

*Microbial deterioration of lamb meat of
Portuguese origin as affected by its
intrinsic properties*

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Introduction

Sheep production system

- Sheep farming is an activity of high economic importance
- In Portugal, sheep and goat meat production constitutes 2.8% of the country's meat production
- Level of self-sufficiency of 82%
- Based on the use of natural pastures and agricultural residues



Meat quality

- Enhancing the quality of meat of autochthonous breeds could contribute to
 - increasing the profitability of these production systems
 - preservation of the rural world and its diversity
 - ensuring the conservation of endangered breeds
 - improving the living standards of the sheep farmers that remain in rural areas

Meat quality

- Multifactorial concept: factors that are intrinsic and extrinsic to the animal
- During maturation, microbial deterioration takes place
- vacuum packaging retards microbial deterioration
 - The extent of retardation depends on chilling system/profile
 - initial microbial contamination
 - physicochemical or intrinsic properties of meat

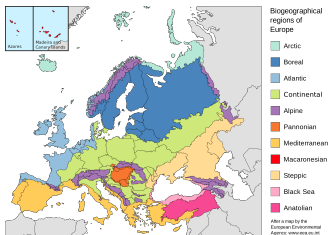
Objectives

- 1 to evaluate the evolution of spoilage indicator microorganisms in refrigerated vacuum-packed lamb meat
- 2 to elucidate any interrelationship between meat's intrinsic properties and microbial growth

Methodology

Lamb rearing and feeding

- Mediterranean bioregion
 - Bragança - Portugal
 - Churra Galega Bragançana (CGB): 30 lambs
- Atlantic bioregion
 - Ponte de Lima - Portugal
 - Bordaleira de Entre Douro e Minho (BEDM): 30 lambs



Lamb rearing and feeding

- Semi-intensive production system
 - Feeding was based on grazing on natural pastures
 - Lambs had access to meadow hay, and supplemented with protein and mineral-rich concentrates
 - Lambs had access to water ad libitum



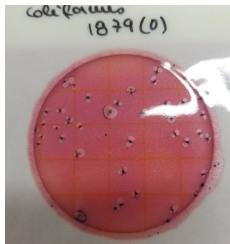
Preparation of meat samples

- Lambs were slaughtered at four months old
- Carcasses were chilled at 4 °C for 24 hours
- Left half of the *Longissimus dorsi* muscle
 - Vacuum packed stored at $4 \pm 0.5^{\circ}\text{C}$ for 3, 9 or 15 days
- Right half of the *Longissimus dorsi* muscle was kept for the physicochemical analyses



Microbiological and physicochemical analyses

- Microbial counts: 3, 9 or 15 days
 - total viable counts
 - psychrotrophic bacteria
 - lactic acid bacteria
 - *Pseudomonas* spp.
- Meat intrinsic properties
 - pH, aw, Proximate composition (dry matter, fat, protein and ash content)



Data analysis - Mixed-effects models

$$Y_{rj} = \beta_{0j} + \beta_{1r} + \beta_2 Day + \beta_3 X Day + \beta_4 Day^2 + \epsilon_{rj}$$

$$\beta_{0j} = \beta_0 + v_j$$

- Y_{rj} is the microbial concentration in the meat sample from lamb j of breed r
- β_{0j} is the model intercept affected by random shifts v_j caused by the different lambs j
- β_{1r} is the fixed effect of lamb breed
- β_2 the linear effect of maturation time
- β_3 assesses the interaction between the maturation time and meat intrinsic property X
- $\beta_4 Day^2$ was added given its significance in all models

- ϵ_{rj} are the residuals assumed to follow a normal distribution
- The models were adjusted in the **R software**

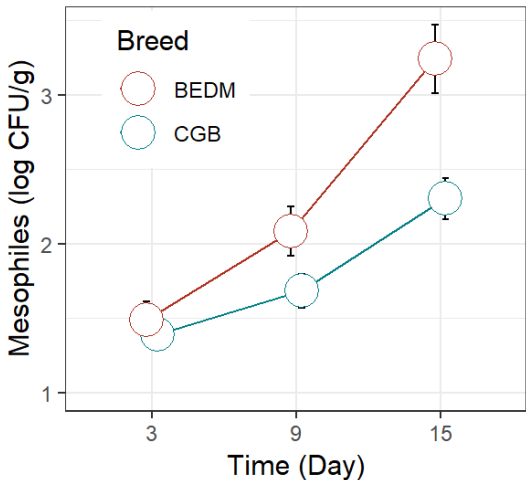
Results and discussion

Evolution of Mesophiles

Table 1: Effects of Initial Intrinsic Factors of Meat on the Concentration of **Mesophilic Bacteria** in Refrigerated Vacuum-Packed Meat as Quantified by Six Separate Linear Mixed Models

Model	Term	Estimate (SE)	F (p-value)
pH	pH × Day	0.592 (0.209)	7.951 (0.006)
Moisture (%)	Moisture × Day	0.125 (0.023)	28.97 (<.0001)
Fat (%db)	Fat × Day	-0.066 (0.012)	33.30 (<.0001)

Evolution of Mesophiles

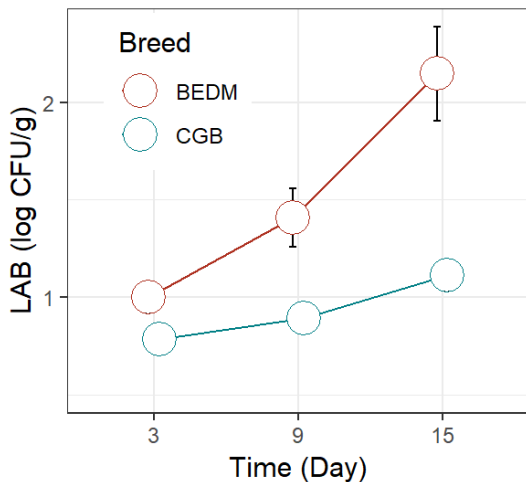


Evolution of LAB

Table 2: Effects of Initial Intrinsic Factors of Meat on the Concentration of **Lactic Acid Bacteria** in Refrigerated Vacuum-Packed Meat as Quantified by Six Separate Linear Mixed Models

Model	Term	Estimate (SE)	F (p-value)
pH	pH \times Day	0.633 (0.018)	12.24 (0.001)
Moisture (%)	Moisture \times Day	0.074 (0.021)	12.23 (<.0001)
Fat (%db)	Fat \times Day	-0.044 (0.010)	17.84 (<.0001)

Evolution of LAB

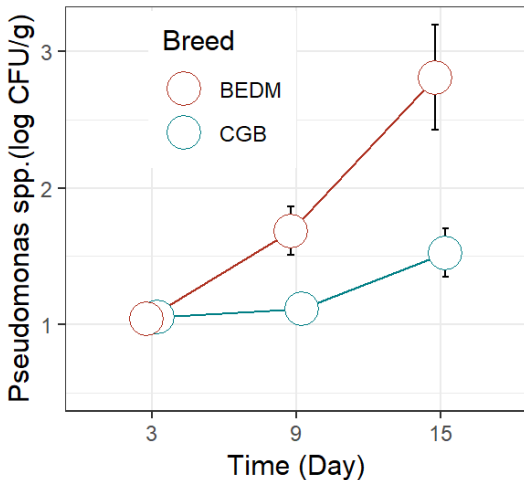


Evolution of *Pseudomonas*

Table 3: Effects of Initial Intrinsic Factors of Meat on the Concentration of *Pseudomonas pp.* in Refrigerated Vacuum-Packed Meat as Quantified by Six Separate Linear Mixed Models

Model	Term	Estimate (SE)	F (p-value)
pH	pH × Day	0.533 (0.270)	3.795 (0.050)
Moisture (%)	Moisture × Day	0.143 (0.031)	21.00 (<.0001)
Fat (%db)	Fat × Day	-0.073 (0.015)	22.01 (<.0001)

Evolution of *Pseudomonas*

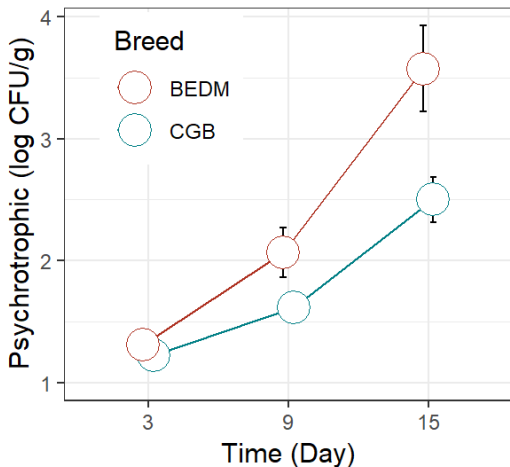


Evolution of Psychrotrophic bacteria

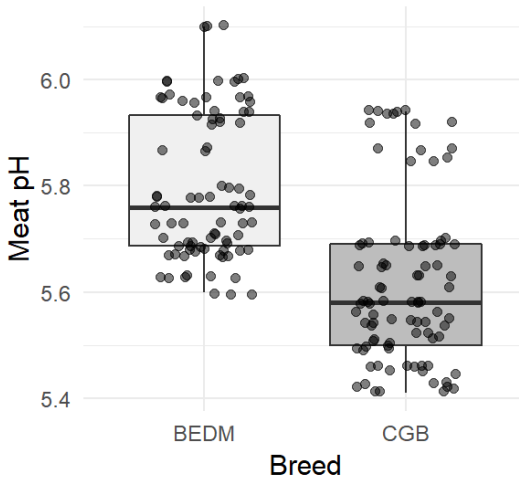
Table 4: Effects of Initial Intrinsic Factors of Meat on the Concentration of **Psychrotrophic Bacteria** in Refrigerated Vacuum-Packed Meat as Quantified by Six Separate Linear Mixed Models

Model	Term	Estimate (SE)	F (p-value)
pH	pH × Day	0.741 (0.282)	6.893 (0.010)
Moisture (%)	Moisture × Day	0.175 (0.031)	30.76 (<.0001)
Fat (%db)	Fat × Day	-0.091 (0.016)	34.51 (<.0001)

Evolution of Psychrotrophic bacteria



Meat pH by breed



Conclusions

Conclusions

- Populations of **spoilage bacterial** groups were **higher** in vacuum-packed lamb meat with **higher ultimate pH**
- A **high ultimate pH** was demonstrated to increase the **rate of microbial deterioration**
- Lamb meat samples with **higher total fat** content tended to have **slower microbial spoilage**
- In order to **extend the shelf-life** of lamb meat
 - Pre-slaughter animal handling - Reduce stress
 - Feeding management to improve energy reserves - Lactic acid

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The End

Obrigado pela atenção!

Thanks for listening!

