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Underutilized Fruit Crops

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Preventing Browning in Tender Jackfruit during Minimal Processing For Ready to Cook Product

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In India, Jackfruit (*Artocarpus heterophyllus* Lam.) is used for culinary purpose at its tender stage and relished as a dessert fruit when ripe. Tender fruits are low in calories and good source of minerals (206mg potassium, 97mg phosphorus and 50.1mg calcium/100g of edible portion), fibre (4.4g/100g of edible portion), protein (2.6g /100g of edible portion) and vitamin C (11mg/100g of edible portion). Unlike other vegetables, it is considered relatively safe, as pesticides are rarely used for its cultivation. The curry prepared from the tender jackfruit tastes as good as meat based curry and is liked by all sections of the society. However, consumers hesitate to purchase it due to cumbersome process of peeling and cutting, as the peel is very hard and full of latex. Thus, there is an ample scope for minimal processing in tender jackfruit so that this vegetable could be made available to the consumers in ready to cook (RTC) form. One of the most important challenges during peeling and cutting is the preservation of normal tissue colour or control of cut-surface

browning/discoloration, as it affects external appearance of the product. Consumer's choice and preferences for minimally processed products are greatly influenced by its colour. Loss of natural colour is considered as deterioration of quality, which in turn lowers the consumer's acceptance for the product. Hence, there is a need to device methodology for preventing/ containing browning in cut tender jackfruit, during its minimal processing.

Browning: The exposed cut-surface of jackfruit flesh becomes brown due to hydroxylation of monophenols to colourless diphenols and oxidation of diphenols to dark coloured quinones by the enzyme polyphenol oxidase (PPO). This process of enzymatic browning does not occur in intact plant cells because PPO (enzyme) and phenolic compounds (substrate) are located separately in the cytoplasm and vacuoles, respectively. This compartmentalization of substrate and enzyme is lost due to physical injury to the cell during minimal processing which in turn allows them to come into contact of each other and initiate the reaction of browning in the presence of

oxygen. The cut-surface of jackfruit becomes very dark within 5-10 minutes as shown in Fig 1.

Prevention of browning: Various physical and chemical agents are known to control the PPO-mediated cut-surface discoloration/ browning in fresh-cut fruits and vegetables. Some of them are listed in Table 1.

Table 1. Antibrowning treatments for fresh-cut/ minimally processed products

Sl. No	Antibrowning Agents	Fresh-cut /minimally processed products
Physical		
1.	Blanching in water	Aonla, Plum, Beet, Brussels sprout, Carrot, Cauliflower, Peas, Potato, Spinach
2.	Blanching in steam	Mango, Pineapple, Carrot, Cauliflower, Peas, Potato, Spinach,
Chemical		
1.	Sodium chloride (common salt)	Apple, Mango, Watermelon, Potato
2.	Ascorbic acid	Apple, Banana (cooking),Carambola, Kiwi, Loquat, Pear, Artichoke
3.	Citric acid	Apple, Banana (cooking), Carambola, Chestnut, Artichoke, Cabbage, Sweet potato
4.	Oxalic acid	Apple, Banana (cooking), Mangosteen
5..	Sodium metabisulphite	Apple, Sweet potato

Considering the tremendous scope of minimally processed tender jackfruit and role of antibrowning agents in maintaining the visual quality of RTC product, an attempt was made at ICAR-IIHR-Central Horticultural Experiment Station, Bhubaneswar to develop suitable antibrowning treatment for fresh-cut tender jackfruit. Chemicals and physical treatments used for the purpose are given in Table 2.

Table 2. Antibrowning treatments used in the study

Sl. no.	Treatments	Concentrations	Method of application
1.	Citric acid	0.5, 1.0 and 1.5%	Solution was poured to the cut-surface during peeling and dicing thereafter, the diced jackfruit pieces were immersed in the solution for 15 minutes.
2.	Ascorbic acid	0.5, 1.0 and 1.5%	
3.	Sodium chloride (common salt)	2, 5, 10, 15 and 20%	
4.	Blanching	-	Water was poured to the cut-surface during peeling and dicing thereafter, the diced jackfruit pieces were immersed in the boiling water for 3-5 minutes.

Blanching and salt treatments were not found effective in preventing the browning. Ascorbic acid at higher concentration, i.e., 1 and 1.5% conferred temporary protection from enzymatic browning that lasted for 15-20 minutes.

Thereafter, discolouration of the product started (Fig 2). As far as citric acid is concerned, 1% concentration was found to be optimum, because below this concentration the control for browning was not effective and at higher concentration, i.e., 1.5% the product became sour. Chelating and acidifying properties of citric acid makes it an excellent antibrowning agent. It reduces the activity of PPO by capturing/chelating copper in the active site of enzyme and reducing the pH of medium. PPO catalyzes enzymatic browning at neutral pH (6-7). Thus, acidification by citric acid leads to reduction in activity of enzyme and containment of cut-surface browning.

The minimally processed tender jackfruit treated with 1% citric acid, retained the visual appeal (off white colour) even after 20-24 hrs at room temperature storage and up to 5-7 days under refrigerated storage (Fig 4). Moreover, as citric acid is a major constituent of several fruit crops, it is recognized as safe for human consumption. Hence, to preserve the normal tissue colour of the RTC tender jackfruit, 1% citric acid solution could be used as an antibrowning agent during minimal processing.

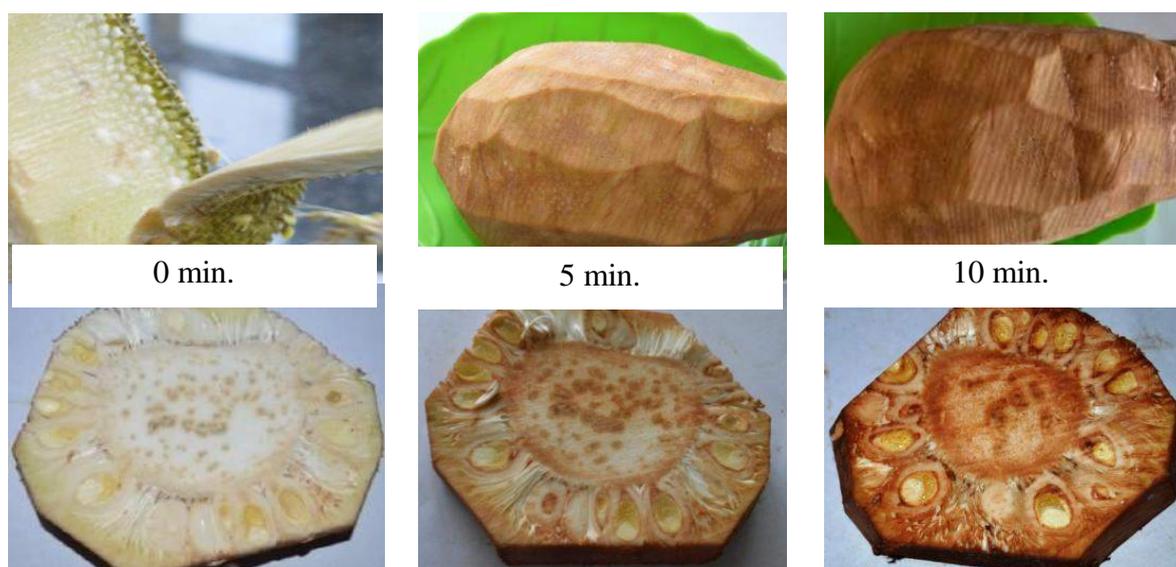


Fig 1. Gradual change in the colour of exposed cut-surface of tender jackfruit



1% Citric acid treated jackfruit
(After 15 min. of treatment)



1% Citric acid treated jackfruit
(After 5 days of treatment)



Ascorbic acid treated jackfruit
(After 15 min. of treatment)



Ascorbic acid treated jackfruit
(After 30 min. of treatment)

Fig 2. Effect of Ascorbic acid and citric acid on preventing the browning in tender jackfruit