APPENDIX A

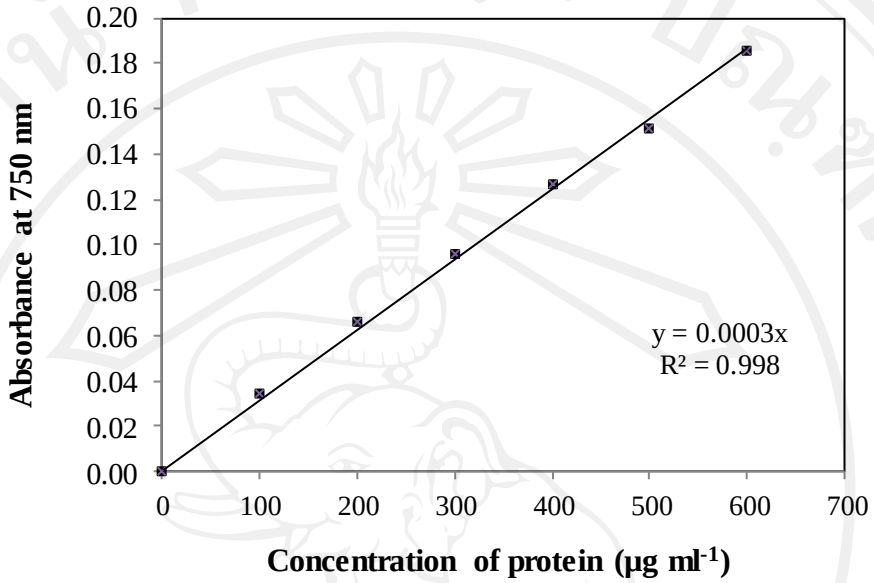

Figure A1 Linearity between absorbance at 750 nm of bovine serum albumin (BSA) concentration for protein assay

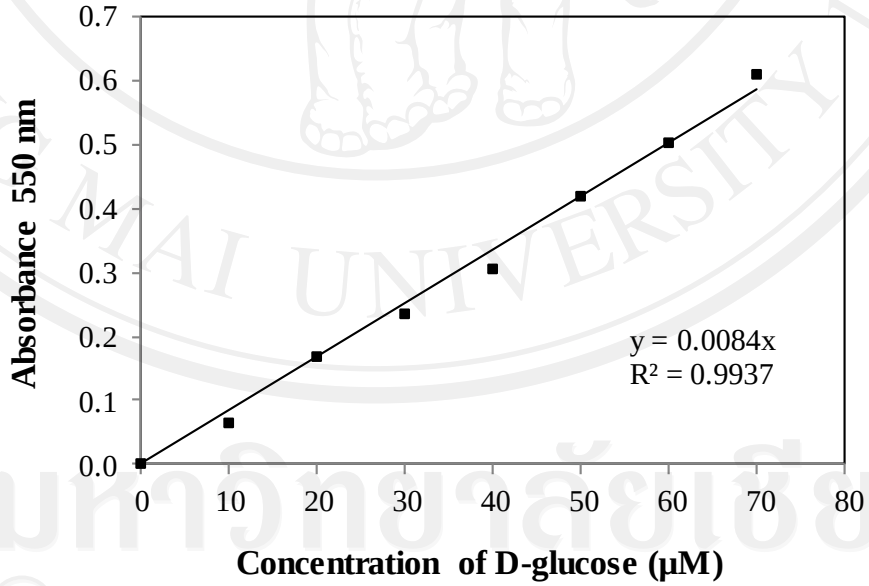

Figure A2 Linearity between absorbance at 550 nm of D-glucose concentration for β-1,3 glucanase assay

APPENDIX B

Table A1 Spore survival populations of *Fusarium* sp. (log cfu per milliliter) on PDA plates, after being treated with electrolyzed water at concentrations of 100, 200 and 300 ppm and incubated at 27 °C for 48 hr.

Treatments	Spore survival (log cfu per milliliter)		
	10 min	30 min	60 min
Control	7.94	7.94	7.94
EO 100 ppm	0	0	0
EO 200 ppm	0	0	0
EO 300 ppm	0	0	0

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A2 Spore survival population of *Fusarium* sp. (log cfu per milliliter) on PDA plates, after being treated with ultrasonic waves at frequencies of 108, 400, 700 KHz and 1 MHz for 10, 30 and 60 min. The samples were incubated at 27 °C for 48 hr.

Treatments	Spore survival (log cfu per milliliter)		
	10 min	30 min	60 min
Control	7.33 ± 0.01a	7.33 ± 0.01a	7.33 ± 0.01a
US 108 kHz	6.92 ± 0.04b	6.07 ± 0.06b	5.63 ± 0.10b
US 400kHz	6.28 ± 0.13b	5.93 ± 0.11b	5.46 ± 0.04b
US 700kHz	6.33 ± 0.09b	5.96 ± 0.05b	5.30 ± 0.02b
US 1 MHz	6.23 ± 0.06b	5.88 ± 0.08b	5.08 ± 0.15b

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A3 Mycelial disc growth diameter of *Fusarium* sp. on PDA plate after treated with EO water (100, 200, and 300 ppm) for 60 min then incubated at 27 °C for 7 days.

Treatment	Mycelial disc growth (cm)				
	Day 0	Day 1	Day 3	Day 5	Day 7
Control	0.7 ± 0a	1.18 ± 0.04a	2.31 ± 0.15a	4.5 ± 0.19a	5.95 ± 0.11a
EO 100 ppm	0.7 ± 0a	0.7 ± 0.00b	2.10 ± 0.11b	3.8 ± 0.10a	5.27 ± 0.12b
EO 200 ppm	0.7 ± 0a	0.7 ± 0.00b	1.97 ± 0.05b	3.7 ± 0.09a	5.35 ± 0.08b
EO 300 ppm	0.7 ± 0a	0.7 ± 0.00b	1.84 ± 0.21b	2.87 ± 0.48b	3.91 ± 0.33c

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A4 Mycelial disc growth diameter of *Fusarium* sp. on PDA plate after treated with EO water (300 ppm) for 10, 30, and 60 min then incubated at 27 °C for 7 days.

Treatment	Mycelial disc growth (cm)				
	Day 0	Day 1	Day 3	Day 5	Day 7
Control	0.7 ± 0a	1.2 ± 0.04a	2.46± 0.01a	4.19 ± 0.07a	5.31 ± 0.20a
10 min	0.7 ± 0a	0.7 ± 0.00b	2.21 ± 0.01ab	3.86 ± 0.12ab	4.54 ± 0.19ab
30 min	0.7 ± 0a	0.7 ± 0.00b	2.07 ± 0.07bc	3.32 ± 0.20bc	4.00 ± 0.33bc
60 min	0.7 ± 0a	0.7 ± 0.00b	1.84 ± 0.21c	2.87 ± 0.41c	3.50 ± 0.37c

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A5 Mycelial disc growth diameter of *Fusarium* sp. on PDA plate after treat with US wave at frequency of 108, 400, 700 and 1,000 kHz for 60 min then incubated at 27 °C for 7 day

Treatment	Mycelial disc growth (cm)				
	Day 0	Day 1	Day 3	Day 5	Day 7
Control	0.7 ± 0a	1.15± 0.03a	2.76 ± 0.07a	4.59 ± 0.19a	5.81 ± 0.41a
US 108 kHz	0.7 ± 0a	1.15± 0.05a	3.14 ± 0.04a	4.83 ± 0.02a	6.03 ± 0.12a
US 400kHz	0.7 ± 0a	1.12± 0.02a	3.0 ± 0.03a	4.51 ± 0.23a	6.09 ± 0.18a
US 700kHz	0.7 ± 0a	1.15± 0.07a	2.67 ± 0.44a	4.96 ± 0.27a	5.93 ± 0.35a
US 1 MHz	0.7 ± 0a	1.12± 0.09a	2.84 ± 0.28a	5.01 ± 0.60a	5.98 ± 0.31a

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A6 Mycelial disc growth diameter of *Fusarium* sp. on PDA plate after treat with US wave at a frequency of 1,000 kHz for 0, 10, 30, and 60 min then incubated at 27 °C for 7 day

Treatment	Mycelial disc growth (cm)				
	Day 0	Day 1	Day 3	Day 5	Day 7
Control	0.7 ± 0a	1.17 ± 0.02a	3.12± 0.11a	5.70 ± 0.24a	6.10 ± 0.08a
10 min	0.7 ± 0a	1.13 ± 0.06b	3.15 ± 0.27a	5.79 ± 0.16a	6.14 ± 0.16a
30 min	0.7 ± 0a	1.16 ± 0.06b	2.85 ± 0.11b	5.48 ± 0.21a	6.22 ± 0.12a
60 min	0.7 ± 0a	1.12 ± 0.04b	2.84 ± 0.12b	5.21 ± 0.27a	5.98 ± 0.14a

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A7 Colony-forming units of *Fusarium* sp. (log cfu per milliliter) on PDA plates after treat with US wave at frequency of 1,000 kHz and EO water at available free chlorine of 100 ppm for 10 min.

Treatment	Spore survival (log cfu per milliliter)
Control	7.9411 ± 0.03a
US	6.2311 ± 0.14a
EO	0.0000 ± 0.00b
EO + US	0.0000 ± 0.00b

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A8 Mycelial disc growth diameter of Fusarium sp. on PDA plate after treat with US wave at frequency of 1,000 kHz and EO water at available free chlorine of 100 ppm for 10 min.

Treatment	Mycelial disc growth (cm)			
	Day 0	Day 3	Day 5	Day 7
Control	0.7± 0.00	3.211±0.11a	4.822± 0.37a	6.166±0.36a
US	0.7± 0.00	2.683±0.14b	4.527± 0.31a	6.124±0.42a
EO	0.7± 0.00	2.022±0.15c	3.711± 0.35b	5.477±0.45b
EO + US	0.7± 0.00	0.972±0.26c	1.555± 0.85c	2.566±1.83c

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A9 Effect of EO water and ultrasonic wave on total aerobic plate count (log cfu/ml) in pineapple fruit during storage at 13 ◦ C for 20 days.

Treatment	Total aerobic plate count (log cfu/ml)				
	Day 0	Day 5	Day 10	Day 15	Day 20
Control	4.87± 0.10a	6.86 ± 0.55a	6.89 ± 0.58a	7.20 ± 0.20a	7.26 ± 0.72a
US	4.49± 0.98b	6.29 ± 0.81a	6.60 ± 0.28a	6.39 ± 0.86b	7.17 ± 0.90a
EO	4.12± 0.25b	5.33 ± 0.62b	6.23 ± 0.30a	6.46 ± 0.60b	6.70 ± 0.52b
EO + US	3.32± 0.85c	5.09 ± 0.86b	5.88 ± 0.60a	6.04 ± 0.35b	6.44 ± 0.55b

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A10 Effect of EO water and ultrasonic wave on Yeast and Mold count (log cfu/ml) in pineapple fruit during storage at 13 ◦ C for 20 days.

Treatment	Yeast and Mold count (log cfu/ml)				
	Day 0	Day 5	Day 10	Day 15	Day 20
Control	4.75 ± 0.14a	5.51± 0.16a	5.87± 0.12a	6.53± 0.45a	7.75± 0.40a
US	4.31 ± 0.03a	5.03± 0.18a	5.44± 0.15a	5.67± 0.45b	6.74± 0.25b
EO	3.95 ± 0.04b	4.67± 0.15b	5.24± 0.15a	5.32± 0.52b	6.53± 0.47b
EO + US	3.81 ± 0.03b	4.58± 0.14b	5.05± 0.15a	5.18± 0.6b	6.02± 0.32b

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A11 Effect of EO water and US wave on the incidence of decay in pineapple fruit during storage at 25 °C.

Treatment	Disease incidence (%)				
	Day 0	Day 1	Day 3	Day 5	Day 7
Control	0± 0.00a	0± 0.00a	3.12± 0.00a	9.37± 6.25a	31.25± 10.83a
US	0± 0.00a	0± 0.00a	0.00± 0.00b	6.25± 10.83b	18.75± 6.25ab
EO	0± 0.00a	0± 0.00a	0.00± 0.00b	3.15± 0.00c	9.37± 6.25ab
EO+US	0± 0.00a	0± 0.00a	0.00± 0.00b	0.00± 0.00d	6.25± 6.25b

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A12 Effect of EO water and US wave on the incidence of decay in pineapple fruit during storage at 13 ◦C.

Treatment	Disease incidence (%)				
	Day 0	Day 5	Day 10	Day 15	Day 20
Control	0.00± 0.00a	0.00± 0.00a	66.67± 8.33a	83.33± 8.33a	100.00± 0.00a
US	0.00± 0.00a	0.00± 0.00a	33.33± 8.33b	66.67± 8.33a	83.33± 8.33a
EO	0.00± 0.00a	0.00± 0.00a	8.33± 8.33c	33.33± 8.33b	41.67± 8.33b
EO+US	0.00± 0.00a	0.00± 0.00a	0.00± 0.00d	8.33± 8.33c	8.33± 8.33c

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A13 Effect of EO water, US wave and their combination on disease incidence (% of infected fruit) of de-crowned pineapple fruit during storage at room temperature for 7 days.

Treatment	Disease incidence (%)				
	Day 0	Day 1	Day 3	Day 5	Day 7
Control	0.00± 0.00a	0.00± 0.00a	81.25± 10.83a	100.00± 0.00a	100.00± 0.00a
US	0.00± 0.00a	0.00± 0.00a	76.25± 2.17a	100.00± 0.00a	100.00± 0.00a
EO	0.00± 0.00a	0.00± 0.00a	12.50± 5.17b	87.50± 12.50b	100.00± 0.00a
EO+US	0.00± 0.00a	0.00± 0.00a	0.00± 0.00c	81.25± 10.83b	100.00± 0.00a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A14 Effect of EO water, US wave and their combination on disease incidence (% of infected fruit) of de-crowned pineapple fruit during storage at 13 °C for 20 days.

Treatment	Disease incidence (%)				
	Day 0	Day 5	Day 10	Day 15	Day 20
Control	0.0 ± 0.0a	25.00 ± 10.49a	91.67 ± 11.45a	100.0 ± 0.0a	100.0 ± 0.0a
US	0.0 ± 0.0a	16.67 ± 11.32ab	58.33 ± 10.79b	100.0 ± 0.0a	100.0 ± 0.0a
EO	0.0 ± 0.0a	8.33 ± 10.79bc	66.67 ± 11.32b	100.0 ± 0.0a	100.0± 0.0a
EO+US	0.0 ± 0.0a	0.00 ± 0.00c	58.33 ± 11.43b	91.67 ± 7.85a	100.0± 0.0a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A15 Chitinase activity of de-crowned pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) and their combination for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Chitinase activity (units mg protein^{-1}; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	0.002 ± 0.00b	0.017 ± 0.0015c	0.025 ± 0.0037b	0.032 ± 0.0022a	0.024 ± 0.0055a
US	0.004 ± 0.00b	0.016 ± 0.0013ab	0.029 ± 0.0025ab	0.030 ± 0.0018a	0.017 ± 0.0010c
EO	0.012 ± 0.00a	0.022 ± 0.0013ab	0.036 ± 0.0029a	0.036 ± 0.0074a	0.020 ± 0.0014b
EO+US	0.009 ± 0.00a	0.028 ± 0.0058a	0.034 ± 0.0050ab	0.039 ± 0.0038a	0.021 ± 0.0058b
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.023 ± 0.0097a	0.037 ± 0.0074b	0.046 ± 0.0073ab	0.028 ± 0.0063a	0.018 ± 0.0080b
US	0.032 ± 0.0055a	0.047 ± 0.0056ab	0.040 ± 0.0120b	0.029 ± 0.0024a	0.026 ± 0.0014a
EO	0.036 ± 0.0039a	0.043 ± 0.0018a	0.052 ± 0.0074b	0.035 ± 0.0094a	0.025 ± 0.0006a
EO+US	0.029 ± 0.0052a	0.049 ± 0.0107a	0.069 ± 0.0099a	0.040 ± 0.0046a	0.024 ± 0.0017a

Note: BF = 0.002±0.001 units mg protein^{-1}

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A16 β-1,3 glucanase activity of de-crowned pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) and their combination for 10 min. The fruits were kept at 25 and 13°C.

Treatment	β-1,3 glucanase activity (units mg protein-1; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	1.39± 0.22b	8.00± 1.69b	5.67± 2.49b	7.05± 1.09b	7.02± 0.52a
US	3.39± 0.10b	6.67± 2.14b	5.25± 0.66b	9.97± 1.22a	4.20± 0.62c
EO	4.03± 0.28b	8.17± 0.63a	7.62± 1.86a	7.49± 0.18b	5.98± 0.39b
EO+US	3.11± 0.19a	10.73± 1.08a	8.90± 0.43a	9.40± 0.20a	6.88± 0.43a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.91± 0.12c	1.60± 0.34c	9.01± 0.93c	2.68± 0.34c	10.35± 0.29c
US	0.76± 0.05c	3.63± 0.13a	9.07± 0.51c	5.90± 0.49b	18.14± 0.49b
EO	1.64± 0.22b	1.33± 0.43c	11.37± 0.63b	5.98± 1.04b	23.35± 0.81a
EO+US	2.13± 0.45a	2.75± 0.44b	14.28± 1.19a	8.88± 1.49a	22.36± 3.32a

Note: BF = 0.81±0.025 units mg protein^{-1}

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A17 Phenylalanin ammonialyase (PAL) activity of de-crowned pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) and their combination for 10 min. The fruits were kept at 25°C and 13°C.

Treatment	PAL activity (units mg protein-1; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	2.49±0.81bc	7.99±1.20b	14.34±0.39c	7.48±0.98a	5.13±0.39b
US	2.96±0.61b	7.10±1.02bc	12.74±0.30b	4.83±0.25b	5.15±0.85b
EO	2.21±0.53c	6.07±0.62c	14.55±0.83b	5.22±0.26b	5.97±0.50a
EO+US	4.29±0.56a	12.30±0.81z	16.28±0.95a	7.34±0.26a	6.10±0.98a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	2.00±0.15d	7.28±0.04a	11.61±0.13c	4.26±0.00b	3.84±0.07b
US	1.47±0.02c	6.38±0.07b	11.75±0.27c	10.49±0.14a	5.99±1.73a
EO	3.31±0.48b	6.71±0.05b	16.13±0.17b	4.44±0.02b	3.49±0.19b
EO+US	4.92±0.70a	7.44±0.04a	20.93±0.47a	5.51±0.04b	3.44±0.07b

Note: BF = 2.03±0.52 units mg protein^{-1}

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A18 Peroxidase (POD) activity of de-crowned pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) and their combination for 10 min. The fruits were kept at 25 and 13°C .

Treatment	POD activity (units mg protein-1; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	0.03± 0.00b	0.26± 0.06b	0.52± 0.04c	0.24± 0.03c	0.52± 0.06a
US	0.20± 0.02a	0.52± 0.06a	0.92± 0.04a	0.36± 0.01b	0.30± 0.02b
EO	0.03± 0.00b	0.29± 0.03b	0.80± 0.04b	0.22± 0.02c	0.49± 0.04ab
EO+US	0.02± 0.00b	0.46± 0.01x	0.74± 0.06b	0.52± 0.04a	0.43± 0.02ab
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.014± 0.006b	0.042± 0.006b	0.084± 0.013c	0.118± 0.017b	0.078± 0.002c
US	0.014± 0.002b	0.079± 0.009a	0.141± 0.013b	0.120± 0.016b	0.160± 0.008ab
EO	0.017± 0.003ab	0.023± 0.001c	0.105± 0.002b	0.103± 0.007c	0.116± 0.018b
EO+US	0.034± 0.001a	0.073± 0.003a	0.167± 0.019a	0.157± 0.030a	0.185± 0.002a

Note: BF = 0.021±0.003 units mg protein^{-1}

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A19 Polyphenol oxidase (PPO) activity of de-crowned pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) and their combination for 10 min. The fruits were kept at 25°C and 13°C.

Treatment	PPO activity (units mg protein-1; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	0.09± 0.02a	0.10± 0.02c	0.20± 0.01c	0.18± 0.01c	0.08± 0.00b
US	0.10± 0.02a	0.13± 0.03b	0.24± 0.03b	0.19± 0.02c	0.21± 0.04a
EO	0.08± 0.00a	0.15± 0.02a	0.25± 0.03b	0.21± 0.02b	0.18± 0.01b
EO+US	0.09± 0.01a	0.16± 0.02a	0.31± 0.03a	0.23± 0.00a	0.20± 0.02a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.11± 0.00a	0.025± 0.002c	0.145± 0.011b	0.174± 0.004b	0.140± 0.028a
US	0.08± 0.00b	0.019± 0.001c	0.081± 0.001c	0.109± 0.006c	0.093± 0.002b
EO	0.08± 0.01b	0.047± 0.003b	0.145± 0.031b	0.256± 0.039a	0.082± 0.017b
EO+US	0.11± 0.03a	0.053± 0.009a	0.205± 0.039a	0.257± 0.050a	0.141± 0.033a

Note: BF = 0.085$\pm$0.002 units mg protein^{-1}

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A 20 Firmness of de-crowned pineapple fruit inoculated with *Fusarium* sp. After being treated with EO water and US wave. The fruits were kept at 25 and 13 °C.

Treatment	Firmness (N; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	13.63± 0.00a	11.41± 0.47a	8.88± 1.01a	7.85± 0.73a	7.48± 0.27a
US	13.63± 0.00a	11.12± 0.77a	7.60± 0.45b	7.49± 0.31a	7.61± 0.37a
EO	13.63± 0.00a	11.10± 0.37a	8.24± 0.93a	7.59± 0.13a	7.33± 0.55a
EO+US	13.63± 0.00a	11.50± 0.31a	8.47± 0.43a	7.37± 0.18a	7.61± 0.34a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	13.63± 0.00a	9.41± 0.47a	8.88± 1.01b	8.85± 0.27b	8.48± 1.03a
US	13.63± 0.00a	9.79± 0.24a	9.94± 0.75a	9.49± 1.57a	8.95± 2.12a
EO	13.63± 0.00a	9.44± 0.66a	9.24± 0.86a	8.59± 0.87b	8.33± 1.14a
EO+US	13.63± 0.00a	9.50± 0.60a	9.13± 0.33	8.70± 0.76b	8.28± 0.34a

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A21 Effect of EO water and US wave on weight loss in pineapple fruit during storage at 25 and 13 ◦C.

Treatment	Weight loss (%; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	0.00±0.00a	1.33±0.05b	2.82±0.11a	4.56±0.18a	6.26±0.24a
US	0.00±0.00a	1.64±0.21a	3.22±0.39a	4.94±0.63a	6.63±0.86a
EO	0.00±0.00a	1.60±0.21a	3.20±0.42a	4.80±0.62a	6.40±0.83a
EO+US	0.00±0.00a	1.39±0.10b	2.94±0.19a	4.48±0.27a	6.18±0.36a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.00±0.00a	2.17±0.19a	3.91±0.64a	5.90±0.41a	7.74±0.86a
US	0.00±0.00a	1.89±0.65a	3.78±0.34a	5.89±0.53a	7.65±0.77a
EO	0.00±0.00a	2.41±0.47a	3.96±0.72a	5.90±1.09a	7.40±1.30a
EO+US	0.00±0.00a	1.86±0.21a	3.48±0.33a	5.52±0.41a	7.04±0.50a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A22 Peel L* value of pineapple fruit inoculated with *Fusarium* sp. after being treated with EO water and US wave then storage at 25 and 13 °C

Treatment	L* value (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	41.32± 3.86a	42.32± 5.11a	45.38± 3.88a	45.29± 3.42a	46.55± 2.92a
US	41.95± 2.26a	42.70± 2.62a	45.66± 1.76a	44.51± 1.79a	44.64± 2.75a
EO	40.57± 2.49a	42.59± 2.63a	43.48± 2.17a	46.44± 3.51a	46.01± 1.53a
EO+US	41.47± 4.11a	43.11± 4.10a	46.96± 3.43a	45.96± 1.64a	45.68± 3.94a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	41.25± 3.78a	36.08± 4.65a	40.61± 2.53a	42.15± 4.52a	40.90± 3.67a
US	43.48± 0.93a	42.35± 1.69a	45.51± 1.90a	44.66± 2.09a	44.41± 2.47a
EO	40.79± 1.81a	41.61± 2.41a	42.85± 1.94a	44.18± 1.76a	46.07± 1.92a
EO+US	41.08± 4.14a	39.68± 2.30a	46.16± 0.96a	46.65± 2.09a	43.85± 1.60a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A 23 Peel a* value of pineapple fruit inoculated with *Fusarium* sp. after being treated with EO water and US wave and storage at 25 and 13 °C.

Treatment	a* value (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	1.468±0.758a	3.358±0.456a	6.483±2.814a	15.273±2.764a	16.218±1.121a
US	3.965±2.423a	5.953±2.364a	9.910±2.870a	15.140±0.978a	18.080±0.725a
EO	2.015±0.317a	5.650±3.265a	10.570±2.939a	13.923±2.774a	17.925±1.405a
EO+US	1.978±0.918a	3.975±1.508a	8.575±3.025a	14.735±2.012a	16.528±1.745a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	1.798±0.902a	3.423±2.578a	8.845±3.238a	16.574±3.181a	16.943±1.323a
US	2.370±0.819a	4.830±2.624a	10.188±2.450a	14.486±2.623a	16.679±2.922a
EO	1.931±0.954a	3.838±1.667a	9.143±2.796a	14.575±1.569a	15.996±1.714a
EO+US	2.718±1.859a	5.154±3.087a	10.984±2.276a	16.270±1.972a	16.035±2.081a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A24 Peel b* value of pineapple fruit inoculated with *Fusarium* sp. after being treated with EO water and US wave and storage at 25 and 13 °C.

Treatment	b* value (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	19.64± 0.76a	33.37± 0.46a	36.06± 2.81a	34.46± 2.76a	37.50± 1.12a
US	17.53± 2.42a	30.98± 2.36a	36.68± 2.87a	31.91± 0.98a	36.48± 0.73a
EO	19.66± 0.32a	32.19± 3.27a	37.12± 2.94a	40.71± 2.77a	34.49± 1.40a
EO+US	19.64± 0.92a	33.37± 1.51a	36.06± 3.03a	34.46± 2.01a	37.50± 1.75a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	15.04± 1.70a	26.62± 3.34a	33.37± 4.22a	36.40± 6.37	32.92± 3.68a
US	18.36± 2.13a	30.70± 5.14a	35.15± 4.60a	33.73± 2.86	35.13± 3.16a
EO	18.64± 3.13a	31.32± 3.51a	36.49± 5.10a	37.97± 3.52	33.86± 3.65a
EO+US	20.63± 3.58a	32.53± 3.53a	40.34± 4.25a	39.48± 4.22	35.72± 5.15a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A25 Pulp L* value of pineapple fruit inoculated with *Fusarium* sp. after being treated with EO water and US wave and storage at 25 and 13 °C.

Treatment	L value (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	62.38± 0.00a	73.77± 1.25a	72.97± 4.25a	75.84± 0.96a	75.63± 2.52a
US	69.17± 0.00a	75.54± 1.87a	74.88± 3.19a	76.60± 0.75a	74.07± 3.04a
EO	67.51± 0.00a	72.91± 4.59a	75.11± 1.43a	76.49± 0.99a	75.53± 1.48a
EO+US	66.96± 0.00a	75.53± 2.29a	76.82± 0.37a	72.05± 4.44a	75.35± 2.09a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	62.38± 0.00a	76.63± 2.67a	75.50± 1.82a	72.52± 4.15a	69.91± 8.12a
US	69.17± 0.00a	76.21± 1.83a	71.54± 5.61a	76.06± 0.91a	74.62± 2.23a
EO	67.51± 0.00a	72.10± 3.03a	75.41± 1.40a	75.78± 1.61a	75.06± 1.17a
EO+US	66.96± 0.00a	76.56± 2.78a	76.23± 1.50a	69.31± 4.36a	73.89± 2.54a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A26 Pulp a* value of pineapple fruit inoculated with *Fusarium* sp. after being treated with EO water and US wave and storage at 25 and 13 °C.

Treatment	a* value (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	5.12± 0.00a	4.39± 0.39a	3.99± 1.12a	4.68± 1.00a	5.65± 0.32a
US	4.07± 0.00a	4.31± 0.27a	2.99± 0.66a	5.26± 0.82a	4.94± 0.46a
EO	4.38± 0.00a	3.97± 0.70a	4.70± 1.78a	5.43± 0.61a	5.74± 1.48a
EO+US	3.99± 0.00a	3.60± 0.78a	4.51± 1.08a	4.47± 0.30a	4.91± 0.43a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	5.12± 0.00a	4.03± 0.47a	4.60± 1.17a	4.94± 0.97a	5.35± 0.64a
US	4.07± 0.00a	3.79± 0.77a	4.74± 1.35a	5.39± 0.46a	5.86± 1.23a
EO	4.38± 0.00a	3.82± 1.45a	4.08± 0.91a	4.66± 0.48a	5.18± 0.60a
EO+US	3.99± 0.00a	3.90± 0.93a	4.32± 0.50a	4.62± 0.77a	5.85± 0.73a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A27 Pulp b* value of pineapple fruit inoculated with *Fusarium* sp. after being treated with EO water and US wave and storage at 25 and 13 °C.

Treatment	b* value (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	38.96± 0.00a	36.31± 2.19a	45.71± 1.98a	38.98± 5.57a	38.07± 1.24a
US	38.94± 0.00a	39.67± 2.93a	45.49± 3.68a	40.43± 2.52a	41.32± 7.21a
EO	39.60± 0.00a	45.83± 2.93a	45.22± 7.66a	41.36± 1.76a	42.06± 6.13a
EO+US	39.06± 0.00a	45.37± 2.56a	43.04± 3.48a	42.39± 2.31a	43.36± 4.83a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	38.96± 0.00a	39.50± 3.89a	44.33± 3.37a	39.95± 4.90a	35.45± 6.04a
US	38.94± 0.00a	44.55± 4.66a	46.31± 5.44a	43.01± 3.67a	40.83± 5.68a
EO	39.60± 0.00a	42.17± 6.51a	44.81± 3.03a	41.96± 3.05a	41.62± 3.65a
EO+US	39.06± 0.00a	44.11± 3.32a	45.68± 1.81a	35.45± 4.91a	42.52± 3.36a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A28 Total soluble solids (TSS) in the flesh of pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	TSS (%Brix; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	16.50± 0.00a	15.30± 1.70a	13.87± 1.15a	13.83± 1.35a	15.50± 0.35a
US	16.50± 0.00a	15.27± 1.40a	14.17± 0.38a	14.33± 0.51a	15.63± 0.42a
EO	16.50± 0.00a	14.80± 0.60a	14.10± 0.56a	14.67± 0.65a	15.17± 0.64a
EO+US	16.50± 0.00a	13.80± 0.70a	14.03± 0.32a	13.57± 0.12a	15.33± 0.67a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	16.50± 0.00a	16.27± 0.20a	15.43± 0.59a	15.27± 0.35a	15.63± 0.32a
US	16.50± 0.00a	15.87± 0.38a	15.50± 0.71a	15.33± 0.25a	15.17± 0.42a
EO	16.50± 0.00a	15.67± 0.12a	16.20± 0.69a	15.30± 0.83a	15.33± 0.64a
EO+US	16.50± 0.00a	16.20± 0.15a	15.93± 0.17a	15.27± 0.52a	14.90± 0.67a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table 29 Titratable acidity (TA) in the flesh of pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	TA (%; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	0.72± 0.00a	0.87± 0.03a	0.83± 0.07a	0.59± 0.06a	0.56± 0.04a
US	0.72± 0.00a	0.79± 0.08a	0.90± 0.06a	0.65± 0.03a	0.57± 0.01a
EO	0.72± 0.00a	0.82± 0.07a	0.89± 0.09a	0.65± 0.03a	0.61± 0.05a
EO+US	0.72± 0.00a	0.83± 0.12a	0.87± 0.04a	0.67± 0.10a	0.61± 0.05a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.72± 0.00a	0.62± 0.01a	0.70± 0.03a	0.63± 0.10a	0.57± 0.01a
US	0.72± 0.00a	0.60± 0.06a	0.76± 0.03a	0.69± 0.08a	0.61± 0.05a
EO	0.72± 0.00a	0.64± 0.02a	0.75± 0.06a	0.62± 0.03a	0.61± 0.05a
EO+US	0.72± 0.00a	0.58± 0.02a	0.70± 0.04a	0.66± 0.02a	0.60± 0.03a

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table 30 Ascorbic acid in the flesh of pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Ascorbic acid content (mg/100mL; Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	16.77± 0.00a	12.59± 0.49a	10.99± 0.37a	8.75± 0.67a	8.64± 0.64a
US	16.77± 0.00a	12.37± 0.49a	11.20± 1.39a	8.64± 1.15a	8.00± 1.60a
EO	16.77± 0.00a	12.48± 1.69a	10.47± 0.81a	9.92± 0.32a	8.11± 0.49a
EO+US	16.77± 0.00a	12.37± 1.29a	10.13± 0.92a	9.17± 1.51a	8.71± 1.13a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	16.77± 0.00a	12.80± 1.15a	11.73± 0.49a	9.92± 0.96a	9.07± 0.98a
US	16.77± 0.00a	13.65± 0.67a	11.41± 0.98a	11.84± 0.85a	9.92± 0.64a
EO	16.77± 0.00a	14.08± 0.32a	9.92± 0.64a	9.60± 0.55a	10.24± 1.15a
EO+US	16.77± 0.00a	14.51± 0.49a	10.67± 0.49a	10.56± 0.64a	9.71± 0.37a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table 31 pH value in the flesh of pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	pH (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	4.01± 0.00a	3.64± 0.05a	3.61± 0.07a	3.52± 0.08a	3.48± 0.10a
US	4.01± 0.00a	3.57± 0.03a	3.52± 0.03a	3.55± 0.04a	3.51± 0.11a
EO	4.01± 0.00a	3.50± 0.02a	3.47± 0.06a	3.53± 0.04a	3.37± 0.14a
EO+US	4.01± 0.00a	3.43± 0.08a	3.51± 0.17a	3.46± 0.08a	3.39± 0.08a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	4.01± 0.00a	3.66± 0.06a	3.49± 0.03a	3.35± 0.03a	3.51± 0.11a
US	4.01± 0.00a	3.66± 0.04a	3.40± 0.03a	3.40± 0.05a	3.50± 0.07a
EO	4.01± 0.00a	3.70± 0.07a	3.51± 0.17a	3.44± 0.07a	3.34± 0.03a
EO+US	4.01± 0.00a	3.56± 0.07a	3.53± 0.16a	3.50± 0.08a	3.43± 0.02a

*Means ± SE within the same column followed by the same letter do not differ significantly at $p = 0.05$ using the least significant difference test.

Table A32 Crispy score in the fresh pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Crispy score (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	9.00± 0.00a	8.75± 0.50a	7.50± 1.00a	5.75± 0.96a	3.25± 0.50a
US	9.00± 0.58a	8.25± 0.96a	7.50± 1.00a	5.00± 0.82a	3.00± 0.82a
EO	9.00± 0.00a	8.25± 0.96a	7.25± 0.96a	6.25± 0.96a	3.00± 0.82a
EO+US	9.00± 0.50a	8.25± 0.50a	7.75± 0.50a	6.00± 0.82a	2.75± 0.50a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	8.00± 0.82a	7.75± 0.50a	7.00± 0.82a	6.00± 0.82a	4.75± 1.89a
US	8.00± 0.82a	7.75± 0.50a	7.25± 0.96a	6.25± 0.96a	5.25± 1.22a
EO	8.00± 0.82a	8.00± 0.00a	6.75± 1.26a	5.75± 1.26a	5.50± 1.38a
EO+US	8.00± 0.82a	7.75± 0.50a	7.00± 1.41a	6.00± 1.41a	5.75± 1.63a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A33 Taste score in the fresh pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Taste score (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	8.25± 0.00a	7.50± 0.58a	7.00± 1.41a	6.00± 1.41a	4.25± 1.71a
US	8.25± 0.00a	7.75± 0.50a	6.75± 0.50a	5.75± 0.50a	4.25± 1.71a
EO	8.25± 0.00a	7.75± 0.50a	7.00± 0.82a	6.00± 0.82a	4.50± 1.91a
EO+US	8.25± 0.00a	7.75± 0.50a	6.75± 1.26a	5.75± 1.26a	5.75± 1.89a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	8.25± 0.00a	7.00± 0.82a	7.25± 0.96a	6.25± 0.96a	5.00± 2.16a
US	8.25± 0.00a	8.25± 0.96a	6.00± 0.82a	5.00± 0.82a	4.75± 1.89a
EO	8.25± 0.00a	8.00± 0.82a	7.25± 0.96a	6.25± 0.96a	6.25± 0.50a
EO+US	8.25± 0.00a	7.75± 0.50a	7.25± 1.71a	6.25± 1.71a	6.75± 0.50a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A34 Aroma score in the fresh pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Aroma score (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	8.25± 0.00a	8.25± 0.96a	7.50± 1.00a	6.50± 1.00a	5.75± 1.50a
US	8.25± 0.00a	8.00± 0.00a	7.75± 0.96a	6.75± 0.96a	4.50± 1.91a
EO	8.25± 0.00a	8.25± 0.96a	7.25± 0.96a	6.25± 0.96a	5.00± 1.71a
EO+US	8.25± 0.00a	7.75± 0.96a	7.50± 0.58a	6.50± 0.58a	5.25± 1.87a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	8.25± 0.00a	9.00± 0.00a	7.25± 0.96a	6.25± 0.96a	5.75± 1.50a
US	8.25± 0.00a	8.50± 1.00a	7.00± 0.00a	6.00± 0.00a	4.75± 1.22a
EO	8.25± 0.00a	8.50± 1.00a	7.25± 0.96a	6.25± 0.96a	5.25± 1.22a
EO+US	8.25± 0.00a	8.25± 0.50a	7.75± 0.50a	6.75± 0.50a	5.50± 1.38a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A35 Overall acceptability score in the pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Overall acceptability Score (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	8.25± 0.96a	8.75± 0.50a	7.00± 1.41a	6.00± 1.41a	5.50± 1.38a
US	8.25± 0.96a	8.25± 0.96a	6.75± 0.96a	5.75± 0.96a	5.25± 1.22a
EO	8.25± 0.96a	8.25± 0.96a	7.25± 0.96a	6.25± 0.96a	5.25± 1.22a
EO+US	8.25± 0.96a	8.25± 0.50a	6.75± 1.26a	5.75± 1.26a	5.50± 1.38a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	8.50± 0.58a	8.00± 0.82a	6.75± 0.96a	5.75± 0.96a	4.75± 1.89a
US	8.50± 0.58a	8.25± 0.50a	7.25± 0.96a	6.25± 0.96a	5.25± 1.50a
EO	8.50± 0.58a	8.25± 0.50a	7.50± 0.58a	6.50± 0.58a	5.75± 1.26a
EO+US	8.50± 0.58a	8.00± 0.82a	7.25± 0.96a	6.25± 0.96a	6.00± 0.82a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

Table A36 Internal browning score in the fresh pineapple fruit inoculated with *Fusarium* sp. and then treated with EO water (100 ppm) and US wave (1 MHz) for 10 min. The fruits were kept at 25 and 13°C.

Treatment	Browning Score (Mean + SD)				
	Day after storage 25 °C				
	AF	1	3	5	7
Control	0.00± 0.00a	0.00± 0.00a	2.00± 0.96a	2.00± 0.00a	2.75± 0.96a
US	0.00± 0.00a	0.00± 0.00a	1.00± 0.96a	2.00± 0.58a	1.75± 0.96a
EO	0.00± 0.00a	0.00± 0.00a	0.50± 0.58a	1.50± 0.00a	1.50± 0.58a
EO+US	0.00± 0.00a	0.00± 0.00a	1.00± 0.50a	1.00± 0.00a	1.25± 0.50a
	Day after storage 13 °C				
	AF	5	10	15	20
Control	0.00± 0.00a	0.00± 0.00a	0.00± 0.00a	1.50± 0.58a	2.75± 0.96a
US	0.00± 0.00a	0.00± 0.00a	0.00± 0.00a	0.50± 0.35a	1.75± 0.96a
EO	0.00± 0.00a	0.00± 0.00a	0.00± 0.00a	0.00± 0.00a	1.50± 0.58a
EO+US	0.00± 0.00a	0.00± 0.00a	0.00± 0.00a	1.00± 0.00a	1.25± 0.50a

*Means ± SE within the same column followed by the same letter do not differ significantly at p = 0.05 using the least significant difference test.

CURRICULUM VITAE

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Publications

Khayankarn, S., Uthaibutra, J., Setha, S. and Whangchai. 2013. Using electrolyzed oxidizing water combined with an ultrasonic wave on the postharvest diseases control of pineapple fruit cv. 'Phu Lae'. *Crop Protection*. 54: 43-47.

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