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Sym'Previus, A USER-FRIENDLY PREDICTIVE TOOL FOR THE FOOD INDUSTRY

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I. INTRODUCTION

Predictive microbiology, or the use of mathematical models to estimate the behavior of microorganisms in food, can be used to enhance food safety by predicting the growth, survival, or inactivation of microorganisms in food products. By simulating factors such as temperature, pH, and humidity, these models help assess potential risks and ensure food safety throughout production, storage, and distribution. This approach enables food manufacturers to make data-driven decisions, reduce the likelihood of contamination, and optimize processing conditions. As food safety regulations become more stringent, predictive microbiology provides a powerful tool for preventing foodborne illnesses and maintaining the quality and safety of food products.
Sym'Previus is a comprehensive tool for predicting microbiological data. Trusted by the scientific community for over 20 years, it assists manufacturers in ensuring food safety and quality. Drawing on the expertise of its partners, Sym'Previus offers tailored solutions to address specific industrial challenges. The purpose of this communication is to present case studies illustrating the application of the tool's various modules.

II. MATERIALS AND METHODS

The Growth/No growth interface module for *Listeria monocytogenes* and *Salmonella* was applied for dry fermented sausages with different experimental pH and a_w. The Growth simulation module was applied to assess the growth of *Clostridium perfringens* in a post-pasteurization refrigeration profile of beef slurry and *L. monocytogenes* during shelf-life of cooked ham stored at different temperatures. The Thermal inactivation module was applied to predict the inactivation of *L. monocytogenes* and type II *C. botulinum* in cooked meats, evaluating the impact of different pH and a_w levels. All the modules are available at https://symprevius.eu/en/.

III. RESULTS AND DISCUSSION

The application of the **Growth/No growth interface module** to evaluate the growth probability of *L. monocytogenes* and *Salmonella* in dry fermented sausages (DFS) (pH 4.6-7.0 and a_w 0.82-0.93) showed that when DFS were stored at 6 ºC the probability of growth of the two pathogens was below 10%. In contrast, under storage at 21 ºC two DFS (those with higher pH and a_w) showed a 50-90% probability of growth of *L. monocytogenes* (Figure 1A).
The growth of *C. perfringens* in a post-pasteurization refrigeration profile of beef slurry was evaluated with the **Growth simulation module**. The safety of the refrigeration profile, from 80 to 5.9 ºC in 12h, depended on the physicochemical characteristics of the slurry. The predictions showed that while a 1.2 log increase of *C. perfringens* was expected in a slurry of pH 5.8±0.2 and a_w 0.985±0.004 (Figure 1B), no growth was predicted in a more stringent slurry with pH 5.4±0.2 and a_w 0.975±0.004.

The **Growth simulation module** was also used to simulate the growth of *L. monocytogenes* in cooked ham (pH=6.0 ± 0.5; a_w=0.974 ± 0.06) during shelf-life storage at three different predefined dynamic conditions (1: 1/3 of shelf-life at 4ºC + 2/3 at 8ºC; 2: 2/3 of shelf-life at 4ºC + 1/3 at 8ºC; 3: 2/3 of shelf-life at 2ºC + 2h at 20ºC + 1/3 at 8ºC). The output of the module showed that the growth of *L. monocytogenes* was 7.7, 5.0 and 7.9 log increase for conditions 1, 2 and 3, respectively (Figure 1C).
Finally, the use of the **Thermal inactivation module** to predict the decrease of *L. monocytogenes* and type II (non-proteolytic) *C. botulinum* in cooked meats (a_w=0.974) showed the decrease in the levels of both pathogens after a 30 min thermal treatment. *L. monocytogenes* was more than 15 log inactivated and the impact of the pH of cooked ham on the inactivation of *C. botulinum* was remarkable, rising from 1.9 log in a product with a pH of 6.0±0.2 to 11.3 log in a slightly more acidic ham (pH 5.0±0.2) (Figure 1D).

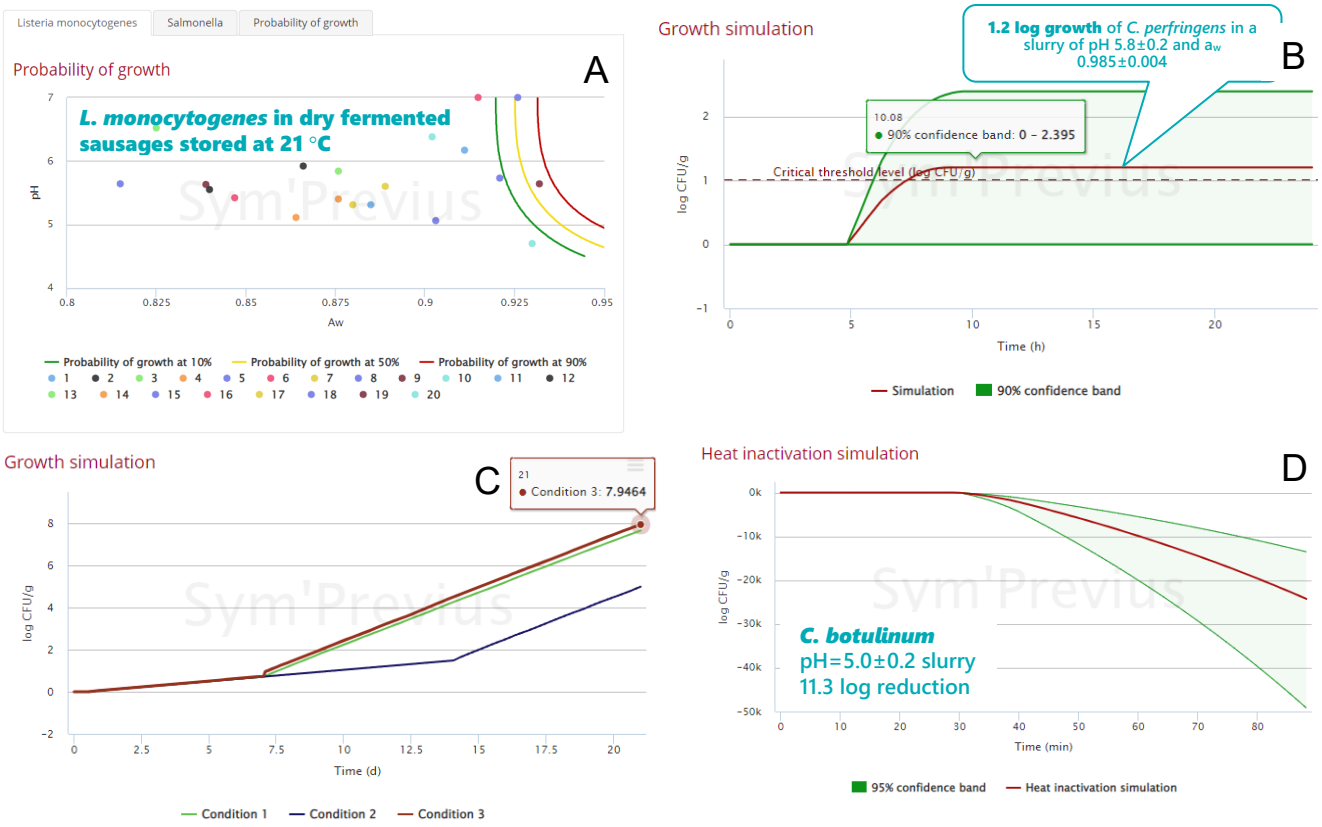


Figure 1. Outputs of the Growth/No growth interface module (A), Growth simulation module (B), Thermal inactivation module (C) and Growth simulation module (D).

IV. CONCLUSION

Sym'Previus is a predictive tool providing outputs that be used to support decision making during the design of products and it is frequently updated with new tools as the prediction of fungal growth or bacterial growth under modified atmosphere.