

Effect of Refrigeration Storage on the Quality of Salted and Vacuum Packaged Rainbow Trout (*Oncorhynchus mykiss*) Belly Flap

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Abstract. *The shelf life of a by-product of the salmon industry was studied. For it, belly flap resulting from rainbow trout (*Oncorhynchus mykiss*) processing was kept under refrigerated conditions (0-1.5 °C), being its quality changes studied by sensory, physical, chemical and microbiological parameters. The trout were grown in a Chilean farming facility, where belly flap processing (salting and vacuum packaging) was also carried out and finally sent to our laboratory. Quality analyses included seven control points (days 0, 4, 8, 14, 20, 25 and 53) throughout the refrigerated storage; the experiment was carried out in triplicate (n = 3). The microbiological analysis was found decisive to determine the lifetime of the product since after day 53, total plate counts showed to exceed the maximum allowed for this kind of product. Statistically significant (p<0.05) differences were found with storage time for physical parameters such as shear, drip loss and colour. Thus, maximum strength occurred at day 0, falling then sharply at day 4 and maintaining low levels until day 53; drip loss values decreased at day 4, and later on increased until day 53; instrumental L*, a* and b* parameters provided differences throughout the experiment. Proximate composition was unchanged over time, but showed higher levels of lipid contents when compared to other species. With respect to pH, its lowest value was obtained at day 53 and the highest at day 20 (6.11 vs. 6.49, respectively). Sensory evaluation was performed using QDA methodology with trained judges; it showed significant differences for the following parameters: brightness, typical colour, hardness, elasticity, drip, humidity and odour (typical, sour, rancid and putrid); such values showed to satisfactorily correlate with those delivered by physical analysis. The study provides a first approach to the promotion and development of this kind of by-product from the salmon industry.*

Keywords: *Rainbow trout, belly flap, by-product, vacuum, salting, refrigeration, shelf life, quality.*

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Introduction

Aquaculture is contributing significantly to the production of food from animal origin for human consumption; within these, the *Salmonidae* family is a group that collaborates efficiently to that demand (Carrera, García, Céspedes, González, Sanz, Hernández, & Martín, 1998).

Fish by-products are parts that, before the fish reaches the final consumer, are removed in order to improve the keeping qualities, reduce the shipping weight or increase the value of the main fish product. These by-products represent almost 50% of the fish and are primarily intended for fishmeal and fish oil. They include blood, viscera, heads, bones, skin, trimmings and fins (Ramírez, 2007). One of these by-products is the so called belly flap, which corresponds to the ventral portion of the fish. This by-product is mainly exported to Japan as a frozen and salted (1.5-3.0 % salt) product, being called in this case Harasu. Research in the area of by-products has been scarce, specially in the case of freshwater species such as rainbow trout (*Oncorhynchus mykiss*), which requires the development of applied research, in order to characterize this species and its by-products.

Shelf life of a food is defined as the maximum length of time for a given product that is found appropriate for human consumption. For fish, shelf life is the time elapsed from the moment it is caught or harvested till it is no longer fit to be eaten (Doyle, 1995).

The common procedure employed to assess the shelf life time is the employment of different quality indices. Therefore, the objective of this study was to comparatively evaluate the physical, chemical, sensory and microbiological parameters related to quality loss throughout the refrigerated storage of the rainbow trout belly flap.

Materials

Belly flap resulting from rainbow trout processing was obtained from Salmenes Antártica S.A (Chiloé, X Region, Chile). This by-product was salted by immersion, vacuum packed and subjected to quick freezing. Finally, the fish were transported to our laboratory and stored at refrigeration temperature (0-1.5°C) up to a 53-day period. Sampling included seven check points (days 0, 4, 8, 14, 20, 25 and 53). Quality change assessment was studied by physical (shear force test; drip loss and instrumental colour including L*, a* and b* parameters), chemical (proximal composition and pH), microbiological (mesophilic aerobic plate count, APC; *Staphylococcus Aureus* and *Enterobacteriaceae* presence) and sensory (Quantitative Descriptive Analysis, QDA; 8 trained judges) analyses. Data collected were analysed by one way analysis of variance (ANOVA) using the Statgraphics Plus version 5.1 (Statistical Graphics Corporation, 2000). Significance was set at 0.05. Relationship between parameters was also analysed (Pearson's correlation coefficient).

Results

The shear force reached the maximum firmness value at date 0 (33.10 ± 5.14 N). The cold storage caused a marked firmness decrease at date 4 (13.40 ± 3.16 N), increased then until day 25 (23.42 ± 4.42) and did not provide further changes till the end of the study.

For the drip loss, there was a marked decrease up to day 4 that corresponds to a 2.98 ± 0.32 % exudate value; then, a continuous increase was observed till day 53, with a maximum value of 11.11 ± 3.12 %.

Colour assessment (L*, a*, b*, Chroma and Hue) did not show a defined tendency with time, which could obey to biological fish-to-fish variations (Refsgaard, Brockhoff, & Jensen, 1998).

Proximate composition analysis led to 5.63% for protein, 57.4% for fat, 29.84% for moisture and 2.83% for ash. Michalczyk & Surówka (2007) evaluated the rainbow trout fillet, finding values of 20.5% for proteins, 4.5% for fat, 73.4% for moisture and 1.3 for ash, being the most notorious difference the high concentration of lipids found in the belly flap, as being a fat deposit area. The belly flap pH showed a variable behaviour, leading to maximum values at day 20 (6.49 ± 0.07) and minimum at day 25 (6.11 ± 0.12).

The curve of bacterial growth is shown in the Figure 1, showing an exponential increasing phase at the 9-25-day period. At day 48, bacterial growth exceeded the maximum permitted limit (1×10^6 cfu/g) by the national legislation (MINSAL, 1997).

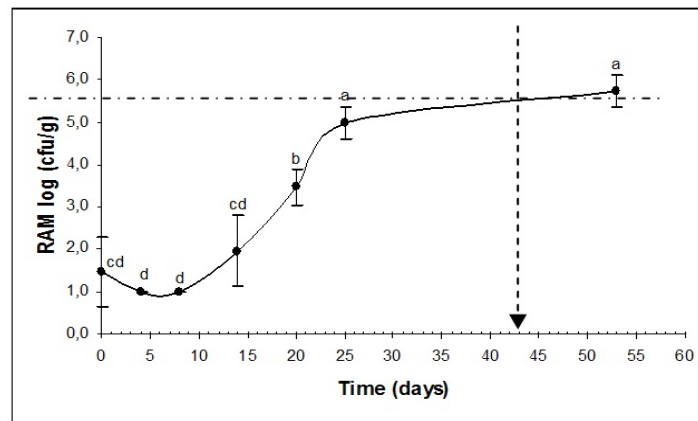


Figure 1. Count of mesophilic aerobic plate count (APC) (cfu/g) in refrigerated (0-1.5°C) belly flap. Different letters indicate significant differences ($p \leq 0.05$).

Although statistical differences were found for parameters such as brightness, humidity, drip, typical odour, hardness, elasticity and total quality, there is no doubt that the descriptor associated to the odour is the most indicative of shelf life of the product. According to Figure 2, it is possible to decide the shelf life time as the time when putrid odour surpasses the typical odour (day 48); at this time, the maximum APC value was attained (Figure 1).

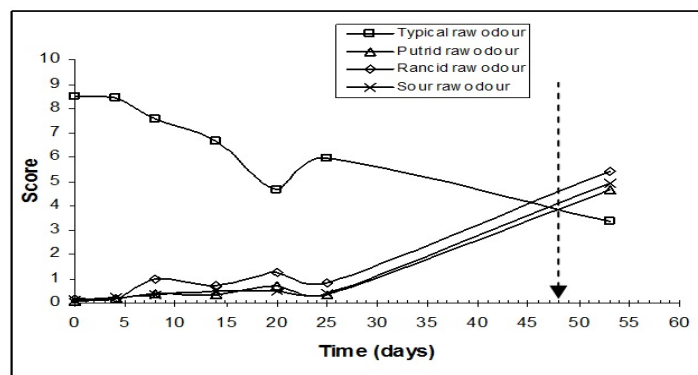


Figure 2. Sensorial evaluation of the typical, putrid, rancid and sour odour parameters in refrigerated (0-1.5°C) belly flap.

Descriptors such as typical, rancid, putrid and sour odours were found to be highly correlated with the total quality ($r=0.8765$; $r=-0.9166$; $r=-0.8717$; $r=-0.7329$, respectively). This strongly indicates that the sensory judges greatly related the smell of the belly flap with the level of quality.

Conclusions

The present study provided valuable information about the shelf life of a by-product of the salmon industry. In spite of the quality loss, formation of lipid oxidation compounds and denaturation and aggregation of proteins, the shelf life of the salted and vacuum-packaged belly flap (Harasu product) can be estimated on 48 days when kept under refrigerated (0° to 1.5° C) conditions, according to the sensory (odour describer) and microbiological (mesophilic aerobic plate counts, APC) properties. The employment of the Pearson's correlation analysis is strongly encouraged in future research in order to establish the behaviour of quality losses during the refrigeration of the belly flap product.

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References

- Carrera, E., García, T., Céspedes A., González I., Sanz B., Hernández P., & Martín, R. 1998. Identification of Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) by using polymerase chain reaction amplification and restriction analysis of the mitochondrial cytochrome *b* gene. *Journal of Food Protection* **61**(4): 482-486.
- Doyle, J. 1995. Seafood Shelf Life as a Function of Temperature. Sea Grant Marine Advisory Program No. 30. 5pp.
- Michalczyk, M., & Surówka K. 2007. The effects of gravading process on the nutritive value of rainbow trout (*Oncorhynchus mykiss*). *Journal of Fisheries Sciences* **1**(3): 130-138.
- MINSAL, 1997. Reglamento Sanitario de los Alimentos. Dto N° 977/96 D. of. 13/05/1997 modificado por el Dto. 37/04. Gobierno de Chile. Ministerio de Salud. Departamento de Asesoría Jurídica.
- Ramírez, A. 2007. Salmon by-product proteins. FAO Fisheries Circular No. 1027. 31pp.
- Refsgaard, H., Brockhoff, P., & Jensen, B. 1998. Sensorial and chemical changes farmed Atlantic salmon (*Salmo salar*) during frozen storage. *Journal of Agricultural and Food Chemistry* **46**: 3473-3479.
- Statgraphics v. 5.1. 2000. Statistical Graphics Corporation, Manugistics Inc., MD, USA.