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Instructions for Using the AMI Process Lethality Determination Spreadsheet

(Print these pages and open the Excel spreadsheet to follow along)

Objective:

The purpose of the process lethality determination model is to provide meat processors with a science-based validation tool that can be used to demonstrate the effectiveness of a specific heat process to destroy a microorganism of concern. Specifically, the interactive model allows the user to input actual in-process data from a given cook cycle and determine if the process achieves the required log reduction for the microorganism of concern. The goal is to define or map the heating and cooling profile of the product by observing the temperature characteristics of the product during heating and cooling. Microbial destruction may occur during a significant portion of the heating and cooling process, not just at the minimum internal temperature.

Definitions:

- Thermal Death Time - This is the time in minutes, necessary to kill a given number of organisms at a specified temperature.
- T ref – The reference temperature used when establishing the D and z values.
- D Value – This indicates time in minutes at a constant temperature, that is necessary to destroy 90% or 1 log of the organism present at a given reference temperature. A D value at one temperature, along with a z value, is used to define the heat resistance of a microorganism, and can be used to calculate the D value at any other temperature.
- z Value – This is the temperature increase required to reduce the thermal death time by a factor of 10. It is the number of degrees between a 10-fold change (or log cycle) in an organism's heat resistance. The z value is considered to be constant for a given strain of microorganisms in a given product.
- F Value – This is the process lethality or the time in minutes, at a specific temperature required to destroy a certain number of viable cells.

User must provide the following:

- Identify organism and product of concern.
- Provide at least 20 time/core product temperatures that represents the products heating and cooling process.

Instructions:

- 1) By using the table that contains the lethality data from literature, we have selected the microorganism and product of concern. For example, let's say our organism of concern is *Salmonella*, and our product is a meat patty. Identify the corresponding T ref (150°F), z values (10°F), and D value (0.172 min) provided in the table. These values should be obtained from your own companies challenge

- study data, from scientific literature, or other reliable sources. These values need to be relevant and appropriate for the type of product and the organism of concern. The table provides some example values from scientific literature that apply to certain products, but you need to justify your choice or provide more relevant values for your specific product and process.
- 2) Once the T_{ref} (150°F), z values (10°F), and D value (0.172 min) have been identified, enter them into the appropriate labeled cells below the table that contains the lethality data from literature.
 - 3) The data table below these two values gives an example of what some time/temperature data points may look like. Time must be recorded in increasing minutes (0, 10 min, 20 min, 30 min) when each temperature value is recorded. The temperature must be the core product temperature that identifies the coolest spot in the product and the product should be in the coolest zone in the cooking chamber. It is suggested that at least 20 data points be entered into the data table. The values that you enter should be a time-temperature map of the product as it heats and cools.
 - 4) Once the table has been completed, the F value, or process lethality, will be calculated at each data point and a cumulative F value will be given as the very last number in the right hand column of the data table (0.884 min). This number adds up the lethality values for each time interval and calculates an approximation of the area under the lethal rate curve. This value will be referred to as the “computed cumulative F value” or the “cumulative process lethality”. In the given example, the calculation results in an equivalent lethality at 150°F of 0.884 minutes. Clear the values in the first two columns and enter your own continuous process time and core product temperature (°F) in the appropriate columns.
 - 5) After the data has been entered, a core temperature and a lethality curve are produced. The first graph shows a plot of the core product time/temperature relationship and the second graph shows a plot of the data converted to lethal rates or the cumulative F value. In the example, because 150°F is the selected reference temperature, the area under the curve represents the total lethal effect of the process equivalent to 150°F. In this example, the lethality of the process is 0.884 minutes. This represents an “equivalent” time. So, even though the product never reached 150°F, the total process of 10 minutes heating and cooling has the same or equivalent lethal effect as instantaneously heating the product to 150°F and holding it at 150°F for 0.884 minutes.
 - 6) The total log reduction of the process is automatically determined by dividing the cumulative F value (0.884) by the D value (0.172) that was entered into the appropriate labeled cell. The resulting value equals the total log reduction of the process (5.14 D 's).
 - 7) By using these estimates, you or a process authority should determine if the process meets regulatory requirements as safe. Additional documents, such as [Appendix A](#), which discuss desired log reductions should also be considered when evaluating a lethality process.

Summary:

This spreadsheet is to be used as a tool to determine if a specific cooking process has provided sufficient time and temperature to achieve a required log reduction for a given microorganism. If the appropriate log reduction is achieved for the process and organism of concern, the data and graphs provided in the spreadsheet may be used as a component of the HACCP validation materials. If the cooking process does not result in the appropriate log reduction, the cooking process needs to be re-evaluated and additional time and or temperature may need to be applied to the process.

Please direct all questions to the AMIF staff at 202-587-4200.

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Note: The process lethality determination spreadsheet model is compatible with either Microsoft Excel version 5.0 (the version of Excel that is packaged with Microsoft Office 95) or Microsoft Excel 97 (the version that is packaged with Microsoft Office 97). Microsoft Excel version 5.0 and Microsoft Excel 97 will work regardless if the operating system is Windows 95, Windows 98 or Windows NT.

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