EFFECT OF BORAGE-ADDED FISH GELATIN FILMS ON LIPID OXIDATION OF HORSE MACKEREL PATTIES DURING FROZEN STORAGE

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Horse mackerel contains high levels of ω-3 polyunsaturated fatty acids (PUFAs), which make this species very susceptible to lipid oxidation. Plant extracts and polyphenolic compounds have been used to successfully improve the oxidative stability of seafood products (1-2). These natural compounds have been also added to edible films in order to obtain an active packaging biomaterial (3).

Borage extract was obtained from seeds (4). Filmogenic solution was obtained by dissolving gelatin in water:borage extract 50:50 (4/g/100ml). Sorbitol and glycerol were used as plasticizers (0.15g/g gelatin). Films were made by casting. Horse mackerel patties were vacuum packed (V), coated with borage-added fish gelatin film (F) or neither coated nor vacuum (C), frozen and stored at -20°C. After 240 days, samples were thawed and stored at chilled temperature for 4 days, simulating conditions previous to consumption. Lipid oxidation was evaluated periodically by peroxide value (PV), quantitation of oxidized triacylglycerols (oxTG) and Fourier transform infrared spectroscopy (FTIR).

PV values were generally higher for C throughout the frozen storage (Fig. 1), while similar values were found for V and F up to 180 days, showing the protective effect of the film comparable to that of vacuum. At 180 days, PV of F considerably increased and, after that, tended to decrease in both C and F because of the formation of secondary oxidation products. PV of V highly increased after thawing and chilling due to exposure to air.

IR-spectra of lipids from the patties frozen stored for 240 days were compared with those that were subsequently thawed at this sampling day and chilled stored for 4 days. The absorbance at 3012 cm⁻¹, higher in V240, revealed some differences in the level of lipid unsaturation among the studied samples (Fig. 2A). Both C and V exhibited a decrease in the height of the 3012 cm⁻¹ peak after 4 days of refrigerated storage, but F remained practically unchanged. Similarly, a slight reduction in the frequency values of this band in C_4r and V_4r was found, indicating the disappearance of cis olefinic double bonds in these samples, in contrast to the F_4r. Results were consistent with values found for oxTG (Table 1). The 1743 cm⁻¹ band did not show definite changes attributable to accumulation of aldehydes and ketones as a result of chilled storage. However, the increased absorbance in the region between 1680 and 1652 cm⁻¹ in C_4r and V_4r, followed by F_4r (Fig. 2B) could be largely related to the production of conjugated double bonds, as well as trans C=C groups.

In summary, film coating had protective effects on lipid oxidation of horse mackerel patties after 240 days-frozen and following thawing and 4 days-chilled storage.

Regarding quantitation of total oxTG, V was scarcely oxidized at the end of frozen storage while C had a considerably level of oxidation, including the presence of polymerized TG. As to F, oxidation was much higher than in V but still lower than in C. The influence of thawing and 4-days chilling at air exposure was outstanding for V since the level oxidation doubled that of F and even polymers, absent in F, were found in considerable amounts (Table 1).

In summary, film coating had protective effects on lipid oxidation of horse mackerel patties throughout frozen storage and particularly after thawing and chilled storage. Furthermore, as compared to vacuum packaging, film coating was similarly effective until advanced stages of oxidation were reached and exerted enhanced protection once samples were thawed and exposed to air oxygen under chilling temperature.

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REFERENCES