



10<sup>TH</sup> INTERNATIONAL  
CONFERENCE ON  
**PREDICTIVE  
MODELLING  
IN FOOD**

CORDOBA, SPAIN, 26-29 SEPTEMBER, 2017  
GOVERNMENT BUILDING OF THE UNIVERSITY OF CORDOBA



CORDOBA, SEPTEMBER, 2017  
**ICPMF10**  
INTERNATIONAL CONFERENCE ON PREDICTIVE MODELLING IN FOOD



UNIVERSIDAD D CORDOBA

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Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Vice-Chair: Prof. Elena Carrasco Jiménez, Ph.D.**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

### Members

**Prof. Vasilis Valdramidis, Ph.D.**

Food Studies & Environmental Health. University of Malta, Msida (Malta)

**Sara Bover Cid, Ph.D.**

Food safety Program. Institute of Agrifood Research and Technology (IRTA). Monells, Girona (Spain)

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Department of Food Technology. University of Lleida, Lleida (Spain)

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Departamento de Ingeniería de Alimentos y del Equipamiento Agrícola. Technical University of Cartagena, Cartagena (Spain)

**Prof. Rosa María García-Gimeno, Ph.D.**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Prof. Gonzalo Zurera Cosano, Ph.D.**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Prof. Guiomar Denisse Posada Izquierdo, Ph.D.**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

### Collaborators

**Jean Carlos Correia Peres Costa**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Arícia Mara Melo Possas**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Araceli Bolívar**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Isabel Bascón**

Department of Food Science and Technology. University of Córdoba, Córdoba (Spain)

**Derya Savran**

Department of Food Engineering. Ankara University, Ankara (Turkey)

**Ferhat Ozcelik**

Izmir Food Laboratory. Ministry of Food, Agriculture and Livestock, Ankara (Turkey)

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Federal University of Santa Catarina, Brazil

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Alfort Veterinary School, France

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Institute Food Research, England

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Universidad Politécnica Valencia, Spain

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Danish Technological University, Denmark

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University of Campinas, Brazil

**Philippe Dantigny**

LUBEM - Université de Bretagne Occidentale, France

**Frank Devlieghere**

Ghent University, Belgium

**Mariem Ellouze**

Nestlé, Switzerland

**Matthias Filter**

Federal Institute for Risk Assessment (BfR), Germany

**Marta Ginovart**

Universidad Politécnica de Catalunya, Spain

**Úrsula Gonzales-Barrón**

CIMO - Mountains Research Centre, Portugal

**Lihan Huang**

US Department of Agriculture - ARS, USA

**Shigenobu Koseki**

Research Faculty of Agriculture, Japan

**Kostas Koutsoumanis**

Aristotle University of Thessaloniki, Greece

**Antonio Martínez**

Instituto de agroquímica y Tecnología de Alimentos (IATA), Spain

**Jeanne-Marie Membré**

National Institute of Agricultural Research (INRA), France

**Marteen Nauta**

Danish Technological University, Denmark

**Regis Pouillot**

Food Drug Administration, USA

**Abani Pradhan**

University of Maryland, College Park, USA

**Ana Sofia Ribeiro Duarte**

Danish Technological University, Denmark

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University of Minnesota, USA

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Food Drug Administration, USA

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Rutger University, USA

**Panos Skandamis**

University of Athens, Greece

**Alberto Tonda**

National Institute of Agricultural Research (INRA), France

**Jan Van Impe**

University of Leuven, Belgium

**An Vermeulen**

Ghent University, Belgium

**Marcel Zwietering**

Wageningen University, The Netherlands

## 11:00 - 13:00 h.: SESSION 6.- Predictive models for food process simulation

Chairs: Vasilis Valdramidis (University of Malta) and Elena Carrasco (University of Cordoba)

### O29.- MODELLING THE INHIBITORY EFFECT OF LAB ON *L. MONOCYTOGENES* AND ENTEROBACTERIACEAE IN A FERMENTED SAUSAGE DURING RIPENING

Vasco Cadavez<sup>1</sup>, Francis Butler<sup>2</sup>, Ursula Gonzales-Barron<sup>1</sup>

1 CIMO Mountain Research Centre, School of Agriculture, Polytechnic Institute of Braganza

2 UCD School of Biosystems and Food Engineering, University College Dublin

**Keywords:** Microbial competition, Lotka-Volterra, interspecific interaction, chorizo.

#### INTRODUCTION AND OBJETIVES

Earlier research has shown that the survivability of Enterobacteriaceae (ENT) and *L. monocytogenes* (LM) in a Portuguese fermented sausage (linguiça) decreases during the ripening stage, and that such inhibition arises from the adverse conditions caused by the competition with autochthonous lactic acid bacteria (LAB) and the progressively lower water activity and pH. The objective of this work was to mathematically characterise the competition or interactions between LAB, LM and ENT that takes place in fermenting linguiça during ripening.

#### MATERIAL AND METHODS

Four experimental conditions that derived from the combinations of the batter formulation with or without starter cultures, and two constant ripening temperatures (10° or 18°C) were evaluated. Batches of linguiça were inoculated with LM during mixing (~6 log CFU/g), while two batches were formulated with a commercial starter culture (Texel, Danisco) (~5 log CFU/g). ENT, LM and LAB were enumerated immediately after batter maceration (3 days after inoculation or day 0) and during ripening (days 2, 4, 6, 8, 9, 10, 11 and 13). A modified Lotka-Volterra (LV) competition model based on the logistic equation was adjusted to each condition as a system of three ordinary differential equations for the populations N\_LAB, N\_LM, N\_ENT, with inhibition functions assumed to be affected by the interspecific bacterial interactions  $\alpha_{LM-LAB}$  and  $\alpha_{ENT-LAB}$ .

#### RESULTS

Using a starter culture and a higher ripening temperature increased LAB's maximum growth rate from 0.256 log CFU/day (no starter, 10°C) up to 0.597 log CFU/day, and LAB's maximum concentration from 7.023 to 8.328 log CFU/g. In all conditions, LAB exhibited a greater effect on ENT ( $\alpha_{ENT-LAB}$ : 8.919-38.71) than on LM ( $\alpha_{LM-LAB}$ : 1.868-4.272), although  $\alpha_{ENT-LAB}$  interspecific interaction was lower at the higher ripening temperature. From the end of maceration, the shortest time to achieve a one-log reduction in LM was attained by the condition with starter/18°C (4.6 days) while the longest by the condition without starter/10°C (9.8 days). Furthermore, LV models were flexible enough to closely describe the increase in ENT that occurred up to day 3-4 (when LAB reached a critical concentration of 6.8 log CFU/g) and its subsequent decline. Overall, a better agreement between observed and predicted counts was observed when models were fitted with interaction effects (residuals 0.112 – 0.157) than when they were set to zero (residuals 0.134 – 0.182), whereas neglecting the interspecific interactions led to a slight underestimation of LM and ENT counts.

#### CONCLUSIONS

Microbial interspecific interactions in fermenting meats should be modelled, and the LV model offers a suitable approach. As LM has been recovered from linguiça in the order of 0 – 150 CFU/g, the model suggests that certain modifications should be introduced in the process such as controlled ripening temperature, longer ripening time or even the use of starter cultures in order to ensure the safety of this product.