AgroStat

Marseille, 14-16 March 2018

Due to the increasing quantity of data in agrosciences, there is a need for specific tools which place statistics and data science at the heart of challenges of the contemporary world. The AGROSTAT conference gives statisticians, engineers and users of statistical methods a unique opportunity to exchange around topics, such as sensometrics, chemometrics, experimental designs, risk analysis, process control or big data.

This event brings together internationally recognized academic and industrial organizations representatives, to take stock of advances in statistics, express their needs and to anticipate future challenges.

This conference, which is held every two years, is organized this year by **Aix-Marseille University,** the "Mediterranean Institute of Biodiversity and Marine and Continental Ecology", UMR CNRS 7263 / IRD 237, team Toxicology & Environmental Health (TSE), under the auspices of the Agro-Industry Group of the French Statistical Society (SFdS). The SFdS is a non-profit organization bringing together researchers, engineers, teachers and statistics users.

SCIENTIFIC COMMITTEE:

- El Mostafa QANNARI (Oniris, France – President)
- Michelle SERGENT (Aix-Marseille University, France - Co-presidente)
- Stéphanie BOUGEARD (Anses Ploufragan, France)
- Damien BREMAUD (L'Oréal, France)
- Per BROCKHOFF (Technical University of Denmark, Denmark)
- Philippe COURCOUX (Oniris, France)
- Bernadette GOVAERTS (UC Louvain, Belgium)
- El Mestafa HADRAMI (FST, Fes, Morocco)
- Sébastien LE (AgroCampus Ouest, France)
- Sébastien MARQUE (Capionis, France)
- Hal MCFIE (Hal MacFie Sensory Training Ltd, Great Britain)
- Nicolas PINEAU (Nestlé, Switzerland)
- Michael MEYNERS (P&G, Germany)
- Pascal SCHLICH (INRA Dijon, France)
- Douglas RUTLEDGE (AgroParisTech, France)

ORGANIZING COMMITTEE :

- Michelle SERGENT (Aix-Marseille University, IMBE, France)
- Magalie CLAEYS-BRUNO (Aix-Marseille University, IMBE, France)
- Valérie DEYRIS (Aix-Marseille University, ISM2, France)
- Franck TORRE (Aix-Marseille University, IMBE, France)
- Marine BERRO (Aix-Marseille University, IMBE, France)

Wednesday 14 March

9h00			**Welcome speech - M. SERGENT, M. QANNARI**
		Inaugural conference	
9h15	**PL1**	**B. K. Ersbøll**	**Big Data from Farm to Fork, advantages and challenges**
		Session 1: BIG DATA/MACHINE LEARNING/DEEP LEARNING - Chair: S. Marque	
10h20	**O01**	P. Rebenaque	Automated analysis of tasting comments in sensory analysis
10h40	**O02**	M.-B Blanquart	Impact of the questionnaire structure on overall results in preference mapping: a meta-analysis on 285 consumer studies
11h00	**O03**	S. Bougeard	Current multiblock methods: competition or complementarity? A comparative study in a unified framework
11h20			***Coffee break***
		Session 2: DEVELOPMENT TOOLS - Chair: D. Brémaud	
11h50	**O04**	N. Pineau	Use of R-Shiny apps to communicate sensory and consumer modeling tools outputs
12h10	**O05**	I. Rebhi	An interactive shiny tool for sensory and consumer data mapping : sensmapui
12h30			***Lunch***
		Session 3: CHEMOMETRICS - Chairs: D. Rutledge/ E. Vigneau	
14h00	**PL2**	**P. Bastien**	**Use of sparse methods in cosmetics**
15h00	**O06**	B. Jaillais	Random forests for the prediction of water content by near-infrared hyperspectral imaging spectroscopy in biscuits
15h20	**OO7**	C. Peltier	What is the better test to detect multivariate differences in large dimensional data?
15h40	**O08**	D.N. Rutledge	Comparison of Principal Components Analysis, Independent Components Analysis and Common Components Analysis
16h00			***Coffee break***
16h30	**O09**	E. Vigneau	Analyse des relations entre plusieurs blocs de données par l'approche Path-Comdim: une application pour évaluer la qualité environnementale sur le littoral atlantique français
16h50			**Poster presentations**
17h15			POSTER SESSION
18h00			***Welcome Reception: Les Halles de la Major***

Thurs day 15 March

Session 4: SENSOMETRICS - Chairs : Ph. Courcoux / P. Schlich

8h45	**PL3**	**J. Castura**	**Consumer diversity in sensory evaluation data**
9h30	**O10**	M. Brard	A latent class regression model for the clustering of multivariate binary ratings
9h50	**O11**	E. Qannari	One thousand and one ways to analyze free sorting data
10h10	**O12**	N. Pineau	CATA as an alternative method to free sorting
10h30			***Coffee break***
11h00	**O13**	F. Llobell	Clustatis: a cluster analysis of multiblock datasets. application to sensometrics
11h20	**O14**	G. Lecuelle	Modeling temporal dominance of sensations data with stochastic processes
11h40	**PL4**	**B. Boulanger**	**Round table: The world beyond p-values: how to make research in the 21st?**
12h30			***Lunch & posters***
14h30			***SOCIAL EVENT***
19h30			***Gala diner : Reverso - Les Terrasses du port***

Friday 16 March

Session 5: EXPERIMENTAL DESIGNS - Chairs: M. Claeys/M. Sergent			
9h00	**PL5**	**J-P Gauchi**	**Metamodeling and global sensitivity analysis for computer models with correlated input**
9h45	**O15**	S. Marque	Plan d'expériences et simulations sur le contrôle qualité des contaminants microbiologiques de produits finaux
10h05	**O16**	Q. Carboué	Experimental design and solid state fermentation: a holistic approach to improve cultural medium for the production of fungal metabolites
10h25			***Coffee break***
10h55	**O17**	V. Rodrigues	Food source attribution of human campylobacteriosis by meta-analysis of case-control studies
11h15	**O18**	U. Gonzales-Barron	An extended bigelow-type meta-regression model describing the heat resistance of neosartorya spores
11h35	**O19**	V. Cadavez	Dynamic determination of optimum growth rate of listeria monocytogenes in minas soft cheese during cold shelf-life
11h55		P. Schlich	Statistical analysis of chocolate tasting data obtained from participants
12h15			***Closing of the conference, Awards*** ***Lunch***

DYNAMIC DETERMINATION OF OPTIMUM GROWTH RATE OF *LISTERIA MONOCYTOGENES* IN MINAS SOFT CHEESE DURING COLD SHELF-LIFE

Vasco Cadavez[1], Fernanda Bovo Campagnollo[2], Ursula Gonzales-Barron[1], Anderson Sant'Ana[2]

[1]CIMO Mountain Research Centre, School of Agriculture (ESA), Polytechnic Institute of Bragança, Portugal
[2]Faculty of Food Engineering, Campinas State University (UNICAMP), Brazil
E-mail: vcadavez@ipb.pt

Abstract

This study aimed to compare the kinetic parameters of *L. monocytogenes* during refrigerated shelf-life of soft Minas cheese produced with raw or pasteurised milk, and with or without addition of a cocktail of selected LAB (starter). A dynamic tertiary model based on the Huang and the cardinal parameter models, adjusted to each of the four treatments, determined that the slowest growth (0.0281 ln CFU/g h^{-1}) and the lowest carrying capacity (14.12 ln CFU/g) of *L. monocytogenes* in Minas cheese was obtained by adding the tailored culture to raw milk.

Keywords - Huang model, cardinal parameter model, dynamic model, tertiary model

INTRODUCTION

Minas cheeses are Brazilian traditional cheeses, often manufactured by small farmers in an empirical manner using raw milk and indigenous lactic acid bacteria (LAB). From all types of Minas cheeses, the refrigerated soft type has shown the highest frequency of *L. monocytogenes* recovery (3 – 45%) despite the fact that some strains of indigenous LAB – isolated from the fermented whey collected from previous cheese production – have been shown to inhibit *L. monocytogenes*. Thus, the objective of this study was to characterise the kinetic parameters of *L. monocytogenes* during refrigerated shelf-life of soft Minas cheese produced with raw or pasteurised milk, and with or without addition of a cocktail of selected LAB with high acidifying capacity.

METHODOLOGY

Four different treatments were performed in duplicate, and consisted of production of Minas cheeses using raw or pasteurised milk, and including the addition of starter culture (i.e., six LAB strains with good acidification capacity isolated from commercial Minas cheeses), or without any addition. Ten litres of raw or pasteurised milk were heated to 34±1 ºC and added with 5 mL of $CaCl_2$, 9 mL of commercial rennet (85% bovine pepsin + 15% bovine chymosin), *L. monocytogenes* strains 3968 –1/2b and 3973 – 4b (10^5 - 10^6 CFU/mL of milk) and/or selected LAB (10^6 - 10^7 CFU/mL of milk), depending upon the treatment. After 40 min coagulation, curd cutting, slightly agitation and resting for 30 min, sodium chloride (2 g/L) was added and curd was allowed to rest for another 30 min. The whey was drained off and curd was placed into perforated moulds. Cheeses were maintained at room temperature for 1 h for dripping, turned and left for an additional 1 h for final dripping. Unmoulded cheeses were packed in plastic bags and stored at 7±1 ºC for 15 days. Microbiological analyses of cheese at determined intervals during refrigerated shelf-life included LAB and *L. monocytogenes* counting (ln CFU/g). Also, cheese pH, water activity (Aw) and temperature were measured.

Taking into consideration that pH and Aw continuously drop during storage, the kinetic parameters of *L. monocytogenes* in fermenting cheese, for each of the four treatments, were determined by dynamic kinetic analysis; this is, by simultaneously fitting a primary growth model (Huang model, Eq. 1) in differential form with an explicit secondary model of the specific growth rate as a function of the cheese pH and Aw (Cardinal parameter model, Eq. 2),

$$\frac{dY}{dt} = \frac{\mu_{max}}{1+e^{-4t)}}\left(1 - e^{Y-Y_{max}}\right) \qquad \text{(Eq. 1)}$$

$$\mu_{max} = \mu_{opt}\left\{\frac{(pH-pH_{min})(pH-pH_{max})}{(pH-pH_{min})(pH-pH_{max})-(pH-pH_{opt})^2}\right\}\left\{\frac{a_w-a_{w\,min}}{1-a_{w\,min}}\right\} \qquad \text{(Eq. 2)}$$

where Y_0, Y_{max} and Y are the natural log of bacterial counts at time 0, maximum level and time t; μ_{max} is the specific growth rate (ln CFU/g h^{-1}); while pH_{min} and pH_{max} are the pH below or above which no growth occurs, pH_{opt} is the pH at which the specific growth μ_{max} is optimal; $a_{w\ min}$ is the water activity below which no growth occurs; μ_{opt} is the optimum growth rate at pH_{opt} and aw_{opt} (fixed at 1.0). Because the cardinal parameters of *L. monocytogenes* (pH_{min}, pH_{opt}, pH_{max} and a_{wmin}) are not estimable from the data – as the monitored pH (7.0 to 4.7) and a_w (0.999 to 0.993) of the Minas cheese correspond to narrow-ranged suboptimal values, they were set to values determined from liquid media (pH_{min}=4.71; pH_{opt}=7.10; pH_{max}=9.61; a_{wmin}=0.913).

RESULTS

Since the LAB strains, making up the starter culture, were purposely chosen for their high acidifying capacity, the treatments with starters, added either in raw or pasteurised milk, caused a greater drop in cheese pH than those treatments with autochthonous LAB (Fig. 1). Thus, in competition with the selected LAB strains, *L. monocytogenes* suffered a retarded growth, as suggested by the change in optimum growth rate μ_{opt} in pasteurised cheese without starter, from 0.0405 ln CFU/g h^{-1} to 0.0336 ln CFU/g h^{-1} when selected LAB were added. The same trend was observed in raw milk cheeses, whereby the growth of *L. monocytogenes* in cheeses with starter (0.0281 ln CFU/g h^{-1}) was slower than in those without starter (0.0389 ln CFU/g h^{-1}). Likewise, the addition of selected LAB brought down the carrying capacity of *L. monocytogenes* in pasteurised and raw milk cheese (from 17.76 and 17.91 ln CFU/g, respectively, when no starters were used) to 14.83 and 14.12 ln CFU/g, respectively (Table 1). Furthermore, regardless of the addition or not of starter cultures, the growth of *L. monocytogenes* was slightly faster in cheeses elaborated with pasteurised milk. This was expected since pasteurisation eliminates a large part of background flora in milk, thereby weakening microbial competition and enhancing pathogen growth. Thus, when cheese was made of pasteurised milk without selected LAB – hence relying only on autochthonous LAB – the optimum growth rate of *L. monocytogenes* was the highest, which can be at least partly explained by the poor acidification taking place in these cheeses (pH from 7.0 to 6.7; Fig. 1). On the other hand, the treatment producing the best acidification profile (i.e., raw milk with starter; pH from 6.7 to 4.8; Fig. 1) supported the slowest development of *L. monocytogenes* (Table 1). Although the LAB strains tested did not cause an inactivation of *L. monocytogenes*, they did exert a strong bacteriostatic effect, as inferred from the only one-ln CFU/g growth that took place in 15 days of cold storage (from Y_0=13.11 to Y_{max} 14.12 ln CFU/g; Table 1).

Table 1. Kinetic parameters (initial and maximum microbial concentration Y_0, Y_{max} in ln CFU/g and optimum growth rate μ_{opt} in ln CFU/g h^{-1}) of *L. monocytogenes* in Minas soft cheese elaborated with raw or pasteurised milk and with addition or not of starter culture (selected LAB)

Milk		Without starter		With starter	
	Parameters	Mean (SE)	Pr > |t|	Mean (SE)	Pr > |t|
Pasteurised	Y_0	14.71 (0.385)	<.0001	13.15 (0.142)	<.0001
	μ_{opt}	0.0405 (0.0135)	0.0122	0.0336 (0.0070)	0.0006
	Y_{max}	17.76 (0.272)	<.0001	14.83 (0.143)	<.0001
Raw	Y_0	14.58 (0.241)	<.0001	13.11 (0.115)	<.0001
	μ_{opt}	0.0389 (0.0068)	0.0010	0.0281 (0.0067)	0.0029
	Y_{max}	17.91 (0.193)	<.0001	14.12 (0.072)	<.0001

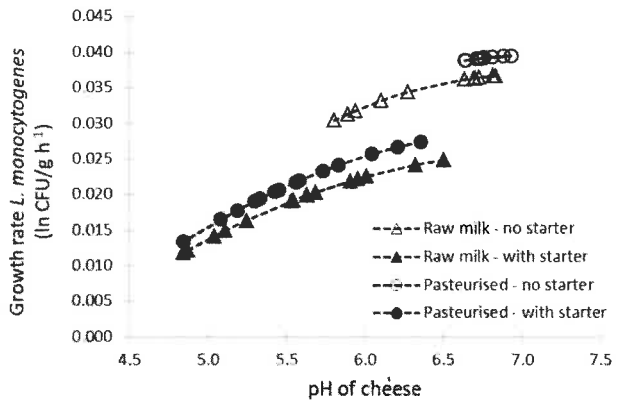

Figure 1. Effect of pH on the growth rate of *L. monocytogenes* in Minas soft cheese by treatment. Markers indicate sampling points from time 0 (rightmost) to 360 h (leftmost)