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Evolution of spoilage microorganisms in vacuum-packed lamb meat from two portuguese breeds (#381)

Ursula Gonzales-Barron¹, Diogo Félix-Oliveira¹, Sara C. Coelho-Fernandes¹, Gisela Santos-Rodrigues¹, Jose M. Lorenzo², Vasco Cadavez¹¹ Centro de Investigação de Montanha, Escola Superior Agrária, Instituto Politécnico de Bragança, Bragança, Portugal; ² Centro Tecnológico de la Carne, Ourense, Spain**Introduction**

Although meat ageing at cold storage is essential to improve meat tenderness (Prates, 2000), the natural process of microbial spoilage takes place at the same time due to the proliferation of psychrotrophic bacteria, lactic acid bacteria, *Pseudomonas* spp. and *Clostridium* spp. (Berruga et al., 2005). A known strategy to moderately extend the shelf-life of meat is vacuum packaging. However, the spoilage retardation rate mainly depends on the initial microbiological quality of meat as well as its initial pH. The objective of this study was to evaluate the evolution of lactic acid bacteria and spoilage microorganisms (i.e., mesophiles, psychrotrophic bacteria and *Pseudomonas* spp.) in vacuum-packed lamb meat during cold storage at 4°C. The microbial spoilage in meat originating from two Portuguese ovine breeds, Bordaleira-de-Entre-Douro-e-Minho (BEDM) and Churra-Galega-Bragançana (CGB), was compared.

Methods

Fifteen BEDM and 15 CGB breed lambs were used in this study conducted in 2018. The animals were slaughtered at 4 months of age in the same abattoir (day zero). After 24-hour chilling at 4±1°C, the muscle *Longissimus dorsi* were removed from the 6th to 13th rib, and cut in three parts. Each piece was vacuum-packed (Silvercrest SFS 110 B2, Germany); and stored at 4±0.5°C in a cool chamber (Portiso ECB-3000, UK). After 3, 9 and 15 days following slaughter, microbiological essays were conducted. Aliquots of decimal dilutions were inoculated on Petrifilms (3M) for mesophiles and LAB. For the quantification of psychrotrophic microorganisms, Plate Count Agar (Liofilchem, Italy) was used while *Pseudomonas* spp. was counted on selective medium *Pseudomonas* Agar Base (Oxoid, UK), added with 1% v/v glycerol and CFC (SR0103, Liofilchem, Italy). To assess the effect of breed and ageing time, analysis of variance were adjusted to each microbial group using the R software.

Results

Table 1 compiles, separately by breed, the counts of spoilage microorganisms quantified in vacuum-packed lamb meat. Although not shown here, an interaction (p<0.05) between breed and ageing time was observed. In this way, at the third and ninth days of maturation, there were no differences (p>0.05) in the counts of spoilage bacteria between the two breeds. However, at the fifteenth day of ageing, lamb meat originating from the BEDM breed presented higher counts of mesophiles, psychrotrophic, lactic acid bacteria and *Pseudomonas* spp. than the meat from CGB breed (Table 1).

As expected, the counts of lactic acid bacteria and spoilage indicators increased (p<0.05) as ageing took place (Table 1). For all bacterial groups, the increment in bacterial load was more accentuated in lamb meat from BEDM breed, which can be related to the higher pH this meat tended to have (mean pH of 5.90 for BEDM versus 5.69 for CGB). It is known that when animals suffer stress from prolonged periods, there is a depletion of glycogen levels, which prevents the normal drop of pH until optimum levels (Watanabe et al., 1996). Consequently, meat of high pH (>5.7) possesses better conditions for microbial development, hence reducing the shelf-life of chilled meat (Sheridan et al., 1997).

Conclusion

Vacuum packaging and cold refrigeration slow down the growth of lactic acid bacteria and spoilage microorganisms for a period of 15 days in meat with normal pH, this is, lower than 5.7. Nevertheless, this effect is not observed in meat of high pH (> 5.8), in which bacterial growth is accelerated from the third day post-slaughter. Taking into account the known levels of psychrotrophic bacteria (10⁶ CFU/g) and *Pseudomonas* spp. (10⁷ CFU/g) that make meat improper for consumption (Feiner, 2006), it is estimated that vacuum-packed lamb meat from BEDM breed would have a shelf-life of 20 days, while that of CGB origin a shelf-life of 35 days when stored at 4°C.

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References

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Notes

Table 1. Mean counts and 95% confidence intervals (log CFU/g) of spoilage indicator microorganisms in vacuum-packed lamb meat, from two Portuguese breeds, Bordaleira-de-Entre-Douro-e-Minho (BEDM) and Churra-Galega-Bragançana (CGB). Pr>|F| indicates the significance of the effect of maturation (day of cold storage) estimated by the least-squares means test

Microorganism	Breed	Day	Mean	95% CI	Pr> F
Mesophiles	BEDM ^a	3	1.57	[1.21 – 1.92]	<.0001
		9	2.48	[2.12 – 2.83]	
		15	3.82	[3.46 – 4.18]	
	CGB ^b	3	1.62	[1.26 – 1.97]	<.0001
		9	1.94	[1.58 – 2.30]	
		15	2.40	[2.04 – 2.76]	
Psychrotrophic bacteria	BEDM ^a	3	1.34	[0.82 – 1.86]	<.0001
		9	2.30	[1.77 – 2.82]	
		15	4.40	[3.88 – 4.92]	
	CGB ^b	3	1.22	[0.69 – 1.74]	<.0001
		9	1.65	[1.13 – 2.17]	
		15	2.40	[1.85 – 2.96]	
Lactic acid bacteria	BEDM ^a	3	1.06	[0.68 – 1.44]	<.0001
		9	1.51	[1.13 – 1.89]	
		15	2.81	[2.43 – 3.19]	
	CGB ^b	3	0.82	[0.44 – 1.20]	<.0001
		9	0.89	[0.51 – 1.27]	
		15	1.14	[0.76 – 1.52]	
<i>Pseudomonas</i> spp.	BEDM ^a	3	1.02	[0.40 – 1.64]	0.003
		9	1.86	[1.23 – 2.48]	
		15	3.40	[2.77 – 4.02]	
	CGB ^b	3	1.06	[0.44 – 1.69]	0.003
		9	1.18	[0.56 – 1.81]	
		15	1.50	[0.88 – 2.13]	

(*) Different letters (a, b) indicate significant differences ($p < 0.001$) between lamb breeds

Notes