



APPENDIX

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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APPENDIX A

Pictures of Equipment and Instruments

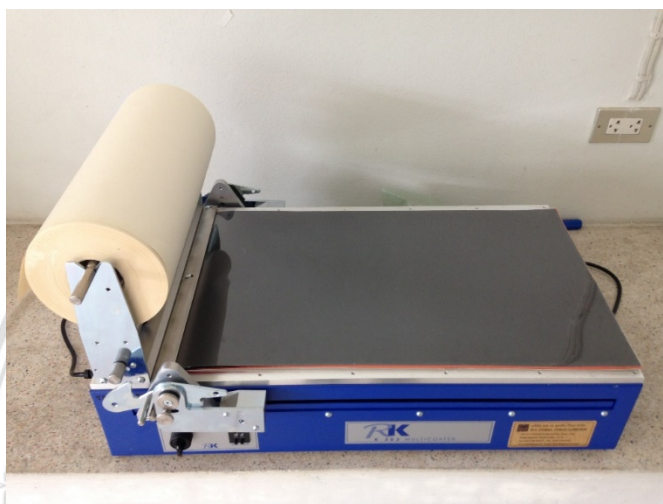


Figure A-1 Instrument image of K303 multicoater used in this study

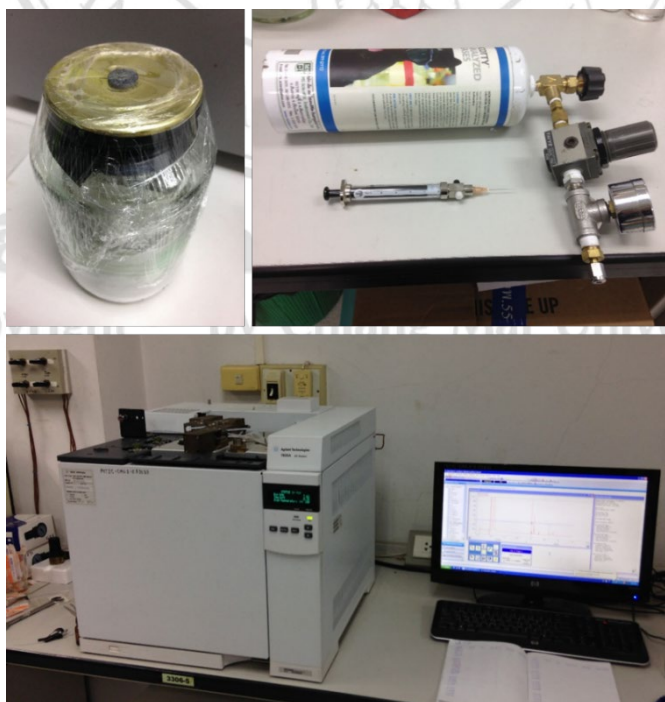


Figure A-2 Instrument image of gas chromatography (GC) used in this study

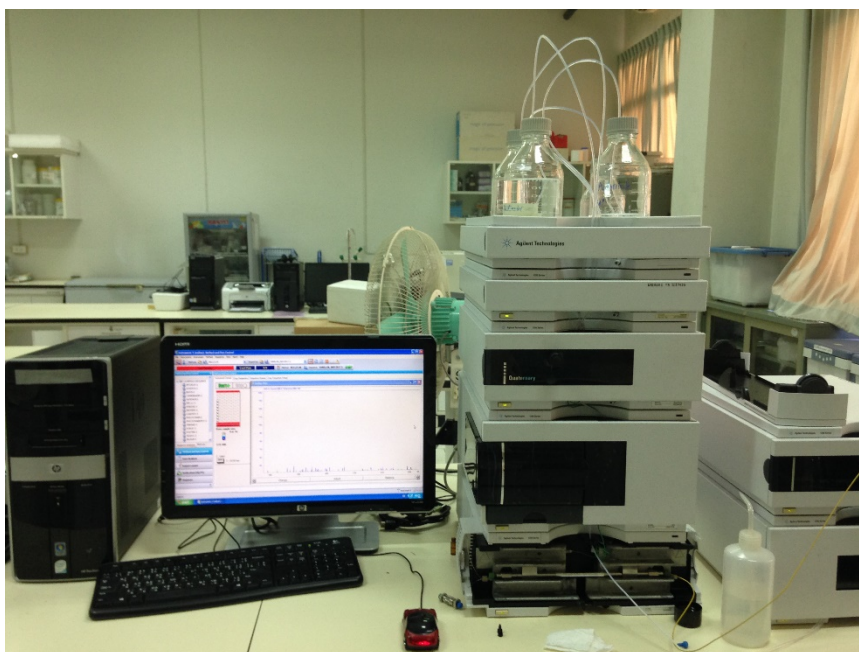


Figure A-3 Instrument image of high performance liquid chromatography (HPLC) used in this study



Figure A-4 Instrument image of scanning electron microscope (SEM) used in this study

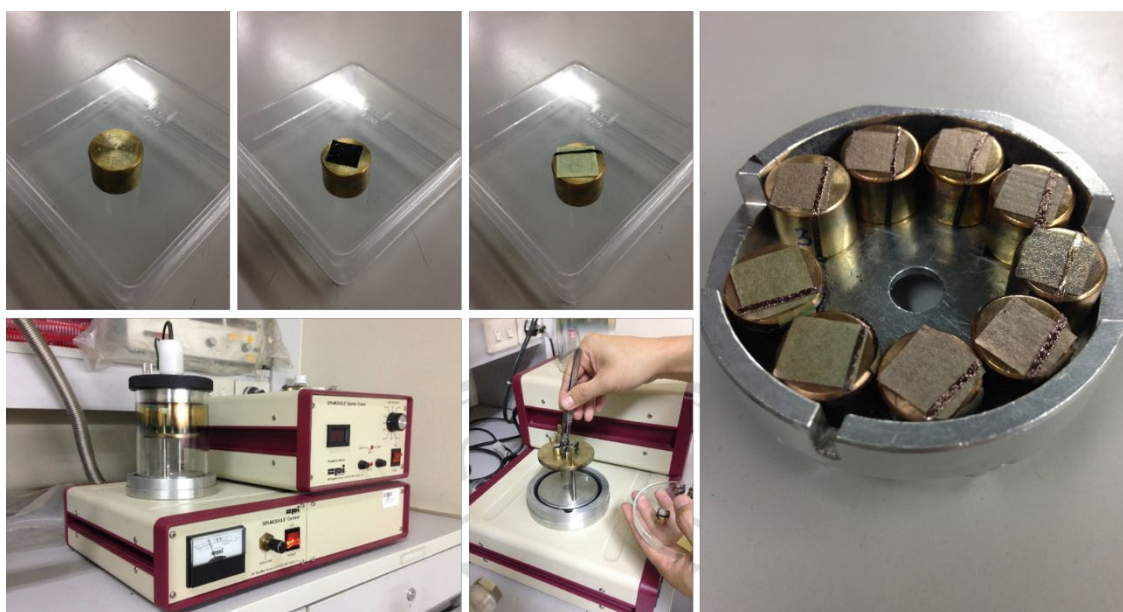


Figure A-5 Sample preparation for SEM

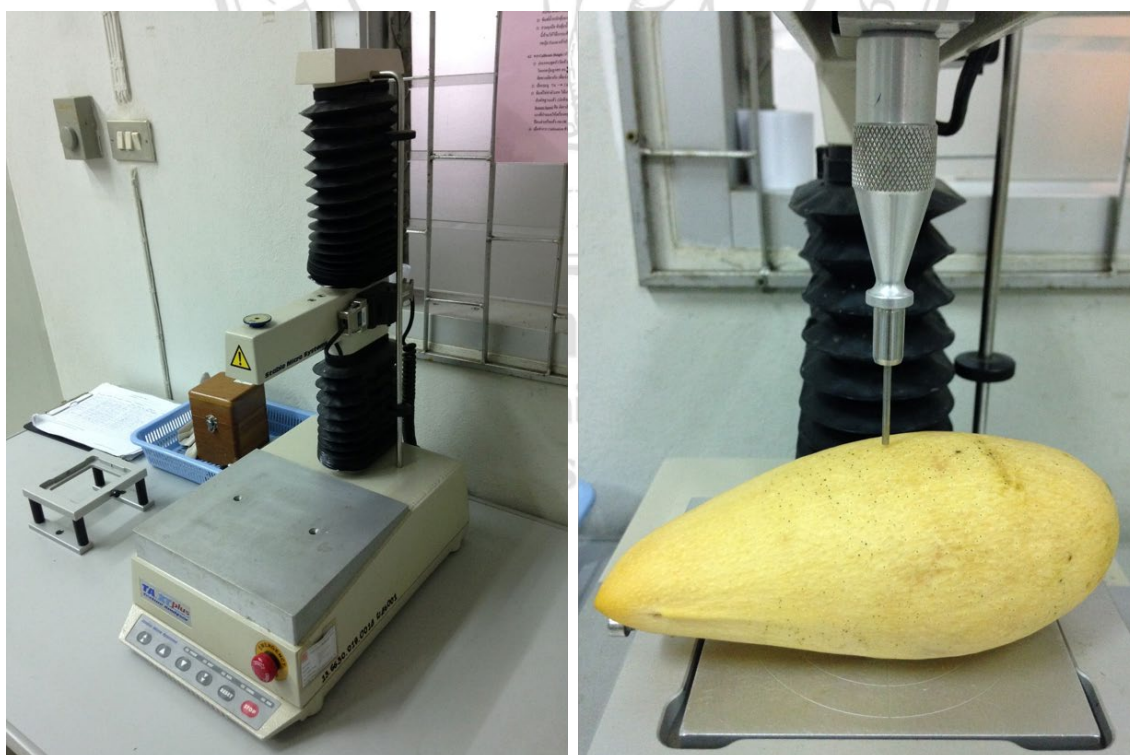


Figure A-6 Instrument image of texture analyzer used in this study

APPENDIX B

Peaks of Ethylene and Vanillin, and Standard Graph for Calibration

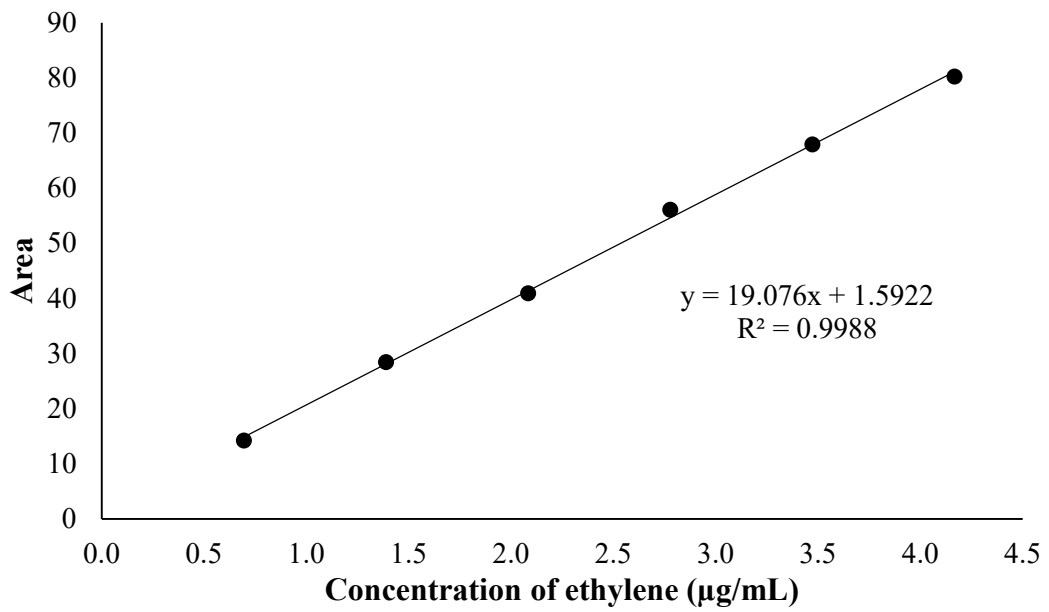


Figure B-1 Standard graph for ethylene quantification

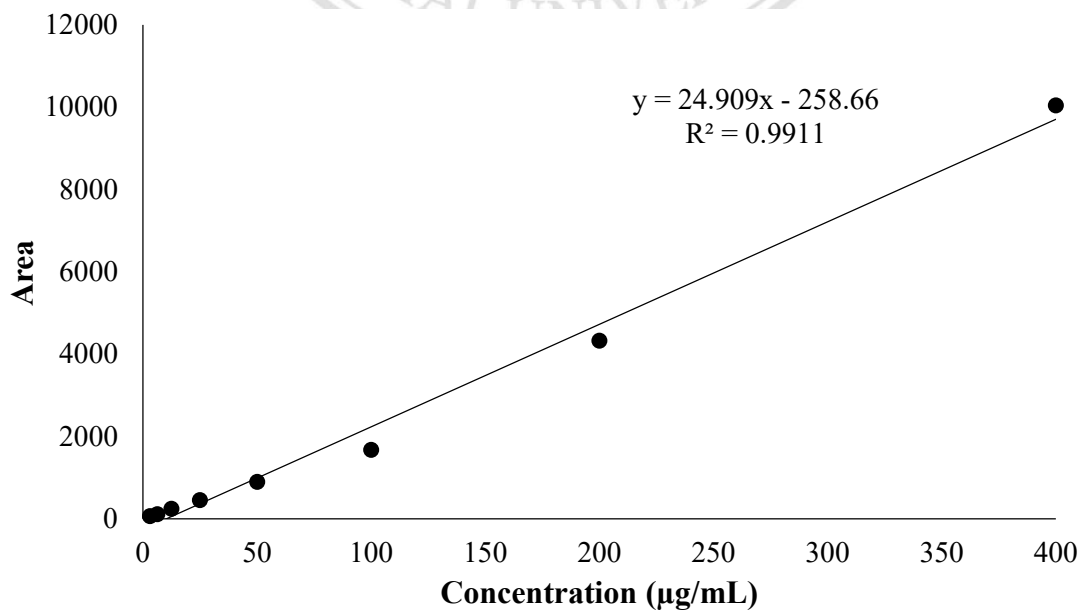


Figure B-2 Standard graph for vanillin quantification

APPENDIX C

Wrapping Process of Mango Fruits with Active-Coated Papers

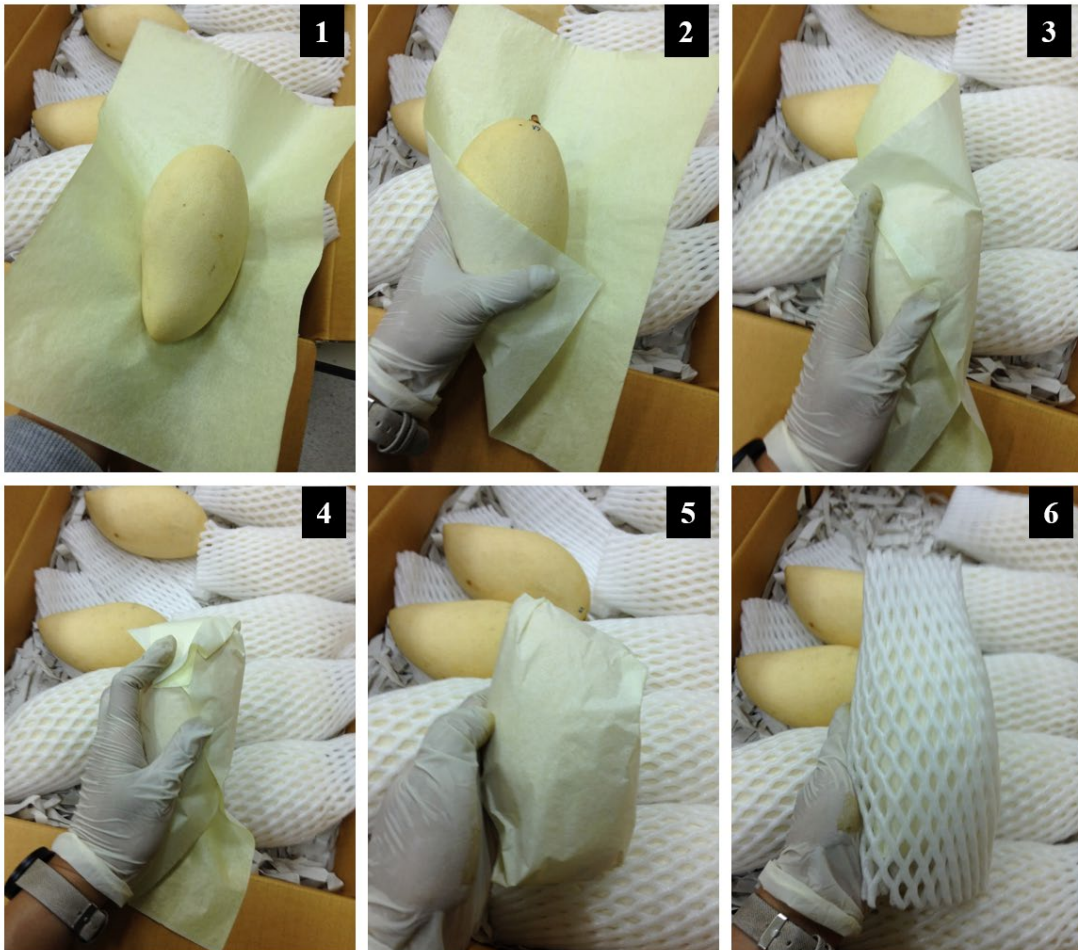


Figure C-1 Wrapping process of mango fruits with active-coated papers

APPENDIX D

Experimental data

Table D-1 Severity index of anthracnose disease in mango fruits

Day	SID (%)			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
3 ^{ns}	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
6	10.00 ^a ± 4.71	6.67 ^{ab} ± 0.00	0.00 ^b ± 0.00	0.00 ^b ± 0.00
9	23.34 ^a ± 4.72	16.67 ^a ± 4.71	6.67 ^b ± 0.00	0.00 ^b ± 0.00
12	36.67 ^a ± 4.71	30.00 ^a ± 4.71	10.00 ^b ± 4.71	3.33 ^b ± 4.71
15	48.33 ^a ± 2.36	41.67 ^a ± 2.35	20.00 ^b ± 9.43	10.00 ^b ± 4.71
18	52.22 ^a ± 1.57	50.00 ^a ± 1.57	33.34 ^b ± 4.72	21.67 ^c ± 2.35
21	58.33 ^a ± 2.36	56.67 ^a ± 2.35	38.89 ^b ± 1.57	30.00 ^c ± 1.57
24	70.00 ^a ± 4.71	70.00 ^a ± 0.00	48.89 ^b ± 3.14	38.89 ^c ± 1.57
27	80.00 ^a ± 2.36	79.17 ^a ± 1.18	56.67 ^b ± 2.35	45.83 ^c ± 3.54
30	85.83 ^a ± 3.54	86.67 ^a ± 2.35	65.00 ^b ± 2.36	56.67 ^c ± 2.35

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

Table D-2 Changes in weight loss of mango fruits during storage

Day	Weight loss (%)			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
3	1.87 ^a ± 0.15	1.81 ^a ± 0.22	1.57 ^b ± 0.23	1.48 ^b ± 0.37
6	2.91 ^a ± 0.14	2.74 ^a ± 0.24	2.61 ^{ab} ± 0.24	2.35 ^b ± 0.56
9	3.95 ^a ± 0.17	3.69 ^a ± 0.29	3.28 ^b ± 0.32	3.09 ^b ± 0.68
12	5.40 ^a ± 0.24	5.01 ^a ± 0.32	4.32 ^b ± 0.37	4.14 ^b ± 0.72
15	6.41 ^a ± 0.29	5.96 ^b ± 0.34	5.31 ^c ± 0.40	5.21 ^c ± 0.60
18	7.31 ^a ± 0.36	6.93 ^a ± 0.38	6.39 ^b ± 0.39	6.11 ^b ± 0.57
21	8.73 ^a ± 0.41	8.02 ^b ± 0.39	7.52 ^c ± 0.45	7.30 ^c ± 0.59
24	10.05 ^a ± 0.48	9.15 ^b ± 0.39	8.76 ^{bc} ± 0.62	8.55 ^c ± 0.51
27	11.07 ^a ± 0.54	10.10 ^b ± 0.41	9.52 ^c ± 0.62	9.26 ^c ± 0.58
30	12.67 ^a ± 0.64	11.51 ^b ± 0.44	10.56 ^c ± 0.63	10.38 ^c ± 0.49

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

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Table D-3 Changes in firmness of mango fruits during storage

Day	Firmness (N)			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	31.51 ± 0.77	31.51 ± 0.77	31.51 ± 0.77	31.51 ± 0.77
7	12.04 ^d ± 0.95	15.74 ^c ± 0.94	19.79 ^b ± 0.60	25.85 ^a ± 0.96
14	6.67 ^d ± 0.74	8.03 ^c ± 0.63	11.59 ^b ± 0.61	16.56 ^a ± 0.74
21	3.55 ^d ± 0.77	5.35 ^c ± 0.91	7.08 ^b ± 0.53	10.42 ^a ± 0.42
28	1.11 ^c ± 0.12	1.89 ^b ± 0.14	2.31 ^b ± 0.30	4.79 ^a ± 0.71

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

Table D-4 Changes in lightness of mango fruits during storage

Day	L^*			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	79.40 ± 0.70	79.40 ± 0.70	79.40 ± 0.70	79.40 ± 0.70
7	74.75 ^b ± 0.80	77.24 ^a ± 0.51	78.08 ^a ± 0.73	77.41 ^a ± 0.91
14	73.32 ^b ± 0.74	73.02 ^b ± 0.48	75.09 ^a ± 0.82	75.46 ^a ± 0.48
21	72.59 ^c ± 0.24	72.68 ^b ± 0.62	74.48 ^a ± 0.62	74.61 ^a ± 0.59
28	70.82 ^b ± 0.49	69.66 ^b ± 0.60	70.80 ^a ± 0.88	70.70 ^a ± 0.47

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

Table D-5 Changes in redness of mango fruits during storage

Day	<i>a</i> *			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	1.90 ± 0.46	1.90 ± 0.46	1.90 ± 0.46	1.90 ± 0.46
7	5.65 ^a ± 1.08	5.14 ^b ± 0.50	5.38 ^{bc} ± 0.51	4.35 ^c ± 0.62
14	6.49 ^a ± 0.79	6.07 ^a ± 0.73	5.45 ^b ± 0.60	5.17 ^b ± 0.47
21	6.49 ^a ± 0.64	5.63 ^{ab} ± 0.79	6.00 ^{ab} ± 0.39	5.09 ^b ± 0.38
28	6.46 ^a ± 0.43	5.93 ^b ± 0.56	6.15 ^c ± 0.84	5.38 ^c ± 0.63

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

Table D-6 Changes in yellowness of mango fruits during storage

Day	<i>b</i> *			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	33.42 ± 3.21	33.42 ± 3.21	33.42 ± 3.21	33.42 ± 3.21
7	41.11 ^a ± 1.19	38.09 ^b ± 1.23	38.52 ^b ± 0.92	37.20 ^b ± 1.04
14 ^{ns}	41.03 ± 2.08	39.93 ± 0.86	40.33 ± 0.92	39.16 ± 0.72
21 ^{ns}	38.62 ± 0.89	38.72 ± 0.87	38.83 ± 0.82	38.09 ± 0.56
28	36.80 ^a ± 0.85	36.88 ^{bc} ± 0.38	37.06 ^{ab} ± 0.60	36.21 ^a ± 0.50

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

Table D-7 Changes in titratable acidity of mango fruits during storage

Day	Titratable acidity (%)			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	3.25 ± 0.39	3.25 ± 0.39	3.25 ± 0.39	3.25 ± 0.39
7	0.97 ^c ± 0.05	1.40 ^b ± 0.23	1.56 ^b ± 0.23	2.18 ^a ± 0.14
14	0.29 ^c ± 0.08	0.46 ^b ± 0.01	0.51 ^b ± 0.09	1.22 ^a ± 0.15
21	0.15 ^d ± 0.03	0.21 ^c ± 0.05	0.29 ^b ± 0.08	0.59 ^a ± 0.06
28	0.10 ^c ± 0.01	0.13 ^{bc} ± 0.02	0.15 ^b ± 0.02	0.30 ^a ± 0.04

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

Table D-8 Changes in total soluble solid of mango fruits during storage

Day	Total soluble solid			
	Control	UNC	VCS 1.0	ZE 0.2
0 ^{ns}	12.50 ± 0.50	12.50 ± 0.50	12.50 ± 0.50	12.50 ± 0.50
7	18.40 ^a ± 0.66	17.00 ^a ± 0.70	17.67 ^a ± 0.70	14.83 ^b ± 0.76
14	19.27 ^a ± 0.31	18.00 ^b ± 0.50	18.93 ^{ab} ± 0.42	16.40 ^c ± 0.69
21	19.70 ^a ± 0.70	18.83 ^a ± 0.42	19.17 ^a ± 1.26	16.83 ^b ± 0.29
28	21.17 ^a ± 0.76	19.57 ^b ± 0.51	20.17 ^{ab} ± 0.47	17.50 ^c ± 0.50

The data shows the average ± standard deviation for investigating three replications ($n = 3$).

Different superscript letters in each row indicate significantly different at $p \leq 0.05$.

The superscript letter, *ns*, indicating that each column has not significantly different at $p > 0.05$.

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Educations

2001-2004 Bachelor of Science in Packaging Technology, Chiang Mai University, Chiang Mai, Thailand

2005-2007 Master of Science in Packaging Technology, Kasetsart University, Bangkok, Thailand

Work Experience

Present A lecturer at Division of Printing and Packaging Technology, Faculty of Art and Architecture, Rajamangala University of Technology Lanna, Chiang Mai, Thailand

2008-2011 An assistant researcher at Science and Technology Research Institute (STRI), Chiang Mai University, Chiang Mai, Thailand

Research

Jaimun, R., Sangsuwan, J., & Chantrasri, P. (2014). Efficacy of vanillin for inhibiting anthracnose pathogen in mango cv. Nam Doc Mai. Proceedings of the 12nd Postharvest Technology Conference. Chiang Mai, Thailand, July 16-18.

Jaimun, R., Sangsuwan, J., & Chantrasri, P. (2015). Efficacy of chitosan and vanillin coated paper against anthracnose disease in mango cv. Nam Doc Mai. *Agricultural Science Journal*, 46, 363–366.

Jaimun, R., Sangsuwan, J., & Chantrasri, P. (2015). Efficacy of chitosan and vanillin coated paper against anthracnose disease in mango cv. Nam Doc Mai. Proceedings of the

- 13th Postharvest Technology Conference. Nakhon Ratchasima, Thailand, June 18-19.
- Jaimun, R., Chootragoon, P., & Saksopin, P. (2016). Design and development sets of packaging for Nara Thai dessert brand. Proceedings of the 12nd National Conference on Art Research Creative Works. Naresuan University, Phitsanulok, Thailand, July 21.
- Orkaew, P., Jaimun, R., & Pomgulasit, S. (2017). Design and development of packaging for golden dried longan: A case study of Mae Pang women group, Phrao, Chiang Mai. Proceedings of the 3rd FENETT' 2017 Conference "Food Industry 4.0: Moving forward with creativity and innovation". Maejo University, Chiang Mai, Thailand, April 4.
- Orkaew, P., Jaimun, R., & Pomgulasit, S. (2017). Design and development of packaging for fruit juice: A case study of Ban Luang women group, Phrao, Chiang Mai. Proceedings of the 3rd FENETT' 2017 Conference "Food Industry 4.0: Moving forward with creativity and innovation". Maejo University, Chiang Mai, Thailand, April 4.
- Orkaew, P., Jaimun, R., & Pomgulasit, S. (2017). Design and development of packaging for safty rice: A case study of safty rice group, Pagee Village, Phrao, Chiang Mai. Proceedings of the 3rd FENETT' 2017 Conference "Food Industry 4.0: Moving forward with creativity and innovation". Maejo University, Chiang Mai, Thailand, April 4.
- Jaimun, R., Chootragoon, P., & Saksopin, P. (2017). Scented package: A creative innovation. Proceedings of the 13nd National Conference on Art Research Creative Works. Phitsanulok, Thailand, July 21.
- Jaimun, R., Sangsuwan, J., & Chantrasri, P. (2017). Application of vanillin-chitosan coated paper on postharvest mango cv. Nam Doc Mai by wrapping for control anthracnose fruit rot disease. Proceedings of the 13th National Plant Protection Conference. Trang, Thailand, November 21-23.

Jaimun, R., Sangsuwan, J., Intipunya, P., & Chantrasri, P. (2018). Active wrapping paper against mango anthracnose fungi and its releasing profiles. *Packaging Technology and Science*, 1 – 11. Doi.org/10.1002/pts.2370.

Training and Certifications

- Course training “Good Manufacturing Practice (GMP) and Hazard Analysis and Critical Control Point (HACCP)” from Faculty of Agro-industry, Chiang Mai University and National Food Institute. Tarin hotel, Chiang Mai, Thailand, March 3-7, 2014.

Achievements/Awards

- Recipient of the honorable mention oral presentation award in Social Sciences and Humanities at the 8th national graduate research conference. Mahidol University, September 7-8, 2007.
- Recipient of the honorable mention poster presentation award in the 13th Postharvest Technology Conference. Nakhon Ratchasima, Thailand, June 18-19, 2015.



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