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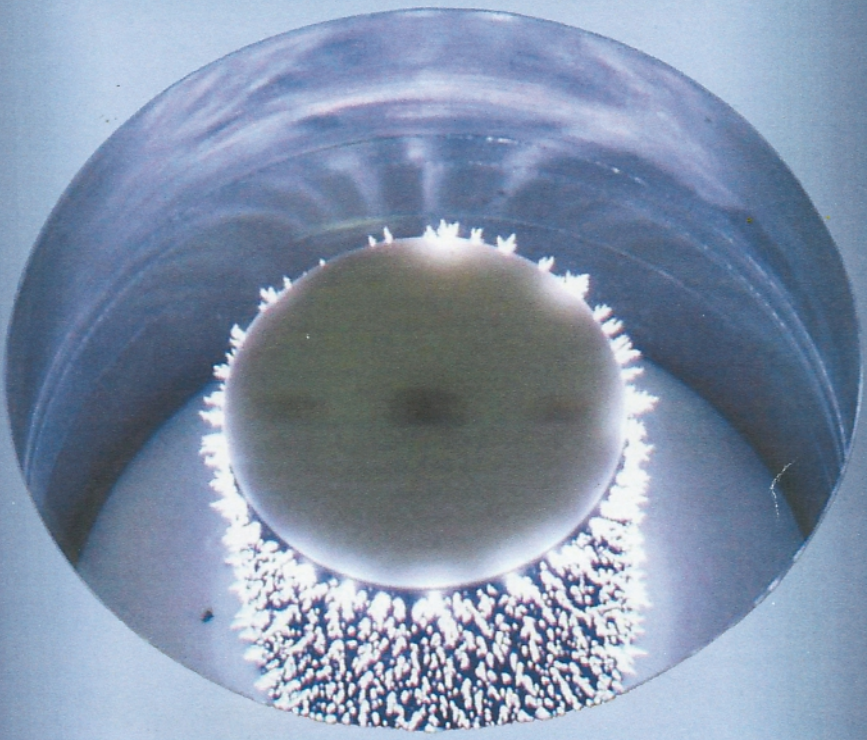

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Cold pasteurization of fresh apple juice by the cold air plasma

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Conventional methods for food processing and inactivation of food borne pathogens are based on using thermal treatments, typically referred to as *pasteurisation*. Particularly ultra-high temperature (UHT) processes may lead, beside the sterilization, to the damage of heat-sensitive products and the loss of food quality. Nowadays, a growing customers' trend demanding long-lasting fresh products leads to the concept of the "minimal processing" technologies, e.g. high hydrostatic pressure, pulsed electric field, ionizing radiation, etc. [1]. Cold plasmas known for their bactericidal properties achieved without heat effects have been successfully tested for sterilization or processing of various food products including fresh juices [2-3].

In this work, cold air plasma generated by the transient spark in air has been tested for non-thermal pasteurization of freshly squeezed apple juice. The juice was treated in two systems: electro-spray system (ES) with the flow rate of juice 1 mL/min and the static (batch) system (SS) with the treatment conditions 1 min treatment per 1 mL of juice. We evaluated the inactivation effect on the model microorganisms (bacteria *Escherichia coli ATCC 25922* and yeasts *Saccharomyces cerevisiae S228C*) and the spoilage rate of fresh juice with natural pathogens. We also followed the cold plasma effects on juice's chemical, nutrient and sensory properties.

We followed the inactivation rate of both *E. coli* and *S. cerevisiae* in the plasma treated juice from 0 up to 21 days post plasma treatment. In both systems, ES and SS, the achieved inactivation of *E. coli* immediately post plasma treatment was quite low (< 1 log) and then significantly increased within the first 2 days post plasma treatment in SS (~ 5-6 log) and remained up to 21 days. Although the treated juice was stored in the fridge at 4°C, the efficiency of plasma treatment on *S. cerevisiae* remained quite low, slightly higher (0.6-0.8 log) in SS system. Freshly squeezed apple juice may contain its native pathogens (different strains of yeasts and bacteria) responsible for the spoilage of the juice, which also affects its shelf-life time. Our preliminary experiments showed that there was no bacterial or yeast growth up to 7 days post treatment in natural juice treated in both plasma systems and stored at 4°C. Cold air plasmas in direct contact with liquids induce the formation of reactive oxygen (RONS) and nitrogen species, especially hydrogen peroxide, nitrites and nitrates. These RONS may be harmful in certain doses therefore their content in food products is regulated. We showed that measured concentrations of nitrites, nitrates and hydrogen peroxide in plasma treated juice are lower than the acceptable daily intake determined by the European Commission's Scientific Committee on Food. We detected no significant changes of pH in plasma treated juice (3.28→3.19) and the measured transmittance slightly decreased in plasma treated juice. Peroxidase (POD) and polyphenyl oxidase (PPO) are enzymes known for the undesirable browning and the loss of the juice quality. We showed that the transient spark treatment successfully inactivated the peroxidase, especially the remaining activity of POD in juice treated in SS system is only about 6 %. Cold air plasma is a promising alternative food processing technique for non-thermal pasteurization of fresh apple juice.

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