ENHANCING ω3 LC-PUFA BIOSYNTHESIS IN THE POLYCHAETE *Platynereis dumerilii* THROUGH SALINITY MODULATION

Khalida Bainour, Óscar Monroig, Francisco Hontoria, Juan C. Navarro

Instituto de Acuicultura Torre de la Sal (IATS), CSIC, 12595 Ribera de Cabanes, Castellón, Spain.
E-mail: khalida.bainour@csic.es

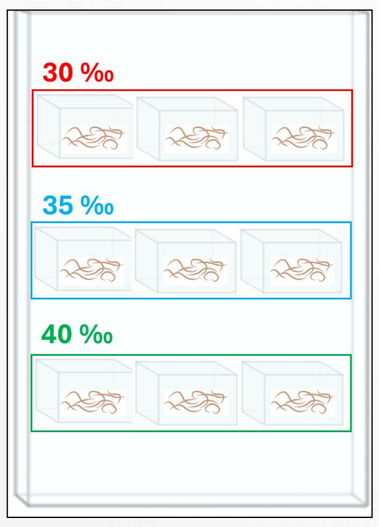
INTRODUCTION

Polychaetes are considered promising sources of ω3 long chain polyunsaturated fatty acids (LC-PUFA) due to their endogenous synthesis capability facilitated by enzymes such as elongases, front-end desaturases (Fed), and methyl-end desaturases. Salinity, like other environmental factors, can modulate the biosynthesis of ω3 LC-PUFA in these organisms [1]. It is believed that changes in osmotic pressure, lead to adjustments in membrane protein production and fatty acid composition to adapt to new conditions. This offers the opportunity to develop optimized cultivation protocols that enhance ω3 LC-PUFA biosynthesis. This study focuses on investigating **the impact of salinity on fatty acid profiles in *Platynereis dumerilii***, a well-established model in Evolutionary and Developmental Biology.

MATERIAL AND METHODS

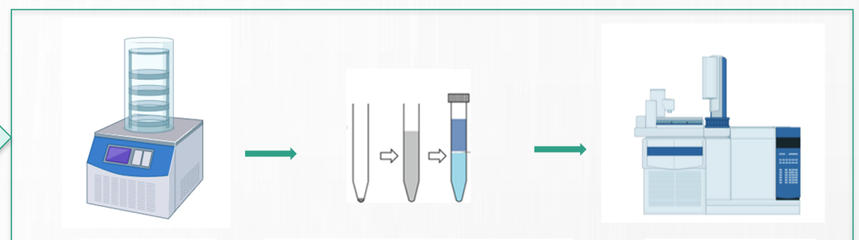
In vivo trials

- 18 °C
- 16h light:8h dark
- **Food:** Frozen spinach
- **Salinity:** optimal, low, and high (35, 30, and 40 ‰, respectively)
- 30 days

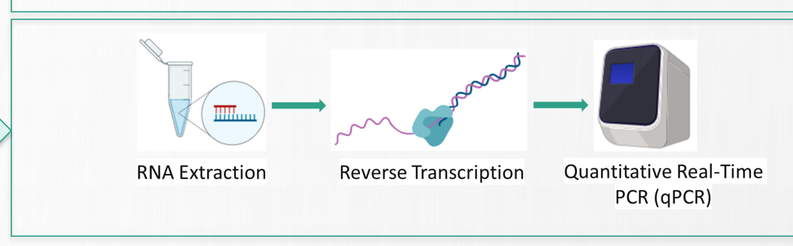


The degree of activation of the biosynthesis pathways of ω3 LC-PUFA is assessed by:

Fatty acid profile analysis



Gene expression analysis of elongases and desaturases



RESULTS AND DISCUSSION

Variations in salinity (30, 35, and 40‰) did not exert discernible effects on the growth dynamics of *P. dumerilii* (Table 1).

Table 1. Initial length, final length (segments), LGR (%), and SGR (% d^{-1}) of *P. dumerilii* at different salinities (30, 35, and 40 ‰).

	30 ‰	35 ‰	40 ‰
Initial length	39.0 ± 0.9	39.6 ± 1.3	39.6 ± 1.4
Final length	56.6 ± 1.2	58.5 ± 1.5	58.2 ± 1.3
LGR	44.9 ± 0.7	47.9 ± 1.2	46.8 ± 2.1
SGR	1.2 ± 0.0	1.3 ± 0.0	1.3 ± 0.0

Values are mean ± SD; LGR: length gain rate; SGR: specific growth rate.

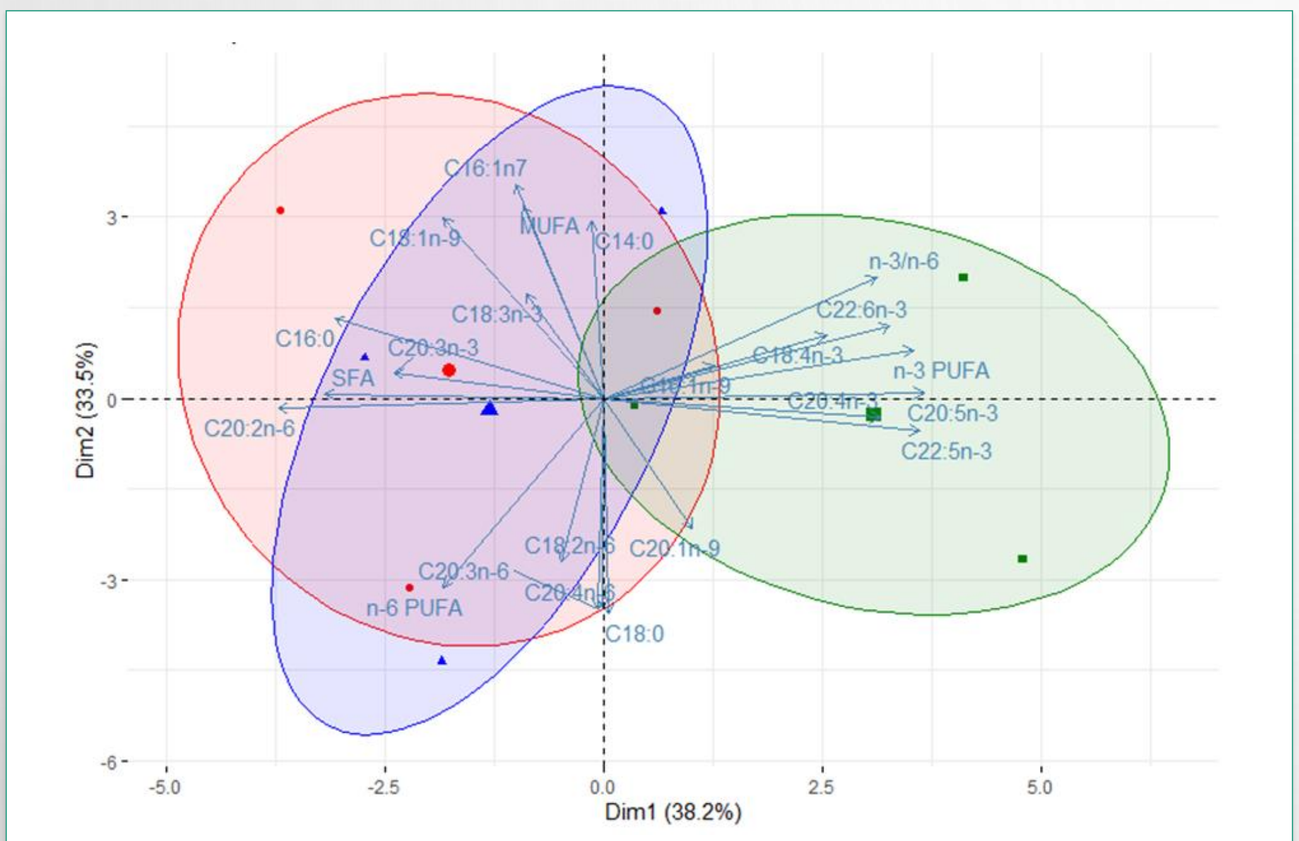


Figure 1. PCA of the fatty acid composition of *P. dumerilii* at different salinities. Triangles (blue), dots (red), and squares (green) are the scores of *P. dumerilii* maintained at standard, low, and high salinities, respectively. Fatty acids responsible for the grouping pattern are displayed in the biplot (blue vectors); 95% confidence ellipses are shown.

Despite the uniform diet, *P. dumerilii* grown under high salinity conditions (40 ‰) exhibited elevated levels of ω3 LC-PUFA, notably eicosatetraenoic acid (20:4n-3), eicosapentaenoic acid (EPA, 20:5n-3), and docosapentaenoic acid (22:5n-3), compared to those maintained at standard and low salinity conditions (35 and 30 ‰, respectively) (Fig. 1). Previous studies in teleost fish have demonstrated an **increase in ω3 LC-PUFA in response to elevated salinity** [2].

Gene expression analysis revealed a **significant upregulation of a desaturase (Fed), with Δ6/Δ8 activity** [3], **under high salinity (40 ‰)** (Fig. 2). Indeed, fatty acid analysis indicated a negative correlation of specific substrates of this enzyme, particularly eicosadienoic acid (20:2n-6) and eicosatrienoic acid (20:3n-3), in worms grown at high salinity (Fig. 1), in agreement with an enhanced Δ8 desaturase activity as shown in the gene expression results (Fig. 2).

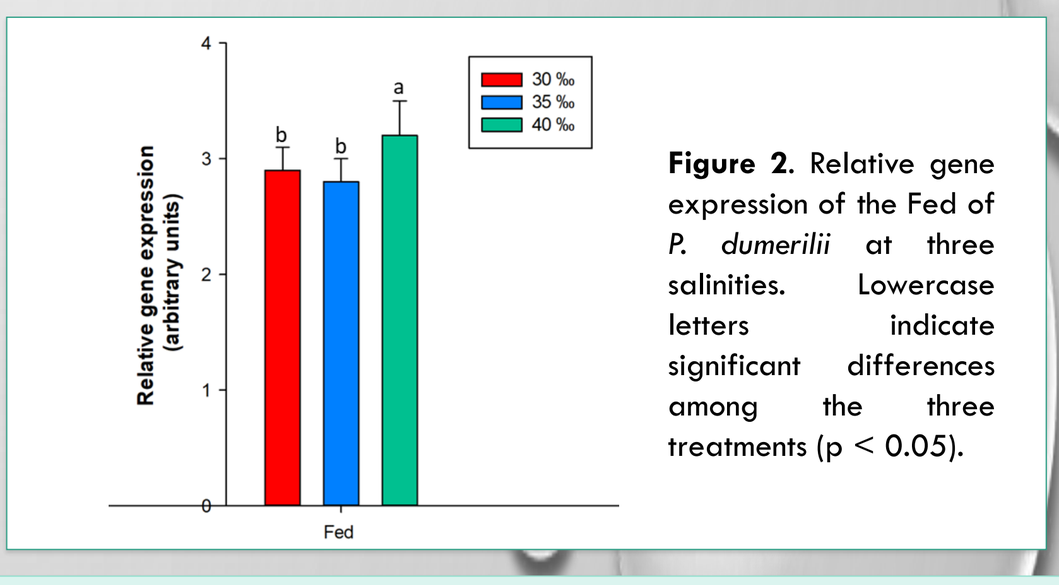


Figure 2. Relative gene expression of the Fed of *P. dumerilii* at three salinities. Lowercase letters indicate significant differences among the three treatments ($p < 0.05$).

These findings suggest that cultivating *P. dumerilii*, and potentially other polychaetes, in high salinity environments can enhance their nutritional value by increasing the contents of the essential and health-beneficial ω3 LC-PUFA.

REFERENCES

[1] Liu, Z.F., Gao, X.Q., Yu, J.X., Qian, X.M., Xue, G.P., Zhang, Q.Y., Liu, B.L., Hong, L., 2017. Fish Physiology and Biochemistry. 43, 761-773.

[2] Monroig, Ó., Kabeya, N., 2018. Fisheries Science. 84, 911-928.

[3] Ramos-Llorens, M., Hontoria, F., Navarro, J.C., Ferrier, D.E.K., Monroig O., 2023. BBA - Molecular and Cell Biology of Lipids. 1868, 159377.

ACKNOWLEDGEMENTS

This work is part of the IMPROMEGA Project (RTI2018-095119-B-I00) funded by MCIN/AEI /10.13039/501100011033/ and FEDER - A way of making Europe. Additionally, this study is part of the ThinkInAzul program funded by the European Union NextGenerationEU (PRTRC17. I1) and the Generalitat Valenciana (THINKINAZUL/2021/026). Khalida Bainour is funded by a predoctoral contract, Santiago Grisolía (GRISOLIA/2021/120), from the Generalitat Valenciana.