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Nonthermal food processing technologies have garnered significant attention in recent years due to their ability to preserve the nutritional and sensory qualities of food while ensuring safety. Traditional thermal processing methods often lead to undesirable changes in flavor, color, texture, and nutritional value. In contrast, nonthermal processing techniques, such as high pressure processing (HHP), pulsed electric fields (PEF), cold plasma, and supercritical fluid extraction, operate at ambient or sub-lethal temperatures, thereby minimizing damage to heat-sensitive nutrients and maintaining the fresh-like characteristics of food.

These technologies have shown great potential in various food industries. For instance, HHP has been successfully applied to a wide range of products, including juices, meats, and seafood, effectively inactivating microorganisms and enzymes while preserving texture and sensory attributes. PEF has demonstrated its efficacy in extending the shelf life of liquid foods by disrupting microbial cell membranes with minimal impact on nutritional and sensory properties. Additionally, cold plasma offers novel applications in pathogen eradication and allergen mitigation.

Despite these advancements, challenges remain in the widespread adoption of non-thermal technologies. Many of these techniques are still confined to laboratory-scale research, and further studies are needed to optimize operational parameters, address technical and economic barriers, and establish industry-specific guidelines. Future research should focus on improving the efficiency and cost-effectiveness of these technologies, as well as exploring their potential in combination with other preservation methods to achieve better microbial control with lower process intensities. The continued development and application of non-thermal food processing technologies hold great promise for meeting consumer demands for high-quality, safe, and environmentally friendly food products.

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