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(54) **TREATMENT TO REDUCE MICROORGANISMS WITII CARBON DIOXIDE BY MULTIPLE PRESSURE OSCILLATIONS**

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(51) **Int. Cl.**
A21D 6/00 (2006.01)

(52) **U.S. Cl.** **426/238**; 426/236; 426/237

(58) **Field of Classification Search** 426/238, 426/237, 236

See application file for complete search history.

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(57) **ABSTRACT**

Apparatus and methods to non-thermally treat goods for human consumption with carbon dioxide. Apparatus and methods rely on multiple pressure changes of carbon dioxide to affect one of three processes. A first process rapidly freezes and thaws water on the surface of the goods in rapid succession multiple times to detrimentally affect pathogens. A second process raises the pressure and temperature of carbon dioxide to supercritical conditions to detrimentally affect the lipids in the membranes of pathogens. A third process adjusts the pressure to form a dense carbon dioxide liquid with a low pH that may also detrimentally affect pathogens. All processes may be repeated or performed in succession, or in any order. Optionally, thereafter, the goods may be stored at low temperature in substantially 100% carbon dioxide for further pathogen reduction.

13 Claims, 8 Drawing Sheets