LOW TEMPERATURE PLASMA: A NEW DISINFECTION METHOD FOR FOOD AND FOOD CONTACT SURFACES

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The need for ensuring microbial food safety and quality, without adversely affecting the nutritional, functional and sensory characteristics of foods, has led to an increase in low-temperature or non-thermal processing technologies for food preservation. These emerging technologies including high hydrostatic pressures, pulsed electric field and low-temperature plasmas inactivate microorganisms at ambient or moderately elevated temperatures and short treatment times.

Plasma is a matter containing partially or wholly ionized gas with a net neutral charge and is often referred to as the fourth state of matter as it shares properties similar to both those of gases and liquids. Low temperature plasmas (LTP) at both atmospheric and low pressures were applied for the sterilization and functional modification of the surfaces of biomedical materials and devices manufactured from heat sensitive plastics. LTP created by excitation of gaseous atoms a derivative species have been also used as a means of inactivating microorganisms on the surface of heat sensitive materials that need to be sterilized for food contact use.

A neutral gas can be converted to plasma by the application of energy in form of thermal, electric or magnetic fields and radio or microwave frequencies, resulting in an increase in the kinetic energy of electrons of constituent gas atoms. This causes a cascade of collisions in the gas resulting in the formation of plasma products of electrons, ions, radicals and radiation of varying wavelengths including that in the UV ranges. The effectiveness of plasma to inactivate microorganisms on inert surfaces will depend greatly on the equipment design and operating conditions like gas type, flow rate and pressure.

The chemical composition of LTP of nitrogen, oxygen and carbon dioxide gas mixtures are dominated by ions free radicals and highly reactive intermediate species. If water vapour is present highly reactive species (H_2O^+, H, OH, HO_2) and cluster ions containing H_2O are formed. The generation of UV radiation occurs between 0–290 nm and the wavelengths above 200 nm have cidal effects on microorganisms.

Plasma inactivation of vegetative cells and bacterial endospores attributed to destruction of DNA by UV irradiation, volatilization of compounds from the spore surface by UV photons and erosion (etching) of the spore surface by adsorption of reactive species such as free radicals. It has been shown that LTP inactivated microbial cells and spores on surfaces and *E. coli* adsorbed to the surfaces of almonds with > 4 and up to 5 log reductions, respectively.

LTP could be used as an effective way of disinfecting solid surfaces for microbial inactivation and enhancement of food safety. Thus, in order to use LTP commercially the selected equipment and conditions should be validated with the food product itself and target microorganisms.