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Chitosan edible coating and vacuum dehydration for preservation of dried *Artemia sp.* Cyst

Minh Phuoc Nguyen

Faculty of Biotechnology, Ho Chi Minh City Open University, Ho Chi Minh City, **Vietnam**

***Correspondence: minh.np@ou.edu.vn** **Received 12-01-2020, Revised: 22-02-2020, Accepted: 24-02-2020 e-Published: 01-03-2020**

Fresh *Artemia* cysts have been considered a good source of proteins, lipids and carbohydrate. However their soft body are highly perishable during post-harvest owing to high water content, proteolytic enzyme. Therefore, appropriate preservation methods are necessary to maintain a good quality of this biomass. Chitosan has been well known with a broad range of applications in the food industry. Vacuum drying is one of the most energy demanding processes. Water evaporation also takes place at lower temperatures under vacuum, and hence the product processing temperature can be significantly lower, offering higher product quality. This study investigated on the possibility of chitosan coating in different concentration (0.5%, 1.0%, 1.5%, 2.0%, 2.5%) and vacuum drying under various pressures (-0.2, -0.4, -0.6, -0.8, -1.0 bar). Our result revealed that 2.0% chitosan coating and -0.8 bar vacuum drying were adequate to maitain the most *eicosa pentaenoic acid* (EPA) content during dehydration of artemia biomass. From this approach, the best valuable component inside the dried artemia cyst would be preserved effectively.

Keywords: ***Artemia, cyst, chitosan, coating, vacuum, drying, eicosa pentaenoic acid***

INTRODUCTION

Artemia spp. are known as brine shrimp which are typical inhabitants of extreme saline biotopes (Camargo et al., 2005). *Artemia* produces cysts that float on the water surface (Hossein Tajik et al., 2008). These cysts are rich of protein, carbohydrate, total lipids, ash, linolenic acid and eicosapentaenoic acid potential use in aquaculture as a suitable live food for postlarval shrimp and fish (Hachem Ben Naceur et al., 2012; Naegel and Rodriguez-Astudillo, 2004; Anh et al., 2009; Peykaran Mana N. et al., 2014). *Artemia* cysts contains a high moisture content with proteolytic enzymes so it's essential to preserve this biomass by appropriate preservation methods (Sorgeloos et al., 2001). The dried *Artemia* cysts could be stored for long shelf-life with various benefits over to fresh or frozen forms (Chua and Chou 2005; Kamalakar et al., 2013; Anh et al., 2014). The level of essential fatty acids such as eicosa pentaenoic acid (EPA) and docosahexaenoic acid (DHA) are a very important factor to determine the dietary value of *Artemia* cysts.

Chitosan is a de-acetylated form of chitin obtained from the crustacean waste (Santosh Kumar et al., 2019). Chitosan has attracted attention for food applications owing to its superior characteristic properties, such as degradability, solubility in weak acids, pH-sensitivity, film-forming property, biodegradability, biocompatibility, non-antigenic, absence of toxicity, and low-cost (Bonilla et al., 2014; Croisier et al., 2013; Kumari et al., 2014; Santosh Kumar et al., 2019). Vacuum drying is more beneficial than hot air drying, because of short drying time, high drying rate and superior quality of dried products (Liliana Seremet et al., 2016). Vacuum drying is an important process for drying highly heat-sensitive materials. The use of vacuum drying lowers the solvent boiling temperature, permitting operation at lower temperatures, directly influencing final product quality (Péré and Rodier, 2002). Vacuum-dried materials are characterized by better quality retention of nutrients and volatile aroma (S. K. Giri et al., 2014). Pupose of our study penetrated on the chitosan coating as pretreatment and vacuum drying to EPA content of the dried artemia cysts.

MATERIALS AND METHODS

2.1 Material

Fresh *Artemia* biomass (cysts) was collected from Bac Lieu province, Vietnam. After collecting, they must be kept in ice chest and quickly transferred to laboratory for experiments. Chemical substances and reagents such as chitosan powder, acetic acid were all analytical grade supplied from Rainbow Trading Co. Ltd., Vietnam.

2.2 Researching procedure

Experiment #1: Fresh *Artemia* cyst was encapsulated in chitosan coating in different concentrations (0.5%, 1.0%, 1.5%, 2.0%, 2.5%) and then dried by vaccum drier at 40ºC under ambient pressure for 4 hours. The dried *Artemia* cyst was then analyzed the eicosa pentaenoic acid (EPA) and docosahexaenoic acid (DHA) content to determine the right edible coating.

Experiment #2: Fresh *Artemia* cyst was encapsulated in 2.0% chitosan coating and then dried by vaccum drier at 40ºC under different pressure (-0.2, -0.4, -0.6, -0.8, -1.0 bar) for 4 hours. The dried *Artemia* cyst was then analyzed the eicosa pentaenoic acid (EPA) and docosahexaenoic acid (DHA) content to determine the right vacuum drying pressure.

2.3 Antioxidant capacity and statistical analysis

Eicosa pentaenoic acid (EPA, mg/g) and docosahexaenoic acid (DHA, mg/g) were determined by high-performance liquid chromatography with electrochemical detection (Kotani A et al., 2016). The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Statgraphics Centurion XVI.

RESULTS AND DISCUSSION

3.1 Effect of chitosan concentration in coating to fatty acids in *artemia* cyst during dehydration

The price of *Artemia* cysts was dependent on nutritional value especially the presence of the eicosa pentaenoic acid (EPA) and docosahexaenoic acid (DHA) content. These contents were significantly affected by the chitosan coating (shown in table 1). Among these treatments, we realized that 2.0% of chitosan was appropriate for preservation of these valuable fatty acids containing in the dried *artemia* cysts during dehydration. In relevent studies, a fluidized bed dryer for dehydration of Artemia cysts at 40ºC was evaluated (T. Bosteels et al., 1996). One study evaluated the effect of different drying techniques at different temperatures on the contents of total lipid and fatty acid profile of *Artemia* biomass. The intermittent microwave combined with convective hot air drying was a promising technique, which could produce high quality dried products in short drying times (Nguyen Thi Ngoc Anh et al., 2015).

3.2 Effect of vacuum drying pressure to fatty acids in *artemia* cyst during dehydration

The DHA level, especially DHA/EPA has an importan role in growth, survival rate and protection against diseases in marine fish and crustacean (Watanabe, 1993; Furuita, 1996; Han et al., 2001). In our research, fatty acid profiles showed a significant difference by vacuum drying pressure (shown in table 2). It's obviously noticed that -0.8 bar was ideal for dehydration of artemia cyst under vacuum.

Table 1: Effect of chitosan concentration in coating to fatty acids in *artemia* cyst during dehydration

Parameter		Chitosan concentration (%)				
	Control	0.5	1.0	1.5	2.0	2.5
EPA (mg/g)	14.25±0.03^{c}	19.78±0.01^{b}	20.37±0.01^{ab}	21.49±0.01^{ab}	22.63±0.00^{a}	22.70±0.02^{a}
DHA (mg/g)	0.37±0.00^{c}	0.65±0.02^{b}	0.78±0.03^{ab}	0.89±0.00^{ab}	0.95±0.03^{a}	0.96±0.01^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

Table 2: Effect of vacuum drying pressure to fatty acids in *artemia* cyst during dehydration

Parameter		Vacuum drying pressure (bar)				
	Control	-0.2	-0.4	-0.6	-0.8	-1.0
EPA (mg/g)	22.63±0.00[c]	22.79±0.03[bc]	22.84±0.02[b]	22.96±0.03[ab]	23.05±0.02[a]	23.06±0.00[a]
DHA (mg/g)	0.95±0.03[c]	1.03±0.01[bc]	1.09±0.03[b]	1.14±0.01[ab]	1.19±0.00[a]	1.20±0.00[a]

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%).

CONCLUSION

The content of highly unsaturated fatty acids like EPA and DHA is a vital parameter that defines the nutritional composition and commercialization of *Artemia* syst for shrimp, marine larvae, fish aquaculture. These fatty acids are highly affected by different variables during processing. We have successfully investigated some major factors influencing to the stability of EPA and DHA content in *artemia* syst throughout the dehydration. In the dried form, shelf-life of artemia syst can be extended for a long period of time.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

This is a single author publication.

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