Effect of binder type and binder addition to artificial diets used for the growth of *Palaemonetes varians* and *Palaemon elegans* (Crustacea: Palaemonidae) produced as aquaculture live preys

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Introduction

Shrimp are slow and continuous eaters, which require water-stable diets. Several binders (natural, synthetic or their combination) have been used in crustacean diets (Cuzon et al., 1994). Most of these studies, however, were concerned with the diet stability rather than with the shrimp growth.

In this study, we tested the effect of two different binders (lignosol and agar) and their addition (through microbinding and microcoating) in artificial diets used for the growth of the species *Palaemonetes varians* and *Palaemon elegans* (Crustacea: Palaemonidae) produced as aquaculture live preys.

Table 1
Feed ingredients used in diet and proximate analysis (dry weight basis)

Ingredient (%)	Dry weight
Herring meal	37
Soybean meal, 55%CP	8
Wheat Gluten	8
CaHPO4	1
Vitamin premix	2
Mineral premix	2
Fish oil	1
Soya lecithin	3
Cholesterol	1
Binder	2
Wheat flour	35.5
Proximate analysis	
Dry Matter (%)	91.6
Crude Protein (%)	42.2
Lipid (%)	9.1
Ash (%)	7.7
Phosphorus (%)	0.89
Gross Energy (kJ g^{-1})	18.7

Material and methods

Specimens were collected from the wild (Ria Formosa lagoon, South coast of Portugal) one week before the start of the experiments for the adaptation to captivity.

Animals were graded individually and weighted to increase the initial sample homogeneity. Initial weights varied between 0.10 g and 0.15 g with an average weight of 0.12±0.02 g for both species.

Indoor plastic rectangular tanks (38cm x 28.5 cm).
Water depth: 12 cm
Tank volume: 10 litter capacity
Water cycling: constant (10lh^{-1}) with moderate aeration
Nine tanks (3x3) were used for each species; 50 shrimps in each tank (450 shrimps in total)
Temperature: 19.9°±0.09°C; salinity: 37.6‰; photoperiod: 12L:12D
Physicochemical water characteristics and experimental conditions: exactly the same for both species.
Food supply: once a day, ≈10% of the shrimp's body weight updated throughout the experiment to maintain this percentage.
One diet (Table 1) was prepared, varying solely the binder type and its addition.
Diet A: Lignosol added through microbinding
Diet B: Agar added through microbinding
Diet C: Llignosol added through microcoating

Experiment: 45 days period

Sampling: Shrimps were counted and individually weighted every 7 days
Data was used to calculate: Specific growth rate (SGR)=$\log eWf - \log eWi)/\Delta T \times 100$
Conversion index (CI)=Cf/Wg,
where, Wi is the initial mean body weight, Wf is the final mean body weight, Dt is the duration (in days) between sampling, Cf is the food consumed during the experiment and Wg is the weight increase ($Wf - Wi$).
One-way ANOVAs were used to test the differences between the replicates , two-way ANOVAs were used to evaluate differences among diets and between samplings. When occurred, significant relationships were tested using the Tukey HSD test at $p<0.05$ level.

Results

SGR (Figure 1a, b)
P. varians: (Diet A: 0.32-1.26; Diet B: 0.18-1.16; Diet C: 0.2-0.81)
P. elegans: (Diet A: 0.91-2.02; Diet B: 0-2.13; Diet C: 0.28-1.54)

CI (Figure 1c, d)
P. varians: (Diet A: 4.18-22.19; Diet B: 5.48-20.54; Diet C: 0-20.54)
P. elegans: (Diet A: 2.26-4.58; Diet B: 2.03-6.09; Diet C: 2.81-8.18)

Growth (Figure 2a, b)
P. varians: From an initial weight of 0.12±0.02, specimens grew to 0.18±0.05 with Diet A, 0.18±0.03 with Diet B and 0.16±0.03 with Diet C
No significant differences were found between Diets A and B ($p>0.106$)
Significant differences were found between Diets A and C, and B and C ($p<0.001$)

P. elegans: From an initial weight of 0.12±0.02, specimens grew to 0.23±0.05 with Diet A, 0.22±0.06 with Diet B and 0.21±0.06 with Diet C
No significant differences were found between Diets B and C ($p>0.427$)
Significant differences were found between Diets A and B, and A and C ($p<0.001$)

No significant differences were found between the beggining of the experiment and the first sampling in both species (P. varians, $p>0.567$, P. elegans, $p>0.691$), but from there on significant differences were always recorded between the samplings ($p<0.001$).

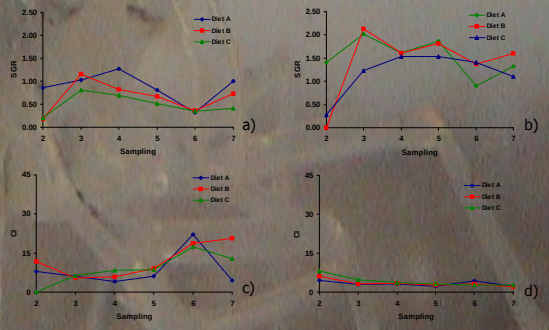

Figure 1- Specific growth rate (SGR) and Conversion index (CI) attained by *P. varians*, a) and c) and *P. elegans*, b) and d).

Discussion

Growth rates

The SGR and CI were significantly better for *P. elegans* than for *P. varians*. Likewise, *P. elegans* showed better growth rates than *P. varians*, which suggests a higher suitability of this species to be produced in aquaculture.

Binder type

Results were quite different between species; for *P. varians* no significant differences were found between binders, with both binders (Diets A and B) providing similar growth rates. On the other hand, the microcoated diet (Diet C) provided the worst results. This seams to enphasize the fact that, when growing this species, the binder addition become more important than the binder itself.

For *P. elegans*, the opposite was verified, since no significant differences were found between diets were the binder addition was different (Diets A and C), but significant differences were found between diets with different binders (Diets A and B). This fact seams to be explained by the feeding ecology of *P. elegans* which is endorsed by a predactory activity, whereas *P. varians* is considered a detritivorous species.

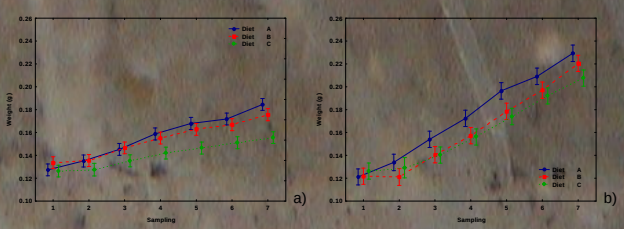

Figure 2 – Growth curves obtained for *P. varians* and *P. elegans* with three studied diets. *P. varians*, $F(12, 3129)=6.794$ $p<0.001$; *P. elegans*, $F(12, 3129)=6.173$ $p<0.001$. Vertical bars denote 0.95 confidence levels.

References

Cuzon, G., Guillaume, J., & Cahu, C., 1994. *Aquaculture.*, 124: 253-267.