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Review

Exploring the Power of Thermosonication: A Comprehensive Review of Its Applications and Impact in the Food Industry

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Abstract: Thermosonication (TS) has been identified as a smart remedy for the shortcomings of heat treatment, which typically requires prolonged exposure to high temperatures. This technique combines moderate heat treatment with acoustic energy to eliminate harmful microorganisms and enzymes in food products. Unlike conventional heat treatment, thermosonication utilizes short holding times, allowing for the preservation of food products' phytochemical compounds and sensory characteristics. The benefits and challenges of this emerging technology, such as equipment cost, limited availability of data, inconsistent results, high energy consumption, and scale-up challenges, have been assessed, and the design process for using ultrasound in combination with mild thermal treatment has been discussed. TS has proven to be a promising technique for eliminating microorganisms and enzymes without compromising the nutritional or sensory quality of food products. Utilizing natural antimicrobial agents such as ascorbic acid, Nisin, and ε-polylysine (ε-PL) in combination with thermosonication is a promising approach to enhancing the safety and shelf life of food products. Further research is required to enhance the utilization of natural antimicrobial agents and to acquire a more comprehensive comprehension of their impact on the safety and quality of food products.

Keywords: TS; food processing; quality parameters; novel technologies; microbial inactivation

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1. Introduction

Foods are composed of numerous constituents, including proteins, vitamins, carbohydrates, fats, minerals, water, and other organic substances, each with their individual compositions [1]. Previous research indicates that the traditional technique of pasteurization, which is referred to as conventional pasteurization (CP), has been utilized for a significant period to safeguard the safety and extend the shelf life of various kinds of foods and drinks by eliminating microorganisms [2–4]. However, Numerous published papers demonstrated that CP possesses adverse impacts on the flavor, consistency, aroma, appearance, and nutritional quality of processed foods. [5,6]. In response to the increasing desire among consumers for good products, novel methods of preserving and processing food have been created and experimented with. One of these innovative techniques is Ultrasound, which may serve as an alternative way to process and conserve food [7].

Previous research has pointed out that ultrasound waves are formed by converting electrical energy to mechanical energy by utilizing piezoelectric materials [8]. While liquid foods are being processed, ultrasound waves propagate through the liquid, causing alterations in pressure that result in the creation of bubbles. As a result of subsequent compression cycles, these bubbles collapse with great force, generating zones of high temperature and pressure that are known as cavitation [9]. When heat is applied to the ultrasonic waves, with temperatures exceeding 50 °C, it is referred to as TS [10].

TS is a method that uses a combination of ultrasound and heat to moderately heat a product. Studies have demonstrated that TS is a successful technique for deactivating various types of microorganisms., including bacteria, viruses, yeasts, and molds. According