

-Technical Report-

Artemia urmiana Günther, 1899 (Crustacea: Anostraca) cyst processing with fluidized bed drying and layer drying techniques

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Abstract

Processing of hatchable *Artemia* cysts and their proper storage has a key role in sustainable supplying of *Artemia* nauplii for aquaculture applications. Processing of *Artemia* cysts is essential to reach the best hatching quality. In order to minimize metabolic activities of embryos and maximize cyst survival, the cysts must be dehydrated, packed in vacuum conditions and very low temperatures. In this study the application of two methods of Fluidized Bed Drying (FBD) and warm room Layer Drying (LD) to improve a better method for processing *Artemia urmiana* cysts was

discussed. The results showed a significant difference in hatching results among various treatments by two methods ($p < 0.05$). Cyst samples processed by warm room system enjoyed a better hatching percentage and hatching efficiency than those that dried by fluidized bed dryer. The best results were obtained including 28 °C internal temperature for 0.5 hour and 34 °C internal temperature for 4 hours by F.B.D. and warm room respectively. Also, warm room system enjoyed a higher drying capacity and was cheaper.

Key words: *Artemia urmiana*, cyst processing, F.B.D., Layer Drying

Introduction

The use of *Artemia* as a food for the larviculture of aquatic species began in the 1930's. However, regarding the expansion of aquaculture industries in 1970's, providing adequate amount of *Artemia* cyst and biomass has become a bottleneck for the larviculture of crustaceans, and freshwater and marine fish (Lavens and Sorgeloos, 1996). Nowadays, processing of hatchable *Artemia* cysts and their storage is essential for a sustainable supplying of *Artemia* nauplii for aquaculture applications. Proper processing of *Artemia* cysts is very important to reach the best hatching quality. The quality of *Artemia* cysts can be preserved by reduction of their water content to under 4%, and avoiding direct exposure to sunlight and oxygen (Vanhaecke and Sorgeloose, 1982; Bosteels et al., 1996).

Urmia Lake is one of the largest permanent hypersaline lakes in the world and the habitat of bisexual *Artemia* species, namely *A. urmiana* (Azari Takami, 1993; Esmaeili, 2005; Eimanifar and Mohebbi, 2007). In Iran, the economic harvesting of *A. urmiana* from the Urmia Lake began in 1996s.

In this study the application of two methods of fluidized bed drying (FBD) and layer drying (LD) for processing of *A. urmiana* cysts are discussed.

Materials and Methods

Lavens et al. (1996) method was applied to prepare the cysts for the experiment; a batch of *A. urmiana* cysts with similar characteristics was harvested, screened and washed. The cysts were then dehydrated in saturated brine, and their diapause was deactivated by cold storage at -20°C for 2 months. Then, the cysts were placed in room temperature for 2 days and the diapause deactivation was confirmed by means of hatching a portion of the cysts by a standard method. The cysts were divided into 2 groups: one group was dried by FBD method with 20 treatments comprising 4 processing time (0.5, 1, 1.5 and 2 h) and 5 drying temperatures (28, 30, 32, 34 and 36°C). The second group of the cysts was dried by LD method with 30 treatments consist of 6 processing times (1, 2, 3, 4, 5 and 6 h) and 5 drying temperatures (28, 30, 32, 34 and 36°C). Each treatment

was done in triplicate by using ca. 200g cysts per replicate. The cysts of all the treatments were packed under vacuum and stored at 4°C . About 45 sub samples of each treatment were examined monthly for qualitative assessments, i.e. estimation of hatching percentage and efficiency and residual water content, for a period of up to 15 months. All data were analyzed by one-way ANOVA. Duncan and t tests at a significance level of 95% ($p < 0.05$).

Results and Discussion

The hatching percentage (mean \pm SE) of the cysts processed by LD (N=450) and FBD (N=320) methods were 88.87 ± 4.1 and $83.16 \pm 7.4\%$, respectively (Fig 1). The average hatching efficiency of the cysts processed by LD and FBD (N=320) methods were 106040.09 ± 17303.3 and 101186.25 ± 19149.5 , respectively (Fig 2). The average final water-content of the cysts processed by LD and FBD methods were 15.03 ± 8.5 and $10.67 \pm 4.4\%$, respectively (Fig 3). There was significant difference between water contents of the cysts of the two examined methods ($p < 0.05$).

The lowest cyst water-content (15%) observed in the treatment of using FBD method at 28°C for 0.5 hour, and this was significantly different from the other treatments in this drying method. For the cysts processed by LD method, the minimum water content (10-15%) was observed in the cysts dried at 34°C for 4 hours, and this was significantly different with the other treatments in this method ($p < 0.05$). Hatching percentage and efficiency were significantly different between the cysts dried by the two studied methods.

Drying of *Artemia* cysts is one of the most critical steps of their processing, which can affect hatching quality of the cysts. The methods for different stages of *Artemia* cyst processing, including washing, dehydration, drying and packing were explained by Voronov (1974) and Sorgeloos et al. (1986). In many strains of *Artemia*, dehydration has been found to be an effective practice for the inactivation of diapause in their cysts (Duterio, 1960; Versicle and Sorgeloos, 1986). Other researchers revealed that in addition to dehydration, the used temperature and final water content of the processed

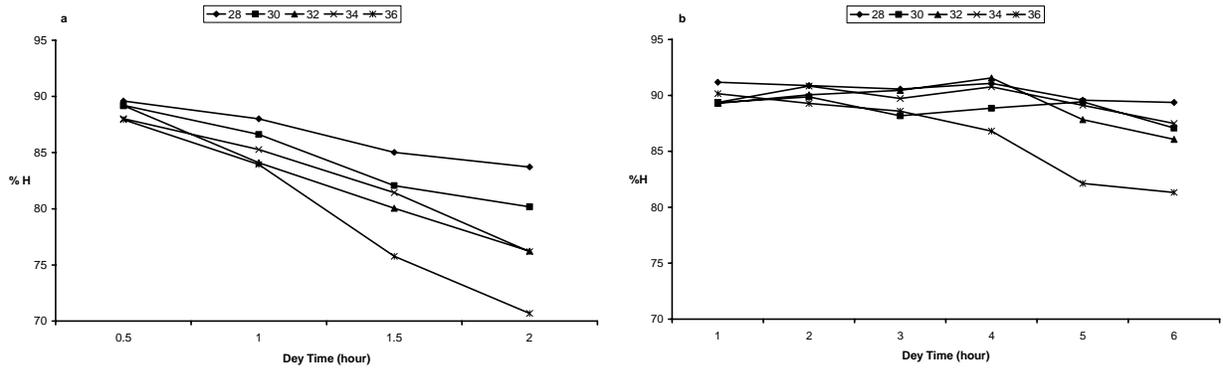


Fig 1. Hatching percentage of *Artemia urmiana* cysts in different drying times and temperatures (a: by Layer Drying method and b: by F.B.D. method)

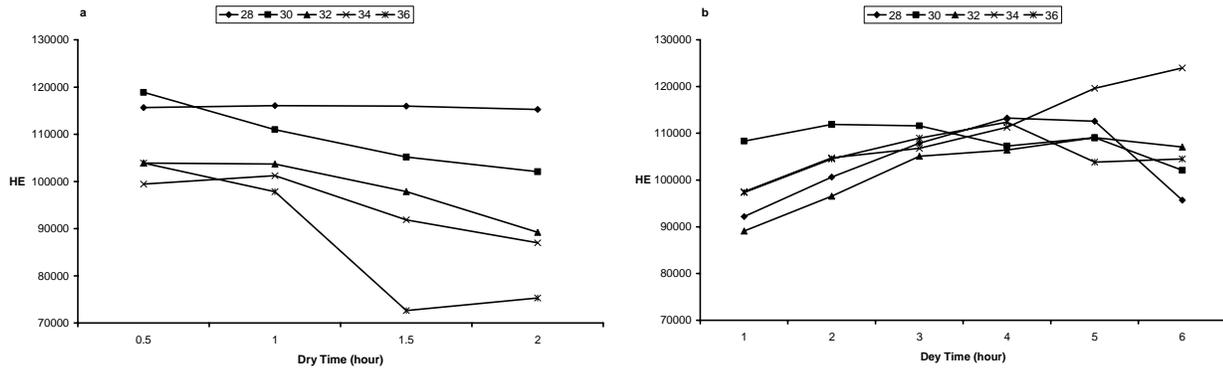


Fig 2. Hatching Efficiency of *Artemia urmiana* cysts in different drying times and temperatures (a: by Layer Drying method and b: by F.B.D. method)

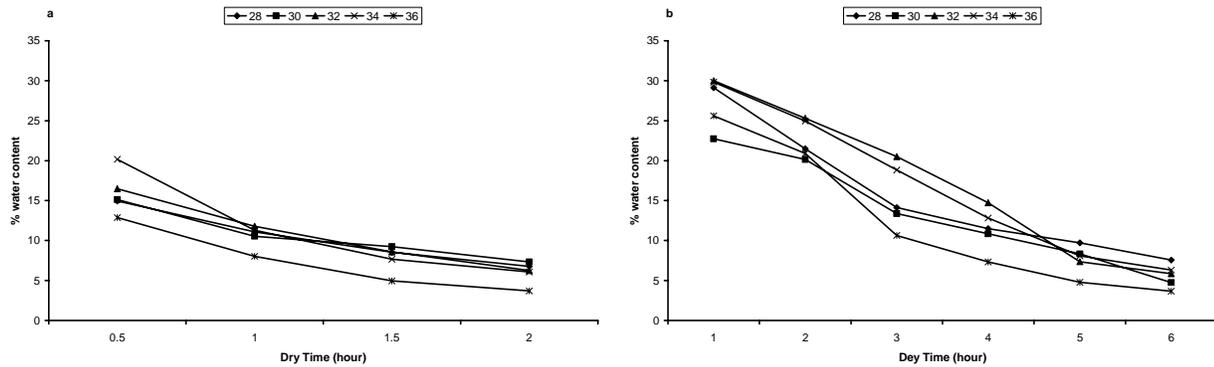


Fig 3. Water Content of dry cysts of *Artemia urmiana* in different drying times and temperatures (a: by Layer Drying method and b: by F.B.D. method)

cysts are the most important factors which have significant effects on the maintenance of the cyst hatchability in a high rate. Furthermore, it has been suggested that long *Artemia* cyst drying times, specially, long storage period may cause considerable decrease in its hatching percentage and efficiency (Godeluck, 1980; Vanhaecke and Sorgeloos, 1982). On the other hand, Miller and McLennan (1988) reported high mortality in the hydrated cysts after they were kept at the temperatures higher than 48 °C. Sorgeloos et al. (1986) recommended 35– 40 °C as a suitable temperature range for drying of *Artemia* cysts. Other studies proposed that the water content of the cysts should be reduced to below 10% for long-term storage purposes (Vanheckle, 1983; Sorgeloos et al., 1986; Lavens and Sorgeloos, 1987). In the study of Sorgeloos et al. (1986) using FBD to process *A. franciscana* cysts at 42 °C for 2.25 hours resulted in the highest cyst quality preservation in long time storage. So, this technique was suggested for the drying of *Artemia* cysts from the Great Salt Lake. However, the use of FBD for *A. urmiana* cysts led to different results, as hatching percentage and efficiency were higher in the cysts processed by LD method.

The best inner temperature and processing time for *A. urmiana* cyst dried by FBD method were 28 °C and 0.5 hour, respectively. In comparison, using 32 – 34 °C for 4 hours were determined as the most suitable condition for processing of the same cysts by LD method. Nevertheless, these results may be attributed to the 15% residual water content of the cysts and/or the different characteristics of *A. urmiana* cyst from those of the other species and strains, especially in terms of corion thickness. In spite of more than 10% water content of the cysts, we observed a considerable hatching percentage and efficiency and long survival time of the *A. urmiana* cysts. However, the temperatures higher than 34 °C and the drying time of 5-6 hours caused significant decreases in the cysts hatching percentage and efficiency.

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