J. Nat. Aq. Res. Ag. Sri Lan. 32 (1985) 130 - 133

# FATTY ACID COMPOSITION OF *ARTEMIA* FROM SRI LANKA

*by*

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## ABSTRACT

The fatty acid composition in the Sri Lankan strain of *Artemia* was analysed with a view to find out the nutritional value. The importance of 20 : 5 W3 in the diet foı the good growth and survival of consumer organisms is discussed.

## INTRODUCTION

*Artemia* is one of the live feeds used extensively in laboratory and is commercial culture of many crganisms. Kinne (1977) has indicated that more than 85% of the marine animals cultured are being offered *Artemia* as a food source either with other foods or more often as a sole diet. An important determinant of the overall nutritional value of any food source is its fatty acid composition. The fatty acid composition in the diet determines the fatty acid composition of the structural phospholipids which is very important in maintaining proper membrane fluidity and cellular transport mechanisms (Castell *et al.*, 1972 *a* & *b*; Norred and Wade, 1972). Recently it has been demonstrated that W3 polyunsaturated fatty acids (PUFA) are essential for the good growth of lobsters (Castell and Covey, 1976), prawns (Guary *et al.*, 1976 and Kanazawa *et al.*, 1979) and for several marine fish including plaice (Owen *et al.*, 1972) red sea bream (Yone and Fujii, 1975 *a*) and turbot (Cowey *et al.*, 1976).

The purpose of the study was to determine the fatty acid compostion in the Sri Lankan strain of *Artemia* especially 16 : 0; 16 : 1, 18 : 3 W 3 and 25: 5 W 3 which are very essential for marine fish and crustacean larvae.

## MATERIAL AND METHODS

Freshly collected cysts from Palavi Salterns (Puttalam Dist; Sri Lanka) were hatched and the nauplii were used for estimation. For lipid extraction and analysis, the hatched out nauplii weıe dried at 60°C for 48 h, ground in a mortar and pestle and the lipid was extracted with chloroform methanol mixture (Bligh and Dyer 1959). Saponfication and methylatic were carried out using sodium methoxide/methanol followed by separation of fatty acid methly esters (FAME) by gas chromatography on 10% SP 2340. The results are presented as g/100g of total acids, represent average of two estimations.

## RESULTS AND DISCUSSION

The fatty acid composition of the Sri Lankan strain of *Artemia* is given in Table 1 together with reported values of other geographical strains for the purpose of comparison. The major fatty acids in most of the *Artemia* strains are 16 : 0, 16 : 1 and 18 : 1 W9. In addition substantial levels of 18: 3 W3 and 20 : 5 W3 are also found. *Artemia* strains are divided into two groups based on their most predominant long chain W3 PUFA (Schaver *et al.*, 1980). The first group which contains mostly 18 : 3 W3 and 18 : 4 W3 are SF 313, SP 1628 and Utah strains, while the groups contain 20 : 5 W3 are SF 321, Italian and Brazilian strains. The Sri Lankan strain which has the highest value of 20 : 5 W3 (18.7%) is included in the second group.

**TABLE 1.**

**FATTY ACID COMPOSITION OF NEWLY HATCHED ARTEMIA OF DIFFERENT STRAINS**

| *Fame* | *Australia* | *Brazil* | *SF 313* | *SF 321* | *SP 1628* | *Italy* | *Utah* | *Sri Lanka* |
|---|---|---|---|---|---|---|---|---|
| 14.0 | 1.34 | 1.57 | 0.99 | 1.57 | 0.43 | 1.53 | 0.93 | 1.9 |
| 14:1 | 2.23 | 0.81 | 1.27 | 0.74 | 2.26 | 3.30 | 1.45 | 1.1 |
| 15:0 | 0.34 | 0.67 | 0.16 | 0.58 | 0.11 | 0.25 | 0.11 | — |
| 15:1 | 0.15 | 0.24 | 0.29 | 0.13 | 0.46 | 0.54 | 0.37 | — |
| 16:0 | 13.45 | 15.42 | 10.33 | 12.13 | 7.79 | 15.23 | 11.78 | 12.5 |
| 16:1 | 9.97 | 10.79 | 13.27 | 19.52 | 5.24 | 10.38 | 5.64 | 15.0 |
| 16:2 W7 | — | — | — | — | 1.51 | 2.94 | — | — |
| 16:3 W4/17:1 W8 | 3.87 | 3.88 | 2.09 | 2.32 | 2.44 | 3.38 | 2.90 | 3.7 |
| 18:0 | 3.07 | 2.79 | 6.83 | 2.90 | 3.08 | 3.17 | 4.07 | 4.5 |
| 18:1 W9 | 28.23 | 35.86 | 26.79 | 31.20 | 29.15 | 19.05 | 28.58 | 25.3 |
| 18:2 W6 | 5.78 | 9.59 | 9.35 | 3.69 | 4.60 | 6.79 | 4.6 | 7.1 |
| 18:3 W3 | 14.77 | 4.87 | 17.33 | 5.16 | 33.59 | 6.35 | 31.46 | 5.1 |
| 18:4 W3 | 4.37 | 0.96 | 3.26 | 1.28 | 4.88 | 1.01 | 3.1 | 0.6 |
| 20:1 W9 | 0.37 | 0.52 | 0.41 | 0.35 | 0.35 | 0.42 | 0.37 | trace |
| 20:2 W6/W9 | 0.12 | 0.06 | 0.06 | — | 0.24 | 0.20 | 0.09 | trace |
| 20:3 W6 | 0.79 | 2.76 | 1.01 | 2.23 | 0.05 | 1.47 | 0.48 | trace |
| 20:3 W3/20:4 W6 | — | — | — | 1.46 | 2.69 | 1.48 | — | 4.5 |
| 20:5 W3 | 10.50 | 8.98 | 4.06 | 12.44 | 1.68 | 13.63 | 3.55 | 18.7 |
| 22:6 W3 | 0.26 | 0.06 | — | — | — | — | — | — |

Studies on the essential fatty acids (EFA) in fish have shown that EFA requirements differ from species to species. Rainbow trout requires fatty acids of W3 whereas Carp, eel and salmon require W6, in addition to W3 for good growth (Castell *et al.*, 1972 and Watnabe *et al.*, 1974, 1975 *a* & *b*).

Detailed investigations carried out on the nutritional quality of *Artemia* of different geographical strains on various species of marine larvae, mud crab (*Rhithropanopeus, harrisii)* and the rock crab (*Cancer irroratus*) showed marked differences in their growth and survival rates (Johns *et al.*, 1978 & 80; Beck *et al.*, 1980). These larvae could not complete their larval development when fed SP 1628 or the Utah (USA) strain, but successfully completed the development with Brazilian, Italian or Australian strains. Similar results were obtained by Klein — MacPhee *et al* (1980) with winter flounder *Pseudopleuronectes americanus.* Both SP 1628 and Utah strains were found to be deficient in 20 : 5 W3. Nauplii, low in 20 : 5 W3 gave low production values for the juveniles of *Mysidopsis* (Johns *et al.*, 1981; Leger *et al* — in press and Jan Vos *et al.*, 1984)

Thus to meet the EFA requirements of marine fish and other organisms, highly unsaturated fatty acids (HUFA) such as 20 : 5 W3 and 22 : 6 W3 are very essential (Yone 1978 : Yone and Fujii, 1975 *a*, Watanabe *et al.*, 1983). Hence *Artemia* strains which have higher 20 : 5 W3 are considered better diets for marine organisms.

Strains with low levels of 20 : 5 W3 may probably bring about a nutritional stress in the consumer organisms. The low values of 20 : 5 W3 could be increased to the required level by feeding the *Artemia* strain with marine *Chlorella* which is rich in long chained polyunsaturated fatty acid which is 20 : 5 W3 (eicosapentaenoic acid).

Thus the Sri Lankan strain of *Artemia* which shows a higher value of 20:5 W3 could be placed in par with the strains of San Francisco, Italy, Brazil and Australia.

## ACKNOWLEDGEMENTS

The authors thank Dr. Hiran W. Jayewardene, Chairman, and Dr. Onil Perera, Director General, NARA, for their keen interest and for all the facilities provided to carry out this work. We are also thankful to CISIR for the analysis of the sample. Thanks are due to Prof. S. S. De Silva for reading the draft.

## REFERENCES

BECK, A. D., D. A., BENGSTON and W. H. HOWELL, 1980.
International study on *Artemia*. V. Nutritional value of five geographical strains of *Artemia*; effects on survival and growth of larval Atlantic Silverside *Menidia menidia*. p. 249 - 259 *In : The Brine shrimp Artemia Vol.* 3. *Ecology, Culturing, Use in Aquaculture*. Persoone G., P. Sorgeloos, O. Roels, and E. Jaspers (Eds). Universa Press, Wetteren, Belgium, 456 p.

BLIGH, E. G., and W. J. DYER, 1959.
*Canadian Journal of Biochemistry and Physiology*, **37** : 911.

CASTELL, J. D., R. O. SINNHUBER, D. J. LEE and J. H. WALES. 1972
Essential fatty acids in the diet of rainbow trout (*Salmo gairdneri*): growth, feed conversion and some gross deficiency symptoms *J. Nutr*, 102 : 77 - 86.

CASTELL, J. D., D. J. LEE and R. O. SINNHUBER. 1972 1.
Essential fatty acids in the diet of rainbow trout (*Salmo gaidneri*) : lipid metabolism and fatty acid composition. *J. Nutr.*, 102: 93-99.

COWEY, C. B., J. M. OWEN, J. W. ADRON and C. MIDDLETON. 1976.
Studies on the nutrition of marine flatfish. The effect of different dietary fatty acids on the growth, and fatty acid composition of turbot (*Scophthalmus maximus*). *Br. J. Nutr.*, **36** : 479 - 486.

GALLAGHER, M. K. and W. D. BROWN. 1975.
Composition of San Francisco Bay brine shrimp (*Artemia salina*). *J. Agric Food Chem.*, **23** : 603 - 632.

GUARY, J. C., M. KAYAMA., Y. MURAKAMI and H. J. CECCALDI. 1976.
The effect of fat — free and compounded diets supplemented with various oils on moult, growth and fatty acid composition of prawn, *Penaeus japonicus* Bate. *Aquaculture*. **7** : 245 - 254.

JOHNS D. M., M. E. PETERS and A. D. BECK. 1978.
International study on *Artemia*. I. An evaluation of five geographical strains of brine shrimps, *Artemia salina*, as food for larval, mud crabs *Rhithropanopeus harrisii*. *Amer Zool.*, **18** : 585 (Abstract).

JOHNS, D. M., M. E. PETERS and A. D. BECK 1980.

International Study on *Artemia*. VI. Nutritional value of geographical and temporal strains of *Artemia* : effects on survival and growth of two species of brachyuran larvae. p. 291 - 304. *In : The Brine shrimp Artemia. vol.* 3. *Ecology, Culturing use in Aquaculture*. Persoone G., P. Sorgeloos, O. Roels and E. Jaspers (Eds.) Universa Press, Wetteren, Belgium, 456 p.

JOHNS, D. M., W. J. BERNY and S. McLEAN. 1981.

International study on Artemia XXI. Investigations into why some strains of Artemia are better food sources than others. Further nutritional work with larvae of the mud crab, *Rhithropanopeus* harrissii. *J. World Maricul. Soc.*, **12** (1) : 303 - 304.

KINNE. O. 1977.

*Marine Ecology*. Vol. III *Cultivation Part* 2. John Wiley and Sons, New York, USA. 1293 p.

LEGER, PH., K. L. SIMPSON, P. VANHAECKE and P. SORGELOOS. 1984.

Factors determining the nutritional effectiveness of *Artemia* : The relative impact of chlorinated hydrocarbons and essential fatty acids in San Francisco Bay *Artemia* (in press).

SCHAUER, P. S., D. M. JOHNS, C. E. OLNEY and K. L. SIMPSON, 1980.

International study on *Artemia* IX. Lipid level, energy content and fatty acid composition of the cysts and newly hatched nauplii from five geographical strains of *Artemia* 365 - 373. In : The brine shrimp *Artemia* vol. 3. Ecology, Culturing, Use in Aquaculture. Persoonse G., P. Sorgeloos, O. Roels and E. Jaspers (Eds). Universa Press : 6 : Wetteren, Belgium. A 56 pp.

TAKEUCHI, T. and T. WATANABE. 1977.

Requirement of carp for essential fatty acids. *Bull. Jpn. Soc. Sci. Fish.* **43** : 541 - 551 (in Japanese)

VOS, J., PH LEGER, P. VANHAECKE and P. SORGELOOS. 1984.

Quality evaluation of brine shrimp *Artemia* cysts produced in Asian saltponds. *Hydrobiologia*. **108** : 17 - 23.

WATANABE, T. and R. G. ACKMAN. 1974.

Lipids and fatty acids of the American (*Crassostrea virginica*) and European flat oysters (*Ostrea edulis*) from a common habitat and after one feeding with *Dicrateria inornata* or *Isochrysis galbanae*. *J. Fish Res. Board Can.*, **31** : 403 - 409.

WATANABE, T., O. UTSUE, I. KOBAYASHI and C. OGINO. 1975.

Effect of dietary methyl linoleate and linolenate on growth of carp. I. *Bull. Jap. Soc, Sci. Fish*, **41** : 257 - 262.

WATANABE T., T. ARAKAWA, C. KITAJIMA and S. FUJITA. 1978.

Nutritional evaluation of proteins of living feeds used in seed production of fish. *Bull. Jap. Soc. Sci. Fish*. **44** : 985 - 988.

WATANABE, T., T. ARAKAWA, C. KITAJIMA, K. FUKUSHAO and S. FUJITA. 1978.

Nutritional quality of living feed from the view point of essential fatty acids for fish. *Bull Jap. Soc. Sci. Fish.*, **44** : 1223 - 1227.

WATANABE, T., C. KITAJIMA and S. FUJITA. 1983.

Nutritional values of live organisms used in Japan for mass propagation of fish. A review *Aquaculture*, **34** : 115 - 143.

YONE, Y. 1978.

Essential fatty acids and lipid requirement of marine fish. *In : Jpn. Soc. Sci. Fish* (Editor). Dietary Lipids in Aquaculture. Koseisha - Koseikaku, Tokyo, pp. 3 - 59.