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Fatty Acid Coating Reduces Weight Loss and Inhibits Browning of Breadfruit

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Abstract. **Breadfruit (*Artocarpus altilis*) has been identified as a priority staple crop with various nutritional benefits. However, due to its vigorous postharvest metabolism, its postharvest commercialization and application are greatly limited. Fruit-coating technology provides a promising strategy for breadfruit preservation due to its ease of use and reliability. In this study, six types of coatings were applied to breadfruit, and their effects on postharvest duration and quality were observed. Fatty acid emulsion [Coating 1 (C1)], reduced weight loss by 75% relative to the control. Carnauba wax emulsions and shellac reduced weight loss by 50% compared with the control. Fruit browning and shriveling were greatly reduced with C1 or shellac (C6) after 7 days of storage. Fruit firmness changed from 55 to 2 N after 7 days in storage. All emulsions slowed the loss of firmness, with values from 15 to 25 N after the storage interval. Soluble solids content (SSC) increased from 5% in day 0 fruit to 20% to 35% in all coated breadfruit after 7 days, regardless of coating type. Titratable acidity was lower in the breadfruit treated with two types of carnauba nanoemulsions relative to the other coatings, to control, and to the day 0 fruit. Zeta potential values were positive for the fatty acid emulsion and negative for carnauba and shellac emulsions. This difference indicates that the fatty acid emulsion formed an evenly distributed film on the fruit surface, effectively slowing weight loss. Fourier transform infrared spectroscopy analysis provided important information on the chemical composition of the coatings, revealing how specific functional groups govern their hydrophobic, film-forming, and emulsifying properties, which are essential for uniform adhesion and effective postharvest preservation. Overall, the application of emulsions helped slow weight loss and softening of breadfruit. Incorporation of a simple wax treatment after harvest may help double storage life and reduce losses.**

Breadfruit (*Artocarpus altilis*) is a tropical plant originating from the Pacific Islands, where its fruit is widely cultivated for its high starch content and often cooked and used like a potato. Currently, more than 100 cultivars are adapted to tropical climates globally and offer an easily cultivated, high-calorie food for rural communities (Langston and Lincoln 2018; Lincoln et al. 2018). Although rich in amino acids, a good source of vitamin C and minerals, and low in fat, breadfruit are climacteric (Badrie and Broomes 2010). Breadfruit can be used at all stages of development and prepared in many ways. It is typically eaten at the mature, starchy stage, when it is often used as a potato substitute in many dishes. Firm, mature breadfruit can be eaten by itself with minimal to no seasoning or to replace any starchy root vegetable like potato in almost any recipe. However, the most common way to eat breadfruit is to first cook it. It can be baked, steamed, boiled, fried, microwaved, grilled, barbecued, and more. Breadfruit have a postharvest shelf life of only 2 to 5 d, with elevated respiration and polyphenol oxidase (Ragone 2018). Skin browning can occur within 2 to 3 d at 20 °C and 5 d at 8 °C, and the accelerated respiration leads to putrefaction (Samsoondar et al. 2000). These challenges curtail local and export market opportunities.

Preservation strategies such as low temperature storage, modified atmosphere (MA) packaging, dehydration, and use of preservatives have all been applied for breadfruit preservation and processing (Roopa et al. 2015; Sankat and Maharaj 2007; Yahia 2006). Edible coatings have been used for many fruits over the years, offer a means to extend shelf life in a cost-effective and simple way (Sun et al. 2014), and have been extensively employed in the industry (Bai et al. 2003; Sun et al. 2017). Wax coatings are widely applied to postharvest fruit to reduce moisture loss and respiration, extending shelf life and maintaining quality (Miranda et al. 2021). However, their potential negatives should also be concerned under some circumstances, such as interference with natural ripening, disturbing sensory properties, and consumer concerns toward the safety and edibility of the coatings themselves (Njombolwana et al. 2013). Carnauba wax is derived from the leaves of the Brazilian carnauba palm (Devi et al. 2022) and is popular in the food industry due to its biodegradability, its antimicrobial and antifungal activity against decay causing microorganisms, and for being accepted as safe for human consumption (Haruna et al. 2019). Carnauba wax coatings have been widely used for citrus preservation (Babarabie et al. 2024). Shellac is another edible and natural form of wax secreted by the lac bug. It has been used for postharvest fruit preservation in foods such as tomatoes (Chauhan et al. 2015), citrus (McGuire and Hagenmaier 1996; Miranda et al. 2021), and apples (Alleyne and Hagenmaier 2000). Shellac coatings are also known to cause the establishment of an internal MA; however, anaerobic compounds and physiological disorders may occur when not being used appropriately (Contreras-Oliva et al. 2012). Fatty acids are long chains of carbon, hydrogen, and oxygen atoms, and they have also been used as wax coating materials due to their antimicrobial and biodegradable properties (Prudnikov et al. 2023). Work in this field is also being conducted to combine current postharvest handing methods with coatings to extend shelf life.

The physical properties of wax coatings are important characteristics for their application. Microemulsions and nanoemulsions are both types of emulsions with small droplet sizes, but they differ primarily in their thermodynamic stability and how they are prepared. Thermodynamic stability describes whether a system will spontaneously change to a lower energy state, indicating its inherent tendency to react, whereas kinetic stability refers to the rate at which a system changes or how resistant it is to reactions over time (Port et al. 2008). Microemulsions are thermodynamically stable, meaning that they can exist in equilibrium without phase separation, while nanoemulsions are kinetically stable and tend to separate over time. Microemulsions typically have droplet sizes ranging from 100 to 400 nm, whereas nanoemulsions have droplet sizes ranging from 1 to 100 nm (Souto et al. 2022). Although nanoemulsions are thermodynamically unstable, due to their smaller droplet size and kinetic stability, they are more stable than microemulsions when applied to food systems (Miranda et al. 2022). The stronger Brownian motion of smaller droplets effectively resists gravity-induced creaming or sedimentation; in addition to their larger surface area, nanoscale droplets with high interfacial tension slow down the Ostwald ripening; smaller droplet mass and kinetic energy help reduce coalescence during collisions. However, the final stability and performance of these systems are highly dependent on various factors, including the specific preparation methods, the precise compositions, and the presence of any cosurfactants or other additives. Nanoemulsions, in general, have a better water barrier and better mechanical, optical, and microstructural properties compared with coatings based on conventional emulsions (de Oliveira Filho et al. 2021). Previous studies have demonstrated that nanoemulsions form more uniform and compact films due to their small droplet size compared with emulsions composed of larger droplet size. This leads to better barriers against moisture loss, gas exchange (O_2, CO_2, C_2H_4), and microorganism infection (Miranda et al. 2021, 2022; Soni et al. 2023). This contributes to improving postharvest quality, reducing weight loss, delaying ripening and senescence, and suppressing metabolism in postharvest fruit. Studies demonstrated that nanoemulsions form more uniform and compact films on fruit surfaces creating a microenvironment that helps regulate metabolism in postharvest fruit (de Oliveira Filho et al. 2021; Miranda et al. 2021).

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The goal of this study was to explore the capability of wax coatings and types of emulsion to affect the physicochemical properties of breadfruit stored at 20 ± 0.5 °C and a relative humidity of 45 ± 2% (shelf life storage conditions) for 7 d. The effects of the coatings on the physical and chemical properties of the breadfruit were investigated, including attributes such as color, weight loss, decay rate, firmness, total soluble solids content (SSC), and titratable acidity (TA), throughout the storage period. The study provides a theoretical and application basis for using wax coatings to improve the marketability and extend the shelf life of breadfruit.

Materials and Methods

Fruit and coating treatments. Mature breadfruit (*Artocarpus altilis* cv Ma'afala) were harvested from a breadfruit variety trial at Pepe'ekeo, Hilo, Hawai'i (Lincoln et al. 2019), located on the east coast of Hawai'i Island at 7 m above sea level (19.8472949° to 155.0818276°). The site receives an average rainfall of 3367 mm/year (142 inches) with a mean annual temperature of 22.6 °C. 'Ma'afala' fruit with no visible mechanical damage were harvested, and the fruit were of similar size (weight = 923 ± 98 g, diameter of 125 mm) and fully mature (as indicated by dark green color and rounded smooth segments). Fruit were then transported to the US Department of Agriculture's Pacific Basin Agricultural Research Center (USDA-PBARC) facility in Hilo, Hawai'i, under ambient conditions (∼25 °C) within 1 h of harvest. Fruit were soaked in cold tap water (10 °C) for 20 min to dissipate field heat and cool them down to ∼18 °C, and then quickly rinsed in flowing distilled water (20 °C) and then left to dry before being coated at 20 °C.

Coatings consisted of emulsions, including micro- and nanoemulsions of carnauba, shellac, and fatty acid (Table 1) obtained from John Bean Technologies Corporation (Chicago, IL, USA). A fatty acid emulsion (C1), a carnauba microemulsion (C2), three carnauba nanoemulsions (C3, C4, and C5), and a shellac emulsion (C6) were used in this study.

Approximately 1 mL of each coating material was manually applied to the fruit peel with latex-gloved hands until complete and even coverage was achieved (Shu et al. 2024). Ten fruits were treated with each coating, with controls being fruit without any applied coating. Ten fruit in each replicate and three replicates in each treatment comprised the experiment. All the fruit were placed in randomized order, well spaced (>10 cm) in a well-ventilated area at 20 ± 0.5 °C and a relative humidity of 45 ± 2% for 7 d. All fruit appearance and weight were taken daily using nondestructive means, and after 7 d the fruit was destructively sampled for firmness, SSC, and TA. The experiment was repeated three times.

Fruit appearance, weight loss, firmness, total SSC, and TA of breadfruit. Weight loss and fruit appearance were monitored daily for 7 d, then firmness, SSC, TA were determined. Weight loss (%) was presented based on the initial fruit weight.

A texture analyzer (Chatillon, LTCM-100; AMETEK, Inc., Berwyn, PA, USA) using a 0.6-cm-diameter probe with rounded tip pushed at a speed of 25.4 cm·min^{-1} was used to measure pulp firmness by puncturing the pulp at the equatorial region 5 mm under the peel to a maximum depth of 1 cm. All data were recorded in Newtons (N). For each repeat at each time interval, three fruit in each treatment were punctured at two opposite sites along the equator of the fruit.

Approximately 20.0 g of fresh pulp in total was excised between 0.5 and 1.5 cm under the epidermis from each of three fruit for each replicate. The flesh was cut into small cubes, put in muslin cloth, and crushed manually, and the filtered juice was collected for further determination. SSC was measured with a PAL-3 refractometer (ATAGO U.S.A., Inc., Bellevue, WA, USA) and is presented as °Brix. TA was measured with a GMK-835F acidity meter (G-WON, Seoul, Korea), which determines the quantity of hydrogen ions and this value is presented as %TA (lactic acid).

Particle size, polydispersity index, and zeta potential of the coatings. Each coating solution was diluted 10 times, and 2.0 mL of these dilutions were added into a cuvette. A dynamic light scattering method for measuring particle size, polydispersity index (PDI), and zeta potential was employed using a Zetasizer analyzer (Ultrablue; Malvern Instruments Ltd, Worcestershire, United Kingdom) at 20 °C. Resulting data were processed via the XS Xplorer 3.2.0.84 software (Malvern Instruments Ltd). The results are the mean of three replications.

Fourier transform infrared spectroscopy of the coatings. The film's Fourier transform infrared spectroscopy (FTIR) spectra were recorded with an IRTracer-100 spectrometer (Shimadzu Scientific Instruments, Kyoto, Japan) equipped with an attenuated total reflectance diamond crystal. Spectra with wavelengths between 400 to 4000 cm^{-1} were collected with a scan rate of 20 spectra per second with a sensitivity of 0.25 cm^{-1} and with the measurement of an empty cell at 20 °C was used as the base background for spectrum calibration. FTIR data were analyzed in Microsoft Excel (Redmond, WA, USA).

The microstructure of the coatings on breadfruit surface. A food grade red dye (McCormick, Hunt Valley, Cockeysville, MD, USA) was added to the wax coating at a ratio of 1:20 (v/v) to improve the contrast between coating and fruit surface. The dyed coating (1.0 mL) was then applied on breadfruit peel,

Table 1. Coating information.

Coating	Main ingredient	Commercial name
C1	Fatty acid	Nature-Cote
C2	Carnauba	Endure-fresh 196V
C3	Carnauba	Endure-fresh 6100
C4	Carnauba	Endure-fresh 9000
C5	Carnauba	Natural Shine TFC210
C6	Shellac	Natural Shine 505-OR

Fig. 1. Visual color changes in breadfruit during storage at 7 d, 20% ± 0.5 °C and relative humidity 45 ± 2% within coating type (see Table 1 for description). The color scale is light green (1) to dark brown (5). Color scale values of 1 to 3 are considered marketable.

and the microstructure of the coating surface and the cross section on the surface was analyzed using an Olympus DSX-1000 digital microscope (Olympus, Tokyo, Japan).

Statistical analysis. All determinations were replicated at least three times. All data were arranged and visualized using Microsoft Excel and evaluated with specialized analysis software (JMP version 16; SAS Institute, Cary, NC, USA). Evaluation of the effect of the various treatments on the quality attributes of breadfruit was determined using one-way analysis of variance (ANOVA) at each individual timepoint. To determine statistical significance between groups, separation of means was evaluated via Tukey's honestly significant test with significance at $P < 0.05$ for the different groups at individual timepoint.

Results and Discussion

Weight loss and firmness of breadfruit. The control fruit were shriveled and dark brown in color after 7-d storage (Fig. 1). Fruit treated with C1 had the best visual quality, defined as least yellowing and browning, followed by C5, compared with the control. After 3 d, the control fruit were not marketable, but the C1 treated fruit were still marketable at day 7 (Fig. 1).

Control fruit showed the highest weight loss during the entire storage period (Fig. 2). C1 reduced the weight loss of breadfruit the most, and the weight loss of C1 was significantly lower than all other groups (Fig. 2). The weight losses of fruit treated with the other coatings were significantly lower than the control but statistically indistinguishable from each other (Fig. 2). After 7 d of storage, the weight loss of breadfruit treated with C1 was <12%, whereas the control group was >25% (Fig. 2).

Weight loss highly affects the profit of many commodities since they are often sold by weight (Miranda et al. 2022). Our consultations with breadfruit producers reveal that weight loss is a significant issue as breadfruit can lose 10% of its weight by the time it reaches a processing facility, with additional weight loss afterward (personal correspondence; data not presented). Coatings may reduce weight loss by blocking lenticels, stomata, and other surface openings (Bai and Plotto 2012). In this study, all the coatings significantly reduced weight loss, with C1 showing the best effect. This is probably due to C1 forming a thick and uniform protection layer on the fruit surface.

At day 0, the flesh firmness was 53.94 ± 5.02 N. After 7 d, the firmness of the control was only 1.65 N, whereas the average firmness of all coating groups ranged from 16.41 to 25.68 N (Fig. 3). All the coating-treated fruit were significantly firmer than control but not statistically different from each other (Fig. 3). A clear association between weight loss and firmness was established in breadfruit. It has been proposed that wax coatings could maintain firmness, inhibit weight loss, and lower fruit metabolism (Günal-Köroğlu and Capanoglu 2024). Firmness is an important factor affecting the transportation and handling of fresh fruits (Sun et al. 2024). Various coatings extended the shelf life of all fruits in a study by about doubling the time it took for them to become completely soft and unable to withstand the probe of a texture analyzer (Ball 1997).

SSC, TA, and SSC-to-TA ratio. SSC was 5.93 ± 0.29°Brix at day 0 and increased dramatically after 7 d (Table 2). Control was significantly higher than all other coating groups. Among coated groups, C1 treated fruit had the highest mean SSC, but it was not statistically nor substantially different from the other coatings. TA at day 0 was 1.17 ± 0.15% but did not show any significant difference within different coatings and control at day 7 (Table 2). The SSC-to-TA ratio was 5.17 ± 0.90 at day 0 and increased dramatically after the storage interval due to the increased SSC, but there were no significant differences between the groups (Table 2).

Ripe breadfruit shows an SSC and TA level >15% and <1.5%, respectively. A higher SSC-to-TA ratio, generally >10, is often associated with better palatability in breadfruit, although specific optimal ratios may vary depending on the variety and consumer preferences (Sankat and Maharaj 2007). Previous research showed that coatings can have significant effects on reducing SSC content loss in breadfruit (Worrell and Carrington 1997). Wax coatings helped in minimizing the loss of SSC while also affecting the TA, which was maintained at °Brix 15 or higher for a longer storage time for apples (Islam et al. 2024; Mao et al. 2022). Similarly, two types of wax treatment (Sta-Fresh 2952 wax and Sta-Fresh 7055 wax) decreased the TA of pineapple (Hu et al. 2011). This might have been caused via the suppression of respiration. In addition, hydrophobic coatings significantly increased the SSC/TA value and improved cherry quality (Rojas-Argudo et al. 2005).

Particle size, PDI, and zeta potential of the coatings. The particle size varied between coatings, with each coating being significantly different from all others. The average particle size of C1 (32.2 μm) was significantly and substantially larger than the next largest coating (0.4 μm) (Table 3). The PDI of C1 was significantly lower than C3 and C5, but not significantly different from the three other coatings (Table 3). The zeta potential of C1 was significantly different from all other coatings, whereas the remaining coatings were statistically indistinguishable from each other. The zeta potential for C1 was positive, whereas for the other five coatings, it was negative.

Particle diameter, PDI, and zeta potential correlated with the stability of the coating emulsions (Lemarchand et al. 2003). The average uniformity of a particle solution is estimated using the PDI, and an increasing value

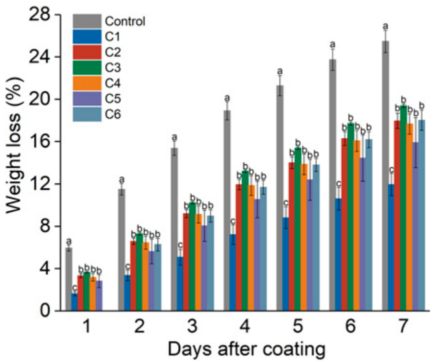

Fig. 2. Weight loss of breadfruit with different coatings (see Table 1 for description) during storage at 20 ± 0.5 °C and relative humidity 45% ± 2%. Each value is the average of three replicates. The vertical bars represent the standard errors of the means. Different letters indicate significant differences ($P < 0.05$) between different groups at the same timepoint, based on Tukey's honestly significant difference test following a significant one-way analysis of variance.

Table 2. Breadfruit soluble solids content (SSC), titratable acidity (TA), and SSC-to-TA ratio after storage at 20 ± 0.5 °C and RH 45 ± 2% for 7 d.

Treatment	SSC (°Brix)	TA (%)	SSC-to-TA ratio
Control	29.80 ± 2.66 a	1.39 ± 0.05	21.48 ± 2.68
C1	25.40 ± 0.33 b	1.30 ± 0.08	19.61 ± 1.05
C2	23.67 ± 1.79 b	1.44 ± 0.11	16.63 ± 2.61
C3	24.93 ± 1.27 b	1.11 ± 0.12	22.54 ± 1.33
C4	23.40 ± 2.56 b	1.00 ± 0.06	23.57 ± 3.99
C5	26.50 ± 1.36 b	1.17 ± 0.16	23.27 ± 4.91
C6	25.73 ± 2.03 b	1.32 ± 0.06	19.55 ± 1.33

Each value is the mean of three replicates. The result was indicated by mean ± standard deviation. Different letters designate significant differences (analysis of variance, $P < 0.05$) between treatments at the same timepoint, according to Tukey's comparison test. Coatings C1 through C6 are defined in Table 1.

Table 3. Physical properties of coatings used on breadfruit.

Coating	Particle diam (nm)	Polydispersity index	Zeta potential (mV)
C1	32200 ± 13900 a	0.62 ± 0.25 cd	6.03 ± 7.65 a
C2	420.10 ± 136.10 b	0.62 ± 0.03 c	−48.21 ± 2.30 b
C3	54.63 ± 1.22 e	0.99 ± 0.00 a	−42.36 ± 2.75 b
C4	58.13 ± 0.29 d	0.59 ± 0.00 c	−45.43 ± 2.03 b
C5	37.77 ± 1.18 f	0.94 ± 0.03 b	−43.45 ± 3.71 b
C6	193.00 ± 4.95 c	0.47 ± 0.03 d	−47.14 ± 3.04 b

Value is the mean of three replicates. The result was indicated by mean ± standard deviation. Different letters designate significant differences (analysis of variance, $P < 0.05$) between coatings, according to Tukey's comparisons test. Coatings C1 through C6 are defined in Table 1.

on the PDI parallels an increase in the distribution of particle sizes in a solution. A PDI ≤0.3 is considered a desirable characteristic and indicates a homogenous population of phospholipid vesicles. The PDI of all the six wax coatings were >0.3 (Table 3). Zeta potential is a measure of the electrical charge on the surface of particles in a suspension or dispersion. It is a crucial parameter for understanding and predicting the stability of these systems. Generally, nanoparticles with zeta potential values above ±30 mV demonstrate stability in suspension because the surface charge prevents particle aggregation (Ohashi et al. 2015). The zeta potential of C2 to C6 were above ±30 mV (Table 3). Therefore, these coatings were more stable than C1.

Wax particles with a net negative surface charge had a double-layer of electrostatic repulsion, and their dispersion in solution was stable (Hunter 2013). These electrostatic charges originated from the existence of functional hydrophilic groups, including single bond -OH, single bond -COOH, and single bond -CHO, in waxes of natural origin (Wagner et al. 2003). These hydrophilic moieties will orient toward the polar water phase when melted wax is mixed in water, resulting in the surface of the particle being more hydrophilic than its center (Lozhechnikova et al. 2017).

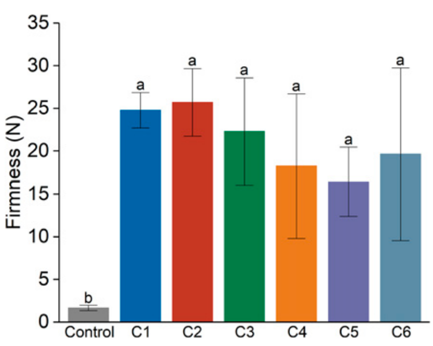

Fig. 3. Breadfruit firmness after 7 d storage at 20 ± 0.5 °C and relative humidity 45% ± 2% for 7 d. Each value is the mean of three replicates. Vertical error bars indicate the mean standard error. Different letters indicate significant differences ($P < 0.05$) between different groups at the same timepoint, based on Tukey's honestly significant difference test following a significant one-way analysis of variance. Coatings C1 through C6 are defined in Table 1.

FTIR spectroscopy of the coatings. The FTIR spectra of the coating materials are shown in Fig. 4. FTIR has the ability to identify and characterize materials based on their molecular vibrations. The type of emulsion (macro, micro, or nano) can indirectly influence the FTIR spectra by affecting the molecular interactions within the emulsion and the physical characteristics of the droplets (Dinache et al. 2021). The results did not show substantial differences among the spectra obtained from C3, C4, and C5 (Fig. 4), which was expected because they are all derived from the same main ingredient, carnauba. The results showed a spectrum with CH stretching bands between 2800 and 3000 cm^{-1}. Peaks in this region correspond to the stretching vibrations of aliphatic CH bonds, typically found in long-chain fatty acids and esters (Fernandes et al. 2011). C6, which is a shellac-based coating, presented the peaks with the least intensity in this region (Fig. 4). These contribute to the wax's hydrophobic properties because shellac is primarily a resin, consisting of complex polyesters formed from hydroxy fatty acids and sesquiterpene acids. This complex structure with a diverse range of functional groups, such as hydroxyl, carboxyl, ester, and aldehyde groups, can lead to a less uniform absorption of infrared radiation across the spectrum (Chen et al. 2024). All the coatings showed C=O stretching at 1720 cm^{-1}. The presence of a C=O stretch indicates the existence of esters or ketones that may be present in the wax structure. Carnauba wax contains a variety of fatty acids, which might also contribute to this peak. Region 1000 to 1300 cm^{-1} typically represents C–O stretching vibrations seen in alcohols, ethers, and esters (Fernandes et al. 2011). C1, which is an ester-based coating, had more peaks in this region (Fig. 4). The presence of these peaks in all the coatings indicates the wax's complex composition, which contributes to its emulsifying properties. The fingerprint region 600 to 800 cm^{-1} includes many overlapping bands that provide a unique fingerprint for the wax coatings (Webber 2000). Analysis of this region can help differentiate carnauba wax from other natural waxes based on slight variations in peak positions and intensities. From this region, the intensities of peaks from C1, C2 through C5, and C6 are significantly different from one another (Fig. 4), indicating the different types of coating formulations.

The microstructure of the coatings on breadfruit surface. Mixing red dye into the coatings helped highlight their surface and

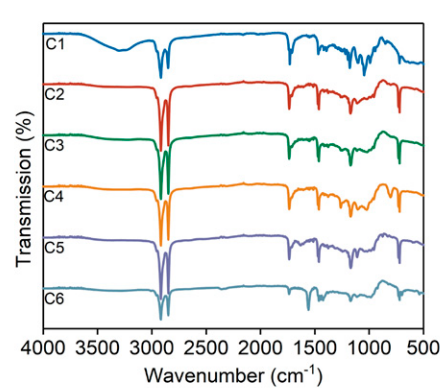

Fig. 4. Fourier transform infrared spectroscopy spectra of coatings. Coatings C1 through C6 are defined in Table 1.

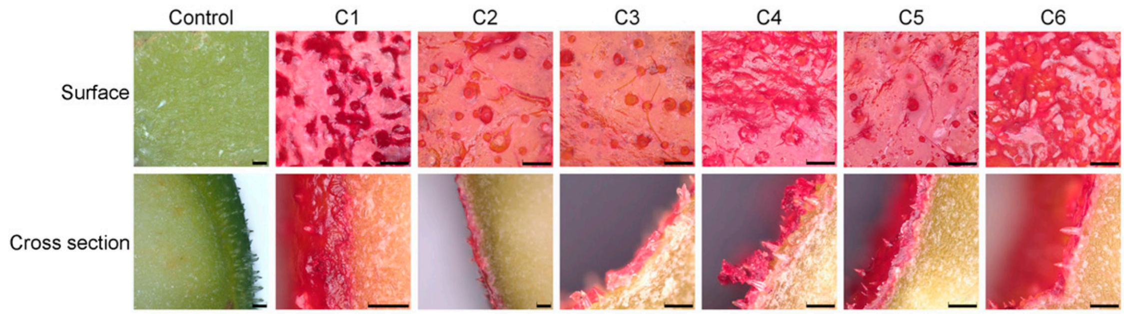

Fig. 5. Surface and cross-sectional microscopy images of red-dyed coatings on breadfruit peel. All the bars are 200 μm. Coatings C1 through C6 are defined in Table 1.

cross-sectional microstructure after application on breadfruit. A thick and uniform protective layer was found on fruit coated with C1. A thinner layer was seen with C2, whereas uneven structures were seen with C3 and C4, indicating worse adhesion properties (Fig. 5). Coating adhesion refers to the ability of a coating to bond strongly to a substrate, crucial for its performance and longevity, and is influenced by factors such as surface preparation, coating composition, and storage conditions (Ding et al. 2023). The structure and adhesion properties of the coatings directly correspond to the physiochemical properties of the treated fruit (Zhang et al. 2022). The combination of better adhesion, higher thickness, and the hydrophobic properties of C1 explain why it treated fruit showed the lowest weight loss (Fig. 2).

Conclusion

Treatments of fatty acid, carnauba, or shellac-based coatings were applied to breadfruit. All coatings reduced weight loss and helped maintain firmness compared with no coating (control). Of the coatings, fatty acid (C1) most significantly reduced weight loss and maintained visual appearance. No negative effects from coatings were noted for SSC or acidity. Our results will be used to test the fatty acid coating in a commercial-scale experiment.

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