Shelf life is normally the amount of time a food product stored under appropriate conditions, retains its freshness, taste, texture, nutritional value and any other quality claimed by the manufacturer.

Food manufacturer’s responsibility is to determine the shelf life of the product and demonstrate that characteristics will be retained throughout the determined shelf life. This will ensure an optimal product and consumer satisfaction.

Increasingly, manufacturers are required by regulatory authorities and retail stores to conduct shelf life studies on their products such as refrigerated ready-to-eat products, products with long shelf life or even frozen products.

Manufacturers with or implementing a recognized GFSI system such as BRC and SQF must prove that the shelf life of their product has been validated.

When to Conduct a Shelf Life Study?

A shelf life study can determine the aging process or spoilage of the product and help set an expiration date. However, the manufacturer must also determine if a new study is justified when a recipe, manufacturing process or packaging are modified. For example, changes in the level of preservatives, salt content and physical-chemical properties such as pH, water or changes of the modified atmosphere packaging should require further validation of shelf life product. Minimal variations to a recipe may result in significant impact on product behaviour.

Shelf life can be determined on an on-going basis to ensure manufacturing process consistency and to target potential problems linked to product preservation. In fact, for some types of products the shelf life is more of a problem in the summer. Followup shelf lives can be less demanding than the original validation.
HOW TO MEASURE SHELF LIFE?

The main method used to determine shelf life is to monitor the product over time. Shelf life is the number of days between the manufacturing date and the time when the product will display the first major signs of degradation. It is strongly recommended to maintain a safety margin.

Characteristics of the product must be identified to set the analysis parameters, in particular:

- Types of ingredients
- Formulation (pH, aw, % of salt, preservative, additives, etc.)
- Process (e.g.: thermal processing, acidification, fermentation, drying, etc.)
- Conditioning (modified atmosphere, type of material, etc.)
- Storage and distribution conditions.

This information will determine the type of analysis to be performed and here is a brief overview.

Microbiological: indicators or spoilage microorganisms (aerobic and anaerobic bacteria, coliforms, lactic acid bacteria, E. coli, yeasts, moulds, Pseudomonas) and pathogenic bacteria (Salmonella, Listeria monocytogenes, E. coli O157:H7, Bacillus cereus, Clostridium perfringens, Staphylococcus aureus and others.)

Physicochemicals: pH, water activity (aw), viscosity, salt content, moisture, free fatty acids and others.

Nutritional: vitamins, probiotics or other main components in your product.

Organoleptic (sensory evaluation): appearance, texture, colour, odour, taste, after cooking evaluation, observation, etc.

STORAGE CONDITIONS

Storage conditions are defined once the parameters and limits have been established. For refrigerated products, it makes sense to take into account the actual cold chain, particularly during the various stages of distribution and the expected time in consumers’ refrigerators where the temperature is often around 70°C. A method used to simulate these variations is to carry out the study with storage at 40°C (prescribed storage temperature) for one-third of the time and at 70°C for the remaining study period.

Product shelf life can also be submitted to “stress” temperatures to simulate a break in the cold chain. Apart from the temperature, other factors can also have an impact on the shelf life of a product during storage for example, exposure to light, moisture, etc.

In parallel, multiple shelf life studies, can also be conducted to measure the impact of storage conditions (e.g.: at 4 °C and at 7 °C, with and without any break in the cold chain, etc.)

SAMPLING

Representative sampling is required to ensure reliable and reproducible results. It is recommended that shelf life studies be conducted on products from regular production runs and with commercialized size containers. Pilot productions and laboratory tests do not represent normal production conditions. A shelf life study is specific to a product under certain manufacturing conditions.

For rigorous results’ interpretation, it is strongly recommended that product analyses be carried out in duplicate, triplicate and on more than one production lot. Product samples can be taken at the start, middle and end of a production run.

According to the use of the product, shelf life testing can also be carried out on a product after opening or thawing. Various conditions can be verified to simulate critical scenarios used to increase the shelf life’s confidence level.
OTHER METHODS

Other methods such as predictive microbiology can also be used to determine the shelf life of food. Predictive microbiology utilizes a database to assess the growth of microorganisms in relation to the properties of an evaluation matrix (e.g.: pH, aw, % salt) and temperature. However, microbiological modelling has limits since it does not consider a number of factors such as the manufacturing conditions specific to each plant. Furthermore, this method cannot predict the behavior of food at the organoleptic level.

Food manufacturers who hope to quickly bring to market products having a long shelf life could be tempted to fast track the shelf life study. Normally, a shelf is fast tracked when the storage temperature is increased to accelerate the reactions leading to product aging. However, this approach is not recommended for microbiological analyses. Increasing the temperature encourages microorganisms growth which would not have been present under normal conditions.

LIMITS

A shelf life study does not guarantee the safety of the product. For example, a pasteurization process must be validated and controlled to obtain a proper reduction of the targeted pathogenic microorganisms. Furthermore, favorable production conditions must be in place such as good manufacturing practices, a cleaning and sanitation program, raw material control, a calibration program and a sampling plan.