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CONVENTIONAL TECHNOLOGIES FOR THE CONSERVATION OF FOODS: LITERATURE REVIEW

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ABSTRACT

The food suffer deterioration because mainly of its composition, packaging and storage. The main causes that provoke this deterioration arising from chemical action caused by oxidation, physical action that causes changes in texture, microbial caused by pathogenic microorganisms and enzyme caused by enzymes as polyphenol oxidases that cause darkening of the food. With the passing of decades the techniques of food preservation has been improving, these techniques, is currently gaining prominence, the non-conventional processes, which use a reduced heat. It developed this bibliographic study in scientific articles and books, seeking to point out the applicability, the advantages and disadvantages of the following processes for the conservation of non-conventional foods: the irradiation of ultraviolet light; irradiation; othmic heating; separation processes using membranes; high pressure technology; use of smart packaging; application of bacteriocins; modified atmosphere and controlled and processes combined. In summary, these processes are applied toimproving the durability, improve the visual aspect without changing the nutrients and flavor of foods, thereby promoting food safety for consumers.

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INTRODUCTION

The processes of conservation of conventional or traditional foods referred to are those that are being used and improved in the course of the history of humanity, including the first procedures that man developed, without in-depth knowledge, even the most sophisticated techniques that allow you to store food for long periods of more rational way. Asexamples, can be cited: The heating, cooling, drying, salting, acidification, the addition of sugar or substances that prevent the deterioration. For Rosenthal, Deliza and Torrezan (s/d, p. 01) "These processes are based on the handling characteristics of the food itself, or the environment (or inside the packaging) in which the food is situated or inserted". In summary, we can say that the heat is on the basis of majority of conventional processes of food conservation.

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To be effective in inactivation of micro-organisms and enzymes, the heat allows the preservation of food. However, the intensity of heat application in food should be controlled because very high temperatures can change from undesirable way the sensory characteristics of the products (flavor or color), as well as the loss of nutritional value. To avoid such occurrences, the food industry has opted to plan the processes of food conservation, based on technical-scientific knowledge. Currently, it has been developed and used new technologies, prioritizing those that do not use or use very low heat, therefore, are known as thermal technologies. Risaralda *et al.* (2013) noted that non-thermal technologies have been cited as an excellent alternative for obtaining products of high quality, in addition to being sure to preserve the nutritional content of the food. These are examples of non-conventional technologies: the irradiation of ultraviolet light; irradiation; othmic heating; separation processes using membranes; high pressure technology; use of smart packaging; application

of bacteriocins; modified atmosphere and controlled and processes combined (ROSENTHAL ; DELIZA TORREZAN, s/d, p. 01). Considering the above, the objective of this research is to understand the processes of conservation of non-conventional foods mentioned above. For both, developed this bibliographic study in scientific articles and books, seeking to point out the applicability, the advantages and disadvantages of each process.

Ultraviolet Light Radiation

The German scientist Johann Ritter in 1801, at the end of the 19th century, discovered the ultraviolet radiation, in which, through their studies, we noticed an invisible form of light beyond the violet able to oxidize silver halide (BALL, 2007). The ultraviolet light covers an extensive range of wave lengths on non-ionising region of the electromagnetic spectrum between the x-rays (200 nm) and visible light (400 nm). Can be divided into three regions: UV-C, with short wavelengths (200 and 280 nm); UV-B, with wave lengths medium (280 and 320 nm); and UV-A, with long wavelengths (320 and 400 nm) (BINTSIS; LITOPOULOU-TZANETAKI; ROBINSON, 2000). The UV-C has been used in the disinfection of minimally processed foods, against a wide variety of microorganisms. As advantages of the application of UV-C radiation in fruits and vegetables can be cited: The low cost, not production of odor, nontoxic compounds on the surface of the waste product, inactivation of enzymes (YAUN *et al*., 2004; LÓPEZ-RUBIRA *et al*., 2005; TRAN; FARID, 2004; KEYSER *et al*., 2008). In this bias, Chang *et al*. (1985) explain that the UV-C radiation generates no chemical residues or undesirable by-products, nor cause sensory changes in food. As advantages of this process, it is noteworthy that the UV radiation is one of the most practical methods for decontamination of residual water, because inactive bacteria, viruses and bacteria spores; it shows low sensitivity to temperature, can be an alternative to the use of chemical products; does not change the sensory characteristics of foods (color, taste, odor, pH), nor nutritional composition of the product, the service is economically feasible; offers no environmental pollution; presents low operating costs; high reliability; only consumes power and exchange of lamps (MOLINA *et al*., 2007; FAUSTINO, 2013). As disadvantages, the process of UV radiation can, in low doses, does not effectively inactivate the microorganisms, but these microorganisms repair or reverse the destructive effects caused by UV radiation, the turbidity of the liquid products can make disinfecting ineffective, in some areas the efficiency is related to the regularity of the materials, therefore, it is necessary to a program of maintenance and cleaning of equipment (OLIVEIRA *et al*., 2002; FAUSTINO, 2013).

Irradiation

The process of irradiation corresponds to exposure of foods, packaged or not, to a pre-established level of ionizing radiation, it is important to know the sources of ionizing radiation, the way energy is quantified, the limitations and advantages of this process. (VENTURA, *et al*. 2010). Irradiation is applied in the food industry for decontamination and improvement of the quality of the product, disinfestation and prolonging the shelf life of (conservation). For the Sousa *et al*. (2013, p. 02):

The irradiation gives the possibility of a single operation, fresh foods are preserved, without the need for insertion of chemical preservatives. Because of the high sensitivity of nutrients present in the food, little energy is spent in processing, maintaining the nutritional alterations in the same levels of other conservative procedures. As advantages in the use of the irradiation process can be cited: Minimize losses of food, (to the extent that disinfect the food, consequently increases the shelf life); improvement of public health (the decontamination of fresh foods, eliminating any pathogenic organisms or parasites improves public health problems; increase in international trade (because it allows fresh foods foods infested or infected are disinfected, prolonging the useful life); an alternative to fumigation in foods (various chemicals, such as ethylene, are used for the fumigation of foods or food ingredients); Increase energy savings (uses low energy in food irradiation, contrasting with the used for chilled products, frozen And canned) (VENTURA, *et al*. 2010). Second Ordóñez Pereda and Cambero Rodríguez (2005) is the only method of food preservation capable of destroying pathogens in raw foods and frozen. Although it is a process of low operational cost, the investment to build a plant of irradiation is high (Sousa *et al*., 2013). There is also the possibility that some foods submitted to this procedure are unfit for consumption, by destroying the microbiota present (FELLOWS, 2006). "If this energy reaches only the deteriorating the pathogenic ones still bring harm when these products are consumed" (Sousa *et al*., 2013, p. 02). Another disadvantage of this process is that it cannot be used in all types of food, those who present with high content of fat, for example, are sensitive and prone to rancidity (SILVA, 2007).

Othmic Heating

The othmic heating it is a technology used for over 100 years. Can be applied in the process of thermal conservation of solid foods, food, liquids, mixtures of solid-liquid foods, meats and vegetables (STANCIL and ZITNY, 2010). In this case "an alternating electrical current passes through the food, through electrodes and the electrical resistance of the food because the power to be translated directly into heat" (birth; REIS; REBELLO, 2014, p. 63). Fellows (2006) ensures that the othmic heating can be used for sterilization *"ultra-high temperature*' of foods, especially those that contains large particles (up to 2.5 cm), difficult to sterilize by other methods.
As advantages of heating resistance, Rocha *et al* (2010) are: fast and uniform heating; absence of surfaces for heat transfer; ideal Process for foods that are sensitive to mechanical stress due to low speed at which circulates the fluid; significant reduction of processes of *fouling*[1] when compared with the traditional processing; Efficiency superior the traditional processes; technology with low environmental impact; industrial process control quite simple and with reduced maintenance costs. Birth, Kings and rebello (2014, p. 63) still stand that is a process: "cleaner and more sustainable, contributing to the preservation of the environment, in addition to enabling greater efficiency and greater retention of nutrients from the food." In 2004, Castro and his collaborators confronted the inactivation of different enzymes with othmic heating and with conventional treatment, reaching the

[1] It is a phenomenon characterized by several processes that cause the decrease of the permeate flow and remain after ceased the operation of the system: Blocking of pores; adsorption; development of microorganisms - BIOFOULING; formation of precipitate on the membrane - scaling; formation of gel layer.

conclusion that the inactivation by othmic heating was faster than the conventional treatment (CASTRO; MACEDO; TEIXEIRA, 2004). Leizson and Shimoni (2005) found that this process was reduced in 98% the Pectinmethylesterase activity[2] in fresh orange juice.

Separation Processes Using Membranes

The conservation of foods through the process of separation by membranes occurs when used as selective barrier synthetic membranes, being possible through this process, separate, concentrate and purify substances (HABERT *et al*., 2006). Usually the separation, this process occurs at ambient temperature and without phase changes, so it becomes advantageous for energy savings, in addition to the non-impairment of sensory quality of products and the conservation of vitamin properties (MULDER, 1987). Among the processes of separation by membranes, the microfiltration, ultrafiltration[34] , nano filtration by approaching the[5] classical filtration (Cabral *et al*. 2005). The membranes can be defined as selective barriers to transport of matter between two phases, restricting, total or partially, the transport of mass or chemical species present in phases, are used in separation processes aiming at the dispensing of the components of the mixture, according to their different rates of permeation (MALDONADO, 1991; ULBRICHT, 2006). Soon, what differentiates these processes of separation is the size of the particles or molecules to be separated. Telles and Costa (2010) cite the following benefits of water treatment plants with membranes: 1- can be avoided adding chemical coagulants, producing, thus, silt without chemicals; 2- the treatment of sludge, in some cases, it may be relatively minimal removal of bacteria, with or without the addition of adjuvants chemicals; 3- large and stable production of water; water treatment systems compact; 4- ultrapure water for industrial purposes; 5- can be economically feasible for small water supply systems. The technology of separation by membranes, second Mulder, 1997 and Baker, 2004, has the following disadvantages: 1- lack of selectivity; 2- high costs; 3- slow filtration process and 4-unreliability inherent in the processes that the used.

High Pressure Technology

The technology of high pressure is used for microbiological destruction and to slow significantly the rate of enzymatic reactions, applied in free heat, using pressures of 100 to 1000 MPa (1120, 1996). This treatment causes the inactivation of enzymes and micro-organisms, while leaving intact small molecules, such as volatile compounds and some vitamins which give flavor to food (smelled, 1998). Soon, "the high pressure technology has the advantage of causing the minimum degradation of flavor and nutrients when compared to traditional thermal pasteurization" (FIELDS; DOSUALDO; CRISTIANINI, 2003, p. 352). Second Flick (2003) This process happens when food is introduced in a camera to the high pressure which has a pressurized hydraulic fluid being via a pump, causing the packaging and the product to receive the pressure subjected. Already Torrezan (2003, p. 249) explains that:

"As the process of high pressure is more bland (in terms of temperatures used than traditional processes) allows you to obtain the final product with better sensory and nutritional characteristics, showing effectiveness in the reduction of microbial contamination". In this bias, it can be stated that the technology of high pressure is a treatment of high potential, applied with the objective to preserve food, in addition to, modify the functionality and improve the rheological and sensory properties of foods. About the advantages of using high-pressure treatment in meat products, Pereira (2003), highlights: 1- efficiency in the microbiological safety of the products; 2- economic advantages arising from short process of time; 3- energy savings compared to other thermal processes; and 4- maintenance and improvement of the quality of products. However, the biggest disadvantage of this process is the high financial cost of equipment, as well as requires a high accuracy in handling machinery, as well as in the use and maintenance.

Smart Packaging

The smart packaging technology has been developed with the objective of protecting the product/food and interact with the same, responding to changes (HONG; Park, 2000). Soon, intelligent packaging can be defined as a system that monitors the condition/quality of the food, providing information about the properties of the packaged product (KRUIJF *et al*., 2002). Intelligent packaging contain sensors or internal or external indicators, which measure a parameter and indicate the result of this measurement (SARANTÓPOULOS *et al*., 2001). In this way, smart indicators are "active" system of these packages and provide useful resources that allows the monitoring of the life-span of foods. The main objective of smart indicators is to warn when the product/food is losing quality, preferably before you start the deterioration (HURME PRINCIPE;; SMOLANDER, 1998). According to Kerry, O'Grady and Hogan (2006) there are five types of indicators: smart temperature; time and temperature; coolness; Leaks and radiofrequency. These indicators can be used to monitor the conditions of processing and storage of foods (HONG; Park, 2000; TAOUKIS, 2008). The great advantage of the use of smart packaging refers to "the possibility to inform the real state of the food, instead of basing the judgment on estimates of validity for consumption, causing huge reduction of food waste in developed countries" (REBELLO, 2009, p. 161-162).

Application of Bacteriocins

To Oliveira, SiqueiraJúnior and Silva (2012, p. 10) "Bacteriocins are antimicrobial peptides or proteins synthesized in the ribosomes of bacterial cells and released into the extracellular medium which have bactericidal or bacteriostatic action on micro organisms taxonomically related". Second Birth, Moreno and kuaye (2008), the BACTERIOCINS does not produce a change in the sensory quality of food, soon, the food industry has shown a growing

[2] The enzyme responsible for extensive loss of quality of orange juice, causing a reduction in viscosity, loss of turbidity and separation of phases in the product (Figueiredo et al., 2001)

[3] In the MICROFILTRATION occurs the separation of particulate material of a solvent for cross flow membranes of low pressure. With Microfiltration is possible filter colloidal substances and in suspension, in procedures like fermentation, the recovery of biomass among others (Moura et al., undated).

[4] The membrane used for this method has a pore size of order of 0.01 to 0.001 micrometers, for this reason, it is small enough to remove most of the bacteria, viruses and substances of high molecular weight (Moura et al., undated).

[5] Normally uses the NANOFILTRATION only when Reverse Osmosis and Ultrafiltration are not the most appropriate procedures for the separation. This can be used in the demineralization, Desalting and the removal of color (Moura et al., undated).

interest on the potential use of these compounds to replace chemical preservatives. In this perspective, currently, the majority of researches on biopreservação are centered on the bacteriocins, emphasizing its production, detection, biochemical characterization, purification, mechanism of action, bactericidal properties, inhibitors or sensitive microorganisms and successful application in food (bioconservaçãovásquez; SUÁREZ; ZAPATA, 2009).

Modified Atmosphere and Controlled

The main conditions for preservation of quality and increase the shelf life of fresh fruit are: the harvest maturity appropriate, minimizing mechanical injuries and use of relatively adequate temperature and humidity during the stages of processing and marketing (KADER; ZAGORY; KERBEL, 1989). In addition to these factors, it is also possible to modify the concentrations of carbon dioxide and oxygen in the atmosphere, next to the product of the distinct concentrations found in the air. This alteration is called modified atmosphere or controlled atmosphere, depending on the degree of control of gases (KADER, ZAGORY and KERBEL, 1989; KADER AND WATKINS, 2000). The atmospheric modification has been more used in prolonged storage of vegetables and fruits, storage and transport of highly perishable products of high commercial value and minimally processed products (KADER AND WATKINS, 2000). Kader (2002) explains that the use of modified atmosphere, even at ambient temperature (20 and 25ºC), you can fold the time of marketing of a product, and being this technique in conjunction with the cooling, in conditions of temperature and humidity relatively adequate, the time available for marketing can be three times higher. The Controlled atmosphere is based on the control of concentrations of O2 and CO2 in storage medium, not being necessary the use of chemical products for the establishment of a controlled atmosphere, because the main objective is to reduce the percentage of oxygen and increase of carbonic gas (CRISOSTO; LABAVITCH, 1990). Already in storage in modified atmosphere packaging, the products are packaged in plastic films, which allow the increase in the concentration of CO2 inside the packaging, due to respiration of the product, and the concentration of O2 decrease, to the extent that the same is used by the respiratory process, thus generating a change of local environmental atmosphere (SOUZA, 2007). Therefore, this type of storage, the concentrations of gases are not controlled, and will vary with temperature, time, respiratory rate and type of film of the product (DEJONG AND DEJONG, 1990). Thus, it can be argued that the difference between the two methods is the degree of control of concentrations of gases.

Combined Processes

The combined methods consist in the application of various parameters for conservation of foods, also called obstacles, which may act sinergisticamente to prevent or postpone the microbial growth, providing stable products at ambient temperature (CHIRIFE & FAVETTO, 1992). These methods are based on the use of soft processes, which Leistner And Gorris (1995) revealed a wide variety of obstacles that are usable, among which: high and low temperature, radiation, enzymes, electromagnetic energy, ultrasound, the Maillard reaction products, low water activity, low pH, smoking, low redox potential, salts, gases, sulfites, organic acids, condiments, spices, and flora competitive.

In addition, Costa, Deliza and Rosenthal (1999) affirm that can also be used emerging obstacles as: packaging with modified atmosphere; high-pressure; bacteriocins and packaging of edible films. These factors act as barriers to prevent the microorganisms present conditions favorable to its development and/or toxin production. Belt, Faraoni And Pinheiro-Sant'ana (2008) emphasize that the technological base of combined methods is facing the simultaneous exposure of microbial cells of plants to several factors, so that the energy used in this homeostatic process needs to be high and the microbial cells do not produce enough energy for growth and reproduction. The process is relatively simple, being a technical alternative to the chiling, freezing, dehydration and other procedures of high investment.

Final Considerations

The different technologies used for processing and preservation of foods have been enhanced with the passing of the years, to serve the consumer profile, which currently maintains a critical stance and concerned with the intake of healthy foods. Non-conventional technologies are conspicuous by their use of processes that allow the reduction of energy consumption, also known as thermal technologies. Thus, the unconventional methods of food preservation result in modifications that improve sensory conditions and/or rheological properties of products, in addition to retain vitamins and nutrients, increases the stability and shelf-life of foods, thereby promoting food safety for consumers. It is worth mentioning that each process has its advantages and disadvantages, causing significant changes or slight in foods, in addition to providing nutritional and sensorial changes. In this way, you should choose the most adequate technique according to the type of food and the final goal to be achieved with the technology employed.

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