EFFECTS OF PROBIOTIC *PEDIOCOCCUS ACIDILACTICI* ON GROWTH AND NUTRITIONAL STATUS IN SHRIMP *LITOPENAEUS STYLIROSTRIS* BASED ON A GROWTH-RATION SIZE APPROACH

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Introduction

Several studies have reported that probiotic bacteria are good candidates for improving the digestion of nutrients and growth of aquatic organisms (Tovar et al., 2002; Lara-Flores et al., 2003; Venkat et al., 2004; Wang, 2007; Suzer et al., 2008). The present study aimed to assess the effect of *Pediococcus acidilactici* MA18/5M on growth and basic nutritional parameters in the shrimp *Litopenaeus stylirostris* by applying the growth ration method (Brett, 1979).

Photo 1 : *Litopenaeus stylirostris*

Material and methods

The experiment was designed with two treatments (probiotic vs control) and five daily ration sizes by treatment expressed as percentage of the shrimp biomass per tank (% BM.day^{-1}) (1%, 2%, 3%, 4% and 5.8%). The five rations tested were completely consumed by the shrimps. Growth ration curves were determined for both treatments (Figure 1) : shrimps fed with the standard diet and shrimps fed diet enriched with Bactocell® PA 10 (Lallemand S.A.S, Blagnac, France) formulated with live freeze-dried *Pediococcus acidilactici* MA 18/5M (Institut Pasteur, Paris, France) at a concentration of 10^{10} CFU.g^{-1}. For each treatment, the relationship between relative growth rate (RGR) and ration size was analysed with a non-linear regression. The model was: (1) GR: y = y0 + a*(1-bx), where y is the tank average RGR, x is the ration size, and a, b are constants determined by the regression. The KR curves were plotted by using the predicted values from the previous growth-ration model: (2) KR: y/x = (y0 + a*(1-bx))/x. Gross conversion efficiency (K_1) was determined for each tank according to the following formula (Brett, 1979): K_1 = (RGR /R) x 100, where RGR , the mean relative daily growth rate for each tank, and R, the ration size per tank, are expressed in the same units (%). From the model two specific rations were determined: (i) the maintenance ration (Rm), which is the feed intake that just maintains the animal without any change in its body weight, and (ii) the optimum ration (Ropt) that represents the feed intake that produces the greatest increase in the body weight for the least feed intake. Net conversion efficiency (K_2) was also determined. This parameter provides a measure of the capacity to convert the food into tissue, which is equal to the amount of feed consumed in excess of the maintenance ration (Rm). It was calculated as K_2 = (RGR /(R-Rm)) x 100 (Brett, 1979).

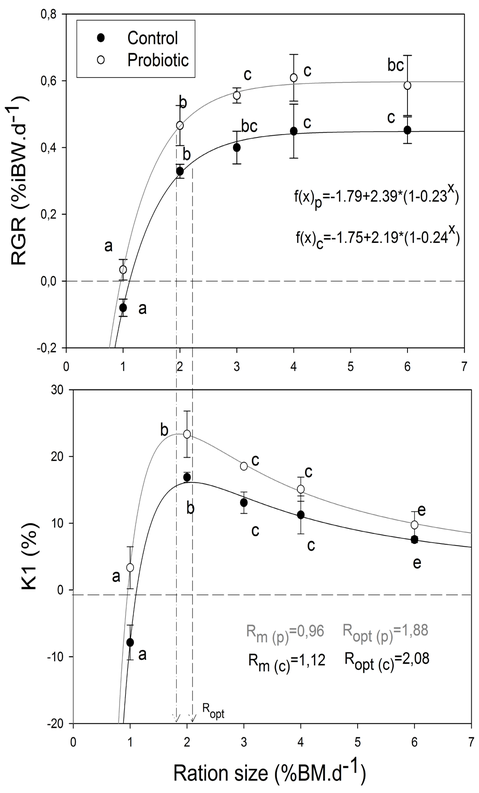

Figure 1 : Relative Growth (RG) of schimp *L. stylirostris* and Gross conversion efficiency (K_1) according ration size.

Results and conclusion

Compared to the control group, Rm and Ropt (Table 2) were reduced and K_1 and K_2 (Table 1) were increased for shrimps fed with the probiotic diets. At the optimal ration size, the probiotic treatment resulted in increased shrimp RGR by more than 36% compared to control (4.5g.kg^{-1}.day^{-1} vs 3.3 g.kg^{-1}.day^{-1} for the control shrimps). Besides K_1 max was improved by 38%, which indicates a better transformation of the feed into tissue. Besides K_2 was improved by 37% at the optimal ration size compared to control, traducing a better transformation of the feed part allocated to growth. Finally, at the 1% ration size, shrimps fed the probiotic diet did not loose weight while control shrimps did (0.3g.kg^{-1}.day^{-1} vs -0.8g.kg^{-1}.day^{-1} for the control shrimps) (Table 2).
This study showed, under controled experimental conditions, that probiotic *P. acidilactici* MA18/5M greatly promote growth and improve the feed utilization by the shrimp. Theses results have been confirmed under pond farming conditions (Castex et al., 2008) so live terrestrial lactic acid bacteria can be an effective and economical way to improve shrimp growth rate and yield as well as feed conversion ratio.

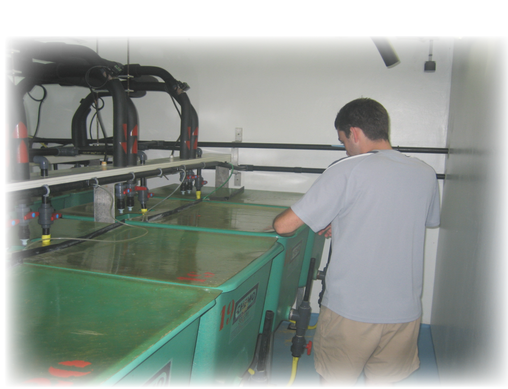

Photo 2 : experimental tanks.

Table 1 : Relative daily growth rate (RGR), Gross conversion efficiency (K_1) and net conversion efficiency (K_2) for the 5 ration sizes tested.

Ration size (%BM[1])	Nbr of Tanks	RGR (%iBW.d^{-1})		K1 (%)		K2 (%)	
		Control	Probiotic	Control	Probiotic	Control	Probiotic
1	3	−0,08±0,03^{a}	0,03±0,03^{b}	-7,87±2,61^{a}	3,33±3,14^{b}	-	83,33±45,3
2	3	0,33±0,02^{a}	0,47±0,06^{b}	16,88±0,75^{a}	23,33±3,47^{b}	36,30±1,88^{a}	49,74±6,68^{b}
3	3	0,40±0,05^{a}	0,56±0,02^{b}	13,08±1,61^{a}	18,53±0,19^{b}	20,87±2,57^{a}	27,25±0,27^{b}
4	3	0,45±0,08^{a}	0,61±0,07^{b}	11,25±2,85^{a}	15,09±1,80^{b}	15,62±3,96^{a}	19,86±2,37^{b}
5,8	3	0,45±0,04^{a}	0,59±0,09^{a}	7,54±0,45	9,73±2,01	9,27±0,55^{a}	11,59±2,40^{b}

[1] % Biomass per tank

Table 2 : maintenance and optimal rations

Rations	Control	Probiotic
Rm (% iBW)	1,12	0,96
Ropt (%iBW)	2,08	1,88

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