Available online at www.sciencedirect.com

ScienceDirect

Procedia Food Science 7 (2016) 125 – 128

Procedia Food Science

9th International Conference on Predictive Modelling in Food

# Is food safety compatible with food waste prevention and sustainability of the food chain?

Laurent Guillier[a,*], Steven Duret[a,b,c], Hong-Minh Hoang[b], Denis Flick[c], Onrawee Laguerre[b]

[a]*ANSES, Food Safety Laboratory, 14 rue Pierre et Marie Curie, 94706 Maisons-Alfort Cedex, France*
[b]*Irstea, Refrigeration Processes Engineering Research Unit, 1 rue Pierre-Gilles de Gennes, 92761 Antony, France*
[c]*AgroParisTech_INRA, UMR 1145, Food Process Engineering, 91300 Massy, France*

**Abstract**

In a context where the sustainability of food chains and food waste prevention are subjects of interest for public authorities and professionals, it is important to assess if these new objectives of food policy are compatible with food safety. The objective of this work was to develop a global model for a ready-to-eat meat product that provides three different outputs, i.e. energy consumption, percentage of spoiled products and exposure levels of *Listeria monocytogenes*. First a cold chain model was developed. The cold chain model was then coupled with (i) predictive microbiology models and (ii) energy consumption models for cold equipments. Various scenarios were tested for assessing the consequences of potential changes in cold chain equipment on safety, food waste and energy cost. This global approach could help policy makers in decision making.



Peer-review under responsibility of Department of Food Science, Faculty of Food Engineering, University of Campinas.
*Keywords:* consumer behaviour; exposure assessement; cold chain

## 1. Introduction

In the food safety field, quantitative microbial risk assessment (QMRA) has been applied for many years. The QMRA approach is primarily aimed at assessing the influence of different control measures on level of safety, rather than an absolute assessment of risk. QMRA can thus provide an objective and scientific basis for risk management decisions. However, a whole and integrated public health assessment also depends on other elements of the different

* Corresponding author. Tel.: +33-(0)149772644; fax: +0-000-000-0000 .
*E-mail address:* laurent.guillier@anses.fr


Peer-review under responsibility of Department of Food Science, Faculty of Food Engineering, University of Campinas.
doi:10.1016/j.profoo.2016.05.001

potential control measures. In Europe, concerns about sustainability of food chains have emerged. Food sustainability is becoming an increasingly important issue because food systems are not sustainable in terms of their consumption of resources, their impact on ecosystems or their effect on health and social equality[1]. This interest on sustainability is confirmed by the growing number of call for research projects dedicated to the topic. Cold chain is involved in the three dimensions of sustainability (environmental, economic and social). The fight against food losses and waste is also one of policy priorities in European Union. In France, following the national pact against food waste, different actions have been launched (including communication to consumers). Thoughts about possible evolution are in progress. One of them is about modification of food shelf-life. Therefore, operators of the food industry and consumers now receive recommendations on food security, energy economy or waste prevention. One can question on the potential contradictions between these recommendations. The objective of the present work is to quantify their impact on energy consumption, the risk for consumers and percentage of products discarded due to spoilage. The methodology was applied on sliced cooked ham.

## 2. Materials and Methods

### *2.1. Cold chain description and simplified heat transfer model for equipments*

Fig. 1 presents the cold chain of sliced ham after production in a plant. A pack of 160g containing 4 slices with a shelf life of 30 days was considered. The probabilities of packs to be transferred from one equipment to another were estimated from investigations dedicated to characterize cold chain logistic[2]. The simplified models used for each equipment in the cold chain were based on the zonal approach. The number of zones in refrigerating equipment was derived from the results of CFD simulation (Computational Fluid Dynamics)[3]. The knowledge of temperature and velocity fields in the equipment leads to the definition of a zonal model which represents the principal phenomena observed by the CFD but in a simplified manner. The load located in each zone is represented by an overall temperature. First, the steady state load temperatures are determined in each zone. Then, the temperature evolution of the food product is calculated.

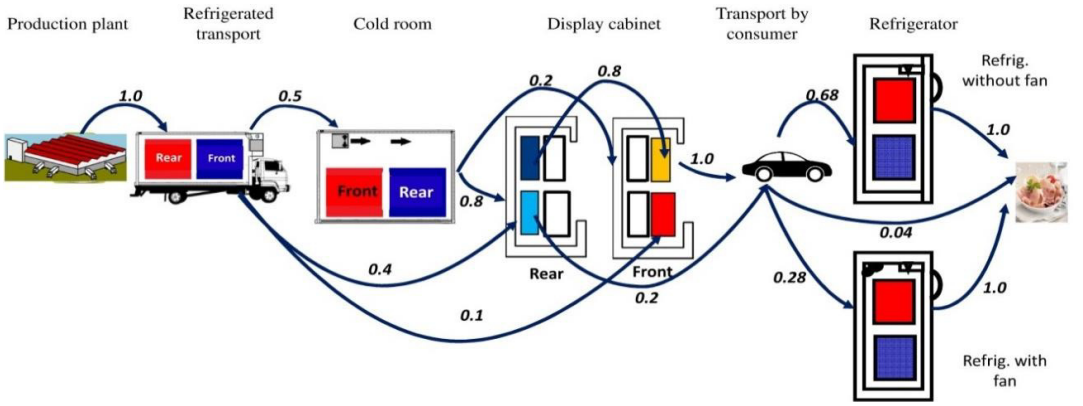


Fig. 1. Cold chain logistics of cooked ham products

### *2.2. Microbiological models*

Spoilage was assessed by modelling the growth of lactic acid bacteria (LAB). The percentage of products spoiled at time of consumption was used as an indicator of food waste. A secondary model was used to predict the growth of LAB in dynamic conditions and describe the effect of environmental conditions (temperature and physico-chemical of cooked ham)[3]. The initial contamination levels of LAB and the concentration at which spoilage occurs were inspired from literature[4]. Risk level was assessed through exposure assessment of *Listeria monocytogenes*. The secondary growth model, initial contamination as well as products characteristics have been described previously[5]. Competition between *L. monocytogenes* and LAB was taken into account with a Jameson-effect model. The percentage of products