Effect of nanocomposite-based packaging on postharvest quality of water content-treated coffee beans during storage

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Abstract

The objective of this study was to evaluate the physical, chemical, and sensory qualities of green coffee beans (Coffea arabica L.) during storage in nanopackaging. A novel nanocomposite-based packaging (NCP) was prepared by blending polyethylene (PE) with nano-Ag, chitosan nanoparticle and montmorillonite. The effects of NCP on the quality parameters of water content, weight loss and colour treated coffee beans were investigated during the 21 d of storage at 25°C. The results showed that adding nanoparticles to the PE significantly decreased the oxygen, water vapor permeability and longitudinal strength. The weight loss, water content, color variation and proximate content of coffee bean were significantly inhibited by 22.67%, 124.84%, 23.46% and 14.42%. The results of this analysis demonstrated that this NCP can potentially increase the effectiveness of methods used to preserve and maintain quality in coffee beans during postharvest storage.

Keywords: nanocomposite, packaging, storage, coffee beans

Introduction

Coffee is one of the most widely consumed beverages in the world because it contains a wide range of aroma compounds, which is a very important factor in food quality (Kumazawa & Masuda, 2003).

Coffee beans are obtained from the plants Coffea arabica and Coffea canephora (mainly variety robusta). The former is more valuable because its beans produce a better tasting beverage, which is therefore more expensive than the robusta coffee (Zambonin, et al., 2005).

Coffee is an agricultural product with a quality-based price. The value of coffee increases significantly with improvements in quality, which are necessary to obtain new markets. During roasting, the taste and aroma of coffee develop from ingredients original present in raw beans. Taste and aroma are the principal factors affecting beverage quality. Storage is one of the stages following production that strongly influences the commercialization of coffee beans. Storage is therefore considered one of the most important factors for maintaining final product quality, meeting between-harvest demand, and securing the best market price for the producer.

Traditionally, green coffee beans have been stored in jute sacks. Jute is most frequently used because it is readily adaptable to small-scale commerce and because it is easily sampled for lot inspections. Elevated operational costs that result from the need for manual handling represent one disadvantage of storage in jute sacks. Another disadvantage is rapid deterioration in quality when the beans are stored in warehouses without ambient air control. Containers called “big bags” represent another form of storage used in Brazilian warehouses. The ease of mechanized handling, along with operational economies of scale, represents the principal advantages offered by this method of storage. However, big bags, like jute sacks, the disadvantage of being permeable to water vapor and to gases present in ambient air, affecting the color and the organoleptic properties of the beans Borém et al. (2008) and Nobre et al. (2007) have stated that storage in hermetically sealed systems that permit atmospheric modification or control represents a viable alternative for preserving coffee bean quality. Certain additional costs are acceptable for the preservation of quality in select coffees of higher value.

Recently, the application of the nanocomposite concept has been proven to be a promising option in order to improve above mentioned properties conveniently (Azeredo, 2009). It is worth emphasizing many diverse characteristics existed in nanocomposites including composite reinforcement, barrier properties, flame resistance, electro-optical properties, cosmetic applications and bactericidal properties.

Relatively little research has been conducted to the food packaging involving in nanotechnology, such as material development of biodegradable starch/clay (Avella et al., 2005), whey protein isolate/clay (Sothornvit et al., 2009), polylactides/nanoclay composite films (Zhou et al., 2007) and their application in Chinese jujube (Li et al., 2009) green asparagus (An et al., 2008), orange juice and Chinese bayberries (Wang et al., 2010).

Microbial growth rate in orange juice were significantly reduced as a result of using packaging material containing Ag and ZnO nanoparticles, which prolonged the shelf life of fresh orange juice.