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Effect of pre-slaughter conditions in European sea bass (*Dicentrarchus labrax*)

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RIASSUNTO – Effetto delle condizioni pre-macellazione in spigole (*Dicentrarchus labrax*). *Allo scopo di valutare l'effetto delle condizioni pre-macellazione sulla qualità e la freschezza durante la conservazione, 210 spigole sono state poste in vasche a bassa densità (20 kg/m^3) e ad alta densità (80 kg/m^3). Entro densità, le sp*

gole sono state macellate dopo 2 o 24 h. La densità nelle vasche pre-macellazione ha influenzato marginalmente

gli indicatori fisiologici di stress e le variabili di freschezza. L'aumento dell'attesa pre-macellazione da 2 a 24 h

non ha modificato il livello plasmatico di cortisolo, ha ridotto la glicemia e ha influenzato negativamente alcun

indici di freschezza. Nel complesso, tuttavia, la qualità e la freschezza del pesce durante la conservazione non

sono state sostanzialmente modificate dalle condizioni di pre-macellazione.

Key words: sea bass, stress indicators, pre-slaughter conditions, freshness.

INTRODUCTION – The increasing attention towards animal welfare also concerns aquaculture species, with special regards to husbandry and slaughter conditions. Both the extent and the duration of stressful events especially before slaughter may affect post-mortem evolution of biochemical processes and product shelf-life (Pottinger, 2001; Zampacavallo *et al.*, 2003). The present work aimed to evaluate the effects of pre-slaughter conditions in European sea bass according to *i)* stocking density and *ii)* time spent in confinement tanks after catch and before slaughter on physiological indicators of stress and meat quality during storage.

MATERIALS AND METHODS – Two-hundred-ten European sea bass (*Dicentrarchus labrax*) were used. The fish were caught on June from an intensive pond integrated in an extensive fish valley of the Veneto region. Soon after catch, 10 sea bass were bled to measure plasma basal levels of glucose (spectrophotometrically, Sigma Chemical Co.) and cortisol (RIA). The remaining 200 animals were put into four pre-slaughter tanks (50 sea bass/tank): two larger tanks with fish kept at a lower stocking density (D20 = 20 kg/m^3) and two smaller tanks at a higher stocking density (D80: 80 kg/m^3). Within stocking density, sea bass waited 2 h (W02, first tank) or 24 h (W24, second tank) before slaughter. Water temperature was constant at 24°C and dissolved oxygen was maintained near saturation (9-10 ppm). At slaughter in water and ice, 10 sea bass per experimental group were used for blood sampling as described above, while the remaining 40 sea bass were moved to the laboratory for carcass and meat quality assessment. Analyses were performed the day of slaughter (3 to 5 h after slaughter) and after 4, 7, 11 and 14 days of refrigeration at 2-3°C on 8 sea bass/treatment/day. Rigor index, biometric measures and dissection were performed as detailed by Poli *et al.* (2001). The pH of eye liquor and right fillets was measured using a pHmeter equipped with a specific electrode (FC230B, Hanna Instruments). Colour was recorded on right fillets by Minolta Spectrophotometer CM-508 C (Minolta, Milano) according to CIEL*a*b* method. Texture profile analysis was performed on a section of the dorsal left fillet by TA.HDI dynamometer (Stabel Micro System Ldt., UK). An aliquot of fresh minced left fillet was immediately analysed for total volatile basic N (TVBN). Data on blood and quality traits measured the day of slaughter were submitted to analysis of variance using the GLM procedure of SAS (1991), according to a bi-factorial arrangement (2x2) with pre-slaughter stocking density and wait as main variability factors and their interaction. Quality traits during storage were analysed according to a three-factorial arrangement, including also the effect of storage time.

RESULTS AND CONCLUSIONS – Blood glucose concentration averaged 1.66±0.43 g/l in sea bass at catch and changed with pre-slaughter conditions (Table 1). Increasing stocking density slightly reduced blood glucose (P=0.06), while increasing pre-slaughter wait from 2 to 24 h reduced it (P<0.001). Sea bass confined for 24 h did not likely recover their initial blood glucose levels due to starvation. A significant interaction between stocking density and pre-slaughter wait was measured (P=0.03). Blood cortisol was affected by catch and confinement stress in pre-slaughter tanks, as it raised from 174±44 ng/ml measured soon after catch to more than 600 ng/ml after a 2 h confinement regardless from stocking density and did not significantly decrease after 24 h. In fact, blood cortisol concentration is known to decrease slowly after an acute stress (Pottinger, 2001).

Table 1. Blood variables in sea bass at slaughter and pre-rigor characteristics.

	Stocking density (D)		Pre-slaughter wait (W)	

RSD

		D20	D80	Prob.	W02	W24	Prob.	
Sea bass	n.	20	20		20	20		
Glucose1	g/l	2.08	1.83	0.06	2.80	1.11	<0.001	0.41
Cortisol	ng/ml	539	640	n.s.	614	565	n.s.	255

1 DxW, P=0.03, glucose: 3.08, 1.09, 2.52 and 1.13 g/l in groups D20-W02, D20-W24, D80-W02 and D80-W24, respectively.

Only few traits of carcass and meat quality measured the day of slaughter were affected by pre-slaughter conditions. A higher rigor index was measured in sea bass kept at a lower stocking density (36.4% in D20 *vs.* 22.6% in D80, P=0.05) and slaughtered after two hours (38.8% in W02 *vs.* 20.3% in W24, P=0.01) (data not reported in tables). Fillet pH, texture, colour and TVBN were not significantly modified, however.
During storage from 4 to 14 d, increasing stocking density only increased eye pH and reduced skin lightness, while other variables were not affected (Table 2). On the other hand, increasing pre-slaughter wait up to 24 h increased carcass dressing percentage (P=0.03), which could be ascribed to a starvation effect. During storage, average rigor index and skin lightness decreased in W24 sea bass, while eye pH increased. Pre-slaughter wait did not affect fillet pH, lightness or hardness, but a significant increase of TVBN was recorded in W24 fish. However, this latter variable was found to be badly correlated with sea bass freshness (Papadopolous *et al.*, 2003).

Table 2. Sea bass and meat quality traits (average value at 4, 7, 11 and 14 d of storage).

		Stocking density (D)			Pre-slaughter wait (W)		
		D20	D80	Prob.	W02	W24	Prob.
Sea bass	n.	64	64		64	64	
Live weight	g	478	482	n.s.	484	476	n.s.
Dressing percentage	% LW	87.9	87.8	n.s.	87.6	88.1	0.03
Fillet percentage	% LW	56.8	57.1	n.s.	57.3	56.6	n.s.
Rigor index	%	74.0	75.0	n.s.	75.9	73.0	<0.01
Eye pH		6.61	6.67	<0.001	6.52	6.76	<0.001
Skin L*		50.3	47.4	<0.001	50.1	47.7	<0.001
Fillet pH		6.34	6.37	n.s.	6.35	6.36	n.s.
Fillet L*		36.8	36.9	n.s.	37.1	36.6	n.s.
Meat hardness	g/cm^2	1.34	1.43	n.s.	1.41	1.36	n.s.
Meat TVBN	mg N/100 g	18.2	18.6	n.s.	17.8	19.0	<0.001

Regardless from pre-slaughter treatment, sea bass resulted sufficiently fresh until 14 d (Table 3). As expected, during storage rigor index decreased, while fillet and eye pH raised (P<0.01); skin lightness was reduced, while fillet lightness and texture did not change. The interaction between storage time and pre-slaughter wait was significant for some traits, showing a different evolution in sea bass slaughtered after 2 or 24 h of confinement, even if differences were limited in absolute value. No significant interaction between storage time and stocking density was measured.

Table 3. Sea bass and meat quality during storage (average value of experimental groups)

		Days after slaughter (T)				Probability		RSD
		4	7	11	14	T	T x W	
Sea bass	n.	32	32	32	32			
Live weight	g	491	461	486	482	n.s.	n.s.	76