

**APPENDICES**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved

## APPENDIX A

### Data Tables of Chapter 3

**Table A1** Changes in BI of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	1.5 ± 0.1a	2.3 ± 0.2a	2.5 ± 0.2a	3.1 ± 0.3a	4.2 ± 0.3a
2% MW	1.4 ± 0.2a	2.1 ± 0.1a	2.3 ± 0.2a	2.7 ± 0.4ab	3.9 ± 0.5a
4% MW	1.3 ± 0.4a	1.5 ± 0.1ab	1.8 ± 0.2ab	2.3 ± 0.2ab	3.1 ± 0.4ab
6% MW	1.0 ± 0.2a	1.3 ± 0.0.2b	1.4 ± 0.2b	1.8 ± 0.1b	2.6 ± 0.3b
8% MW	1.2 ± 0.4a	1.5 ± 0.2ab	1.8 ± 0.2ab	2.5 ± 0.3ab	3.3 ± 0.2ab
10% MW	1.4 ± 0.3a	1.6 ± 0.1ab	2.2 ± 0.1a	2.8 ± 0.5ab	3.7 ± 0.4ab

**Table A2** Changes in L\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	49.2 ± 1.3b	45.9 ± 0.5c	45.1 ± 1.7c	44.4 ± 0.7d	41.6 ± 1.5c
2% MW	51.2 ± 0.6ab	49.5 ± 0.8b	50.4 ± 0.8ab	49.8 ± 0.5b	48.9 ± 1.3ab
4% MW	53.2 ± 1.0a	51.4 ± 0.9ab	50.7 ± 0.9ab	50.9 ± 0.7ab	49.3 ± 0.9ab
6% MW	52.7 ± 1.0a	52.5 ± 0.4a	52.6 ± 0.6a	52.5 ± 0.9a	51.2 ± 0.5a
8% MW	50.4 ± 1.2ab	49.5 ± 0.9b	49.9 ± 0.6ab	50.1 ± 0.9ab	48.8 ± 0.6ab
10% MW	48.7 ± 0.7b	49.0 ± 1.1b	47.6 ± 1.2bc	47.2 ± 0.9c	46.1 ± 0.8b

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

**Table A3** Changes in b\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	24.9 ± 0.8ab	22.1 ± 0.9d	23.3 ± 0.4b	21.5 ± 0.7c	20.4 ± 0.8b
2% MW	25.4 ± 0.8ab	23.6 ± 0.6cd	25.3 ± 0.8b	23.1 ± 0.4bc	21.2 ± 0.9b
4% MW	26.5 ± 0.7a	26.3 ± 0.7ab	24.9 ± 0.9b	24.3 ± 0.9ab	20.9 ± 0.6b
6% MW	26.6 ± 0.7a	27.2 ± 0.8a	28.1 ± 0.8a	26.3 ± 0.8a	23.7 ± 0.6a
8% MW	26.3 ± 0.7a	24.4 ± 0.7bc	24.6 ± 0.5b	24.6 ± 0.5ab	22.6 ± 0.7ab
10% MW	23.9 ± 0.9b	24.8 ± 0.7bc	24.1 ± 0.8b	22.6 ± 1.1bc	21.4 ± 0.7b

**Table A4** Changes in pericarp pH of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	5.3 ± 0.1a	5.5 ± 0.3a	5.7 ± 0.3a	5.9 ± 0.2a	5.9 ± 0.1a
2% MW	5.1 ± 0.3a	5.4 ± 0.4a	5.1 ± 0.2ab	5.1 ± 0.2b	5.3 ± 0.2b
4% MW	4.9 ± 0.3a	5.0 ± 0.2a	5.0 ± 0.1ab	5.1 ± 0.3b	5.3 ± 0.1b
6% MW	4.7 ± 0.6a	4.8 ± 0.2a	4.8 ± 0.1b	4.9 ± 0.1b	5.0 ± 0.2b
8% MW	4.8 ± 0.4a	4.8 ± 0.4a	4.8 ± 0.3b	5.1 ± 0.2b	5.2 ± 0.1b
10% MW	4.9 ± 0.5a	4.9 ± 0.6a	4.9 ± 0.2b	5.1 ± 0.2b	5.3 ± 0.1b

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright © by Chiang Mai University  
All rights reserved

**Table A5** Changes in weight loss (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	3.8 ± 0.4a	4.7 ± 0.4a	5.8 ± 0.5a	6.9 ± 0.5a	9.8 ± 0.4a
2% MW	1.9 ± 0.6bc	3.8 ± 0.3a	4.6 ± 0.3b	6.1 ± 0.3a	8.9 ± 0.5a
4% MW	1.7 ± 0.2bc	1.8 ± 0.3b	2.3 ± 0.2c	4.5 ± 0.3b	7.1 ± 0.3b
6% MW	1.0 ± 0.3c	1.2 ± 0.2b	2.1 ± 0.2c	2.9 ± 0.2c	4.6 ± 0.3c
8% MW	2.5 ± 0.3b	3.6 ± 0.3a	4.3 ± 0.2b	5.7 ± 0.4a	7.3 ± 0.2b
10% MW	2.0 ± 0.3bc	3.9 ± 0.4a	4.8 ± 0.5ab	6.7 ± 0.3a	7.7 ± 0.5b

**Table A6** Changes in fruit decay of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	0	4.5 ± 0.7a	7.6 ± 0.7a	25.6 ± 1.4a	45.3 ± 1.7a
2% MW	0	2.5 ± 0.6b	6.7 ± 0.6a	21.7 ± 1.0b	43 ± 1.2b
4% MW	0	0	0	0	15 ± 0.9c
6% MW	0	0	0	0	9.4 ± 0.3d
8% MW	0	0	0	0	13.2 ± 0.9c
10% MW	0	0	0	7.3 ± 0.7c	14.5 ± 1.1c

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright © by Chiang Mai University  
All rights reserved

**Table A7** Changes in respiration rate (mg CO<sub>2</sub>/kg/hour) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	6.4 ± 0.5a	4.7 ± 0.3a	4.5 ± 0.6a	5.1 ± 0.4a	7.6 ± 0.9a
2% MW	3.7 ± 0.1b	2.8 ± 0.2b	2.6 ± 0.4b	3.4 ± 0.1b	4.7 ± 0.3b
4% MW	3.2 ± 0.3bc	2.9 ± 0.1b	2.5 ± 0.2bc	1.7 ± 0.2c	2.7 ± 0.4c
6% MW	2.6 ± 0.1cd	2.0 ± 0.2c	1.5 ± 0.2cd	1.2 ± 0.3c	2.0 ± 0.2c
8% MW	2.2 ± 0.2d	1.7 ± 0.1c	1.5 ± 0.2cd	1.4 ± 0.2c	2.3 ± 0.1c
10% MW	1.9 ± 0.1d	1.6 ± 0.1c	1.3 ± 0.2c	1.8 ± 0.2c	2.7 ± 0.3c

**Table A8** Changes in TSS contents (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
Control	22.4 ± 0.7a	23.6 ± .3a	23.1 ± 0.5a	23.6 ± 0.4a	24.9 ± 0.6a
2% MW	18.2 ± 1.0b	21.1 ± 0.7ab	21.7 ± 0.5ab	23.7 ± 0.6a	23.3 ± 1.0ab
4% MW	19.3 ± 1.4ab	19.7 ± 1.5b	20.9 ± 0.7b	20.4 ± 0.6b	22.7 ± 0.5bc
6% MW	19.3 ± 1.1ab	19.9 ± 1.4b	19.8 ± 0.9b	20.6 ± 0.8b	20.8 ± 0.8c
8% MW	20.4 ± 1.1ab	22.1 ± 0.9ab	21.8 ± 0.7ab	23.3 ± 0.6a	23.2 ± 0.5ab
10% MW	19.7 ± 0.3ab	21.6 ± 1.1ab	21.9 ± 0.7ab	22.1 ± 0.7ab	23.0 ± 0.5ab

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

Copyright© by Chiang Mai University  
All rights reserved

## APPENDIX B

### Data Tables of Chapter 4

**Table B1** Changes in BI of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	1.5 ± 0.1a	2.2 ± 0.1a	2.6 ± 0.3a	3.2 ± 0.2a	4.3 ± 0.2a	4.9 ± 0.1a
T <sub>1</sub>	1.0 ± 0.0b	1.3 ± 0.1b	1.5 ± 0.2b	1.6 ± 0.1b	2.1 ± 0.1b	2.5 ± 0.1b
T <sub>2</sub>	1.0 ± 0.0b	1.1 ± 0.1b	1.3 ± 0.1b	1.4 ± 0.1b	1.7 ± 0.1c	2.1 ± 0.1c

**Table B2** Changes in L\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	50.6 ± 1.1b	48.1 ± 1.1b	48.1 ± 0.8c	46.4 ± 0.8b	43.7 ± 0.7c	43.2 ± 0.7b
T <sub>1</sub>	59.3 ± 1.5a	59.5 ± 1.7a	57.3 ± 1.4b	58.9 ± 1.4a	55.6 ± 0.8b	54.4 ± 1.3a
T <sub>2</sub>	60.7 ± 1.6a	61.4 ± 1.2a	62.6 ± 0.8a	60.0 ± 1.4a	59.6 ± 0.8a	57.4 ± 1.4a

<sup>1</sup>Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.

**Table B3** Changes in b\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	29.6 ± 1.3b	26.0 ± 1.3b	26.7 ± 1.7b	25.2 ± 1.2b	20.2 ± 1.0c	18.9 ± 0.6c
T <sub>1</sub>	33.0 ± 1.4b	36.0 ± 1.9a	35.2 ± 1.6a	35.5 ± 1.2a	32.8 ± 1.1b	28.8 ± 1.1b
T <sub>2</sub>	37.6 ± 0.9a	37.3 ± 0.9a	36.4 ± 0.9a	35.7 ± 0.9a	38.0 ± 1.0a	34.6 ± 1.1a

**Table B4** Changes in pericarp pH of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	5.2 ± 0.03a	5.3 ± 0.03a	5.5 ± 0.03a	5.7 ± 0.1a	5.7 ± 0.1a	5.8 ± 0.1a
T <sub>1</sub>	3.2 ± 0.03b	3.3 ± 0.03b	3.4 ± 0.03b	3.5 ± 0.1b	3.7 ± 0.1b	4.0 ± 0.1b
T <sub>2</sub>	3.1 ± 0.06b	3.2 ± 0.03b	3.2 ± 0.03c	3.3 ± 0.03b	3.4 ± 0.1c	3.6 ± 0.1c

**Table B5** Changes in PPO activity (unit/mg protein) of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
T <sub>0</sub>	2.9 ± 0.3a	3.1 ± 0.1a	3.3 ± 0.2a	3.5 ± 0.3a	4.5 ± 0.2a
T <sub>1</sub>	1.6 ± 0.2b	1.8 ± 0.1b	2.0 ± 0.1b	2.3 ± .2b	2.8 ± 0.3b
T <sub>2</sub>	1.5 ± 0.2b	1.6 ± 0.2b	1.9 ± 0.2b	2.0 ± 0.3b	2.2 ± 0.2c

<sup>1</sup>Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.

**Table B6** Changes in weight loss (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	3.3 ± 0.4a	5.3 ± 0.5a	5.7 ± 0.3a	6.3 ± 0.4a	9.2 ± 0.8a	13.0 ± 0.4a
T <sub>1</sub>	1.0 ± 0.1b	1.2 ± 0.1b	2.2 ± 0.2b	2.9 ± 0.2b	4.7 ± 0.1b	7.8 ± 0.3b
T <sub>2</sub>	1.0 ± 0.1b	1.2 ± 0.1b	2.2 ± 0.1b	2.9 ± 0.1b	4.4 ± 0.2b	7.6 ± 0.4b

**Table B7** Changes in fruit decay (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	0.0 ± 0.0	3.3 ± 0.7a	7.0 ± 0.3a	23.5 ± 2.3a	50.4 ± 3.3a	91.0 ± 4.8a
T <sub>1</sub>	0.0 ± 0.0	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b	6.3 ± 0.9b	17.8 ± 1.6b
T <sub>2</sub>	0.0 ± 0.0	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b	2.6 ± 0.5b	6.6 ± 0.8c

**Table B8** Changes in TSS contents (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
T <sub>0</sub>	19.1 ± 1.0a	20.5 ± 0.6a	21.0 ± 0.7a	23.0 ± 0.4a	23.1 ± 0.5a	23.5 ± 0.4a
T <sub>1</sub>	20.1 ± 0.5a	20.3 ± 0.6a	20.7 ± 0.3a	21.3 ± 0.7a	20.9 ± 0.9ab	20.9 ± 0.4ab
T <sub>2</sub>	20.2 ± 0.9a	20.6 ± 0.7a	20.2 ± 0.2a	21.0 ± 0.9a	20.5 ± 0.8b	21.3 ± 1.0b

<sup>1</sup>Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.



## APPENDIX C

### Data Tables of Chapter 5

**Table C1** Changes in BI of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	1.5 ± 0.1a	2.2 ± 0.1a	2.6 ± 0.3a	3.2 ± 0.2b	4.3 ± 0.2ab
SH <sub>1</sub>	1.3 ± 0.1b	2.3 ± 0.1a	3.1 ± 0.2a	4.5 ± 0.4a	4.9 ± 0.1a
SH <sub>2</sub>	1.2 ± 0.1bc	1.7 ± 0.1b	1.9 ± 0.1b	2.6 ± 0.3bc	3.8 ± 0.4bc
SH <sub>3</sub>	1.1 ± 0.1c	1.5 ± 0.1b	1.7 ± 0.2b	1.9 ± 0.1c	2.9 ± 0.2c

**Table C2** Changes in L\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	48.6 ± 1.1a	48.1 ± 1.1b	48.1 ± 0.8b	46.4 ± 0.8b	43.7 ± 0.7ab
SH <sub>1</sub>	48.5 ± 1.2a	50.1 ± 1.0ab	47.6 ± 0.8b	43.0 ± 1.3c	42.5 ± 1.4b
SH <sub>2</sub>	52.1 ± 1.6a	52.8 ± 1.0a	50.6 ± 0.6a	48.8 ± 0.3b	46.7 ± 1.2a
SH <sub>3</sub>	50.7 ± 1.0a	51.9 ± 0.7a	52.4 ± 0.4a	51.6 ± 0.9a	46.9 ± 0.9a

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

**Table C3** Changes in b\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	29.6 ± 1.3a	26.0 ± 1.3b	26.7 ± 1.7ab	25.2 ± 1.2bc	20.2 ± 1.0b
SH <sub>1</sub>	27.3 ± 0.6a	28.7 ± 0.9a	25.7 ± 1.1b	22.6 ± 0.5c	22.3 ± 1.0b
SH <sub>2</sub>	28.9 ± 1.3a	29.4 ± 0.8a	29.1 ± 0.9a	27.7 ± 0.5ab	25.5 ± 0.5a
SH <sub>3</sub>	30.5 ± 0.6a	30.7 ± 0.6a	29.8 ± 0.3a	30.5 ± 1.4a	27.2 ± 1.3a

**Table C4** Changes in pericarp pH of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	5.2 ± 0.03a	5.3 ± 0.03a	5.5 ± 0.03a	5.7 ± 0.1a	5.7 ± 0.1a
SH <sub>1</sub>	5.1 ± 0.1a	5.3 ± 0.1a	5.4 ± 0.1a	5.5 ± 0.1b	5.5 ± 0.1ab
SH <sub>2</sub>	5.1 ± 0.1a	5.2 ± 0.1a	5.2 ± 0.1b	5.2 ± 0.1bc	5.5 ± 0.1b
SH <sub>3</sub>	4.9 ± 0.1b	5.0 ± 0.1b	5.1 ± 0.1b	5.1 ± 0.1c	5.3 ± 0.1b

**Table C5** Changes in weight loss (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	3.3 ± 0.4a	5.3 ± 0.5a	5.7 ± 0.3a	6.3 ± 0.4a	9.2 ± 0.8a
SH <sub>1</sub>	0.6 ± 0.2b	0.9 ± 0.1b	2.3 ± 0.4b	3.1 ± 0.1b	4.4 ± 0.2b
SH <sub>2</sub>	0.7 ± 0.1b	1.2 ± 0.2b	2.3 ± 0.2b	3.1 ± 0.2b	4.0 ± 0.6b
SH <sub>3</sub>	0.7 ± 0.2b	1.4 ± 0.3b	2.2 ± 0.2b	3.0 ± 0.4b	3.8 ± 0.5b

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

**Table C6** Changes in total microorganisms of longan fruit pericarp surface during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	2.1 ± 0.2a	4.4 ± 0.3a	5.8 ± 0.4a	7.1 ± 0.6a	16.9 ± 1.7a
SH <sub>1</sub>	0.7 ± 0.1b	1.2 ± 0.1b	2.5 ± 0.3b	4.3 ± 0.4b	5.9 ± 0.6b
SH <sub>2</sub>	0.3 ± 0.1c	0.3 ± 0.1c	0.7 ± 0.1c	1.9 ± 0.1c	3.5 ± 0.5bc
SH <sub>3</sub>	0.1 ± 0.1c	0.2 ± 0.1c	0.4 ± 0.1c	1.0 ± 0.4c	2.2 ± 0.3c

**Table C7** Changes in fruit decay (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
SH <sub>0</sub>	0.0	3.3 ± 0.7a	7.0 ± 0.3a	23.5 ± 2.3a	50.4 ± 3.3a	91.0 ± 4.8a
SH <sub>1</sub>	0.0	0.0 ± 0.0b	1.4 ± 0.2b	7.4 ± 0.6b	13.4 ± 0.8b	47.1 ± 0.3b
SH <sub>2</sub>	0.0	0.0 ± 0.0b	0.0 ± 0.0c	0.0 ± 0.0c	5.9 ± 0.3c	19.7 ± 1.3c
SH <sub>3</sub>	0.0	0.0 ± 0.0b	0.0 ± 0.0c	0.0 ± 0.0c	0.0 ± 0.0d	5.6 ± 0.5d

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

**Table C8** Changes in TSS contents (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	19.1 ± 1.0a	20.5 ± 0.6a	21.0 ± 0.7a	23.0 ± 0.4a	23.1 ± 0.5a
SH <sub>1</sub>	19.8 ± 0.8a	21.1 ± 0.3a	20.5 ± 0.5a	21.3 ± 0.5ab	20.9 ± 0.5b
SH <sub>2</sub>	19.9 ± 0.8a	17.1 ± 3.7a	20.3 ± 0.9a	20.5 ± 0.7b	20.9 ± 0.7b
SH <sub>3</sub>	19.2 ± 1.0a	20.4 ± 0.9a	20.4 ± 0.8a	20.1 ± 0.6b	20.5 ± 0.5b

**Table C9** Changes in eating quality scores of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
SH <sub>0</sub>	7.2 ± 0.1b	6.2 ± 0.1c	5.1 ± 0.3c	4.2 ± 0.2c	3.3 ± 0.1c
SH <sub>1</sub>	7.2 ± 0.1b	6.4 ± 0.2c	5.1 ± 0.2c	3.9 ± 0.2c	3.6 ± 0.2c
SH <sub>2</sub>	7.6 ± 0.1b	6.9 ± 0.2b	6.2 ± 0.1b	5.4 ± 0.2b	4.4 ± 0.1b
SH <sub>3</sub>	8.5 ± 0.1a	7.8 ± 0.1a	7.2 ± 0.1a	6.6 ± 0.1a	5.2 ± 0.1a

<sup>1</sup>Means within a column with the same letter are not significantly different ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

## APPENDIX D

### Data Tables of Chapter 6

**Table D1** Changes in BI of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	1.4 ± 0.1a	2.2 ± 0.1a	2.9 ± 0.2a	4.0 ± 0.2a	5.0 ± 0.0a	5.0 ± 0.0a
H <sub>1</sub>	1.0 ± 0.0b	1.2 ± 0.1b	1.3 ± 0.1b	1.7 ± 0.1b	2.0 ± 0.1b	2.9 ± 0.1b
H <sub>2</sub>	1.0 ± 0.0b	1.2 ± 0.1b	1.2 ± 0.1b	1.5 ± 0.1b	1.8 ± 0.1c	2.5 ± 0.2b

**Table D2** Changes in L\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	50.6 ± 1.1b	48.4 ± 1.0b	46.0 ± 1.3b	47.3 ± 2.2b	48.0 ± 2.1c	46.7 ± 1.3c
H <sub>1</sub>	63.7 ± 0.8a	63.1 ± 0.9a	61.5 ± 0.8a	56.8 ± 1.4a	54.8 ± 1.0b	51.8 ± 0.6b
H <sub>2</sub>	64.8 ± 0.9a	64.4 ± 0.7a	63.3 ± 0.7a	59.6 ± 1.1a	59.6 ± 0.5a	56.8 ± 0.6a

<sup>1</sup>Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.

Copyright© by Chiang Mai University  
All rights reserved

**Table D3** Changes in b\* values of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	28.4 ± 0.6b	25.6 ± 0.9b	24.9 ± 0.8b	24.3 ± 0.9b	24.5 ± 0.8b	23.3 ± 0.8b
H <sub>1</sub>	33.3 ± 0.9a	32.3 ± 0.7a	30.3 ± 0.8a	30.0 ± 0.5a	26.7 ± 0.7ab	25.6 ± 0.9a
H <sub>2</sub>	33.5 ± 0.9a	32.9 ± 0.6a	31.0 ± 0.8a	30.7 ± 0.8a	28.5 ± 1.0a	26.2 ± 0.5a

**Table D4** Changes in PPO activity (unit/mg protein) of longan fruit pericarp during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
H <sub>0</sub>	2.7 ± 0.24a	3.1 ± 0.07a	3.2 ± 0.1a	3.6 ± 0.07a	4.4 ± 0.13a
H <sub>1</sub>	1.7 ± 0.15b	1.8 ± 0.09b	1.9 ± 0.07b	2.1 ± 0.09b	2.8 ± 0.11b
H <sub>2</sub>	1.6 ± 0.12b	1.7 ± 0.1b	1.8 ± 0.1b	1.8 ± 0.03b	2.1 ± 0.15c

**Table D5** Changes in fruit decay (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	0.0 ± 0.0	2.8 ± 0.4a	6.6 ± 1.4a	20.5 ± 1.7a	58.9 ± 2.8a	98.8 ± 1.2a
H <sub>1</sub>	0.0 ± 0.0	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b	5.2 ± 0.4b
H <sub>2</sub>	0.0 ± 0.0	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b	0.0 ± 0.0b	4.7 ± 0.5b

<sup>1</sup>Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.

**Table D6** Changes in total microorganism populations ( $\times 10^6$  CFU ml<sup>-1</sup>) on longan fruit surface during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>				
	5	10	15	20	25
H <sub>0</sub>	2.0 ± 0.2a	4.0 ± 0.5a	5.6 ± 0.3a	6.9 ± 0.5a	14.1 ± 0.8a
H <sub>1</sub>	0.2 ± 0.1b	0.4 ± 0.1b	0.6 ± 0.1b	1.3 ± 0.4b	2.2 ± 0.2b
H <sub>2</sub>	0.2 ± 0.1b	0.3 ± 0.1b	0.5 ± 0.1b	1.2 ± 0.4b	2.1 ± 0.2b

**Table D7** Changes in weight loss (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	3.5 ± 0.1a	5.3 ± 0.2a	5.8 ± 0.1a	6.2 ± 0.2a	9.4 ± 0.5a	11.9 ± 1.0a
H <sub>1</sub>	1.5 ± 0.2b	1.9 ± 0.1b	2.8 ± 0.3b	4.7 ± 0.2b	6.1 ± 0.1b	8.6 ± 0.3b
H <sub>2</sub>	0.7 ± 0.2c	1.5 ± 0.2b	2.4 ± 0.1b	3.1 ± 0.1c	4.1 ± 0.2c	6.3 ± 0.2c

<sup>1</sup>Means within a column with the same letter are not significantly different at 95% ( $P \leq 0.05$ ) level by least significant difference comparison. Data are mean value ± SE.

**Table D8** Changes in TSS contents (%) of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	21.1 ± 0.4a	21.5 ± 0.8a	21.4 ± 0.4a	22.6 ± 0.4a	22.4 ± 0.4a	22.9 ± 0.4a
H <sub>1</sub>	20.5 ± 0.2a	20.9 ± 0.5a	20.6 ± 0.2a	21.4 ± 0.4b	22.3 ± 0.3a	22.6 ± 0.3a
H <sub>2</sub>	20.7 ± 0.2a	21.1 ± 0.5a	20.7 ± 0.3a	21.2 ± 0.3b	21.6 ± 0.7a	22.0 ± 0.4a

**Table D9** Changes in eating quality scores of longan fruit during the storage period

Treatments	Days of storage at 5°C <sup>1</sup>					
	5	10	15	20	25	30
H <sub>0</sub>	7.2 ± 0.1b	6.2 ± 0.1b	5.1 ± 0.3b	3.5 ± 0.2c	3.2 ± 0.1c	1.0 ± 0.1c
H <sub>1</sub>	8.3 ± 0.1a	7.5 ± 0.2a	6.9 ± 0.2a	6.1 ± 0.2b	5.0 ± 0.2b	4.1 ± 0.2b
H <sub>2</sub>	8.5 ± 0.1a	7.8 ± 0.2a	7.2 ± 0.1a	6.8 ± 0.2a	6.5 ± 0.1a	5.2 ± 0.3a

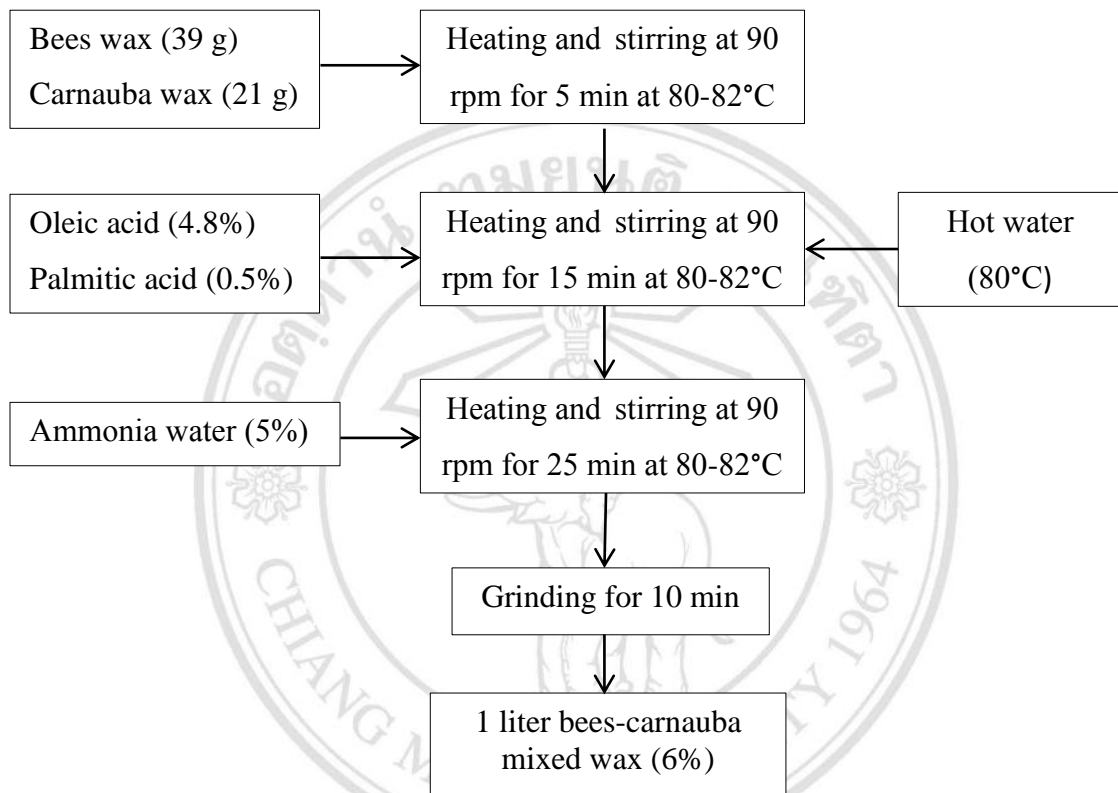
<sup>1</sup>Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved



## APPENDIX E

### Procedure of 6% bees-carnauba mixed wax preparation and cost



**Figure E1** Process to make 1 liter of 6% bees-carnauba mixed wax

Copyright© by Chiang Mai University  
All rights reserved

**Table E1** Cost for 6% bees-carnauba wax (3.9% bees wax and 2.1% carnauba wax),  
7.5% oxalic acid and 200 ppm sodium hypochlorite

Materials	Price of raw materials (Baht)	The cost for 1 liter of 6% bees-carnauba mixed wax		
		Vietnamese Dongs	Thai Baht	US Dollar
Bees wax (3.9%)	590 (Baht/kg)	15,037	23.01	0.69
Carnauba wax (2.1%)	640 (Baht/kg)	8,783	13.44	0.41
Ammonia water (5%)	172 (Baht/L)	5620	8.6	0.26
Oleic acid (4.8%)	949 (Baht/L)	29,766	45.55	1.38
Palmitic acid (0.5%)	2160 (Baht/kg)	7,057	10.8	0.33
<b>Total</b>		<b>66,264</b>	<b>101.4</b>	<b>3.07</b>

Average, 1 liter of bees-carnauba mixed wax is coated for 40-50 kg longan fruit, so for 1 kg is about from 2.028 to 2.535 Baht.

Price of oxalic acid for 1 kg longan fruit is about 0.88 Baht, SH is negligible

Total cost for 1 kg longan fruit is about from 2.908 to 3.145 Baht [from 1,861 to 2,012 Vietnamese Dongs (VND)]

The above price is confirmed in 15 April 2015 (1 USD = 33.34 Bath; 1 Baht = 653.5 VND)

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved

## PUBLICATIONS

### International oral presentation

- 1) **Hai, L. H.** and J. Uthaibutra. 2014. “Effect of oxalic acid on visual appearance and quality of longan fruit cv. Long during low temperature storage”. The 3<sup>rd</sup> Asia Pacific Symposium on Postharvest Research, Education and Extension, 9-11 December 2014. The Victory Hotel, Ho Chi Minh City, Vietnam.

### Journal Publications

- 1) **Hai, L. H.**, J. Uthaibutra, Y. Chanbang and A. Joomwong. 2014. “Effects of bee-carnauba mixed wax coating on the reduction of respiration rate, weight loss, fruit decay, and the maintenance of visual appearance and quality of Vietnamese longan cv. Long during low temperature storage”. *International Journal of Agriculture Innovations and Research*. 2 (4): 554-560.
- 2) **Hai, L. H.**, A. Joomwong, Y. Chanbang and J. Uthaibutra. 2014. “Effects of oxalic acid dipping and wax coating on pericarp browning and storage life of fresh Vietnamese longan fruit cv. Long”. *International Journal of Agriculture Innovations and Research*. 3 (2): 670-677.
- 3) **Hai, L. H.**, J. Uthaibutra and Y. Chanbang. 2014. “Effects of sodium hypochlorite soaking in combination with wax coating to control fruit decay and to maintain visual appearance of fresh Vietnamese longan cv. Long”. *International Journal of Bio-Technology and Research*. 4 (6): 33-44.
- 4) **Hai, L. H.** and J. Uthaibutra. 2015. “Effect of oxalic acid on visual appearance and quality of longan fruit cv. Long during low temperature storage”. *Acta Horticulturae* (Accepted, in press).

- 5) **Hai, L. H.** and J. Uthaibutra. 2015. “Effect of fruit dipping in sodium hypochlorite and oxalic acid then coating in bees-carnauba mixed wax on peel browning and decay of Vietnamese longan fruit”. *Pakistan Journal of Bio-Technology* (Accepted, in press).



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved

## CURRICULUM VITAE

**Name** Mr. Le Ha Hai

**Date of birth** January 5<sup>th</sup>, 1975

### Education background

- 2009-2011 M.Sc. in Postharvest Technology, Postharvest Technology Research Institute, Chiang Mai University, Thailand.
- 1994 -1998 B.Sc. in Storage and Processing of Agricultural Products, Faculty of Agriculture, Hanoi University of Agriculture, Vietnam.
- 1991-1994 High school at Ba Dinh High School, Nga Son District, Thanh Hoa Province, Vietnam.

### Scholarships

- 2012-2015 Program of Agriculture and Aquaculture Biotechnology of the Vietnamese Government.
- 2009-2011 Agricultural Science and Technology Project VIE-2283 (SF), Ministry of Agriculture and Rural Development of Vietnam.

### Working experience

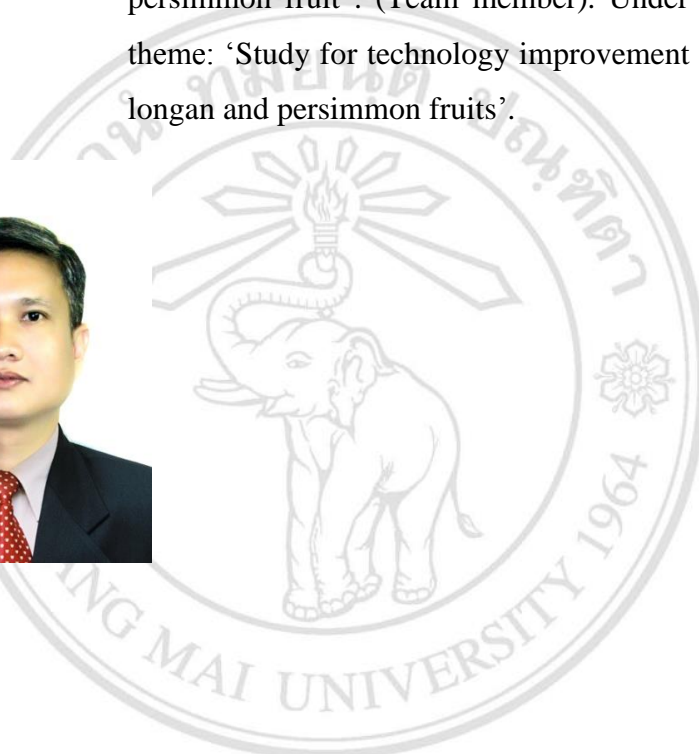
- 2012 to present Senior researcher, Head of Department for Research of Technology, Center for Research of Agro-Food Processing - Under Vietnam Institute of Agricultural Engineering and Post-harvest Technology (VIAEP)

2011- 2012	Senior researcher, Vice Head of Department for Research of Technology, Center for Research of Agro-Food Processing, VIAEP
2007 – 2009	Senior researcher at Center for Research of Agro-Food Processing, VIAEP
2002 – 2007	Senior researcher at Department of Technology and Equipment for Processing of Agro-products, VIAEP
1998 – 2002	Employed by Vietnam Institute of Postharvest Technology to work at Department of Processing and Storage of Agro-Products

**Conducted subjects and projects**

2013-2014	“Assessment on postharvest situation in Quang Binh and Binh Dinh provinces” for the project ‘Sowing the seed of change: Community-based climate change mitigation through sustainable rice production’. (Team leader). SNV-Netherland Development Organization project.
2007-2008	“Survey and assessment the real storage situation of rice, fruits, and vegetables”. (Team leader). Under ministry level project.
2007-2008	“Survey and assessment postharvest situation of vegetables and fruits in some northern provinces of Vietnam”. (Team member). Under ministry level project: ‘Research and selection of technology and equipment for fruits and vegetables packing house’.
2006-2008	“Study to produce salt by spraying method”. (Team leader). Under ministry level theme: ‘Research to improve some stages in salt production’.

- 2005-2006 “Compare different methods to assess the postharvest loss of rice”. (Team member). Under DANIDA component postharvest (DANIDA/ASPS).
- 2002-2003 “Research on storage technology of onion”. (Team leader). Institute level theme.
- 2000-2002 “Research on storage technology of longan and persimmon fruit”. (Team member). Under ministry level theme: ‘Study for technology improvement in handling of longan and persimmon fruits’.



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่  
Copyright© by Chiang Mai University  
All rights reserved