Innovative techniques to improve the quality and shelf-life of cultured mussels and various commercial fish species

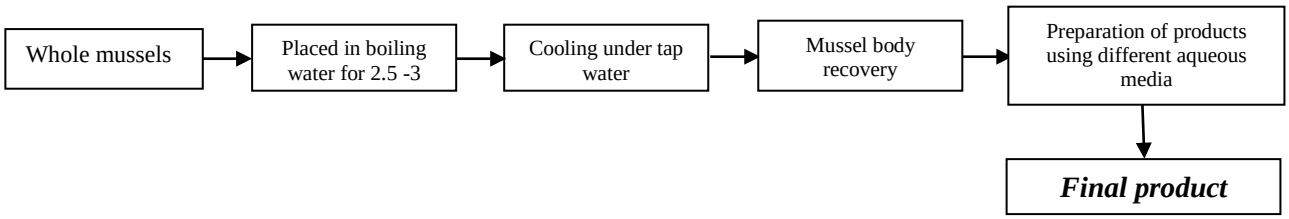
Copyediting: Karayannakidis[1], P.D., Petridis[1], D., Fazio[2] G., Fricano[2] S., Messina[2] C.M., Santulli[2] A.
[1]Department of Food Technology, ATEI of Thessaloniki
[2]Scienze Economiche, Universita Degli Studi di Palermo

Fish and fishery products have been recognized as a nutrition source due to their high protein content. However, shelf-life of seafood is limited by biochemical and microbiological changes

A prolonged shelf-life of unvalved mussels and various fish products in the local seafood market of Greece and Italy is currently in high demand. Normally, these products exhibit a shelf-life of 5-6 days under refrigeration after which they are destroyed immediately or returned back to the producers (aquaculture). Two innovative preservation techniques are proposed in this article, one oriented to cultured unvalved mussels and the other to commercially important fish species.

In the Greek seafood market, there is a processed product from mussel bodies ('unvalved', i.e. mussels separated from the shells by hand using a knife), it's packed into plastic bags along with potable water as a medium. Currently, there are 32 mussel processing plants producing this type of product in Northern Greece only. However, the product faces rapid degradation with an estimated shelf life of 5-6 days, lacks the unique mussel taste and shows a brownish color, thus rendering the product unappealing. Therefore, the objective of the present study is to develop processing methodologies that would be applicable on a commercial scale, in order to improve the quality (i.e. taste, appearance and shelf life) of the unvalved mussel product, which is an important food commodity in the Greek market.

Briefly, the methodology includes the steps described by the following procedure



All samples have been assessed in terms of their microbiological quality (*E. coli*, *Salmonella* spp. and total viable count), appearance and taste (sensory tests). Regarding the sensory tests, the products were assessed in terms of their sensorial acceptability using an unstructured scale (0-15 cm).
Results indicated the following:

- Products placed in 4% brine and 10 and 15% white vinegar solution were the most preferable by the panelists (adequately acceptable), while mussels placed in 10% brine were found to be very salty (Fig. 1).
- Unvalved mussels placed in 4% brine exhibited a shelf-life of 17 days, while those placed in 10% brine, 27 days. Unvalved mussels placed in aqueous white vinegar solution exhibited a shelf-life of at least 32 days. These findings were based on the results of the microbiological analyses.
- The brownish color totally disappeared from all products (Fig. 2) (from left to right: control, 4% and 10% in brine, 10% and 15% in white vinegar)

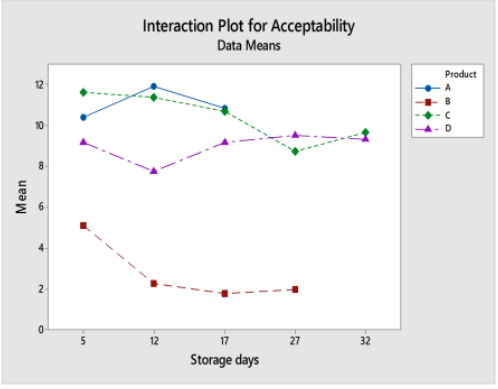


Fig. 1. Mean acceptability of various mussel products throughout refrigerated storage (A: 4% brine, B: 10% brine, C: 10% vinegar, D: 15% vinegar)

Fig.2. Unvalved mussel products

From the above the following can be concluded:

- ✓ An alternative mussel recovery process was employed in order to overcome problems associated with the color.
- ✓ The proposed process can be easily adapted by any mussel processing plant.
- ✓ Overall the proposed unvalved mussel products exhibit better shelf-life (1.8-fold to 4.3-fold increase), taste and appearance.

The limited shelf life of fresh fish products is a large hurdle for the export of fresh products. The value of the product depends on the perceived quality, which is associated for the consumer to the visual appearance (i.e. freshness). The influence of raw material quality, cooling methods, processing, packaging and storage conditions on freshness and shelf life extension are important and there are some critical issues that affect the economical aspects:

- The shelf life of the fish is short and in joint with the fact that the economic value of the fish is reduced due to the loss of freshness, result in a number of unsold items.
- The frequent use of chemical additives to apparently increase the lifespan (cafados, hydrogen peroxide, chlorine, sulphite agents, aniline, ammonia, etc.)

The application of MAP and combination process in seafood is a promising preservation method to extend the shelf life of fish and fishery products. In the proposed methodology the fish fillets are sealed in trays and stored at -1 ±0.5 ºC after applying a modified atmosphere (45% CO_2, 50% N_2, 5% O_2) and pretreated with natural antioxidants (halophytes) as shown below.

Modified Atmoshpere Packaging (MAP) + Nat. antioxidants (AOX) + "smart" packaging

Packed dolphinfish **MAP** **AOX (Halophytes)** **«Smart» packaging**

The shelf life of fish was considerably increased by using the above treatment without reasonably affecting the sensorial quality parameters (Fig. 3 and 4). MAP+AOX treatment elongates up to 12 days (plus 6 of normally preserved) the lifespan as compared to 9 days when treated simply with MAP and only 3 days with CO_2.

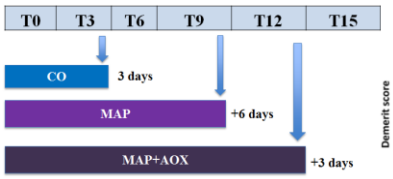


Fig. 3. Shelf life of various fish products

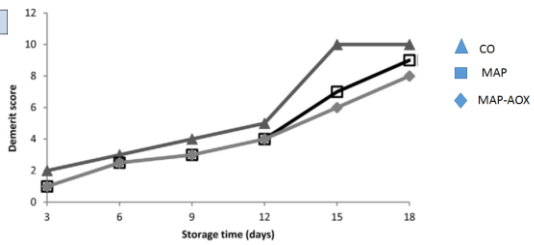


Fig. 4. Sensory evaluation scores

Conclusively, as a result of applying the MAP + AOX + «SMART» packaging the following competitive implications and benefits to business can be achieved:

- A far longer shelf life for fresh products and reaching new markets (the shelf life is extended from 6 to 9 days).
- Reducing unsold and thus indirectly also fishing effort.
- Fills the information gap on freshness in packed fish.
- The fish retains its qualities (freshness, flavor) without using chemical additives.
- A real profit in the supply chain: Coastal fishery, Industrial fishing, Aquaculture industry, Processing company

Literature cited

Messina, C.M., Bono, G., Arena, R., Randazzo, M., Manuguerra, S. and Santulli, A. 2016. *Food Science and Nutrition* 4: 723–732.

Messina, C.M., Bono, G., Arena, R., Randazzo, M., Manuguerra, S. and Santulli, A. 2015. *Food Science and Technology*, 62: 271-277.

Karayannakidis, P.D., Petridis, D., Galinou-Mitsoudi, S., Avdelas, L., Papaharisis, L. and Tsiaras, S. *6th International Congress in Food Technology,* Athens, Greece, 18 & 19 March 2017.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635188