TECHNICAL NOTE

# FOOD SHELF LIFE STUDIES: BASICS, PRINCIPLES AND CONCEPTS

Overview of two test methods for conducting a shelf life study.

## Overview

Shelf life studies determine how long a product can reasonably be expected to maintain its quality, safety and character. To conduct a shelf life study, there are direct method and the indirect methods.

## Background

A product's acceptable shelf life allows its desired end of shelf life parameters (EOSLs) to be maintained; these include a product's sensory, chemical, functional, microbiological and physical properties. Because the EOSL for each product is different, the shelf life study procedure will be unique.

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## Methods and Examples

There are two test methods for conducting a shelf life study. The direct method involves storing the product under specific conditions for a period of time that is longer than its expected shelf life and checking it at regular intervals to see when it begins to spoil. Two indirect methods allow for shelf life prediction without conducting a full-length storage trial and are useful for products with a long shelf life.

The first indirect method uses a predictive model to calculate shelf life based on information of bacterial growth under specific conditions.

The second method is an accelerated shelf life study, which involves deliberately increasing the rate at which a product will spoil, usually by increasing the storage temperature. A tool used here is "the rule of ten," or $Q_{10}$, which is the factor by which the rate of spoilage increases when the temperature is raised by 10°C. $Q_{10}$ allows for the prediction of a product's shelf life under real-life conditions based on the results of testing conducted at high temperatures. It is unitless and can be calculated with the equation $Q_{10} = (R_2/R_1)^{(10/(T_2-T_1))}$, where R is the rate for a product to spoil and T is the temperature at which the testing is conducted. For most products, the $Q_{10}$ value is 2.0, which means that for every increase of 10°C, the rate of a chemical reaction will double.

In an example, a product was tested at three different temperatures to obtain the time to spoilage. $Q_{10}$ values were obtained by comparing $T_2/T_1$ with $R_2/R_1$ and $T_3/T_2$ with $R_3/R_0$, as defined in Table 1.

| T1 | T2 | T3 |
|---|---|---|
| 20C | 30C | 40C |
| R1 | R2 | R3 |
| 15 | 24 | 38 |

*Table 1. Temperature and Time to Spoilage Data*

Applying two different sets of parameters to the equation:

$$Q_{10} = (24/15)^{(10/(30-20))} = 1.61$$

$$Q_{10} = (38/24)^{(10/(40-30))} = 1.58$$

From above calculations, the actual $Q_{10}$ for this product is approximately 1.6, not the theoretical value of 2.0. When using a $Q_{10}$ value of 2.0, the predicted shelf life is 32 weeks (8 months), but with a $Q_{10}$ value of 1.6 the predicted shelf life is 20.48 weeks (5.2 months).

## Conclusion

- Shelf life studies need to be product specific with detailed product information to establish the end of shelf life parameters.
- Direct methods are most accurate results and should be used for products with shorter shelf lives (perishable).
- Accelerated studies provide results for products with longer shelf lives in a shorter time.
- $Q_{10}$ theory can be a useful tool for accelerated study.


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