嘉南藥理科技大學專題研究計畫成果報告

不同豐年蝦品種之脂肪酸種類比較

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計畫主持人：王瑞顯

共同主持人：

計畫參與人員：

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Study of various fatty acid profiles on different *Artemia* species

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中文摘要

豐年蝦(Brine shrimp, *Artemia* sp.)由於它容易取得，孵化簡單、大小適當與營養價值極高，因此至今在水產養殖上仍極廣泛的被使用在孵育魚貝幼苗的最佳生物活餌料。餵食豐年蝦後之幼魚貝苗其存活率皆比餵食人工合成或單一飼料之存活率為最高，此為除了其為活生之餌料外，其優越之營養素成份、比率與種類為主因；其營養素中除了蛋白質與碳水化合物外，尤其多元不飽合脂肪酸之種類為幼魚貝苗賴以合成為本身之脂肪酸及存活之主要營養素來源，又由於豐年蝦之品質與來源之差異，有可能導致餵食後幼魚貝苗其存活率之影響，因此本研究欲探討不同豐年蝦品種之脂肪酸種類比較。分析結果發現從Reference *Artemia* cysts (RAC)之豐年蝦比較其他兩種San Fransico Bay (SFB)與Great Salt Lake (GSL)有極顯著較高之16:1ω7 (13.30%), 18:1 (36.10%) 與20:5ω3 (7.44%)脂肪酸百分比組成，然而San Fransico Bay (SFB) and Great Salt Lake (GSL)之*Artemia*卻比Reference *Artemia* cysts (RAC)有顯著較高之18:3ω3。

關鍵詞: 脂肪酸種類分佈、豐年蝦、比較。

ABSTRACT

Due to the availability, hatchery, size and high nutritional values of brine shrimp, *Artemia* sp., this zooplanktonic specie has been widely used as the best live diets for the rearing of the larval fish in aquatic culture. By feeing with the live *Artemia* nauplii, the survival percentages are normally higher than other feeding with artificial or mono diets. This is mainly due to the significant various nutrient types, profiles and types. Other than proteins and carbohydrates, polyunsaturated fatty acids are the main nutrient sources for providing the main sources in order to keep a good survival of aquatic larvae. Therefore, the quality or geographic origin differences of the *Artemia* nauplii may result a survival effect on the fish larvae. This study is conducted to compare the various fatty acid profiles on three different *Artemia* sp. Results show that relatively high of fatty acids are found in 16:1ω7 (13.30%), 18:1 (36.10%) and 20:5ω3 (7.44%) from Reference *Artemia* cysts (RAC) compared to the other two *Artemia* specie. However, a significant higher of 18:3ω3 are found to be from the *Artemia* of San Fransico Bay (SFB) and Great Salt Lake (GSL).

Keywords: Fatty acid profiles, *Artemia sp.*, comparison.

INTRODUCTION

Live zooplankton, especially live brine shrimp (*Artemia*) nauplii, usually provide the best performing diet for rearing the larval stages of aquatic fish and crustaceans, since it is easily obtained or cultured, has an appropriate size and is nutritionally adequate (Simpson et al., 1983; Leger et al., 1986). Various reports have shown that the *Artemia* are able to tolerate heavy metals, oil and oil dispersant, and this species has been used as an inexpensive system for the study of marine pollution due to its ready availability, low cost, and ease of culture However, various reports has also stated that using *Artemia* nauplii resulted in poor larval rearing, e.g. chlorinated hydrocarbon contamination (Olney, 1980) and lack of essential fatty acids (Schauer et al., 1980; Leger et al., 1985). Several publications, however, report significant variations in nutritional effectiveness *of Artemia* nauplii from different geographical origins. Although various explanations for poor culture success with specific *Artemia* sources have been proposed by different authors to date no conclusive answer has been put forward.

In order to ascertain the relate impact of essential fatty acids (highly unsaturated long-chain fatty acids) a series of chemical analyses and culture tests have been done with these suspected as well as other batches of RAC *Artemia* (Reference *Artemia* cysts), San Francisco Bay *Artemia* and Great Salt Lake *Artemia.*

MATERIALS AND METHODS

Filtered seawater (0.45 μm) of 30‰ salinity was obtained from a local aquaculture farm. One gram of each dry *Artemia* cysts, RAC *Artemia* (Reference *Artemia* cysts), San Francisco Bay (SFB) and Great Salt Lake (GSL) was separately hatched in a separatory glass funnel containing 2 L of filtered seawater (30‰ salinity) under continuous strong aeration at 25 ± 2°C for 24-h with light.

After 24-h of hatching, samples of *Artemia* nauplii were collected under a filter and freeze-dried for further chemical analysis. Freeze-drized nauplii were blended in a Polytron tissue homogenizer with hexane and acetone to obtain the lipid extracts. The crude fat extracts were chosen for saponification with KOH and methylation with methanol for fatty acid analysis. All samples were prepared for gas chromatography. Separation of fatty acid methyl esters was performed on a HP 4890 gas chromatograph. The column was a borosil-icate glass capillary column 60 meters in length, 0.75 millimeters I.D. with a 1.0 micrometer stationary phase of Supelcowax 10 (polypropylene glycol) (Supelco Inc., Bel-lefonte. Pennsylvania USA). Identification of individual fatty acids was accomplished by comparison of retention times to fatty acid methyl esters of known standards purchased from Supelco USA. The recovery after extraction procedures was 85-90%. The detection limit on GC was 1.0 ng/g in this study.

RESULTS AND DISCUSSION

Mean fatty acid content for all three specie of *Artemia* in the present study is shown in Table I. The fatty acid profile of freshly hatched *Artemia* nauplii from Reference *Artemia* Cysts and from the Great Salt Lake and the San Francisco Bay batches are given in Table I. Clear differences can be noticed especially for the fatty acids 18:3ω3 and 20:5ω3.

Three *Artemia* groups of cyst batches can be distinguished:

(1) relatively high in 16:1ω7, 18:1 and 20:5ω3, relatively low in 18:3ω3 and 18:4ω3: RAC;

(2) relatively low in 16:1ω7, and 20:5ω3, GSL;

(3) intermediate values for 18:3ω3 and 20:5ω3: SFB.

The dominant fatty acids for RAC are found in 16:0(12.59%), 16:1ω7(13.30%), 18:1(36.10%). An 18:1 isomer (<10%) was also identified in these samples. The significant difference of the fatty acids is found to be on 20:5ω3, where RAC has a highest percentage of 7.44 compared to the other two specie, SFB(3.44%)and GSL(0.66%). Though, RAC has a lowest of 18:3ω3 (1.7%).

Fatty acid profile in the *Artemia* nauplii is better correlated with the results of the bioassay test: i.e. the relative concentrations of 20:5ω3 is positively correlated, whereas the relative concentrations of 18:2ω6, 18:3ω3, and 18:4ω3 are negatively correlated with mysid biomass production. Indeed, fatty acid profile more than observed chlorinated hydrocarbon contamination, seems to play a determining role in the nutritional effectiveness of *Artemia* nauplii. Since highly unsaturated fatty acids are essential for marine predators, the presence of sufficient amounts of 20:5ω3 must be one of the most important factors in determining the food value of RAC *Artemia*.

Table I. Fatty acid profiles as expressed as mean fatty acid methyl esters of 24-h freshly hatched RAC *Artemia* (Reference *Artemia* cysts), San Francisco Bay (SFB) and Great Salt Lake (GSL) in the present study.

Fatty acid methyl esters	RAC	SFB	GSL
14:0	1.61	0.68	0.53
16:0	12.59	11.42	9.22
16:1ω9	0.28	0.32	0.48
16:1ω7	13.30	5.37	3.64
18:0	4.48	2.84	3.82
18:1	36.10	30.80	29.17
18:2ω6	9.46	8.65	9.45
18:3ω3	1.70	21.78	26.83
20:1	0.37	0.37	-
22:1	0.59	0.77	-
20:5ω3	7.44	3.44	0.66
22:6ω3	0.04	-	-