Enhancement of Shelf Life of Jackfruit Bulbs through Edible Coating: A Mini Review

ABSTRACT

Jackfruit (*Artopus heterophyllus)* is an important fruit crop grown in india. This highly nutritious fruit contains carbohydrate, protein, fibre, calcium, phosphorus, vitamin A, vitamin C, thiamine and riboflavin, fructose, glucose and sucrose and fatty acids of palmitic, oleic, stearic, linoleic, lauric, arachidic acids. It is highly perishable and loses its flavor, texture and turns into brown colour. The fruit softening makes it more susceptible to bruising and mechanical injury and result in rapid decomposition. Minimally processed jackfruit bulbs can provide convenience for consumers and an appropriate post-harvest technology for enhancement of shelf-life. Jackfruit is commonly available for consumers as a fresh cut product because of the convenience in its utilization. Fresh-cut produce are mostly preferred by the consumers in today's food market. Scientists and industrialists have taken numerous efforts to extend the shelf life of jackfruit bulbs and preserve their nutritional quality through post-harvest technologies and processing methods. Edible coatings can be applied to minimally processed fruits, with the goal of increasing their shelf life. It is the best postharvest treatment to preserve fruits quality to extend the shelf life of fruits both at ambient conditions and low temperature preservation. Physiological changes cannot be inhibited completely but it can be delayed by using edible coatings. In this review effects of edible coating on physiological and physicochemical parameters, as well as effects on shelf life and sensory attributes are discussed. Evidence shows that minimal processing technique of edible coating is a feasible option that can be used on jackfruit bulbs, which preserve quality and sensory attributes by reducing metabolic reactions like respiration rate and ethylene production.

Keywords: Food Processing, Jack fruit bulbs, Edible coating, Post harvest technology, Shelf life

1. INTRODUCTION

The nutritional composition of 100 g of ripe jackfruit are moisture 78.56 g, protein 2.74 g, fat 0.17 g, dietary fibre 3.62 g, carbohydrate 14.01 g, energy 302 KJ, total folates 32.15 µg, ascorbic acid 6.73 mg, β-Carotene 23.53 µg, total carotenoids 59.61 µg, calcium 35.03 mg, iron 0.36 mg magnesium 31.84 mg, phosphorus 23.02 mg, potassium 279 mg, total free sugars 12.21 g and total polyphenols 53.74 mg [1]. “Jackfruit contains phytonutrients like lignans, isoflavones, and saponins that shows some health benefits that are wide ranging from antiulcer, antibacterial, antioxidant, anti-inflammatory and antihypertensive” [2]. The jackfruits are highly perishable not exceeding four to five days at room temperature. Its availability is seasonal and even when in season, a large quantity of these fruits are wasted due to lack of adequate postharvest knowledge during harvesting, transporting and storing, both in quality and quantity. The seasonal nature of the production of the perishable jackfruits, the poor storability and the lack of information on an appropriate processing technology are the reasons hindering the full utilisation of the fruit. Extension of shelf life of jackfruits continues to be a challenge in india. The possible solution to overcome the problem is to market the edible portion after necessary minimal processing.

“Minimally processed products are ready-to-eat fresh-cut products. Jackfruit bulbs in pre-cut form can provide convenience for consumers and an appropriate post-harvest technology for shelf life extension may facilitate its transportation from production site to remote location in a fresh-like state” [3]. “The processes like washing, sorting, peeling and cutting enhances oxidative stress in pre-cut fruits and leads to deterioration on quality of pre-cut fruits by increase in microbial contaminations. The search for safe, healthy and environmental friendly treatments has led to increased interest in research in to edible and biodegradable films and coatings. Edible coatings are useful as postharvest treatments to preserve fruits quality. Increasing health concerns in relation to the residual effect of chemicals have initiated searches for alternatives that prolong the storage life of fruits, where edible coatings have been widely used for postharvest management due to their safe nature” [4]. This review attempts to summarize recent studies of different edible coatings applied on jackfruit bulbs effects on food shelf life and quality.

2. Edible coating

“The post harvest technology of fruits includes some pretreatments for maintaining their quality. The commonly employed technology is the application of edible coatings, which can be applied to fruits to regulate the exchange of moisture and gases between the fruit and its environment. In addition, edible coatings provide a significant benefit by allowing the integration of different active ingredients into the coating’s matrix, meaning that these substances will associate with and possibly be eaten together with the fruit. This would help improve the organoleptic and nutritional qualities of the fruit as well as the shelf life” [5]. “Edible coatings can be applied through different techniques, like dipping, spraying, or coating, in order to control moisture transfer, gas exchange, or oxidative processes. The use of edible coatings on minimally processed fruits consists on the application of a layer of any edible material on the surface of a cut-fruit with the purpose of providing it with a modified atmosphere, retarding gas transfer, reducing moisture and aroma loss, delaying color changes, and improving the general appearance of the product through storage” [6].

3. Edible coating materials

3.1 Chitosan

“Chitosan is one of the most widely used edible coatings in horticultural produce, where it has also been employed to improve the biochemical composition of jackfruit during storage. Chitosan, an edible polymer, made by treating the chitin shells of shrimp and other crustaceans with an alkaline substance, like sodium hydroxide. It is a natural product which is non-toxic and eco-friendly. Chitosan has an antibacterial and antifungal property which helps in food protection. These films are flexible, tough, high durable and very difficult to tear” [7]. “It was reported that cassava starch-chitosan-coated jackfruit bulbs resulted in lower microbial infestation along with better biochemical composition and antioxidative capacity” [8].

“Chitosan based coatings can counteract oxidative stress reducing reactive oxygen species over-production through enhancing of antioxidative defense system including enzymatic and non-enzymatic components that work synergistically to improve cellular defense in fruits” [9]. “In an another investigation, the jackfruit bulbs pretreated with $CaCl_2$, ascorbic acid, citric acid, and sodium benzoate followed by chitosan coating were subjected to controlled atmosphere (CA) storage or normal air at 6 °C. It was found that CA conditions, pretreatment, as well as chitosan coating in synergy with each other, could significantly minimize the loss in total phenolics and ascorbic acid content of the samples to the levels of around 5% and 17%, respectively, during extended storage up to 50 days. Chitosan coating could also restrict the changes in microbial load. The CA condition was found to render higher efficacy in retaining quality attributes of the samples” [10].

3.2 Aloe vera gel

“Aloe vera gel is one of the most widely used coatings for horticultural produce, where it has no harmful residual effects” [11]. “The combination of aloe vera gel with traditional biopolymers such as proteins and polysaccharides and lipids may enhance the physico chemical properties of fruits. The results of a study showed that the water content of jackfruit bulbs could be retained using an aloe vera gel edible coating. The shelf life of jackfruit was high at 10^oC than stored at 29^oC. The best edible coating results obtained on the treatment of aloe vera gel with a concentration of 0.5% CMC because it could inhibit the increase in water content, maintained texture, and the color of jackfruit bulbs” [12] . “The effect of different edible coatings revealed that the aloe vera coating reduced the weight loss in jackfruit bulbs stored under refrigerated conditions. It resulted in high retention of calorific value, protein, vitamin C and vitamin A. It showed minimum amount of bacterial as well as fungal count whereas the carbohydrate content high in pectin coated sample. Hence it was concluded that alovera coating was best coating for jackfruit bulbs. The parameters of weight loss, ascorbic acid and pH which are related to post harvest quality loss were however significantly controlled in the different coated fresh cut jackfruit and the storability of fresh cut jackfruits was extended by seven days. It was found that aloe vera gel coating for jackfruit could serve as alternative to post-harvest chemicals treatments” [13].

3.3 Combined application of edible coatings

"It was reported that a combination of white bean starch-based coating and $CaCl_2$ was shown to be effective in reducing ethylene production, rate of respiration, alleviating chilling injury and maintaining better phenolics and sugar content" [14]. "In an another study it was indicated that application of potassium sorbate/calcium chloride with 1-methylcyclopropene (1-MCP) to jackfruit bulbs and edible coatings (xanthan gum, sodium alginate or gellan gum) showed decreased maturation rate and reduced weight loss and breathing, compared to uncoated bulbs. In addition, it increased the shelf life up to 12 days without changes in sensory attributes, achieving high quality values in color, total soluble solids, titratable acidity pH,. total soluble solids, and titratable acidity of the products" [15]. A research study results revealed that "the transglutaminase crosslinked whey protein: pectin (80%: 20%) in film forming and coating to preserve jackfruit bulb was adequate for application. Certain hydrophobic ingredients need to be integrated into the functional coating to overcome the low moisture barrier characteristic contributed by the hydrophilicity of pectin. This approach opens an alternative strategy to prolong jackfruit bulb product shelf life in commercial distribution. This could be achieved by the formation of transglutaminase-crosslinked whey protein/pectin complexes that significantly reduced the interstitial space within the film network and consequently increased film water vapor and gas barrier properties. These coatings effectively delay decrement of ascorbic acid by slowing the respiration rate. Loss of phenolics in uncoated tissues was due to senescence and breakdown of cell structure. It effectively delayed senescence by controlling the metabolic rate, retaining phenolics for a longer storage period" [16].

3.4 Alginate

"These are polysaccharides obtained from marine brown algae. Alginate is soluble in water; it also has good filming and good adhesion properties. Water soluble sodium alginate is commonly used in the making of edible films and coatings and should be mixed with divalent ions to reduce its water solubility. The addition of divalent ions such as calcium allows for the formation of divalent salt bridges due to the binding of calcium ions between two chains, which provides rigid and dense gels. Alginate polymers form gels, i.e., ionic cross-links form in the presence of several divalent cations such as $Ca2^+$, $Mg2^+$, $Sr2^+$ and $Ba2^+$, by cross-linking the carboxylate groups of the guluronate groups on the polymer backbone" [17]. "The crude alginate extracted from algae species, *Sargassum ilicifolium* and commercial food grade alginate, gelatin with and without ascorbic acid were coated at the room temperature on sliced jackfruit lam and stored at room temperature and refrigeration conditions. Among the treatments, crude alginate with ascorbic acid were recorded as highest radical scavenging activity in 2,2-diphenyl-1-picrylhydrazyl assay, overall sensory quality, lowest microbial count in total plate count and extended the shelf life since the ascorbic acid enhanced the effectiveness of the coating. The rate of browning was reduced in jackfruit slices coated with crude sodium alginate with ascorbic acid" [18]. According to a research investigation report, "during the storage period of 5 days, a higher weight loss percentage was observed in uncoated pre-cut jack fruits than the coated sample. Higher decrement in the titrable acidity was observed in uncoated sample. Ascorbic acid content was decreased during the storage period but there was no significant difference in the decrement of ascorbic acid content between coated and uncoated sample. Pre-cut jack fruits coated with 1% alginate exhibited lesser weight loss and higher quality values of total soluble solids, titratable acidity and pH within 5 days of storage" [19]. It was also observed that "the application of alginate and agar-based coatings on jackfruit bulbs preserved volatile compounds such as hexadecane, pentadecane tetradecane, tridecane, naphthalene and 6-methyl-2-heptanone, where all these compounds were lost in untreated fruit samples" [20].

4. CONCLUSION

At present, there is a growing consumer demand for wholesome, nutritional, and convenient food products which could be achieved through minimally processed fruits. Processing of jackfruit into value-added products such as precut bulbs may remove the difficulty in preprocessing of jack fruit and it may be commercialized among the consumers. However, once the fruit is cut, it can undergo rapid deterioration due to the physiological stress caused by physical damage. Edible coating is a promising technology in enhancing the physicochemical, nutritive and sensory characteristics of fresh cut jackfruits. As a result, this enhancement of product quality would surely gain the consumers' preferences.

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