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A web-based application customized to food safety requirements of small-sized enterprises*

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Abstract

Today, European legislation considers predictive microbiology as a tool to define food safety. People in the food industry, including those in small-sized enterprises, even if they are unable to avail themselves of specific knowledge, are encouraged to use the same approach. To extend a bridge between both sides, a user-friendly, simplified, web-based application (*Praedicere Possumus*, PP) has been developed. Through this application, users have access to different modules, which apply a set of models, some of them already validated and considered reliable for determining the compliance of a food product with EU safety criteria[1]. In particular, the PP applies the growth/no-growth boundary model[2], coupled with a three-phase linear growth model and thermal/non-thermal models. Two complementary functionalities, such as the fractional contribution of each inhibitory factor to growth probability (f) and the time evolution of the growth probability (P_t) have also been included[3]. The PP application is expected to assist users in defining processing and storage conditions to attain a desirable food safety level and to support food safety authorities in demonstrating compliance with legislation.

Key words: simplified modelling approach; *Praedicere Possumus*; factor fractional contribution; time-dependent growth probability

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1. Introduction

Predictive microbiology is a well-established and well-recognised scientific discipline[4]. Recently, this discipline has been accepted as a tool to define food safety, which is fundamentally based on the control of hazard. Food safety should be managed and guaranteed by the food business operators (FBOs), including those in small-sized enterprises (SEs). Small-sized businesses require cost-effective and less time-consuming ways to define food safety, and more specifically, they are interested in: i) understanding the factors that impact positively or negatively on the ability of pathogenic bacteria to survive or grow; ii) assessing the compliance of food to safety criteria; iii) validating the control measures; iv) predicting an appropriate shelf-life. Thus, to meet these requests, people in SEs, even if not availing themselves of specific knowledge, should be encouraged to use the modelling approach. Since SEs are more interested in solutions rather than in scientific findings, an effective modelling tool should be intended for practical use, enabling users to retrieve information intuitively and providing an easy way to access prediction.

This paper describes the web-based application *Praedicere Possumus* (PP) to evaluate the queried pathogen responses, which are translated into outcomes of practical uses to meet the demand of small producers and those of food control authorities. Based on an adapted version of the Polese et al.[1,2] model, the proposed application introduces two functionalities[3], namely the fractional contribution of each inhibitory factor to growth probability (f) and the time-dependent probability parameter (P_t), which offers the possibility to account for the storage time in evaluating the probability of growth.

2. The web-based application Praedicere P*ossumus*

2.1. The models incorporated in PP

The PP application, which provides a deterministic approach for prediction, contains a group of models that address the growth/no-growth[1,2], the growth[5] and the thermal[6] and non-thermal inactivation[7] of 10 foodborne pathogenic bacteria. The fractional contribution (f) of each inhibitory factor to growth probability (P) is evaluated as a function of the difference between the actual level of the factor and the inhibiting value, adjusted for the sub-optimal interval of the factor, whereas the time-dependent probability parameter (P_t) can be described as a function of the growth probability and the growth rate (GR) and represents the change in growth probability over time[3].

2.2.The structure of PP

The internal database of PP includes growth parameters derived from Combase Predictor and thermal inactivation parameters from van Asselt and Zwietering[8]. Non-thermal inactivation parameters are obtained by using a gamma-like model[7] derived from the model of McQuestin et al.[9]. Users have the possibility of selecting MIC values.

The menu structure is *via* modules, which assist the operator in organizing information around the user's specific needs.

The first module provides the opportunity to predict the growth probability (P and P_t), the growth and the thermal/non thermal inactivation of all the 10 pathogenic bacteria under different conditions (T°C, pH, a_w), including a generic gamma factor (g) for other controlling elements defined by the user. This module helps the operator to identify which pathogenic bacteria are able to grow and the pathogen levels in the selected conditions, which can include processing and/or storage situations.

In a second module, for each specific pathogen, additional environmental factors are taken into account for predicting probability/growth/inactivation, including also organic acids, food additives and microbial interaction. The introduction of the (f) option, which quantifies the fractional contribution of each inhibitory factor to growth probability, can assist the user in defining processing and storage conditions in order to attain a desirable food safety level. The other variable outcome (P_t), which takes into account the storage time in a time-dependent probability parameter, allows the user to evaluate the probability of growth related to a specific time. This validated option[3] is expected to assist users in the estimation/validation of the shelf-life of food under safety constraints.

A further module enables the user to describe specific food production processes, including different steps, which are modelled such as growth probability, time-dependent probability, growth and inactivation. Quantification of the contribution of each inhibitory factor on the pathogen behaviour helps the user to optimise a process and to identify the critical control points.

2.3.Availability of PP

Praedicere Possumus (PP) is a web-based application tool for predictive microbiology available free of charge. PP can be used from the web page of the University of Udine at http://praedicere.uniud.it/. It provides an opportunity for users to take full advantage of what can be acquired from a limited amount of essential data. To achieve further insight into PP, an Excel version can be provided by the authors.

3. Conclusions

The PP application, which incorporates a number of models already validated and considered reliable for determining the compliance of RTE products with EU safety criteria[1], also includes two complementary functionalities, such as the fractional contribution of each inhibitory factor to growth probability and the time evolution of the growth probability[3], which can be exploited in the framework of processing and shelf-life validation.

While we acknowledge the high variability of the factors affecting the pathogen behaviour in food produced in small enterprises and the effectiveness of the stochastic approach to deal with this variability, we believe it could be more practical and realistic in those circumstances to apply a simplified approach, which does not require modelling specialists to assist small producers. We hope that this application will represent a bridge between producers and food safety authorities and will assist in their common commitment towards the production of safe food.

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