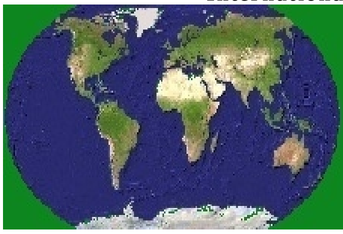
International Journal of Multidisciplinary Research and Development 2014; 1(6): 173-177



International Journal of Multidisciplinary Research and Development

IJMRD 2014; 1(6): 173-177
www.allsubjectjournal.com
Received: 12-10-2014
Accepted: 30-10-2014
e-ISSN: 2349-4182
p-ISSN: 2349-5979

Nguyen Phuoc Minh
Tra Vinh University, Vietnam.

Correspondence:
Nguyen Phuoc Minh
Tra Vinh University, Vietnam

Application of edible coating for acerola preservation

Nguyen Phuoc Minh

Abstract
Acerola fruit is live tissue having high moisture content and which lose water and continue respiration thereby producing heat and water at the expense of food reserves. Fresh fruit cannot continue replenishing carbohydrates or water after harvesting. Packaging plays a decisive role in the improvement of acerola'shelf life and new packaging materials are being developed, most of them are derived from renewable resources. Edible coating is beneficial to the shelf life of postharvest fruit and vegetable. Gelatin-based coating was concerned in recent years owing to its non-toxic, biodegradable, and biocompatible properties. We have successfully exploited gelatin-based coating to extend shelf-life of acerola fruit to approximately 30 days compared to 10 days as normal preservation method.

Keywords: Acerola, gelatin-based coating, shelf-life, postharvest, preservation

1. Introduction

Malpighia emarginata (acerola) is a tropical fruit-bearing shrub or small tree in the family Malpighiaceae. The fruit is edible and widely consumed in local market. The fruit can be used to make juices and pulps, vitamin C concentrate, and baby food, among other things. However, consumers prefer to the fresh fruit consumption. Their characters such as nutrition, favor, and appearance deteriorated during the process of storage and transportation owing to water loss, browning, decay, and so on.

Decay is primarily caused by weight-loss, not only through direct quantitative loss but also through the deterioration of appearance, textural quality (softness, loss of turgidity and juiciness), and nutritional quality (D. Moncayo *et al.*, 2013). Transpiration rate (evaporation of water from plant tissues) is influenced by internal or intrinsic factors (morphological and anatomical characteristics, surface lesions, and maturity stage) (Barreiro and Sandoval, 2006).

Thus, the commercial value also decreases and many damages are caused to producer. To extend the shelf life of postharvest fruit, some effective measures including low temperature, modified atmosphere packaging, irradiation and coating, have been applied (Duan Jianglian and Zhang Shaoying, 2013).

Packaging is widely used for preserving, distributing and marketing fruit and vegetables and is often used in combination with other preservation methods (Hoover, 1997; Miguel A. Cerqueira *et al.*, 2009). However, the disposal of packaging materials leads to ecological problems and additional recycling costs (Tzoumaki *et al.*, 2009; Viña *et al.*, 2007). Edible coatings are one of the most innovative strategies for extending fruit and vegetable shelf-life life; such coatings act as barriers to gas transport and produce similar effects to storage in a controlled atmosphere (Park, 1999).

Edible coatings and edible films are terms which are frequently interchangeably regarding food packaging. A coating is a suspension or an emulsion which is applied directly to the food surface, and later becomes transformed into a film (Souzaet al., 2010). Edible coatings are usually made from materials such as proteins, lipids and polysaccharides; the main polysaccharides used in this are starches and modified starches, cellulose derivatives, chitosan, pectin, alginate and other gums (Hernandez-Izquierdo and Krochta, 2008; Tzoumaki *et al.*, 2009). Thin edible films act as barriers to external elements (such as moisture, lipids and gasses) and improve mechanical properties during handling, transportation and may also serve as food additive carrier. Films also prevent the loss of and even increase volatile flavour production, thus extending product postharvest shelf-life (Azeredo et al., 2012; Durango et al., 2011; Guilbert *et al.*, 1996; Oliva and Barbosa-Cánovas, 2005; Quintero *et al.*, 2010; Ramos *et al.*, 2013).

Edible coatings represent a novel approach to preserving the quality of characteristics such as fresh or minimally-processed products' colour, texture, antioxidant properties and freshness,

thus extending product shelf-life (Ali *et al.*, 2010; Chiumarelli and Hubinger, 2012; Das *et al.*, 2013; Fan *et al.*, 2009; Gounga *et al.*, 2007; Qi *et al.*, 2011; Robles-Sánchez *et al.*, 2013). It has been reported that chitosan (a chitin derivative) can form excellent films having antimicrobial properties; it has been widely used in controlling weight-loss in fresh strawberries (Fragaria x ananassa) and raspberries (Rubus idaeus) (Han *et al.*, 2004; Park, 1999; Ribeiro *et al.*, 2007; Vargas *et al.*, 2006), mango (Mangifera indica), litchi (Martínez-Castellanos, 2009), blueberries (Duan *et al.*, 2011) and other fruit and vegetables (Lin and Zhao, 2007). Coatings consisting of caseinates and milk proteins provide an excellent barrier to oxygen and have been studied for controlling postharvest respiration in apples (Malus sylvestris) (Letien *et al.*, 2001) and strawberries (Vachon *et al.*, 2003).
Acerola is a red fruit whose demand has increased in the last decades, thanks to its high ascorbic acid (Johnson, 2003). However, because of the short postharvest shelf life of the fresh fruit; it is mainly commercialized as puree (Henriette *et al.*, 2012). In this research, we focus on using the edible coating film, gelatin, to extend shelf-life of fresh acerola fruits after harvesting.

2. Material & Method
2.1 Material
Acerola fruits were purchased from a local supermarket of Mekong river delta, Vietnam. All fruits were maintained at 8–10ºC until further use. The fruits were selected for their uniformity, size, colour (paying particular attention at their ripeness state) and the absence of damage and fungal infection. Before testing, the fruits were left at room temperature (20 ºC) and their surface was cleaned with distilled water. Thin portions of the outer surface (skin) of the fruits were cut with a knife and placed on a glass plate for contact angle measurements.

Fig 1: Acerola fruit

i) Gelatin-based coating is prepared as follows: 15 gram of gelatin is dissolved in 1 litre of CH_3COOH 1%; oleic acid 3%: 30g; Tween 80: 1g. Adding gelatin into stainless steel containing CH_3COOH 1%; mixing thoroughly in 30 minutes at 40ºC; heating in 10 minutes, cooling and filtering to remove insoluble particles; adding above materials and mixing; adjusting solution to pH 5.6 by NaOH 0.1N. This solution is ready for coating.

ii) Acerola treatment protocol: Acerola fruit → cleaning → dipping in ozonated solution 140ppm in 5 minutes → coating gelatin→ naturally drying → preserving (temperature 0-2ºC, moisture 90-95%).

2.2 Research method
2.2.1 Basic characteristics of gelatin-based coating film
2.2.1.1 Thickness of gelatin-based coating film
Thickness of gelatin-based coating is measured by Mitutoyo Tokyo equipment, model: 293-766 at room temperature 32 ºC, relative humidity RH 45%.

2.2.1.2 Clearance of gelatin-based coating film
Clearance of gelatin-based coating film is measured by ASTM equipment D1746-92 based on absorbance at wave length 600nm with formula:

$$T = \frac{A_{600}}{b}$$

A_{600}: absorbance of coating film at wave length 600 nm
b: thickness of coating film

2.2.1.3 Moisture permeability of gelatin-based coating film
Moisture permeability of gelatin based coating film is measured by dipping the gelatin-based coating film into phosphat buffer at pH 7.4 in 30 minutes; then absorbs the residual water on the surface of coating film. Weigh the weight of coating film before and after coating. Moisture permeability of gelatin-based coating film is determined

$$W_{ab} = \frac{W_{30} - W_0}{W_0} \text{ x } 100$$

W_{ab}: percentage of water absorbed in coating film
W_{30}: weight of coating film dipped 30 minutes in buffer solution
W_0: weight of coating film before dipping

2.2.1.4 Solubility in water of coating film
Solubility in water of coating film S% is measured by Gontard method when soaking the coating film in water within 24 hours at 25 ºC:

$$S\% = \frac{Wt_0 - Wt_{24}}{Wt_0} \text{x} 100$$

Wt_0: weight of coating film before dipping
Wt_{24}: weight of coating film after dipping 24 hours

2.2.2 Effect of gelatin-based coating film to acerola preservation
2.2.2.1 Ratio of acerola weight loss
Weigh acerola weight before preservation: Po
Weigh acerola weight at measuring point: P
Ratio of acerola weight loss:

$$\Delta P(\%) = \frac{P_o - P}{P_o} x100$$

2.2.2.2 Respiration rate
Measure CO_2 concentration by time using OXYBABY equipment

2.2.2.3. Total soluble solid (TSS)
Total soluble solid (ºBrix) is measured by refractometer (model MR10ATC)

2.2.2.4 Total acidity (TA)
Total acidity is expessed by titration with NaOH 0.1N.

2.2.2.5 Vitamin C content
Vitamin C is measured on HPLC equipment AGILENT 1100 at wave length 254nm, RT = 4.573nm.

2.2.2.6 Sugar content (fructose, glucose, saccharose)
Sugar content (fructose, glucose, saccharose) is determined by HPLC

2.2.2.7 Starch content
Hydrolize starch completely into glucose, then measure glucose, multiply with 0.9 to define starch content.

2.2.2.8 Decay deficiency
Decay deficiency is estimated in scale from 0 to 5.
0: without decay
1: decay less than 5%
2: decay 5% - 10%
3: decay 10% - 20%
4: decay 20% - 30%
5: decay over 30%

2.3 Statistical analysis
All data are processeed by Excel 2003.

3. Result & Discussion
3.1 Basic characteristics of gelatin-based coating film

Table 1: Characteristics of gelatin-based coating film

No	Type of gelatin-based coating film	Thickness (µm)	Clearance (A/mm)	Moisture permeability (%)	Solubility (%)
1	Gelatin-based coating film (with oleic acid)	32±1	180±2	125±2	15±2
2	Gelatin-based coating film (without oleic acid)	30±1	220±2	350±2	34±2

Gelatin-based coating film with oleic acid has the low moisture permeability and solubility compared to the gelatin-based coating film without oleic acid. So the first coating film is suitable for acerola preservation to prevent water loss. We choose gelatin-based coating film with oleic acid 3% to extend shelf-life of acerola fruits.

3.2 Quality of acerola fruit by gelatin-based coating film in preservation

Table 2: Quality of acerola fruit by gelatin-based coating film in preservation

No	Description	0 day	12 days f preservation		30 days of preservation
		Treated sample	Treated sample	Control sample	Treated sample
1	Weight loss (%)	0	3.21	7.25	7.05
2	Respiration rate (ml CO_2/kg/h)	0.03	0.05	0.10	0.08
3	TTS (ºBrix)	11.75	15.41	22.43	19.10
4	TA (mg/100ml)	0.27	0.23	0.14	0.18
5	Vitamin C (mg/100ml)	28.15	26.17	24.11	24.42
6	Total sugar (%)	4.48	6.15	15.39	14.73
	Fructose (%)	1.65	1.88	1.98	2.21
	Glucose (%)	0.59	0.76	0.95	1.01
	Saccharose (%)	0.24	3.51	12.46	12.51
7	Starch (%)	16.23	12.09	1.23	4.62
8	Decay deformity	0	1	3	2

Gelatin-based coating film has good color, clearance, water permeability, solubility for acerola preservation. During preservation, weight of acerola is decreased slightly owing to moisture evaporation. Respiration rate increases from beginning 0.03ml CO_2/kg/h, after 12 days 0.05ml CO_2/kg/h. Meanwhile the control sample has double respiration rate. Total soluble solid (ºBrix) increases owing to starch hydrolization. Acidity and vitamin C are decreased slightly.
Total sugar (fructose, glucose, saccharose) increases during ripen. After 12 days of preservation, decay deformity is evaluated at 3rd level on control sample. Meanwhile, acerola is extended to more than 30 days on gelatin-based coating film (decay deformity at 2nd level).

4. Conclusion
Acerola, when harvested has high moisture content and higher water activity that provides suitable ground for the growth of microorganisms. In addition, the biochemical and metabolic processes do not cease; though the fruit have left their parent plants. The processes such as respiration, senescence, and conversion of starch etc. contribute to the degradation process. Therefore, preservation of these fresh fruits becomes the top most priority for the producers, dealers and vendors. Edible coatings act by creating a

modified atmosphere surrounding the commodity, similar to that achieved by controlled or modified atmospheric storage conditions. The modified atmosphere created by edible coatings protects the food from the moment it is applied until it reaches the final consumer. To effectively extend the shelf life of postharvest acerola fruit, gelatin-based coating as a relatively convenient and safe measure, is more and more concerned in food industry in recent years.

5. Reference

1. Ali A, Maqbool M, Ramachandran S, Alderson PG. Gum arabic as a novel edible coating for enhancing shelf-life and improving postharvest quality of tomato (*Solanum lycopersicum* L.) fruit. Postharvest Biology and Technology 2010; 58(1):42-47.
2. Azeredo HMC, Miranda KWE, Ribeiro HL, Rosa MF, Nascimento DM. Nanoreinforced alginate–acerola puree coatings on acerola fruits. Journal of Food Engineering 2012; 113(4):505510.
3. Barreiro J, Sandoval A. Operaciones de conservación de alimentos por bajas temperaturas., C. Pacheco (Ed.), Venezuela, Equinoccio, 2006.
4. Chiumarelli M, Hubinger MD, solubility S. mechanical and barrier properties of cassava starch – Carnauba wax edible coatings to preserve fresh-cut apples. Food Hydrocolloids 2012; 28(1):59-67.
5. Das DK, Dutta H, Mahanta CL. Development of a rice starchbased coating with antioxidant and microbe-barrier properties and study of its effect on tomatoes stored at room temperature. Food Science and Technology 2013; 50(1):272-278.
6. Duan J, Wu R, Strik BC, Zhao Y. Effect of edible coatings on the quality of fresh blueberries (Duke and Elliott) under commercial storage conditions. Postharvest Biology and Technology 2011; 59(1):71-79.
7. Jianglian D, Shaoying Z. Application of chitosan based coating in fruit and vegetable preservation. J Food Process Technol 2013; 4(5):1-4.
8. Durango AM, Soares F, Arteaga MR. Filmes revestimientos comestibles como empaques activos biodegradables en la conservación de alimentos. *Biotecnología en el Sector Agropecuario y Agroindustrial* 2011; 9(1):112118.
9. Fan Y, Xu Y, Wang D, Zhang L, Sun J, Sun L, Zhang B. Effect of alginate coating combined with yeast antagonist on strawberry (Fragariaananassa) preservation quality. Postharvest Biology and Technology 2009; 53:84-90.
10. Gounga ME, Xu SY, Wang Z. Whey protein isolate-based edible films as affected by protein concentration, glycerol ratio and pullulan addition in film formation. Journal of Food Engineering 2007; 83(4):521-530.
11. Guilbert S, Gontard N, Gorris L. Prolongation of the Shelf-life of Perishable Food Products using Biodegradable Films and Coatings., LWT 1996; 17:10-17.
12. Han C, Zhao Y, Leonard S, Traber M. Edible coatings to improve storability and enhance nutritional value of fresh and frozen strawberries (*Fragaria ananassa*) and raspberries (*Rubus ideaus*). Postharvest Biology and Technology 2004; 33(1):67-78.
13. Azeredo HMC, Miranda KWE, Ribeiro HL, Morsyleide F. Nascimento RDM. Nanoreinforced alginate–acerola puree coatings on acerola fruits. Journal of Food Engineering 2012; 113:505-510.
14. Hernandez-Izquierdo V, Krochta J. Thermoplastic processing of proteins for film formation-a review. Journal of Food Science 2008; 73(2):30-39.
15. Hoover D. Minimally processed fruit and vegetables: Reducing microbial load by nonthermal physical treatments., Food Technology 1997; 51(6):66-71.
16. Johnson PD. Acerola (Malpighia glabra L., M. punicifolia L., M. emarginata D.C.): agriculture, production and nutrition. In: Simopoulos, A.P., Gopalan, C. (Eds.), Plants in Human Health and Nutrition Policy. Karger, Basel, 2003, 67-75.
17. Letien C, Vachion C, Mateescu M, Lacroix M. Milk protein coatings prevent oxidative browning of apples and potatoes. Journal of Food Science 2001; 66:512-516.
18. Lin D, Zhao Y. Innovations in development and application of edible coatings for fresh and minimally processed fruits and vegetables. Comprehensive Reviews in Food Science and Food Safety 2007; 6:1-15.
19. Moncayo D, Buitrago G, Algecira N. The surface properties of biopolymer-coated fruit. Ingeniería E Investigación 2013; 33(3):11-16.
20. Oliva G, Barbosa-Cánovas G. Edible coatings for fresh-cut Fruits., Critical Reviews in Food Science and Nutrition 2005; 45:657-670.
21. Park H. Development of advanced edible coatings for fruits. Trends in Food Science and Technology 1999; 10: 254-260.
22. Qi H, Hu W, Jiang A, Tian M, Li Y. Extending shelf-life of Freshcut "Fuji" apples with chitosan-coatings. Innovative Food Science Emerging Technologies 2011; 12(1):62-66.
23. Quintero CJ, Falguera V, Muñoz HA, Películas y. recubrimientos comestibles: importancia y tendencias recientes en la cadena hortofrutícola. Edible films and coatings: importance and recent trends in the horticultural chain. *Tumbaga* 2010; 5:93-118.
24. Ramos ÓL, Reinas I, Silva SI, Fernandes JC, Cerqueira, MA, Pereira RN *et al*. Effect of whey protein purity and glycerol content upon physical properties of edible films manufactured therefrom. Food Hydrocolloids, 2013; 30 (1):110-122.
25. Martínez-Castellanos G. Uso de bacterias lácticas en recubrimientos de quitosano para la conservación poscosecha de litchi y rambután., Tesis de doctorado presentado a la Universidad Autónoma Metropolitana, Unidad Iztapalapa, 2009.
26. Miguel A, Cerqueira Álvaro M, Lima José A, Teixeira Renato A *et al*. Suitability of novel galactomannans as edible coatings for tropical fruits. Journal of Food Engineering 2009; 94:372-378.
27. Ribeiro C, Vicente AA, Teixeira JA, Miranda C. Optimization of edible coating composition to retard strawberry fruit senescence. Postharvest Biology and Technology 2007; 44(1):6370.
28. Robles-Sánchez RM, Rojas-Graü MA, Odriozola-Serrano I, González-Aguilar G, Martin-Belloso O. Influence of alginatebased edible coating as carrier of antibrowning agents on bioactive compounds and antioxidant activity in fresh-cut Kent mangoes. Food Science and Technology 2013; 50(1):240-246.
29. Souza BWS, Cerqueira MA, Teixeira JA, Vicente AA. The use of Electric Fields for Edible Coatings and Films

Development and Production: A Review. Food Engineering Reviews 2010; 2(4):244255.
30. Tzoumaki MV, Biliaderis CG, Vasilakakis M. Impact of edible coatings and packaging on quality of white asparagus (*Asparagus officinalis,* L.) during cold storage., *Food Chemistry* 2009; 117(1):5563.
31. Vachon C, D' Aprano G, Lacroix M, Letendre M. Effect of edible coating process and irradiation treatment of Strawberry Fragaria spp. on storage - keeping quality. *Journal of Food Science* 2003; 68:608-612.
32. Vargas M, Albors A, Chiralt A, Gonz C. Quality of cold-stored strawberries as affected by chitosan – oleic acid edible coatings. Postharvest Biology and Technology 2006; 41:164-171.
33. Viña SZ, Mugridge A, García MA, Ferreyra RM, Martino MN, Chaves AR, Zaritzky NE. Effects of polyvinylchloride films and edible starch coatings on quality aspects of refrigerated Brussels sprouts. Food Chemistry 2007; 10ss3(3):701-709.