CONTROL OF PRODUCTION METHOD OF TURBOT (*Scophthalmus maximus*) BY BIOELECTRICAL IMPEDANCE ANALYSIS (BIA)

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WILD OR FARMED TURBOT?



- Atlantic turbot: **wild turbot** highly **appreciated by consumers**
- However, **92,4 %** of global production of turbot comes from **aquaculture**
- **Galicia**: main producer of **farmed** turbot in **Europe**
- European regulation (ED 1379/2013): the **production method** should be indicated on the **label** of fresh fish (**Fig. 1**)
- **Mislabelling** could occur due to **economic motivation**
- **Differentiation between wild and farmed:** based on lipid content and fatty acids profile; farmed turbot present a higher lipid content and a lower ω-3/ω-6 ratio (Sérot et al., 1998)
- **Bioelectrical Impedance Analysis (BIA):** based on the electric impedance of an organism or a tissue to the pass of a low intensity current through it. It is useful for determining fish composition (Champion et al., 2020)

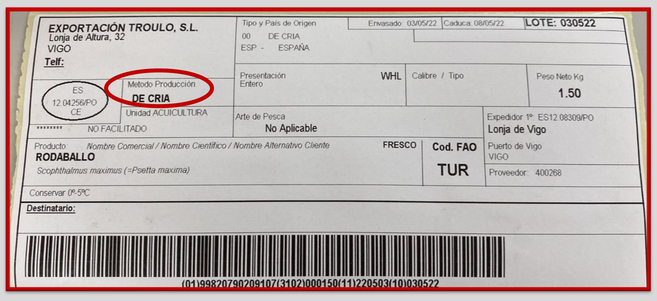


Figure 1. Example of a fresh turbot label from a Spanish fishmonger. Production method (marked in red) indicates that the product is farmed ("DE CRIA", in Spanish).

OBJECTIVE: To develop a fast, non-destructive, safe, and portable method based on BIA for controlling the turbot production method

MATERIAL AND METHODS

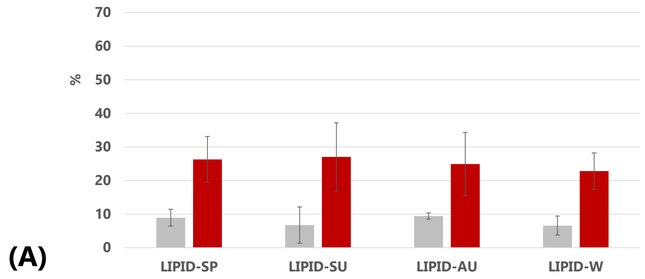
Wild (n=5) and farmed (n=5) turbots (average weight of 1,5 Kg) were obtained in the four seasons of the year from local producers (FAO 27, Subzone IX A). Once in the laboratory, turbots were placed on a nonconductive board and awaited until an internal temperature between 6,5 and 7,5 ºC was achieved **(Fig.2 A)**. Electrode needle was positioned on the turbot upper edge at 1 cm above the dorsal fin base and 10 cm from the posterior head end, to obtain BIA measures **(Fig.2 B)**. Electrode needle was positioned 5 cm from the posterior head end, on the lateral line **(Fig. 2 C)**. BIA device (BIA 101 Anniversary - Akern SRL) provides values of resistance (R), reactance (Xc), and phase angle (Pa) **(Fig. 2 D)**. Proximal composition was determined in the upper edge and central tissues, the same places where BIA measurements were performed **(Fig. 2 E)**.



Figure 2. BIA data collection and tissue sampling.

RESULTS

Wild (W) and farmed (F) turbot specimens presented a localized lipid accumulation in the upper edge compared with the central tissues. The lipid content in both regions showed significant differences along the year (ANOVA, *p*-value<0,01) between W and F turbots **(Fig.3 A and B)**. Furthermore, the ANOVA results also indicated that there were significant differences (*p*-value<0,01) in R in the upper edge (with higher lipid content) between W and F turbots **(Fig.4)**. Pearson correlation coefficient analysis showed a strong significant positive correlation (r=0,56; *p*-value<0,01). **Figure 5** shows that R increases as it does the lipid content because fat is a poor conductor of electricity.



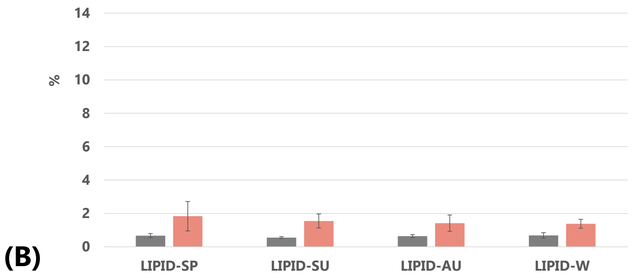


Figure 3. Seasonal variation of lipid content in the upper edge **(A)** and central tissues **(B)** in W and F turbots (mean ± SD), expressed in wet weight. SP: Spring; SU: Summer; AU: Autumn; and W: Winter.

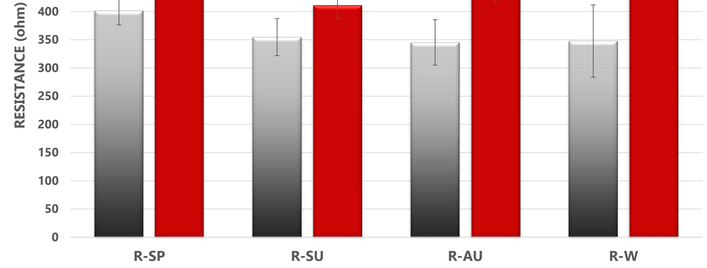


Figure 4. Resistance (R) of the upper edge tissues in W and F turbots (mean ± SD) in ohms. SP: Spring; SU: Summer; AU: Autumn; and W: Winter.

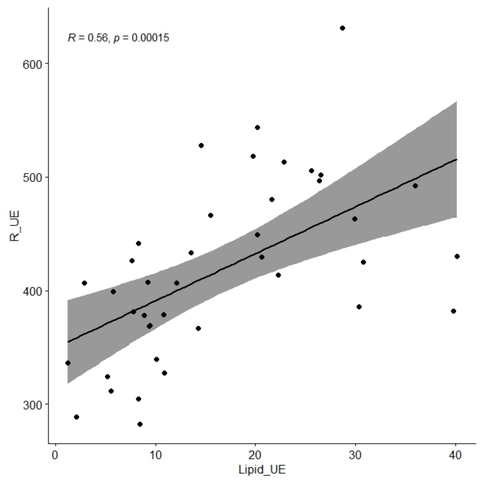


Figure 5. Pearson correlation plot for lipid content and resistance in the upper edge tissues in W and F turbots.

CONCLUSIONS

- Lipid content is significantly higher in F compared with W turbot and it is preferentially localized in the upper edge tissues.
- Differences in lipid content remain throughout the year for both F and W turbots and both tissues.
- Resistance of the upper edge tissues correlated significantly with lipid content in the same region.
- BIA may be an alternative fast method for controlling turbot production instead of the chemical analysis of lipids.

REFERENCES

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Champion, C., Hobday, A. J., Pecl, G. T., & Tracey, S. R. (2020). Maximising the utility of bioelectrical impedance analysis for measuring fish condition requires identifying and controlling for sources of error. *Fisheries Research*, *229*, 105575.

ACKNOWLEDGEMENTS

Authors thank the financial support received from Ministry of Science and Innovation (AEI /10.13039/501100011033 PID2020-118012RB-C21) and Xunta de Galicia (Grupos de Potencial Crecimiento, IN607B).

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