RF Plasma processing of organic powdered materials

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Current methods of decontamination must weigh the level of microbial reduction with the amount of acceptable product degradation. Some current methods affect detriment upon the substrate. For instance, substances with heat-labile active ingredients are prone to degradation when exposed to high heat; the active element in dry and steam heat treatments. Oxidizing agents, such as, ethylene oxide or sodium hypochlorite can either be reactive toward or be absorbed into the processed material.

RF plasma was modeled for decontamination of powdered botanicals, such as: hydrilla, stinging nettle leaf, organic wheat grass powder and saw palmetto. Chia seeds were tested as a coarse-material out-group. RF plasma can decontaminate without modifying compounds liable to heat or oxidation. During CLPP treatment, decontamination is achieved as a result of direct contact with ions of high kinetic energy, electrons and UV radiation. In this study, plasma decontamination of different nutritional supplements was carried out in a controlled atmosphere for two different plasma reactor configurations: stationary shelf and rotary drum. The CLPP device includes: RF generator; matching network; plasma reactor; gas supply and vacuum unit. Variables include: power; plasma gas composition; pressure and processing time. Treated materials were assessed for Total Coliform, *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, yeast and mold. A comparative analysis of air, pure oxygen and pure nitrogen plasma gas upon an oxidation-prone substrate was also done.

For most samples, a 3 to 5 log reduction in bacterial colonies was observed within 15 minutes of processing. Efficiency of inactivation was variable for different types of bacteria and also depends of the powder size distribution and plasma gas mixture. A comparison analysis of survival curves and plasma optical emission spectral data demonstrate that Nitrogen/Oxygen gas mixture play a significant role in inactivation of bacteria, yeast and mold. All processed materials were in the temperature range between 20C to 60C immediately after venting of the chamber. Preservation of ascorbic acid using pure nitrogen was observed, with only 2.5% decomposition to dehydroascorbic acid after 15 minutes of treatment.

Processing parameters, such as power, processing time and temperature, are unique to the product and batch in order to inactivate microorganisms without affecting the material property. Using non-thermal plasma for treatment of food powder is a promising technology due to that processed material does not content toxic residuals and the temperature range can be kept to an acceptable level. The next step of plasma development is pairing it with other decontamination process such as RF pulse electric field treatment. Synergetic effects might be more significant than either technology alone.