Meta-regression models describing the effects of essential oils and added lactic acid bacteria on *L. monocytogenes* inactivation in cheese

Beatriz Nunes Silva, Vasco Cadavez, José António Teixeira, Ursula Gonzales-Barron

19th September 2019

Cofinanciado por:

MOTIVATION

- ***L. monocytogenes*** (LM) has been described as a prevalent foodborne pathogen in goat (12.8%) and sheep (3.61%) milk cheeses (Gonzales-Barron et al., 2017)
- Soft and semi-soft cheeses sampled at retail: level of LM contamination up to 5% (EFSA report 2017)
- In faulty fermentations, pathogens can survive and even grow during the brining and ripening stages

MOTIVATION

- **Biopreservatives** have been proposed as **hurdles** to increase microbiological safety and stability of cheeses:
  - ✓ plant-based antimicrobials (essential oils, plant extracts)
  - ✓ bacteriocinogenic starter cultures
- **Meta-regression models** can be used to understand LM growth, allowing optimisation of hurdles that provide long term stability and safety to cheeses

OBJECTIVES

To summarise the effectiveness of (i) **lactic acid bacteria (LAB)** and

(ii) **essential oils (EO)** on *L. monocytogenes* inactivation in cheese

To evaluate other affecting factors and possible interactions

META-REGRESSION MODELS

METHODOLOGY

Systematic literature search

Modelling in R Studio

LAB meta-regression model

24 studies, N = 429

Mixed-effects linear models with weights

- Exposure time as nested fixed effects in application type

EO meta-regression model

23 studies, N = 754

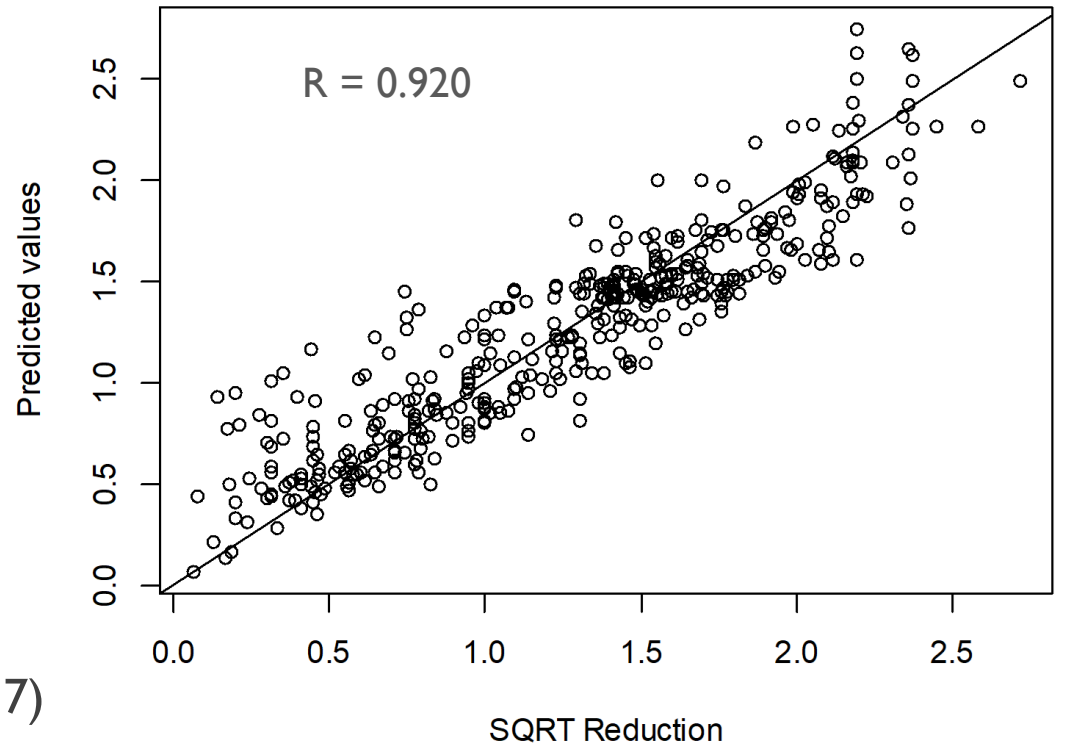
Mixed-effects linear models with weights

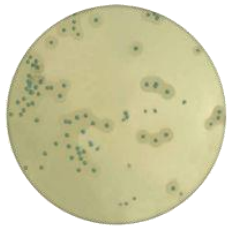
- Exposure time and antimicrobial concentration as nested fixed effects in application type

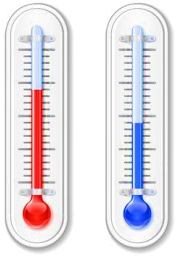
RESULTS

(i) LAB meta-regression model

- Significant impact on LM inactivation in cheese:
  - ✓ application type (p<.0001)
  - ✓ pathogen inoculum level (p=0.0007)
  - ✓ storage temperature (p=0.001)
  - ✓ application type / exposure time (p<.0001)
  - ✗ LAB concentration showed no significant effect (p=0.317)



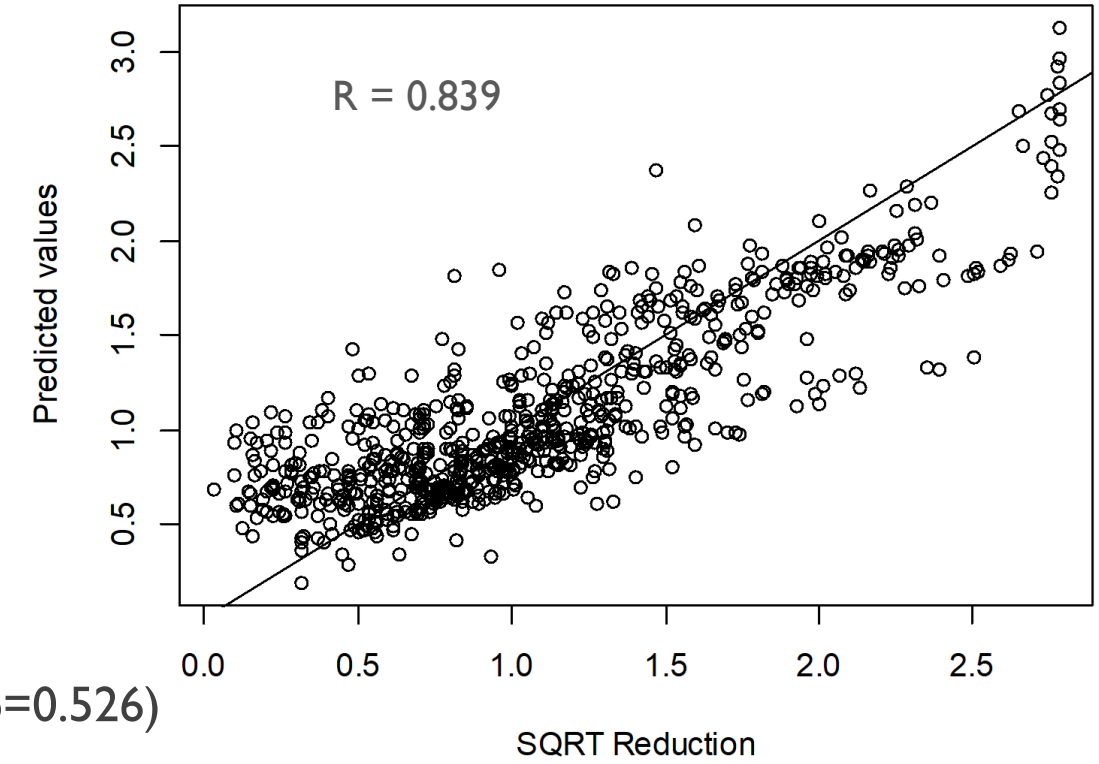


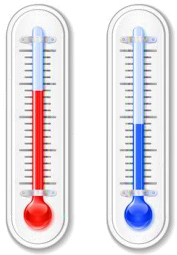


RESULTS

(i) EO meta-regression model

- Significant impact on LM inactivation in cheese:
  - ✓ application type (p<.0001)
  - ✓ storage temperature (p=0.001)
  - ✓ application type / exposure time (p<.0001)
  - ✓ application type / concentration applied (p<.0001)
  - ✗ Pathogen inoculum level showed no significant effect (p=0.526)





RESULTS

EO	N	RE
Black cumin seed	35	-0.652
Zataria multiflora boiss.	56	-0.406
Pink pepper	38	-0.391
Thyme	124	-0.196
Sage	12	-0.143
Rosemary	16	-0.141
Lemon balm	12	-0.105
Pennyroyal	24	-0.041
Basil	36	-0.036
Hogweed	15	-0.029
Tarragon	24	-0.015
Clove	68	0.028
Oregano	85	0.050
Mint	83	0.147
Salvia	**34**	**0.471**
Cinnamon	**47**	**0.595**
Bay	**45**	**0.862**

CONCLUSIONS

- Meta-analytical regression models were built, summarising the effects of LAB and EO on LM log reduction
- Antimicrobials' effectiveness depends on storage temperature, exposure time, [EO], application type
  - for the same exposure time, application in milk or surface cause greater log reduction (LAB model)
  - for the same exposure time, application in cheese causes greater log reduction; application in milk causes the lowest log reduction (EO model)
- Insight on the most effective EO for LM control in (soft) cheeses

Through **meta-regression modelling** it is possible to optimise manufacturing processes and the use of hurdles

→ ensure microbial stability and safety of cheeses ←

ACKNOWLEDGEMENTS

BNS wishes to acknowledge the financial support provided by the

Portuguese Foundation for Science and Technology (FCT)

through the PhD grant SFRH/BD/137801/2018.

Cofinanciado por:

FCT Fundação para a Ciência e a Tecnologia

POCH

PORTUGAL 2020

UNIÃO EUROPEIA

Fundo Social Europeu

Meta-regression models describing the effects of essential oils and added lactic acid bacteria on *L. monocytogenes* inactivation in cheese

Beatriz Silva

beatrizsilva@ceb.uminho.pt

University of Minho
School of Engineering

ipb INSTITUTO POLITÉCNICO DE BRAGANÇA

CIMO Centro de Investigação de Montanha

ICPMF 11
BRAGANÇA · 2019