Results for today; Ideas for tomorrow

Predictive Modelling of Bacterial Growth

Predictive microbiology is one of the tools a risk manager can use to determine if a breakdown in refrigeration has compromised the safety of the product. Predictive microbiology provides us with an estimate of the potential growth of particular microorganisms under a variety of conditions. The models used in predictive microbiology are developed from experimental work, usually conducted in laboratory media. These models are then extrapolated to foods. There are three types of models:

Primary models are used to estimate the generation times of bacteria from growth experiments.

Secondary models describe the growth of microorganisms under a range of conditions. In most cases, certainly for boxed meat, the dominant factor determining growth is temperature. For carcases meat water activity (a_w) is also very important. The model currently in use by AQIS and the meat industry to estimate the likely amount of growth of *E. coli* on meat (*E. coli* Growth Predictor) is a secondary model developed by researchers at the University of Tasmania. Similar models are available from other sources including Food Science Australia.

Tertiary models are the final stage in the evolution of predictive microbiology. They combine primary and secondary models in a user-friendly computer package that allows the growth rate of a number of microorganisms to be estimated under a variety of conditions. One of the main uses of such software is in product development since it lets the user see the effect of formulation changes on the safety of the product without costly pilot plant trials. The software packages that are available include:

- Pathogen Modelling Program (US), and
- Food Micro Model (UK).

The Pathogen Modelling Program is the most widely used, not because it is better (Food Micro Model has more features) but because it is available free and on-line at http://www.arserrc.gov/mfs/pathogen.htm

There are some limitations of predictive microbiology that need to be considered. These include:

1. The models cannot be extrapolated outside the ranges (eg. T°C, a_w) in which they were derived. This is because the models are derived from fitting the observed data and therefore do not model microbial behaviour. Predictions outside the experimental ranges are usually not accurate and in some cases are nonsensical.

2. The models usually predict faster growth rates than are observed. This makes them fail-safe but they may be overly conservative. The reason for this is the models are usually conducted in laboratory media and while they are validated in foods, they may not have widespread application in the food industry.

E. coli Growth Predictor

This model was developed by researchers at the University of Tasmania and is provided courtesy of Meat & Livestock Australia.

Instructions for Use

1. Load the CD-ROM and open the program in Microsoft Excel. When asked, click on the 'Enable Macros' button.
2. Insert temperature data into the 'DATA' worksheet. The data MUST be in the form of hours, with temperature starting at 0 hours.
3. Temperatures below 7°C are not required
4. There should be no breaks in the data ie. intervals should be uniform. eg.

Time (Hours)	Temperature (°C)
0.00	37.0
0.25	36.5
0.50	36.0
0.75	34.0

5. Click on the 'RUN' button.
6. The program will ask you to specify the time intervals of the data logger, and then it automatically calculates the data.
7. The results are displayed in the 'GRAPH' worksheet as log growth (the red box) and a graph showing the temperature and predicted log growth over time.
8. If you want to print the graph, follow the instructions in the worksheet.
9. To enter more temperature data, click on the 'Reset and start again' button in the top right-hand corner of the worksheet.

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