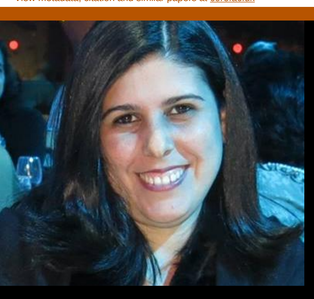


Gene expression of *Solea senegalensis* Kaup, 1858 fed with the synbiotic composed by sodic alginate and the probiotic *Shewanella putrefaciens* Pdp11

Danielle De Carla Dias [1 2], Sara Vidal [2], Silvana Tapia-Paniagua [2], Carmen Lobo [3], Inés García de la Banda [3], Maria Carmen Balebona [2], Miguel Ángel Moriñigo [2].
1. Research Center in Aquaculture, Fisheries Institute, São Paulo, Brazil. 2. Microbiology, University of Málaga, Málaga. 3. Spanish Institute of Oceanography , Santander, Spain

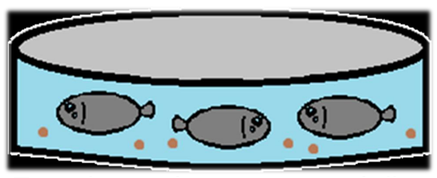
Introduction

The culture of the Senegalese sole (*Solea senegalensis*, Kaup 1858) is a promising industry in the Mediterranean countries. This species is very attractive for aquaculture, but the problems for controlling infectious diseases can seriously constrain its production. The use of antibiotics can control most diseases, but they also have adverse effects such as accumulation in the tissue, immunosuppression, and development of antibiotic resistant bacteria. The use of probiotics and prebiotics seems to be a favorable alternative to antibiotics.

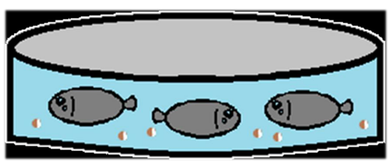
Previous studies showed that probiotic *Shewanella putrefaciens* Pdp11 has the ability to control the infection by several pathogens in *S. senegalensis*. The administration of the probiotic increased fish growth, enhanced resistance to diseases and induced changes in the intestinal microbiota. On the other hand, prebiotics are non-digestible food ingredients that stimulate the growth and/or activity of bacteria in the digestive system leading to benefits for the host. Nowadays, some studies are focused in the co-administration effects of probiotic and prebiotic as a synbiotic. The present work investigates the effect of *S. putrefaciens* Pdp11 (as probiotic) administered together with alginate (as prebiotic), on the immune system of cultured Senegalese sole.

Material and methods

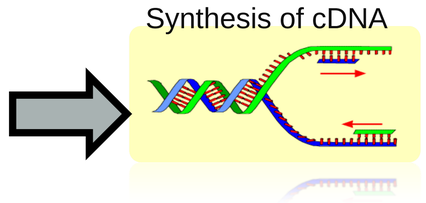
Control group: control diet



Experimental group: control diet supplemented with Pdp11 (10^9cfu g^{-1}) + alginate (2 gkg^{-1})



mRNA extraction from head kidney after 10 days



Data analysis by ΔΔct method

$$R = \frac{(E_{target})^{\Delta CP target\ (control - sample)}}{(E_{ref})^{\Delta CP ref\ (control - sample)}}$$

Target genes

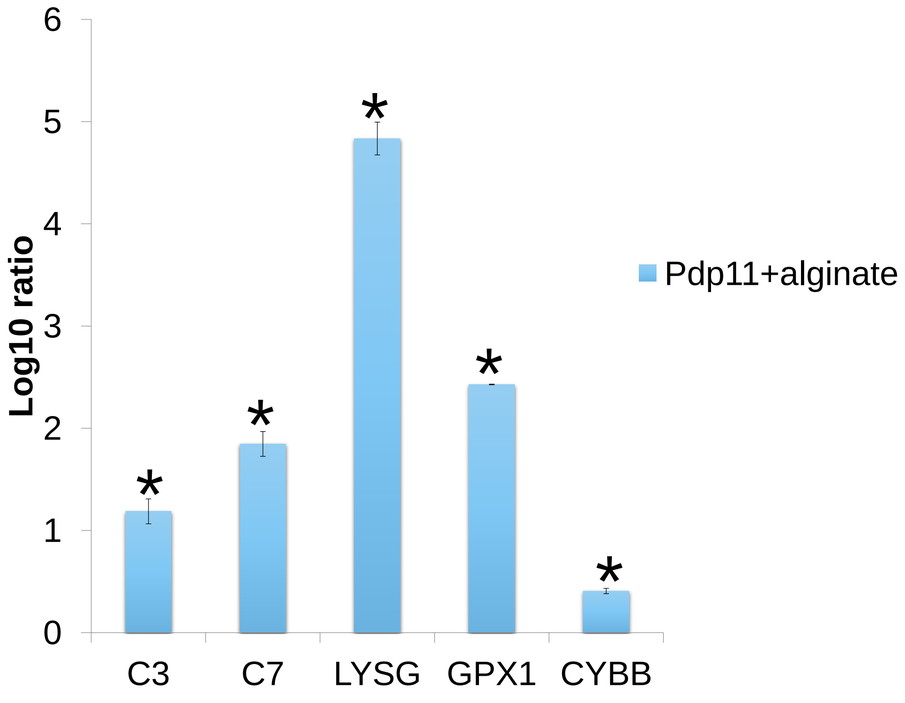
Protein	Gene	Primers (5'-3')	Amplicon (pb)	References
C3 component	**C3**	F: ACCTTAGACTGCCCTACTCTGCTGTCCGTG R: GCACTGCACACATCATCCGTCTCAGAC	127	Prieto-Álamo *et al*., 2009
C7 component	***C7***	F: GGCACACACTATCTGTCGCAGGGCTC R: GGCGAACGCCTGATGGTTTAACTCCAG	78	Prieto-Álamo *et al*., 2009
Lysozime G	***LYSG***	F: ACTGCTCGCGGTGAATGGGACA R: CCTGAAAATTTATTACGGATTCGGCCAATG	95	Salas-Leiton *et al*., 2010
Gluthatition peroxidase	***GPX1***	F: GATTCGTTCCAAACTTCCTGCTA R: GCTCCCAGAACAGCCTGTTG	212	Teles *et al*., 2011
NADPH oxidase	***CYBB***	F: CATCGCCCACCTGTTTAACT R: GTATGACCTGCGGATGACCT	250	Teles et al., 2011

Housekeeping genes

Gene	Primers (5'-3')	Amplicon (pb)	References
ACTB2	F: AATCGTGACCTCTGCTTCCCCCTGT R: TCTGGCACCCCATGTTACCCCATC	113	Infante *et al*., 2008
RPS4	F: GTGAAGAAGCTCCTTGTCGGCACCA R: AGGGGGTCGGGGTAGCGGATG	83	Infante *et al*., 2008

Results

Gene expression



Discussion and conclusions

After 10 days feeding with the synbiotic, gene expression showed a significant upregulation in comparison to control fish in all studied genes. These results can demonstrate that the synbiotic can alter the expression of genes related with immune system functions. The immuno-stimulation produced by the synbiotic may provide an additional overprotection against pathogens or stressors processes. However, the permanent application of the synbiotic and the continuous immuno-stimulation could be harmful to the fish. Therefore, more studies are necessary to see how would affect to fish if we still adding the synbiotic and if the synbiotic could give protection against experimental infections.

References

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