Vida útil de los alimentos

Lifetime food

María Luisa Carrillo Inungaray
Universidad Autónoma de San Luis Potosí
maluisa@uaslp.mx

Abigail Reyes Munguía
Universidad Autónoma de San Luis Potosí
abigail.reyes@uaslp.mx

Resumen

En un mundo de consumismo, en el que la duración de las cosas puede haber pasado a un segundo plano, conocer el tiempo que durarán los alimentos ha cobrado gran importancia. Esto puede explicarse por el interés de los consumidores por el cuidado de su salud, lo que los lleva a tomar precauciones para minimizar riesgos de contraer enfermedades por el consumo de alimentos contaminados, o de alimentos procesados. La elaboración de alimentos con procesamiento mínimo requiere de un conocimiento de las complejas reacciones que se llevan a cabo en el alimento, ya que si la combinación de factores de conservación que se aplican en el alimento no son en la cantidad y la intensidad adecuadas, puede ocurrir una mayor velocidad de deterioro de los mismos.

La información que aquí se presenta, pretende servir de apoyo al personal de la industria alimentaria, a estudiantes y profesores del área de los alimentos, que requieran de información básica acerca de cómo lograr la estabilidad de los alimentos, así como los factores que participan en su descomposición. Los conceptos que se presentan permitirán comprender los factores relacionados con la descomposición de los alimentos y la influencia en su estabilidad. Asimismo, se mostrará cómo aplicar e interpretar pruebas para prolongar la vida útil de los alimentos, lo que contribuirá a la mejora de la calidad y a la consecuente disminución del riesgo de adquirir enfermedades transmitidas por ellos.

Palabras Clave: alimentos, vida útil, contaminación, descomposición.

Abstract

In a world of consumerism, in which the duration of things could have happened to the background, knowing the last time that food has become very important. This can be explained by the interest of consumers in their health care, which leads them to take precautions to minimize risk of disease by consuming contaminated food or processed foods. Food processing with minimal processing requires knowledge of the complex reactions that take place in the food, as if the combination of preservation factors that are applied in the food are not in the appropriate quantity and intensity, can be occur faster deterioration thereof.

The information presented here aims to support the food industry personnel, students and professors of food, requiring basic information on how to achieve food stability, as well as factors involved in decomposition. The concepts presented allow us to understand the factors related to the breakdown of food and its influence on stability. Furthermore, we show how to apply and interpret evidence to extend the life of food, which will contribute to improving the quality and the consequent reduction in the risk of acquiring foodborne disease.

Key words: food, life, contamination, decomposition.

Fecha recepción: Agosto 2012 **Fecha aceptación:** Noviembre 2012

Introduction

The shelf life of a food is defined as the finite time after production under controlled storage conditions, which will have a loss of sensory and physicochemical properties, and undergo a change in its microbiological profile.

One way consumers can know the life of the food they are buying, is looking at the product label expiration date or date of minimum durability; both indicate the end of the shelf life of food. Expiration date: the date from which a product should not be eating, in order to avoid health problems. Best before: is the date that indicates that the content does not offer any consumer quality.

Factors influencing the shelf life of food

Factors that may affect the duration of the life of a food are the type of raw material, product formulation, the applied process, the sanitary conditions of processing, packaging, storage and distribution and consumer practices.

Raw material

The nature of the raw materials is one of the factors that most influence on the life of a food. This can have a high content of protein, fat or carbohydrate. Depending on the predominant macronutrient, or combination of these in the food, it is the kind of reactions that take place. For example, they are different reactions occurring in meat in a pan or on a cookie in a cheese.

The composition of raw materials is crucial to the deterioration reactions to be carried out on the product. In the raw material for food, they may predominate proteins, fats or carbohydrates. They may also have a high moisture content, or may not be of good quality.

For example, if the raw materials are rich in protein, they can probably develop bacteria; if they have a high fat content in the final product, possibly you run the risk of becoming stale, or if it contains carbohydrates, processed food will be susceptible to damage by fungi and yeasts. Also, the combination of nutrients in the raw material will be the type of reactions that predominate in the finished product.

Product formulation

The ingredients and additives containing a product directly affect the shelf life of a food. Some products may contain a high salt content, such as some types of ripened cheese, dried meat or artisan, consumed in various parts of the world. Similarly, in the formulation of many products a high sugar content is used, which reduces the water activity and limits the number of undesirable reactions in the feed, and the use of conservative, traditionally added to many products .

Process applied

Food can undergo pasteurization, sterilization, or to hurdle technology. The latter may jeopardize the safety and quality of the product if conservation factors intelligently are not used.

Sanitary process conditions

Depending on the health conditions that are followed during the process of developing a product, be the useful life of the same. If proper hygiene management is not maintained throughout the process, it is possible that the final product contains a microbial load, having favorable conditions, can develop and break down food or even more, cause infection or poisoning to consumers.

Packing

An aseptically packaged product will have a shelf life greater than that which was packed and then subjected to heat treatment. So, canned foods have a longer life than those packed in plastic containers. Packaging can promote anaerobic conditions or modify the atmosphere between the food and the packaging material, so that under such conditions can prolong the shelf life of food.

Storage and distribution

Where the finished products are stored, and the time in which they are distributed can shorten the life of a food, if this is not done in proper condition. Care must be taken that the transport of the products are made in transport units with cooling, if transportation requires it.

Consumer practices

Although food products have good physical, chemical or microbial stability, if they are not treated under the conditions specified by the manufacturer, it is possible to decrease the lifetime of the products. A common practice among consumers is to refrigerate the food until several hours after purchase in a supermarket, exposing many times at elevated temperatures. Once in the home, can not be stored immediately in the right conditions.

When the foodstuffs are opened for consumption, they can also be operated unhygienically form, with the consequent risk of contamination and therefore the loss of life. A latent risk at home what is cross-contamination, which occurs when contaminated with microorganisms capable of growing in the food, in the preparation of foods that do not have a subsequent heat treatment used utensils. This can shorten its life derived metabolite production by microorganisms, causing the food unpleasant tastes and flavors acquired.

Microbiological aspects

Main microorganisms that can grow in food

A food fails to reach its microbiological stability after being exposed to conservation techniques, single or multiple, to eliminate, reduce or prevent microbial growth. Among the groups of microorganisms that can grow in food are: bacteria and fungi, which are able to multiply in food and damage the product; protozoa and viruses, although not grow in food, used as a vehicle to these.

Bacteria

They are prokaryotic cells, have cell walls with peptidoglycan. A general classification of microorganisms such as Gram-negative bacteria is including oxidase negative non-fermenting bacteria positive oxidase, oxidase positive fermenters, fermentors, and as gram-positive bacteria, including sporulated bacilli, bacilli spore and coconuts.

Virus

They constitute an important class of microorganisms which are not cells. They lack many attributes of cells and differ from those that are not open in dynamic systems that take up nutrients and substances discharged outside. Although genes contain their own lack ribosomes therefore they depend on the biosynthetic machinery of the infected cell, to synthesize proteins. However, viruses are the cause of infectious diseases transmitted by water and food. Among the viruses that cause disease in the digestive tract, include hepatitis A, rotavirus and Norwalk. The polio virus has the same path, but it is neurotropic.

Viruses are considered the most common cause of diarrhea. Etiologic agents include rotaviruses, adenoviruses, caliciviruses including Norwalk-virus and astrovirus and hepatitis. Although viruses do not multiply outside the cells, they have the capacity to remain infective outside. It has been found that remain infectious rotavirus for 10 days on inert surfaces such as plastic, glass and stainless steel, if they dry out on suspensions of contaminated feces. The hepatitis A virus survives in vegetables stored at 4-20 ° C. The virus resistance to heat, is generally greater than that of most non-sporulating bacteria. Any food exposed to faecal contamination should be treated as potentially contaminated by viruses. Due to strictly intracellular parasitic nature of the virus, none of them multiply in food. Enteritis and hepatitis are forms of viral infection among the most important food-borne. Viruses food contaminants are rarely lethal.

Vermin

They are unicellular organisms (protozoa) or multicellular (helminths). You are foodborne. They do not multiply in food. Protozoa are eukaryotes (true nucleus surrounded by membrane). Often they require an intermediate host animals; man when ingested it becomes parasitic adult form. The behavior of infectious forms of the parasite, differs in some respects from that of other microorganisms. The parasites multiply in food, but they are biological cycles of more or less complexity, which are not equivalent from bacteria, fungi and viruses. Just one little egg or cyst of parasite to cause the development of adult heartworms or the corresponding infective larvae inside the host. The contamination of food by parasites is related to the level of environmental health and hygienic handling practices.

Role of microorganisms in a food

The presence of microorganisms in food does not always represent a threat of deterioration of the same, but play different roles in food.

As an ingredient in food production and manufacturing

In food processing biotechnologically improved strains that develop specific characteristics are used in food. A list of foodstuffs and microorganisms used in its production is presented in Table 1.

Table 1. Microorganisms involved in the preparation of foodstuffs

Producto	Microorganismo involucrado en su elaboración
Cerveza, pan y vino	Saccharomyces cerevisiae
Yogurth	Streptococcus termophilus y Lactobacillus bulgaricus
Productos fermentados	Bacterias lácticas
Quesos	Hongos filamentosos
Salchichas	Bacterias ácido lácticas
Vinagre	Acetobacter spp.

Lactic acid bacteria have been used to ferment or create food crops for at least four millennia. Its most common use has been applied worldwide to fermented milk products such as yogurt, cheese, butter, cream, kefir and koumiss.

As causing diseases

A list of pathogens that may be present in foods and cause disease is presented in Table 2. Among the microorganisms associated with food-borne illness are bacteria, fungi, viruses and parasites. Although the latter do not multiply in foods, they may be in them and cause disease; Examples of these are: Cryptosporidium parvum, Cyclospora cayetanis, Entamoeba histolytica, Giardia lamblia, Trichinela spiralis and Taenia spp. Sometimes it is not itself the microorganism that causes the disease, but it is the toxin it produces, like the case of Staphylococcus aureus and Clostridium botulinum. In the case of fungi are mycotoxins that cause serious illness in the consumer.

Table 2. Bacterial pathogens that may be present in food.

Microorganismo	Enfermedad que causa	Alimentos involucrados
Bacillus cereus	Intoxicación	Arroz cocido
Staphylococcus aureus	Intoxicación	Alimentos crudos o cocinados de origen animal
Salmonella thiphy	Fiebre tifoidea	Carne, huevo
Escherichia coli O7:H57	Gastroenteritis	Carne, agua
Vibrio cholerae	Cólera	Mariscos, agua
Shigella disenteriae	Disentería	Verduras
Listeria monocytogenes	Gastroenteritis	Ensaladas y productos cárnicos
Clostridium botulinum	Botulismo	Alimentos enlatados
Campilobacter jejuni	Enteritis	Pollos rostizados y asados

As decomposers

Table 3 microorganisms that can grow in food and decompose presented. Although consumption of food decomposed by microorganisms not always cause harm to those who consume it, they make it unpleasant to the product. Furthermore, the development of microorganisms in food usually causes changes in taste, texture, visual appearance and smell them.

Table 3. causative agents of food spoilage

Microorganismo	Alimento que deteriora
Rhizopus orizae	Tomate
Aspergillus flavus	Cereales, cacahuates
Penicillium	Cítricos
Zygosacharomyces bailii	Jarabes, jamones y jaleas
Rhizopus	Pan
Aspergillus	Tortilla
Pseudomonas,	Carne de res y de ave

Use of microorganisms in food

The presence of specific microorganisms has served for important information about the state keeping a food, to meet the conditions under which it was made, although it was not present at the time of preparation. Knowing the presence of some microorganisms in food, and even more their numbers help predict the time of your life.

In the area of food safety, some microorganisms are used as indicators (Table 4). The characteristics that must have an indicator organism are: being exclusive of intestinal contents, often found in the stool, found in abundance, have the same resistance to pathogens and be easy to detect.

Table 4. Microorganisms indicators of food hygiene

Bacterias mesófilas aerobias
Indicadores del valor comercial de un alimento
Indicadores del manejo higiénico de un alimento
Indicadores de idoneidad de materias primas
Indicadores de la eficiencia de un proceso germicida o de conservación
Indicadores de la vida útil de un alimento
Indicadores de la frescura
No indicadores de contaminación fecal
No relación con la presencia de patógenos
Organismos coliformes totales
Indicadores de la calidad microbiológica del alimento
Indicadores de malas prácticas sanitarias
No indicadores de contaminación fecal en alimentos
No relación con la presencia de patógenos en los alimentos
No indicadores de contaminación fecal en alimentos. Sí en el agua
No relación con la presencia de patógenos en los alimentos
No indicadores de contaminación fecal en alimentos. Sí en el agua.
No relación con la presencia de patógenos en los alimentos. Si en el agua.
Indicadores de la eficiencia de un proceso germicida
No relación en algunos casos con prácticas higiénicas
Organismos coliformes fecales
Indicadores de contaminación fecal solo en el agua, bivalvos y algunas verduras crudas
Relación con la presencia de patógenos solo en el agua, bivalvos y algunas verduras crudas
Indicadores de la calidad microbiológica del alimento
Indicadores de la eficiencia de un proceso germicida
Enterococos
Indicadores de higiene en general
Indicadores de higiene en productos congelados
Indicadores de contaminación fecal en ostiones
Indicadores de contaminación fecal en agua
Hongos y levaduras
Indicadores de contaminación ambiental en equipo y alimentos
Indicadores de frescura del alimento
Indicadores vida útil
Indicadores de deterioro
No indicadores de contaminación fecal
Staphylococcus aureus
Indicador de contaminación humana
Productor de toxina

Factors affecting the growth of microorganisms

Figure 1 shows the factors influencing the growth of microorganisms in food. A smart combination of preservation methods, control the growth of microorganisms in food, prolonging its life.

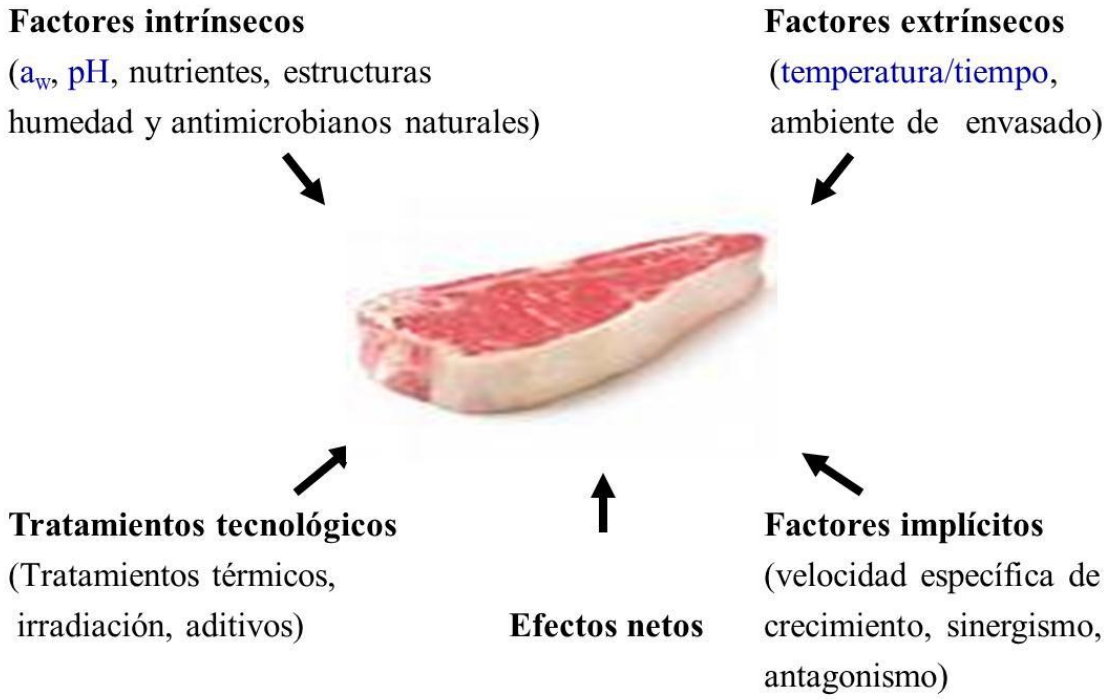
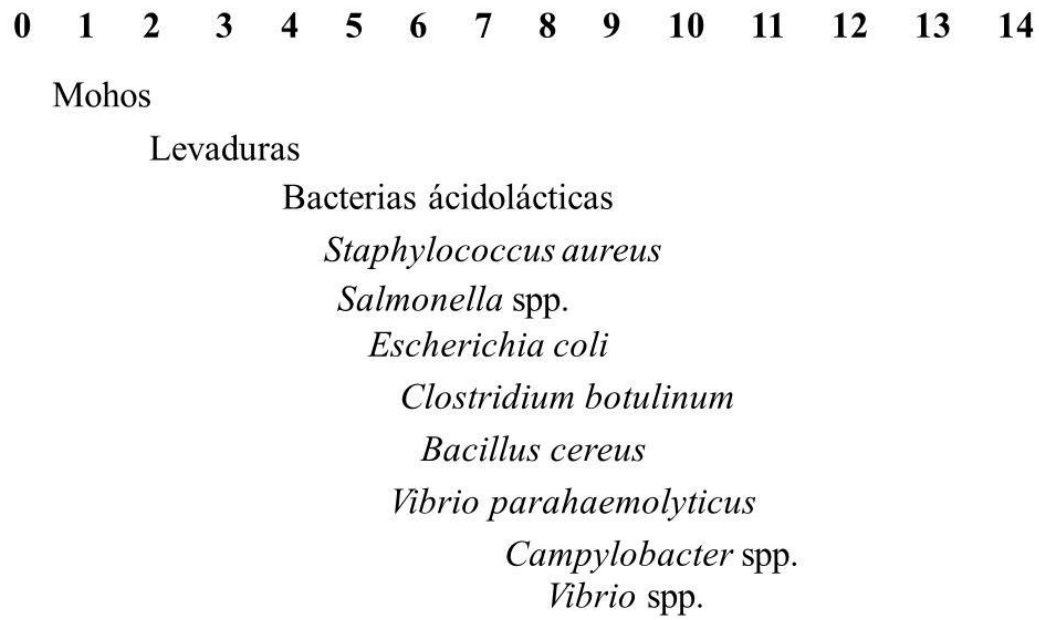


Figure 1. Factors influencing the growth micoorganismos in a food.

Among the factors that affect the development of microorganisms in foods include temperature, pH and water activity. The temperature at which food is stored, is one of the factors that most influence the micoorganismos can grow in them and break them down.

The microorganisms are able to grow in environments with different pH (Figure 2), why be found in a favorable food conditions for their development and break it down or use it as a vehicle to cause illness in the consumer.



At different pH Figure 2. Development of microorganisms.

Another important for the growth of microorganisms factor is the water activity (aw), which refers to the amount of water is present for reactions taking place in a food. The value of aw in food may vary from 0.0 to 1.0 (Table 5).

Table 5. Water activity (aw) in some foods.

Alimentos	Valor de a_w
Carnes, pescados frescos, fruta, hortaliza, leche.	< 0.98
Leche concentrada por evaporación, concentrado de tomate, productos cárnicos, carnes curadas, embutidos fermentados, quesos poco madurados y de pasta semidura, frutas en almíbar, pan, ciruelas.	0.93 a 0.98
Embutidos fermentados y madurados, queso Cheddar salado, jamón tipo serrano, leche condensada.	0.85 a 0.93
Frutas secas, harina, cereales, mermeladas, pescado muy salado, nueces, quesos muy madurados.	0.60 a 0.85
Galletas, papas fritas, miel, chocolate, huevos y leche en polvo.	< 0.60

Aspectos químicos

The components usually affected to deteriorate foods are: moisture, protein, fat, carbohydrates, vitamins and minerals. The negative effects on the food may occur include: loss of vitamins, insolubility of powdered materials, modification of proteins, fats and carbohydrates, microbial growth and toxin production. The modification in some of these effects is considered the end of the useful life of a food.

Modifications can be evaluated by physico-chemical, microbiological, instrumental and sensory tests. To that end, the choice of test methods is very important. To select a technique is necessary to know the reason for the analysis, when results are needed, what equipment is counted in the laboratory, what is the cost of the analysis, what is the composition of the food-evaluate and what the standards with the type of food must comply.

Caution is advised when selecting tests to be performed, taking care that they are representative of what is measured. It is also essential to be aware of each chemical parameter whose measurement can be evaluated and used to establish the shelf life of food.

Humidity

Because storage conditions, a food can gain or lose moisture, which in both cases may be adverse to the loss of quality. For example, in powders for making drinks, milk powders or candy coating.

Moisture determination can be carried out in a drying chamber, thermobalance, by azeotropic distillation or by the Karl Fischer method.

Greases

Fats in foods may be saturated, constituted by fatty acids without double bond or unsaturated fatty acids having double bonds. The degree of saturation of fat influences the oxidative stability of the product. A higher degree of unsaturation of the fat or oil in a food, increased risk of rancidity. Rancidity can be hidrolótica or oxidative. In the first case it is due to the release of short-chain fatty acid and the second in the production of peroxides.

Among the factors that promote fat oxidation are oxygen, light, presence of metals and water activity. To protect fat oxidation while controlling the variables mentioned, antioxidants may be added. To measure oxidative rancidity can be determined the peroxide, p-anisidine index, or from totox value, among others. It can also be measured by gas chromatography, by testing the value Kreiss or ultraviolet.

Hydrolytic rancidity is caused by the breaking of ester bonds between fatty acids and glycerol. It is catalyzed by enzymes and when carrying out the reaction, fatty acids are released and the acidity is increased.

Carbohydrates

Carbohydrates present in food can be attacked by the Food and transformed plant metabolites such as alcohols and acids. Carbohydrates in food can be quantified by gas chromatography, liquid chromatography, Lane and Eynon, Nelson, enzymatic kits and capillary electrophoresis.

Other components

Substances which quantification can be used to monitor chemical changes that occur in the food and consequently the loss of quality, alcohols, acids, nutrients such as protein and vitamins encentran. Similarly, changes in the solubility of the components or color change serve to indicate that a food has reached the end of its useful life.

Sensory evaluation as a tool for studies of life

Sensory evaluation comprises a set of techniques to measure human responses to food and potentially bias minimizes the effects of identity and other information that influence consumer perception.

Human senses have been used for centuries to assess the quality of food. We all have judgments about the food we eat or drink anywhere. This does not mean that all trials are useful or that anyone is qualified to participate in a sensory evaluation test.

Food production quality often depends on the sensory acuity of one expert, who has the burden of production or changes must be made to a process, so that the product is safe and desirable characteristics . This was used in brewing and winemaking.

Modern sensory evaluation replaced these individual authorities paneled people participating in a specific test method, which has the form of planned experiments. This happened for several reasons. First, it was recognized that the trial of a group of people could be more reliable than a single person, if that person also ill, who would make decisions? Second, the expert may or may not reflect what consumers might want in a product.

The main interest of specialists in sensory evaluation is to ensure that the appropriate test method to respond to the questions asked about the product on the test. Sensory tests used most common form is the evidence of discrimination or difference, descriptive and affective. Each answers a question of interest in relation to product quality (Table 6).

Table 6. Classification of test methods for sensory evaluation.

Clase	Pregunta de interés	Tipo de prueba	Características de los panelistas
Discriminación o diferencia	¿Son los productos diferentes en alguna forma?	Analítica	Tener agudeza sensorial, orientados a métodos de prueba, requiere un panel algunas veces entrenado.
Descriptiva	¿Cómo difieren los productos en características sensoriales específicas?	Analítica	Tener agudeza sensorial y motivación, requiere un panel entrenado o altamente entrenado.
Afectiva	¿Qué tanto gustan los productos o cuales productos son los preferidos?	Hedónica	Puede usarse un panel no entrenado, que conozca el producto a evaluar.

Evidence of discrimination or difference

The simplest sensory tests attempt to respond if there is a difference between two types of products. These are the evidence of discrimination: triangle test, duo-trio test and paired comparison. The analysis is based on statistics and ratios frequency (counting right and wrong answers). From the test results, the differences based on the proportions of people who were able to correctly select the test product, from a group of similar or control is inferred.

Typically proof of discrimination can be performed with 25-40 participants who are familiar with the test method. Difference tests are the most commonly used today. Part of the popularity of these tests is due to the simplicity of the data analysis.

The statistical tables derived from a binomial distribution given a minimum number of correct answers needed to conclude with statistical significance, depending on the number of participants. You only need to have the right answers and refer to the table to give a statistical conclusion, and the results can be easily and quickly reported.

Triangle Test

A classic example of this triangle test was used in Carlsberg Breweries and the Seagram distillery in 1940. In this test, two products of the same batch, while a third product was a different lot. Judges should answer which of the three samples was different.

Duo-trio test

The procedure of this test is to provide a reference sample and two-sample test. One of the test samples is related to the reference, while the other corresponds to a product, different process or batch.

Paired Comparison

It is a very popular test difference, in which participants can choose which of the two products had a stronger or as strong attribute. Because the attention of the panelists is directed toward a specific attribute, this kind of test is very sensitive to differences.

Descriptive tests

They are those that quantify the perceived intensities of the sensory characteristics of a product. These procedures are known as descriptive analysis. The first method to do this with a trained panel of judges was the flavor profile. They formulated a method that involves intensive training of panelists that they train to characterize all the notes in a food flavor and intensity of these notes using a simple category scale and record their order of appearance. Currently this method is called quantitative descriptive analysis and use experimental designs and statistical analysis such as analysis of variance. In product development hybrid applications are used, with the advantage that they can be applied to products of a particular company. Descriptive analysis is applicable for characterizing a wide variety of changes to a product in the development of new products. The information may relate to consumer acceptance and instrumental measurements using statistical techniques such as regression and correlation.

In Table 7 a descriptive evaluation to assess in a biscuit texture is presented. The product is tested at different time intervals in a controlled and uniform manner, a typical analytical procedure sensory test. For example, the first bite is defined as the cutting incisors.

Table 7. Evaluation descriptive attributes of texture in cookies.

Fase	Atributo	Rango descriptivo
Superficie	Aspereza	Suave-rugosa
	Particulosidad	Ninguna - muchas
	Sequedad	Grasosa-seco
Primera mordida	Fracturabilidad	Desmoronadizo- quebradizo
	Dureza	Suave - dura
	Tamaño de partícula	Pequeña - grande
Primera masticada	Espesura	Ligera - Densidad
	Uniformidad de masticada	Igual - desigual
Segunda masticada	Absorción de humedad	Nada - mucho
	Cohesividad de la masa	Suelto - cohesivo
	Acomodo a los dientes	Nada - mucho
	Arenosidad	Nada - mucho
Residual	Aceitosidad	Seco - grasoso
	Partículosidad	Nada- mucho

The panel for such analysis could consist of perhaps 10 to 12 individuals trained in the meaning of the terms. Practical examples are given. Current references were also given to illustrate the scale of points. The relatively small number of panelists is warranted due to calibration level.

The third main class of sensory tests are those that attempt to quantify the degree of like or dislike a product, called hedonic methods or affective test. Its main application to this problem is to offer people a choice between alternatives, then see if there is a clear preference for most respondents. The problem of choice tests do not provide information about liking or disliking.

A historic landmark in this kind of evidence is the hedonic scale. This method provides a balanced nine-point scale to the scale of taste, with a centered neutral category, and attempts to produce a scale of points with adverbs represent physiologically equal steps or changes in hedonic tone and the intervals can be managed on a statistical analysis .

An example of how to apply a hedonic test to determine if a food sample has reached the end of its useful life.

Example

It assess whether a candy stored for eight months (storage at 24 ° C and 60% relative humidity equals one freshly prepared (Control). A panel of 29 consumers was used. acceptance test (pleasantness) was applied and He employed a hedonic scale of 9 points (9 is the highest rating).

Juez	Caramelo 8 meses	Caramelo control	D	D^2
1	7	9	2	4
2	6	9	3	9
3	8	9	1	1
4	8	8	0	0
5	9	9	0	0
6	7	8	1	1
7	6	8	2	4
8	9	8	-1	1
9	7	8	1	1
10	8	8	0	0
11	8	9	1	1
12	6	7	1	1
13	6	8	2	4
14	7	8	1	1
15	7	7	0	0
16	8	9	1	1
17	8	9	1	1
18	8	8	0	0
19	7	8	1	1
20	6	8	2	4
21	8	9	1	1
22	7	9	2	4
23	8	9	1	1
24	6	7	1	1
25	8	9	1	1

Escala Hedónica

9 Gusta extremadamente

8 Gusta mucho

7 Gusta moderadamente

6 Gusta ligeramente

5 Ni gusta ni disgusta

4 Disgusta ligeramente

3 Disgusta moderadamente

2 Disgusta mucho

1 Disgusta extremadamente

H_0: Caramelo de ocho meses = caramelo recién elaborado

$t=\Box D \ / \ v^{---} [\{n\Box D^2 -(\Box D)^2\}/(n-1)]$

D = valor de la diferencia entre referencia y la muestra.

n = 29

grados de libertad = (n-1)

n-1=29-1=28

$n\Box D^2=29*49=1421$

$\{n\Box D^2 -(\Box D)^2\}=1421-25*25=796$

$\{n\Box D^2 -(\Box D)^2\}/(n-1)= 796/(29-1) =28.43$

$v^{---} \{n\Box D^2 -(\Box D)^2\}/(n-1)= v^{---}(29)49-(25*25)/(29-1) =5.33$

$\Box D=25$

$t =25/ v^{---}[\{(29 *49)-(25)^2\}/(29-1)\}=4.69$

$t =\Box D \ / \ v^{---} [\{n\Box D^2 -(\Box D)^2\}/(n-1)]= 4.69$

t tabla =2.048 (Prob. 0.05)

26	8	8	0	0
27	8	7	-1	1
28	9	8	-1	1
29	7	9	2	4
Suma	**215**	**240**	**25**	**49**
Media	7.4	8.3		

t 4.69 > t 2.048

t calculada > t tabla

.: hay diferencia entre las muestras.

To interpret the results if strict criteria are applied, the sample is outside life as it loses acceptance significantly compared to the control, although some consumers may still to like the product. It will be the evaluating how to apply the scale, since the product despite being different according to the scale is accepted by the common consumer.

Strategies to extend the shelf life of food

While today's consumers demand fresh produce, it is very difficult to extend the lifetime without sacrificing the image of freshness of the food and in many cases, the expiration of a food can not be lengthened.

The methods to prolong the shelf life of food should be based on knowledge of the different mechanisms involved in food spoilage. The more you get to know the mechanisms involved in the deterioration of food, the greater the potential to prolong their shelf life. Therefore, the first thing that is recommended to extend the shelf life of a food, is to ask the most frequent and important causes decomposition. Once detected the causes of deterioration, they must know the mechanisms that are followed in each particular cause and identify the factors contributing to this deterioration. For example, we know that in some cookies, the main deterioration is due to lose texture. Factors contributing to this deterioration would be high water activity and an excess relative humidity storage. Once detected and the cause of deterioration factors contributing should conservation technologies that control these decomposition mechanisms selected.

Table 9 shows examples of causes of deterioration of some foods and technique that can be used to extend its life. Although, generally, there are several reasons why a food may decompose, when it aims to extend the shelf life of food the most common reason that food is removed from the market should be chosen.

Table 8. Examples of techniques for extending the shelf life of food

Alimento	Causa de deterioro	Técnica para extender la vida útil
Galletas	Crecimiento de hongos Ablandamiento por ganancia de humedad Pérdida de textura	Uso de conservadores Uso de envase no permeable
Productos cárnicos	Desarrollo de microorganismos patógenos	Refrigeración Uso de conservadores
Leche	Crecimiento de microorganismos patógenos y deterioradores	Pasteurización Refrigeración Envasado aséptico
Vegetales frescos	Pérdida de humedad	Envasado en materiales no permeables
Jugo de frutas	Crecimiento de microorganismos Cambios bioquímicos	Altas presiones hidrostáticas
Salsas	Crecimiento de microorganismos	Uso de conservadores Disminución del pH
Carne congelada	Transferencia de vapor de agua: sublimación del hielo	Uso de envase no permeable

Once selected the most common cause of deterioration in food, it is necessary to use a conservation technology that maintains the quality characteristics of the food.

Preservation technologies

Between conservation technologies they have conventional and modern. Cases reported in the latter allow to produce a food with characteristics superior to those produced by conventional techniques have quality.

Knowing conservation technologies to select the most appropriate method to extend the shelf life of a food. In general, conservation technologies using the following mechanisms:

Inactivation of microorganisms, for which the pasteurization, sterilization, high hydrostatic pressure, irradiation can be used.

Prevent or inhibit bacterial growth, for which refrigeration, freezing may be employed, curing, vacuum packed, modified atmosphere packaging, acidification, fermentation, addition of preservatives.

Restricting access of microorganisms to products, for which can be used, aseptic packaging, decontamination of raw materials and environment, packaging materials.

Currently, to meet consumer demands for foods with less processing and use of additives, is implemented hurdle technology, which involves using several factors conservation jointly, so that it is not abused one factor of conservation.

Factors that may be used in combination in a food to extend its life: heating, cooling, water activity, redox potential, conservative and competitive flora.

Design of a lifetime study

To assign the expiration date of a food requires multiple testing times. Several types of tests, each with a different use:

Study of initial expiration. It takes place during the study phase of the product, when it has not been established or the actual production process, nor has decided the format of the product or packaging. It aims to evaluate the safety of the product and indicate the probable mechanism of deterioration.

Preliminary study of expiration. It takes place during the latter part of the pilot study, or when they have already made the initial production tests. The information obtained is used

to grant provisional expiration to be included in the draft product specifications and packaging process.

Confirmation study expiration. Usually it has done at the end of the product development process, using product samples produced in normal production conditions and meeting a series of interim specifications.

Expiration study routine. It is done to support production. It serves as a source of information on which the renewal of the expiration is based.

Parameters that indicate the end of its useful life

Despite advances in science and food technology, food products have a finite life. Therefore, there are indications that the useful life of a product has ended. These can be the following: high numbers of microorganisms, oxidation of fats and oils, moisture migration, loss of vitamins and nutrients, texture changes due to enzymatic activities, protein degradation, loss of flavor and color, decrease or increase viscosity.

When the knowledge we have about food is related: their characteristics, processes involved in their development, microorganisms that can grow in it, the chemical reactions that can be triggered because of the components it contains, the conditions to be stored and how transported until reaching consumers, it is possible to predict who will suffer deterioration food, making it possible to ensure the quality of products is accurate and reproducible.

To start a study of life, it is necessary to identify negative changes that may suffer are food-evaluate. From such knowledge it is necessary to select those measurements that indicate that a component has been a decrease in the initial concentration or deterioration. You can also start from the initial count of an indicator organism or group of organisms to detect when the presence of the organism or account does not comply with health specifications defined in the current regulations of a country.

Prediction of deterioration

Given the widespread use of computers in all areas of human activity, today the development of computer models that can be used to predict the safety and shelf life of many foods is possible.

By the need to ensure the microbiological safety of food, most of the best known computer models are predictive models for food pathogens.

Predictive microbiology is a scientific field that combines elements of microbiology, mathematics and statistics to develop mathematical equations that describe and predict the evolution of microorganisms in environmental conditions established. The predictive models used in microbiology, have been classified into:

Primary models: describe changes in the number of microorganisms, either of these responses over time under one set of conditions. Among the models that are used most frequently are: Gompertz function and non-autonomous differential equation Baranyi.

Secondary models describe the response of one or more parameters of a primary model, changes in one or more culture conditions. Among them they are: Arrhenius equation, square root model, response surface model and neural networks.

Tertiary models: Describe the response of one or more parameters of growth of any microorganism, using computer programs. Some of them are: Food Micromodel, Pathogen Modelling Program, Seafood Spoilage Predictor, Chefcad software, Food Spoilage Predictor, MIRINZ-software and Quantitative Risk Assessment (QRA).

Conclusions

Expiration testing food served notice to avoid potential problems of damage to the health of consumers. Thus, a better understanding of the factors involved in the loss of food quality, and microbial ecology of microorganisms capable of development in the particular conditions of a food, it will establish a more precise way its lifetime useful.

Bibliography

Badui Dergal, S. (2006). Química de los Alimentos. México: Alhambra Mexicana.

Carpenter, R. P., Lyon, D. H. & Hasdell, T. A. (2002). Análisis sensorial en el desarrollo y control de la calidad de alimentos. Zaragoza, España: Ed. Acribia.

Leistner, L. (2000). Basic aspects of food preservation by hurdle technology. *International Journal of Food Microbiology*. 55, 181-186.

Madigan, M. T., Martinko, J. M. & Parker, J. (2004). Brock. Biología de los microorganismos. España: Pearson, Prentice Hall.

Nielsen, S. S. (2009). Análisis de alimentos. Zaragoza, España: Ed. Acribia.

Sizer, C. (2000). Engineering a safer food supply. *Chemistry and Industry*, 19, 637-640.

Vermeiren, L. Devlieghere, F., van Beest, M. de Kruijf, N. & Debevere, J. (1999). Developments in the active packaging of foods. *Trends in Food Science and Technology*, 10, 77-86.