1	1.1±0.1	1.1±0.1
Energy (Kcal/kg)	4375.5±10.4[b]	4695±10.4[ab]	5448.3±10.4[a]

Different superscript letters in each row show significant difference ($p \leq 0.05$).

Table 6: Fatty acid profile of *Artemia* cysts from 3 geographical regions of Iran.

Fatty acids	Meighan Lake		Maharlou Lake		Urmia Lake	
	DW (mg/g)	Area (%)	DW (mg/g)	Area (%)	DW (mg/g)	Area (%)
C14:0						
C14:1n5	1.68	2.19	1.30	1.97	1.47	2.06
C16:0	0.91	1.18	0.81	1.23	0.76	1.06
C16: 1n7	14.39	18.76	21.87	33.04	12.61	17.64
C17:0	14.92	19.45	9.27	14.00	3.07	4.29
C17:1n7	0.60	0.78	nd	nd	nd	nd
C18:0	1.12	1.46	0.54	0.81	nd	nd
C18:1n9	3.36	4.38	2.81	4.25	2.62	3.67
C18:1n7	12.83	16.73	9.94	15.01	13.23	18.5
C18:2n6-t	10.40	13.56	6.66	10.07	6.12	8.56
C18:2n6-cis	nd	nd	nd	nd	nd	nd
C18:3n3	2.05	2.67	2.14	3.24	5.77	8.07
C20:0	0.47	0.61	2.20	3.33	1.94	2.71
C20:1n9	nd	nd	nd	nd	2.39	3.34
C20:2n6	nd	nd	nd	nd	0.28	0.39
C20:3n3	nd	nd	nd	nd	nd	nd
C20:4n6	1.18	1.54	nd	nd	nd	nd
C20:4n3	nd	nd	nd	nd	nd	nd
C20:5n3	nd	nd	nd	nd	nd	nd
(EPA)	7.61	9.92	3.24	4.90	0.24	0.33
C22:0	nd	nd	0.48	0.73	0.44	0.61
C22:6n3(DH	nd	nd	nd	nd	0.40	0.56
A)	8.90	11.60	4.85	7.33	0.68	0.95
C24:0	0	0	0	0	1.70	1.70
DHA/EPA						
Total	80.42[a]		66.11[b]		52.02[c]	
SFA	28.33[b]		31.31[a]		20.21[c]	
MUFA	40.18[a]		27.22[b]		23.46[c]	
PUFA	9.26[a]		5.44[b]		2.18[c]	
n6-PUFA	2.05[b]		2.14[b]		5.77[a]	
n3-PUFA	9.26[a]		5.44[b]		2.58[c]	
n-3 HUFA	8.79[a]		3.24[b]		0.64[c]	

Values in the same row with different superscript are significantly different ($p \leq 0.05$). nd=not detected.

Table 7: Fatty acid profile of nauplii from *Artemia* cysts of 3 geographical regions of Iran.

Fatty acids	Meighan Lake		Maharlou Lake		Urmia Lake	
	DW (mg/g)	Area (%)	DW (mg/g)	Area (%)	DW (mg/g)	Area (%)
C14:0						
C14:1n5	3.94	3.17	6.16	3.31	1.86	1.50
C16:0	1.71	1.38	3.20	1.72	1.51	1.22
C16: 1n7	16.52	13.3	27.99	15.05	16.59	13.40
C17:0	28.57	23.00	39.36	21.16	2.85	2.30
C17:1n7	nd	nd	nd	nd	0.64	0.51
C18:0	nd	nd	nd	nd	2.34	1.89
C18:1n9	4.65	3.74	5.34	2.87	4.72	3.81
C18:1n7	17.13	13.79	27.03	14.53	22.65	18.29
C18:2n6-t	17.23	13.87	19.53	10.5	12.75	10.30
C18:2n6-cis	nd	nd	nd	nd	nd	nd
C18:3n3	3.04	2.45	4.24	2.28	3.51	2.84
C20:0	2.24	1.8	7.12	3.83	5.78	4.67
C20:1n9	0.76	0.61	0.50	0.27	nd	nd
C20:2n6	0.24	0.19	nd	nd	nd	nd
C20:3n3	nd	nd	nd	nd	nd	nd
C20:4n6	nd	nd	nd	nd	0.33	0.26
C20:4n3	nd	nd	nd	nd	0.32	0.26
C20:5n3	nd	nd	1.43	0.77	nd	nd
(EPA)	0.34	0.27	nd	nd	15.29	12.35
C22:0	1.28	1.03	0.61	0.33	1.18	0.95
C22:6n3	0.55	0.44	nd	nd	0.78	0.63
(DHA)	14.95	12.04	15.44	8.3	2.56	2.07
C24:0	1.63	1.63	0	0	0.05	0.05
DHA/EPA						
Total	113.15^{b}		157.95^{a}		95.66^{c}	
SFA	42.1^{b}		56.04^{a}		26.91^{c}	
MUFA	64.88^{b}		89.12^{a}		42.1^{c}	
PUFA	2.58^{c}		8.55^{b}		21.4^{a}	
n6-PUFA	3.04		4.24		3.83	
n3-PUFA	3.13^{c}		8.55^{b}		22.18^{a}	
n-3 HUFA	0.88^{b}		1.43^{b}		16.40^{a}	

Values in the same row with different superscript are significantly different ($p \leq 0.05$). nd=not detected.

Table 8: Fatty acid profile of decapsulated *Artemia* cysts from 3 geographical regions of Iran.

Fatty acids	Meighan Lake		Maharlou Lake		Urmia Lake	
	DW(mg/g)	**Area (%)**	**DW(mg/g)**	**Area(%)**	**DW(mg/g)**	**Area (%)**
C14:0	1.54	1.59	1.83	1.96	2.06	1.74
C14:1n5	1.23	1.26	1.17	1.26	1.48	1.25
C16:0	12.22	12.60	13.95	14.94	18.39	15.49
C16: 1n7	19.63	20.24	17.23	18.45	13.54	11.41
C17:0	0.52	0.53	0.52	0.56	0.51	0.43
C17:1n7	1.96	2.02	1.73	1.85	3.32	2.80
C18:0	3.39	3.49	3.22	3.44	4.31	3.63
C18:1n9	17.77	18.31	16.81	17.99	19.15	16.14
C18:1n7	9.88	10.19	9.60	10.28	7.43	6.26
C18:2n6-t	nd	nd	nd	nd	nd	nd
C18:2n6-cis	2.94	3.03	2.91	3.12	8.58	7.23
C18:3n3	4.55	4.69	4.46	4.78	21.99	18.53
C20:0	nd	nd	1.01	1.08	nd	nd
C20:1n9	0.42	0.43	nd	nd	0.52	0.44
C20:2n6	nd	nd	nd	nd	nd	nd
C20:3n3	nd	nd	1.01	1.08	nd	nd
C20:4n6	nd	nd	nd	nd	nd	nd
C20:4n3	nd	nd	nd	nd	nd	nd
C20:5n3	11.37	11.72	10.52	11.26	6.16	5.19
(EPA)	0.65	0.67	nd	nd	nd	nd
C22:0	nd	nd	0.24	0.25	nd	nd
C22:6n3	8.44	4.44	7.58	8.11	8.62	7.26
(DHA)	0	0	0.02	0.02	0	0
C24:0						
DHA/EPA						
Total	96.51[b]		93.79[b]		116.06[a]	
SFA	26.24[b]		27.59[b]		33.38[a]	
MUFA	50.89[a]		46.54[b]		45.44[b]	
PUFA	15.92[b]		15.99[b]		28.15[a]	
n6-PUFA	2.94[b]		2.91[b]		8.58[a]	
n3-PUFA	15.92[b]		16.23[b]		28.15[a]	
n-3 HUFA	11.7[a]		11.76[a]		6.16[b]	

Values in the same row with different superscript are significantly different ($p\leq 0.05$). nd=not detected.

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Table 9: Fatty acid profile of nauplii from decapsulated *Artemia* cysts from 3 geographical regions of Iran.

Fatty acids	Meighan Lake		Maharlou Lake		Urmia Lake	
	DW (mg/g)	Area (%)	DW (mg/g)	Area (%)	DW (mg/g)	Area (%)
C14:0						
C14:1n5	2.12	1.51	3.34	2.01	2.08	1.50
C16:0	1.42	1.01	1.82	1.09	1.56	1.12
C16: 1n7	15.64	11.12	22.09	13.28	20.10	14.45
C17:0	26.72	18.99	36.93	22.21	14.33	10.30
C17:1n7	1.15	0.82	1.83	1.10	0.52	0.37
C18:0	1.49	1.06	1.88	1.13	3.71	2.67
C18:1n9	5.27	3.75	5.77	3.47	6.19	4.45
C18:1n7	20.39	14.49	26.10	15.69	22.88	16.45
C18:2n6-t	16.48	11.71	18.34	11.03	9.99	7.18
C18:2n6-cis	nd	nd	nd	nd	nd	nd
C18:3n3	3.29	2.34	4.95	2.98	10.31	7.41
C20:0	2.42	1.72	2.57	1.55	24.92	17.91
C20:1n9	nd	nd	nd	nd	nd	nd
C20:2n6	nd	nd	nd	nd	0.67	0.48
C20:3n3	nd	nd	nd	nd	0.29	0.21
C20:4n6	1.60	1.14	nd	nd	0.51	0.37
C20:4n3	nd	nd	nd	nd	nd	nd
C20:5n3	nd	nd	nd	nd	nd	nd
(EPA)	15.89	11.29	24.24	14.57	6.70	4.82
C22:0	0.46	0.33	1.28	0.77	nd	nd
C22:6n3	nd	nd	0.57	0.34	nd	nd
(DHA)	8.81	6.26	14.00	8.42	10.10	7.26
C24:0	0	0	0.02	0.02	0	0
DHA/EPA						
Total	123.15^{c}		165.71^{a}		134.86^{b}	
SFA	32.3^{c}		46.48^{a}		38.47^{b}	
MUFA	66.5^{b}		85.07^{a}		53.14^{c}	
PUFA	19.91^{c}		26.81^{b}		32.13^{a}	
n6-PUFA	3.29^{b}		4.95^{b}		10.6^{a}	
n3-PUFA	19.91^{c}		27.38^{b}		32.13^{a}	
n-3 HUFA	17.49^{b}		24.81^{a}		7.22^{c}	

Values in the same row with different superscript are significantly different ($p \leq 0.05$). nd=not detected.

Discussion

Variations in different *Artemia* species and their use in aquaculture as to their nutritional value and fatty acid profiles have been well documented (Bengtson *et al*., 1991 ; Rezaei *et al*., 2000;Agh and Hoseini Ghatre, 2002). The price of *Artemia* cysts is dependent on nutritional value especially the presence of n-3 HUFA and their hatchability (Lavens and

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Sorgeloos, 1996). The lipid and energy content of *Artemia* strains are decreased as growth occurred, and the highest lipid and energy content is due to decapsulated cyst: while, nauplii is in the second place (Fujita *et al*., 1980). The differences observed in total lipid and protein from different strains of *Artemia* can be due to their genetic structure and /or variation of their feeding nutrients (Schauer *et al*., 1980; Agh *et al*., 2002). Royan-jozeph (1980) reported that lipid and protein content of decapsulated *Artemia* cyst was higher than its cyst and instar I nauplii. Schauer *et al*., (1980) determined the lipid content and fatty acid profile of *Artemia* cyst and newborn nauplii from Australia, Brazil, Italy and USA (California, Utah) .Our study showed that the lipid content in *Artemia* nauplii from Urmia Lake was slightly higher than nauplii from Italy and Sanfransisco Bay, but the ration of lipid content was less in nauplii from Australia, Brazil, Sanfransisco Bay and Great Salt Lake ones. Vanhaecke and Sorgeloos (1980) argued that energy content and dry weight of newborn nauplii were 0.0366- 0.0725 J. and 1.61- 3.32, respectively. Also, in newborn nauplii protein, lipid, carbohydrate and ash content were calculated as 37-71%, 12-13%, 11-23% and 4-21%, respectively (Vanhaecke et al., 1987). The average total lipid of nauplii from Urmia Lake was reported as 15.45% (Pour Jafar, 1988). This study revealed that the mean (±SD) protein content of newborn nauplii from *Artemia* cyst and decapsulated cyst were different ranging from 49.7± 0.7 – 58.6± 8.1% and 52.5± 0.3-56.8± 1.1%, respectively, which were higher than those of Margarita de Savia – Italy (41.92%), San Pablo – Spain (49.73%), Sanfransisco Bay (53.25%) and Macau- Brazil (53.77%) but were less than those of Cyprus (58.07%) ones. In addition, the lipid percentage in newborn nauplii from *Artemia* cyst and decapsulated cyst of the 3 studied regions were 12.42± 3.1- 16.62± 2.1% and 13.91±0.9- 14.07± 1.1 %, respectively. It can be concluded that the lipid content of studying samples was less than *Artemia* from Italy, San Francisco Bay, San Pablo, Australia, Brazil and Utah. Although average (±SD) lipid content of nauplii from cyst (18.60± 1.1%) and decapsulated cyst (16.62±2.1%) of Maharlou Lake were higher than Italy, San Francisco Bay and San Pablo ones: but. it was the same as that of nauplii from Australia.

Ahmadi *et al*., (1990) reported that *Artemia* nauplii enjoys a good amount of C18:3n3 and very low amount of C20:5n3 (EPA); therefore, is considered as useful for fresh water applications . The DHA level, especially DHA/EPA has a key role in growth, survival rate and protection against diseases in marine fish and crustacean (Kanazawa, 1993; Watanabe, 1993; Furuita, 1996; Han *et al*., 2001) . In all studied samples, the DHA/EPA was decreased, that might be due to low amount of DHA level (Paykaran Mana, 2007). In spite of this, the highest amount of this ratio among studied regions was due to cysts from Urmia Lake. The difference in Carotenoid complex (Soiejima *et al*., 1980), minerals (Watanabe *et al*., 1978), lipid and energy contents (Schauer *et al*., 1980) may not be responsible in aquaculture. Yet, fatty acid profiles showed a significant difference

(Léger *et al*., 1987). Léger et al. (1986) reported that C20:5n3 (EPA) levels in different species of *Artemia* cyst from different regions of the world ranged from 0.3 to 15.4 area (%) and the C20:5n3 (EPA) levels showed significant differences among species, even within species. Besides, genetic structure, habitat characteristics especially food availability and quality for example nutritional composition of algae, play major roles in this variation. The *Artemia* fed with higher n-3HUFA levels contained higher n-3HUFA (Fujita *et al*., 1980; Schauer *et al*., 1980; Léger *et al*., 1986; Mura *et al*., 1997). In fact, *Artemia* cysts reflected the C20:5n3 (EPA) level of their parental nutritional ration (Léger et al., 1987). The significant differences in fatty acid profile of nauplii from different *Artemia* strains, even within a strain differences may be due to genetic structures, feeding strategy or a combination of them (Schauer *et al*., 1980). Schauer *et al*. (1980) reported that the C20: 5n3 (EPA) levels in nauplii from San Francisco bay ranged from 0.3 – 13 (%), while the same fatty acid in the studied samples (cyst, decapsulated cyst and ongoing nauplii) from 3 geographical regions of Iran were higher and ranged from 0.27 (%) in nauplii from Arak's Mighan *Artemia* cyst to 14.57 (%) in nauplii from Maharlou's decapsulated cyst that were similar to results of other studies in the world. As different strains of *Artemia* contained different C20:5n3 (EPA) and very low C22:6n3 (DHA), their nauplii need to be enriched for marine fish and shrimp post larvae feeding. Likewise, it would be suggested that suitable enriched unicellular algae should be used for culture of suitable strain of *Artemia* to enhance the quality and quantity of producing cysts.

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