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Novel Food Processing

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SUMMARY

Over the past few decades, consumers have been increasingly demanding high-quality, minimally processed food. These requests, coupled with the inadequacy of traditional food processing technologies, have been the driving forces behind improvements in existing technologies and for the development of new food preservation technologies, such as high-intensity pulsed electric field, pulsed white light, high pressure processing, irradiation, microwave heating, radio frequency, UV-C light, ozone and ultraviolet irradiation. Non-thermal food processing/preservation methods interest food and food packaging scientists, manufacturers and consumers because they exert a minimal impact on the nutritional and sensory properties of foods, and extend shelf life by inhibiting or killing microorganisms. Non-thermal methods allow the processing of foods below temperatures used during thermal pasteurisation, so flavours, essential nutrients, and vitamins undergo minimal or no changes. considering the present scenario, it is concluded that Non thermal processes offer shelf life extension without the use of preservatives or additives, while still retaining colour, flavour, texture, nutritive and functional qualities.

INTRODUCTION

During food preservation processing, the safety and quality of food need to be considered. The traditional food technologies, such as pasteurisation, high temperature sterilisation, drying and evaporation, can guarantee the microbiological safety or stability of their products, but can destroy some of the food ingredients, especially the heat sensitive vitamins and polyphenols, which were related to the quality of the food (Lima et al., 2014). Higher processing temperatures and longer process times during food processing also produce some potentially harmful components that threaten human (Hellwig & Henle, 2014). With the increasing demands for high-quality foods with 'fresh-like' characteristics, the non-thermal technologies introduced to the food industry, such as low processing temperatures with a short treatment time, exert minimal or no changes on food flavours and essential nutrients (Rawson et al., 2011; Birmpa *et al*., 2013; Pina-Perez *et al*., 2014). Therefore, non-thermal technologies in food processing have been researched extensively in recent years (Frewer *et al*., 2011). The non-thermal technology has the potential ability to partially, or completely, replace the traditional well established preservation processes. Non -thermal technology means, for a food processor, the process that produces the inactivation of pathogens does not rely upon on the thermal kill (Niemira, 2012; Troy *et al.*, 2016). Non-thermal processing refers to relatively young technologies that use mechanisms other than conventional heating to reduce or eliminate microorganisms that might be harmful or cause spoilage.

Why Non-Thermal Processing ?

The main problem with the thermal processing of food is loss of volatile compounds, nutrients, and flavour. To overcome these problems non thermal methods came into food industries to increase the production rate and profit. The non thermal processing is used for all foods for its better quality, acceptance, and for its shelf life. The new processing techniques are mostly employed to the liquid packed foods when compared to solid foods. Since the non thermal methods are used for bulk quantities of foods, these methods of food preservation are mainly used in the large scale production. The cost of equipments used in the non thermal processing is high when compared to equipments used in thermal processing. After minimising the investment costs of non thermal processing methods, it can also be employed in small scale industries. Non -thermal emerging technologies like ultrasound, high hydrostatic pressure, pulsed electric field, ionising radiation and atmospheric cold plasma, as alternative food preservation process

Pulsed Electric Field (PEF)

Pulsed electric field (PEF) is one of the promising non-thermal technologies for fruit juice processing. It constitutes a suitable substitute for thermal methods for inactivating enzymes and pathogenic microorganisms simultaneously retaining sensorial and nutritional components of fruit juices (Cortés, Esteve, & Frígola, 2008).

The process generates some amount of heat during its application but its maximum temperature (40 °C) is way below thermal processing temperatures. Fruit juices are placed between two electrodes and are applied pulses with a high voltage (usually 50 kv/cm) for short periods of time (μs to ms) (Puértolas & Barba, 2016). Its principle is a combination of electroporation and electropermeabilization (Teissie, Golzio, & Rols, 2005).

High Pressure Processing (HPP)

The first line of HPP was demonstrated in 1899 by Bert H Hite, as a possible food preservation process at West Virginia Agricultural Experimental Station.

High Pressure Processing is also known as "High Hydrostatic Pressure" or "Ultra High Pressure" processing. HPP uses up to 900 mpa to kill many of the micro organisms found in foods even at room temperature without degrading vitamins, flavor and colour molecules in the process. Food packages are loaded onto the vessel and the top is closed. The pressure medium usually water is pumped into the vessel from the bottom. Once the desired pressure is reached, the pumping is stopped, valves are closed, pressure can be maintained without further need for energy input. Principle: A principle underlying HPP is that the high pressure is applied in an "isostatic" manner such that all regions of food experience a uniform pressure, unlike heat processing.

Pulsed Light (PL) Technology

The technique of pulsed light food processing was developed as a non-thermal food processing technique, that involves discharge of high voltage electric pulses (upto 70 Kilovolt/cm) into the food product placed between two electrodes for few seconds (Angersbach et al., 2000). It is one of the emerging technologies which are used for the replacement of traditional thermal pasteurization among non thermal processes (Heinz et al., 2002). It is a decontamination technique which aims at reducing the pests, spoilage microorganisms and pathogens from food without much effect on its quality (Bank et al., 1990). It is recognized by several names in scientific literature i.e., Pulsed ultraviolet light (Sharma and Demirci, 2003), high intensity broad-spectrum pulsed light , Pulsed light and pulsed white light.

Microwaves Heating

Microwaves have been used as a heat source since the 1940s. Nowadays, microwave heating acceptance is increasing tremendously for both domestic usage and industrial applications. It refers to the use of electromagnetic waves of certain frequencies to generate heat in material. Container with food is placed in a microwave oven. And then oven is activated, the food at the edge of the container heats faster and a temperature gradient develops between the center and the edges.

Radio Frequency

Radio frequency (RF) heating is an advanced and emerging technology for food application. With the increasing demand for safe, hygienic, tastier, no fat and preservative free food in the world market this Radio frequency heating technology has gained an advantage in recent times. The main goal of all these novel technologies is to preserve our food by ensuring its safety and quality, which is a prime goal of food processing industry. Therefore, considering the consumer demand for high quality food and increasing processing cost involved in traditional methods, processors have started searching new alternatives.

Food Irradiation

Food irradiation (application of ionizing radiation to food) is a technology that improves the safety and extends the shelf life of foods by reducing or eliminating microorganisms. Like pasteurizing milk and canning fruits and vegetables, irradiation can make different food safer for the consumer.

Ultrasound Processing

The application of ultrasound in food processing has been stared as another area in non-thermal approaches, which exploits the preservative effect of the high intensity sound waves. The preservative effect is by the inactivation of microbes and spoilage enzyme by mechanical actions. Mechanism is that when propagates

through biological structures, Ultrasonic cavitation produces shear forces, which causes mechanical cell breakage and allows material transfer from cell into solvents. Cavitation causes particle size reduction thereby increases the surface area in contact when extracting a compounds. The technology finds its application in the field of extraction of proteins, lipids and their functional modifications, emulsification, viscosity improvement, homogenization and improvement of dispersion stability in liquid foods. So this technology is utilized in the field of processing, preservation and extraction, which makes use of physical and chemical phenomena that are fundamentally different from conventional extraction, processing or preservation techniques.

Cold Plasma

Plasma is the fourth state of matter. It can be described as gas cloud with ion-atom and free electron. Fluidity is more or less like gas, but composition is different. The state of matter can be changed when matter acquires energy. The intramolecular and intra-atomic structures can then be broken, which can liberate free electrons and ions. Plasma may be thought of as an ionised gas consisting of neutral molecules, electrons and positive and negative ions, which can transfer their energy by colliding with gas molecules, and then generating various highly reactive species can interact with the food surface, such as reactive hydroxyl radicals, hydrogen peroxide, ozone, nitrogen oxide and UV radiation (Niemira, 2012a). There are many methods to ionise gases into plasma, such as heating, electricity and the use of lasers. Therefore, the composition of plasma is different due to various type of the carrier gas (air, oxygen, helium, nitrogen and argon), the plasma generator (radiowave, microwave, plasma jet and dielectric discharges) and the operating conditions (pressure and temperature) (Niemira, 2012a).

Overall Advantages of NTP

- Low processing temperature i.e., the NTP allows processing of foods below temperature used during thermal pasteurization.
- Low energy utilization No need of continuous supply of energy.
- Retention of flavors and taste
- Gives consumer a fresh like taste.
- Inactivates enzymes and Micro organisms.
- Safe and environmentally acceptable

CONCLUSION

Non-thermal technologies are being investigated due to consumer demand for food products that are minimally processed, of high quality, and are convenient and safe. Nonthermal processes offer shelf life extension without the use of preservatives or additives, while still retaining colour, flavour, texture, nutritive and functional qualities. Emerging technologies like high hydrostatic pressure, pulsed electric field, ultrasound, ionising radiation and cold atmospheric plasma have shown the potential in achieving industrial application in foods. Non-thermal technologies to achieve quality assurance and safety in the foods in order to scale the process at industrial level, successfully.

REFERENCES

Angersbach, A., Heinz, V. And Knorr, D. (2000). Effects of pulsed electric fields on cell membranes in real food systems. *Innovative Food Science and Emerging Technologies*, 1(2): 135-149.

Bank, H. L., John, J., Schmehl, M. And Dracht, R .K. (1990). Bactericidal effectiveness of Modulated Ultravoilet Light. *Applied and Environmental Microbiology*, 60: 3888-3889.

Birmpa, A., Sfika, V. & Vantarakis, A. (2013). Ultraviolet light and ultrasound as non-thermal treatments for the inactivation of microorganisms in fresh ready-to-eat foods. *International Journal of Food Microbiology*, 167, 96–102.

Clara Corte´s, Marı´a J. Esteve, Ana Frı´gola (2008). Color of orange juice treated by High Intensity Pulsed Electric Fields during refrigerated storage and comparison with pasteurized juice. *Food Control* , 151-158.

Frewer, L., Bergmann, K., Brennan, M. et al. (2011). Consumer response to novel agri-food technologies: implications for predicting consumer acceptance of emerging food technologies. *Trends in Food Science & Technology*, 22, 442–456.

H.M. Hernández-Hernández, L. Moreno-Vilet and S.J. Villanueva-Rodríguez, (2018). Current status of emerging food processing technologies in Latin America: Novel non-thermal processing, *Innovative Food Science and Emerging Technologies*, https://doi.org/10.1016/j.ifset.2019.102233.

Harder, M. N. C.; Arthur, V.; Arthur, P. B., (2016). Irradiation of Foods: Processing Technology and Effects on Nutrients: Effect of Ionizing Radiation on Food Components. In: Caballero, B., P. M. Finglas & F. Toldrá (eds.), *Encyclopedia of Food and Health*. Academic Press, Oxford, 476 –481.

Heinz, V., Alvarez, I., Angersbach, A. And Knorr, D. (2002). Preservation of liquid foods by high intensity pulsed electric fields – basic concepts for process design. *Trends in Food Science and Technology* ,12: 103–111.

Hellwig, M. & Henle, T. (2014). Baking, ageing, diabetes: a short history of the Maillard reaction. *Angewandte Chemie International Edition*, 53, 10316–10329.

Https://en.wikipedia.org/Food processing - Wikipedia

Https://www.pulsemaster.us/pef-pulsemaster/product-process-improvement

Lima, G.P.P., Vianello, F., Corr^ea, C.R., da Silva Campos, R.A. & Borguini, M.G. (2014). Polyphenols in fruits and vegetables and its effect on human health. *Food and Nutrition sciences*, 5, 1065–1082.

Niemira, B.A. (2012a). Cold plasma decontamination of foods. *Annual Review of Food Science and Technology*, 3, 125–142.

Pina-Perez, M., Rodrigo, D. & Martınez, A. (2014). Non-thermal inactivation of Cronobacter Sakazakii in infant formula milk: a review. *Critical Reviews in Food Science and Nutrition*, 56, 1620–1629.

Puertolas, E., Barba, F.J. (2016). Electrotechnologies applied ´ to valorization of by-products from food industry: Main findings, energy and economic cost of their industrialization, *Food and Bioproducts Processing*,

Rawson, A.; Patras, A.; Tiwari, B. K.; Noci, F.; Koutchma, T.; Brunton, N., (2011). Effect of thermal and non thermal processing technologies on the bioactive content of exotic fruits and their products: Review of recent advances. *Food Research International*., 44, 1875 – 1887.

Shahbaz, H. M.; Kim, J. U.; Kim, S. H.; Park, J., (2018). Chapter 7 - Advances in Nonthermal Processing Technologies for Enhanced Microbiological Safety and Quality of Fresh Fruit and Juice Products. In: Grumezescu, A. M. & A. M. Holban (eds.), Food Processing for Increased Quality and Consumption., Handbook of Food Bioengineering. Academic Press, pp. 179 –217.

Sharma, R. R. And Demirci, A. (2003). Inactivation of Escherichia coli O157:H7 on inoculated alfalfa seeds with pulsed ultraviolet light and response surface modeling. *Journal of Food Science* ,68: 1448-1453.

Teissie; M. Golzio; M.P. Rols (2005). *Mechanisms of cell membrane electropermeabilization: A minireview of our present (lack of ?) Knowledge. Biochimica et Biophysica Acta*, 270 –280. Doi:10.1016/j.bbagen.

Troy, D. J. D. J.; Ojha, K. S.; Kerry, J. P. J. P.; Tiwari, B. K. B. K., (2016). Sustainable and consumer -friendly emerging technologies for application within the meat industry : An overview. *Meat Science.*,120, 2-9.

Zhi-Hong Zhang, Lang-Hong Wang, Xin-An Zeng, Zhong Han & Charles S. Brennan (2018). Non-thermal technologies and its current and future application in the food industry: a review. *International Journal of Food Science and Technology*.

Zs. Cserhalmi; Á. Sass-Kiss; M. Tóth-Markus; N. Lechner (2006). *Study of pulsed electric field treated citrus juices*. Innovative Food Science and Emerging Technologies, 7 :49