

THE CONFINEMENT ODOUR OF THAWED LAMB RACKS, FROZEN AFTER AN INITIAL AGEING PERIOD OF UP TO 3 WEEKS

Benjamin W.B. Holman^{1*} and Emma E.M. Lynch²

¹Wagga Wagga Agricultural Institute, NSW Department of Primary Industries, Wagga Wagga, NSW, 2650, Australia

²School of Environmental and Rural Sciences, University of New England, Armidale, NSW, 2350, Australia

*Corresponding author email: benjamin.holman@dpi.nsw.gov.au

I. INTRODUCTION

The malodours released when vacuum packaged lamb meat is first opened (confinement odour) are sometimes used to characterise its freshness and quality. Yet, safe and unspoilt meat may generate confinement odour and the associated sour, dairy-cheesy, sulphurous, and yeasty smells will only persist for a short period of time after opening the packaging [1]. Microbes contribute to the generation of volatile organic compounds and the odour of vacuum packaged meat [2]. Microbial growth is a secondary outcome to wet ageing, a practice to enhance the eating quality of meat. Frozen storage will restrict microbial growth on lamb meat and facilitate its sustainable access to high value markets. Storage effects on confinement odour are not fully understood, specifically, for bone-in cuts of lamb that have been wet aged, frozen, and ultimately thawed – by the end consumer. Therefore, quantifying these effects will help meat processors to better understand their clients and adjust lamb meat storage practices to enhance its appeal. This study investigated the pack sensory scores for thawed lamb racks (bone-in) that were frozen, after being aged for up to 3 weeks.

II. MATERIALS AND METHODS

Vacuum packaged French trimmed lamb racks (*longissimus* muscle) were randomly selected from the boning room of a commercial Australian abattoir. Six lamb racks were immediately frozen (Week 0) using a commercial plate freezer, and the others wet aged for 1, 2, or 3 weeks ($1.3 \pm 0.3^\circ\text{C}$) before being frozen (6 per ageing period, $n = 24$). The frozen lamb racks were thawed under refrigeration for the 24 h and assessed using a pack sensory assessment method modified from Frank *et al.* [1]. This method was approved by the CSU Human Ethics Committee (H224409). Assessments were conducted in the same environment. The 12×12 Latin square design resulted in 2 sessions of 12 volunteer participants ($n = 24$), who assessed 3 packs from each wet ageing period.

Participants first inspected the unopened packs, (Question, Q1) rate the vacuum integrity on a scale of 1 to 4 (vacuum broken, very loose, slightly loose, tight fit). Other assessments were recorded using 100 mm line scales: (Q2) how fresh does the product look in the pack (Not Fresh - Very Fresh); (Q3) how much liquid is visible in the pack (None - A Lot); (Q4) how consistent is the meat colour (Not Homogenous - Very Homogenous); and (Q5) how much do you like the appearance of the meat (Dislike Extremely - Like Extremely). The packs were then opened and immediately re-sealed using clips. Participants were requested to remove the clip, smell the headspace, replace the clips, and score (Q6) how much visual sliminess is there on the meat surface (None - A Lot); (Q7) how strong is the overall odour of the meat (Very Weak - Very Strong); (Q8) how strong is the fresh odour of the meat (Very Weak - Very Strong); (Q9) how strong is the sulphur (eggy) rotten odour of the meat (Very Weak - Very Strong); (Q10) how strong is the fruity (overripe fruit) rotten odour of the meat (Very Weak - Very Strong); and (Q11) how strong is the cheesy or fermented odour of the meat (Very Weak - Very Strong). The packs were fully opened, and the lamb racks removed and patted with paper towel. A fresh surface was cut, allowed to bloom for ~ 15 min (25°C), and the lamb racks returned for further assessment. Participants then scored (Q12) how much do you like the appearance of the meat; (Q13) how fresh does the product look; and (Q14) how strong is the fresh odour of the meat.

Data were analysed in Genstat (22nd Ed.). Pack assessment scores were analysed using linear mixed models (REML) fitted with the fixed effects of ageing period and the random effects of assessor, assessment order, and their interaction. Least significant difference of means was set to the 5% level.

III. RESULTS AND DISCUSSION

Vacuum packaging integrity (Q1) was scored to be lowest for Week 0, with greater integrity observed for Week 2, then Weeks 1 and 3 respectively ($P < 0.05$). The other pre-opening assessments were scored within ranges that indicate broad consumer acceptance of all lamb racks, irrespective to wet ageing period. Sliminess (Q6) was observed to increase with ageing period ($P < 0.05$), although Weeks 1 and 2 were found to be comparably scored. Overall odour intensity (Q7) scores increased with ageing period ($P < 0.05$) and were lowest for Week 1 and highest for Week 3. These results confirm research on lamb leg joints and beef, although longer ageing periods were investigated [1,2]. Overall liking of appearance (Q12) was higher for Weeks 1 and 3 than for Week 2 ($P < 0.05$), with Week 0 scored as comparable to the other ageing periods. Freshness appearance (Q13) was scored to be higher for Week 1 than for Weeks 0 and 2 ($P < 0.05$). These results demonstrate the dissipation of any confinement odour (Q14) and an enhancement of consumer appeal with wet ageing period.

Table 1 Pack sensory assessment scores for the experimental samples.

Assessment question	Ageing period, Weeks				SEM	P-value
	0	1	2	3		
Pack vacuum integrity (Q1)	2.5 ^c	3.3 ^{ab}	3.0 ^b	3.5 ^a	0.2	0.007
Freshness appearance (Q2)	64.8	66.1	55.4	57.9	4.5	0.258
Amount of weep/liquid in the pack (Q3)	34.0	33.8	30.0	34.6	5.0	0.450
Meat colour homogeneity (excl. fat) (Q4)	70.3	70.4	67.7	62.0	3.6	0.189
Overall liking of appearance (Q5)	62.6	62.8	53.2	55.6	4.4	0.291
Sliminess (Q6)	39.8 ^b	46.7 ^{ab}	45.0 ^{ab}	51.6 ^a	5.9	0.014
Overall odour intensity (Q7)	45.2 ^c	50.6 ^{bc}	57.6 ^{ab}	62.4 ^a	4.7	0.012
Odour freshness (Q8)	55.4	53.9	49.4	53.9	4.9	0.374
Sulphur-rotten odour (Q9)	16.8	18.8	12.3	14.3	3.7	0.367
Fruity-rotten odour (Q10)	15.6	19.0	26.4	26.6	5.4	0.313
Cheesy-fermented odour (Q11)	15.6	17.1	20.9	20.4	4.7	0.802
Overall liking of appearance (Q12)	54.4 ^{ab}	63.5 ^a	52.1 ^b	62.5 ^a	4.2	< 0.001
Freshness appearance (Q13)	53.7 ^b	64.3 ^a	52.6 ^b	59.8 ^{ab}	3.8	0.006
Odour freshness (Q14)	36.3	44.0	40.3	45.1	4.7	0.065

IV. CONCLUSION

Wet ageing had some effect on lamb rack confinement odour, but this did not persist 'post-bloom'. The freshness and overall liking scores for 'post-bloom' lamb racks were generally enhanced with wet ageing. Variability in the pack sensory scores, between assessors, warrants further investigation.

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