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Tuna side-streams account for up to 70% of fish used in industrial processing. This biomass is often discarded, or a limited fraction is used, with negative environmental impact. This by-product represents an opportunity to improve the sustainability of fisheries and aquaculture while generating additional revenue.

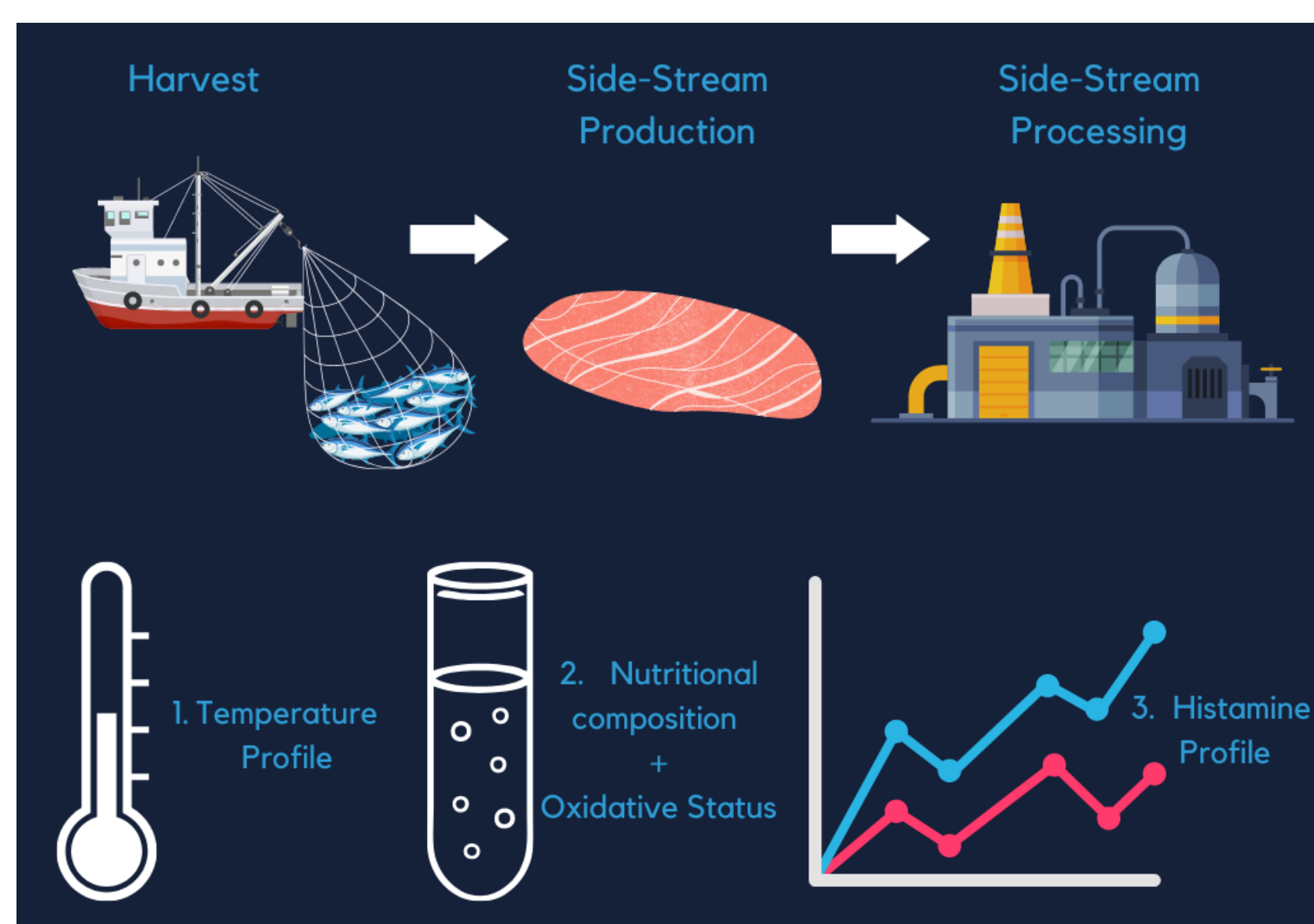
The aim of this project is to address biological and logistic preservation issues that prevent the utilization of fish side-stream, and to identify innovative ways to use this product.



## MATERIALS AND METHODS

Samples of tuna side streams were collected in Malta during the tuna harvesting season, from October to December 2022. The temperature profile was recorded in tuna head, liver and mixed samples from harvest until storage at -20°C (between 3 to 6 hours) and used to predict histamine production by *M. psychrotolerans* and *M. Morganii* using the software Food Spoilage and Safety Predictor (FSSP)[1]. The proximate composition of the samples was assessed following the methodology indicated by AOAC International [2] for Dry Matter (DM), Crude Protein (CP), Ether Extract (EE) and ash. The Peroxide Value (PV) and ThioBarbituric Acid Reactive Substances (TBARS) were determined on the lipid extract to evaluate the oxidation status.

In parallel, representatives of Maltese tuna farmers were interviewed in order to investigate the value chain and to identify the logistic issues related to the utilization of the side-stream.



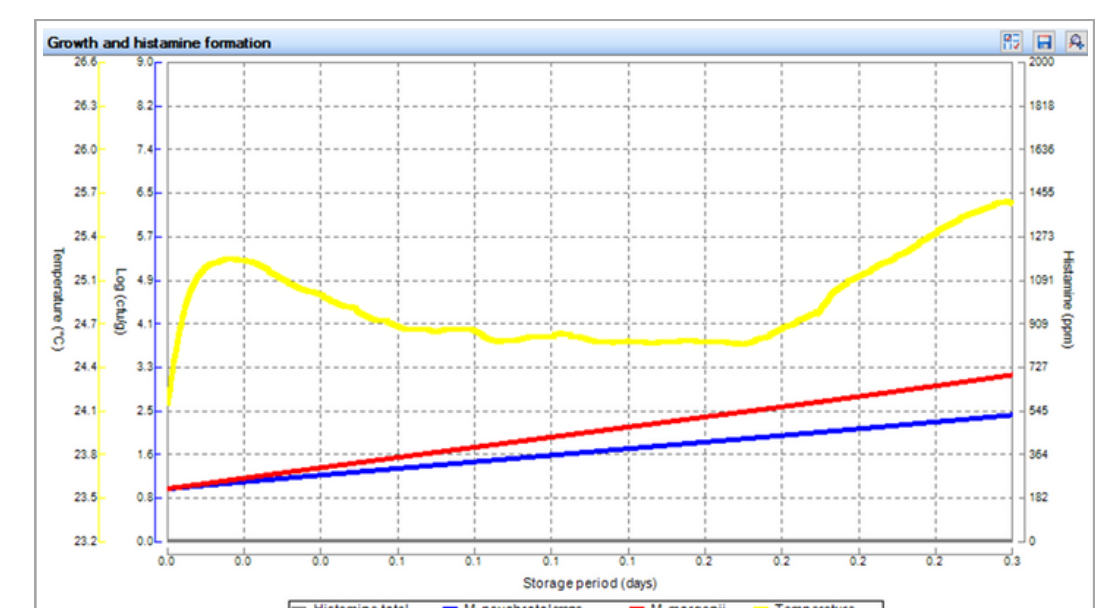
## REFERENCES

- [1] J. Emborg, P. Dalgaard, Modelling the effect of temperature, carbon dioxide, water activity and pH on growth and histamine formation by *Morganella psychrotolerans*, Int J Food Microbiol. 128 (2008). <https://doi.org/10.1016/j.ijfoodmicro.2008.08.016>
- [2] AOAC International. Official methods of analysis of AOAC International. 17th ed. Gaithersburg: Association of Official Analytical Chemists; 2003.

## RESULTS

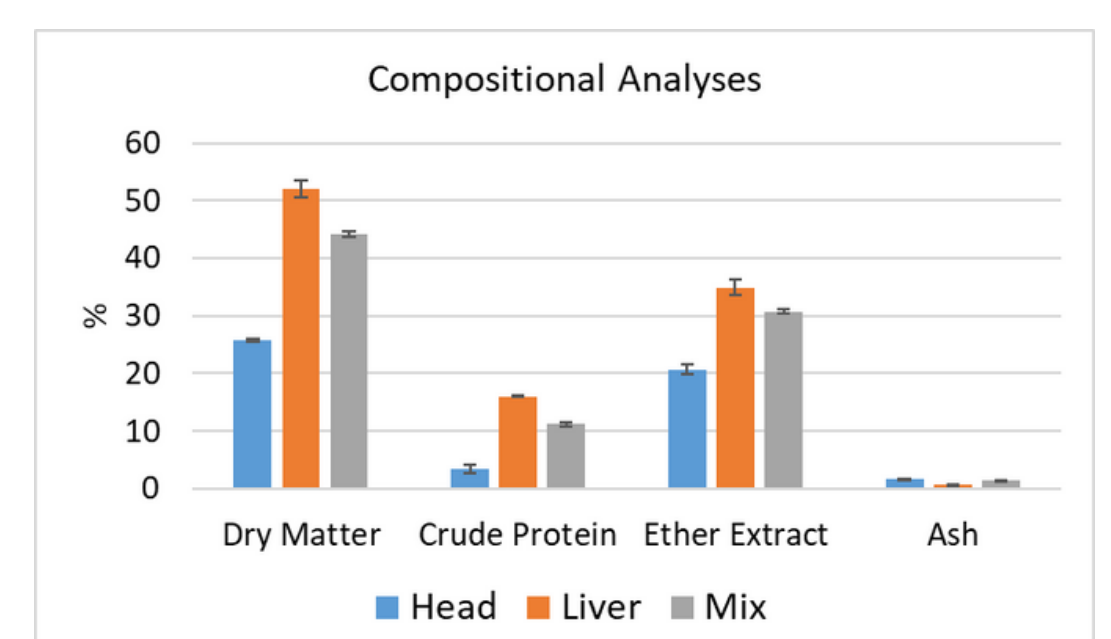
### Temperature and Histamine Profile

- The temperature of the samples varied between 15 and 26°C
- No histamine production was predicted by the model



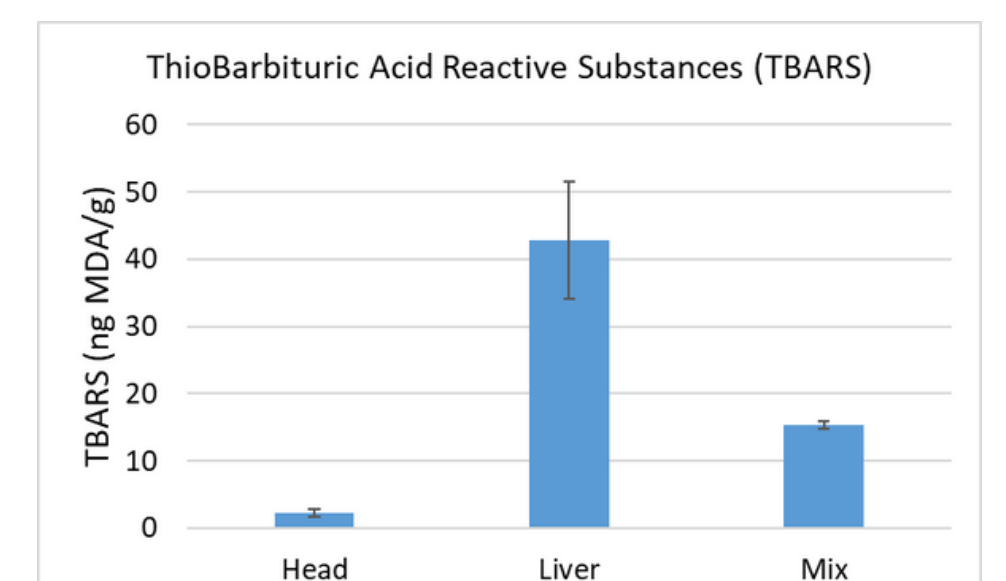
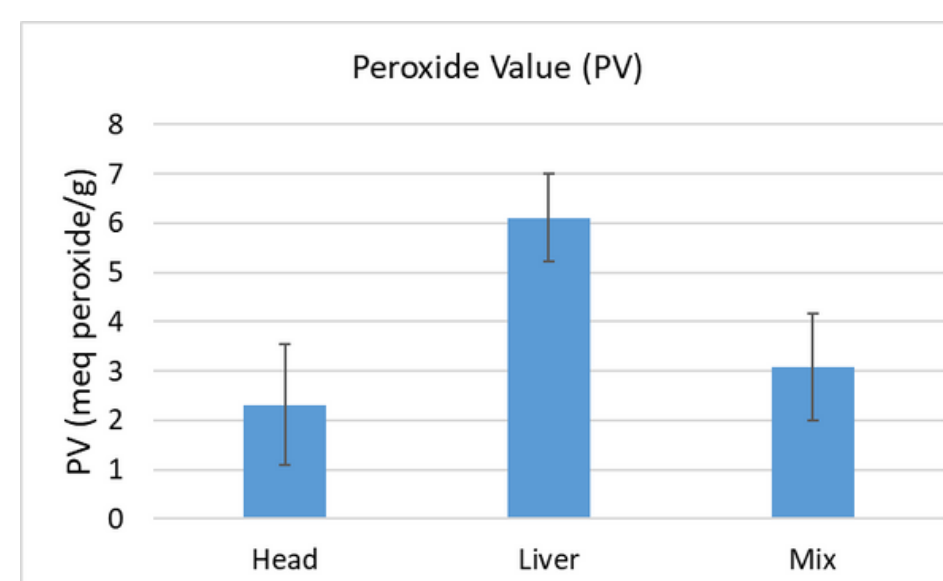
### Nutritional and Proximate Analysis

- DM content varied between 25.65% (head) and 53% (liver)
- CP content highest in liver samples (16%), lower in head (2.8%) and mixed (11.5%) samples
- Crude fat, expressed as EE, showed highest concentration in the liver (35.9%), lowest concentration in the head (20.04%)



### Oxidation Analysis

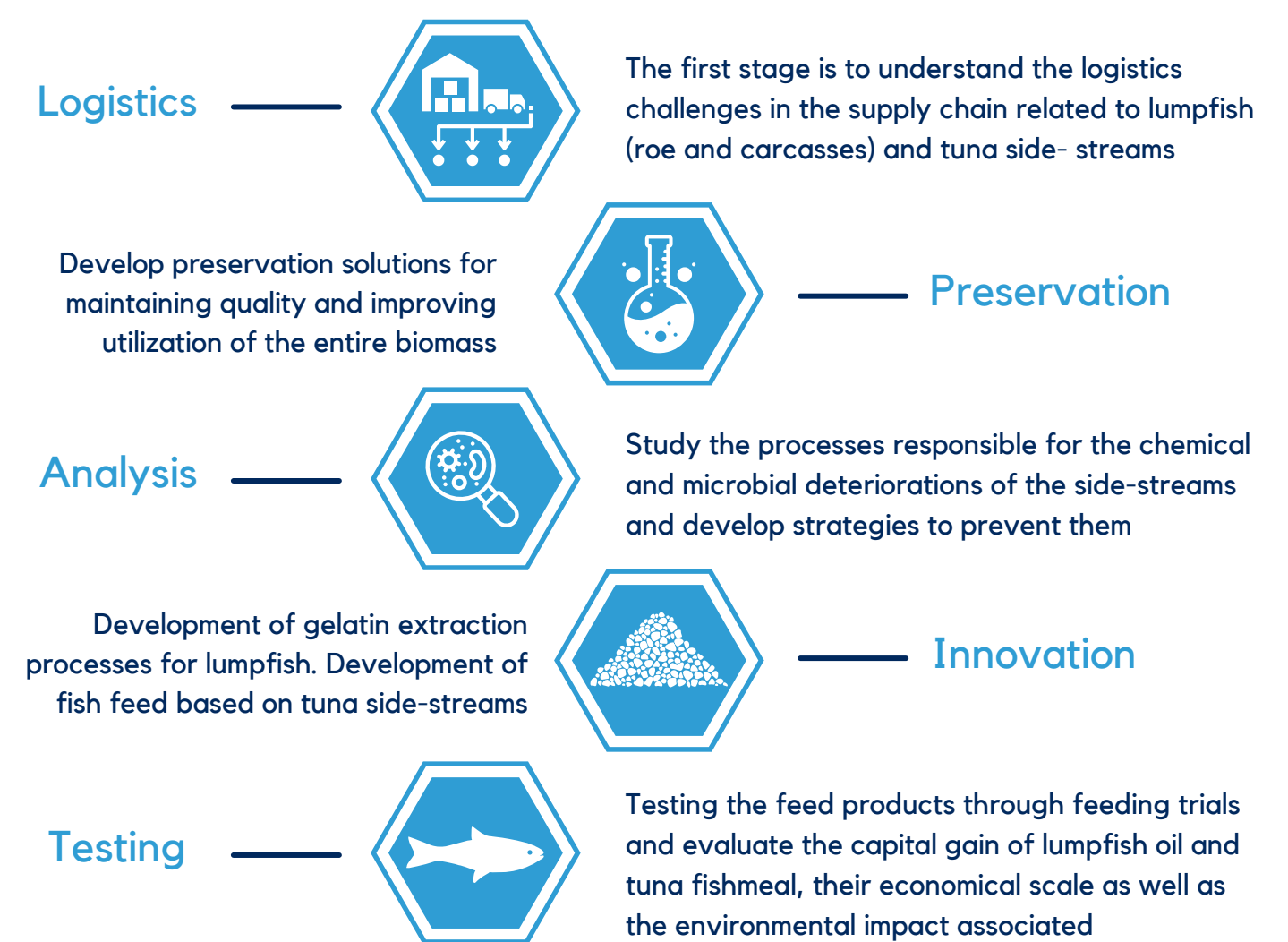
- Primary oxidation highest value recorded in the liver (5.48 to 6.74 meq peroxide/kg oil) and lowest in head (1.45 meq peroxide/kg oil)
- Secondary oxidation ranged between 1.89 and 49.00 ng MDA/g across all samples, with the highest levels being recorded in liver and the lowest in the head
- After 72 hours at -20°C, all the PV and TBARS values increased, indicating slow oxidation processes



### Logistic challenges

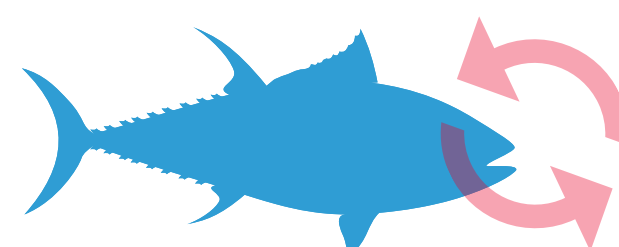
- No refrigerated space for the side-stream on the harvesting vessels
- Limited capacity for storage in freezers in the processing plant
- Separation of the different type of side-stream (head, liver, bones etc.) time-consuming and expensive in terms of man-hours

Preservation of underutilized fish biomasses for improved quality, stability and utilization



## CONCLUSIONS

- The side-stream material should be processed either immediately after harvest or not later than 72 hours at -20 degrees
- The utilization of natural antioxidants might extend this time, but further research is needed
- Involvement of stakeholders to address the logistic challenges should be considered to develop a system that allows the utilization of side stream materials in a circular economy model



To learn more about the PROFIOUS project and the preservation of underutilized fish biomass, visit us at our website:



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