Enhancing the Shelf Life of Fruits and Vegetables with Edible Coatings Made from Xanthan Gum and Pomegranate Peel Extract

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Abstract

One of the difficulties in the food industry is food preservation, particularly for horticultural crops where food loss from concurrent production or food chains, including post-harvest loss, occurs in fruits to an amount of 30 to 60% in both developed and developing countries. This can be risky, so natural compounds are being developed and taken into consideration in the food industry to increase the population's economic value while reducing the need for climate- reliant storage. When edible coatings are applied to fruit surfaces, they act as physical barriers that alter the interior atmosphere of the fruit and slow down the ripening process. Comparing application of xanthan gum (XG) based edible formulations with pomegranate peel extract (PPE) to control samples, it was found that these formulations effectively maintained quality attributes and characteristics, such as lowering respiration rate, ethylene production, weight loss, maintaining total soluble solids (TSS), acidity, pH, texture property, ascorbic acid, phenols, and antioxidant activity. This review aims to highlight the most relevant and current information in the use of polysaccharides in postharvest shelf life extension and preservation of overall quality of fruits.

Introduction

Despite 8% annual increase in packaging materials, less than 5% of packaging materials primarily polyethylene terephthalate and high-density polyethylene are recycled. This leads to an accumulation of plastics in the environment. Customers want fresh produce that is safe to eat and abundant in compounds with aroma and health benefits. Extending the shelf life of fruits is a crucial objective to fulfil in order to ensure food security. Therefore, numerous storage methods have been created to increase the duration that commodities are held after harvest and for commercial purposes. Eating coatings as a modified atmosphere (MA) is one way to increase the post-harvest shelf life of fruits. During fruit maturation, a series of metabolic activities take place that lead to chemical changes, increased respiration, changes in structural polysaccharides that cause fruit to soften, deterioration of chlorophyll and carotenoids' biosynthesis, and starch hydrolysis to sugars that cause fruit to ripen and soften to a quality that is acceptable. Semi-permeable materials that constitute edible coatings can be applied directly to products in the form of coatings to reduce the physiological response to mechanical stress.

In addition to offering other advantages like enhancing health via vitamin fortification and serving as a vehicle for organic preservatives like antioxidants and antimicrobials, edible coatings can help solve some of these issues. Studies conducted recently have demonstrated that edible coatings are biocompatible, sustainable, efficient, and biodegradable. They can also increase the shelf life of food.

Edible coating

Fruit and vegetable quality is preserved and edible covering made from polysaccharide sources is also eco-friendly. A single gum, blends, or even a multi-component formulation (including antioxidant and antibacterial ingredients) can be used to create the edible coating. To get the most effective results, they could be applied as single- or multi-layer coatings. The use of Edible coatings such as Xanthan Gum (XG), which is produced under unfavourable conditions by *Xanthomonas campestris* as an exo-polysaccharide, is widely recognised as a safe (GRAS) substance (FDA, 21CFR172.695, 2020) to be utilised as an emulsifier, thickener, or stabilizer.

The action of gum edible coating

An edible coating solution, such as gum or gum combined with bioactive ingredients, applied thin layer to fruits and vegetables creates a barrier between the treated samples and their surroundings. The ripening process, which has the potential to delay a number of metabolic changes in fruits and vegetables, including ascorbic acid, polyphenols, anthocyanins, antioxidant activity, firmness, and colour, is controlled by this barrier. It also regulates the exchange of gases and water vapour.

Materials and methods

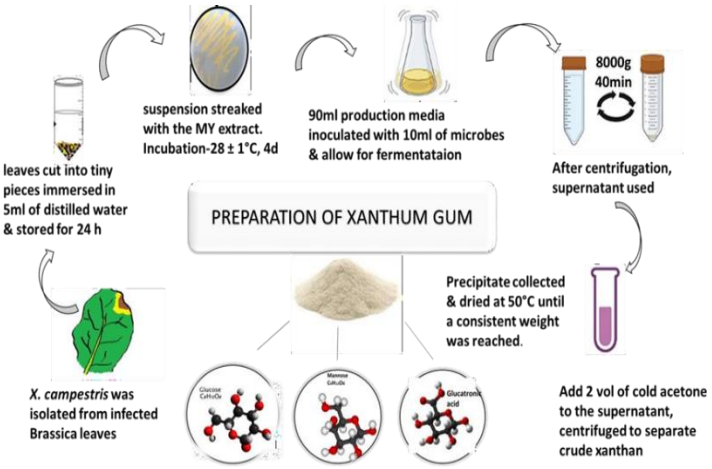

Fig. 1. Preparation of Xanthum gum

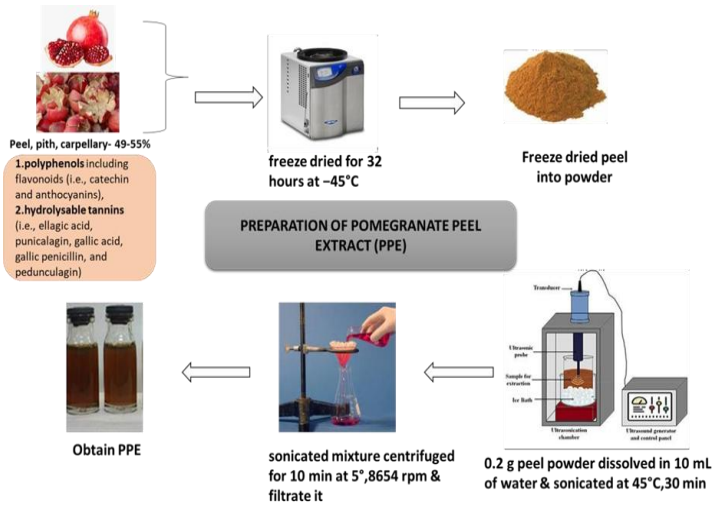

Fig. 2. Preparation of pomegranate peel extracts (PPE)

Table 1. Application of edible coating on fruits and vegetables

Fruit	Main material	Additional compound	Technology	Result
Mango	Xanthum gum (2%)	Pomegranate peel extract (0.02g/ml)	Conventional technology (dipping, 15s), dried at 22 °C for ½ h	Maintaining the qualitative features and prolonging their shelf life
Papaya	Xanthum gum (2%)	-	Sterilized brush was used to apply purified xanthum gum on the Papaya fruit uniformly.	Delayed softening of the fruit, Ascorbic acid and TSS losses and maintained the quality fruit.
Pear	Xanthum gum (2.5%)	Cinnamic acid (1%)	Conventional dipping method for 5s	Reduce the surface browning and Enhance the shelf-life of fresh-cut pears
Tomato	Whey protein (5%),	Glycerol (5%), Xanthum gum (1%), Clove oil	Conventional dipping method for 10s	Slows down respiration rate and was found effective in inhibiting the proliferation of aerobic microorganisms in tomatoes
Bell pepper	Pomegranate peel extract (1%)	Chitosan (1%)	Dipping method for 20s	effective in retaining the physiochemical and organoleptic quality of green bell pepper
Guava	Pomegranate peel extract (1%)	Chitosan (1%)	Conventional dipping method	the most effective treatment in maintaining the overall fruit quality.

Conclusion

The agricultural sector increasingly has to deal with a number of issues, such as post-harvest damage, management considerations, health indications, packing, and preservation methods. In this instance, using healthy preservation techniques such edible

coatings is necessary to extend the storage quality. These natural gums have been shown in multiple studies to effectively maintain the quality of agricultural products and increase their shelf life. Gums have been mentioned as a feasible effective substitute for protecting fruits and vegetables from deterioration.

Reference

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