HORTSCIENCE 60(10):1697–1698. 2025. https://doi.org/10.21273/HORTSCI18813-25

Lipid Ester Edible Coating Preserves Postharvest Qualities of Soursop

Yanan Lin, Chang Shu, and Zahra Yusufali
US Department of Agriculture, Agricultural Research Service, US Pacific Basin Agricultural Research Center, 64 Nowelo Street, Hilo, HI 96720, USA

Xiuxiu Sun
US Department of Agriculture, Agricultural Research Service, US Pacific Basin Agricultural Research Center, 64 Nowelo Street, Hilo, HI 96720, USA; and US Department of Agriculture, Agricultural Research Service, Southeastern Fruit & Tree Nut Research Station, 21 Dunbar Road, Byron, GA, 31008, USA

Keywords. Annona muricata, postharvest, total phenolic content, total antioxidant capacity, volatiles

Abstract. **A lipid ester edible coating (Nature-Cote™ AVO) delayed the onset of senescence in the tropical fruit soursop (*Annona muricata*). The total soluble solids/titratable acidity of the coated fruit was 15% higher than the control. The total phenolic content and total antioxidant capacity of the coated fruit were 23% and 24% higher than the control, respectively. The presence of the alcoholic compounds 1-hexanol and 3-hexen-1-ol indicated that the control fruit progressed to a more advanced level of fermentation compared with the coating treated fruit.**

Soursop (*Annona muricata* L.) is a tropical fruit rich in polyphenols and antioxidants but with a short postharvest life prone to browning and reaching senescence after 5 d at room temperature (Vu et al. 2023). Soursop fruits approaching senescence during storage have greater softness and deteriorated levels of vitamin C, polyphenols, and total soluble solids (Vu et al. 2023). Preserving nutritional and sensory qualities of soursop is important in preparing it for commercialization.

Edible coatings are composed of edible polymers that protect fruit from the external environment (Kumar et al. 2017). They create a semipermeable protective layer around the fruit surface that modifies the surrounding gaseous environment (Yadav et al. 2023). This reduces respiration rate and ethylene biosynthesis, which extends shelf life (Kumar et al. 2017). Different polymers may have varying levels of effectiveness depending on the physical qualities of the tropical fruit on which they are applied (Yadav et al. 2023).

The present study explored the use of a lipid ester edible coating to preserve soursop. Nature-Cote AVO edible coating is a water-soluble polymer composed of food-grade monoglycerides, diglycerides, and sorbitan esters. The untreated control and the coated fruit were compared over 7 d for total soluble solids (TSS), titratable acidity (TA), total phenolic content (TPC), total antioxidant capacity (TAC), and volatiles.

Received for publication 24 Jun 2025. Accepted for publication 21 Jul 2025.
Published online 29 Aug 2025.
X.S. is the corresponding author. E-mail: xiuxiu.sun@usda.gov.

Materials and Methods

Fruit with 14.8 °Brix and 0.52% TA were picked from a farm in Keaau, HI, USA. Nature-Cote AVO was obtained from JBT Corporation (Chicago, IL, USA). Five milliliters of coating solution was brushed onto the fruit surface and air dried. The control and coated fruit were stored for 7 d at a temperature of 20 ± 0.5 °C with a relative humidity of 45%. Three samples each were taken for control and coating treatments, and the experiments were conducted in triplicate. Fruit pulp was taken from both hemispheres of the fruit. The juice was strained with cheesecloth. The TSS of the juice was measured with a PAL-3 Atago refractometer (Bellevue, WA, USA). The TA of the juice was measured with the GMK-835N acidity meter (G-WON, Seoul, South Korea), and the result was expressed as percentage.

The TAC was determined with the TAC kit (MAK334, ThermoFischer, Pittsburgh, PA, USA). Absorbances were measured at 570 nm using a SpectraMax M2 (Molecular Devices, Sunnyvale, CA, USA). The Folin-Ciocalteu method was used to determine the TPC (Spanos and Wrolstad 1990). Absorbances were measured at 750 nm using the SpectraMax M2.

Volatiles were examined using solid-phase microextraction-gas chromatography mass spectrometry using a divinylbenzene/carboxen/polydimethylsiloxane fiber following an adjusted method seen in prior studies (Li et al. 2020). Samples were extracted as described in a previous study (Yusufali et al. 2024). The adjusted oven temperature regime was: 40 °C (5 min), 15 °C·min^{-1} to 250 °C, and 5 min at 250 °C. Compounds were identified by their linear retention indices and structure.

One-way analysis of variance with a *P* value threshold of 0.05 was used to assess changes in the organoleptic qualities of soursop fruit induced using edible coating.

Results and Discussion

The TSS/TA ratio of the coated fruit was 13% higher than control (Table 1). There were no negative effects on fruit quality in the coated fruit as indicated by the TSS/TA values. The TA in coated fruit was significantly lower than the control (Table 1), which may reflect increased organic acid breakdown by the coating treatment (Batista-Silva et al. 2018).

The TPC and TAC of the control were 23% and 24% lower than the coated fruit, respectively (Table 1). TPC decreases at the climacteric peak of soursop (Paull 1982). Lower values for both in the control fruit reflect ripening-associated losses and delayed ripening in the coated sample relative to the control (Quirós-Sauceda et al. 2019). Lipid and polysaccharide coatings protect flavonoids by reducing respiration and ethylene synthesis (Kohli et al. 2024). Higher TPC and TAC in the coated sample suggests this effect is present in lipid-based coatings on soursop.

Both sample volatile profiles contained alcohols and esters with the alcohols 1-hexanol, hexen-3-ol, and nonanol uniquely present in the control sample (Table 2). These fermentation products reflected overripening and fermentation onset during storage in the control (Vázquez-Araújo 2023). Additionally, the relative abundance of ethanol in the control was greater than the coated fruit. This indicates that the coating may have delayed fruit degradation and the natural fermentation process of the fruit. Butanoic acid, 3-hydroxy, methyl ester (S), 3-octenoic acid, methyl ester (Z), and the hexenoic acid methyl esters found in the control are known microbial esterification products (Yu et al. 2022). The presence of linalool oxide may further indicate a loss of antioxidative activity in the control (Fu et al. 2024).

The coated fruit yielded higher TSS/TA, TPC, and TAC compared with the control. The presence of the alcoholic compounds

Table 1. Total soluble solids (TSS), titratable acidity (TA), TSS/TA, total phenolic content (TPC), and total antioxidant capacity (TAC) of soursop after 7 d of storage at room temperature.

Treatment	TSS (°Brix)	TA (%)	TSS/TA	TPC (GAE/mg)	TAC (μM/mL)
Control	15.03 ± 0.21	0.78 ± 0.02 a	19.40 ± 0.26 b	15.62 ± 1.09 b	2188.095 ± 91.007 b
Nature-Cote AVO	14.93 ± 0.06	0.67 ± 0.03 b	22.31 ± 0.87 a	20.26 ± 0.50 a	2895.238 ± 91.007 a

The results are expressed as mean ± standard deviation (n = 3), followed by different letters within a column, which indicate significant differences using a Tukey's honestly significant difference comparison test at $P \leq 0.05$.

Table 2. Volatile compound profile for soursop after 7 d of storage.

Compound	Class	Aroma
Acetaldehyde[i]	Aldehyde	Fresh, green
Ethanol[i]	Alcohol	Wine-like
Butanoic acid, methyl ester[i]	Ester	Apples, pineapples
2-Butenoic acid, methyl ester (E)[ii]	Ester	Sharp, green, fruity
Hexanoic acid, methyl ester[i]	Ester	Apples, pineapples
2-Hexenal[i]	Aldehyde	Fruity, citrus
3-Hexenoic acid, methyl ester (Z)[ii]	Ester	Fruity, floral
2-Hexenoic acid, methyl ester (E)[ii]	Ester	Fruity, green, honey
1-Hexanol[ii]	Alcohol	Pungent, alcoholic, green
3-Hexen-1-ol[ii]	Alcohol	Green, grassy, oily, melon
3-Hexen-1-ol (E)[iii]	Alcohol	Leafy, grassy
Octanoic acid, methyl ester[i]	Ester	Waxy, citrus, herbal
2,4-Hexadienoic acid, methyl ester[iii]	Ester	Sweet, fruity, licorice
Nonanol[ii]	Alcohol	Cucumber, green, cheesy
Methyl sorbate[i]	Ester	Sweet, fruity, green, anise
Linalool oxide[ii]	Terpenoid	Floral, herbal, earthy, green
3-Octenoic acid, methyl ester (Z)[ii]	Ester	Fruity, woody, coconut
Butanoic acid, 3-hydroxy, methyl ester (S)[ii]	Ester	Fruity, apple
Nonanoic acid, methyl ester[i]	Ester	Fruity, pear, winey, tropical
2-Octenoic acid, methyl ester[iii]	Ester	Fruity, pear
Pentanoic acid, 2-hydroxy, 3-methyl, methyl ester[ii]	Ester	Fruity, caramelly, ester-like
4-Isopropyl 1-methylcyclohex-2-enol[ii]	Terpenoid	Spicy, woody, herbal
Terpinen-4-ol[iii]	Terpenoid	Woody, spicy
Benzoic acid, methyl ester[iii]	Ester	Bitter, phenolic, cherry
Pentenoic acid[iii]	Fatty acid	Cheesy, fruity, buttery
Benzenepropanoic acid, methyl ester[iii]	Ester	Honey, floral, balsamic
Benzenepropanoic acid, methyl ester[ii]	Ester	Honey, fruity, wine-like
2-Propenoic acid 3-phenyl methyl ester[iii]	Ester	Sweet, balsamic, fruity

[i] Compounds confirmed in both control and coated fruit.
[ii] Compounds confirmed solely in control.
[iii] Compounds confirmed solely in coated fruit.

1-hexanol and 3-hexen-1-ol supports the physical observation that the control fruit progressed to a more advanced level of fermentation compared with the treated fruit. These results indicate that lipid-based coatings may extend the shelf life of tropical fruits such as soursop. Further experimentation based on current postharvest advances in temperature and humidity control to prolong storage may be merited. A combination of edible coatings and controlled environment storage may improve soursop's viability for commercialization.

References Cited

Batista-Silva W, Nascimento VL, Medeiros DB, Nunes-Nesi A, Ribeiro DM, Zsögön A, Araújo WL. 2018. Modifications in organic acid profiles during fruit development and ripening: Correlation or causation? Front Plant Sci. 9:1689. https://doi.org/10.3389/fpls.2018.01689.

Fu Z, Guo S, Yu Y, Xie HB, Li S, Lv D, Zhou P, Song K, Chen Z, Tan R, Hu K, Shen R, Yao M, Hu M. 2024. Oxidation mechanism and toxicity evolution of linalool, a typical indoor volatile chemical product. Environ Health. 2(7):486–498. https://doi.org/10.1021/envhealth.4c00033.

Kohli K, Kumar A, Singh O, Dey P. 2024. Composite edible coatings can extend shelf-life and maintain postharvest qualities of guava under natural storage. Hort Environ Biotechnol. 65(3): 413–431. https://doi.org/10.1007/s13580-023-00576-1.

Kumar P, Sethi S, Sharma RR, Srivastav M, Varghese E. 2017. Effect of chitosan coating on postharvest life and quality of plum during storage at low temperature. Sci Hort. 226: 104–109. https://doi.org/10.1016/j.scienta.2017.08.037.

Li Y, Wang Y, Yuan D, Li Y, Zhang L. 2020. Comparison of SDE and SPME for the analysis of volatile compounds in butters. Food Sci Biotechnol. 29(1):55–62. https://doi.org/10.1007/s10068-019-00647-z.

Paull RE. 1982. Postharvest variation in composition of soursop (*Annona muricata* L.) fruit in relation to respiration and ethylene production. J Am Soc Hort Sci. 107(4):582–585. https://doi.org/10.21273/JASHS.107.4.582.

Quirós-Sauceda AE, Sañudo-Barajas JA, Vélez-de la Rocha R, Domínguez-Avila JA, Ayala-Zavala JF, Villegas-Ochoa MA, González-Aguilar GA. 2019. Effects of ripening on the in vitro antioxidant capacity and bioaccessibility of mango cv. Ataulfo phenolics. J Food Sci Technol. 56(4):2073–2082. https://doi.org/10.1007/s13197-019-03685-x.

Spanos GA, Wrolstad RE. 1990. Influence of processing and storage on the phenolic composition of Thompson Seedless grape juice. J Agric Food Chem. 38(7):1565–1571. https://doi.org/10.1021/jf00097a030.

Vázquez-Araújo L. 2023. Analysis of volatile compounds during food fermentation. Foods. 12(19):3635. https://doi.org/10.3390/foods12193635.

Vu ND, Doan TKL, Dao TP, Tran TYN, Nguyen NQ. 2023. Soursop fruit supply chains: Critical stages impacting fruit quality. J Agri Food Res. 14:100754. https://doi.org/10.1016/j.jafr.2023.100754.

Yadav A, Kumar N, Upadhyay A, Anurag RK, Pratibha. 2023. Edible packaging from fruit processing waste: A comprehensive review. Food Rev Int. 39(4):2075–2106. https://doi.org/10.1080/87559129.2021.1940198.

Yu S, Song J, Hu T, Wang J, Liu X, Zheng Y, Shi L, Wan S, Wang M. 2022. Unraveling the core functional bacteria and their succession throughout three fermentation stages of broad bean paste with chili. Food Sci Hum Well. 11(4): 874–885. https://doi.org/10.1016/j.fshw.2022.03.011.

Yusufali Z, Follett P, Wall M, Sun X. 2024. Physiochemical and sensory properties of a turmeric, ginger, and pineapple functional beverage with effects of pulp content. Foods. 13(5):718. https://doi.org/10.3390/foods13050718.