LARVI '09 – FISH & SHELLFISH LARVICULTURE SYMPOSIUM
C.I. Hendry, G. Van Stappen, M. Wille and P. Sorgeloos (Eds)
European Aquaculture Society, Special Publication No. 38, Oostende, Belgium, 2009

ADVANCES IN REARING TECHNIQUES AND ANALYSIS OF NUTRITIONAL QUALITY OF TWO MYSIDS SPECIES PRESENT IN GRAN CANARIA

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Introduction

Studies on the relationship between mysids and fish indicate that mysids are one of the most important foods for fish, especially in coastal environments, where they are abundant (Murano, 1999). In aquaculture mysids have to be a very good quality food for the juvenile stages of cuttlefish *Sepia officinalis* (Domínguez et al., 2001), and adult seahorse *Hippocampus hippocampus* (Otero et al., 2007). Traditionally two types of live food are used in culture of fish larvae: *Artemia* and rotifers, and this reduction in the range of food available can lead to nutritional imbalances (Izquierdo, 1996). The aim of this paper is to study the survival and production of *Leptomysis lingvura* and *Paramysis nouveli* under the conditions of our facilities, to determine the nutritional quality of these species, and to determine if they could be reared as live prey in our aquaculture program. As a first step in our research, we present their lipid and protein composition.

Materials and methods

In the area of Risco Verde, Gran Canaria (Spain) samples of both species were captured at depths between 5 and 15m with a 500-µm hand net**.** After an acclimation period of 2 days, 10 males and 10 females of each species were then placed in small 1-l farrowing containers that were placed in larger 14-l tanks with filtered seawater at a salinity of 37‰. The seawater, common to the farrowing containers and the 14-l tanks, was maintained at 18.2±0.4ºC, renewed ever 12 hours, and monitored for pH, oxygen, ammonium, nitrate, and nitrite. pH was maintained at 8.2± 0.1, O_2 at 7.1±0.1mg.l^{-1}, and NH_4^+, NO_3^-, and NO_2^- at concentrations below 0.2, 0.02, and 1mg.l^{-1}, respectively. The photoperiod was 14h:10h light and dark. Mysids were fed twice daily using 100 enriched (Easy –DHA, INVE, Belgium) *Artemia* (EG type, INVE aquaculture, Dendermonde, Belgium) nauplii per mysid.

Adults and young were counted daily. The survival rate was expressed as a percentage. Every day the count was made of the offspring and production was estimated by dividing the number of hatchlings per day by the number of females alive. Production rates were expressed as young.female^{-1}. The experiments were carried out in three replicates. Mann-Whitney non-parametric test with significance $P<0.05$ was used to determine statistical differences in the survival and production of each species. The results were processed using a SPSS Statistical Software System version 14.0 (SPSS Chicago, Illinois,1999).

Samples for lipid and protein analysis were collected in Risco Verde between March and April 2009. The mysids captured were separated by species and after an acclimatization period of 2 days were maintained in three tanks. The culture conditions were identical to those used in the survival and production experiments. Proteins are calculated from total nitrogen in the samples as determined by Kjeldhal technique (AOAC, 1995). Crude lipids (% wet weight) were extracted following the method of Folch et al. (1957). Fatty acid methyl esters from total lipids were prepared by transmethylation as described by Christie (1982), separated and quantified by Gas-Liquid chromatography. Proteins, lipids, ash and moisture were expressed as percentage of dry weight. Fatty acids are expressed as percentage of total them.

Results

At the end of experiment the average survival for *L. lingvura* was 65±8.7% and for *P. nouveli* 16.7±5.8% and the total hatchling production was 166±2 and 45±7 respectively. The relative production (young.female^{-1}) and survival was significantly higher ($P<0.05$) in *L. linguvura* that *P. nouveli*, from day 9. Not hatchlings of *P. nouveli* were found from day 12 of the experiment.

Lipid and protein analysis was the first step in determining the nutritional quality of these mysids. The proteins and lipids as a % of dry weight, for *P. nouveli* were 73.38±1.77% and 15.01±1.12% and for *L. lingvura,* 74.19±5.22% and 14.79±2.66% (Table I). The most abundant fatty acids in both species were oleic acid 18:1n-9, 16:00, eicosapentaenoic acid (EPA) 20:5n-3, docosahexaenoic acid (DHA) 22:6n-3, α-linoleic acid (ALA)18:3n-3, and linolenic acid (LA) 18:2n-6 (Table I). The omega-3 (n-3) and the omega-6 (n-6) polyunsaturated fatty acids (PUFA), in *P. nouveli* and *L. lingvura* accounted for 39.44±0,94% and 8.43±0,42%, and 42.4±0,8% and 8.4±0,15% of the total lipids, respectively (Table I). The ratio DHA:EPA was 0.85 and 0.89, DHA: arachidonic acid (AA) 6.26 and 4.74, and EPA:AA 7.32 and 5.32, respectively (Table I). The PUFA, DHA, EPA and AA are required for normal growth and development of fish, they satisfy a fundamental role in the structure and function of integral cell-membrane and as precursors of a group of highly active hormones known as eicosanoids (Izquierdo, 1996; Sargent, 1999; Roo et al., 2008). The EPA:AA ratio is also important in the formation of these hormones (Sargent et al., 1999). Both mysids have a high DHA content. However, current evidence suggests that not only the content of DHA and the n-3 highly unsaturated fatty acids (HUFA) are important for normal growth and development of the larvae, but also that a balanced dietary ratio of DHA:EPA:AA it necessary (Izquierdo, 1996; Sargent et al., 1999). The composition of DHA, EPA and AA in our mysids is higher than that reported by Roo et al. (2009) for rotifers and *Artemia* enriched with Selco® (INVE, Belgium) (Table I).

Table I. Lipids, proteins and ash composition (% dry weight) and fatty acids (% total fatty acids) of *Paramysis nouveli*, *Leptomysis lingvura*, and two live prey used frequently in aquaculture (rotifers and *Artemia*) reported by Roo et al. (2009). Values (mean±SD).

		Paramysis nouveli	***Leptomysis lingvura***	**Rotifers enriched with Selco®**	***Artemia* enriched with Selco®**
% Lipids (dw)		15.01±1.12	14.79±2.66	22.05±3.84	26.04±0.41
% Proteins (dw)		73.38±1.77	74.19±5.22	54.28±4.57	56.39±4.84
% Ash (dw)		2.99±0.07	3.63±0.21	1.48±0.5	0.75±0.02
16:00	Palmitic acid	16.94±0.62	15.48±0.23	13.00±2.48	15.22±3.8
18:00	Stearic acid	4.01±0.1	3.64±0.04	4.73±1.21	4.42±0.37
18:1n9	Oleic acid	19.11±0.39	17.9±0.23	20.1±1.72	20.36±7.38
18:2n6	Linolenic acid	4.79±0.24	4.76±0.02	8.14±1.31	3.78±2.61
18:3n3	α linoleic acid	8.22±0.19	14.18±0.26	1.62±0.11	10.81±4.23
20:5n3 EPA	Eicosapentaenoic acid	14.78±0.2	12.45±0.15	6.51±0.62	11.10±4.27
22:6n3 DHA	Docosahexaenoic acid	12.63±0.37	11.10±0.2	9.68±0.93	4.47±1.43
20:4n6 AA	Arachidonic acid	2.02±0.06	2.34±0.09	1.46±0.73	1.49±0.37
∑PUFA n-3		39.44±0.94	42.40±0.8	21.12±0.48	31.14±11.43
∑PUFA n-6		8.43±0.42	8.40±0.15	10.77±2.11	7.03±3.73
DHA/EPA		0.85	0.89	1.49±0.01	0.4±0.34
DHA/AA		6.26	4.74	8.10±4.45	2.99±3.87
EPA/AA		7.32	5.32	5.45±2.99	7.43±11.53

Conclusions

The study of lipid and protein composition reveals that both species have a high potential as live food in aquaculture. The levels of lipids, proteins, and fatty acids in *P. nouveli* and *L. lingvura* meet the food requirements for fish and crustacean farming according to FAO recommendations (Tacon, 1989). Furthermore the composition in DHA, EPA, and AA is higher than that present in rotifers and *Artemia,* organisms commonly used as live prey in aquaculture.

According to the preliminary results of our survival and production experiments, *Leptomysis lingvura* appears to be the most suitable, of the two mysid species, for cultivation under the conditions given.

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