

## APPENDIX A

Table 1 Temperature (<sup>0</sup>C) in laboratory during storage orange cv. Canh fruit

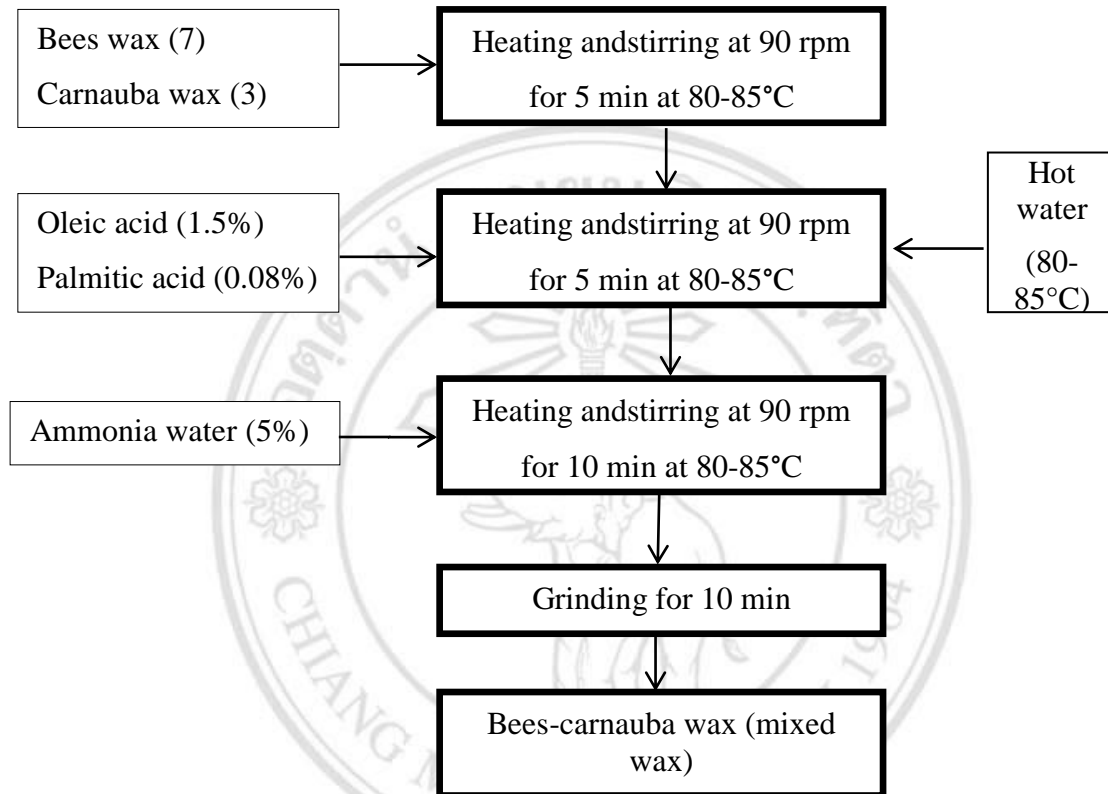
TT	November 2015		December 2015		January 2016		February 2016	
	9am	4pm	9am	4pm	9am	4pm	9am	4pm
1	24.0	24.0	21.0	21.2	21.5	21.5	18.0	18.0
2	24.0	24.0	21.0	21.0	21.5	21.5	18.0	18.0
3	24.0	23.8	21.2	21.4	21.0	21.0	18.0	18.0
4	23.0	23.2	21.3	21.6	21.0	21.0	19.0	19.0
5	23.0	23.0	21.3	21.6	21.0	21.0	19.0	19.0
6	23.0	22.9	21.3	21.5	21.0	21.0	19.0	19.0
7	22.5	22.5	21.3	21.3	21.0	21.0	19.0	19.0
8	22.6	22.5	21.3	21.3	20.2	20.5	21.9	21.9
9	22.5	22.5	21.3	21.3	20.5	20.5	21.9	21.9
10	22.6	22.5	21.3	21.2	20.5	20.5	21.9	21.9
11	22.5	22.5	21.0	21.2	21.0	21.0	22.0	22.0
12	22.3	22.3	21.0	21.2	21.0	21.2	22.0	22.0
13	22.3	22.3	21.0	21.1	21.0	21.2	22.0	22.0
14	22.4	22.5	20.8	21.0	21.3	21.5	22.2	22.0
15	22.5	22.5	21.0	21.0	21.3	21.5	22.5	22.5
16	22.3	22.3	21.0	21.0	21.5	21.5	20.0	20.0
17	22.4	22.5	21.0	21.0	21.5	21.5	20.0	20.0
18	22.4	22.4	21.0	21.0	21.5	21.5	20.5	20.5
19	22.5	22.5	20.5	20.7	21.6	21.9	20.5	20.5
20	22.3	22.4	20.5	20.5	21.6	21.8	21.0	21.0
21	22.0	22.0	20.6	20.7	21.9	21.9	21.0	21.0
22	22.0	22.1	20.5	20.5	21.9	21.9	21.0	21.0
23	22.0	22.0	20.5	20.5	17.0	17.0	22.0	22.0
24	22.1	22.1	20.6	20.7	15.0	15.0	22.0	22.0
25	22.1	22.1	20.6	20.6	15.0	15.0	22.5	22.8
26	22.0	22.0	20.5	20.8	15.0	15.0	22.5	22.8
27	22.0	22.2	20.8	20.8	17.0	17.0	22.0	22.0
28	21.6	21.6	20.8	20.8	17.0	17.0	22.0	22.0
29	21.7	21.7	20.8	21.0	18.0	18.0	22.0	22.0
30	21.0	21.2	21.0	21.0	20.0	20.0		
31			21.0	21.2	20.0	20.2		
<b>Ave</b>	<b>22.5</b>	<b>22.5</b>	<b>20.9</b>	<b>21.0</b>	<b>20.0</b>	<b>20.0</b>	<b>20.9</b>	<b>20.9</b>

Table 2 Humidity (RH)(%) in laboratory during storage orange cv. Canh fruit

TT	November 2015		December 2015		January 2016		February 2016	
	9am	4pm	9am	4pm	9am	4pm	9am	4pm
1	79	79	84	82	75	75	80	82
2	80	80	84	84	75	75	84	84
3	84	82	83	83	77	77	83	82
4	83	82	83	83	76	76	83	82
5	83	83	84	84	77	77	82	81
6	82	82	85	84	77	77	82	81
7	80	80	85	85	76	76	82	81
8	83	82	85	85	76	76	82	83
9	79	77	83	83	75	75	78	78
10	77	78	83	83	75	75	78	78
11	81	80	83	83	77	77	80	80
12	80	80	84	84	76	76	80	80
13	80	78	84	84	78	78	80	79
14	79	79	84	85	78	78	78	78
15	80	79	83	84	80	80	78	78
16	75	75	83	83	80	80	75	75
17	77	77	80	80	80	80	75	74
18	80	79	80	80	82	82	75	75
19	81	81	80	81	82	82	65	65
20	80	80	80	80	82	82	65	65
21	78	78	82	82	81	81	65	65
22	77	77	82	81	81	81	65	65
23	80	79	85	85	75	75	70	70
24	79	78	85	84	76	76	73	73
25	77	77	85	85	65	65	73	74
26	75	78	85	85	65	65	72	72
27	80	80	83	82	60	60	75	75
28	80	80	83	81	60	60	75	75
29	82	81	77	78	70	70	75	73
30	82	81	75	76	75	75		
31			75	75	77	77		
<b>Ave</b>	<b>79.8</b>	<b>79.4</b>	<b>82.5</b>	<b>82.4</b>	<b>75.5</b>	<b>75.5</b>	<b>76.6</b>	<b>76.3</b>

## APPENDIX B

### Procedure of mixed wax (bees-carnauba wax) preparation and cost



**Figure:** Process to mixed bees-carnauba wax

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## APPENDIX C

Table: The cost for mixed wax emulsion

Materials	Price (Baht)	Portion (%)	Price (Baht)/1L	Price (VND)/1L
Beeswax	590 (B/kg)	7	41.3	26,845
Carnauba wax	1000 (B/kg)	3	30.0	19,500
Ammonia water	172 (B/L)	5	8.6	5,590
Oleic acid	949 (B/L)	1.5	14.2	9,230
Palmitic acid	2160 (B/kg)	0.08	1.7	1,105
<b>Total</b>			<b>95.8</b>	<b>62,200</b>

Average, 1 liter of bees-carnauba mixed wax could coated for 100 kg orange so for 1 kg is about from 0.958baht (622VND).

Price of phenyllactic acid (PLA) for 1 kg orange fruit is about 3.0 Baht.

**Total cost for 1 kg orange fruit is about 3.958 Baht [2,573 Vietnamese Dongs (VND)]**

The above price is confirmed in June 2016 (1 USD = 33.3 Bath; 1 Baht = 650 VND)

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## APPENDIX D

Table 1. Changes in the shrinkage of MW (4, 6, 8, 10%) orange cv. Canh peel and control at (22 ± 2°C), 80 ± 5%RH.

	Treatments	Day of storage				
		0	5	10	15	20
Shrinkage on the top (mm)	MW 4%	10.00±0.00a	10.00±0.00a	9.98±0.00a	9.92±0.06a	9.83±0.08a
	MW 6%	10.00±0.00a	10.00±0.00a	10.00±0.00a	9.98±0.02a	9.96±0.03a
	MW 8%	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a
	MW 10%	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a
	Control	10.00±0.00a	9.98±0.02b	9.82±0.05b	9.38±0.04b	8.60±1.51b
Shrinkage on the middle (mm)	MW 4%	10.00±0.00a	10.00±0.00a	9.98±0.02a	9.92±0.04a	9.84±0.05a
	MW 6%	10.00±0.00a	10.00±0.00a	10.00±0.00a	9.92±0.03a	9.96±0.03a
	MW 8%	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a
	MW 10%	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a
	Control	10.00±0.00a	9.98±0.02b	9.84±0.05b	9.44±0.06b	8.64±0.11b
Shrinkage on the bottom (mm)	MW 4%	10.00±0.00a	10.00±0.00a	9.98±0.02a	9.92±0.05a	9.90±0.03a
	MW 6%	10.00±0.00a	10.00±0.00a	10.00±0.00a	9.98±0.02a	9.94±0.02a
	MW 8%	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a
	MW 10%	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a	10.00±0.00a
	Control	10.00±0.00a	9.96±0.03b	9.84±0.03b	9.36±0.05b	8.94±0.13b

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Table 2 Changes in the titrable acid, total sugars, Vitamin C and TSS of mixed wax coated (4, 6, 8, 10%) orange cv. Canh fruit and control at ( $22 \pm 2^\circ\text{C}$ ),  $80 \pm 5\% \text{RH}$

	Treatments (%)	Day of storage				
		0	5	10	15	20
Titrable acid (%)	MW 4	0.090±0.00a	0.132±0.00b	0.157±0.01a	0.142±0.01a	0.161±0.02ab
	MW 6	0.090±0.00a	0.168±0.00a	0.154±0.01a	0.158±0.02a	0.134±0.01b
	MW 8	0.090±0.00a	0.129±0.00b	0.158±0.01a	0.119±0.00a	0.151±0.00ab
	MW 10	0.090±0.00a	0.146±0.01ab	0.152±0.01a	0.150±0.02a	0.167±0.00ab
	Control	0.090±0.00a	0.098±0.01c	0.164±0.01a	0.141±0.01a	0.196±0.03a
Total sugars (%)	MW 4	6.54±0.20a	6.17±0.28ab	5.86±0.26a	5.34±0.18a	5.58±0.49ab
	MW 6	6.54±0.20a	5.96±0.41ab	5.92±0.16a	5.42±0.58a	5.69±0.35ab
	MW 8	6.54±0.20a	5.95±0.24b	6.08±0.11a	5.97±0.25a	5.94±0.43a
	MW 10	6.54±0.20a	6.02±0.21ab	6.01±0.15a	5.93±0.44a	5.82±0.39a
	Control	6.54±0.20a	6.52±0.05a	6.02±0.13a	5.21±0.10a	4.86±0.20b
Vitamin C (mg/100g)	MW 4	36.46±0.44a	36.58±2.25a	32.96±2.83a	27.71±0.51a	24.69±0.38a
	MW 6	36.46±0.44a	34.20±3.14a	31.04±3.78a	23.99±1.59a	29.32±0.47a
	MW 8	36.46±0.44a	34.73±0.46a	32.57±0.62a	31.20±1.77a	29.39±0.88a
	MW 10	36.46±0.44a	36.71±0.97a	31.62±1.04a	29.68±4.16a	28.24±1.18a
	Control	36.46±0.20a	32.43±1.53a	34.52±1.94a	21.97±0.81b	16.78±1.71b
TSS (%)	MW 4	11.60±0.10a	11.17±0.67a	11.00±0.33a	10.83±0.33a	10.33±0.33a
	MW 6	11.60±0.10a	12.00±0.00a	11.00±0.35a	10.67±0.33a	10.33±0.44a
	MW 8	11.60±0.10a	11.17±0.73a	11.67±0.33a	11.17±0.44a	11.00±0.17a
	MW 10	11.60±0.10a	11.00±0.67a	10.67±0.33a	11.00±1.00a	10.67±0.00a
	Control	11.60±0.10a	10.83±0.60a	11.00±0.00a	10.83±0.60a	10.33±0.33a

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Table 3. Changes in the weight loss (%), decay (%), respiration (mg CO<sub>2</sub>.kg.h) of MW (4, 6, 8, 10%) orange cv. Canh fruit and control at (22 ± 2°C), 80 ± 5%RH.

Treatments	Day of storage					
	0	5	10	15	20	
Weight loss(%)	MW 4%	0.00±0.00a	1.05±0.06bc	2.04±0.36b	9.51±2.26b	13.29±4.50b
	MW 6%	0.00±0.00a	1.24±0.22b	2.74±0.32b	6.39±1.89b	10.94±2.46c
	MW 8%	0.00±0.00a	0.87±0.14c	2.88±0.86b	4.45±1.00b	8.87±1.16c
	MW 10%	0.00±0.00a	0.97±0.04bc	1.69±0.32b	4.36±0.54b	8.37±1.30c
	Control	0.00±0.00a	3.56±0.06a	17.32±0.63a	22.42±0.49a	31.72±0.61a
Decay (%)	MW 4%	0.00±0.00a	0.00±0.00a	3.03±3.03a	8.08±1.01a	14.28±2.59a
	MW 6%	0.00±0.00a	0.00±0.00a	3.03±3.03a	7.08±1.00a	13.58±2.29a
	MW 8%	0.00±0.00a	0.00±0.00a	3.03±3.03a	7.08±1.00a	13.58±2.29a
	MW 10%	0.00±0.00a	0.00±0.00a	3.03±3.03a	7.80±1.00a	11.36±1.83a
	Control	0.00±0.00a	0.00±0.00a	3.03±3.03a	6.70±1.75a	12.97±0.92a
Respiration (mg CO <sub>2</sub> .kg.h)	MW 4%	12.43±0.85b	10.52±1.34b	9.28±0.70b	8.49±0.36b	8.94±0.60b
	MW 6%	11.63±0.45b	11.02±0.26b	9.79±0.72b	7.98±0.49b	8.67±0.19b
	MW 8%	12.72±1.17b	10.41±0.60b	7.57±0.37b	7.72±1.18b	6.61±1.48b
	MW 10%	12.46±0.61b	10.57±0.89b	8.96±1.76b	7.89±0.70b	7.65±0.55b
	Control	25.63±1.20a	27.62±0.57a	30.32±0.15a	25.74±0.65a	31.39±1.21a

Table 4 Changes in the titrable acid, total sugars, Vitamin C, and TSS of MW (4, 6, 8, 10%) orange cv. Canh fruit and control at ( $5 \pm 1^\circ\text{C}$ ),  $80 \pm 5\% \text{RH}$

	Treat ment	Day of storage					
		0	10	20	30	40	50
Titrable acid (%)	T1	0.091±0.00a	0.101±0.00b	0.185±0.01b	0.110±0.01b	0.116±0.02a	0.095±0.01a
	T2	0.091±0.00a	0.108±0.00b	0.138±0.01b	0.098±0.01b	0.125±0.02a	0.092±0.00a
	T3	0.091±0.00a	0.088±0.00a	0.157±0.00b	0.180±0.00b	0.153±0.01a	0.119±0.00a
	T4	0.091±0.00a	0.083±0.00a	0.143±0.01a	0.112±0.02a	0.121±0.00a	0.108±0.00a
	T0	0.091±0.04a	0.153±0.11a	0.157±0.0b	0.102±0.01a	0.118±0.01a	0.105±0.0a
Total sugars (%)	T1	6.540±0.20a	6.44±0.07a	6.42±0.06a	5.80±0.30a	5.79±0.17a	5.45±0.19a
	T2	6.540±0.20a	6.58±0.14a	6.52±0.16a	6.37±0.16a	6.27±0.17a	5.43±0.16a
	T3	6.540±0.20a	6.34±0.15a	6.30±0.19a	5.92±0.10a	5.84±0.17a	5.56±0.07a
	T4	6.540±0.20a	6.48±0.03a	6.36±0.26a	6.29±0.11a	6.18±0.17a	5.66±0.49a
	T0	6.54±0.20a	6.15±0.22a	5.45±0.26a	5.28±0.19b	5.18±0.23b	5.01±0.15a
Vit C mg/10 og	T1	35.34±0.44a	35.44±0.46a	32.05±2.4a	33.37±0.72a	23.98±2.61b	21.16±0.3a
	T2	35.34±0.44a	35.60±2.77a	31.72±2.8a	32.33±2.31a	27.72±1.57b	22.92±3.4a
	T3	35.34±0.44a	37.69±3.08a	33.23±0.2a	31.36±1.65a	31.68±2.30a	24.94±2.0a
	T4	35.34±0.44a	39.37±2.77a	32.94±2.9a	31.70±1.40a	30.03±3.48a	26.65±2.9a
	T0	35.34±0.44a	35.43±1.26a	31.60±0.1a	31.53±3.45a	27.90±0.85b	21.02±1.2a
TSS (oBrix )	T1	11.60±0.10a	10.33±0.33a	9.33±0.33a	9.00±0.58a	9.33±0.67a	10.66±0.88a
	T2	11.60±0.10a	10.33±0.33a	10.00±0.58a	10.00±0.58a	10.33±0.33a	9.33±0.33a
	T3	11.60±0.10a	11.00±0.58a	10.83±0.17a	10.66±0.33a	10.66±0.33a	10.00±0.58a
	T4	11.60±0.10a	11.00±0.58a	10.83±0.60a	10.50±0.50a	10.50±0.29a	10.33±0.33a
	T0	11.60±0.10a	11.33±0.67a	11.16±0.4a	10.66±0.33a	10.66±0.33a	9.66±0.0a



Table 5 Changes in the weight loss, decay, respiration of MW (4, 6, 8, 10%) orange cv. Canh fruit and control at ( $5 \pm 1^\circ\text{C}$ ),  $80 \pm 5\%$ RH

Treat- ments		Day of storage					
		0	10	20	30	40	50
Wei ght loss (%)	T1	0.000±0.00a	0.39±0.05b	2.51±0.28b	2.74±0.43b	6.69±0.15a	11.15±0.49b
	T2	0.000±0.00a	1.37±0.01b	3.09±0.24b	4.95±0.14a	6.75±0.25a	10.39±0.46b
	T3	0.000±0.00a	1.38±0.02b	2.90±0.17b	3.04±0.26b	6.55±0.11a	7.41±0.10b
	T4	0.000±0.00a	1.23±0.05b	1.95±0.03b	2.78±0.17b	6.00±0.15a	7.57±0.13b
	T0	0.000±0.00a	3.18±0.08b	4.75±0.20b	5.44±0.22a	6.77±0.25a	15.76±1.43a
Dec ay (%)	T1	0.000±0.00a	0.000±0.00a	0.00±0.00a	0.000±0.00a	5.95±1.19a	8.88±0.55b
	T2	0.000±0.00a	0.000±0.00a	0.00±0.00a	0.000±0.00a	5.34±0.59a	8.33±0.01b
	T3	0.000±0.00a	0.000±0.00a	0.00±0.00a	0.000±0.00a	4.84±0.15b	7.39±1.33b
	T4	0.000±0.00a	0.000±0.00a	0.00±0.00a	0.000±0.00a	4.84±0.15b	6.20±1.44b
	T0	0.000±0.00a	0.000±0.00a	0.00±0.00a	0.000±0.00a	8.58±0.25a	12.43±1.22a
Respi ration (mg CO <sub>2</sub> / kg.h)	T1	2.40±0.17ab	2.78±0.21b	3.20±0.28b	2.19 ±0.28b	2.75±0.06b	2.73±0.29b
	T2	1.84±0.17ab	2.89±0.37b	3.04±0.37b	2.13±0.24b	2.49±0.29b	2.66±0.27b
	T3	1.36±0.12b	2.63±0.29b	3.01±0.29b	2.03±0.10b	2.28±0.22b	2.12±0.21b
	T4	1.89±0.24b	2.76±0.22b	3.20±0.22b	1.84±0.23b	2.14±0.08b	2.09±0.21b
	T0	4.90±0.19a	6.04±0.26a	5.63±0.26a	4.82±0.33a	4.16±0.19a	5.03±0.24a

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Table 6 Changes in the titrable acid (%), and TSS (%), weight loss (%), decay (%) of mix wax coated ( 8%) + PLA 2.5%; MW+ CBZ (0.2%) orange cv. Canh fruit and control at (22 ± 2°C), 80 ± 5%RH

	Treatments	Day of storage					
		0	5	10	15	20	25
TSS (°Brix)	Control	11.38±0.17a	11.17±0.67a	11.33±0.33a	11.00±0.57a	10.53±0.17a	10.00±0.00b
	PLA	11.38±0.17a	11.67±0.33a	11.67±0.33a	11.33±0.33a	11.33±0.33a	11.17±0.17a
	CBZ	11.38±0.17a	11.33±0.33a	11.00±0.00a	11.00±0.57a	10.33±0.33a	10.50±0.46a
Titrable acid (%)	Control	0.102±0.007a	0.131±0.005b	0.125±0.003b	0.176±0.000a	0.190±0.000a	0.213±0.007a
	PLA	0.102±0.007a	0.150±0.009b	0.162±0.002b	0.167±0.002a	0.175±0.007a	0.167±0.006a
	CBZ	0.102±0.007a	0.190±0.000a	0.193±0.000a	0.185±0.029a	0.211±0.036a	0.207±0.003a
Weight loss (%)	Control	0.00±0.00a	1.73±0.00a	13.05±0.00a	18.10±3.28a	32.37±1.55a	39.19±3.20a
	PLA	0.00±0.00a	1.00±0.00a	5.70±2.33b	9.84±1.39b	11.38±1.15b	12.65±2.88b
	CBZ	0.00±0.00a	1.80±0.00a	7.45±2.92b	8.99±3.30b	13.90±1.07b	16.12±0.78b
Decay (%)	Control	0.00±0.00a	0.00±0.00a	3.03±3.03a	10.60±3.03a	14.62±2.52a	20.71±2.91a
	PLA	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00b	0.00±0.00b	4.54±4.54b
	CBZ	0.00±0.00a	0.00±0.00a	0.00±0.00a	3.03±0.00b	6.73±3.42b	6.73±3.41b

Table 7 Changes in the titrable acid, total sugars, vitamin C and TSS, weight loss, decay, ethanol of mixed wax ( 8%) + PLA 2.5%; Chitosan (0.2%) + PLA (2.5%) orange cv. Canh fruit and control at ( $5 \pm 1^\circ\text{C}$ ),  $80 \pm 5\% \text{RH}$ .

	Treatments	Day of storage						
		0	10	20	30	40	50	60
Titrable acid (%)	Control	0.900±0.000a	0.111±0.004a	0.112±0.003a	0.106±0.007a	0.114±0.004a	0.112±0.006a	0.119±0.000a
	MW+PLA	0.900±0.00a	0.101±0.005a	0.095±0.011a	0.106±0.013a	0.103±0.012a	0.106±0.006a	0.108±0.004a
	CW+PLA	0.900±0.00a	0.109±0.02a	0.107±0.008a	0.108±0.009a	0.114±0.004a	0.109±0.004a	0.109±0.011a
Total sugars (%)	Control	6.78±0.22a	6.48±0.45a	6.27±0.25a	6.19±0.24a	5.67±0.31a	5.10±0.09b	4.65±0.28b
	MW+PLA	6.78±0.22a	6.79±0.13a	6.58±0.29a	6.71±0.13a	6.30±0.09a	6.02±0.19a	5.53±0.26a
	CW+PLA	6.78±0.22a	6.66±0.24a	6.70±0.27a	6.33±0.15a	6.33±0.33a	5.32±0.09b	5.33±0.14a
VitC (mg/100g)	Control	35.68±0.21a	33.16±3.40a	30.13±2.97a	24.75±1.03a	23.67±0.31b	20.94±0.88b	15.92±3.02b
	MW+PLA	35.68±0.21a	37.66±3.07a	36.67±0.82a	33.61±0.31a	32.98±1.07a	28.67±2.75a	23.52±1.12a
	CW+PLA	35.68±0.21a	36.32±3.34a	35.72±2.80a	26.33±0.41a	25.01±1.53b	23.41±2.61b	17.10±0.64b
TSS (oBrix)	Control	11.83±0.16a	12.00±0.00a	11.00±0.00b	11.00±0.00b	10.50±0.28b	10.00±0.00c	9.83±0.16b
	MW+PLA	11.83±0.16a	12.00±0.00a	12.00±0.00a	12.00±0.00a	11.67±0.33a	11.50±0.00a	11.00±0.00a
	CW+PLA	11.83±0.16a	11.50±0.00a	11.50±0.0ab	11.16±0.33b	11.16±0.23a	10.83±0.33b	10.00±0.00b

	Treatments	Day of storage						
		0	10	20	30	40	50	60
Decay (%)	Control	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	8.17±1.59a	13.17±0.97a	24.53±3.79a
	MW+PLA	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00b	0.00±0.00b	5.69±1.12b
	CW+PLA	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00b	3.25±2.61b	6.75±0.64b
Weight loss (%)	Control	0.00±0.00	3.22±0.19a	4.82±0.38a	5.65±0.17a	6.49±1.11a	15.09±0.19a	29.15±0.62a
	MW+PLA	0.00±0.00	2.29±0.33a	4.40±0.23a	5.81±0.17a	7.01±0.29a	7.56±0.23c	10.06±0.74c
	CW+PLA	0.00±0.00	2.92±0.45a	4.31±0.15a	6.17±0.76	6.41±0.16a	9.82±0.48b	19.17±0.14b

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#### Presentations

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