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Impact of pomegranate peel nanoparticles on quality attributes of meatballs during refrigerated storage

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ABSTRACT

This investigation was performed to evaluate the impact of lyophilized pomegranate peel nanoparticles (LPP-NPs) as an antioxidant and antimicrobial in meatballs during storage at 4 ± 1 °C up to 15 days. LPP-NPs were incorporated into freshly minced beef meat at 1 and 1.5% and compared with 0.01% butylated hydroxytoluene (BHT) as a reference and control sample (without antioxidant). The LPP-NPs showed a high phenolic content and antioxidant capacity. In LPP-NPs-treated samples, contents of peroxide, thiobarbituric acid reactive substances (TBARS), and total volatile base nitrogen (TVB-N) were lower than the control (over 15 days). Cooking characteristics in meatball including LPP-NPs were improved during the storage. The microbial load of samples treated with LPP-NPs was lower than the control during storage. Sensory evaluation of color and rancid odor in treated meatballs were accepted with a high score up to 15 days. The results demonstrated that LPP-NPs were more effective in retarding lipid oxidation, improving the microbial quality, and cooking characteristics of meatballs.

1. Introduction

Meatballs are one of the most important meat products in many countries and highly consumed in the world (Oz & Cakmak, 2016). However, meatballs have a short shelf-life due to deterioration during storage (Turp, 2016). Lipid oxidation, protein decomposition, and microbial contamination are the main factors for reducing the quality and shelf-life of meat, particularly minced meats (Lund, Heinonen, Baron, & Estevez, 2011). These alterations result in extensive flavor changes, color loss, and protein structure damage (Fernández, Pérez-Álvarez, & Fernández-López, 1997), which reduce sensory parameters and consumer acceptability of meat products.

The main reason for quality loss in meat products is lipid and protein oxidation (Vuorela et al., 2005). The rate of oxidative changes can be reduced through synthetic or natural antioxidants (Ledesma, Rendueles, & Díaz, 2015). Although synthetic antioxidants have been successfully utilized to prevent meat products oxidation, like butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), and gallate propyl (GP), they have been found to exhibit various health effects (Shahidi, Janitha, & Wanasundara, 1992). Therefore, the demand of natural antioxidants has been increased in the recent years such as rosemary (Guo et al., 2016), potato peel (Jeddou et al., 2016), and pomegranate peel (Kazemi, Karim, Mirhosseini, & Hamid, 2016).

Pomegranate (*Punica granatum* L.) peels are by-products of pomegranate juice processing, which constitute about 40% of the whole fruit (Çam & Hışıl, 2010). Pomegranate peel extracts (PPE) have remarkable antioxidants with high efficiency free radical scavenging and inhibiting LDL oxidation (Akhtar, Ismail, Fraternale, & Sestili, 2015), as well antibacterial (Negi & Jayaprakasha, 2003). The antioxidant effect of PPE has been investigated in cooked chicken products (Kanatt, Chander, & Sharma, 2010), in ground pork meat (Qin et al., 2013), in beef sausage (El-Nashi, Fattah, Rahman, & El-Razik, 2015), and in white shrimp (Yuan, Lv, Tang, Zhang, & Sun, 2016). Also, the PPE has been reported as antibacterial against *L. monocytogenes* and *E. coli* (Al-Zoreky, 2009; Wu, Jahncke, Eifert, O'Keefe, & Welbaum, 2016), *S. aureus,* and *B. cereus* (Kanatt et al., 2010), and *A. flavus* and *A. parasiticus* (Rosas-Burgos et al., 2016).

Recently, nanotechnology has been utilized to create new products with numerous benefits for the food industry sector (Rodrigues et al., 2017) such as prolonging shelf-life and improving food quality and safety (Morsy, Khalaf, Sharoba, El-Tanahi, & Cutter, 2014). One study showed that nano-encapsulation of phenolic compounds has a fine delivery system in the preventing of degenerative diseases (Esfanjani & Jafari, 2016).

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