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WET AGEING OF RABBIT MEAT: EFFECTS ON TECHNOLOGICAL AND MICROBIOLOGICAL MEAT QUALITY

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I. INTRODUCTION

Ageing meat is a strategy that improves sensory characteristics of meat and can also modify its flavor [1]. It can be applied in wet conditions, where meat is vacuum-packed, or in dry conditions, with or without a permeable water vapor bag. During ageing, the meat is stored at refrigerated temperatures and relative humidity is controlled. The use of ageing is well widespread in beef [2], while its application in rabbit meat is very limited. As in other species, rabbit meat evolves favorably during post-mortem refrigeration [3]. Thus, the application of ageing processes in rabbit meat may improve its tenderness and upgrade its market value. The microbiological quality of dry-aged beef and wet-aged beef, pork and lamb has been recently assessed [4], and best practices for the ageing of these meats have been provided. In the same way, ageing protocols should be adapted to rabbit meat to obtain the expected benefits without compromising food safety. The aim of this study was to assess the evolution of technological and microbiological quality of rabbit loins submitted to different wet ageing and storage conditions.

II. MATERIALS AND METHODS

Sixty vacuum-packed commercial rabbit loins were transferred to IRTA-Monells facilities at 48 h *post-mortem*. Once arrived, loins were divided into homogeneous groups by weight of 12 samples, and each group was assigned an ageing-storage condition. Twelve loins were processed and analyzed the arrival day (Fresh group), and the remaining 48 were vacuum-packaged aged for 9 days (d) at 2.0 °C ± 0.22 ºC. After that time, 12 loins were processed and analyzed (Aged group) and the remaining samples were stored vacuum packaged at 6.0 °C ± 0.41 ºC under a 12 h light regime (to simulate retail conditions) for 4, 6 or 8 d (Aged + Stored 4d, Aged + Stored 6d, Aged + Stored 8d groups, respectively). Muscle pH (with a Xerolyt electrode; Crison, Spain) and instrumental color (after 10 min of blooming with a portable spectrophotometer Minolta CM-600d; Minolta Inc., Japan) were measured in all loins. Microbiological and texture analysis were performed in a subsample of 50 loins (10 per group). Total Viable Counts (TVC, in PCA (Merck) incubating 48 h at 30ºC), Enterobacteriaceae (Ent, in Rebecca EB (biomérieux) incubating 24 h at 37ºC), and Lactic Acid Bacteria (LAB, in MRS (Merck Millipore) incubating 2-3 d at 30 ºC under anaerobiosis) were determined in two small portions from the cranial and caudal loin sides. Then, the central portion was submitted to texture analysis. Samples were cooked in a water bath until reaching a core temperature of 80°C. Cooking loss was calculated. Shear force was measured in a TA.TX2 texture analyser (Aname, Stable Micro Systems, United Kingdom) with an Allokramer probe (10 blades) (load cell: 100 kg; distance between the blades: 5 mm; thickness: 2 mm; cutting speed: 500 mm/min). Data were analyzed with SAS software (v.9.4, SAS Institute Inc., Cary, NC, US) applying a model with the fixed effect of ageing-storage condition (5 levels) and the MIXED procedure.

III. RESULTS AND DISCUSSION

Except for redness (a*), all technological and microbiological quality parameters evaluated in rabbit loins differed significantly according to the ageing-storage condition applied (Table 1). When comparing non-aged (fresh) loins and wet-aged loins for 9 d, only variations in lightness (L*) and yellowness (b*) were found, with higher values for the wet-aged group. Loins submitted to a subsequent refrigerated storage had a higher pH and lower L* compared to loins submitted only to wet aging. The b* index also varied among groups, but the results did not show a clear pattern. Besides, loins submitted to wet aging and refrigerated storage lost less water during cooking and were more tender than those only wet aged. When comparing among storage days, loins stored for larger periods did not significantly change their technological quality. A previous study in rabbit meat reported a decrease in toughness during an ageing period of 9 d at 4 °C [3], which was related to a myofibrillar structure weakening. In another study comparing different modified atmospheres packaging [5], the authors reported increased exudate losses and microbiological counts with storage time, without changes in other physicochemical traits such as pH and lactic acid.

Regarding microbiological counts, loins submitted to wet aging and refrigerated storage had significantly higher counts for the 3 microbial groups than fresh and wet-aged loins. In addition, TVC and Ent increased with storage days. TVC counts are usually used to monitor the microbiological shelf life, with values of 6-7 log indicating the end of it [4]. These values were reached in the loins submitted to wet ageing with a following refrigerated storage. LAB are usually the main microorganisms associated with the spoilage of meat refrigerated in vacuum-packaged conditions [5], and its proliferation at high levels can be accompanied by an organoleptic deterioration. The increase of microbial counts observed during refrigerated storage can be related to the temperature change from 2 °C (ageing) to 6°C (storage). In fact, as previously reported in refrigerated rabbit meat [5], storage temperature is a limiting factor for durability of vacuum-packaged meat.

Table 1 – Effect of the ageing and storage condition on the technological and microbiological quality of rabbit loins (least square mean).

	Ageing-storage condition					RMSE	P-value
Traits	Fresh	Aged	Aged + Stored 4d	Aged + Stored 6d	Aged + Stored 8d		
pH	5.93^{b}	5.79^{b}	6.13^{a}	5.97^{ab}	6.14^{a}	0.238	0.003
L*	45.8^{b}	51.7^{a}	46.6^{b}	48.8^{ab}	47.5^{b}	4.640	0.026
a*	-1.07	-0.84	-1.70	-0.69	-1.07	0.928	0.100
b*	6.52^{b}	7.68^{a}	7.24^{ab}	6.28^{b}	6.96^{ab}	0.967	0.007
Cooking loss (%)	28.2^{ab}	30.5^{a}	25.9^{bc}	25.4^{bc}	25.4^{c}	3.770	0.004
Shear force (kg)	41.4^{a}	44.6^{a}	25.4^{b}	32.6^{ab}	27.1^{b}	13.29	0.006
TVC (log UFC/g)	3.65^{c}	4.13^{c}	6.37^{b}	7.50^{a}	7.92^{a}	0.487	<0.001
Ent (log UFC/g)	1.75^{c}	1.31^{c}	4.67^{b}	5.62^{b}	7.08^{a}	0.902	<0.001
LAB (log UFC/g)	1.72^{bc}	1.02^{c}	2.60^{ab}	3.17^{a}	3.50^{a}	1.115	<0.001

RMSE=root mean square error; TVC=Total Viable Counts; Ent=Enterobacteriaceae; LAB=Lactic Acid Bacteria
Different superscripts letters within row indicate significant differences (P ≤ 0.05; Tukey test).

IV. CONCLUSION

Under the conditions of the present study, wet ageing for 9 d did not substantially enhance the tenderness of rabbit loins, and a subsequent storage period of at least 4 d was necessary to observe this improvement. However, the applied storage conditions at 6 °C had a negative impact on microbiological counts, which discourages extending the wet ageing period beyond 9 days if temperature is changed to 6 °C. A further study would be needed to assess the evolution of rabbit loins aged for a longer period and maintaining the storage temperature below 4 ºC, as stated by the EFSA Panel on Biological Hazards for aged meat [4].

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REFERENCES

[1] Kim, Y. H. B.; Ma, D.; Setyabrata, D.; Farouk, M. M.; Lonergan, S. M.; Huff-Lonergan, E.; Hunt, M. C. (2018). Understanding postmortem biochemical processes and post-harvest aging factors to develop novel smart-aging strategies. Meat Science 144, 74-90.
[2] Warner, R. D.; Wheeler, T. L.; Ha, M.; Li, X.; Bekhit, A. E.-D.; Morton, J.; Vaskiska, R.; Dunshea, F.; Liu, R.; Purslow, P.; Zhang, W. (2022). Meat tenderness: advances in biology, biochemistry, molecular mechanisms and new technologies. Meat Science, 185, 108657.
[3] Mestre Prates, J. A.; Garcia e Costa, F. J. S.; Ribeiro, A. M. R; Dias Correia, A. A. (2002). Contribution of major structural changes in myofibrils to rabbit meat tenderisation during ageing. Meat Science 61(1), 103-113.
[4] Koutsoumanis, K; Allende, A; Alvarez-Ordóñez, A; Bover-Cid, S.; Chemaly, M.; De Cesare, A.; Herman, L.; Hilbert, F.; Lindqvist, R.; Nauta, M.; Peixe, L.; Ru, G.; Simmons, M.; Skandamis, P; Suffredini, E.; Blagojevic, B.; Van Damme, I.; Hempen, M.; Messens, W.; Bolton, D. (2023). Scientific Opinion on the microbiological safety of aged meat. EFSA Journal 21(1):7745, 101 pp.
[5] Rodríguez-Calleja, J. M.; Santos, J. A.; Otero, A.: García-López, M. L. (2010). Effect of vacuum and modified atmosphere packaging on the shelf life of rabbit meat. Journal of Food, 8(2), 109–116.