Emerging and New Non-Thermal Food Preservation Technologies in Egg Processing – Trends and Future Industrial Perspectives: An Overview

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Abstract

There is an increasing demand for an emerging non-thermal food processing techniques which are finding increasingly new applications in the food preservation. Novel techniques also have a potential in improving functional and physico-chemical properties of foods with high-value-added functional food and bioactive ingredients. Egg products which are known as products are obtained from eggs and egg derivatives are ready for use in human consumption available in form of frozen, liquid, concentrated, salted, and powdered.

This research provides an overview and industry-based projections about the egg and egg products and novel technology perspectives.

Key words: egg and egg products, non-thermal processing, novel and emerging food technologies.

Yumurta İşleme Endüstrisindeki Yenilikçi ve İstil Olmayan Yeni Gıda Muhafaza Teknolojileri: Güncel Gelişimler ve Gelecekteki Endüstriyel Perspektifler - Genel Bakış

Özet

Gıda muhafazasında istil-olmayan yenilikçi gıda işleme uygulamalarına yönelik talep artmaktadır. Yenilikçi teknikleri ile fonksiyonel gıda ve biyoaktif bileşenleri içeren gıdaların fonksiyonel ve fiziko-kimyasal özelliklerini geliştirmek mümkün olmaktadır. Yumurta ürünleri yumurtdan elde edilen; yumurtanın sıvı, konsantrasyon, toz, dondurulmuş ve tuzlanmış olan formalarını kapsayan insan tüketime uygun olan endüstriyel ürünlerdir.

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Bu araştırma, yumurta ve yumurta ürünlerinde yeni ve yenilikçi teknolojik perspektifler hakkında genel bir bakış açısı ile endüstriyel temelli projeksiyonlar sağlamak amacıyla hazırlanmaktadır.

Anahtar kelimeler: yumurta ve yumurta ürünleri, ısıl olmayan işlemler, yenilikçi gıda teknolojileri.

Introduction

Eggs are excellent protein sources, easy to obtain, contains proteins and have been utilized as benefit to functional ingredient applications with functionalities of foaming, gelling, binding etc. Egg Products are ready to use, and adaptable to different recipes of food products such as meringue, cake, and mayonnaise. Egg undergo considerable quality changes resulting in losses during storage due to the fact that eggs are highly perishable. Thus, it is necessary for eggs to reach the final consumer market without considerable time lapse (Caner ve Cansiz, 2007; Caner ve Cansiz, 2008) or if time lapse is unavoidable it is important to improve the egg freshness and extend the shelf life using effective treatment techniques during storage and beyond.

Development of non-thermal food preservation methods is necessary for maintaining the qualities of perishable foods. Non-thermal methods allow processing of foods below the temperatures used during thermal pasteurization. Thermal and non-thermal processing technologies are both used in the preserving and extending shelf life of food products. However, the common food processing methods currently used to increase shelf life and inactivate microbial growth in foods are conventional heat treatment, whereas thermal treatment cause to nutritional losses, deterioration of functional properties, development of undesirable flavors, and odors (Shankar, et al., 2014). Novel non-thermal food processing techniques include such as high hydrostatic pressure (HHP), pulsed electric field (PEF), UV, ultrasound (US), ozone, radio frequency (RF) and pulsed light technology (PL). The novel technology has been shown to be an attractive alternative to conventional thermal treatments. Many researchers have been studying to develop and design process replacing heat treatments in food and egg industry. However, this emerging technology must also maintain or surpass the main purpose of egg pasteurization, which is to yield a wholesome product by eliminating pathogenic bacteria and maintain functional properties (Anonymous, 2015).
The goal of this review discusses various non-thermal techniques (ultraviolet light, ionizing radiation, pulsed light processing, pulsed electric field, high pressure processing, ultrasound, ozone processing, plasma technology, pulse x-rays, etc.) functional effects on the egg products in order to minimize functional loses and physico-chemical degradation whereas increasing shelf life and physico-functional properties.

High hydrostatic pressure (HPP) is suitable for inactivation of microorganisms and enzymes, and denaturation of functionality of protein in liquid egg products (Nemeth, et al., 2012). HPP can be used to replace thermal processing methods as it provide minimum losses in functional properties (Ahmed, et al., 2003). Ibarz, et al. (1999) studied high hydrostatic pressure application in egg products (egg yolk, egg white and whole egg) for 410-690 MPa with exposure time of 1-30 min. The results of study showed that, egg yolk was susceptible to pressure than egg white and whole egg samples.

Ultrasonic treatment is one of these emerging techniques that could be the alternative to existing thermal processing techniques. It is based on the transmission of ultrasonic sound waves (20 kHz to 100 kHz frequency) through a media. It enhances convective heat transfer as well as generates bubble explosions, which produce local hot spots that could cause microorganism inactivation and enzyme destruction by cavitation (Ajlouni, et al., 2006; Piyasena, et al., 2003). High power ultrasonic treatment is also known to damage or disrupt biological cell walls, which will result in the destruction of living cells (Aday, et al., 2013; Ajlouni, et al., 2006; Chemat, et al., 2011; Feng, et al., 2011).

The use of ultrasound in fresh produce as a non-thermal technique is a relatively recent endeavour and considered as a food preservation method to enhance food quality, safety and stability. Recently, numerous ultrasound studies were published on fruits, vegetables, fruit juices and dairy products (Ajlouni, et al., 2006; Birmpa, et al., 2013; Chemat, et al., 2011). Similarly, using ultrasonic waves may improve the overall characteristics of shell eggs that will result in significant savings for the egg industry (Caner ve Yuceer, 2015).

The ozone treatments have gained interest for extending the shelf life of perishable foods. Ozone (O₃), a highly reactive and an effective antimicrobial agent, generates no residual chemicals (Braun, et al.,
The United States Department of Agriculture (USDA) and Food and Drug Administration (FDA) approved gaseous and aqueous ozone as an antimicrobial agent for direct use in food applications (Anonymous, 2014; Braun, et al., 2011; Kamotani, et al., 2010). Ozone is also approved in the US on meat and poultry products in accordance with industrial standards of good manufacturing practice (21 CFR 173.368; FDA 2003). As a result, there is a growing research interest in use of ozone applications for extending shelf life of food products (Khadre, et al., 2001; Kim, et al., 1999; Kim, et al., 2003; Pirani, 2010; Sopher, et al., 2002).

In the last decade the efficacy of ozonation on the surface of fresh eggs have been studied (Braun, et al., 2011; Fuhrmann, et al., 2010; Goo-Hee ve Kyung-Haeng, 2012; Kamotani, 2009; Maxkwee, 2013; Perry, 2010; Rodriguez-Romo, et al., 2007). Rodriguez-Romo, et al. (2007) reported that gaseous ozone can penetrate through eggshell pores. Fuhrmann, et al. (2010) showed that even at low ozone concentrations, cuticula proteins of the egg can be destroyed by oxidation of amino acids and three-dimensional structures. Goo-Hee ve Kyung-Haeng (2012) studied the effects of gaseous ozone (38.8 ppm) for 10 to 30 minutes treatment times on the egg’s physical and chemical characteristics including HU, yolk colour, pH of egg albumen and yolk, foaming ability, foam stability and lipid oxidation development. The results of that study showed that ozone treated eggs were no different than controls when stored at 4 °C for 14 days. The effects of gaseous ozone on extending the shelf of eggs and internal quality (Yucek, et al., 2016).

Conclusion

In conclusion, nowadays several non-thermal methods including high-pressure, ultrasound and ozonation have been studied as food preservation technologies. Thus, novel food processing methods are relatively new in industrial application and the development of emerging technologies with larger capacities are still have some both technical and economic issues needs to be solved. But a combination of both traditional pasteurization technologies and novel non-thermal methods with use of hurdle strategy method could be an emerging approach for near-future egg processing plants.
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CONGRESS BOOK

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FOREWORD

On the behalf of the Organising Committee, it is a great pleasure and honour for us to welcome you all to the “International Poultry Science Congress of WPSA Turkish Branch’2018”.

This congress will provide a platform for the exchange of new ideas, information and to build up and to strength professional relationships.

We would like to express our sincere gratitude to the esteemed scientists who have made this congress more meaningful with their presentations and to the sponsors who made this congress possible.

We want to thank all the representatives of Niğde Ömer Hasdemir University, Department of Animal Production and Technologies, Faculty of Agricultural Science and Technologies for their priceless help in the organisation of the congress.

There are 350 scientists from 14 countries participating in the congress.

This is also the first time that we are inviting students to the congress. We hope that it will be an unforgettable experience for them.

We wish you all an enjoyable and productive time during the congress and a wonderful stay in this amazing wonderland right in the centre of Turkey, Cappadocia.

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