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To cite this article: Refilda *et al* 2023 *IOP Conf. Ser.: Earth Environ. Sci.* **1241** 012073

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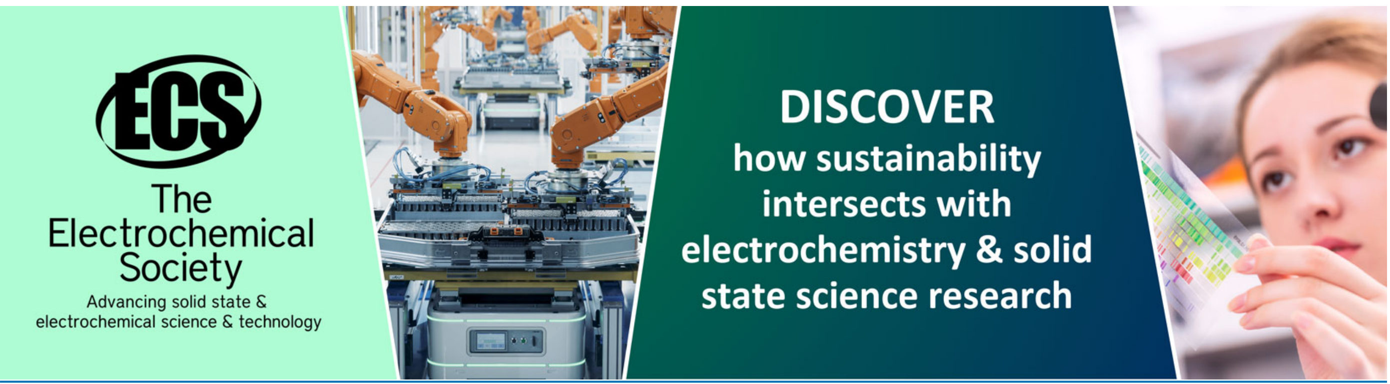

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IOP Conf. Series: Earth and Environmental Science 1241 (2023) 012073 doi:10.1088/1755-1315/1241/1/012073

The effect of sungkai leaf water extract addition to aloe vera gel edible coating on quality and shelf life of strawberries (*Fragaria* sp.)

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Abstract. Strawberries are the most consumed fruits by people in the world. This fruit has a delicious taste and high nutritional content. But the shelf life is very short. The purpose of this study was to find method to extend the shelf life of postharvest strawberries. Edible coating from aloe vera gel and varying concentration of sungkai leaf water extract (0%, 30%, 50%, 70% and 90%) was prepared and applied to strawberries. Coated strawberries were evaluated in the days 0 to 8 for fruit weight loss, percent spoilage, total soluble solids and total antioxidant. The best results were obtained on the composition of aloe vera gel with 50% water extract of sungkai leaves. Strawberries coated with this material could be stored for 6 days longer than uncoated strawberries for 2 days with a decrease in fruit weight of 10.6%, percent spoilage 11.1%, total dissolved solids value 7.47 ^{o} Brix, and total antioxidants 0.28 mg AA/g FW. In conclution the sungkai leaf water extract can increase the shelf life of post-harvest strawberries.

1. Introduction

Strawberries (*Fragaria* sp) are fruits found around the world with a very unique taste. The ripe strawberries have texture, taste, nutrients and antioxidants [1]. However, ripe strawberries are highly perishable, mainly due to their delicate texture, high softening and respiration rate, and are susceptible to fungal attack and the development of an unpleasant taste. Strawberry fruit according to the experience of local farmers can only last one to two days, therefore the strawberries should be sent to the market as soon as possible. Delay in the delivery of strawberries will cause the strawberries to have an in fresh appearance and the strawberries to begin to rot, which causes losses to strawberry growers. Fresh fruit naturally contaminated by various microorganisms through different sources. These microbial contaminants are the cause of microbial spoilage in strawberries [2].

To overcome post-harvest losses and prolong shelf life, several methods and technologies have been developed and designed. Various methods and technologies have been developed including Modified Atmosphere Packaging (MAP) [3], cold storage [4], controlled atmosphere (CA) storage [5], gamma irradiation [6], and edible coatings [7] can maintain the fruit and vegetables. One of the methods studied is atmospheric modification, which can extend fruit shelf life. It caused by removed the levels of gasses. Environmental conditions have an unfavorable impact which tends to slow down the ripening fruit's metabolic activity [8].

Edible coating with a modified method has shown promising results to maintain fruit quality [9]. In

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this study, aloe vera was used as a coating material, where aloe vera is a plant that contains nutrients and potential bioactive compounds [10]. In addition, consumers will tend to choose manufactures that use natural, biodegradable ingredients with few artificial additives, high nutritional value, safety, and guaranteed quality. Coating on strawberries using 5% aloe vera gel and 5% ascorbic acid can reduce microbial growth; and maintained fruit quality for 18 days at 1°C and 95% humidity [11]. Meanwhile, coating strawberries using 20% aloe vera combined with 3% banana starch and 2% chitosan it could reduce spoilage by fungi, maintain hardness and inhibit discoloration for 15 days at 8°C and 70% humidity [12]. The use of aloe vera itself can be proven as a natural ingredient that promises to increase shelf life and post-harvest shelf life in good quality. For this reason, in this case aloe vera gel is combined with Sungkai leaves, where this material as an additional ingredient containing antifungal or antibacterial ingredients in edible coatings is useful for reducing microorganism activity and product damage. Sungkai leaf extract using methanol as a solvent have antibacterial activity against *Str. mutans* [13]. The best plant water extract was then varied with a mixture of aloe vera gel to determine the optimum combination of coatings that could extend the shelf life of strawberries.

Sungkai leaf was extracted by water using the infundantion method. The water solvent was chosen to get safety and halal food, people could use a simple, easy method and reduce organic waste which is eco-friendly. Other solvent commonly used was alcohol derivatives whose halal is still in doubt. For this reason, testing is carried out using safe and halal water solvents. The effect of edible coating on physical and chemical parameters of strawberries were studied. The fruit weight loss using gravimetric method, spoilage, soluble solids using the refractometric method, and total antioxidant using the modified phenanthroline method. The data obtained were then processedstatistically using the one-variable ANOVA method.

2. Material and Methods

2.1 Coating material preparation
The materials used in this study were citric acid ($C_6H_8O_7$, Merck), ascorbic acid ($C_6H_8O_6$, Merck), $FeCl_3.6H_2O$, Merck, 1,10-phenantroline (Sigma), glycerol ($C_3H_8O_3$, Merck), Distillated water (H_2O), Sodium Hypochlorite (NaOCl), CMC, strawberries, aloe vera and sungkai leaf.

Aloe vera is soaked in 10% citric acid for 30 minutes, then peeled off the outer skin and then mashed using a blender. Sungkai leaf was extracted by adding 30 grams of sungkai leaf powder into a beaker glass and then adding 150 mL of distilled water (ratio 1:5). The water bath is filled with enough water so that the beaker is partially submerged, heated for 15 minutes at 90°C while stirring, then allowed to stand and filtered using filter paper.

2.2 Coating strawberry fruit with various coating materials
Strawberries are selected first with good fruit conditions, red and ripe. The fruit was washed with 1% NaOCl and dried. The fruit was then immersed in a solution of coating material (Table. 1) about 30 seconds. Fruits that have been coated are stored at room temperature (28°C-30°C). Strawberry physicochemical properties were measured every 2 days, on days 0, 2, 4, 6 and 8 days during storage.

Table 1. The strawberry fruit coating material composition with plant extract variations.

No	Coating Material Code	Aloe Vera Gel (mL)	Leaf Extract Sungkai (mL)	CMC 1% (mL)	Glycerol 20% (mL)
1.	CC	0	0	0	0
2.	SLC0	90	0	5	5
3.	SLC30	60	30	5	5
4.	SLC50	40	50	5	5
5.	SLC60	20	70	5	5
6.	SLC90	0	90	5	5

Information:
CC : control coating (without treatment).
SLC 0 : coating 0 mL sungkai leaf water extract + 90 mL aloe vera gel extract.
SLC30 : coating 30 mL of sungkai leaf water extract + 60 mL of aloe vera gel extract.
SLC50 : coating 50 mL sungkai leaf water extract + 40 mL aloe vera gel extract.
SLC70 : coating 70 mL water extract of sungkai leaf + 20 mL aloe vera gel extract.
SLC90 : coating 90 mL sungkai leaf water extract + 0 mL aloe vera gel extract.

2.3 Determination of fruit weight loss
Weight loss of strawberry is calculated by formula .1[12]:

$$Sb = \frac{W_t - W_0}{W_0} \times 100\% \quad (1)$$

Description:
Sb = Strawberry weight loss (%)
W_0 = Weight of strawberries before storage (grams)
W_t = Weight of strawberries after storage (grams)

2.4 Determination of fruit decay
The decay percentage equation (%) = 100 × AB/CD, where A is the level of damage total value, B is the number of fruits at this level, C = the number of fruits in the treatment and D = the highest level of damage**.**The rate of spoilage visually using a scale:[2]
0 = no signs of decay, 1 = 1–10% spoilage, 2 = 11–25% spoilage, 3 = 26–40% spoilage, 4 = 40–50% spoilage, 5 = 50% spoilage. The best fruit found when the spoilage less than 4%.

2.5 Determination of total dissolved solids
The reading done byplacing the mashed strawberries on the refractometer glass prism. The value was obtained at the blue and white line [12].

2.6 Determination of total antioxidants
About 1 mL of ascorbic acid standard solution and strawberry extract were put into a test tube, then added to a test tube of 2 mL of distilled water and 1 mL of 0.1% $FeCl_3.6H_2O$ and 1 mL of 1.10 orthophenanthroline 0.1%. Then the solutions were incubated for 20 minutes and the measured at a wavelength of 510 nm using UV-Vis spectrophotometer. Contracted standard calibration cuve and total antioxidant calculated by using regression equation [14].

2.7 Statistical analysis
The ANOVA is used for the deviation of one variable, and continued with Duncan's test if $p<0.05$.

3. Results and Discussion

3.1. Coating strawberry fruit with various coating materials
Fig1. shows edible coating materials made from various concentrations of sungkai leaf water extract. SLC0 coating has a thick texture and a slightly yellowish clear color, SLC30 has a thick texture with a slightly reddish orange color, SLC50 has a thick texture with a slightly reddish-brown color, and SLC70 has a thick texture with a reddish-brown color. The SLC90 coating has a thick, darkbrown texture. The more sungkai leaf water extract added, the more concentrated color of the coating solution.

Figure 1. Coating Materials with various compositions, (a) SLC0; (b) SLC30; (c) SLC50; (d) SLC70; (e) SLC90.

Strawberries coated with aloe vera and variations in the concentration of sungkai leaf extract can beseen in Figure 2.

Figure 2. Strawberries coated with various coatings composition during storage (a) CC; (b) SLC0; (c) SLC30; (d) SLC50; (e) SLC70; (f) SLC90.

The coated strawberries showed better performance on SLC50 treatment. The fruit withthe SLC50 coating composition was still in good condition until the sixth day, while the untreated strawberries showed a darker color and mold began to appear. The appearance of the fruit of thisgroup decreased due to wilting, the texture of the fruit became soft, the crispness was absent and the water content of the fruit was much reduced.

3.2. Fruit weight loss

Based on Duncan's test, the weight loss of fruit coated with SLC30, SLC50 and SLC70 coating compositions were not significantly different on the eighth day. Fruits coated with SLC30, SLC50 and SLC70 coating compositions had a lower percentage of weight loss than strawberries with other treatments (Figure 3). It acts as an antibacterial so there is a smaller percentage of fruit weight loss.

Previous studies have reported that coating strawberries with ascorbic acid and rosehip oil also decreased fruit weight loss compared to untreated fruit [11]. The coating material reduced water vapor transmission, oxygen uptake and lipid transfer and thus retains more fruit weight [15]. Similar studies on nectarines by using 2.50% aloe vera gel and calcium chloride helped on maintaining fruit weight and prolonging storage time after harvest [16].

3.3. Fruit decay

Figure 4 shows the fruit decay index increased during storage time. Total decay occurred in untreated fruit on the sixth day, while decay index of fruit with SLC50 on the sixth day was11.1%. The sungkai leaves gave the best effect on the fruit with SLC50 coating composition. On the eighth day, treatment with SLC30 and SLC50 coating compositions gave significantly different decay index results from other treatments. Treatment with SLC50 coating composition gave the best effect among other treatments, with the smallest decay index value. Strawberries treated with SLC50 could last for 6 days. The strawberries coated with synthetic coatings such as chitosan based and beeswax has seven days shelf life [17].

Fruit rot begins with the browning process, browning cause by the action of several enzymes. A loe vera is able to inhibit phenolic oxidation and protect the membrane integrity between phenolic and enzymes [18]. The guavafruit coated with coating material consist of 85% A. vera gel, 10% *A. indica*. L leaf extract had a weight loss of 11.19%, fruit decay index 3.33%, total soluble solids of 7.67 °Brix and 15 days shelf life [19].

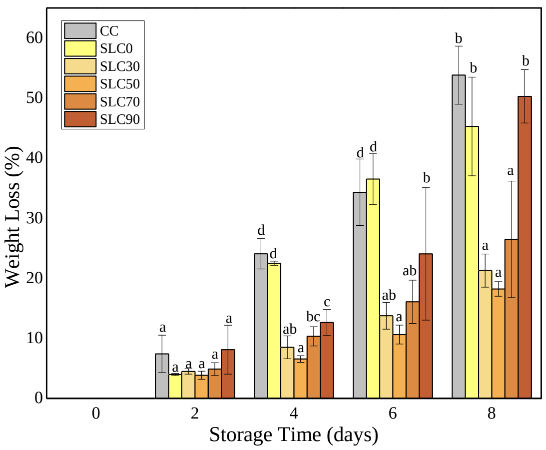

Figure 3. The effect of storage time on weight loss of coated strawberries with variations composition of edible coating.

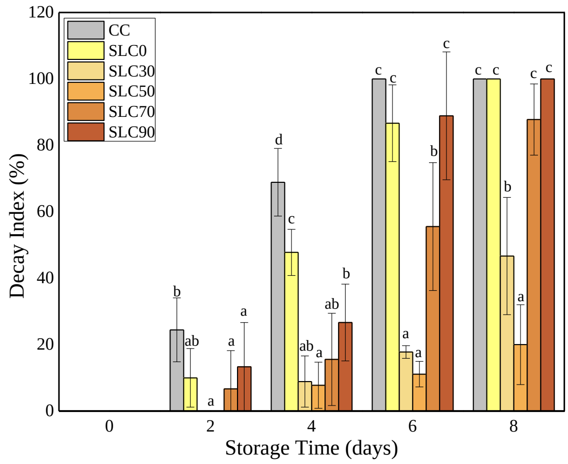

Figure 4. The effect of storage time on decay index of coated strawberries with variations composition of edible coating.

3.4. Total disolved solids of coated strawberries

TDS are a parameter in determining shelf life of food because it shows dissolved solids in solution which indicates the level of ripeness or spoilage of the fruit [20]. Figure 5 shows the total dissolved solids of strawberries decreased during storage. This can be seen in untreated fruit and fruit coated with SLC0, while SLC30 and SLC50 treatments tend to maintain their total solubele solids values. The results of Duncan's test on day 2 showed that untreated fruit (CC) was significantly different from SLC30, but not significantly different from SLC0, SLC30, SLC70 and SLC90. On the fourth day of treatment, the total soluble solids in the fruit with SLC50 coating composition were significantly different from all treatments, while CC and SLC0 were not significantly different. On the sixth day of storage, fruits with SLC50 coating were significantly different from CC, SLC0, SLC70 and SLC90 treatments but not significantly different from SLC30. Meanwhile on the 8th day, the total dissolved solids in all treatments gave significantly different results except those coated with SLC90 and SLC70.

Total disolved solids are related to the level of clarity of a solution and the level of sweetness because the decomposition of the substrate during the ripening process causing the fruit to taste sweeter [2]. The TDS in strawberries decreased, it showed that the fruit sugar content in strawberries was reduced. The decreasing was due to the existing glucose being reused for the respiration process so that it had an impact on decreasing the total dissolved solids of fruit [21]. Regarding the respiration process after harvest, agricultural products (especially fruits) can be classified into 2, climacteric and non-climacteric fruits. Strawberry fruit is a non-climacteric fruit, where non-climacteric fruit has a normal pattern of respiration rate after harvest, which continues to decrease until the fruit finally rots. The higher the total dissolved solids value, it means that glucose and fructose will increase during ripening. Meanwhile, the decrease in total soluble solids as shown in Figure 5, indicates that the strawberries have undergone a post-harvest ripening process, so there is no increase in the total dissolved solids value [22].

3.5. Total antioxidants of coated strawberries
Total antioxidant of coated strawberries was higher than that of uncoated strawberries. the highest antioxidant content was shown in fruit coated with SLC50 coating composition (Figure 6). From Duncan's test on the second day, the total antioxidant fruit without treatment was not significantly different from the SLC90 coated fruit, but significantly different from the other treatments. While the total antioxidants of fruit with coating composition SLC0, SLC30, SLC50 and SLC70 were not significantly different. On the fourth day, the total antioxidant uncoated fruit was not significantly different from the SLC70 and SLC90 treatments but significantly different from the SLC0, SLC30, and SLC50 treatments. Similarly, on the sixth day, SLC50 was significantly different from all treatments except SLC30 treatment. Also on the eighth day, SLC50 was significantlydifferent from all treatments. All the total antioxidant content in the fruit decreased, whether uncoated, or coated fruit, however the total antioxidant content was relatively stable for 8 days in fruit coated by coated compared to other treatments.

Aloe vera gel can increase the ability to protect fruit decay. [23]. In this study aloe vera gel alone could not maintain the antioxidant content, while aloe vera gel combined with water extract of sungkai leaf could delay the decrease in antioxidant content of the fruit. This effect can be caused by the capacity of the water extract of sungkai leaves to maintain fruit quality, reduce of decay and inhibit the enzymes that degrade antioxidant compounds. The antioxidant content of strawberries during storage decreased by compounds that antioxidants easily degraded by temperature, light and ambient air. In another study, coating raspberries with aloe vera gel could increase the resistance to spoilage by increasing the antioxidant capacity and antioxidant enzymes [24].Other studies have also shown that the reduction in the antioxidant content [25]. Edible coatings can maintain the antioxidant properties and antibacterial activity, coated guava fruit has a higher total antioxidant compared to uncoated fruit [26].

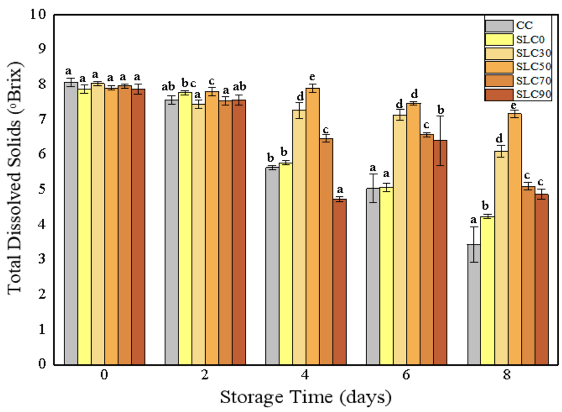

Figure 5. The effect of storage time on total dissolved solids of coated strawberries with variations composition of edible coating.

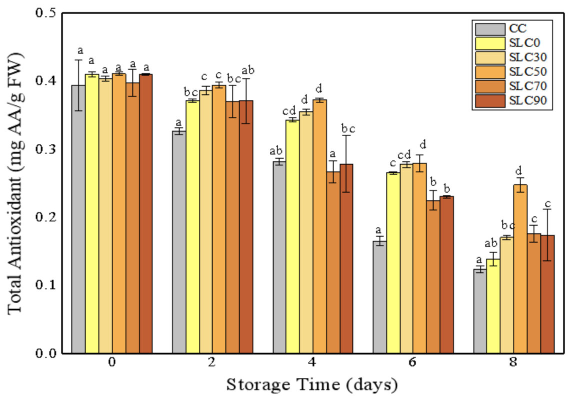

Figure 6. The effect of storage time on the total antioxidant conten of coated strawberries with variationsin the composition of edible coating.

4. Conclusion
The use of edible coating aloe vera gel and sungkai leaf water extract is an environmentally friendly technology that can extend the shelf life of postharvest strawbarries up to 6 days by using formulation of edible coating SLC50 (40% aloe vera gel, 50% sungkai leaf water extract, 5% Carboxymethyl

Cellulose, and 5% glycerol).

References

[1] Van V F 2013 Bioactive compounds and antioxidant capacity of camarosa and selva strawberries (*Fragaria x ananassa* Duch.) *Foods* **2** p 120
[2] Minjares F R 2016 Effect of different drying procedures on physicochemical properties and flow behavior of Aloe vera (*Aloe barbadensis* Miller) gel *LWT* **74** pp 378–386
[3] Chauhan O, Nanjappa C, Ashok N, Ravi N Nagaraj R and Raju P 2013 Shellac and Aloe vera gel based surface coating for shelf life extension of tomatoes *J. Food Sci. Technol* **52(**2) pp 1200–1205
[4] Sayyari M, Soleimani Aghdam M, Salehi F and Ghanbari F 2016 Salicyloyl chitosan alleviates chilling injury and maintains antioxidant capacity of pomegranate fruits during cold storage *Sci. Hortic* **211** p 110–117
[5] Dziedzic E, Błaszczyk J, Bieniasz M, Dziadek K and Kopeć A, 2020 Effect of modified (MAP) and controlled atmosphere (CA) storage on the quality and bioactive compounds of blue honeysuckle fruits (*Lonicera caerulea* L.) *Sci. Hortic* **265** p 109226
[6] Khalili R, Ayoobian N, Jafarpour M and Shirani B 2017 The effect of gamma irradiation on the properties of cucumber *J. Food Sci. Technol* **54**(13) pp 4277–4283
[7] Ebrahimi F and Rastegar S 2020 Preservation of mango fruit with guar-based edible coatings enriched with Spirulina platensis and Aloe vera extract during storage at ambient temperature *Sci. Hortic* **265** p 109258
[8] Mantilla N, Castell-Perez M E, Gomes C and Moreira R G 2013 Multilayered antimicrobial edible coating and its effect on quality and shelf-life of fresh-cut pineappl*e (Ananas comosus) Food Sci. Technol* **51**(1) pp 37–43
[9] Guimarães A, Abrunhosa L, Pastrana L M and Cerqueira M A 2018 Edible films and coatings as carriers of living microorganisms: a new strategy towards biopreservation and healthier foods *Compr. Rev. Food Science. Food Saf* **17**(3) pp 594–614
[10] Farina V 2020 Postharvest application of aloe vera gel-based edible coating to improve the quality and storage stability of fresh-cut papaya *J. Food Qual* **2020** pp 1-10
[11] Sogvar O B, Koushesh S M and Emamifar A 2016 Aloe vera and ascorbic acid coatings maintain postharvest quality and reduce microbial load of strawberry fruit *Postharvest Biol. Technol* **114** pp 29–35
[12] Pinzon M I, Sanchez L T, Garcia O R, Gutierrez R, Luna J C and Villa C C 2020 Increasing shelf life of strawberries (*Fragaria* sp) by using a banana starch-chitosan-Aloe vera gel composite edible coating *Int. J. Food Science. Technol* **55**(1) pp 92–98
[13] Ibrahim A and Kuncoro H 2012 Identification of secondary metabolites and antibacterial activity of sungkai leaf extract (*Peronema Canescens* Jack.) against several pathogenic bacteria *J. Trop. Pharm. Chem* **2**(1) pp 8–18
[14] Yefrida, Suyani H, Aziz H and Efdi M 2020 Validation of MPM Method for determination of antioxidant content in herbal samples and comparison with PM, FRAP and DPPH methods *J. Ris. Kim* **11**(1) pp 24-34
[15] Martínez R D 2017 The addition of rosehip oil to aloe gels improves their properties as postharvest coatings for maintaining quality in plum *Food Chem* **217** pp 585–592
[16] Khan N, Riaz A, Rahman Z, Mawa J U and Begum H 2019 Shelf-life assessment of apple fruit coated with aloe vera gel and calcium chloride *Pure Appl. Biol* **8**(3) pp 1876–1889
[17] Elena V, Vítor D A, Eleonora W, Moldão M 2013 Impact of chitosan-beeswax edible coatings on the quality of fresh strawberries (*Fragaria ananassa* cv Camarosa) under commercial storage conditions *Food Science and Technol* **52** pp 80-92
[18] Supapvanich S, Mitrsang P, Srinorkham P, Boonyaritthongchai P and Wongs A C 2016Effects of fresh Aloe vera gel coating on browning alleviation of fresh cut wax apple (*Syzygium samarangenese*) fruit cv. Taaptimjaan *J. Food Science. Technol* **53**(6) pp 2844-2850

[19] Refilda, Oktafia N, Winardi P R, Salim E and Yefrida 2022 Utilization of Aloe vera gel and Acalypha indica. L leaf extract as edible coating to increase the shelf life of guava (*Psidium guajava*. L) fruit *IOP Conf. Ser. Earth Environ. Sci* **1059** 012-048
[20] Dhyan C, Sumarlan S H and Susilo B 2014 The influence of bee wax coating and storage temperature on guava's quality (Psidium guajava L.) *J. Bioprocess Komod. Trop* **2**(1) pp 79–90
[21] Khaliq G, Ramzan M and Baloch A H 2019 Effect of aloe vera gel coating enriched with Fagonia indica plant extract on physicochemical and antioxidant activity of sapodilla fruit during postharvest storage *Food Chem* **286** pp 346–353
[22] Lucini L, Pellizzoni M, Pellegrino R, Molinari G, Pietro and Colla G 2015 Phytochemical constituents and in vitro radical scavenging activity of different Aloe species *Food Chem* **170** pp 501–507
[23] Hu Q, Hu Y and Xu J 2005 Free radical-scavenging activity of Aloe vera (*Aloe barbadensis* Miller) extracts by supercritical carbon dioxide extraction *Food Chem* **91**(1) pp 85–90
[24] Tahir H, Pervez N, Nadeem J, Khan A and Hassan Z 2020 Esculent coating of spider silk enhanced the preservation and shelf life of apricot *Brazilian J. Biol* **80**(1) pp 115-121
[25] Sakihama Y, Cohen M F, Grace SC and Yamasaki H 2002 Plant phenolic antioxidant and prooxidant activities: phenolics-induced oxidative damage mediated by metals in plants *Toxicology* **177**(1) pp 67–80
[26] Abraham J and Banerjee A 2018 Study on the efficacy of aloe vera gel blended with xanthan gum gel in enhancing the shelf life of guava *Univers. Rev* **7**(11) pp 195–199