F-value calculator – a tool for calculation of acceptable F-value in canned meat reduced in NaCl

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INTRODUCTION

Canned meat products are usually protected against growth of C. botulinum by combination of heat, sodium chloride and sodium nitrite. When meat products are reduced in NaCl for health reasons, they need a higher heat treatment to maintain same level of protection against C. botulinum. We developed a new tool for calculating the F-value, necessary to obtain equivalent safety for canned meat when reduced in NaCl, compared to the original combination of aqueous salt and F-value. The tool is available at http://dmripredict.dk.

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MATERIALS & METHODS

A spore mixture of three gas producing strains of the closely related species C. sporogenes (putrefactive 93R, putrefactive 3679 and putrefactive 1075) were used for spiking the chopped pork meat during production of the canned luncheon meat (pH 6.0; 144 ppm NaNO2).

26 different meat batters with various aqueous salt content (1.66 – 3.54%) were spiked at 5.000 spores/g (calibrating series) and 11 were spiked at 100 spores/g (validation series). 70 cans of inoculated meat batter were autoclaved at 112 °C until the requested F-values (0.51 to 3.25) were obtained. After cooling, the cans were challenged at 37°C (calibrating series) or 25°C (validation series) and visually examined for blown cans for up to 120 days.

By fitting corresponding values of time and percent blown cans (MicroFit 1.0), the “time to 50% of the cans were blown” (bomb50) was estimated as a measure for the observed “relative shelf life”. It is assumed that the relative shelf life in days (Ds) is a function of F-value (F), aqueous salt in the product (WPS) and storage temperature (T). A model of the type

\[
\ln(Ds) = \ln(K) + a \cdot \ln(F) + b \cdot \ln(\text{WPS})
\]

was hypothesized, where a and b are constants that are to be determined experimentally and K is a temperature dependent constant. The data for determining the constants (a, b and K) consisted of simultaneously fitted values of “bomb50”, actual measured F-values and aqueous salt. PLS regression (Unscrambler ver 9.2, CAMO Norway) was used to determine a, b and K.

RESULTS

- The best fitted values for a = 0.200; b = 0.642 and K = 12.01 giving the formula

\[
D_s = 12.01 \cdot F^{0.200} \cdot \text{WPS}^{0.642}
\]

- A tool for prediction of the necessary increase in F-value in NaCl-reduced luncheon meat (F-value: 0.51-3.25 and aqueous salt: 1.66-3.54)

- Accuracy factor = 1.21 and Bias factor = 1.15 (fail safe model)

- The F-value calculator is available at http://dmripredict.dk

<table>
<thead>
<tr>
<th>In-put values</th>
<th>Actual aqueous salt</th>
<th>Actual F-value</th>
<th>Requested aqueous salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>0.5</td>
<td>2.4</td>
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<table>
<thead>
<tr>
<th>Out-put values</th>
<th>Necessary F-value</th>
<th>Log reduction C. botulinum, initial F-value</th>
<th>Log reduction C. botulinum, new F-value</th>
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<tbody>
<tr>
<td>1.68</td>
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| Fig. 3. Example of user interface from the “F-value calculator”. Full line shows combinations of aqueous salt and F-value having equal protection as a meat product with 3.5% aqueous salt, heat treated to F = 0.5. |  |

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