APPENDICES

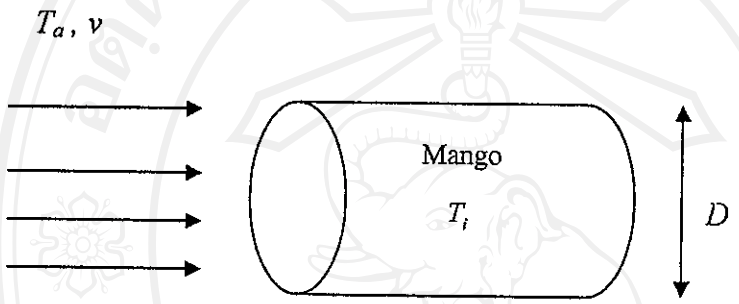
APPENDIX A

CALCULATION

Appendix A.1: The Calculation of Heat Transfer Coefficient of Air Inside the Temperature Controlled Incubator (Geankoplis, 1993)

Assumptions

1) Mango has a cylindrical shape
2) The thermal properties of mango is constant
3) The medium flows through the cylinder in axial position



Initial conditions:

Mango;	Initial temperature (T_i)	=	27.19°C
	Diameter (D)	=	0.073325 m
Medium;	Air		
	Temperature (T_a)	=	12.8°C
	Velocity (v)	=	0.6 m/s

Calculations:

Film temperature (T_f)

$$T_f = \frac{T_i + T_a}{2}$$

$$T_f = 19.995\ ^\circ\text{C} \approx 20.0\ ^\circ\text{C}$$

Air property at 20.0°C

Thermal conductvity (k)	=	0.0256 W/m·°C
Density (ρ)	=	1.207 kg/m^3
Viscosity (μ)	=	1.823 x 10^{-5} kg/m·s
Prandtl number (Pr)	=	0.71

Computation of Reynolds number (Re)

$$\mathrm{Re} = \frac{Dv\rho}{\mu}$$

$$\mathrm{Re} = 2.912 \times 10^3$$

When $40 < \mathrm{Re} < 4 \times 10^3$

$$C = 0.683$$

$$m = 0.466$$

Calculation of Nusselt number (Nu) from

$$Nu = C\,\mathrm{Re}^m\,\mathrm{Pr}^{1/3}$$

$$Nu = 25.0739$$

Calculation of heat transfer coefficient (h) from

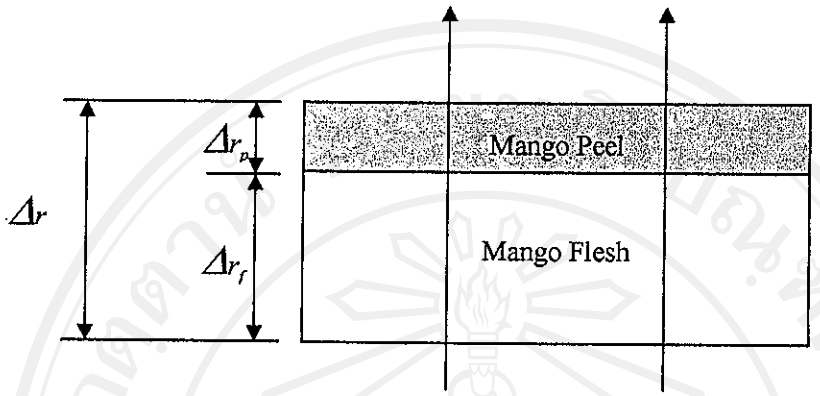
$$Nu = \frac{hD}{k}$$

$$h = Nu\frac{k}{D}$$

$$h = 8.778\ \mathrm{W/m^2 \cdot ^\circ C}$$

Thus the heat transfer coefficient in this condition is equal to 8.778 $\mathrm{W/m^2 \cdot ^\circ C}$

Appendix A.2: The Calculation of Thermal Conductivity of the Pericarp Attached to the Mango Flesh



The folllowing constants were used

Thermal conductivity of the pericarp (k_p)	=	0.3447 W/m·°C
Thermal conductivity of the flesh (k_f)	=	0.3519 W/m·°C
Thickness of m (Δr)	=	7.3325×10^{-3} m
Thickness of pericarp (Δr_p)	=	8.0×10^{-4} m
Thickness of the flesh (Δr_f)	=	Δr-Δr_p
	=	6.5325×10^{-3} m

Cross section area (A) has the unit of m^2

Volume ratio of the pericarp (v_p)

$$v_p = \frac{\Delta r_p A}{\Delta r A} = \frac{\Delta r_p}{\Delta r}$$

$$v_p = 0.1091$$

Volume ratio of the flesh (v_f)

$$v_f = \frac{\Delta r_f A}{\Delta r A} = \frac{\Delta r_f}{\Delta r}$$

$$v_f = 0.8909$$

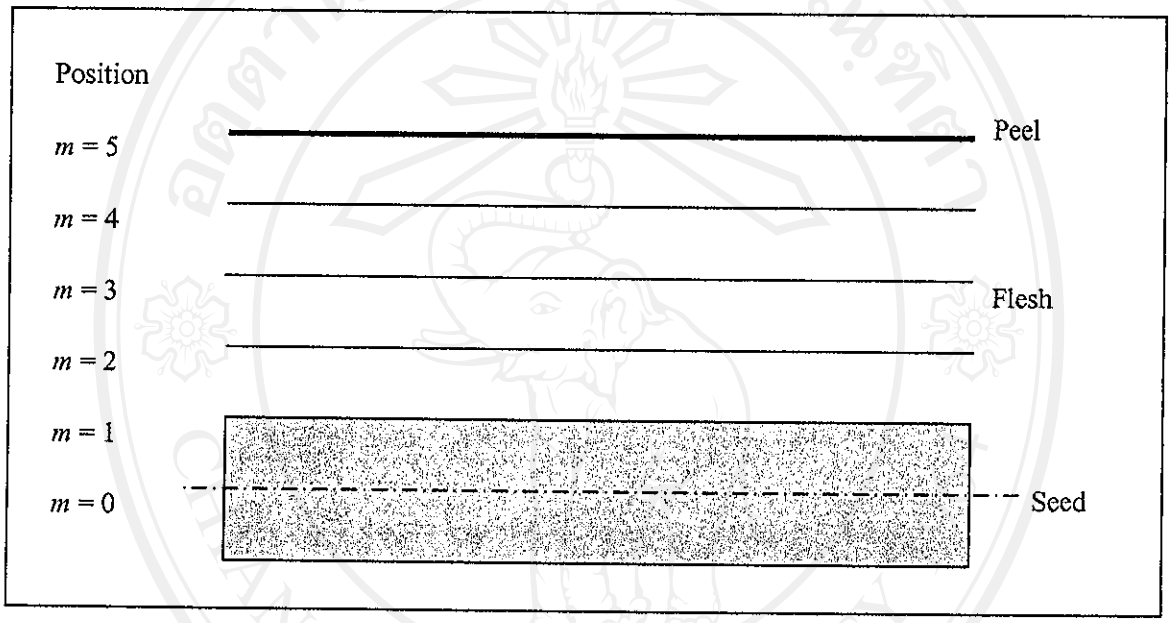
The heat transfer from the surface of mango for a specific radial position of Δr was considered to happen in series, the conductivities of pericarp and flesh (k_{pf}) were conducted using Series Model (Sweat, 1994).

$$\frac{1}{k_{pf}} = \frac{v_p}{k_p} + \frac{v_f}{k_f}$$

$$k_{pf} = 0.3511 \text{ W/m·°C}$$

The difference of 1% in computed thermal conductivity of the pericarp and flesh of mango within the thickness range of Δr (measured from the mango pericarp) was considered to be relatively small. Therefore in the practice, the thermal conductivity of the flesh may be used instead because of the limitation in measuring the thermal conductivity of the pericarp directly. In fact, the determination of the thermal conductivity using the chemical composition is also one of the popular methods.

Appendix A.3: Application of Finite Difference Method in The Prediction of Temperature Profile Inside The Mango Fruit During Cooling Step from 27.19°C to 13.00°C (The controlled temperature inside the incubator was maintained at 13.0 ± 0.5°C).



Mango;

Initial temperature (T_i)	=	27.19°C
Diameter (D)	=	0.073325 m
Thickness of the seed	=	14.665×10^{-3} m

The cross section was divided into five zones ($m = 5$)

$$\Delta r = \frac{D}{2m}$$

$$\Delta r = 7.3325 \times 10^{-3} \text{ m}$$

Medium; Air

Temperature (T_a)	=	12.8°C
Velocity (v)	=	0.6 m/s
Heat Transfer Coefficient (h)	=	8.778 W/m^2·°C

The following thermal properties of mango were applied

Specific heat capacity of the flesh (C_p)	=	3.4269 kJ/kg·°C
Density of the flesh (ρ)	=	1036.0949 kg/m^3
Thermal conductivity of the flesh (k_f)	=	0.3519 W/m·°C
Thermal conductivity of the pericarp (k_p)	=	0.3447 W/m·°C
Thermal conductivity of flesh & pericarp (k_{pf})	=	0.3511 W/m·°C

Computation of thermal diffusivity (α)

$$\alpha = \frac{k}{\rho C_p}$$

$$\alpha = 9.9110 \text{ x } 10^{-8} \text{ m}^2/\text{s}$$

A finite difference equation describing the temperature profile inside the cylindrical shape object is as follows;

At the core ($m = 0$);

$$T_{0,n+1} = 4F_0 T_{1,n} + (1 - 4F_0) T_{0,n}$$

At a specific location inside the fruit ($5 < m < 0$);

$$T_{m,n+1} = (F_0 + \frac{F_0}{m}) T_{m+1,n} + \left(1 - 2F_0 - \frac{F_0}{m}\right) T_{m,n} + (F_0) T_{m-1,n}$$

At the surface ($m = 5$);

$$T_{m,n+1} = \frac{BiT_{a,n+1} + T_{m-1,n+1}}{1 + Bi}$$

When Bi is a finite difference form of Biot number

$$Bi = \frac{h\Delta r}{k_{pf}}$$

$$Bi = 0.1833$$

For the cylindrical shape, $F_0 \leq ¼$ (Geankoplis, 1993)

Setting $F_0 = ¼$

Calculate Δt from

$$F_0 = \frac{\alpha \Delta t}{(\Delta r)^2}$$

$$\Delta t = 135.62 \text{ s}$$

Initial condition ($t = 0$);

$$T_{(m,0)} = T_i$$

From the computed value, the finite difference equation to evaluate the temperature at a specific location of the mango fruit as follows;

When $F_0 = ¼$

At the core ($m = 0$);

$$T_{0,n+1} = T_{1,n}$$

At the specific location inside the fruit ($5 < m < 0$);

$$T_{m,n+1} = (0.25 + \frac{0.25}{m})T_{m+1,n} + \left(0.5 - \frac{0.25}{m}\right)T_{m,n} + (0.25)T_{m-1,n}$$

At the surface ($m = 5$);

$$T_{5,n+1} = \frac{0.183T_{a,n+1} + T_{m-1,n+1}}{1.183}$$

Appendix A.4: Application of Finite Difference Method in The Prediction of Temperature Profile Inside The Mango Fruit During Heating Step

from 25.08°C to 46.5°C (The controlled temperature inside the incubator was maintained at 48.0 ± 0.5°C).

Mango; Initial temperature (T_i) = 25.08°C
Diameter (D) = 0.073325 m
Thickness of the seed = 14.665×10^{-3} m

Divide into five zones ($m = 5$)

$$\Delta r = \frac{D}{2m}$$

$$\Delta r = 7.3325 \times 10^{-3} \text{ m}$$

Medium; Warm water
Thermometer (T_a) = 48.4°C

When the experimental results were examined, the rapid temperature change at the mango surface was an indication of high heat transfer coefficient (h).

Mango had the following thermal properties;

Specific heat capacity of the flesh (C_p) = 3.4269 kJ/kg·°C
Density of the flesh (ρ) = 1036.0949 kg/m^3
Thermal conductivity of the flesh (k_f) = 0.3519 W/m·°C
Thermal conductivity of the pericarp (k_p) = 0.3447 W/m·°C
Thermal conductivity of flesh & pericarp (k_{pf}) = 0.3511 W/m·°C

Computation of thermal diffusivity (α)

$$\alpha = \frac{k}{\rho C_p}$$

$$\alpha = 9.911 \times 10^{-8} \text{ m}^2/\text{s}$$

A finite difference equation for determining the temperature at a specific location of the cylindrical shape object is as follow;

At the core ($m = 0$) ;

$$T_{0,n+1} = 4F_0T_{1,n} + (1-4F_0)T_{0,n}$$

At the specific location within the fruit ($5<m<0$);

$$T_{m,n+1} = (F_0 + \frac{F_0}{m})T_{m+1,n} + \left(1-2F_0 - \frac{F_0}{m}\right)T_{m,n} + (F_0)T_{m-1,n}$$

For the cylindrical shape, use $F_0 \leq ¼$ (Geankoplis, 1993)

By setting F_0 = ¼

Evaluate Δt from

$$F_0 = \frac{\alpha \Delta t}{(\Delta r)^2}$$

$$\Delta t = 135.62 \text{ s}$$

Initial condition ($t = 0$) ;

$$T_{5,0} = \frac{T_i(r) + T_a}{2}$$

$$T(r,t) = T_i(r)$$

When F_0 = ¼

At the core ($m = 0$) ;

$$T_{0,n+1} = T_{1,n}$$

At the specific location inside the fruit ($5< m < 0$);

$$T_{m,n+1} = (0.25 + \frac{0.25}{m})T_{m+1,n} + \left(0.5 - \frac{0.25}{m}\right)T_{m,n} + (0.25)T_{m-1,n}$$

At the outer surface ($m = 5$);

Direct measurement of the heat transfer coefficient indicated a relatively high value that the surface temperature could be equated to the temperature of warm water after time Δt had passed.

Appendix B

Data from Experiment

Table A4.1 Average of temperature at difference position of mango fruit cv. Nam Dok Mai Si Thong during cooling experiment (Incubator 13±0.5°C).

Time (mins)	Temperature (°C)						
		Plane m =					
	Air	5	4	3	2	1	0
0	12.8	27.19	27.19	27.19	27.19	27.19	27.19
10	12.8	24.12	25.79	26.74	27.10	27.19	27.19
20	12.8	23.06	24.57	25.68	26.37	26.73	26.86
30	12.8	22.41	23.83	24.93	25.68	26.10	26.27
40	12.8	21.71	23.02	24.07	24.81	25.24	25.41
50	12.8	21.20	22.44	23.43	24.14	24.56	24.73
60	12.8	20.72	21.89	22.83	23.51	23.90	24.06
70	12.8	20.17	21.25	22.13	22.76	23.13	23.28
80	12.8	19.75	20.78	21.60	22.20	22.55	22.69
90	12.8	19.26	20.22	20.99	21.54	21.87	22.00
100	12.8	18.90	19.80	20.53	21.05	21.36	21.48
110	12.8	18.47	19.31	19.99	20.47	20.76	20.88
120	12.8	18.15	18.95	19.58	20.04	20.31	20.42
130	12.8	17.85	18.60	19.20	19.63	19.89	19.99
140	12.8	17.50	18.20	18.75	19.16	19.39	19.49
150	12.8	17.24	17.89	18.42	18.80	19.02	19.11
160	12.8	16.93	17.54	18.03	18.38	18.59	18.67
170	12.8	16.69	17.27	17.73	18.07	18.26	18.34
180	12.8	16.47	17.02	17.45	17.77	17.95	18.03
190	12.8	16.22	16.72	17.13	17.42	17.59	17.66
200	12.8	16.03	16.50	16.89	17.16	17.32	17.39
210	12.8	15.80	16.24	16.60	16.86	17.01	17.07

Table A 4.1 (cont.) Average of temperature at difference position of mango fruit cv. Nam Dok Mai Si Thong during cooling experiment (Incubator 13±0.5°C).

Time (mins)	Temperature (°C)						
		Plane m =					
	Air	5	4	3	2	1	0
220	12.8	15.63	16.05	16.39	16.63	16.77	16.83
230	12.8	15.43	15.82	16.14	16.36	16.49	16.55
240	12.8	15.29	15.65	15.95	16.16	16.29	16.34
250	12.8	15.15	15.49	15.77	15.97	16.09	16.14
260	12.8	14.98	15.30	15.56	15.75	15.86	15.90
270	12.8	14.86	15.16	15.41	15.58	15.69	15.73
280	12.8	14.71	15.00	15.23	15.39	15.49	15.53
290	12.8	14.61	14.87	15.09	15.24	15.33	15.37
300	12.8	14.48	14.73	14.93	15.07	15.16	15.19
310	12.8	14.39	14.62	14.81	14.94	15.03	15.06
320	12.8	14.30	14.52	14.70	14.82	14.90	14.93
330	12.8	14.19	14.40	14.56	14.68	14.75	14.78
340	12.8	14.11	14.31	14.46	14.58	14.64	14.67
350	12.8	14.02	14.20	14.35	14.45	14.51	14.54
360	12.8	13.95	14.12	14.26	14.36	14.42	14.44
370	12.8	13.87	14.03	14.16	14.25	14.30	14.33
380	12.8	13.81	13.96	14.08	14.17	14.22	14.24
390	12.8	13.76	13.90	14.01	14.09	14.14	14.16
400	12.8	13.69	13.82	13.93	14.00	14.05	14.06
410	12.8	13.64	13.76	13.86	13.93	13.98	13.99
420	12.8	13.58	13.70	13.79	13.85	13.89	13.91
430	12.8	13.54	13.64	13.73	13.80	13.83	13.85

Table A 4.1 (cont.) Average of temperature at difference position of mango fruit cv. Nam Dok Mai Si Thong during cooling experiment (Incubator 13±0.5°C).

Time (mins)	Temperature (°C)						
		Plane m =					
	Air	5	4	3	2	1	0
439	12.8	13.49	13.60	13.68	13.74	13.77	13.79
450	12.8	13.45	13.54	13.62	13.67	13.71	13.72
459	12.8	13.41	13.50	13.57	13.62	13.66	13.67
470	12.8	13.37	13.45	13.52	13.57	13.60	13.61
479	12.8	13.34	13.41	13.48	13.52	13.55	13.56
490	12.8	13.30	13.37	13.43	13.47	13.50	13.51
500	12.8	13.27	13.34	13.40	13.44	13.46	13.47
509	12.8	13.24	13.31	13.36	13.40	13.42	13.43
520	12.8	13.21	13.27	13.32	13.36	13.38	13.39

Table A 4.2 Average of temperature at difference position of mango fruit cv. Nam Dok Mai Si Thong during heating experiment (water bath 48.0±0.5°C).

Time		Temperature (°C)						
		water	Plane m =					
(min)	(sec)		5	4	3	2	1	0
0	0	48.40	36.74	25.08	25.08	25.08	25.08	25.08
2	135.62	48.40	48.40	28.72	25.08	25.08	25.08	25.08
5	271.24	48.40	48.40	33.96	26.29	25.08	25.08	25.08
7	406.86	48.40	48.40	36.56	28.55	25.54	25.08	25.08
9	542.48	48.40	48.40	38.26	30.46	26.55	25.31	25.08
11	678.1	48.40	48.40	39.48	32.08	27.71	25.87	25.31
14	813.72	48.40	48.40	40.42	33.45	28.89	26.65	25.87
16	949.34	48.40	48.40	41.17	34.63	30.04	27.57	26.65
18	1084.96	48.40	48.40	41.80	35.66	31.15	28.58	27.57
20	1220.58	48.40	48.40	42.33	36.58	32.20	29.61	28.58
23	1356.2	48.40	48.40	42.79	37.40	33.19	30.65	29.61
25	1491.82	48.40	48.40	43.19	38.14	34.13	31.66	30.65
27	1627.44	48.40	48.40	43.56	38.83	35.02	32.64	31.66
29	1763.06	48.40	48.40	43.89	39.45	35.85	33.59	32.64
32	1898.68	48.40	48.40	44.19	40.03	36.64	34.48	33.59
34	2034.3	48.40	48.40	44.47	40.57	37.37	35.34	34.48
36	2169.92	48.40	48.40	44.72	41.07	38.06	36.14	35.34
38	2305.54	48.40	48.40	44.96	41.53	38.71	36.90	36.14
41	2441.16	48.40	48.40	45.18	41.97	39.32	37.61	36.90
43	2576.78	48.40	48.40	45.38	42.37	39.89	38.29	37.61
45	2712.4	48.40	48.40	45.57	42.75	40.42	38.92	38.29
47	2848.02	48.40	48.40	45.75	43.11	40.92	39.51	38.92

Table A 4.2 (cont.) Average of temperature at difference position of mango fruit cv. Nam Dok Mai Si Thong during heating experiment (water bath 48.0±0.5°C).

Time		Temperature (°C)						
		water	Plane m =					
(min)	(sec)		5	4	3	2	1	0
50	2983.64	48.40	48.40	45.92	43.44	41.39	40.07	39.51
52	3119.26	48.40	48.40	46.08	43.76	41.83	40.59	40.07
54	3254.88	48.40	48.40	46.22	44.05	42.24	41.08	40.59
57	3390.5	48.40	48.40	46.36	44.32	42.63	41.54	41.08
59	3526.12	48.40	48.40	46.49	44.58	42.99	41.97	41.54
61	3661.74	48.40	48.40	46.61	44.82	43.33	42.37	41.97
63	3797.36	48.40	48.40	46.72	45.04	43.65	42.75	42.37
66	3932.98	48.40	48.40	46.83	45.25	43.95	43.10	42.75
68	4068.6	48.40	48.40	46.92	45.45	44.23	43.44	43.10
70	4204.22	48.40	48.40	47.02	45.64	44.49	43.75	43.44
72	4339.84	48.40	48.40	47.10	45.81	44.73	44.04	43.75
75	4475.46	48.40	48.40	47.19	45.97	44.96	44.31	44.04
77	4611.08	48.40	48.40	47.26	46.12	45.18	44.57	44.31
79	4746.7	48.40	48.40	47.33	46.27	45.38	44.81	44.57
81	4882.32	48.40	48.40	47.40	46.40	45.57	45.04	44.81
84	5017.94	48.40	48.40	47.46	46.53	45.75	45.25	45.04
86	5153.56	48.40	48.40	47.52	46.64	45.91	45.44	45.25
88	5289.18	48.40	48.40	47.58	46.75	46.07	45.63	45.44
90	5424.8	48.40	48.40	47.63	46.86	46.22	45.80	45.63
93	5560.42	48.40	48.40	47.68	46.95	46.35	45.97	45.80
95	5696.04	48.40	48.40	47.72	47.04	46.48	46.12	45.97
97	5831.66	48.40	48.40	47.76	47.13	46.60	46.26	46.12

Table A 4.2 (cont.) Average of temperature at difference position of mango fruit cv. Nam Dok Mai Si Thong during heating experiment (water bath 48.0±0.5°C).

Time		Temperature (°C)						
		water	Plane m =					
(min)	(sec)		5	4	3	2	1	0
99	5967.28	48.40	48.40	47.80	47.21	46.72	46.40	46.26
102	6102.9	48.40	48.40	47.84	47.28	46.82	46.52	46.40
104	6238.52	48.40	48.40	47.88	47.35	46.92	46.64	46.52
106	6374.14	48.40	48.40	47.91	47.42	47.01	46.75	46.64
108	6509.76	48.40	48.40	47.94	47.48	47.10	46.85	46.75
111	6645.38	48.40	48.40	47.97	47.54	47.18	46.95	46.85
113	6781	48.40	48.40	48.00	47.59	47.26	47.04	46.95
115	6916.62	48.40	48.40	48.02	47.64	47.33	47.13	47.04
118	7052.24	48.40	48.40	48.05	47.69	47.40	47.21	47.13
120	7187.86	48.40	48.40	48.07	47.74	47.46	47.28	47.21
122	7323.48	48.40	48.40	48.09	47.78	47.52	47.35	47.28
124	7459.1	48.40	48.40	48.11	47.82	47.57	47.42	47.35
127	7594.72	48.40	48.40	48.13	47.85	47.63	47.48	47.42

Table A 4.3 Average of chilling score and thermal properties of mango peel during storage at 5°C

Properties	Days after storage at 5°C					
	0	5	10	15	20	25
CI index	0	0.11	0.98	2.19	2.59	2.92
%EL	11.15^{a}	13.54^{ab}	16.55^{b}	17.42^{b}	23.73^{c}	23.77^{c}
CO_2 (mg/kg hr)	34^{b}	12.69^{a}	13.82^{a}	14.52^{a}	16.78^{a}	13.11^{a}
Cp (kJ/kg K)	2.52^{a}	2.51^{a}	2.97^{b}	2.46^{a}	2.42^{a}	2.35^{a}
k (W/m K)	0.31^{a}	0.38^{b}	0.38^{b}	0.39^{b}	0.47^{c}	0.46^{c}
Density (kg/m^3)	1088.28^{a}	1093.44^{ab}	1106.55^{b}	1111.84^{c}	1105.06^{c}	1117.98^{c}
α (m^2/s)	1.13 x10^{-7a}	1.38 x10^{-7b}	1.16 x10$^{-7\,a}$	1.43 x10^{-7b}	1.76 x10^{-7c}	1.75 x10^{-7c}
%MC	70.43^{a}	66.6^{b}	65^{bc}	63.53 ^{cd}	59.47^{c}	61.72^{d}

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.4 Average of chilling score and thermal properties of mango peel during storage at 13°C

Properties	Days after storage at 13°C					
	0	5	10	15	20	25
CI index	0	0	0.08	0.33	0.72	1.48
%EL	11.15^{a}	10.96^{a}	12.78^{ab}	14.95^{b}	19.95^{c}	24.7^{d}
CO_2 (mg/kg hr)	34^{a}	21.22^{a}	69.9^{b}	86.4^{c}	108.1^{d}	73.15^{b}
Cp (kJ/kg K)	2.52^{a}	2.62^{a}	2.69^{ab}	2.81^{b}	2.88^{b}	2.86^{b}
k (W/m K)	0.31^{a}	0.36^{b}	0.37^{b}	0.37^{b}	0.38^{bc}	0.4^{c}
Density (kg/m^3)	1088.28^{ab}	1081.16^{ab}	1075.89^{a}	1092.75^{bc}	1088.56^{abc}	1099.40^{c}
α (m^2/s)	1.13×10^{-7a}	1.27×10^{-7c}	1.28×10^{-7c}	1.2×10^{-7b}	1.21×10^{-7b}	1.27×10^{-7c}
%MC	70.43^{b}	70.03^{b}	70.32^{b}	71.31^{c}	67.86^{a}	72.26^{c}

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.5 Average of chilling score and thermal properties of mango peel during storage at 25°C

Properties	Days after storage at 25°C				
	0	2	4	6	8
Chilling index	0	0	0	0	0
%EL	11.15^{a}	10.31^{a}	16.47^{b}	23.53^{c}	18.15^{b}
CO_2 (mg/kg hr)	34^{a}	77.75^{b}	90.22^{c}	94.7^{c}	74.53^{b}
Cp (kJ/kg K)	2.52^{a}	2.62^{b}	2.8^{b}	2.8^{b}	2.92^{b}
k (W/m K)	0.31^{a}	0.35^{b}	0.37^{b}	0.38^{bc}	0.4^{c}
Density (kg/m^3)	1088.28^{ab}	1085.52^{a}	1092.06^{b}	1092.2^{b}	1094.16^{b}
α (m^2/s)	1.13 x10^{-7a}	1.23 x10^{-7b}	1.21 x10^{-7b}	1.24 x10^{-7b}	1.25 x10^{-7b}
%MC	70.43^{a}	69.51^{a}	72.33^{b}	72.66^{b}	74.94^{c}

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.6 Average of chilling score and thermal properties of mango flesh during storage at 5°C

Properties	Days after storage at 5°C					
	0	5	10	15	20	25
CI index	0	0	0	0	0	0
%EL	14.34[a]	13.26[a]	13.35[a]	14.97[a]	14.67[a]	14.15[a]
CO_2 (mg/kg hr)	34[a]	12.69[b]	13.82[b]	14.52[b]	16.78[c]	13.11[b]
Cp (kJ/kg K)	3.17[a]	3.23[b]	3.39[b]	3.36[b]	3.4[b]	3.36[b]
k (W/m K)	0.33[a]	0.4[b]	0.4[b]	0.41[b]	0.41[b]	0.4[b]
Density (kg/m^3)	1044.43[b]	1046.14[b]	1037.17[ab]	1037.42[ab]	1040.47[ab]	1033.73[a]
α (m^2/s)	1×10^{-7a}	1.18×10^{-7c}	1.14×10^{-7b}	1.18×10^{-7c}	1.16×10^{-7c}	1.15×10^{-7b}
%MC	81.61[a]	80.98[a]	81.53[a]	81.1[a]	81.21[a]	80.46[a]

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.7 Average of chilling score and thermal properties of mango flesh during storage at 13°C.

Properties	Days after storage at 13°C					
	0	5	10	15	20	25
CI index	-	-	-	-	-	-
%EL	14.34^{a}	14.29^{a}	28.02^{b}	36.99^{c}	48.04^{d}	52.73^{d}
CO_2 (mg/kg hr)	34	21.22	69.9	86.4	108.1	73.15
Cp (kJ/kg K)	3.17^{a}	3.34^{a}	3.38^{a}	3.56^{b}	3.59^{b}	3.35^{a}
k (W/m K)	0.33^{a}	0.35^{ab}	0.35^{ab}	0.36^{b}	0.38^{c}	0.42^{d}
Density (kg/m^3)	1044.43^{ab}	1040.03^{ab}	1037.97^{ab}	1047.12^{b}	1036.32^{a}	1030.19^{a}
α (m^2/s)	1×10^{-7a}	1.01×10^{-7a}	9.98×10^{-8a}	9.66×10^{-8a}	1.02×10^{-7a}	1.22×10^{-7b}
%MC	81.61^{a}	80.88^{b}	79.89^{bc}	79.97^{bc}	79.07^{a}	79.77^{bc}

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.8 Average of chilling score and thermal properties of mango flesh during storage at 25°C.

Properties	Days after storage at 25°C				
	0	2	4	6	8
Chilling index	-	-	-	-	-
%EL	14.34[a]	14.86[a]	35.03[b]	56.84[c]	36.34[b]
CO_2 (mg/kg hr)	34[a]	77.75[b]	90.22[c]	94.7[c]	74.53[b]
Cp (kJ/kg K)	3.17[a]	3.41[b]	3.48b	3.46b	3.56b
k (W/m K)	0.33[a]	0.32[a]	0.35[b]	0.41[c]	0.39[c]
Density (kg/m^3)	1044.43[c]	1052.21[d]	1029.65[b]	999.49[a]	1009.11[ab]
α (m^2/s)	1 x10^{-7b}	8.92 x10^{-8a}	9.77 x10^{-8ab}	1.19 x10^{-7c}	1.09 x10^{-7b}
%MC	81.61[a]	81.07[a]	81.33[a]	80.78[a]	82.7[b]

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.9 Average peel color of mango fruit cv. Nam Dok Mai Si Thong during Storage at 5°C.

Properties	Days after storage at 5°C					
	0	5	10	15	20	25
L	64.56[a]	64.1[a]	61.91[a]	65.07[a]	74.67[b]	62.53[a]
a*	-5.85[a]	-5.01[a]	-5.16[a]	-2.96[a]	0.96[b]	-3.11[a]
b*	37.13[cd]	35.51[c]	38.1[d]	32.33[ab]	34.61[bc]	30.03[a]
C*	37.65[bc]	36.09[bc]	38.53[c]	32.54[ab]	32.71[ab]	30.23[a]
Hue angle	98.8[b]	97.55[b]	97.71[b]	95.21[b]	89.23[a]	95.78[b]

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.10 Average peel color of mango fruit cv. Nam Dok Mai Si Thong during storage at 13°C.

Properties	Days after storage at 13°C					
	0	5	10	15	20	25
L	64.56[a]	68.87[b]	64.63[a]	67.16[ab]	65.42[ab]	67.1[ab]
a*	-5.85[a]	-3.34[b]	-4.07[b]	-2.07[bc]	-1.81[bc]	0.29[c]
b*	37.13[a]	39.08[ab]	39.5[ab]	38.88[ab]	37.36[a]	40.94[b]
C*	37.65[a]	39.35[ab]	39.78[ab]	39.02[ab]	37.46[a]	41.04[b]
Hue angle	98.8[c]	95.01[b]	95.99[b]	92.85[ab]	92.65[ab]	89.76[a]

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.11 Average peel color of mango fruit cv. Nam Dok Mai Si Thong during storage at 25°C.

Properties	Days after storage at 25°C				
	0	2	4	6	8
L	64.56[a]	66.49[a]	68.18[b]	69.64[b]	70.09[b]
a*	-5.85[a]	1.9[b]	4.45[c]	8.01[d]	8[d]
b*	37.13[ab]	35.56[a]	39.41[b]	43.06[c]	41.47[bc]
C*	37.65[ab]	35.86[a]	39.73[b]	43.81[c]	42.25[c]
Hue angle	98.8[d]	92.49[c]	83.55[b]	79.4[a]	79.11[a]

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.12 Average flesh color of mango fruit cv. Nam Dok Mai Si Thong during storage at 5°C.

Properties	Days after storage at 5°C					
	0	5	10	15	20	25
L	72.98[a]	74.28[b]	77.81[b]	78.38[b]	74.56[b]	77.69[b]
a*	0.093[a]	0.5[bc]	0.02[a]	-0.38[ab]	-0.26[ab]	-0.6b[c]
b*	28.94[a]	28.77[a]	29.23[a]	24.43[a]	31.73[b]	25.16[a]
C*	28.95[ab]	28.8[ab]	29.23[ab]	24.44[a]	35.21[c]	25.17[a]
Hue angle	89.97[a]	89.42[a]	90[ab]	91.23[b]	89.21[a]	91.49[b]

[x]Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.13 Average flesh color of mango fruit cv. Nam Dok Mai Si Thong during storage at 13°C.

Properties	Days after storage at 13°C					
	0	5	10	15	20	25
L	72.98^{c}	76.25^{d}	73.17^{c}	67.38^{b}	62.5^{a}	65.53^{ab}
a*	0.093^{a}	0.09^{a}	1.05^{ab}	1.33^{b}	3.1^{c}	2.72^{c}
b*	28.94^{a}	28.89^{a}	35.96^{b}	36.3^{b}	37.51^{b}	37.42^{b}
C*	28.95^{a}	28.9^{a}	35.99^{b}	36.34^{b}	37.68^{b}	37.52^{b}
Hue angle	89.97^{cd}	89.98^{cd}	88.66^{bc}	88.02^{b}	85.67^{a}	85.94^{a}

^{x}Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.14 Average flesh color of mango fruit cv. Nam Dok Mai Si Thong during storage at 25°C.

Properties	Days after storage at 25°C				
	0	2	4	6	8
L	72.98^{c}	72.46^{c}	61.51^{ab}	59.71^{a}	58.49^{a}
a*	0.093^{a}	2.66^{b}	8.98^{c}	11.95^{d}	10.55^{cd}
b*	28.94^{a}	48.59^{b}	48.81^{b}	52.16^{c}	51.82^{c}
C*	28.95^{a}	49.03^{b}	49.66^{b}	53.52^{c}	52.9^{c}
Hue angle	89.97^{b}	87.03^{b}	79.58^{a}	77.02^{a}	78.43^{a}

^{x}Different letters within treatment denote significant different by using DMRT at $p \leq 0.05$

Table A 4.15 Average of physical and chemical changes of mango fruit cv. Nam Dok Mai Si Thong during storage at 5 °C

Properties	Days after storage at 5°C					
	0	5	10	15	20	25
Texture (N)	57.52	50.23	48.07	45.18	44.44	43.1
%Wt loss	0	1.76	2.9	4.17	5.18	7.16
%MC peel	70.43	66.6	65	63.53	59.47	61.72
%Mc flesh	81.61	80.98	81.53	81.1	81.21	80.46
%TSS	9.17	9.24	8.75	9.02	10.93	9.31
pH	3.04	2.76	3.03	2.82	3.06	2.84
%Citric acid	1.75	1.85	1.9	1.99	1.8	2.13

Table A 4.16 Average of physical and chemical changes of mango fruit cv. Nam Dok Mai Si Thong during storag at 13 °C

Properties	Days after storage at 13°C					
	0	5	10	15	20	25
Texture (N)	57.52	54.45	54.53	39.13	31.01	12.04
%Wt loss	0	2.4	3.88	6.08	8.17	10.53
%MC peel	70.43	70.03	70.32	71.31	67.86	72.26
%Mc flesh	81.61	80.88	79.89	79.97	79.07	79.77
%TSS	9.17	11.15	14.25	14.71	16.37	15.55
pH	3.04	3.07	3.24	3.07	3.19	3.14
%Citric acid	1.75	1.74	1.31	1.26	1.23	1.25

Table A 4.17 Average of physical and chemical changes of mango fruit cv. Nam Dok Mai Si Thong during storage at 25 °C

Properties	Days after storage at 25°C				
	0	2	4	6	8
Texture (N)	57.52	34.35	4.91	3.15	2.4
%Wt loss	0	3.02	5.81	7	9.33
%MC peel	70.43	69.51	72.33	72.66	74.94
%Mc flesh	81.61	81.07	81.33	80.78	82.7
%TSS	9.17	14.38	16.35	15.89	18.15
pH	3.04	3.14	3.78	4.44	4.92
%Citric acid	1.75	1.21	0.52	0.16	0.12

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PUBLICATIONS