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Effect of edible coating on physiological parameters of papaya fruit (*Carica papaya* L.) for shelf-life enhancement

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Abstract
The main objective of this study was to increase the shelf life of papaya by using edible coating. It is a serious problem for fruits to suffer postharvest losses due to rapid deterioration during handling, transport and storage. Use of edible coatings over fruits is used to improve their quality and self-life. To improve the performance of edible coating of Aloe Vera gel various other plant-based product were incorporated like chitosan and ascorbic acid. The purpose of this study was to compare the effect of chitosan and ascorbic acid along with aloe vera gel on reducing Papaya's post-harvest fruit weight and determining the most effective coating material. Freshly harvested papaya fruits were coated with Aloe vera gel 50% (T1), Aloe vera gel + Ascorbic acid (T2), Chitosan(T3), Aloe vera gel + Chitosan (T4), Chitosan + Ascorbic acid (T5) Aloe vera gel + Chitosan + Ascorbic acid (T6). Among all the treatments, Aloe vera gel, Chitosan, and Ascorbic acid (T6) coated fruits exhibited least changes followed by uncoated fruits (control).

Keywords: *Aloe vera*, ascorbic acid, chitosan, papaya, physiological attributes

Introduction
The papaya (*Carica papaya* L.) is one of the most important fruits of tropical and subtropical regions (Vij and Prashar, 2015) [20]. It is native to the lowlands of eastern Central America, Mexico and Panama (Ikram *et al*., 2015) [9]. They have long fruiting season and require less maintenance than other fruit crops and have high nutritional value (Ming *et al.*, 2015) [12]. Papaya plants are cultivated across different continents, such as Brazil, India, Mexico, Nigeria, Indonesia and others, after Spanish colonization of the Americans (Bautista-Baños *et al*., 2013) [4]. The fruit has high nutritive and medicinal value (Azad, *et al*., 2012) [3] especially vitamin A (2020 IU/l00g). Papaya is rich in vitamins C, A, B, E, and K content. A serving of 100 g ripe papaya has 32 calories, 0.6 g protein, 0.1 g fat, 7.2 g carbs, and 2.6 g fibre (Patil *et al.*, 2017) [16].

Fruits can be stored at the proper temperature and relative humidity to lengthen their shelf life. When stored at a low temperature, fruits have a shelf life of up to a few weeks. Temperature must be reduced to slow respiration and senescence, relative humidity must be maintained to reduce water loss without accelerating decay, chemical preservatives must be added to reduce physiological and microbial losses, and a gaseous environment must be maintained to slow respiration and senescence (Workneh *et al*., 2011) [21]. Fully grown, yellow-coloured fruits are favoured for low-temperature storage over immature and ripe fruits. Harvesting, washing, packaging, and transportation processes can introduce additional circumstances after production. Microorganism-caused quality decline can result in a variety of commercially unattractive types of spoiling. The microbial contamination, however, can adversely affect the fruit quality and hence the final product quality (Lee, 2004) [10].

Dang preserving postharvest quality and reducing production costs. (Chaudhari *et al*., 2015) [7]. Aloe vera gel coatings provide fruits with a number of benefits, including imparting a glossy appearance and better colour, preventing weight loss, and extending storage/shelf life by preventing microbial growth (Dang *et al*., 2008) [5]. Aloe gel juice (orally) is used for treating skin diseases, constipation, radiation damage, gastrointestinal problems, kidney problems, and cardiovascular ailments (Akbari *et al*., 2013) [18]. Decreased blood cholesterol and triglyceride levels. Aloe Vera has also been reported to have anti-inflammatory and antibiotic properties that can be used to treat diseases such as diabetics, cancer, allergies, and AIDS (Arowora *et al*., 2013) [2]. When Chitosan is applied to a fruit's skin, it forms a thin film that efficiently

reduces water loss. A coating with 1.5% or 2.0% chitosan reduced weight loss up to 6% of what was observed in the control, which is sufficient for maintaining the quality and appearance of papaya (Muhammad *et al.*, 2011) [1].

The current experiment was carried out with the following goal in mind: to study the influence of edible coating on the physiological properties of papaya fruits in order to improve their quality and shelf-life.

1. To standardize the best coating material for extending the shelf-life of papaya fruits.
2. Characterize the effectiveness of the optimized coating to enhance physiological attributes of papaya fruits and extend shelf-life.

Materials and Methods

The experiment was carried out in a laboratory of Lovely professional university, Kapurthala, Punjab, India during the years 2021 and 2022. Two replications of a Completely Randomized Design (CRD) were carried out for this experiment. The treatments included seven levels of coating i.e., Aloe vera gel 50% (T1), Aloe vera gel + Ascorbic acid (T2), Chitosan(T3), Aloe vera gel + Chitosan (T4), Chitosan + Ascorbic acid (T5), Aloe vera gel + Chitosan + Ascorbic acid (T6) and Control (T7).

Physiological weight loss: For determining PLW (Water loss) of all Papaya fruits, the initial and final weight of the fruits were recorded. The results were then expressed in percentage using following formula (Marpudi *et al*, 2011) [11]:

$$\text{PWL (\%)} = \frac{\text{Initial weight-final weight}}{\text{Initial weight}} \text{ x100}$$

Specific gravity: The specific gravity of the fruit was determined by 1 L clean beaker. The beaker was filled with water (distilled water) and taken the weight. After drying the beaker, it was filled with the papaya fruit sample and weight taken (Onwuka., 2005) [14].

$$\text{Specific gravity (\%)} = \frac{\text{Weight of fruits}}{\text{Volume of water replaced by the fruit}} \text{ x 100}$$

Statistical analysis: The data were recorded during the period of study and subjected to statistical analysis of variance. The data generated from these investigations were appropriately computed, tabulated, and analyzed as described by Panse and Sukhatme, 1985 and OPSTAT in Completely Randomized Design (CRD).

Results and Discussions

Effect of the different edible coating on fruit weight and physiological weight loss % of papaya: The data are given in the table no.1, indicates that the treatment T6 (Aloe vera gel + Chitosan + Ascorbic acid) showed the highest fruit weight (905g, 895g and 885g) at 5th, 10th and 15th days after coating on papaya fruit and minimum fruit weight was observed in control (807.500g, 792.500g and 777.500g).

The data presented in the table no.2, indicates that the treatment T6 (Aloe vera gel + Chitosan + Ascorbic acid) showed lowest physiological weight loss (1.670%, 2.115% and 2.245%) at 5th, 10th and 15th days after coating as compared to control (3.140%, 3.750% and 3.940%).

Similar results were observed by Sharmin *et al*. (2016) who applied a layer of aloe vera gel 0.5%, 1% and 1.5% as a coating material on papaya fruit and found 7.3% of physiological weight loss in 12 days after coating. Hazarika *et al.*, (2017) applied carboxymethyl cellulose, chitosan, Aloe vera gel and liquid paraffin wax (100%) as a coating material to the papaya fruit and found 7.83% physiological weight loss. The rate of water loss to fruit depends on the water pressure gradient between the fruit tissue and the surrounding storage temperature, and the coatings act as a barrier between this causing less moisture loss and less physiological weight loss (Pandey *et al.*, 2010 and Nasrin *et al.*, 2018).

Effect of the different edible coating on specific gravity (g) of papaya: The experimental data given in the table no.3, represents that the treatment T6 (Aloe vera gel + Chitosan + Ascorbic acid) showed highest specific gravity (0.9g, 0.8g and 0.7g) at 5th, 10th and 15th days after coating as compared to minimum in Control (0.4g, 0.3g and 0.2g).

With increasing the days after coating, weight and specific gravity of the papaya fruit decreases. Coated papaya fruit shows less loss in weight and specific gravity as compared to uncoated fruits. Coating material acts as barrier for transpiration and respiration processes, helps to maintain the weight and volume of the fruit which causes higher specific gravity (Singh *et al.*, 2017 and Yamanur *et al.*, 2021) [19, 22].

Table 1: Effect of the different edible coating on fruit weight

Treatment	5 DAC	10 DAC	15 DAC
T1: Aloe vera gel (50%)	895.000	885.000	875.000
T2: Aloe vera gel (50%) + Ascorbic acid (1%)	825.500	816.500	805.500
T3: Chitosan (1%)	856.000	846.000	835.000
T4: Aloe vera gel (1%) + Chitosan (1%)	875.000	865.000	855.000
T5: Chitosan (1%) + Ascorbic acid (1%)	836.500	826.000	816.000
T6: Aloe vera gel (50%) + Chitosan (1%) + Ascorbic acid (1%)	905.000	895.000	885.000
T7: Control	807.500	792.500	777.500
C.D.	19.908	19.647	19.647
SE(m)	5.852	5.776	5.776

Table 2: Effect of the different edible coating on Physiological weight loss

Treatment	5 DAC	10 DAC	15 DAC
T1: Aloe vera gel (50%)	1.705	2.125	2.340
T2: Aloe vera gel (50%) + Ascorbic acid (1%)	2.475	2.695	2.891
T3: Chitosan (1%)	2.295	2.415	2.532
T4: Aloe vera gel (1%) + Chitosan (1%)	2.070	2.225	2.387

T5: Chitosan (1%) + Ascorbic acid (1%)	2.700	2.715	2.802
T6: Aloe vera gel (50%) + Chitosan (1%) + Ascorbic acid (1%)	1.670	2.115	2.245
T7: Control	3.140	3.750	3.940
C.D.	0.145	0.183	0.241
SE(m)	0.043	0.054	0.071

Table 3: Effect of the different edible coating on specific gravity

Treatment	5 DAC	10 DAC	15 DAC
T1: Aloe vera gel (50%)	0.8	0.7	0.6
T2: Aloe vera gel (50%) + Ascorbic acid (1%)	0.6	0.5	0.4
T3: Chitosan (1%)	0.5	0.4	0.3
T4: Aloe vera gel (1%) + Chitosan (1%)	0.7	0.6	0.5
T5: Chitosan (1%) + Ascorbic acid (1%)	0.5	0.4	0.3
T6: Aloe vera gel (50%) + Chitosan (1%) + Ascorbic acid (1%)	0.9	0.8	0.7
T7: Control	0.4	0.3	0.2
C.D.	0.159	0.170	0.162
SE(m)	0.045	0.050	0.048

Conclusion

Compared to the uncoated fruits that had remarkable compositional changes with maximum quality loss during storage at room temperature, the coated papayas exhibited a significant delay in ripening and minimized weight loss. The coating acted as a physical barrier between the fruit and the environment, extending shelf-life. Amongst all the experimental treatments, T6 *i.e.*, Aloe vera gel (50%) + Chitosan (1%) + Ascorbic acid (1%) was observed to be the most effective for the better fruit weight, specific gravity and physiological weight loss and was at par with T1 (Aloe vera gel) and T4 (Aloe vera gel + Chitosan). As a result, it can be concluded that for better quality preservation and improved shelf life, Aloe vera gel + Chitosan + Ascorbic acid coating should be considered as a commercial product for papaya fruit storage, transportation, and marketing.

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