CRITICAL REVIEW ON PROCESSING EFFECT ON NUTRITIONAL COMPOSITION OF FOOD PRODUCTS

Georgiana-Aurora ŞTEFĂNOIU (APOSTOL), Elisabeta Elena POPA, Amalia Carmen MITELUŢ, Mona Elena POPA

*University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania

The International Conference of the University of Agronomic Sciences and Veterinary Medicine of Bucharest
AGRICULTURE FOR LIFE, LIFE FOR AGRICULTURE
June 8 – 10, 2017, Bucharest, Romania

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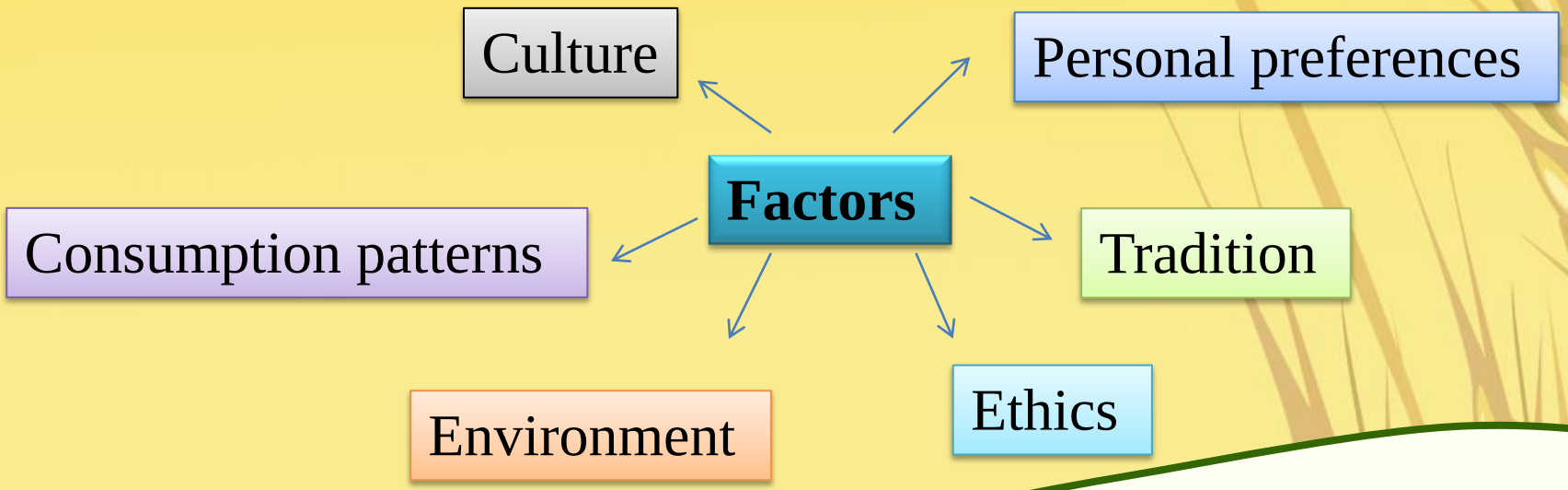
The aim of this paper is to make a short review in respect to unconventional treatments of foods, which are already implemented in industry or are in the research and development phase and to present the effects of these treatments on nutritional composition of food products.

INTRODUCTION

- In recent years, attention has been increasingly paid to the nutritional characteristics of traditional foods and recipes, in order to accurately estimate dietary intake of the population, prevent diseases such as cardiovascular diseases, cancer, diabetes, etc., provide dietary information, and preserve some cultural elements (Costa et al., 2013; Durazzo et al., 2017).



INTRODUCTION

- Recently, unconventional treatments technologies in food processing have gained increased industrial interest and have potential to replace, at least partially, the traditional well-established preservation processes (Pereira and Vicente, 2010).

COOKING PROCESS → **NUTRITIONAL VALUE**

INFRARED TREATMENT

- Infrared (IR) radiation has unique characteristics in its ability to transfer energy directly by radiation to a product, without heating the air.

- It is generally applied to: the dehydration of vegetables, fish, pasta and rice; heating flour; frying meat; roasting cereals; roasting coffee and cocoa; and baking biscuits and bread. The technique has also been used for thawing, surface pasteurization of bread and packaging materials (Rastogi, 2015).

IR heating of grass pea seeds resulted in a decreased TIA (trypsin inhibitor activity) compared with that of raw seeds. Reactive lysine proved to be relatively stable in the applied heating conditions (Sagan et al., 2016).

Far-IR radiation resulted in higher antioxidative activity of extracts from peanut shells as compared to heat treated sample. The antioxidative activity was found to increase with an increase in exposure time (Rim et al., 2005).

IR APPLICATIONS

Microwave-IR oven for roasting of hazelnut resulted in a product of comparable quality with conventionally roasted ones with respect to colour, texture, moisture content and fatty acid composition (Uysal et al.,2009)

PULSED ELECTRIC FIELD TREATMENT

- Pulsed electric field (PEF) processing is a non-thermal food-processing technology, which uses short bursts of electricity (Wang et al., 2014), which causes electroporation in the cell wall of microorganism and inactivating them (Li and Farid, 2016) providing fresh-like, safe foods and reduces loss of quality (Wang et al., 2014).

- In other applications than foods, PEF processing can also improve the performance of industrial processes such as the removal of water from sludge, or the extraction of sugars and starches from plants, because the ruptured cells release their intracellular liquids more easily into their surroundings (Kempkes, 2010).

PULSED ELECTRIC FIELD TREATMENT

PRODUCT	PARAMETERS	EFECTS	REFERENCE
Green tea	38.4 kV/cm for 160 and 200 ms	No considerable changes in color, GTP (green tea polyphenols) and total free amino acids	Zhao et al., 2008
Blueberries	PEF and PAA (peracetic acid)	The concentration of anthocyanins and phenolic compounds in blueberries increased by 10 and 25% after PEF treatments	Jin et al., 2017
Orange juice	PEF and storage at 4°C for 180 days	More stable flavonoids and phenolic acids than those treated with the thermal pasteurisation.	Agcam et al., 2014
Kombucha beverages	PEF	There is an influence of PEF, especially at low feed flows, when it increases the bioactive contents, although there is no effect on the antioxidant capacity of treated samples	Vazquez-Cabral et al., 2016

OHMIC TREATMENT

- Ohmic treatment is used in a wide range of applications such as preheating, cooking, blanching, pasteurization, sterilization and extraction of food products (Yildiz-Turp et al., 2013).

- Compared to conventional treatments, ohmic blanching is beneficial in terms of enzyme inactivation (for example POD-peroxidase and PPO-polyphenol oxidase).

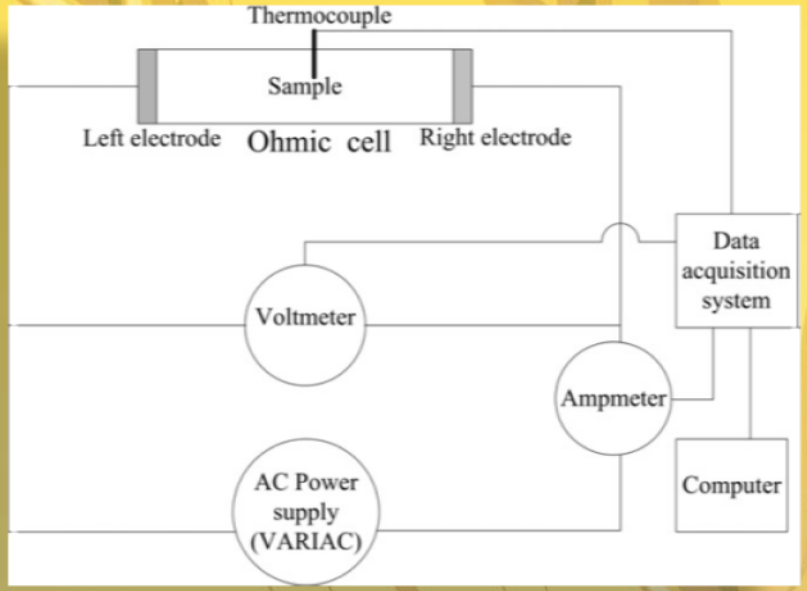


Diagram of ohmic heating

OHMIC TREATMENT

- This treatment appears as a solution to reduce thermal damage because it heats materials in a rapid and homogeneous manner and may allow improved retention of vitamins, pigments and nutrients, resulting in less thermal damage to labile substances (Sarkis et al., 2012).

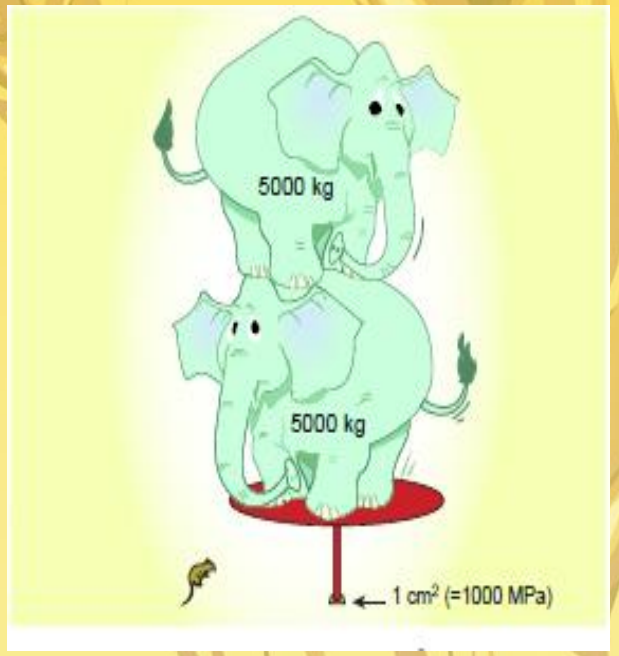
APPLICATIONS

- it's potential to increase dye diffusion in beet
- its capability to extract sucrose from sugar beet
- and its possibility to enhance the diffusion of soy milk from soybeans

ULTRA HIGH PRESSURE

- High-pressure processing (HPP) is a method of food processing where food is subjected to elevated pressures (up to 87,000 pounds per square inch or approximately 600 MPa)

- Many studies on vitamin stability under HP (at moderate temperatures) have shown that HP does not significantly affect or affects only slightly the vitamin content of fruit and vegetable products, except at extreme pressure and temperature combinations (Oey et al., 2008).



ULTRA HIGH PRESSURE

UHP APPLICATIONS

Sugarcane bagasse

HPP, in the pressure range tested, induced changes on microstructure and crystalline structure of SCB (Castanón-Rodríguez et al., 2013)

Beef meat

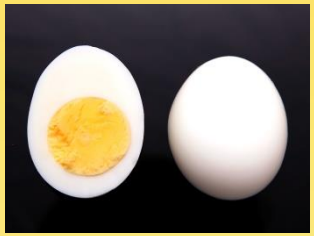
It has a lower effect than conventional cooking on colour, pH, lipid oxidation and fatty acid composition parameters (McArdle et al., 2011).

Manuka honey

HPP at ambient temperatures could be an appropriate method to produce tastier and more nutritive manuka honey (Akhmazillah et al., 2013).

ULTRAVIOLET TREATMENT

Ultraviolet (UV) light is the part of the electromagnetic spectrum with wavelengths between 100 and 400 nm (Gomez- Lopez et al., 2012).



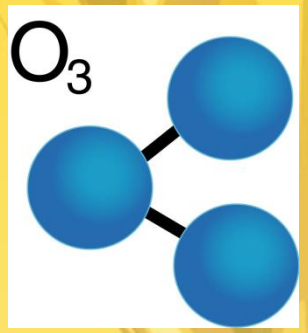
The main UV-C radiation nutritional effect was on retinol content, which presented higher reductions as higher the applied doses, and on vitamin C content, which is less important since egg is not a common source of this vitamin.

For orange juice, a treatment of 299 mJ/cm^2 destroyed about 50% riboflavin and β-carotene, 17% vitamin C, 11% vitamin A, and did not affect folic acid or vitamin E.

UV APPLICATIONS

No evidence of Maillard reaction in milk has been observed after 10 light pulses of 2,200 mJ/cm^2 each but the Vitamin A present in milk is degraded by UV treatment (Elmnasser et al., 2008).

OZONE TREATMENT



- Ozone is a triatomic form of oxygen and is characterized by a high oxidation potential that conveys bactericidal and virucidal properties.

- Ozone treatment was shown to be a promising technique for enhancing the antioxidant capacity of some fresh fruits such as banana, but at the same time a reduction in vitamin C content was also observed (Alothman et al., 2010).

OZONE TREATMENT

- The effect of continuous exposure to ozone at 0.45, 0.9 and 2 µmol mol^{-1} on quality changes during the storage of red and green chilli peppers at 10°C was investigated by Glowaczand Rees (2016). Total phenolic content was not affected by ozone but antioxidant activity was reduced in green chilli peppers exposed to ozone at 2 µmol mol^{-1}, due to lower ascorbic acid content in those samples. Ozone at 0.9 µmol mol^{-1} 1 extended the shelf-life of chilli peppers.

- Following a 20 min ozone treatment, the total phenolic content of fresh-cut papaya increased by 10.3% while the ascorbic acid content decreased by 2.3% compared to that of untreated control fruit (Yeoh et al., 2014).

MICROWAVE TREATMENT

⚠ Microwaves are electromagnetic radiation with wavelengths from 1 mm to 1 m in length and with frequencies from about 300 MHz to 300 GHz (Scaman et al., 2014).

⚠ In a study, Conte et al. (2017) demonstrated that microwave treatment on honeybee had a damaging action on antioxidant compounds (i.e. reduction in the content of tocopherols).

⚠ Microwave-pretreated samples of pomelo retained higher amounts of pectin, naringin, and limonin compared with non-pretreated samples. No obvious change in the degree of pectin esterification was observed (Liu et al., 2017).

RADIOFREQUENCY TREATMENT

- Radio frequency dielectric heating is now widely used in industrial applications such as drying textile products (spools, rovings, and skeins), final drying of paper, final dehydration of biscuits at outlets of baking ovens, and melting honey.

- Bottled juices including peach, quince and orange moving through an RF applicator offered better bacteriological and sensorial qualities than juices treated by conventional thermal processing methods (Wang et al., 2003) .

- The non-thermal process of radio frequency electric fields (RFEF) has been shown to inactivate bacteria in apple juice at moderately low temperatures, but has yet to be extended to inactivate bacteria in orange juice. No loss in ascorbic acid or enzymatic browning was observed due to RFEF processing (Geveke et al., 2007).

CONCLUSIONS

- In today's food market, consumers want healthy, biologically grown, preservative-free, high-quality produce.
- The conventional processing of products often requires a long heating time and those results in the degradation of food qualities, texture and nutritional values (Bhattacharya and Basak, 2017).
- The unconventional treatments have been found to upgrade the processing by preserving the quality, texture and nutritional values.

ACKNOWLEDGEMENTS

This paper was realised under the frame of Partnerships in priority areas Programme, PCCA Contract no. 164 / 2014, RAFSIG.

http://rafsig.usamv.ro/

SELECTIVE REFERENCES

Akhmazillah M.F.N., Farid M.M., Silva F.V.M., 2013. High pressure processing (HPP) of honey for the improvement of nutritional value.Innovative Food Science and Emerging Technologies, 20, 59–63.

Alothman M., Kaur B., Fazilah A., Bhat R., Karim A.A., 2010. Ozone induced changes of antioxidant capacity of fresh-cut tropical fruits. Innovative Food Science and Emerging Technologies, 11, 666-671.

Bhattacharya M., Basak T., 2017. A comprehensive analysis on the effect of shape on the microwave heating dynamics of food materials.Innovative Food Science and Emerging Technologies, 39, 247–266.

Conte G., Benelli G., Serra A., Signorini F., Bientinesi M., Nicolella C., Mele M., Canale A., 2017. Lipid characterization of chestnut and willow honeybee-collected pollen: Impact of freeze-drying and microwave-assisted drying.Journal of Food Composition and Analysis, 55, 12–19.

Dominguez R., Borrajo P., Lorenzo J.M., 2015. The effect of cooking methods on nutritional value of foal meat. Journal of Food Composition and Analysis, 43, 61–67.

DurazzoA., Lisciani S., Camilli E., Gabrielli P., Marconi S., Gambelli L., Aguzzi A., Lucarini M., Maiani G., Casale G., Marletta L., 2017. Nutritional composition and antioxidant properties of traditional Italian dishes. Food Chemistry, 218, 70–77.

Jin T. Z., Yu Y., Gurtler J. B., 2017.Effects of pulsed electric field processing on microbial survival, quality change and nutritional characteristics of blueberries. LWT - Food Science and Technology, 77, 517-524.

Lin S., Liang R., Xue P., Zhang S., Liu Z., Dong X., 2017. Antioxidant activity improvement of identified pine nut peptides by pulsed electric field (PEF) and the mechanism exploration. LWT - Food Science and Technology, 75, 366-372.

Sagan A., Andrejko D., Jaśkiewicz T., Ślaska-Grzywna B., Szmigielski M., Masłowski A., Żukiewicz-Sobczak W., 2016. The effect of infrared radiation in modifying nutritional and mechanical properties of grass pea seeds.Italian Journal of Food Science, 28, 697- 704.

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