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Is hydrogen peroxide and peracetic acid dipping solution before MAP effective as an antimicrobial and antioxidant agent in extending rabbit meat shelf life? (#190)

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Introduction

Abstract – This study aimed at evaluating the effect of different packaging systems, i.e. normal atmosphere packaging (BAG), modified atmosphere packaging (MAP) and hydrogen peroxide and peracetic acid-MAP (H-MAP), on rabbit loin meat stored at 12 °C for 14-day shelf life trial. Analyses were made at days 0 (control), 7 and 14 and involved drip loss, pH, L*a*b* color values, lipid oxidation and mesophilic growth. Results indicated that the H-MAP packaging was the best solution to improve the shelf life of rabbit meat stored at refrigerated temperature.

Introduction

Packaging plays a very important role to preserve food, facilitate sales and thus reduce food waste. In particular, MAP contains a mixture of gases which extends the shelf life of food products: high CO_2 acts as an antimicrobial agent and low O_2 reduces oxidation [1]. Furthermore, the combination of MAP with pre-packaging treatments, like hydrogen peroxide (H; H_2O_2) and peracetic acid (PAA; $C_2H_4O_3$), could improve the anti-microbial activities [2] and further extend the shelf life of meat products. Therefore, the present research tested the pretreatment with H-PAA solution and packaging system on rabbit meat shelf life.

Methods

A total n=124 rabbit loins were bought at a commercial slaughterhouse, weighed, coded and packaged in: BAG (atmospheric composition), MAP (59.5% N_2, 40.0% CO_2, 0.5% O_2) and H-MAP (59.5% N_2, 40.0% CO_2, 0.5% O_2). The H-MAP samples were pretreated with 5% of OX-VIRIN (25% H_2O_2 and 5% PAA; H-PAA solution) before MAP packaging. Samples were displayed at 12.0 °C in order to exacerbate oxidative and microbial spoilage processes. Samples were analyzed at days 0 (control), 7 and 14. A total of n=80 samples were used for physicochemical (drip loss, L*a*b* color, pH cooking loss, WBSF, TBARS) and n=44 samples for microbial (total mesophilic count; UNI EN ISO 4833:2004) analyses. Data were analyzed by two separate one-way ANOVA considering the effects of packaging system and time.

Results

The packaging system neither influenced pH nor color values of rabbit meat, whereas it affected rabbit meat drip loss when considering the whole shelf life period (Table 1): it was higher in H-MAP than BAG group, likely due to a cell membrane breaking effect of the H-PAA solution [2]. MAP group showed intermediate results. MAP and H-MAP packaging systems improved the oxidative stability of rabbit meat throughout the shelf life (Table 2), which was mainly due to the minimal concentration of residual O_2 compared to the BAG group, as suggested by Berruga *et al*. [3]. Compared to BAG, the MAP and H-MAP treatments improved the microbial stability, but in different manners: the mesophilic count was the lowest at day 7 for MAP, at day 14 for H-MAP. The presence of CO_2 and/or H-PAA solution might explain such results as both possess antimicrobial properties: CO_2 alters cell membrane function and it changes the intracellular pH and the physicochemical properties of proteins [1]. The H-PAA solution has a strong oxidizing power against lipids, proteins and nucleic acids, thus damaging the cell membrane and its biochemical pathways [2]. Despite this, no negative effects, but rather positive, on the oxidative status of meat lipids were observed along the shelf life which was explained by the protective effect of the MAP. Results of the present study agree with previous ones on MAP system of rabbit meat under retail display conditions [4]. As expected, independently to the packaging system, the overall physicochemical quality of rabbit meat generally worsened with storage.

Conclusion

Compared to BAG packaging, the MAP effectively preserved the rabbit meat refrigerated at 12 °C for 14 days, however H-PAA solution/MAP combination ensured the best results.

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Notes

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	Treatments			SE	Sign.
	BAG	MAP	H-MAP		
Cooking Loss					
Day 0	19.2	19.2	19.2^{XYy}	0.650	-
Day 7	20.7	19.4	18.8^{Y}	0.887	ns
Day 14	21.6	21.8	21.9^{Xx}	0.774	ns
SE	0.923	0.849	0.695		
Sign.	ns	ns	<0.01		
Shear force					
Day 0	10.6^{Y}	10.6^{y}	10.6^{Y}	0.641	-
Day 7	12.2^{XY}	12.4^{xy}	12.8^{XY}	0.777	ns
Day 14	14.0^{X}	14.1^{x}	15.1^{X}	0.727	ns
SE	0.704	0.788	0.710		
Sign.	<0.05	<0.05	<0.001		
TBARs					
Day 0	0.73^{Yy}	0.73^{Y}	0.73^{Y}	0.009	-
Day 7	2.25^{XYxa}	0.89^{Yb}	0.80^{XYyb}	0.301	<0.01
Day 14	3.28^{XA}	1.51^{XB}	1.45^{XxB}	0.307	<0.001
SE	0.397	0.093	0.137		
Sign.	<0.01	<0.001	<0.01		
Mesophilic					
Day 0	0.70^{Z}	0.70^{Z}	0.70^{Y}	-	-
Day 7	6.32^{YA}	3.05^{YBb}	5.23^{XAa}	0.493	<0.01
Day 14	7.28^{Xa}	6.95^{Xab}	4.45^{Xb}	0.710	<0.05
SE	0.049	0.392	0.668		
Sign.	<0.001	<0.001	<0.001		

$^{A, B \text{ or } a, b}$ Means in a row with different superscripts differ significantly; $^{X, Y \text{ or } x, y}$ Means in a column with different superscripts differ significantly (P<0.0001; P<0.001; P<0.05); ns = not significant.

Table 2.
Effect of different packaging systems on cooking loss, shear force, TBARs (mg MDA/kg meat) and mesophilic count in rabbit meat refrigerated at 12 °C for 14 days.

	Treatments			SE	Sign.
	BAG	MAP	H-MAP		
Drip Loss					
Day 0-7	4.62	3.97	5.16	0.583	ns
Day 0-14	4.90^{b}	6.28^{ab}	6.81^{a}	0.524	<0.05
SE	0.704	0.290	0.590		
Sign.	ns	<0.001	ns		
pH					
Day 0	5.52^{Yy}	5.52^{Y}	5.52^{Y}	0.098	-
Day 7	5.71^{X}	5.70^{X}	5.67^{X}	0.013	ns
Day 14	5.66^{XYx}	5.65^{X}	5.66^{X}	0.029	ns
SE	0.030	0.018	0.020		
Sign.	<0.001	<0.001	<0.001		
L*					
Day 0	50.8^{Y}	50.8^{Y}	50.8^{Y}	0.754	-
Day 7	53.9^{XY}	55.9^{X}	56.7^{X}	0.890	ns
Day 14	57.0^{X}	56.6^{X}	57.6^{X}	0.930	ns
SE	0.962	0.879	0.892		
Sign.	<0.001	<0.001	<0.001		
*a**					
Day 0	-3.46^{Yy}	-3.46^{Y}	-3.46^{Y}	0.196	-
Day 7	-2.24^{Xx}	-2.47^{XY}	-2.22^{X}	0.312	ns
Day 14	-1.37^{X}	-1.72^{X}	-2.15^{X}	0.255	ns
SE	0.293	0.304	0.238		
Sign.	<0.001	<0.01	<0.01		
*b**					
Day 0	6.43^{y}	6.43^{Y}	6.43^{Y}	0.344	-
Day 7	8.16^{x}	7.69^{XY}	7.92^{XY}	0.423	ns
Day 14	7.70^{xy}	9.06^{X}	8.50^{X}	0.461	ns
SE	0.427	0.466	0.426		
Sign.	<0.05	<0.01	<0.01		

$^{A, B \text{ or } a, b}$ Means in a row with different superscripts differ significantly; $^{X, Y \text{ or } x, y}$ Means in a column with different superscripts differ significantly (P<0.0001; P<0.001; P<0.05); ns = not significant.

Table 1.
Effect ofdifferent packaging systems on drip loss, pH, L*a*b* color values of rabbit meat refrigerated at 12 °C for 14 days.

Notes