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CONSERVATION TECHNOLOGIES IN PRODUCTS OF ANIMAL ORIGIN - LITERATURE REVIEW

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Abstract: Food preservation is a method that can be carried out in several ways, all of which are important for increasing commercial validity, food safety and the conservation of their sensory characteristics. Due to the evolution of technologies, forms of conservation have gained new forms and today, we can find methods such as the use of heat, cold, dehydration, salting, smoking, irradiation, fermentation, addition of additives, among others. In addition, packaging presents its importance in food storage with the type of material present in its composition in order to ensure the purposes of each process. The main objective of all this conservation technology is to inhibit or delay deterioration processes caused by microorganisms, enzymes and/or chemical reactions. The heat used on the food results in a change in its texture and palatability, in addition to providing the destruction or delay of microorganisms, undesirable enzymes, insects and parasites. Cold works by decreasing the temperature of the food, causing a control over the proliferation of microorganisms, slowing down metabolism, as well as their enzymatic reactions and slower deterioration. Dehydration is used to reduce the water activity in the food, thus resulting in the inhibition of microbial growth and enzyme activity, without changing the original microbial load. The salt enters the food through diffusion and/or osmosis, thus eliminating the bacteria present due to the high concentration of the same through the resulting dehydration of the product, in addition to adding sensory characteristics. Ionizing radiation is used to inhibit germination, disinfestation, pasteurization and sterilization. Despite all these methods, there are still many other conservation processes that help to promote food safety and increase the commercial validity of food.

Keywords: Food Technology. Food preservation. Commercial validity.

INTRODUCTION

Conserving food has been a concern since ancient times. However, when prehistoric men discovered fire, the food preservation process took a leap. Over time, new conservation methods were discovered, such as: smoking, cold, salting and the use of additives. Through modern technologies these methods are still used. With human evolution and its scientific and technological knowledge, new conservation methods have been developed, such as the use of radiation, modified atmosphere, UHT (Ultra Hight Temperature), pasteurization, among others. Conservation methods have always been important because, in the past, they represented the survival of many tribes and today, in addition to providing food security (avoiding pathogens, via food.

CONSERVATION TECHNOLOGIES

Many products available on the world market have seasonal characteristics and, therefore, for the extension of these products on the market, it was necessary to develop and apply methods of conservation of these foods in order to increase their commercial validity. or delay the deterioration processes caused by microorganisms, enzymes and/or chemical reactions. In the case of the action of microorganisms, methods of asepsis, filtration, centrifugation, inhibition of microbial activity using low temperatures, reduction of moisture content, imposition of anaerobic or aerobic conditions and addition of additives are used. However, thermal processes using heat, irradiation or even germicides are also used. When thinking about preventing or delaying the self-decomposition of food, methods of destruction or inactivation of enzymes and

prevention or delay of chemical reactions are more used (CÉSAR, 2008). CONCEPT OF LEISTNER'S OBSTACLES: The knowledge of intrinsic and extrinsic factors of foods is important to verify the microbiological stability, growth capacity and/or production of toxins from pathogenic and/or spoilage microorganisms that may be present in the food. However, the joint action of these factors is more efficient because there are interactive effects between them, which can be additive, synergistic or antagonistic, known as Leistner's Obstacle Concept. (FRANCO; LANDGRAF, 2008). The intrinsic factors refer to the food matrix, which are: Acidity (pH), Water Activity (Aa), oxidation-reduction potential (Eh), chemical composition, antimicrobial constituents and biological structures. On the other hand, extrinsic factors refer to the properties of the storage medium that affect the products and microorganisms. The most important for microbial growth are: storage temperature, relative humidity of the medium, presence and concentration of gases, presence and activity of other microorganisms (JAY, 2015). The concept of Leistner's Obstacles gave rise to the Hurdle Technology, which is based on the use of more than one form of microbial control in foods, which can be: salting, thermal process, acidification, addition of chemical preservatives, among others. The objective of this technology is to obtain stable food products, with a prolonged commercial validity and safe for the health of consumers. The microbial control used has the help of mathematics and informatics, since, when used together, they are able to calculate and predict the product's shelf life from equations about intrinsic and extrinsic factors (such as the microbial growth and/or or toxin production) (FRANCO; LANDGRAF, 2008, POMBO, 2012). HEAT PRESERVATION: It is an extremely important method, widely used and easily accessible, which consists of the use of heat on the food in a way that will result in the alteration of the texture and palatability of the same, in addition to destroying or delaying microorganisms, undesirable enzymes, insects and parasites. Heat acts on proteins, coagulating them, resulting in the inactivation of enzymes necessary for the metabolism of microorganisms. This way, it is possible to establish the food safety of the product and prevent its recontamination (VASCONCELOS; FILHO, 2010; PAHO, 2019). This conservation method has advantages and disadvantages. Among the advantages we can mention the ease in controlling the conditions (temperatures), providing food with a longer shelf life, inactivation of enzymes, fixing color, aroma and flavor in addition to eliminating air from the food tissues (avoiding oxidation), giving textures, elimination of anti-nutritional factors and increased availability of some nutrients. As for the disadvantages, we find the destruction of components responsible for the flavor, color, texture of the food (OPAS, 2019). However, this method presents some variations that are determined by time and temperature, that is, each food will have a different need for time and temperature depending on its size, consistency, microorganisms present, nutrients present and the preservation of the product's sensory characteristics. Among the variations of the heat conservation process are bleaching, pasteurization and sterilization (CÉSAR, 2008; VASCONCELOS; FILHO, 2010). Blanching, also called blanching, uses mild temperatures between 70 and 100ºC (using hot water or steam) with a time ranging from 1 to 5 minutes (depending on the size and consistency of the food) followed by cooling in order to to cease further cooking of the product. Its objective is to favor color fixation,

soften the texture, reduce contaminating microorganisms on the surface of food, inactivate natural enzymes, eliminate gases and air present in the food. It is mostly used for fruits and vegetables before freezing or dehydration, however it is also used in products that are going to be canned, frozen or dehydrated. (OPAS, 2019; BARROS et al., 2020). This method can be considered as a pre-treatment that is done between the raw material preparation processes and subsequent operations such as sterilization, drying and freezing. Among the commercial blanching methods, the steam method generates greater retention of nutrients (requiring post-cooling with cold air) and also preserves the sensory characteristics of the food. However, the hot water method generates greater loss of nutrients since components can be solubilized in the "bath" water, but it also presents itself as a cheaper process. (VASCONCELOS; FILHO, 2010; COSTA, 2018; PAHO, 2019). Pasteurization was developed by Louis Pasteur in 1864, in which food is heated to temperatures below 100°C. The aim is to partially destroy the vegetative forms of pathogenic microorganisms present in food. In this process, the spores are not destroyed and a portion of the spoilage microorganisms survives, requiring the complementation of the conservation by another complementary conservation process, which can be refrigeration, addition of preservatives, packaging under anaerobic conditions and even fermentation. with selected microorganisms. (OLIVEIRA, 2014; FURTADO, 2021). There are two types of pasteurization, slow and fast. Slow pasteurization or (LTLT – Low Temperature and Long Time) uses a temperature of 63 - 65ºC for 30 minutes; fast pasteurization or (HTST – High Temperature and Short Time) used a temperature of 72 - 75ºC for 15 seconds. (BRAZIL, 2020). Sterilization is characterized by the inactivation of all microorganisms, pathogens and spoilage, that present the possibility of growing under storage conditions. The process can result in sensory and nutritional changes in foods such as: color, flavor, aroma, consistency, loss of vitamin C, loss of vitamins A and E (in anaerobiosis) and loss of vitamin B1 in foods with low acidity (LEONARDI; AZEVEDO), 2018). Some more resistant sporulated forms can survive the heat treatment, but it is important that they cannot develop under the storage conditions of the product. This is how the term "commercial sterility" arises. Several factors influence the design of the commercial sterility process: the nature of the food, the initial load of microorganisms, the thermal resistance of the microorganisms and their spores, the water activity, the type and size of the package, the heat transfer characteristics of the food, packaging and heating medium and storage and marketing conditions (FURTADO, 2021). In the Apertization process, the previously prepared food, contained in hermetically closed packaging, undergoes a process with high temperatures, in order to destroy the microorganisms present, without altering the final result of the product. The quality of the food will depend on the time of exposure to heat and the amount of temperature involved (COSTA, 2018). Tindalization is a thermal process in which heat is used discontinuously on the food. The temperatures used in this process can vary from 60 to 90ºC, according to the type of product used and thermal severity. The process is still done after the arrangement of the raw material to be used, inside a closed container, and then you can start the tindalization process, which lasts around a few seconds (SILVA, 2012). COLD STORAGE: The use of the cold chain on food

is important to reduce the temperature of the food, which provides a control over the proliferation of microorganisms, resulting in the deceleration of metabolism and enzymatic reactions of the same and slower deterioration of the product. There are two ways to use cold in food: freezing and refrigeration (BOGSAN, 2016) be present in the food, commercial validity, time of application of the cold, air circulation, relative humidity, temperature, light, characteristics of the food and composition of the storage atmosphere (CÉSAR, 2008; LINO; LINO, 2014). The main objective of refrigeration is to reduce the temperature of the food (between 0ºC and 7ºC), generating quality maintenance for a longer period, as the deterioration and reproduction reactions of microorganisms are delayed. The water present in the food does not change its physical state, so the shelf life of the product is shorter when compared to the freezing method. Additionally, the impact on the sensory and nutritional characteristics of the food are also smaller (LINO; LINO, 2014; FERREIRA, 2017). The relative humidity of the air inside the cooling chamber is variable and is directly related to the humidity of the food. This way, a low humidity in the chamber results in the loss of moisture from the food, causing the probability of dehydration to increase, and a high humidity in the chamber can result in favoring microbial growth in the product (PEREIRA, 2011). It is therefore recommended that the relative humidity does not vary more than 3 to 5% and that it is maintained between levels of 80 to 90% (SOUSA, 2017). The temperature that must be applied in this method varies according to the type of product, the desired time and storage conditions (FREITAS; FIGUEIREDO, 2000). Air circulation distributes the cold between products inside a storage chamber. So, the way in which the products are organized inside the chambers is important so that the conservation can be carried out correctly, also avoiding damages with deterioration (LINO; LINO, 2014; ROCHA et al., 2014). Freezing is a method in which lower temperatures are used when compared to refrigeration and the objective is to reduce the temperature of the food by -40 °C to -10 °C so that it is performed correctly, once 80% of the water is transformed into ice. The transformation of water into ice results in the reduction or stabilization of the metabolic activity of the microorganisms present, however, there is also the possibility of modification of proteins, fats, nutritional and sensory aspects. So that there is no major change during storage, the ideal temperature of the food must be at -18 ºC. It is also recommended for the maintenance of temperature, the continuous storage of products in order not to undergo changes in freezing levels and consequent physical-chemical reactions (SILVA, 2018; OPAS, 2019). PRESERVATION BY DEHYDRATION: It is a very old method that is also known as drying, acting on the removal of water from the food in the form of vapor (gaseous) through thermal vaporization that reaches temperatures below those necessary for boiling (CELESTINO, 2010; FOOD INGREDIENTS). BRAZIL, 2016). It aims to reduce the water activity of the food resulting in the inhibition of microbial growth and enzymatic activity, without changing the microbial load. The method still has the advantages of transforming foods into products that are easier to handle and more diversified, in addition to the same, reduces the weight/ volume of the product, favoring it economically as transport and storage costs decrease (VASCONCELOS; FILHO, 2010; FOOD INGREDIENTS BRASIL, 2016). For product dehydration, we can cite the natural

(sun) or artificial drying method. There are several types of dryers available on the market, which can be: tray/cabin, tunnel type, by sprinkling/atomization (Spray dryers), fluidized bed, drum (Drum, dryers), by lyophilization (Freezer-dryers or cryodehydration), (CELESTINO, 2010). The drying process can be divided into 3 types: drying by osmosis, by heated air and by lyophilization. In osmosis drying, food (usually fruits and vegetables) is immersed in solutions below the solute saturation point, removing water from the food and resulting in dehydration. Drying by heated air is a process in which there is the use of dryers that use hot air, which results in the heating of the food with consequent loss of water. The method is unfavorable because there is nutritional and sensory loss in the food (thermosensitive substances). In freeze drying, the method performs rapid freezing with subsequent sublimation of water by means of vacuum. It has the advantage of preserving the sensory and nutritional characteristics of the food, but it also has the disadvantage of having a high cost in the process (SILVA, 2018). Freeze-drying is a process indicated for products that have delicate aromas and textures, such as meat, seafood and complete meals (SEBBEN, 2019). PRESERVATION BY SALTING AND SMOKING: Salting is one of the oldest methods in the world, in addition to being a very simple and inexpensive process to perform, in which salt is used in the food (which penetrates through diffusion and/or osmosis) in order to destroy the bacteria present due to the high concentration of salt (up to 30%). which results in dehydration, in addition, it also has the utility of imparting sensory characteristics to foods. The process can be done by dry salting, wet salting or mixed brine and salting. Dry salting is the simplest process, which consists of applying salt on the surface of the food, thus resulting in great dehydration. In wet salting (brine) it is the process of immersion of the product in a brine, containing the desired level of salt for the final product. In mixed salting, where there is a combination of dry salting and wet saga, the process takes place first by salting the product by dry salting (without removing excess salt), with subsequent immersion in brine. Salting, despite not preventing the process of food degradation and fat oxidation (generating rancidity), still makes it possible to preserve food, in microbiological (LOPES, 2007; PAHO, 2019). Smoking is a process in which the objective is to impregnate chemical substances (acids, phenols, esters, ketones, carbonyls, polycyclic hydrocarbons) that result from the smoke produced in the combustion of wood, in order to preserve the product, in addition to a more pleasant to the palate. The degree of heating of the food varies according to each type of product; the smoke varies according to the material that was burned. There are two types of smoking, hot and cold. Cold smoking uses temperatures between 25ºC and 35ºC, while hot smoking uses higher temperatures (60ºC) and thus results in the cooking of the product, along with the smoking process. It is also important to know that the amount of smoke used on the food will depend on the density, air velocity in the oven, the relative humidity and the surface of the food that will undergo this process. The combination of smoke and heat results in the reduction of the bacterial population present on the surface of the food, in addition this combination also acts by transforming the surface of the product into a physical and chemical barrier layer against the growth and penetration of microorganisms, all resulting from the dehydration and protein coagulation (PAHO, 2019). CONSERVATION BY IRRADIATION: In Brazil, research on food irradiation has

been carried out under the care of the National Nuclear Energy Commission. Thus, the Ministry of Health has already approved and established norms and standards for the production of irradiated foods (BRASIL, 2001). It is possible to use irradiation in any type of food, as long as it respects: the use of the minimum dose absorbed by the food in order to reach the purpose of its application, the minimum dose also needs to be smaller than the one that compromises the functional and product (BRASIL, 2001; ROSA, 2004). Currently, ionizing radiation is used to achieve specific and main objectives, namely: germination inhibition, disinfestation, pasteurization and sterilization (GCIIA, 2000; VIEIRA et al., 2016; IPEN, 2020). In the inhibition of germination, the process has a high success and is therefore used in potatoes and onions (IPEN, 2020); in disinfestation there is the destruction of parasites and insects (ARTHUR, 2012); in pasteurization, radiation is used with a lower capacity, allowing the partial destruction of the microorganisms present and thus, requiring refrigerated storage (OLIVEIRA; ANJOS, 2012). In sterilization, the product is stored at room temperature for long periods (having a similarity to the canning process) (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). The process, in addition to its many advantages, also has its disadvantages, which are: alteration of physicochemical characteristics and because it is a technological process little known by the consumer, there is still a lot of prejudice regarding its use (VIEIRA et al., 2016). For better understanding, there are two types of radiation, non-ionizing and ionizing. Non-ionizing radiation has a low frequency, which includes electrical, sound, infrared, radio waves; in short, they are radiations that present electronic and molecular movements to generate heat. On the other hand, ionizing radiation has a high frequency, which includes alpha, beta, gamma radiation, X-rays, neutrons, this type of radiation that is of interest in food preservation. (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). It is a process that subjects the product (packaged or in bulk) to controlled doses of ionizing radiation, aiming at sanitary, phytosanitary and technological issues. The name Ionizing results from the possible ionization of matter (withdrawal of one or more electrons from the atom) (GCIIA, 2000; BRASIL, 2001; DECONTE et al., 2019). Within the ionizing irradiation process, there are still other "subclasses" which are: radapertization, radicidation, raduration. Radapertization is a process similar to sterilization which results in commercially sterile products that can be stored at room temperature, however, for fatty products this process can alter sensory characteristics resulting in little interest in food sterilization (with the exception of seasonings and spices). Radiation/ radicidation is a method similar to pasteurization, in which doses are used that are capable of reducing the amount of microorganisms (thus eliminating non-spore-forming pathogens). In radurization, the process is also similar to pasteurization, however, with different doses than those used for rooting, this way, at the levels used in this type of process, they are capable of destroying yeasts, molds, non-sporulating bacteria and thus, make it possible to increase the shelf life of the product (given that refrigeration processes are also used, for example, in conjunction with this one) (PAHO, 2019). In food irradiation processes, it is important to know the absorption capacity of the matter/substrate and the way in which it is absorbed. In addition, it is also important to know that foods have great variability when it comes to their chemical composition, physical composition and the

degree of alteration that it will undergo until the food reaches the hands of consumers. Generally, the irradiation process does not alter the physical, nutritional and flavor aspects of the food. For these and other reasons, the use of radiation at correct levels is of great importance, as otherwise radiation may hydrolyze starch and cellulose, alter food nutrients, denature proteins, alter the fat, resulting in greater rancidity, among others (GAVA, 2002; ROSA, 2004; GAVA; SILVA; FRIAS, 2009). There are three types of radiation and energies that can be used in food treatment: Radioactive isotopes that emit gamma radiation (Cobalt 60 and Cesium 137); X-rays generated by working machines with energies up to 5 MeV; Electrons generated by machines that work with energies of up to 10 MeV (PAHO, 2019). PRESERVATION BY ADDITIVES: Food Additive is any ingredient intentionally added to food, without the purpose of nourishing, with the aim of modifying the physical, chemical, biological or sensory characteristics, during manufacture, processing, preparation, treatment, packaging, packaging, storage, transport or handling of a food (ANVISA, 2021) Conservation by additives is a recommended method for foods that cannot be subjected to physical and/or biological conservation processes, thus requiring the use of preservatives in the product. Chemical preservatives are additives that act by inhibiting/delaying changes caused by microorganisms, as they act on DNA, plasma membrane, cell wall, protein synthesis, enzymatic activities and even the transport of nutrients by these microorganisms (FOOD INGREDIENTS, 2012). There are several types of preservatives, however, it is necessary to choose the right preservative so that it works properly as a preservative. The most used preservatives are antimicrobials (organic acids and their salts, sulfites and nitrates/nitrites) (PAHO, 2019). pH, product composition, water content in the food, initial level of contamination (both in the food and in the environment), the latter being related to the processes used in the food and the facilities in which it passed (TORREZAN, 2020). Food additives are classified and subclassified according to each function, namely: food supplements (liquid, solid and semi-solid), food supplements for breastfeeding mothers and young children. They can be: acidulants, carrier agents, bulking agents, anti-foaming, antioxidant, anti-wetting, flavoring, preservative, coloring, sweetener, emulsifier, thickener, stabilizer, flavor enhancer, acidity regulator, sequestrant, humectant. firming agent (BRASIL, 2018). Among the various forms of additives, we can also classify 4 groups, namely: modifiers of sensory characteristics (colorants, flavorings and flavor enhancers and sweeteners), improvers of physical characteristics (stabilizers, emulsifiers, thickeners, gelling agents, anti-caking agents, defoamers, humidifiers), those that prevent chemical and biological alterations (anti-oxidants, preservatives, synergists of antioxidants) and the improvers/correctors of properties (pH regulators and gasifiers) (FREITAS; FIGUEIREDO, 2000; BRASIL, 2019). PRESERVATION BY FERMENTATION: The fermentation process is among the oldest methods practiced in food and even today, this process has great participation in the food trade (BRITES et al., 2012). Some examples of the fermentation process can be found in bakery, alcoholic beverages, yogurts, cheeses, soy-based products, among others. During the fermentation process, the controlled action of microorganisms is able to change food textures, in addition to preserving them due to the production of acids or alcohol in order

to impart aromas and flavors to the products that result in their valorization and their quality. Due to the development of technologies, nowadays the fermentation process is still combined with processes such as: pasteurization, refrigeration, packaging with modified atmosphere (FELLOWS, 2006; OPAS, 2019). The fermentation method has a different action on food and this is due to the amount of carbon and nitrogen available in the food (nutrients necessary for microbial action), pH level, humidity level, incubation temperature, reduction-oxidation potential, growth stage of each microorganism. the presence or absence of competing microorganisms, minute concentrations of salts, anaerobic environment. In addition to all, there is still the classification of homofermentative microorganisms, which are those that produce one type of product and heterofermentative microorganisms that produce several types of products (FELLOWS, 2006; PAHO, 2019). Fermentation has the advantages of using low pH and temperature conditions that improve the nutritional and physicochemical properties of the food, transforms food by obtaining more aroma and different texture (in a way that no other process can achieve), has a low consumption of energy, low investment operation cost in addition to presenting a "simple" technology (FELLOWS, 2006; FELLOWS, 2019). Within the fermentation process, there is also the process of separating and purifying enzymes from microbial cells or animal/plant sources (RUIZ; RODARTE, 2003). This process allows the formation of immobilized solutions in materials, concentrated or in powder, of enzymes causing specific reactions in foods, and therefore, this method can be applied in different ways in the industry (baking, fruit juices, glucose syrups, cheese). The types of lactic and ethyl fermentations are the most important in the industry (FELLOWS, 2006; FELLOWS, 2019). In lactic fermentations, there is a selection of bacteria that go according to their acid tolerance. In some processes that involve low-acidity substrates such as milk and meat, a starter culture is used, which allows for greater speed in generating a production of microorganisms, thus resulting in a reduction in fermentation time in addition to inhibiting the growth of pathogens. and other spoilage bacteria of dairy products (HELLER, 2001; FELLOWS, 2006; FELLOWS, 2019). The advancement of today's technologies has enabled the development of biotechnologies that are producing lactic acid bacteria that also have stabilizing and viscosity-increasing properties. This technology is used in various ways in fermented milks, sauces and breads in order to reduce or avoid the use of synthetic stabilizers and emulsifiers. In cheeses, there is the use of the Lactococcus lactis stater, which is capable of producing the bacteriocin nisin so that it prevents the growth of Clostridium tyrobutyricum, thus resulting in the inhibition of the development of unwanted flavors, in addition to the "cracking" of cheeses from the Swiss type during its maturation. Nisin is also important because in addition to preventing the growth of C. tyrobutyricum, it also reduces/avoids the use of chemical preservatives such as nitrate, sorbic acid and benzoic acid (FELLOWS, 2006; FOOD INGREDIENTS BRASIL, 2012). CONSERVATION BY PACKAGING: Packaging is used to meet some purposes, namely: protection of food against contamination or loss, ease and safety in transport, ease of distribution, identification of the content in question of quality and quantity, identification of the manufacturer, identification of the quality standard, attract consumer interest, induce the purchase of the product, instruct the

consumer on the use of the product (GAVA, 2002; GAVA; SILVA; FRIAS, 2009; SOUSA et al, 2012; FONTOURA, CALIL, CALIL, 2016). When selected for use, they must present important requirements such as: compatibility with the product, being non-toxic, promoting sanitary protection, promote protection against moisture, light and air, have impact resistance, have a good appearance, be easy to open, respect limitations on weight, shape and size of the product, easy disposal of the packaging (environmental issues), have low cost (GAVA, 2002; GAVA; SILVA; FRIAS, 2009; SOUSA et al, 2012; FONTOURA, CALIL, CALIL, 2016). There are several types of packaging, which can be simpler or more complex (requiring more technology and/or more layers of materials). Packaging can be classified by categories, as follows: rigid metal containers (can, stainless steel drum, aluminum), flexible metal containers (aluminium, steel sheets), glass, rigid and semi-rigid plastics, flexible plastics, barrels and cardboard boxes and wooden packaging, flexible papers, laminated and multi-plywood (GAVA, 2002; GAVA; SILVA; FRIAS, 2009; SOUSA et al, 2012; FONTOURA, CALIL, CALIL, 2016). Among the rigid metallic containers, the most used are the cans, formed by a tinplate, which may also have a layer of sanitary varnish, in a way that gives greater protection to the food. Sanitary varnish works by preserving the appearance of the content, improves the internal and external appearance of the package, reduces costs and increases the commercial validity of the food. It is worth mentioning that the type of varnish also needs to be suitable according to the content, for this it is necessary to know how the acidity of the food is, if there is presence of sulfur in the food, type of stamping that the packaging will be submitted and the type of treatment. that will be used (GAVA, 2002; GAVA; SILVA; FRIAS, 2009; SANTOS; GONÇALVES, 2011). The tinplate is a material made up of a steel sheet coated on two sides of pure tin, in some cases the sheets can also be coated with a layer of sanitary varnish, chrome plating, phosphating process, etc. The composition of the steel sheet contained in the tinplate allows a high durability in addition to the deformation of the material for stamping without it breaking (GAVA, 2002; GAVA; SILVA; FRIAS, 2009; SANTOS; GONÇALVES, 2011). The tinplate of the steel sheet provides insulation from the atmosphere, from the surface of the material, resulting in a slower appearance of rust, in addition to isolating the product from the internal material of the packaging (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). ; SANTOS; GONÇALVES, 2011). Steels in the food industry are classified according to their chemical composition and hardness. They are chosen according to the chemical nature of the content. The tinplates are classified according to quality: standard quality (QP), second quality (QS), third quality (QT). (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). Another type of packaging that is widely used is glass, which is made up of a silica base and small amounts of materials such as boron, soda, lime and metal oxides. It presents the advantages of not being "attacked" by components of the food content, being visually more attractive to the consumer in addition to inspiring consumer confidence due to the visibility of the content. However, it has disadvantages such as: excess weight, higher price, more difficult (fragile) handling, high risk of packaging breakage and lower resistance to high temperatures (GAVA, 2002; SILVA; FRIAS, 2009; ROÇA, 2011). Among flexible packaging, paper was the pioneer material, followed by cellophane, plastics and metallic foils. When choosing

the material to be used in this type of packaging, consideration must be given to issues such as: material and process cost, water vapor permeability, gas permeability, material resistance, clarity, appearance, heat sealing (process where the packaging is hot closed), shrinkage, chemical resistance, odor, printability, toxicity, availability, compatibility and machinability (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). Paper is obtained from cellulosic fibers, where it presents a great variability of types, highlighting Kraft paper, which has good resistance, dark color, being generally used in paper bags and wrapping papers (GAVA, 2002; GAVA; SILVA), FRIAS, 2009) cellulose as a substrate. Cellophane has the advantages of having a good appearance and being easy to print, but it also has the disadvantages of not being heat-sealed and having low water protection. Several combinations of cellophane paper with other materials can be made, among them, we can highlight the combination of cellophane paper with plastic, which results in a material that is more resistant to oil and gases (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). Plastics are materials produced by polymers derived from petroleum or coal (KAREL; LUND, 2003). Polymers can be thermostable (little used in food packaging) or thermoplastic (often used for food). In the group of thermoplastics, polyethylene and polypropylene stand out (SOUSA et al., 2012). Polyethylene stands out for presenting the advantages of good resistance, low cost, good availability, transparency, ease of thermowelding, high water barrier, but it also has some disadvantages, which are the low barrier to oxygen and fats. Ethylene polymer that can be obtained by two different processes: low and high density. Low density polyethylene is the most used plastic material in Brazil, being used in powdered foods, candies, milk, cereals. On the other hand, high density polyethylene is widely used in greasy and moist products such as lard, butter, margarine (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). Polypropylene is obtained through the polymerization of propylene. Thus presenting a more rigid, resistant and light shape when compared to polyethylene. The advantages of this material are its greater brightness and high clarity, and its disadvantage is that it is difficult to weld, requiring a higher temperature than the polyethylene material (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). Aluminum, when used in packaging, can present different degrees of rigidity. This is due to the shape, type of alloy, temper and thickness. The great advantage of this material is that food can be cooked or frozen in its own packaging (GAVA, 2002; GAVA; SILVA; FRIAS, 2009). Aluminum has five times higher water vapor permeability when compared to polyethylene. However, the sheet alone constitutes a not so excellent material for packaging, since it has holes, making it easier to tear the material, having a high cost, not being able to be thermowelded, besides being difficult to print. Despite its "fragile" characteristics, aluminum foil when combined with other materials becomes a great material for packaging production (GAVA, 2002; GAVA; SILVA; FRIAS, 2009).

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