PRELIMINARY RESULTS
DIETARY EVALUATION OF SINGLE CELL PROTEIN (SCP), INCLUSION IN COMPOUND DIETS FOR WHITELEG SHRIMP.

1. Objectives

Determine the optimal level of fishmeal replacement in compound diets for whiteleg shrimp (*Pennaus vannamei*) by means of using a single cell protein source (Uniprotein®) produced by Unibio within the VALUEWASTE EU project.

2. Materials and methods

2.1 Diets

Five isoproteic (36% crude protein) and isolipidic (8% crude fat) experimental extruded diets were manufactured by Sparos Lda. (Portugal).

A basal diet (control, D1) was formulated based on fish commercial compound feed for whiteleg shrimp, whereas four additional diets (D2-D5) were formulated by the progressive substitution of fishmeal (FM) by single cell protein (SCP) Uniprotein® (Unibio, Denmark) at 25, 50, 75 and 100% FM replacement levels.

Table 1. Formulation and proximate composition of diets (D1-D5).

	D1	D2	D3	D4	D5
Ingredients, %					
Fishmeal Super Prime	16.0	12.0	8.0	4.0	0.0
Squid liver meal	2.0	2.0	2.0	2.0	2.0
Poultry meal	5.0	5.0	5.0	5.0	5.0
Uniprotein	0.0	4.0	8.0	12.0	16.0
Wheat gluten	2.1	2.3	2.4	2.5	2.5
Soybean meal	28.0	28.0	28.0	28.0	28.0
Wheat meal	26.43	26.23	26.03	25.83	25.73
Wheat bran	10.0	10.0	10.0	10.0	10.0
Vitamin and mineral premix	1.0	1.0	1.0	1.0	1.0
Antioxidant	0.2	0.2	0.2	0.2	0.2
Monocalcium phosphate	1.8	1.8	1.8	1.8	1.8
Calcium carbonate	1.1	1.1	1.1	1.1	1.1
Binder (guar gum)	1.0	1.0	1.0	1.0	1.0
L-lysine HCL 99%	0.5	0.5	0.5	0.5	0.5
DL-methionine	0.15	0.15	0.15	0.15	0.15
Yttrium oxide	0.02	0.02	0.02	0.02	0.02
Soy lecithin	1.0	1.0	1.0	1.0	1.0
Fish oil	1.0	1.0	1.0	1.0	1.0
Soybean meal	2.7	2.7	2.7	2.7	2.7
Proximate composition, %					
Crude protein, % feed	36.0	36.0	36.0	36.0	36.0
Crude fat, % feed	8.0	8.0	8.0	8.0	8.0
Fiber, % feed	3.0	3.0	3.0	3.0	3.0
Starch, % feed	22.7	22.5	22.4	22.3	22.2

2.2 Experimental design

The trial was divided in two different stages, a nutritional trial that lasted 139 days to evaluate the effect of dietary treatments on key performance indicators associated to growth and feed performance, followed by a challenge with a pathogenic bacterium (*Vibrio harveyi*) to evaluate the immunological competence of shrimp fed the experimental diets (12 days).

To minimize shrimp handling and stress, animals were only measured at the end of the nutritional trial, when all whiteleg shrimp were individually weighted from each tank. Shrimp body weight (BW) was measured to the nearest 0.1 g.

The following formular was used for calculating growth:

- Specific growth rate in body weight, BW (SGR, % BW/day) = 100 x ((ln BWf – ln BWi) / days)

Whiteleg shrimp survival was computed as the differences between the initial number of stocked specimens and the number of shrimps counted and weighted at the end of the trial.

2.3 Bacterial challenge

To test whether different levels of fishmeal replacement by the tested SCP compromised the immune response of whiteleg shrimps, once concluded the nutritional trial, shrimp were exposed to a bacterial challenge with *Vibrio harveyi* (courtesy of CIAD, Mazatlán Unit, Mexico). *V. harveyi* is the causative agent of the 'Bright-red' syndrome as described as Soto-Rodriguez et al. (2010; Dis. Aquat. Org. 92: 11–19). Before conducting such bacterial challenge, the lethal dose 60 (DL60) was established for this strain and whiteleg shrimps from the control group (D1).

2.4 Statistical analyses

All results are expressed as mean ± standard deviation (SD). All data were checked for normality and homoscedasticity prior their analysis. Differences between groups (D1-D5) will be evaluated by means of a one-way ANOVA. When differences were found among groups ($P < 0.05$), the ANOVA was followed by the post-hoc Tukey test. All statistical analyses were performed using Graph Pad Prism V.6.1. (GraphPad Software, San Diego, USA).

3. Results

3.1 Survival, growth, and feed performance indicators

Preliminary results are presented below. Table 2 displays survival, final wet body weight and standard growth rate throughout the trial period in the 5 dietary treatment groups. Figure 1 shows how the accumulative mortality is affected by increased levels of Uniprotein® as a replacement for fishmeal.

Table 2. Survival, final wet body weight (BW), and standard growth rate shrimp allocated to diet 1 to 5.

	D1	D2	D3	D4	D5
Survival (%)	37.7 ± 2.9^{b}	44.3 ± 6.8^{b}	44.3 ± 4.0^{b}	51.7 ± 11.0^{ab}	65.3 ± 2.5^{a}
Wet body weight (g)	16.0 ± 0.34^{a}	15.0 ± 0.61^{a}	14.8 ± 1.23^{a}	13.1 ± 0.72^{ab}	11.5 ± 0.72^{b}
SGR (%BW/d)	4.89 ± 0.02^{a}	4.8 ± 0.03^{ab}	4.77 ± 0.1^{ab}	4.65 ± 0.05^{bc}	4.63 ± 0.03^{c}

$^{a, b, c}$ Values within a row are different if superscript differs ($P < 0.05$)

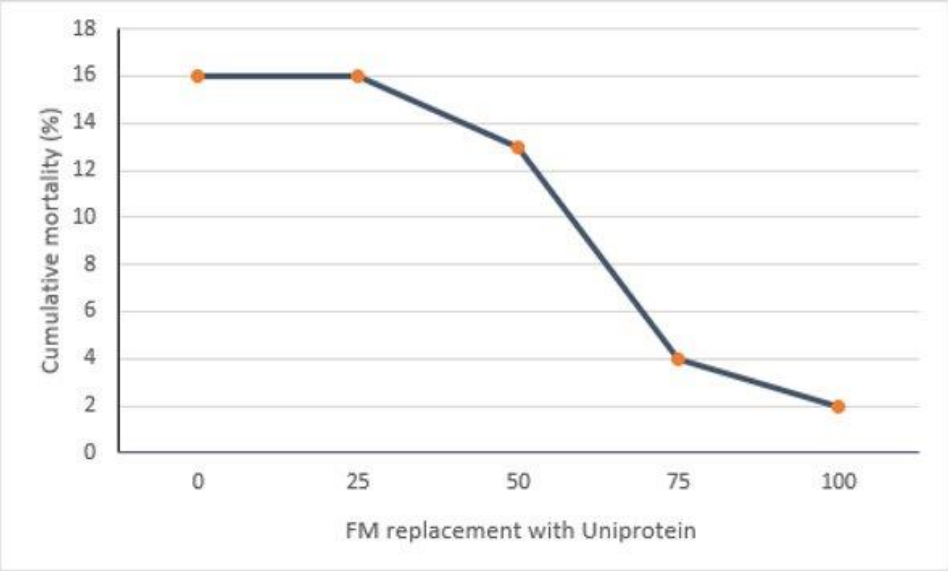

Figure 1. Cumulative mortality rate at increasing levels of Uniprotein® as a replacement for fishmeal in diets for Whiteleg Shrimp.

4. Conclusions

This study showed that the replacement of fishmeal in diets for whiteleg shrimp (*P. vannamei*) by single cell protein (Uniprotein®, Unibio) is a feasible and sound nutritional strategy in feed formulation, since it did not compromise shrimp performance in terms of growth, survival, and apparent feed conversion ratio (data not shown).