International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 1908-1910

Received: 17-03-2018
Accepted: 19-04-2018

Amee Macwan
College of food Processing Technology & Bio Energy, Anand Agricultural University, Anand, Gujarat, India

Bhavesh Joshi
College of food Processing Technology & Bio Energy, Anand Agricultural University, Anand, Gujarat, India

Avanee Macwan
College of food Processing Technology & Bio Energy, Anand Agricultural University, Anand, Gujarat, India

Correspondence
Amee Macwan
College of food Processing Technology & Bio Energy, Anand Agricultural University, Anand, Gujarat, India

Edible coating and irradiation of sapota fruit: A concise review

Amee Macwan, Bhavesh Joshi and Avanee Macwan

Abstract
Sapota is one of the most prominent fruits in India and belongs to family Sapotaceae, and now widely cultivated throughout the tropical climate countries for its delicious and nutritional value. Due to its highly perishable nature and fast ripening process of fruits, it has short post-harvest life. To increase the shelf-life of Sapota, proper post-harvest management is required. Research efforts have been succeed in increasing the production of sapota fruit, but the purpose of obtaining maximum profit will not be achieved until the post-harvest losses will be minimized. Therefore, there is necessity to have interventions for increase its shelf life using various technologies like edible coating, irradiation, modified atmospheric storage, proper packaging and refrigerated storage etc. Different edible coating and irradiation doses with proper storage temperature and packaging will reduce metabolic activity, respiration rate, quality loss are used to increase the shelf-life of fruits which have been suggested by published literature. This review explores the different edible coatings and irradiation studies adopted to enhance the shelf-life of sapota fruit.

Keywords: post-harvest management, edible coating, irradiation, shelf-life

Introduction
Sapota (*Manilkara zapota)* is one of the most prominent fruits in India and belongs to family Sapotaceae. sapota is a native fruit of Mexico (Mexico is a country between the U.S. and Central America), and now widely cultivated throughout the tropical climate countries for its delicious taste and nutritional value. Being a hardy crop, it can be grown on wide range of soil and climatic conditions. It is an evergreen tree usually growing up to 10 m height. Latex is also tapped from the bark for chicle gum, the base for chewing gum.

India is the largest producer of sapota followed by Mexico, Guatemala and Venezuela with a production of 12,52,000 tons in the year 2016-17 (Indian Horticulture Database, 2017, Ministry of Agriculture) but the export constitutes very minor fraction as fruit ripens within 9 days at ambient (27±3°C) temperatures and spoils within 13 days after harvest. The states growing sapota in India on commercial scale are Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamilnadu, Kerala, Punjab, West Bengal and Haryana.

sapota fruit in full ripe stage, it is delicious and eaten as dessert fruit. The pulp is sweet and melting. Bose and Mitra (1990) [2] reported that the fruits of sapota are a good source of sugar which ranges between 12 and 14 %. Edible portion of fruit (100 g) contains moisture (73.7 g), carbohydrates (21.49 g), protein (0.7 g), fat (1.1 g), calcium (28 mg), phosphorus (27 mg), iron (2 mg) and ascorbic acid (6 mg).

Fruit deteriorate due to physiological and biochemical changes, increase in respiration rate and ethylene production rate, which leads to discoloration, loss of firmness, development of off-flavors, acidification and microbial spoilage. The producer does not have any sustain technology. To overcome these problems there is need to find out suitable low cost processing techniques for adoption by the fruit producer. Therefore, processing and preservation of the fruit from the point of the production and harvesting is the only solution to the economic disposal of these marketable fruits, to secure better returns to the producers as well as to provide fresh, delicious, nutritive food to the people. Now-a-days, consumers are more aware and interested in minimally-processed fresh fruit with superior quality and less compromise on nutritional attributes (Pasha *et al*., 2012) [3].

An edible coating provides a protective layer to fresh agricultural produce and it give same effect as modified atmosphere storage (Park *et al*., 1999) [4]. The concept of using edible coatings to extend shelf-life of fresh and minimally processed produce and to protect them from harmful environmental effects has been emphasized based on the need for high quality and the demand for minimal food processing and storage technologies (Tharanathan, 2003) [5]. However, the edible coating has opened a new concept to overcome the problem of keeping quality of fruits because coating slows down the rate of respiration which decrease metabolism and also reduce the rate of ethylene production which delays ripening. A new concept is being developed, in which antimicrobial compounds incorporated into packaging films or edible coatings in order to maintain texture and surface of foods as well as increasing the shelf life of food. According to the microbiological hurdle concept, active films or coating containing antimicrobial agents can also be combined with low-dose gamma irradiation to obtain a synergistic inhibitory effect (Lacroix and Ouattara, 2000) [6].

Recently, the irradiation technology is being used for improving shelf life, reducing of spoilage of various fruits and spices. Irradiation of fruits/foods is being accepted in 60 countries. Food irradiation is the process of exposing food to ionizing radiations, that is, radiation at a high enough energy level can expel electrons from atoms and ionize molecules. Radiations can be in the form accelerated electrons (electron beams) or high-energy photons (Gamma rays or X-rays).

Very little work has been carried out in the world on shelf life extension of sapota fruits, thereby scarce literature is available. Present review was attempted to explore the different edible coatings and irradiation studies adopted to enhance the shelf life and maintain the quality of Sapota.

Coating of Sapota fruit

Saha *et al.*, (2015) [19] reported that the edible coatings with different proportion of chitosan and their effectiveness in sapota quality. Different coatings are T1 (chitosan 1%+oleic acid 0.1%), T2 chitosan 1%+cinnamon oil 0.1%), T3 (chitosan 1%+oleic acid 1%+ cinnamon oil 0.1%+ Calcium chloride 0.1%) while the fourth group that is uncoated was designated as (T0).The effects of these coatings on the weight loss, respiration rate, total soluble solids, pH, titratable acidity, ascorbic acid, firmness and decay incidence of coated fruit were studied at 21±1ºC and 75-80% relative humidity for 10 days. The results revealed a lesser weight loss and respiration rate for T3 (chitosan 1%+oleic acid 1%+ cinnamon oil 0.1%+ calcium chloride 0.1%) coated fruits followed by T2 (chitosan 1%+cinnamon oil 0.1%), T1 (chitosan 1%+oleic acid 0.1%) and uncoated fruits, respectively. After 9 days of storage, T1, T2 and T3 showed 14.9, 16.6% and 13% decay due to shriveling and excessive browning while uncoated ones shows 50% fungal decay which was absent in coated ones. Maximum fruit firmness was recorded in T3 coated fruits whereas minimum firmness was recorded in control ones.

Padmaja *et al.*, (2015) reported that the coating of Aloe vera gel with water in ratio of 1:2 and 7 minutes dipping time and packaged in LDPE film has extended the storage life of sapota up to 20 days at 15± 2ºC by maintaining initial characteristics of fruits while the untreated sapota lost its quality attributes after 10 days. Optimization is done with 6 different treatments in which different Aloe vera gel concentration with water and three different dipping time for coating. Aloe vera juice mixed with 1.5% pectin at 60°C for gelation was taken in three different concentrations i.e., 1:1(200 ml of Water: 200 ml of aloe vera gel), 1:2 (133.3 ml of water: 266.6 ml of aloe vera gel) and 1:3 (100 ml of water: 300 ml of aloe vera gel) with distilled water in increasing concentration of aloe vera gel and three different dipping periods i.e. 3, 5, 7 min for each concentration.

Vishwasrao and Ananthanarayan, (2016) [18] reported that the fruits coated with methyl cellulose and palm oil showed significant delay in physiological weight loss, decrease in fruit firmness losses as well as slow down the deterioration. The result suggest that the edible coating maintained fruit quality for up to 7 days as compared to a shelf-life of 4 days of control fruit when stored at 24±1°C and 65±5% RH. Thus, the edible coating showed significant delay in post-harvest changes occurring in the sapota fruit. An increased shelf-life of 3 days at near ambient environmental storage conditions can provide sapota fruit with a good market potential.

Menezes *et al.*, (2016) [13, 14] stated that the sapota fruits coated with sodium alginate-pectin edible coating (2%) with 2 min dipping time showed significant reduction in changes in the physico-chemical parameters such as weight loss, total soluble solids, acidity, color, ascorbic acid, firmness and pH at refrigerated temperature storage (4±1ºC). The sensory analysis of sodium alginate-pectin coated sapota fruits and control showed that, the polysaccharide coating with 2 min dipping time was effective more against the 4 min dipping time and control fruits in maintaining the organoleptic properties of the fruits up to 30 days of refrigerated storage. The pectin based edible coating extended the shelf life of sapota fruits up to 11 days by delaying the changes in the physico-chemical parameters such as weight loss, TSS, pH, total acidity, ascorbic acid, firmness and colour whereas the uncoated sapota fruits were in the edible state up to 5th day at 30±3°C. The control fruits showed the weight loss in the range of 48±0.12% to 37.21±0.54% which is higher than the coated ones, where as in the coated fruits with 2 and 4 min dipping time, the weight loss increased from 0.86±0.37 to 24.98±0.35% and 0.88±0.66 to 29.65±0.44%, respectively in which weight loss is higher in 4 min dipping time than the 2 min dipping time.

Joslin Menezes and Athmaselvi, (2016) [13, 14] reported that the pectin, poly vinyl alcohol based edible coating increasing the shelf life of sapota fruit by 11 days where the control fruit spoiled into 5 days. Pectin based coating very effective in delaying the changes in the physico-chemical parameters such as weight loss, TSS, pH, total acidity, ascorbic acid, firmness and colour whereas the uncoated sapota fruits were in the edible state upto 5th day at room temperature (30±3ºC). The weight loss of control fruits increased from 2.22±0.5% to 16.98±0.4% whereas the weight loss in the coated fruits increased from 1.19±0.1% to 17.28±0.5%, firmness of control and coated fruits measured on alternate day and on 11th day of storage it ranged from 429.49±0.3 to 79.87±0.45 g and from 563.49±0.42 to 75.337±0.6 g respectively. The titratable or total acidity of control fruits decreased from 0.405±0.6% to 0.16±0.09% where as in the coated fruits acidity decreased from 0.426±0.1% to 0.18±0.2% and ascorbic acid content of control fruits reduced from 4.68±0.5 mg/ 100g of fruit pulp to 6.08±0.3 mg/ 100g of fruit pulp whereas, in the coated fruits the ascorbic acid is decreased from 14. 2±0.13 mg/ 100 g of fruit pulp to 5.91±0.15 mg per 100 g.

Dey *et al.*, (2014) [12] indicated that sapota fruit coated with 2.5% corn starch showed a significant delay in change of weight, length and breadth, total soluble solids, titratable acidity, total and reducing 3% sugar, ascorbic acid content, phenol content and color during storage as compared to uncoated control fruit. The result revealed that corn starch extends the shelf life as well as preserves the ascorbic acid and phenol content during storage. The physiological loss in weight was found minimum (17.56%) in 2.5 % corn starch coated fruit followed by starch 3% (21.06%), whereas, it was maximum (54.38%) in control. The coated fruit treated with corn starch-2.5% showed minimum decay (38.71%) after 9 days of storage whereas uncoated fruits showed maximum decay (72.91%).

Sarkar *et al*. (1995) [15] done waxing of sapota by waxol and result of their research work revealed that waxed fruits have minimum physiological weight loss and maintained higher TSS, total sugars, reducing sugar content, and acidity as compare to control one.

Chundawat, (1991) [16] stated that fruits treated with 6 % wax emulsion and packed in 50 µm polyethylene cover which contain ethylene and CO_2 absorbents had a shelf life of 45 days at 12 C, i.e., 10 days more than in control.

Irradiation of Sapota fruit

Yadav *et al.,* (2012) [8] studied the effect of irradiation on extension of shelf life. Different irradiation dose applied to sapota fruit. The different treatments are 0.2 KGY, 0.4 KGY, 0.6 KGY and 0.8 KGY including control. The results of the experiment revealed that the irradiation treatments at 0.20 KGY found to lower physiological loss in weight (14.73%), spoilage (31.52%), ripening (59.75%), brix: acid ratio (114.55), higher firmness (1.97 kg/cm^2), acidity (0.15%), total soluble solids (23.430 B), reducing sugars (8.46%), total sugars (11.98%) and highest organoleptic score (8.12) over all other treatments and thereby recorded higher shelf life of 12.00 days.

Srinu *et al.,* (2015) [11] reported in their experiment that, the Sapota fruits were packed in 25 µm with 0.1% perforation polypropylene packaging and irradiated with different doses of gamma radiation for extending their shelf life and for stabilizing the market demand. Irradiation of sapota fruits with 0.2 KGY gamma radiations and stored at 15°C for 20 days increased the post-harvest life 100% of sapota fruits by 26 days over control 5 days, lower doses of gamma radiation without affecting fruit quality. Higher doses of irradiation 0.8 KGY exhibited brownish spots after 3 days of storage on surface of the fruits.

Yadav *et al.*, (2013 b) [10] revealed that gamma irradiation combined with different plant growth regulator can be used to increase the shelf-life of sapota fruits. Different four treatments imposed in the experiment were (Gibberellic acid) GA_3 200 ppm with dose at 0.2 KGY; (2,4 dichlorophenoxy acetic acid) 2,4-D 4 ppm with dose at 0.2 KGY; GA_3 200 ppm with dose at 0.4 KGY; 2,4-D 4 ppm with dose at 0.4 KGY along with control. They concluded that these treatments resulted lower physiological loss in weight, higher firmness during the entire storage period, decreased spoilage %, increased total soluble solids and sugars, increased acidity and ultimately enhanced shelf-life during storage.

Salunkhe and Desai, (1984) stated that exposure of sapota fruit to gamma irradiation at 0.1 KGY extended storage life by 3–5 days at 26.7 C and 15 days at 10°C temperatures without any effect on ascorbate content.

Conclusion

Sapota is a climacteric fruit. Respiratory pattern in sapota is same as the other climacteric fruits but it will not reach its climacteric peak while attached on the tree. Due to very perishable in nature the fruit is not that much popular. This review attempts to shed light on the edible coating and irradiation of sapota as a shelf-life incremental treatment with maintaining the physico-chemical parameters of fruit. The scarcity of literature indicates good potential for different treatments which help to increase the shelf-life.

Reference

1. NHB. Data Base published by National Horticulture Board Department of Agriculture And Co-operation Government of India, 2016-17.
2. Bose TK, Mitra SK. Fruits: Tropical and subtropical, Naya Prakash, Calcutta, 1990, 565-591.
3. Pasha I, Saeed F, Sultan T, Khan MR, Rohi M. Recent developments in minimal processing; a tool to retain nutritional quality of food. Crit. Rev. Food Sci. Nutr. 2012; 54(3):340-3.
4. Park HJ. Development of advanced edible coatings for fruits. Trends in Food Science & Technology. 1999; 10:254-260.
5. Tharanathan RN. Biodegradable films and composite coatings: Past, present and future. Trends in Food Science & Technology. 2003; 14:71-78.
6. Lacroix M, Ouattara B. Combined industrial processes with irradiation to assure innocuity and preservation of food products-A review. Food Res. Int. 2000; 33:719-72.
7. Sadecka J. Irradiation of spices-A review on trichzech. J Food sci, 2007; 25:231-242.
8. Yadav NKK, Bharathi N, Goud PV. Combined effect of growth regulators and irradiation on shelf life of sapota (*Manilkara achras* (Mill.) Fosberg) cv. Kalipatti. Plant Arch. 2012; 13(2):1039-1042.
9. Padmaja N, John DB. Preservation of Jujube fruits by edible aloe vera gel coating to maintain quality and safety. Ind. J Sci. Res. and Tech. 2014; 2(3):79-88.
10. Yadav NKK, Bharathi N, Goud PV. Effect of irradiation on quality of sapota (*Manilkara achras*) cv. Kalipatti. Inter. J Applied Agri. & Horti. Sci. 2013 b; 3(6):713-715.
11. Srinu B, Bhagwan A, Babu JD, Effect of combination of polypropylene packaging and irradiation on shelf life of sapota fruit stored at low temperature. Environments and ecology. 2015; 33:1672-1675.
12. Dey K, Ghosh A, Bhowmick N, Ghosh A. Physico-chemical properties of sapota (*Manilkara achras* (Mill) Fosberg.) fruits coated with corn starch. J Crop Weed. 2014; 10:43-49.
13. Menezes J, Athmaselvi KM. Study on Effect of Pectin Based Edible Coating on the Shelf Life of sapota Fruits. Bioscience biotechnology research Asia. 2016; 13(2):1195-1199.
14. Menezes J, Athmaselvi KM. Polysaccharide based edible coating on sapota fruit. The Journal of Institute of Agrophysics of Polish Academy of Sciences. 2016; 30(4):551-557.
15. Sarkar HN, Hasan MA, Chattopadhyay PK. Effect of packaging and chemicals on the storage behavior of Sapota. Hortic J. 1995; 8(1):17-24.
16. Chundawat BS. Postharvest handling and marketing of sapota fruits, Navsari, Gujarat, 1991.
17. Salunkhe DK, Desai BB, Postharvest biotechnology of fruits, volume II. CRC Press, Boca Raton, 1984, 387-396.
18. Vishwasrao C, Ananthanarayan L. Delayed post-harvest ripening-associated changes in *Manilkara Zapota* L. Var. LKalipatti with composite edible coting. J Sci Food Agric. 2016; 97(2):536-542.
19. Saha A, Ahlawat A, Yogesh KT, Rajinder KG. Development of chitosan based edible coatings to study sapota (*Manilkara zapota*) fruit shelf life**.** J Chem. and Pharma. Re. 2015; 17:879-885.