Journal of Food Engineering 355 (2023) 111579

Contents lists available at ScienceDirect

Journal of Food Engineering

journal homepage: www.elsevier.com/locate/jfoodeng

Application of nanoemulsion based edible coating on fresh-cut papaya

Nazia Tabassum [a,*], Rameez Ahmad Aftab [b], Owais Yousuf [c], Sadaf Ahmad [d], Sadaf Zaidi [a]

[a] Department of Post Harvest Engineering & Technology, Aligarh Muslim University, Aligarh, 202002, Uttar Pradesh, India
[b] Department of Chemical Engineering, Zakir Husain College of Engineering & Technology, Aligarh Muslim University, Aligarh, 202002, Uttar Pradesh, India
[c] Department of Food Technology, Islamic Univeristy of Science & Technology, Awantipora, JK, India
[d] Centre for Food Science & Technology, Aligarh Muslim University, Aligarh, 202002, Uttar Pradesh, India

ARTICLE INFO

Keywords:
Essential oil
Nanoemulsion coatings
Ultrasonic emulsification
Machine learning
Papaya

ABSTRACT

Edible coatings effectively delay the ripening process in fresh fruits while maintaining nutritional properties. The incorporation of active compounds such as essential oils can further improve their effectiveness. This study aimed to formulate alginate-based edible coating containing varying concentrations (0.5, 1.0, and 2.0 ml) of oregano essential oil. The obtained coarse emulsions were further sonicated to obtain nanoemulsions. Characterization study of the coarse and nanoemulsions revealed reduced droplet size of about 160 nm and surface charge of around −13 mV with high translucency for nanoemulsions with reduced concentration of essential oil, thereby indicating high stability for nanoemulsions compared to their coarse counterparts. Further, the coating formulations were applied on fresh-cut papaya to assess physico-chemical, headspace, microbial, sensory and microstructural changes. The uncoated sample exhibited the highest water loss, microbial growth and lowest sensory scores. Contrarily, the coated samples exhibited reduced moisture loss and retarded respiratory and microbial activities, while the nanoemulsion coated samples presented better results than their coarse counterparts. The scanning electron microscope (SEM) images also supported the same. Increasing the essential oil concentration increased the shelf life and the moisture retention capacity. Moreover, machine learning models (ANN and SVR) were employed to predict the color characteristics of the samples and were found to be satisfactorily fitted ($R^2 > 0.99$) to the experimental data. This study thus demonstrated that nanoemulsions are better coatings to extend the shelf life of freshly cut papaya, and, therefore, can be used to preserve a variety of other minimally processed fruits and vegetables.

1. Introduction

Edible coatings are thin layered coverings prepared from edible materials, viz. hydrocolloids and lipids that can be applied on fresh produce. They prevent microbial spoilage, gas and/or moisture movement, improve mechanical properties as well as keep the sensory properties of fresh fruits and vegetables intact (Galus and Kadzińska, 2015), thus prolonging their freshness. While the hydrocolloid-based coatings prove to be effective barriers against the transport of gases (Bertuzzi et al., 2007) and also display improved mechanical properties, lipid-based coatings are effective against moisture loss but are lacking in the latter. To overcome the drawbacks of these individual coatings, researchers have explored the prospect of using composite coatings to produce emulsions with improved characteristics. Some examples of fruits preserved using edible coatings are fresh-cut apples (Salvia--Trujillo et al., 2015), fresh-cut pineapple (Azarakhsh et al., 2014; Prakash et al., 2020); fresh/fresh-cut papaya (Tabassum and Khan, 2020; Zillo et al., 2018).

Lately, edible coatings have also been incorporated with active ingredients, such as natural antimicrobial compounds and antioxidants that provide improved health benefits, quality and storage life of cut-fruits (Rojas-Graü et al., 2009). Recently, essential oils (EO) such as lemongrass, basil, thyme, and many others have particularly been employed as the lipid component for nano-based edible coatings to preserve fresh/fresh-cut fruits. Their application towards preservation of fresh-cut fruits though, is largely limited due to their intense flavor, potential toxicity at high doses and high costs (Zillo et al., 2018) but disrupting the essential oil particles into nano size may reduce their dosage while maintaining or enhancing their effectiveness (Perdones et al., 2012).

Hence, researchers have ventured into the field of nanotechnology, aiming to formulate and apply nanoemulsion based coating on fresh-cut

* Corresponding author.
E-mail address: nazia.tabassum@gmail.com (N. Tabassum).

https://doi.org/10.1016/j.jfoodeng.2023.111579
Received 31 December 2022; Received in revised form 16 April 2023; Accepted 6 May 2023
Available online 8 May 2023