Accelerated Shelf-Life Testing

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Depending on the product in question, the definition of shelf life can vary. For example, for chilled foods, the microbiological quality may be the important factor, but for most confectionery products, it is the sensory quality that determines the endpoint of the product life. Shelf-life predictions need to relate to the shelf-life-limiting attributes of the product life. The best definition, and probably the most widely accepted, is one given by the IFST in 1993, stating that shelf life is the time during which the product will be safe, retain the desired quality attributes and comply with all the labeling declarations for the product (Figure 1).

Accelerated shelf-life testing (ASLT) involves storing the products under a controlled set of storage conditions designed to accelerate the rate of deterioration of the product. The rate of deterioration can then be related to that occurring in normal ambient conditions, and the results can be used to devise models to predict shelf life in different storage conditions (Figure 2). Although the storage conditions used in ASLT need to increase the rate of deterioration, the deteriorative changes must be the same as those occurring under normal conditions. The accelerated tests assume that the deteriorative processes will fit a kinetic model.

Although accelerated tests provide useful results, there are many pitfalls if the tests are carried out incorrectly. The accuracy of the predictions rely on the accuracy of the test methods by which the changes in the products are monitored and also the frequency of the tests. The greater the precision of the measurements and the greater the sampling points, the better the prediction of shelf life.

Since the accelerated tests are often carried out under elevated temperatures, this may induce changes, such as meltdown of fats and structural changes, which result in inaccurate predictions (Figure 3).

DETERIORATIVE MECHANISMS

A complete understanding of the normal deteriorative processes is required. In the case of a single-component product, such as a wafer or a biscuit, this may be quite straightforward, as the most important change is moisture pick-up from the environment, which then leads to development of a stale texture and flavor. The moisture content at which the product becomes unacceptable, often called the critical moisture content, can then be determined.

The rate of moisture pick-up and the rate of development of staleness under different storage conditions can be measured over time.

In multi-component systems, the situation is more