Ecodesign in Food packaging

Unit 4: the quality of the food packaging and the shelf life

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After acquiring this unit, the student will be able to:

- Objective: Understand the concept of quality of packaged food and the shelf life of packaged food

Funded by the Erasmus+ Programme of the European Union

Eco innovation Skills for European Designers, Project number: 562573-EPP-1-2015-1-SI-EPPKA2-SSA. Disclaimer: The European Commission support for the production of this publication does not constitute endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

4.1 The packaging and avoidance of food degradation

Today in the world, when about 99% of foods are packaged, we talk about the system food-packaging and about its role in the world economy. To avoid the contamination or recontamination, in the process of avoidance of food degradation and the preservation of their quality, besides direct approach to food preservation, such as, for example, drying and freezing, an important role has the food packaging.

The packaging has the following main functions: the isolation and food protection against the environment, the quality preservation, the food presentation and the convenience of packaging use, the protection and insurance of the warranty period during storage. A classification of the used materials for the packaging realization, types of food packaging and practical strategies for food packaging, has been presented in the UNIT I.

4.1.1 Notions regarding EU Legislation for food packaging

The importance of food packaging is underlined by the EU Directives related to this. A few regulations are indicated in **annex 1**.

The foods come in contact with many materials and articles during the production, processing, storage, preparation and serving, before the final consumption. Such materials and objects are called "Materials that come in contact with food’ (Food Contact Materials-FCM). The term includes the direct or indirect contact. Examples: containers for food transport, machines for food processing, packaging materials, kitchen utensils and cutlery. The term does not include public or private fixed equipment of water supply.

REGULATION (EC) NO. 1935/2004 is a framework regulation which establishes regulations regarding materials and objects intended to come into contact with food. The fundamental principle of the regulation is that any material or object intended to come into direct or indirect contact with food must be sufficiently inert to prevent the constituents transfer to food in bigger quantities than the limit to which they would put in danger people's health or causing an unacceptable change in the food composition or an alteration of its organoleptic properties.

REGULATION (EC) no. 2023/2006 ensures that the manufacturing process is well controlled, so that the specifications for the FCM remain in compliance with the legislation:

- the prerequisites realization regarding the packages effectiveness in achieving the purpose for which they are designed and the awareness of staff in the critical stages of production,

- quality assurance systems and quality control systems backed up to the manufacturer,

- selection of suitable raw materials for the manufacturing process in order to ensure the safety of final articles.

The FCM safety is evaluated by the European Food Safety Authority. On EFSA's website you can obtain information regarding substances that should be used in materials that come into contact with food. Certain FCM - , plastic materials (including recycled plastics), ceramic materials, foil of regenerated cellulose, as well as active and intelligent materials - are covered by specific EU measures. There are also specific regulations concerning some initial substances, used for the FCM production[1].

The plastics - specific Regulation regarding plastic materials and objects intended to come into contact with food (EC 10/2011) contains a positive list of monomers and additives which may be used in plastic materials that come in contact with food. Plastic objects from mono - and multilayer materials are regulated, as well as the coating layers on the plastic and used seals in closing bottles and jars.

Regarding the plastics, for food safety, maximum limits on the plastics migration into food have been introduced. For substances from the EU list, the regulation establishes "specific migration Limits" (LMS). They are established by EFSA on the basis of data regarding the toxicity of each specific substance. To be able to use a certain quality of plastic, the overall migration of all substances to a food must not exceed the overall migration limit (OML) of 60 mg / kg food or 10 mg / dm^2 of plastic that comes in contact with food. For ensure the safety, quality and compliance of plastic materials, the appropriate data regarding the intermediate materials composition, must be communicated through the manufacturing chain, without include the stage of retail sale. For this purpose, a "Declaration of conformity" (DoC) must be provided, based on the supporting documentation.

The mechanically recycled plastics come from materials that have already came into contact with food, therefore, new regulations have been established (EC 282/2008) which provide that, for the plastics recycling process which will again enter in contact with food, to ensure an authorisation from the EFSA.

Regenerated cellulose films - are regulated by the Directive 2007/42 /EC which contains a list of substances that can be used for their manufacture. In addition, the printed surfaces can not come into contact with food. In the marketing stage, the cellulose films intended to come into contact with food must be accompanied by a written statement, other than the retail price.

[1] https://ec.europa.eu/food/safety/chemical_safety/food_contact_materials

Ceramic products - have not been individually regulated, but the Directive 84/500 /EC, (which currently is under review by the EU commission), establishes migration limits for cadmium and plumb, heavy metals that are known to migrate frequently at low levels[2].

Active and smart materials - extend the preservation time by the release or absorption of substances in or from food, to or from the environment. In consequence, they are exempted from the general rule of inertia from EC/1935/2004. The specific rules of the EC/450/2009 apply to answer their specific purpose, for example: The absorption of substances from inside the food packaging, such as the liquid and oxygen, the release of substances in food, such as preservatives, indications about the food expiration which change their color, when the maximum preservation time or storage temperature is exceeded, by labelling. The active material does not include systems which absorb substances from the atmosphere, such as barriers with active oxygen. EC/450/2009 provides the establishment of an Union list regarding allowed substances for the manufacture of active and smart materials.

4.1.2 Food packaging functions

1) Food isolation and protection against the environment

It is the basic function of any packaging. Isolation against the environment refers to food protection against the external factors and the food obtaining in a suitable form for transport and the protection refers to food preservation, so as to prevent the significant deterioration of the quality. External factors can be physical factors (moisture, dust particles from the atmosphere, light, temperature, etc.), chemical and physico-chemical factors (air, water, oxygen, CO2, etc.), biological factors (microorganisms, insects, etc.). The biological protection aimed at maintaining the hygienic and microbiological food quality[3]. From a physical point of view, the packaging must protect the product from mechanical shocks which could deform it, compress, collapse, crack, etc.

[2] Food Packaging Regulation in Europe, Charlotte Wagner, May 8, 2013 in http://www.foodpackagingforum.org/food-packaging-health/regulation-on-food-packaging/food-packaging-regulation-in-europe

[3] Merceologie alimentară , Suport de curs, Prof univ. dr. MIRCEA POP, Universitatea „PETRE ANDREI" IASI

The barrier quality of the packaging- The food packaging have to act as a barrier, stopping or decreasing to normal limits the penetration of light, temperature or other physical agents that could lead to the deterioration of the food qualitative characteristics. From the chemical and physico-chemical point of view it is very important that through the gases vapors produced by volatile substances (hydrocarbons, smoke, perfumes etc.) the product does not come in contact with aggressive chemicals such as H_2, NH_3, SO_2, CO_2. The barrier role also targets the gas transfer from the inside to the outside, to avoid the loss of product specific aromas, its dehydration, the gases loss introduced in packaging in order to preserve the products etc. If the packaging material does not provide an adequate barrier, the microorganisms can contaminate the food and make them unsafe. If the packaging allows the transfer, for example, of moisture or O_2 from the atmosphere, microbial contamination can occur. In this situation, the microorganisms present in food, but which does not present a risk due to the initial absence of moisture or O_2, could be able to grow and to present an alteration risk. Other examples regarding the risks that may occur include the unsaturated lipids oxidation, for eg. polyunsaturated fatty acids of ω3 type, nutrients loss through oxidation, vitamins A,C,E loss, etc. The light can also produce the food photodegradation with vitamins loss, fading, the emergence of some volatiles with an unpleasant odor. The use of light barriers and UV absorbers in the packaging can sensitively decrease the fats oxidation.

Active and smart packaging – Today, different types of active substances can be incorporated in the packaging material to improve its functionality and to confer it new or additional functions. Thus, the controlled atmosphere with less oxygen and more carbon dioxide has as a result the slowing enzymes effects existing in the system. Smart packaging with antimicrobial support adds a new dimension to safety. The additional functions that it offers include: the oxygen absorption (they absorb the oxygen gas from the package and prevent the rancidity), antimicrobial activity, moisture absorption, the removal of ethylene and ethanol emissions. Today, it is possible to adapt the atmosphere from the packaging to the food needs from its inside. Thus, the package itself can be the main regulator of the atmospheric conditions from the packed space. The atmosphere modification offers benefits to consumers, including the quality protection, the additives reduction, the disinfectants removal. When are antimicrobial incorporated agents in a polymer, the material limits or prevents microbial growth. This app could be used for food, not only in the film form, but also for containers and utensils.

The edible coatings can inhibit the microbial growth and these films also provide the opportunity to achieve high antimicrobial concentrations on the food surfaces. Edible films can also be used to overcome some of the difficulties regarding the keeping of the modified atmosphere around the packaged baking products.

The ratio between the film permeability to carbon dioxide and oxygen can be essential[4].

For most food products, the protection offered by the packaging is an essential part of the preservation process. In this way, aseptic packaging has been developed.

Aseptic packaging can be defined as the filling of a commercial sterile food, in sterile containers, in aseptic conditions and hermetic closure of containers so that reinfection is prevented. Among the first aseptic packaging applications are: milk and dairy products, fruit and vegetables juices, products with particle (stewed fruit), soups, puddings, desserts, etc . In general, once the integrity of the packaging is compromised, the product is no longer preserved. For example, the aseptically packaged milk in boxes of laminate cardboard remains aseptically only as long as the package provides protection; Vacuum packed meat will not achieve the desired shelf life if the packaging allow the entrance of O2, etc.

An efficiently packing reduce food waste and, in this way, protects or conserves a large part of the consumed energy during the food production and processing. For example, for the production, transport, sale and storage of 1 kg of bread 15,8 MJ is consumed. This energy is required in the form of fuel for transportation, heat, power, refrigeration in agriculture, grinding wheat, baking and retailing of bread and distribution of both raw materials and finished product. To the production of the polyethylene bag for packing a bread of 1 kg 1,4 MJ is consumed. It follows that each unit of energy from the packaging protects 11 units of energy from the product. Although removing packaging could save 1.4 MJ of energy, this would also lead to bread deterioration and the waste of 15.8 MJ[5].

The migration - It has been shown above that there is a special concern for avoiding the migration of the packaging material to the food, an inconvenience related, in the first place, by the use of plastics as packaging material. The plastic itself is a polymer or a copolymer made from one or more monomers, such as styrene, vinyl acetate, ethylene, propylene or acrylonitrile. All polymers contain small amounts of residual monomers left unchanged by the polymerization reaction. These constituents are available potentials to migrate into the food. The migration proportion from materials in contact with food, however, depends on a number of factors. The amount

[4] Handbook of Food Preservation, Second Edition, edited by M. Shafiur Rahman, CRC Press Taylor & Francis Group – 2007

[5] Gordon L. Robertson, Food Packaging and Shelf Life, University of Queensland and Food Packaging Environment, Brisbane, Australia

of available migrants in the packaging material has a paramount importance. These levels must be minimized by careful design and through packaging production.

The contact surface between food and packaging has also a direct influence.

Because migration is a process that usually occurs gradually, the period of time for which the food and packaging are in contact should be taken into consideration when trying to anticipate the potential problems of migration. Thus, there can be less concern of migration for a cooled dairy product with a short storage time, than for a biscuits box with a storage time of six months.

The food intrinsic factors have a great importance for the migration degree that can occur. A potential migrant constituent of the packiging is gradually transferred and it causes an increase in the concentration of that constituent in the food.

Finally, an equilibrium point is reached when the constituent concentration in the food and packaging remains constant. The constituent amount in the food, in equilibrium point, depends on the physics affinity of the constituent for packaging and food. For example, the migration degree of a hydrophobic monomer, such as styrene, is partly dependent on the fat content of the food.

The supervision exercise of the food conducted in the UK found styrene levels (monomer) in a total of 248 samples of food, from a wide variety of manufacturers and in a wide variety of packaging types and sizes[6]. Also, a danger on migration is represented by the other substances added during the polymerization process for change the materials characteristics (ex. plasticizator PVC, mineral hydrocarbons, etc.). The food may come in contact or in close proximity to printing inks, which can pose a greater threat to the product safety and quality than the basic material of the pack. One of the most common ink and varnish types is treated ink with UV (ultraviolet). This is made up of monomers, initiators and pigments. During the polymerization, polymers are formed which irreversibly bind to the basic packaging and catch the dye in the polymers matrix, which ensures a high, fast and safe quality to the printed surface. The migration of these constituents in the food may pose a risk to health and may affect the food flavor. In addition to the inherent smell in these constituents, it is known that interactions between migrants and the food components can lead to food spoilage.

Although the plastics are a major concern on the migration and other materials like paper, cardboard or cans present the danger of some constituents migration. For

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[6] RICHARD COLES, DEREK MCDOWELL, MARK J. KIRWAN, FOOD PACKAGING TECHNOLOGY, Blackwell Publishing Ltd, 2003

paper and cardboard, the chlorophenols may be responsible for the antiseptic qualities degeneration. An investigation regarding to a disagreeable odor and taste in a shipment of cocoa powder, found that paper bags used for the food packaging contained a chlorophenol in the bag paper at levels of up to 520 µgkg-1, and in the side soldering of their up to 40,000 µgkg-1. It was concluded that these chlorophenols have been formed during the bleaching of the wood pulp for paper manufacturing, for which pentachlorophenol in the adhesive[7] has been used as a biocide. It is important that the wood used in the pallets construction also be devoid of such treatment with biocides . For cans, the migration danger occurs from the inner coatings films such as epoxy resins. Of all inner coatings types for cans, the epoxyphenolics lakes are the more used (85-90%), for both the boxes in two and three parts and for the hollows. During the sterilization process, the bisphenols migration from the packaging into the food can be more rapid and intense. A similar situation may be for example encountered in the case of thermal instability of the lakes for canning. This aspect is very important considering the toxicity, **Bisphenol A (BPA)** presenting the activity which disrupts the endocrine system (endocrine disruptors - endocrine disruptor), and **Bisphenol A diglycidyl ether (BADGE**) being classified as carcinogenic and mutagenic[8].

For the general selection of confection materials for packaging, it is very important to ensure that the material complies with the relevant legislation. This thing may involve certain problems and measurements of the global migration to check if the packaging is safe.

When selecting a packaging material for a defined purpose, it is important to take into account all the final product components, the way in which they are likely to interact and what effect the interaction will have on the food. The potential of alteration can be assessed by examining the following issues:

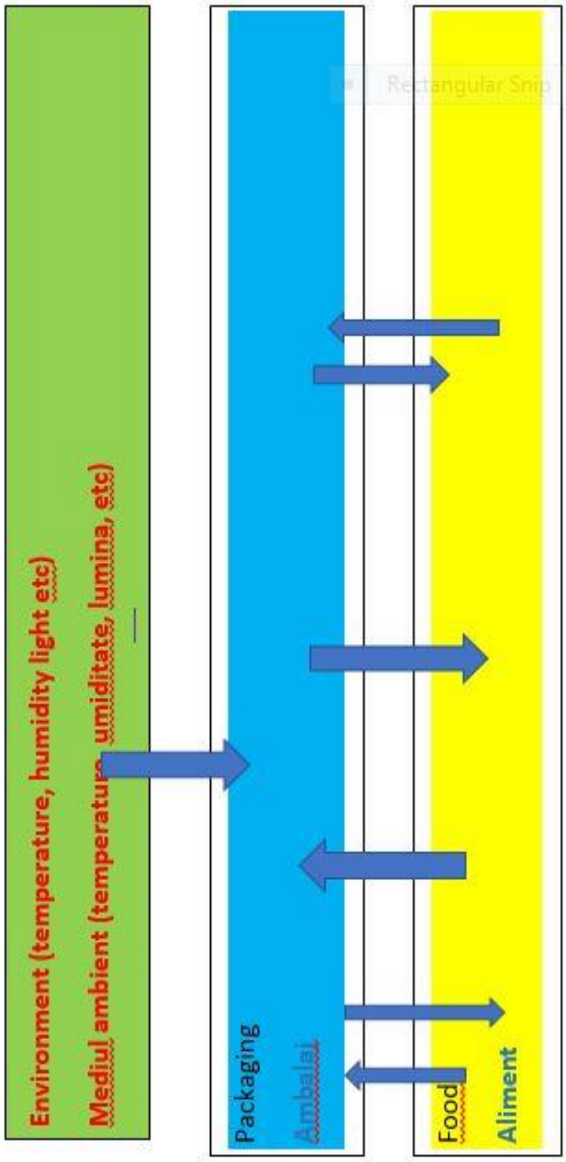
- The composition of the packing material is optimized to minimize the amount of migration potential of components into food?
- What is the probability that all the available migratory components can migrate - this will depend on the food composition which determines the migrants affinity for the food matrix. The majority of the migratory constituents which could result in spoilage, are hydrophobic and thus is more probably to present problems for foods rich in fat.
- What impact has the migrated compound on the food? This is influenced by how strongly flavored the product is. For example, similar levels of migration in a white chocolate and a pork pie can make the chocolate to be no longer enjoyable, but it

[7] Whitfield, F.R. and Last, J.H. (1985) Off-flavours encountered in packaged foods, in The Shelf Life of Foods and Beverages (ed. G. Charambalous), Elsevier, Amsterdam,
[8] http://www.rasfoiesc.com/business/economie/merceologie/STUDIUL-PRIVIND-SIGURANTA-CONS22.php

can't be detected in pie. Thus, the migration levels that can be tolerated (within the legislation limits) depend on the characteristics of flavourings for foods.

In annex 3 are presented the components of plastics and non-plastics that can migrate and some foods in which they migrate.

In fig.1 are shown and other processes that can occur in the interaction environment – packaging – food.



Process Proces	Migrating substances Substanțe care migrează	Consequences Consecințe
Permeation Permeabilitate	O2, H2O vapor, CO2, etc.	Oxidation - Oxidare Microbial growth (Creștere microbiană) Mold growth (Creștere mucegai) Off-flavor (Pierdere aromă) Dehydration (Dehidratare) Decarbonation (Decarburare)
Migration Migrare	Monomers (Monomeri) Additive (Aditivi)	Off-flavor (Pierdere aromă) Safety problems (Probleme de siguranță)
Sorption Absorbție	Aroma compounds (Componenți ai aromei) Fats (Grăsimi) Organic acids Pigments	Loss of aroma intensity (Pierderi de aromă), Unbalanced flavor profile (dezechilibrări în felul mirosului), Damge packaging (Deteriorare ambalaj)
Corrosion Coroziune	Metal ions (Ioni ai metalului)	Color change (Schimbarea culorii), Safety problems (Probleme de siguranță)

Fig. 1 Un scenariu complet al interacțiunii mediu- ambalaj- aliment
(A complete scenario of product–package interaction resulted from several modes)
Conform: Handbook of Food Preservation, Second Edition, edited by M. Shafiur Rahman, CRC Press Taylor & Francis Group – 2007

2) Products presentation and the usefulness of the pack

Modern methods of consumer marketing would fail if on the packaging there would not exist a distinctive branding and the labelling to allow the supermarket to function on the basis of self-service. By law it is provided that the food packaging labels to ensure all the necessary information to the buyer to orient themselves in relation to the purchase of the product, i.e. information on the food composition, shelf life, instructions for use and brand. Other communication functions of the packaging comprise a universal product code (Universal Product Code - UPC) which can be read accurately and quickly using the modern scanning equipment to retail houses, nutritional informations and about the ingredients (including E numbers for additives) and the country of origin.

The presentation of the packaged food, for the eventual buyer, must be done in an attractive manner. A designed pack with ingenuity, using shapes and drawings or appropriate photos, can contribute to a faster sale of the packaged product, thereby contributing to the economic efficiency of its. In other words, "the package must protect what it sells and sell what it protects", calling it also "'silent salesman"[9].

The consumer of today wants to buy processed food with an affordable price. With the increasing use of microwaves, the packaging industry is faced with the need to design food packaging that are directly inserted in the oven. Food processors can accelerate the use of microwave ovens through the design of products and packaging which use the heating phenomenon / baking with microwave ensuring the quality of the cooking food. Two types of materials, transparent to microwave and reflective in the microwave, can affect the cooking. Transparent materials are non-metallic, eg. ceramics, which are coated or alloyed with absorbent materials of microwaves. The reflective category encompass all metal devices, which absorb the heat. Other facilities might be the ease of opening, methods of resealing and methods to avoid fraudulent opening. In general, the resistant packaging to fraudulent opening make products more difficult to open, so it is necessary to balance the two requirements, safety and consumers accessibility[10].

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[9] Gordon L. Robertson, Food Packaging and Shelf Life, University of Queensland and Food Packaging Environment, Brisbane, Australia

[10] Handbook of Food Preservation, Second Edition, edited by M. Shafiur Rahman, CRC Press Taylor & Francis Group – 2007

3) Protection and insurance of the shelf life during storage

During the lifetime of the products, in particular to the storage, distribution and handling, the products are subjected to vibration in vehicles, compressive loads during stacking in warehouses and sudden blows to the unloading /loading. Packaging design must ensure the resistance to such shocks or long periods of vibration. Vulnerable areas are the seals (to heat), screw caps, where damage leads to leaks. For fragile products susceptible to crushing, such as soft cheeses, breakfast cereals and biscuits, an outer box ensures protection to physical tasks and to handling. Susceptible fruits and vegetables to crushing requires protection against handling and the outer packaging used for distribution shall withstand stacking to considerable heights and variable humidity. It follows that the packaging design must comply with the food requirements related to moisture, permeability, food respiration and its susceptibility to crushing/crushing. Primary packaging shall be entered in sealed cardboard boxes and then are transported from the various processing lines by specialized conveyors and sorted finally on individual pallets of products. The protective packaging is a term designed for packaging which first is used to protect rather the goods than for appearance or presentation. In general it is used for the outer containers used for the goods transport from manufacturer to sale point and for filling materials inside the outer containers, for example, the barrier sealed from nylon with bubbles, urethane foam, "pillows" made of polyethylene foam (PE) and the expanded polystyrene packaging (PS).

To oversee the products quality during transport or storage is used " Time-temperature indicator (TTI)". This indicator helps to ensure an appropriate manipulations and provides a benchmark of products quality. It is used for sensitive products where the temperature and exposure time control is imperative for efficacy and safety. According to the response mechanisms, the TTI can be divided into three groups: (i) biological(Ii) chemical and (iii) physical systems. An example is the use of TTI based on enzymes for the monitoring and prediction of the products shelf life. Signs are available in a version with a color and a version with three colors that change color at different rates. The color changing of the point indicates the time and temperature at which the product has been exposed.

4) The best food packaging

Are listed below the criteria which tend to be satisfied in the packaging design:

- Zero toxicity;
- Strong and expanded marketing;
- High visibility of the product;
- Moisture and gas control;

- Stable performance on a range of high temperature;
- Low cost and availability;
- Adequate mechanical resistance (i.e., resistance to compression, wear and puncture resistance);
- Easy handling of the machine and the appropriate coefficient of friction;
- Closing firm features, like opening, sealing and resealing;
- Ability to include appropriate labelling;
- The resistance to the migration or leakage from the package;
- Protection against loss of flavor and odor;
- Gas controlled transmission needed or unwanted.

5) Environment and packaging

The packaging should carry out its functions in three different environments (Lockhart, 1997). During the design of food packaging, for a good result, it is necessary to take into account all the three environments. Thus, increased costs may occur, consumer complaints and even the product avoidance or rejection by the consumer.

- The physical environment

This is the environment that may be caused material damage to the product, including shocks, falls and bumps; damage caused by the vibration arising from transport, as well as the damage of compression and crushing arising from stacking during transport or storage in warehouses, sale points and the home environment.

- The environment and environmental issues

It is the environment that surrounds the package. Food deterioration can be caused as a result of exposure to gas (particularly O2), water and water vapour, light (particularly ultraviolet radiation) and the effects of heat and cold, as well as microorganisms (bacteria, fungi, molds, yeasts and viruses) and macroorganisms (rodents, insects, mites and birds), which are ubiquitous in many warehouses and retail outlets. Contaminants from the environment, such as exhaust fumes from cars, dust and dirt, can also find in the product if the packaging does not effectively acts as a barrier.

Once its original function has been fulfilled satisfying the physical, chemical and biological criteria, by completing their life cycle as packaging, it should be removed without polluting the environment (passive protection function). The presence of plastics in the wildlife habitat, both on land and at sea has created problems which are vigorously exploited by the environment lobby to require solutions from the plastic industry. The global protection of the environment and the rescue pressures of resources (environmental issues become increasingly important to the consumer) need to develop through the design of friendly packaging to the environment, easily reusable, recyclable or easy to store in landfills.

- The human environment

This is the environment in which the package is managed by people and packaging design for this environment requires knowledge of the strengths and fragility and strength of human vision, human force, weakness, dexterity, memory, cognitive behavior, etc. Also, it includes the results of human activity, such as liability, litigation, legislation and regulations. Because one of the packaging functions is to communicate, it is important that the messages to be received clearly by consumers. In addition, the packaging must contain the information required by law, such as the nutritional information, the content and net mass. In order to maximize the comfort or utility functions, the packaging should be simple to maintain, open and use and (if applicable) reclosed by the consumer[11].

6) The shelf life of the food

Until 2000, the EU did not have a definition of the shelf life or a law regarding to the way in which a shelf life should be determined; the consolidated EU Directive on food labelling (2000/13 /EC) requires the food prepacking with the inscription of a date of "minimum durability" or, in the case of foods which are highly perishable from a microbiological point of view, a "use up to ....". Any distribution after that date is prohibited. Has been defined the date of minimum durability as "the date to which a food retains its specific properties when properly stored". Also, must be given special storage conditions (for example, the temperature which should not exceed 7 °C). This concept allows to the processor to set the quality standard of the food, because the product will still be acceptable for many consumers after the date of "best before ..." has past. More recently, the shelf life has been defined for the first time, in Regulation (EC) no. 2073/2005 of the Commission, as follows: 'shelf-life' means either the period corresponding to the period preceding the 'use by' or the minimum durability data, as defined respectively in Articles 9 and 10 of Directive 2000/13/EC.

In annex 2 presents: the shelf life for a few common foods.
The shelf life of a food is controlled by three factors:

[11] Gordon L. Robertson, Food Packaging and Shelf Life, University of Queensland and Food Packaging Environment, Brisbane, Australia

1. The product characteristics, including definition and processing parameters (intrinsic factors) were earlier presented and are the PH, water activity, enzymes, microorganisms and the concentration of the reactive compounds. Many of these factors can be controlled by selection of raw materials and ingredients, as well as the choice of the processing parameters.

2.The environment in which the product is exposed during distribution and storage (extrinsic factors) . These include temperature, rH, light, total and partial pressure of the various gases and mechanical stresses, including the consumer manipulation. Many of these factors can affect the rates of deterioration reactions, which occur during the shelf life of the product. The packaging properties can have a significant effect on many extrinsic factors and thus indirectly on the rates of the deteriorative reactions. Thus, the shelf life of a food can be modified by the changing of the composition and formulation, processing parameters, packaging system or the environment to which it is exposed.

3. The packaging properties
Food packaged may classify such:

Perishable foods- are those which must be kept at low temperatures or freezing (e.g., 0 °C to 7 °C or -12 °C to -18 °C) if they need to be kept more than a short period of time. Examples of such foods are: milk; fresh foods, ex. meat, poultry and fish; least processed foods; and many fresh fruit and vegetables.

Semiperishable foods- are those which contain natural inhibitors (e.g., some cheeses, root vegetables and eggs) and those who have suffered some type of light conservation treatment (for example, milk pasteurization, smoked ham and pickles), which have a higher tolerance to the environmental conditions and the excessive use of distribution and handling.

Stable food (to shelf) are considered "non-perishable" at room temperature. In this category fall many unprocessed foods that are not affected by the microorganisms due to their low humidity (for example, cereal grains, nuts and some confectionery products). Processed foods can be stable if they are preserved by thermal sterilization (e.g., canning), contain preservatives (e.g. soft drinks), are formed as dry mixes (for example, different cakes,) or are processed to reduce the water content (for example, raisins or biscuits). However, the stable food maintain this status only if the integrity of the packaging that contains them remains intact, and for these the shelf life is longer, but still finite.

Details and complete tables with the products and shelf life for the three categories can be found in http://www.localfoodbank.org/wp-content/uploads/2014/07/SHFB-SHELF-LIFE.pdf publication of Second Harvest Food Bank, the REV 7/2014.

Foods can be classified according to the protection degree required for the packing, ex. the maximum increase of moisture or absorption of O2. This allows performing calculations to determine if a special packaging material would provide the required barrier to give the desired shelf life for the product. Metal containers and glass containers can be considered as being essentially impermeable to the gases passage, odors and water vapor, and packaging material of paper can be considered permeable. Packing materials on the base of plastics provide different degrees of protection, depending largely of the polymers nature used in their manufacture[12].

- REGULATION (EU) No 1169/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004

- [REGULATION (EC) No 852/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 29 April 2004 on the hygiene of foodstuffs

- Directive 2000/13/EC of the European Parliament and of the Council of 20 March 2000 on the approximation of the laws of the Member States relating to the labelling, presentation and advertising of foodstuffs

[12] Gordon L. Robertson, Food Packaging and Shelf Life, University of Queensland and Food Packaging Environment, Brisbane, Australia

General Regulations on FCM[13]	
Regulation EC 1935/2004 (on materials and articles intended to come into contact with food)	
Regulation EC 2023/2006 (on Good Manufacturing Practices)	
Specific Materials	
Ceramics	Directive 84/500/EEC
Epoxy Resins	Regulation EC 1895/2005
Regenerated Cellulose Film	Directive 2007/42/EC
Recycled Plastics Material	Regulation EC 282/2008
Active and Intelligent Packaging	Regulation EC 450/2009
Plastics	Regulation EU 10/2011, and Regulation (EU) 2016/1416 - amending and correcting Regulation (EU) No 10/2011.
Specific Regulation	
Regulation EU 321/2011 (restricting the use of bisphenol A in polycarbonate infant feeding bottles)	
Regulation EU 284/2011 (import procedures for polyamide and melamine plastic kitchenware from China and Hong Kong)	
Regulation EC 1895/2005 (restricting the use of certain epoxy resins)	
Directive 93/11/EEC (regulating the release of N-nitrosamines and N-nitrosatable substances from rubber teats and soothers)	

Conform: http://www.foodpackagingforum.org/food-packaging-health/regulation-on-food-packaging/food-packaging-regulation-in-europe

The amendments below only amend Annex I of Regulation (EU) No 10/2011, thus changing the Union list of authorized substances.

- Regulation EU 2015/174 - plastic materials and articles intended for contact with food amending Regulation (EU) No 10/2011

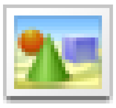
[13] food contact materials

- Regulation EU 202/2014 - plastic materials and articles intended for contact with food amending Regulation (EU) No 10/2011
- Regulation EU 1183/2012 - plastic materials and articles intended for contact with food amending Regulation (EU) No 10/2011
- Corrigendum to Regulation EU 1183/2012 - plastic materials and articles intended for contact with food amending Regulation (EU) No 10/2011.
- Regulation EU 1282/2011 - plastic materials and articles intended for contact with food amending Regulation (EU) No 10/2011
- Regulation EU 321/2011 - restricting Bisphenol A use in plastic infant feeding bottles

- **Symbols to label food contact materials - FCM**

Figure 1: Article 15 of the Framework Regulation (EC) No 1935/2004. It says that food contact materials shall be accompanied by the words "for food contact" or this symbol, unless when it is obvious that the article is for food contact.

The size of this symbol is 5x5 cm, it has 300 dpi.



FCM symbol - JPG File

Figure 2: the file here enclosed is the food contact materials symbol and is downloadable as .JPEG file

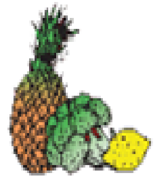
FCM symbol can be downloaded as .JPEG file

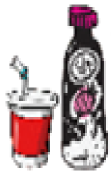
Figure 3: DO NOT EAT symbol

Article 11 of Regulation (EC) No 450/2009 on active and intelligent materials and articles intended to come into contact with food contains additional rules on labelling. One of these rules is the following: To allow identification by the consumer of non-edible parts, active and intelligent materials and articles or parts thereof shall be labelled:

(a) with the words 'DO NOT EAT'; and (b) always where technically possible, with the symbol reproduced in Annex I.

	Fridge	Freezer	Pantry
Bread	7 days	3 months	4-6 days
Milk	7-10 days	3 months	
Fruit	7 days*	3 months*	1 week
Vegetables	7 days	12 months	
Potatoes & Onions			3 months
Fresh Herbs	6 days		
Beef	2 days	8 months	
Chicken	2 days	9 months	
Pork	2 days	6 months	
Lamb	2 days	12 months	
Fish & Seafood	2-3 days	3-6 months	
Deli Meat	4 days		
Eggs	1 month	1 year**	
Yoghurt	14 days		
Cheeses	14 days	6 months	
Butter	3 months	9 months	
Cooked Rice	2 days	3 weeks	
Cooked Pasta	3 days		



* Avoid refrigerating fruit before it's ripe, as the cold environment can prevent ripening in some fruits. Many fruits like bananas and berries can be frozen for later use in cooking and making smoothies.

** Egg whites can be separated and frozen.

Note: The above times are approximations based on good storage. Always check the dates on packaging and assess food based on smell and physical condition before consuming. Freezer dates are based on when foods will remain in their best condition.
For more detail on ways to store fresh foods, see FoodWise.com.au.

According to: http://www.foodwise.com.au/wp-content/uploads/2013/07/Shelf-Life-ONLINE.pdf

Annex 3. Migrating Components from Packaging Materials to Food

Packaging Material	Migrating Component	Food
PS	Styrene dimmers/trimmers	Instant food
PS cups	Styrene	Yoghurt
PS	Styrene	Water, milk, cold and hot beverages, olive oils
Polyester cookware	Benzene	Olive oils
PVC films	DEHA	Cheese
LDPE, HDPE, PP, microwave packaging	Irganox 1010 (I-1010) cPET	Food simulant liquids (FSL)
PVC films	Dioctyladipate	Cheese sausages
PVC films	DEHA	Cheese
Polymeric material	Styrene	Dairy products
PP cups	DEHA	Dairy products
Polystyrene	Styrene/ethyl benzene	Dairy product
PP cups	2-Decanone	Cheese sauce
PS (+recycled material)	Monostyrene	Dairy products
PS+ABS+waxed paperboard	Mineral hydrocarbons	Dairy products
Wax coatings	Mineral hydrocarbons	Cheese sausages
Polymer	Dioctyl phthalate	Milk
PS	Monostyrene	Milk
PP	Monomers	Yoghurt
PS	Styrene	Food oil
PS	Styrene	Cheese, dessert, meat products
PVC	DEHA	Cheese
LDPE	Naphthalene	Milk
ABS	Mineral hydrocarbons	Dairy products
PC	Bisphenol A (BPA)	FSL
PVC films	DEHA	Bread, olive oil, cheese, meat
PVC	DEHA	Microwave fatty foods

Migrating Components from Packaging Materials (other than Polymer) to Food

Packaging Material	Migrating Component	Food
Wooden packaging	1-Propanol	Apples

Annex 3. Migrating Components from Packaging Materials to Food

Tin	BADGE	Canned foods
Metals/plastics/glass/aseptic	DIPNs	Tomato
Recycled Paper and board, Cans coated with lacquer	Epichlorohydrin	
Paper, cardboard and board	Metals (Zn, Sn, Al, Mn, Ba)	Test foods
Cartons (Al-laminated)	Al	Skimmed milk, yogurt drink
Aseptic	H2O2	Milk
Aluminum foil paper laminates	Phthalate esters (DBP, BBP, DEHP)	Butter, margarine
Cans	BADGE (lacquer)	Water-based simulants
Aluminum	Al	Food and drinks
Paper-based food packaging	2378-TCDD/2378-TCDE	Fatty and nonfatty foods
	(polychlorinated dibenzofurans)	
Ceramic containers	Pb, Cd	Dairy products
Aluminum	Al	Milk
Cans	BADGE	Canned foods
Aluminum	Al	Dairy products
	4,4-bis(dimethylamino) benzophenone (MK),	
Paper and board	4,4-bis-(diethylamino benzophenone) (DBAB)	Dairy products

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Abbreviations

APET—Amorphous polyethylene terephthalate
ATBC—Acetyl tributyl citrate
BADGE—Bisphenol A diglyceride ether
BBP—benzyl butyl phthalate
BHA—Butylated hydroxyanisole
BHT—Butylated hydroxytoluene
BOPA—Biaxially oriented polyamide
BPA—Bisphenol A
CPET—Crystalline polyethylene terephthalate
DAD—Diode array detection
DBP—Di-n-butyl phthalate
DCHP—Dicyclohexyl phthalate
DEHA—Di(2-ethylhexyl) adipate
DEHP—Di-2-ethylhexyl phthalate
DEHS—Diethylhexyl succinate
DEP—Diethyl phthalate
DHA—Diheptyl adipate
DIBP—Diisobutyl phthalate
DIDP—Diisodecyl phthalate
DINP—Diisononyl phthalate
DMP—Dimethyl phthalate
DOA—Dioctyl adipate
DOP—Dioctyl phthalate
DPP—Di-n-propyl phthalate
EA—Ethyl acetate
EAA—Ethylene acrylic acid
ESBO—Epoxidized soybean oil
ESI—Electrospray ionization
EVA—Ethyl vinyl acetate
EVOH —Ethylene-vinyl alcohol
FCM—Food-contact material
FID—Flame ionization detector
GC—Gas chromatography
GPPS—General purpose polystyrene
HAD—Heptyl adipate
HDPE—High-density polyethylene
HIPS—High-impact polystyrene
HOA—Heptyl octyl adipate
HPLC—High-performance liquid chromatography
LC—Liquid chromatography
LDPE—Low-density polyethylene
LLDPE—Linear low-density polyethylene
MPPO—Modified polyphenylene oxide
MS—Mass spectrometry
MW—Microwave
OM—Overall migration
OPP—Oriented polypropylene
PA—Polyamide (nylon)
PC—Polycarbonate
PP—Polypropylene
PS—Polystyrene
PVC—Poly vinyl chloride
PVDC—Polyvinylidene chloride
SIM—Selected ion monitoring
SM—Specific migration
SML—Specific migration limit
SPME—Solid-phase micro-extraction
TDI—Total daily intake
TNPP—Tris-nonyphenyl phosphate
TPA—Terephthalic acid
UPLC—Ultra-performance liquid chromatography
VA—Vinyl acetate
VDC—Vinylidene chloride
VOH—Vinyl alcohol
WVTR—Water vapor transmission rate
DIPNs - diisopropylnaphthalene