Chemical Changes in Chilled Farmed Sea Bass (*Dicentrarchus labrax*): Effect of Advanced Icing Conditions

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Abstract: The present research was focused on the commercialisation of fresh farmed sea bass (*Dicentrarchus labrax*). A slurry ice prototype (60% water/40% ice) coupled to an ozone generator (700 mV, 0.17 mg/l) was tested for the slaughtering and chilling storage (up to 7 days) of this species; comparison with slurry ice treatment alone was undergone. The study was addressed to chemical constituent changes (autolysis, lipid hydrolysis and oxidation, volatile amine formation) in fish muscle related to quality loss; comparison to sensory assessment (skin, eyes, external odour, gills, consistency) was carried out. Increasing values ($P < 0.05$) with icing time could be observed for autolysis (K value assessment), lipid hydrolysis (free fatty acid formation) and microbiological activity (trimethylamine formation); however, no effect ($P > 0.05$) of icing time on lipid oxidation (primary and secondary compounds) could be depicted. Concerning differences between both icing conditions, a lower ($P < 0.05$) free fatty acid formation was concluded for individuals kept under slurry ice-ozone condition. For both icing conditions, acceptable sensory quality was accorded at day 7, being scores better (eyes and gills) in the case of fish where ozone was incorporated to slurry ice.

Keywords: sea bass; slurry ice; ozone; microbial activity; autolysis; lipid damage

INTRODUCTION

Slurry ice has proved to be a profitable technique for the preservation of marine species. Among the different advantages reported over flake ice, lower temperature, faster chilling and lower physical damage can be mentioned (Piñeiro *et al*. 2004). On the other hand, ozone has shown to be a powerful antimicrobial agent that is suitable for application to marine food preservation, although some detrimental action concerning its prooxidant effect has been reported (Fukunaga *et al*. 1991).

In recent years, the fishing sector has suffered from dwindling stocks of traditional species. This has prompted the fish trade to pay more attention to aquaculture development as a source of marine food products. An important farmed species is sea bass (*Dicentrarchus labrax*). The present work focuses on the quality retention of this species under chilling conditions; for it, an advanced chilling system combining slurry ice and ozone is checked (Project 2005).

MATERIAL AND METHODS

A slurry ice prototype (60% water/40% ice) was coupled to an ozone generator (700 mV, 0.17 mg/l) (OSI system) and tested for the slaughtering and chilling storage (up to 7 days) of sea bass; comparison with slurry ice treatment alone (SI system) was undergone. Sea bass individuals (32–38 cm length; 450–600 g weight) were obtained from an aquaculture facility (Project 2005). For each icing

condition, three different batches were considered and analysed separately (n = 3).

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

Different chemical indices related to quality loss were measured in fish muscle. The K value (%) was analysed according to Aubourg *et al.* (2005). Total volatile base-nitrogen (TVB-N) content was measured according to Aubourg *et al.* (1997); results are expressed as mg TVB-N/100 g muscle. Trimethylamine-nitrogen (TMA-N) content was determined by the Tozawa *et al.* (1971) method; results are expressed as mg TMA-N/100 g muscle. Lipid extraction was carried out according to the Bligh and Dyer (1959) method. Free fatty acid (FFA) content was determined by the Lowry and Tinsley (1976) method; results are expressed as g FFA/100 g lipids. The peroxide value (PV) was determined according to Chapman and McKay (1949); results are expressed as meq active oxygen/kg lipids. The thiobarbituric acid index (TBA-i) was determined according to Vyncke (1970); results are expressed as mg malondialdehyde/kg muscle. 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 as the fatty acid ratio: C22:6ω3 + C20:5ω3/C16:0.

Data were subjected to statistical analysis (P < 0.05) to explore significant differences as a result of icing conditions and chilling time (SPSS Inc., Chicago, Il, USA).

Table 1. K value evolution and amine (total and trimethylamine) formation in sea bass after slaughtering and chilling storage under SI and OSI conditions*

Icing time (days)	K value (%)		TVB-N		TMA-N	
	SI	OSI	SI	OSI	SI	OSI
1	6.14 a	8.78 a	29.35	30.30	0.04 a	0.03 a
	(0.51)	(3.76)	(1.77)	(0.58)	(0.00)	(0.01)
4	17.45 b	19.68 b	28.45	29.63	0.05 a	0.08 b
	(1.19)	(2.98)	(1.78)	(0.34)	(0.01)	(0.02)
7	29.97 c	32.83 c	28.16	28.37	0.10 b	0.10 b
	(2.51)	(1.54)	(1.08)	(0.85)	(0.02)	(0.01)

Table 2. Lipid hydrolysis and oxidation assessment in sea bass after slaughtering and chilling storage under SI and OSI conditions*

Icing time (days)	FFA formation		Peroxide value		TBA-i	
	SI	OSI	SI	OSI	SI	OSI
1	0.07 a	0.14 a	4.38	3.12	0.36	0.28
	(0.05)	(0.08)	(1.35)	(0.55)	(0.05)	(0.16)
4	0.30 b	0.18 a	3.75	3.36	0.41	0.32
	(0.11)	(0.12)	(0.33)	(0.95)	(0.17)	(0.18)
7	y 1.47 c	z 0.53 b	4.51	3.55	0.52	0.41
	(0.82)	(0.17)	(2.60)	(0.67)	(0.13)	(0.05)

*For both tables, mean values of three (n = 3) independent determinations are expressed. Standard deviations are indicated in brackets. For each parameter, mean values followed by a different letter (a, b, c) denote significant differences (P < 0.05) as a result of icing time. Mean values preceded by a different letter (y, z) indicate a significant difference (P < 0.05) as a result of icing condition

RESULTS

For both icing conditions, acceptable sensory quality was accorded at day 7 (end of the experiment), being scores better (eyes and gills) in the case of fish corresponding to OSI system. An increasing K value was observed with time for both kinds of fish material; individuals treated under OSI system showed higher mean values than their corresponding samples from SI conditions. TVB-N content did not afford differences as a result of storage, neither as a result of the treatment conditions. An increasing trimethylamine content with time could be depicted for both icing conditions; however, no differences between OSI and SI individual fishes were observed. A marked increase could be observed for the FFA content in all cases, this showing higher values for individuals kept under SI system. Peroxide formation did not afford differences as a result of storage, neither as a result of the treatment conditions. Slight increases with time could be observed for thiobarbituric acid index assessment in both kinds of fish; however, no differences could be concluded between both kinds of fish material. Fluorescent compound formation and polyene index provided no changes throughout the icing time.

It is concluded that, ozone incorporation to slurry ice during the slaughtering and chilled storage steps of sea bass commercialisation has led to performances in sensory acceptance and lipid hydrolysis development. However, no other chemical difference could be concluded, these including no effect on lipid oxidation development.

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