Notes

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Evolution of instrumental colour coordinates (CIE L*a*b*) in vacuum-packaged Iberian dry-cured loin as affected by nitrate/nitrite reduction and hydrostatic high pressure processing (#376)

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Introduction

Nitrates and nitrites are currently authorised as food additives within the EU. Both of them are recognized for their function as preservatives in meat and meat products and providing the characteristic reddish colour and flavour of cured meats. Nitrite improves meat safety by inhibiting the growth of microorganism, such as *Clostridium botulinum* and other pathogenic bacteria. High hydrostatic pressure processing (HHPP) in dry cured meats allows to obtain minimally-processed meats, preservative-free products, while maintaining consistent sensory attributes over an extended shelf life, and still assuring product safety.

The aim of this study was to evaluate the instrumental colour coordinates (CIE L*a*b*) changes during cold storage of Iberian dry-cured loins formulated with reduced levels of nitrate/nitrite and processed with hydrostatic high pressure processing.

Methods

Iberian dry-cured loins. Four batches of Iberian dry-cured loins were manufactured, according to a traditional process for this type of products, with decreasing amounts of added nitrite/nitrate: **1. 100% NO_2^-/NO_3^- (150 mg/Kg NO_2^- + 150 mg/Kg NO_3^-), 2. 50% reduction NO_2^-/NO_3^- (75 mg/Kg NO_2^-+ 75 mg/Kg NO_3^-), 3. 75% reduction NO_2^-/NO_3^- (37.5 mg/Kg NO_2^-+ 37.5 mg/Kg NO_3^-)** and **4. no NO_2^-/NO_3^- added (0 mg/Kg NO_2^-/NO_3^-)**. Loins were seasoned by rubbing a mixture of salt, ascorbate and potassium nitrate and sodium nitrite and spanish paprika. All batches followed a usual drying-ripening process.

At the end of processing, dry-cured loins from the experimental groups were portioned and divided in: **1. Control** and **2. Hydrostatic High-Pressure-Processing (HHPP)** and were vacuum packed.

Hydrostatic high pressure processing. Dry-cured loins were pressurised in a semi-industrial hydrostatic pressure unit (Hiperbaric Wave 6000/55; Burgos, Spain) and processed at 600 MPa - 7 min.

Storage. Loin samples (150, 75, 37.5 and 0 mg/Kg NO_2^-/NO_3^-) from control and HHPP batches were stored at +4ºC. At days 0, 30, 60 and 120 of chilled storage samples were taken.

Instrumental colour determination. Measurements were done following the recommendations of the AMSA. Colour coordinates were measured using a Minolta CR-300 colorimeter (Minolta Camera, Osaka, Japan) with an illuminant D65, a 0°standard observer and 0.8 cm port/viewing area. The colorimeter was standardized before use (CR-A43, CM-A182). Nine measurements were taken in randomly selected sites on each slice of sample and mean values were calculated. Lightness (L*), redness (a*) and yellowness (b*) colour coordinates were determined. In addition, the psychophysical magnitudes hue angle (H^o= atanb^*/a^*·360/2π), and the saturation index or chroma (C^*) (C= $(a^{*2}+b^{*2})^{0.5}$) were calculated.

Statistical analysis. Instrumental colour values were analysed by a Two-Ways Analysis of Variance with interaction procedure using SPSS statistical software. There were five replicates per different treatment and time of storage. Tukey's test was used to compare differences among mean values of the treatments when MANOVA showed significance. Mean values and standard error of the mean were reported.

Results

CIE L*a*b* values were affected differently by the added nitrate/nitrite level or HHPP (**Table 1**). In this way, no effect was found on CIE L * due to the level of added NO_3^-/NO_2^- but due to HHPP. In contrast, the values of a * and b * were affected by added NO_3^-/NO_2^- and to a lesser extent by HHPP. Thereby, CIE L* values were significantly higher in HHPP samples than in those non-treated (control) at day 30, 60 and 120 resulting in lighter samples. In all sampling days, loins without added NO_3^-/NO_2^- (0 mg/Kg) showed lower CIE a*-values indicating a lower redness. No differences were found within batches with different level of added NO_3^-/NO_2^- (37.5, 75 and 150 mg/Kg). HHPP only changed CIE a*-value at day 0 and 60. CIE b*-values were not affected by HHPP at day 30, 60 and 120. In those loins with NO_3^-/NO_2^- (37.5, 75 and 150 mg/Kg) no differences were found as a result of the added level. At day 30 and 60 of storage, CIE b*-values of loins without NO_3^-/NO_2^-were significantly higher than in those with 150 mg/kg NO_3^-/NO_2^-.

Regarding psychophysical variables (**Table 2**), NO_3^-/NO_2^- addition to formulation of Iberian dry-cured loins did not significantly affect C* values at any of time of sampling. Control samples showed a significantly lower chroma value at day 0; however, HHPP significantly reduced C*-value at day 60 of refrigerated storage. In contrast, hue values did significantly change as a consequence of the level of NO_3^-/NO_2^- adde. Thus, highest ºH-values

($p<0.05$) were found in loins without added NO_3^-/NO_2^- at day 30, 60 and 120 of chilled storage while HPPP did not affect hue values.

Conclusion

Removal of NO_3^-/NO_2^- from Iberian dry-cured loins produces less red-coloured loins during chilled storage. It is possible to reduce at 37.5 mg/kg added NO_3^-/NO_2^- without changes in instrumental colour with respect to loins with 150 mg/kg NO_3^-/NO_2^- added. HHPP is a useful technology in reduced or removed NO_3^-/NO_2^- in Iberian dry-cured Iberian loins due to the lack of effect on colour changes.

Acknowledgements

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	NO2/NO3								HHPP/No HHPP		SEM	Significance		
	0 ppm		37.5 ppm		75 ppm		150 ppm		HHPP	Control		NO2/NO3	HHPP	NO2/NO3*HHPP
Lightness (L*)														
Day 0	42.9		44.0		40.9		40.4		41.8	42.4	0.58	n.s.	n.s.	n.s.
Day 30	39.9		40.2		40.6		40.4		42.5	38.1	0.63	n.s.	***	n.s.
Day 60	40.2		41.8		40.9		41.3		44.6	37.5	0.77	n.s.	***	n.s.
Day 120	38.1		40.2		37.3		38.7		40.3	36.9	0.60	n.s.	**	n.s.
Redness (CIE a*)														
Day 0	7.8	b	9.2	a	9.9	a	9.8	a	9.5	8.8	0.20	***	*	n.s.
Day 30	9.0	b	10.1	a	9.9	ab	9.9	ab	9.5	9.9	0.15	*	n.s.	n.s.
Day 60	9.1	b	10.4	a	10.1	ab	9.8	ab	9.4	10.3	0.16	*	**	n.s.
Day 120	9.5	b	10.7	ab	11.6	a	11.3	a	10.9	10.7	0.24	**	n.s.	n.s.
Yellowness (CIE b*)														
Day 0	6.2		5.6		5.9		5.2		7.4	4.1	0.40	n.s.	***	*
Day 30	9.6	a	7.9	b	8.4	ab	7.9	b	8.6	8.4	0.20	**	n.s.	n.s.
Day 60	9.4	a	8.8	ab	8.2	ab	7.5	b	8.3	8.7	0.23	*	n.s.	n.s.
Day 120	8.6		7.0		8.2		7.3		8.1	7.5	0.32	n.s.	n.s.	n.s.

Table 1. Intrumental color parameters (CIE L*a*b*) of Iberian dry-cured loins Effect of nitrate-nitrite addition and hydrostatic high pressure processing on intrumental color paramenters (CIE L*a*b*) of Iberian dry-cured loins throughout cold storage. a,b: means with different letter are statistically different (Tukey's test, p<0.005) *: p<0.05; **: p<0.01; p<0.001

Table 2. Chroma and hue of Iberian dry-cured loins

Effect of nitrate-nitrite addition and hydrostatic high pressure processing on chroma and hue of Iberian dry-cured loins throughout cold storage. a,b: means with different letter are statistically different (Tukey's test, p<0.005) *: p<0.05; **: p<0.01; p<0.001

	NO2/NO3								HHPP/No HHPP		SEM	Significance		
	0 ppm		37.5 ppm		75 ppm		150 ppm		HHPP	Control		NO2/NO3	HHPP	NO2/NO3*HHPP
Chroma (C*)														
Day 0	10.3		10.9		11.6		11.1		12.2	9.8	0.32	n.s.	***	*
Day 30	13.2		12.9		13.0		12.7		12.8	13.0	0.18	n.s.	n.s.	n.s.
Day 60	13.1		13.6		13.0		12.4		12.6	13.5	0.23	n.s.	*	n.s.
Day 120	12.9		12.8		14.3		13.5		13.6	13.2	0.33	n.s.	n.s.	n.s.
Hue (°H)														
Day 0	34.8		30.1		30.2		27.7		37,6	23,8	1,69	n.s.	***	*
Day 30	46.8	a	37.9	b	40.5	b	38.6	b	41,9	40,0	0,80	***	n.s.	n.s.
Day 60	45.9	a	40.2	b	39.2	b	37.2	b	41,1	40,1	0,77	***	n.s.	n.s.
Day 120	41.2	a	32.9	b	34.6	b	32.6	b	36,3	34,3	0,99	**	n.s.	n.s.

Notes