MATHEMATICAL MODELS WILL HELP YOU TO DETERMINE SHELF LIFE OF COOKED MEAT PRODUCTS

L. Meinert[1*], A. G. Koch[1], and T. Jacobsen[1],

[1]*Food Safety, Danish Meat Research Institute, Taastrup, Denmark*,

*lme@dti.dk

I. OBJECTIVES

The aim was to develop mathematical models that describe the microbial development and sensory shelf life of cooked pork products. The hypothesis is that it is possible to estimate shelf life, when you know the number of bacteria in the cold cuts at the time of packaging combined with storage temperature and preservations used.

II. MATERIALS AND METHODS

The dataset used to develop the models consists of 37 individual trial series in which approximately 2,000 packages of cold cuts were analyzed for psychrotrophic colony forming units and lactic acid bacteria. Furthermore, approximately 10,000 sensory assessments were made of the appearance, smell, and taste of the cold cuts by 5 expert assessors. The sensory assessment was based on scores from 1–4 (1–2 acceptable; 3–4 unacceptable)

The growth models: As primary model a logistic function of the form (see below in the Image section) was applied. Here, l_0 is the aerobic initial counts in the used meat, and t is the storage time in days. The variable φ constitutes the secondary model depending on water phase salt content, temperature, and whether nitrite and lactate were added.

The sensory models: The time dependency of all sensory profiles is all linear or slightly logistic. These profiles were modeled using a small neural network with 6 input neurons, 2 hidden neurons with logistic response functions, and a single output neuron. The 6 inputs were, nitrite (Y/N), lactate (Y/N), water phase salt, temperature, l_0, and storage time. This neural network model incorporates both primary and secondary models.

III. RESULTS

The results in Figure 1 show an example of a dataset used in the model. It can be seen from Figure 1 that, after 28 d of storage at 8°C, some samples were assessed as unacceptable (above 2). At this time, the number of bacteria was between 7 and 8 log CFU/g. The psychrotrophic colony forming units reached a maximum after approximately 30 d. At that time, the sensory assessments were above an average score of 2, which means that most of the assessors assessed the product as sensory unacceptable.

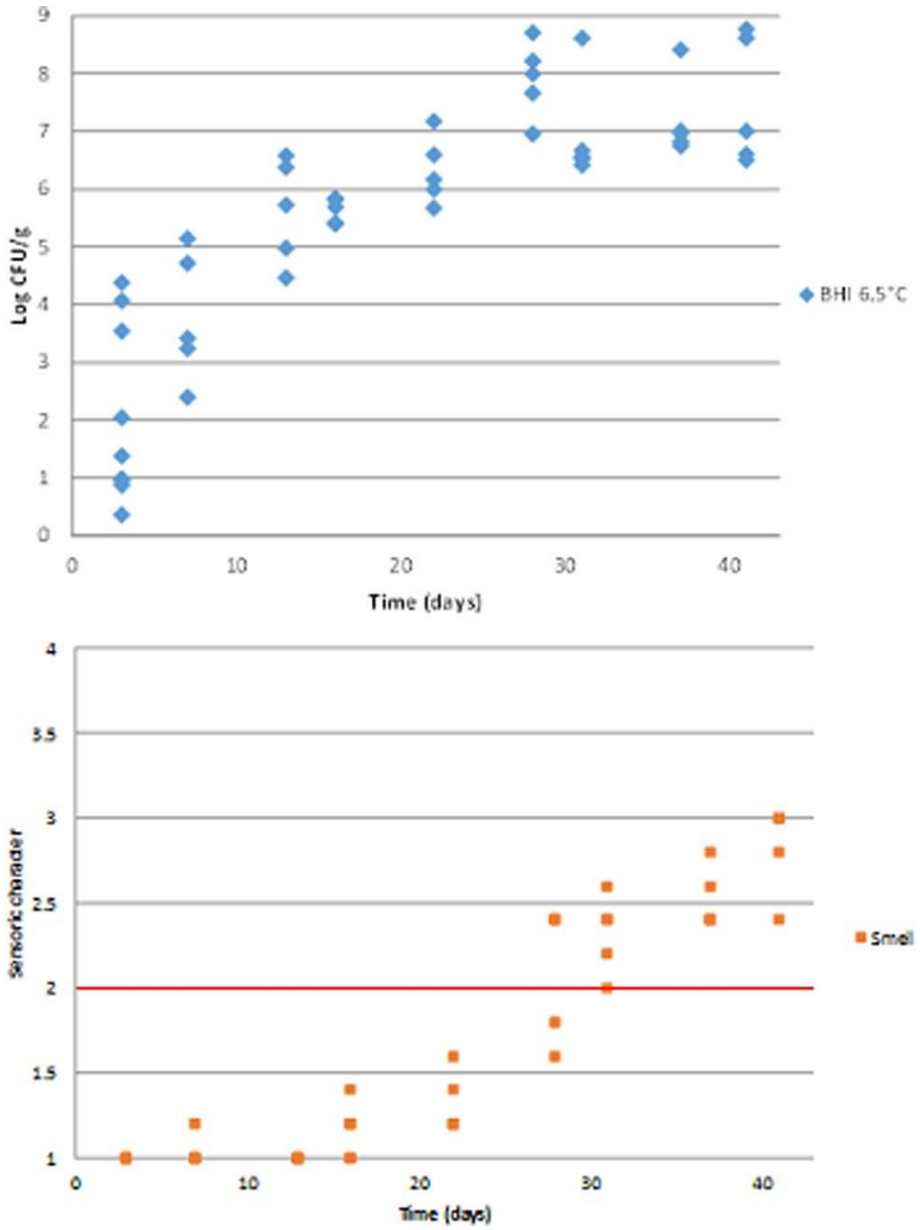

Figure 1.

Microbial growth (psychrotrophic colony forming units grown in BHI-agar) and sensory development in sliced cold cuts (2.2% salt/water, nitrite and lactate) stored at 8°C. Initial counts: 2-24,000 cfu/g. The odour (smell) character is the mean value of 5 assessors' assessment of cold cuts from the same package.

$$\log(cfu(t))=8/(1+(8\log(l_0)-1)e^{-t/\phi}\log(cfu(t))=8/(1+(8\log(l0)-1)e-t/\phi$$

IV. CONCLUSION

The data showed variations in the number of bacteria in the cold cuts packages, both between different products and within the same product, as expected. These variations are a part of the real life situation for meat producers when they determine end dates of their products. But even so, it is possible to predict shelf life of cooked meat products with the use of the mathematical models, which will be of great help for the quality managers in companies producing cooked meat products.

Find the shelf life model (and other predictive models) at DMRIPredict.dk. It is free of charge to use the models.