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An Informative
Guide For Calculating
Shelf Life Of Food Products

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INTRODUCTION

What is Shelf-Life Testing?

Shelf-life of a food product is the period of time for which the food product can be kept before it starts to deteriorate, provided all the stated storage conditions have been followed. The beginning of the shelf life period is marked from the time the food product manufacturing finishes. The length of shelf life is dependent on a number of factors, such as, types of ingredients used, various processes used during manufacturing Its, type of packaging being used, how the food is to be stored, and many more.

*FSSAI has made it **mandatory** to mention manufacturing date and **best before date/use by date/expiry date** on the label of the product, in order to **inform the customers** about the shelf life period of the product.*

How is the Shelf-life of food related to food safety?

Shelf-life Testing helps in keeping the food product -
➢ Safe for consumption
➢ Maintaining the desired sensory, physicochemical and microbiological characteristics
➢ Retaining maximum nutritional qualities of it

SHELF-LIFE CALCULATION

Who is liable for calculating the Shelf-life of the food products?

The **food manufacturers** who package and sell the food products are the ones legally responsible for the calculation of acceptability time period of the product. Also the label of the food product should include details about the manufacturing date, and expiry date/ use by date/ best before date, along with correct storage instructions to meet that shelf life. Generally it is the responsibility of the food manufacturer, but in some special conditions it might lay up on the repackers, secondary processors, food retailers, and supermarkets.

The Shelf-life of the product can be influenced by -

Food manufacturing chain is long and involves a number of individuals. Each and Every person in this chain has a great amount of influence on the quality and safety of the food product. It is not possible to declare food as safe until and unless proper control measures have been taken throughout the chain.

➤ **RAW MATERIAL PRODUCERS**
Variable quality of the raw material can hamper the consistency of the product.

➤ **MEDIATORS**
Mediators are important for procurement from raw material producers to manufacturing factories. Proper care of raw material is to be taken to ensure no cross contamination or deterioration takes place. Raw material should be kept at adequate temperature and humidity to maintain quality.

SHELF-LIFE CALCULATION

➢ **MANUFACTURERS**

Manufacturers should make sure that the food product has contacted any contaminate that might hamper the quality of product. They are also responsible for estimating the shelf life for the food product.

➢ **DISTRIBUTORS**

The transportation of the food product from the manufacturer to the retailer should be carried out in a controlled environment. It is essential that food is stored safely and securely in the warehouse, transported at the correct temperature, delays are avoided, and packaging is not damaged.

➢ **RETAILERS**

The handling and storing of the product immediately before it reaches the consumer is also very essential, in order to maintain the acceptability of the product. They must be stored according to the directions provided by the manufacturer.

➢ **CONSUMERS**

They are the final level in the chain and it is important that they are provided with the correct information on storage conditions of the food product.
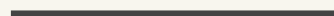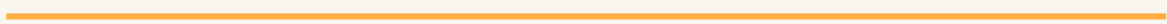
FACTORS INFLUENCING SHELF-LIFE OF A PRODUCT

The major factors which can cause food spoilage and influence the shelf life of the products are:

➢ **Moisture**
Change in Moisture content on the food product can cause initiation of various chemical reactions such as Maillard reaction, Rancidity, which will eventually lead to deterioration of the nutritive quality of the product. Products with low moisture content have longer shelf life and products with high moisture content have shorter shelf lifes. Also if, in case low moisture content takes up moisture from the surrounding , it can cause spoilage and shorten the shelf life.

➢ **Temperature**
Change in temperature can hamper the speed of the spoilage process, which will indirectly cause an effect in the shelf life of the product. Temperature majorly constitutes the determining finished food product parameter for shelf-life, therefore monitoring and controlling the temperature of the surrounding, therefore it is of central importance.

➢ **Physicochemical changes**
These changes can cause off flavours, colour changes, browning and loss of nutrients. These can be initiated due to many reasons such as, change in surrounding temperature, pH, and humidity ,or contamination during processing of the food products. Also tampering of the packaging can cause serious quality related issues.

FACTORS INFLUENCING SHELF-LIFE OF A PRODUCT

❖ **Light**
Keeping the products direct under the sunlight can increase the temperature as well as can cause rancidity, fading of natural colours and nutritional loss(vitamins).

❖ **Microbial spoilage**
Microbial spoilage can start depending on their levels in the food when it has been processed, as well as on any contamination which took place during packing, storage and other handling. The temperature and time of storage, as well as the type of food, also play a major role.

Other than these, there are few factors which can help in enhancing the shelf life.

➢ Formulation of a Product
➢ Processing Technology
➢ Packaging
➢ Storage Conditions

FACTORS INFLUENCING SHELF-LIFE OF A PRODUCT

These factors can be broadly classified as intrinsic and extrinsic factors. The **intrinsic factors** are the ones that respond to the formulation of the food. In the food industry, it is the duty of the manufacturer to have knowledge about the following of the product:

➢ **Raw Materials**
➢ **Composition and formulation of the product (additives used)**
➢ **Water Activity**
➢ **Total Acidity and pH Value**
➢ **Potential Redox**
➢ **Available Oxygen**

The **extrinsic factors** are the ones that are present in the process, packaging and storage of the product. Mainly they are:

➢ **Exposure to sunlight**
➢ **Temperature**
➢ **Humidity**
➢ **Damage to packaging**

REAL-TIME SHELF-LIFE TESTING METHOD

What is Real-time Shelf-life Testing method?

It involves storing the food product under specific conditions for a period of time longer than expected shelf life and checking the product at regular intervals to see when it begins to spoil. It is one of the most preferred methods for determining shelf life.

Process to conduct Real-time Shelf-life Testing

THE PROCESS

STEP 1

Define the Objective
First it is necessary to define the reason for the shelf life study. Reasons could be -
- ❖ Development of a new product, or
- ❖ A new formulation for an existing product.

STEP 2

Identify mode of Deterioration
Shelf life time period criterias vary from food product to product.
- ❖ For frozen foods, the shelf life period is attributed to elevated levels of spoilage microorganisms.
- ❖ For fried snack foods, mode of deterioration may be oxidation of fats
- ❖ For fruit juices it may be vitamin degradation
- ❖ For breads it may be starch retrogradation or staling.

REAL-TIME SHELF-LIFE TESTING METHOD

THE PROCESS

STEP 3

Define Key Attributes to Monitor

Identify all the key parameters by various analysis that can be monitored throughout the shelf life study, such as,

- ❖ Microbial examination,
- ❖ chemical analysis (for example lipid oxidation and vitamin degradation),
- ❖ physical testing (for colour or viscosity) or
- ❖ sensory evaluation

STEP 4

Select Test Methods

Determining suitable test to the above identified parameters is essential for setting a standard procedure for shelf life study of the food product. For example:

- ❖ For chemical analysis, lipid oxidation could be monitored by measuring peroxide, free fatty acid or thiobarbituric acid reactive substances formation.
- ❖ Sensory evaluation could be determined by various methods such as discrimination, descriptive or acceptance testing.

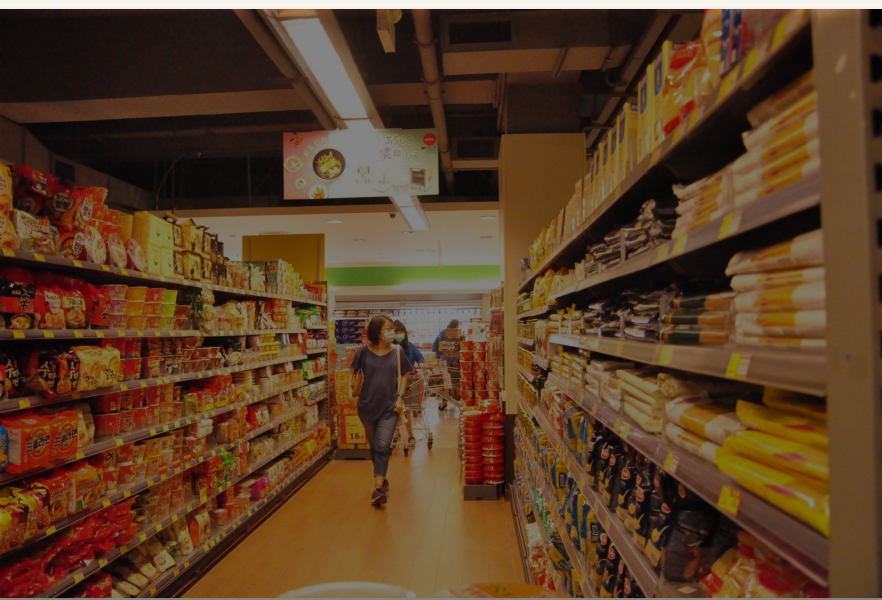# REAL-TIME SHELF-LIFE TESTING METHOD

THE PROCESS

STEP 5

Set Storage Conditions

Selecting the correct range of variables such as temperature, relative humidity and lighting conditions for the product is very important. These variables can also be fixed or changed to simulate real-life product exposure during storage, distribution and the retail environment.

STEP 6

Set Target-end Point and Testing Frequency

❖ For food products with shorter shelf life (like seven to 10 days), testing can be performed daily or every two days.

❖ For food products with intermediate shelf life (like three weeks) or longer shelf life (like one year), testing can be done at starting point and expected end point, plus two to three times more in between and at one point after the expected end point.

REAL-TIME SHELF-LIFE TESTING METHOD

THE PROCESS

STEP 7

Determine Appropriate Test and Control Samples

The formula, processing and packaging should be tested for the shelf life study. Test samples should be taken from the same batch being sent to the market to minimise fluctuations. Selecting the appropriate sensory control tests for freshly manufactured products, if the product deteriorates over time or freeze samples to ensure minimal deterioration.

STEP 8

Perform a Shelf-life Study

Store the test samples under controlled conditions outlined in the above steps and test at the selected intervals.

REAL-TIME SHELF-LIFE TESTING METHOD

THE PROCESS

STEP 9

Analyse Results

In the absence of mandatory standards, manufacturers are supposed to set their own endpoint based on microbiological, chemical or sensory criteria. The shelf life time period is assigned on the last day of an acceptable sensory score or analytical results.

STEP 10

Monitor and Confirm Shelf-life

Once the product has been launched into the market, still collect test samples at the distribution and retail levels and adjust the shelf life date accordingly.

ACCELERATED SHELF-LIFE TESTING METHOD

What is Accelerated Shelf-life Testing method?

This involves *a more flexible testing method.* It is a very useful method for the product that has a longer shelf life. It involves *intentionally increasing the product deterioration, through increasing the storage temperature.* This helps in determining the threshold parameters for the food products.

Real-time shelf life testing methods can be very lengthy, therefore food processors seek methods such as accelerated shelf life testing. One of the most common methods to *accelerate oxidative reactions* is to *store the product at an elevated temperature.*

For simple chemical systems such as bulk fat and oil, there is a direct relationship between oxidation rate and temperature. This mathematical equation can only be used if there is a *correlation between the storage behaviour under normal conditions and under accelerated conditions.* But *in reality, foods are more complex* and elevated temperature storage may initiate various other reactions that would not occur at normal temperature storage.
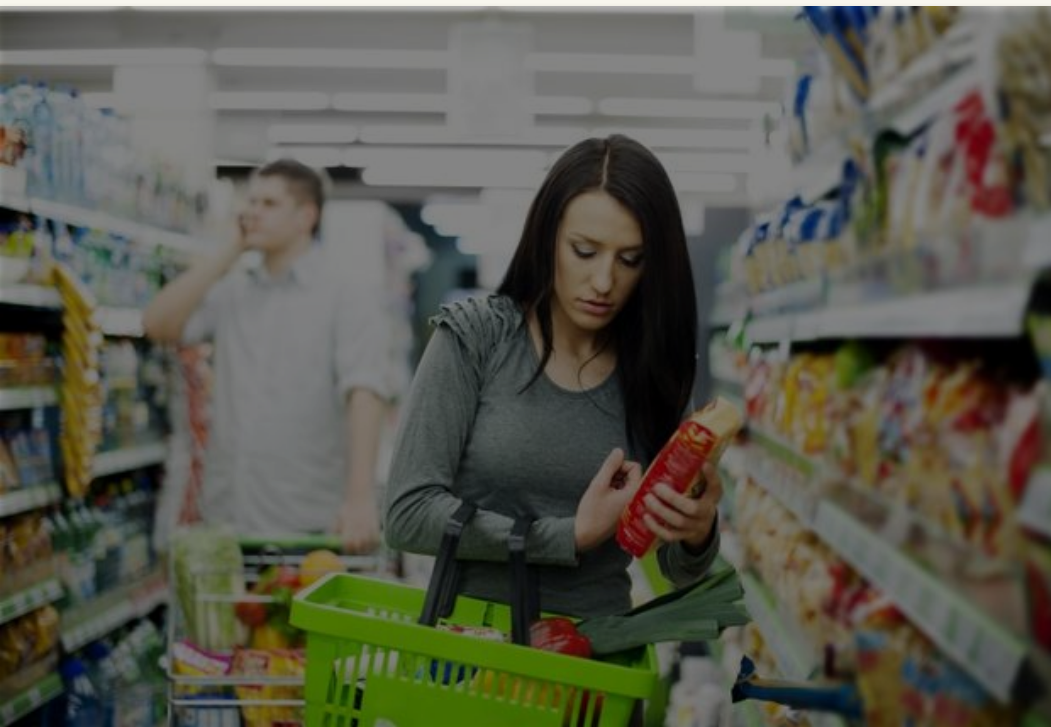
ACCELERATED SHELF-LIFE TESTING METHOD

What is Accelerated Shelf-life Testing method?

Increasing storage temperature may lead to changes that *enhance the deterioration process such as melting of solid fats, crystallisation of amorphous carbohydrates, increased water activity, denaturation of proteins and decreased solubility of gases.* Relative humidity may also affect reaction rate.

Accelerated shelf life testing is not applicable for short shelf life chilled foods where microorganisms flourish at different temperatures. These studies are *very versatile, low cost, and allow comparison of different environments.* Obviously, since it is not an exact representation of reality, there is some margin of error in the obtained results.

REGULATIONS RELATING TO SHELF-LIFE TESTING

FSSAI states the following guidance notes for product approval process relating to real time shelf-life stability data sheet, or accelerated shelf-life stability data sheet

Every packaged food product (except Alcoholic Beverages with alcohol content of more than 10%) has a given life. The Shelf life stability data is relevant to businesses if the shelf life claimed on the label of the food product is established scientifically or done arbitrarily.

➢ Shelf-life of a product refers to the period spanning between the date of **manufacture/packaging** and its **"Expiry"/"Use by"** date i.e. the period by which the product remains safe for consumption. Various food products are manufactured with a prescribed shelf-life.

➢ A product shelf-life is determined as a part of the R&D effort at the manufacturer's end. The most dependable studies are based on **real-time analysis.** However, there are methods prescribed for arriving at the shelf-life using **accelerated methods.**

➢ Real-time shelf-life stability data is the data which is calculated by the FBO at the R&D stage of the product to decide **until what time period** the product is **safe for human consumption.**

REGULATIONS RELATIONS TO SHELF-LIFE TESTING

FSSAI states the following guidance notes for product approval process relating to real time shelf-life stability data sheet, or accelerated shelf-life stability data sheet

➢ Accelerated shelf-life stability data is the data in which temperatures are increased along with relative humidity with *appropriate mathematical calculations* to be able to calculate shelf-life faster.

➢ This data should provide all *physical, chemical, and microbiological parameters* for safety as well as composition of content in case of vitamins and minerals and substances which are likely to deteriorate.

➢ Ideally, shelf-life data for *3 batches* is essential to corroborate the shelf-life, but as of now, even 1 batch data would be acceptable.

➢ In case of imports, such shelf-life stability data has to be *obtained* from and *furnished* by the *manufacturer*.

➢ All these studies need to be done *scientifically.*

➢ Mere simple statement of shelf-life is not sufficient, the *entire data* has to be submitted to the authority with the calculation of *actual estimation* of shelf-life.

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