Chemical Changes in Chilled Farmed Salmon (*Oncorhynchus kisutch*): Effect of Previous High Pressure Treatment

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Abstract: Coho salmon (*Oncorhynchus kisutch*) has recently attracted a great interest as a farmed product. This research focuses on its commercialisation as a chilled product. Thus, the effect of a previous hydrostatic high pressure (HHP) treatment on chemical changes related to quality loss was studied. A marked effect of HHP treatment was observed on lipid hydrolysis (free fatty acid formation), lipid oxidation (primary, secondary and tertiary compounds) and protein breakdown (sarcoplasmic fraction) throughout the chilling storage; however, no influence could be observed on nucleotide degradation and polyene index. Sensory analysis (putrid and amine odour development) showed a profitable effect of HHP on chilled salmon quality; however, no effect could be concluded on rancid odour development.

Keywords: Coho salamon; high pressure; chilling; proteins; lipids; nucleatides

INTRODUCTION

During fish chilled storage, significant deterioration of sensory quality and nutritional value has been detected as a result of chemical constituent changes (Whittle *et al*. 1990). Among the different recent technologies to be applied for marine food preservation, hydrostatic high pressure (HHP) processing has been investigated. HHP has shown to inactivate microbial and endogenous enzymes; however, deteriorative problems have been encountered with constituents (proteins and lipids, namely) (Ohshima *et al*. 1993).

In recent years, the fishing sector is paying more attention to aquaculture development as a source of marine food products. One of such species is coho salmon (*Oncorhynchus kisutch*). The present work was focused on the chilled storage of this species; the effect of a previous HHP treatment on chemical changes during its chilling storage was studied (Project 2006).

MATERIAL AND METHODS

Three different HHP conditions (135 MPa for 30 s; 170 MPa for 30 s; 200 MPa for 30 s; treatments T1, T2 and T3, respectively) were applied to fresh fish and compared to untreated fish (control, treatment C). Coho salmon individuals (50–52 cm length; 2.8–3.0 kg weight) were obtained from an aquaculture facility (Project 2006). For each HHP condition, three different batches (n = 3) were considered and analysed separately. Sampling was carried out at days 0, 6, 10, 15, and 20 of chilled storage. The study was addressed to nucleotide, lipid and protein changes in salmon muscle and compared to sensory acceptance.

Sensory analysis (skin, eyes, external odour, gills, consistency) was conducted by a trained sensory panel according to EC guidelines (DOCE 1989).

The K value (%) was analysed according to Aubourg *et al*. (2005). The lipid fraction was extracted by the Bligh and Dyer (1959) method.

Free fatty acid (FFA) content was determined by the Lowry and Tinsley (1976) method. The peroxide value (PV) was determined according to Chapman and McKay (1949). The thiobarbituric acid index (TBA-i) was determined according to Vyncke (1970). Fluorescent compound formation was analysed according to Aubourg *et al.* (1997). Fatty acid methyl esters were prepared and analysed according to Aubourg *et al.* (1996); polyene index was calculated according to the fatty acid content ratio: C 22:6ω3 + C20:5ω3/C16:0. Protein extraction, quantification and electrophoretic analysis were carried out according to Aubourg *et al.* (2005); quantification of sarcoplasmic protein is expressed as g/100 g muscle. Electrophoretic band identification was achieved by tandem mass spectrometry analysis (ion trap mass spectrometer model LCQ Deca XP Plus) according to Carrera *et al.* (2007). Data were subjected to statistical analysis ($P < 0.05$) to explore significant differences as a result of HHP conditions and chilling time (SPSS Inc., Chicago, USA).

RESULTS

Nucleotide degradation was important during the chilled storage (Whittle *et al.* 1990); however, the K value did not afford differences as a result of the previous HHP treatment (Table 1). FFA formation was also relevant during the chilled storage for all kinds of samples; some higher values were obtained for individuals previously treated under T1 condition. A marked lipid oxidation development was evident in all kinds of fishes throughout the chilled storage. Thus, formation of primary (PV) and secondary (TBA-i) lipid oxidation compounds was found higher in samples corresponding to C and T1 treatments, while a higher fluorescent compound formation (tertiary oxidation) could be depicted from individual fishes corresponding to T2 and T3 treatments. Previous research has shown a marked effect of interaction compound formation (tertiary lipid oxidation) on nutritional and sensory value losses (Pokorný 1981; Mackie 1993); however, in the present study, the polyene index did not provide differences as a result of chilled storage or previous HHP treatment. Concerning the protein fraction, an important loss in sarcoplasmic content was evident in samples corresponding to T2 and T3 treatments (Table 2). In addition, the electrophoretic analysis of such protein fraction showed an important loss of a band placed at 29 kDa resulting from the pressure treatment and the chilled storage; protein present in such band was identified as phosphoglycerate mutase by tandem mass spectrometry. Sensory analysis (putrid and amine odour development) showed a profitable effect of HHP on chilled salmon quality; however, no effect could be concluded on rancid odour development.

Table 1. Evolution of the K value (%) in chilled salmon muscle that was previously treated under different conditions*

Chilling time (days)	Previous treatment			
	C	T1	T2	T3
0	25.89	24.31	24.85	25.46
	(4.96)	(1.75)	(0.29)	(5.62)
6	49.63	65.95	57.84	62.02
	(6.37)	(7.44)	(8.10)	(4.56)
10	72.71	72.10	74.48	70.85
	(1.62)	(1.66)	(2.01)	(2.12)
15	81.04	78.11	83.49	79.39
	(2.00)	(1.36)	(0.63)	(1.07)
20	83.11	84.43	80.71	83.79
	(0.68)	(2.68)	(1.93)	(1.58)

Table 2. Evolution of sarcoplasmic protein content in chilled salmon muscle that was previously treated under different conditions*

Chilling time (days)	Previous treatment			
	C	T1	T2	T3
0	2.66	2.61	2.28	2.13
	(0.28)	(0.31)	(0.29)	(0.18)
6	2.76	2.58	2.28	2.21
	(0.10)	(0.16)	(0.10)	(0.11)
10	2.57	2.43	2.13	2.08
	(0.57)	(0.04)	(0.30)	(0.17)
15	2.50	2.25	2.04	1.96
	(0.11)	(0.33)	(0.30)	(0.15)
20	2.13	2.14	1.58	1.46
	(0.02)	(0.10)	(0.18)	(0.10)

*For both tables, mean values of three (n = 3) independent determinations are expressed. Standard deviations are indicated in brackets. Previous treatment abbreviations as expressed in the Material and Methods section

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Project (2006): This research was carried out in the frame of the Project "2006 CL 0034" (2007–2008), granted by the U. Chile-CSIC Cooperation Program. Coho salmon fish was provided by AQUACHILE S.A. Puerto Montt, Chile.

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