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Cold air plasma for apple juice shelf-life extension

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Conventional methods for food processing and inactivation of food borne pathogens are based on thermal treatments, typically referred to as *pasteurisation*. These thermal processes often lead, besides sterilization, to the loss of food quality. A growing customers' demand of long-lasting fresh products requires "minimal processing", e.g. non-thermal food technologies. Non-thermal (cold) air plasmas generated by electrical discharges in atmospheric pressure air are sources of various reactive species, free radicals and charged particles. Such plasmas can be generated in contact with water or other aqueous solutions to generate reactive oxygen and nitrogen species (RONS), leading typically to strong antibacterial effects. They represent a great potential for liquid food processing, such as fruit juices, or in agriculture applications [1-3].

The transient spark discharge in air was successfully tested to induce antimicrobial effects in fruit juices. Inactivation of model and natural pathogens (bacteria *E. coli* and yeast *S. cerevisiae)* in fresh apple juice and a significant extension of the shelf-life time of the juice up to 26 days were achieved; both in the batch system and in the flowing electrospray system.

We also examined the potential cold plasma treatment effects on chemical, nutrient and sensory properties of the juice, such as changes of pH, conductivity, color, and produced nitrites/nitrates and hydrogen peroxide. The most typical juice components including polyphenols, organic acids and sugars were detected in the natural juice by HPLC coupled with mass spectrometry, UV and refractive index detectors, respectively. These compounds were cold plasma treated separately in aqueous solutions and together in the treated juice, and further examined. Polyphenols were effectively hydroxylated and nitrated when treated alone but remained unmodified in the plasma treated juice. This can be attributed to the fact that although RONS are formed during plasma treatment, they react with many targets in the juice and their effects on each particular component are low. We also detected no significant changes of pH, conductivity and °Brix degree (sugar content) in the plasma treated juice. The peroxidase (POD) enzyme known for the undesirable browning and the juice quality loss [4], was successfully inactivated.

This cold plasma method represents a novel approach for the non-thermal pasteurization of fresh fruit juices with potential applications in non-thermal food processing.

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