

**The Mangosteen Fruit
in Cha-Uat District, Nakhon Si Thammarat
and Pa Phayom District, Phatthalung:
Its Sweetness, Color, pH Level & Shell Characteristics**

by:

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ABSTRACT

This study on the fruit mangosteen was done by the researchers to learn the differences in sweetness, color, pH level, and pericarp characteristics in three (3) different areas. We also studied the concentration of the tannin substance and xanthone in mangosteen. For this research, the temperature and humidity were also measured. The chosen locations were the subdistricts of Ban Tha Samet, Ban Lan Na, and Ban Lan Khoi. Sixteen (16) plants by sampling were collected per area during the harvesting period in September 2021.

Based on the research, all the mangosteen fruits changed from green (5GY6/10) to dark purple (5R 3/4) ten (10) days after harvest. The fruit was hard during days 1 and 2 but the hardness decreased on day eight (8) and increased again the day after. The temperature in Ban Lan Na's box is 27.75 to 30 °C while in Ban Tha Samet's box, it is 28.33 to 29.83 °C, and Ban Lan Khoi's box has a temperature of 27.25 to 28.67 °C. The relative humidity in Ban Lan Na's box is 89.14 to 95.71 %, Ban Tha Samet's box has 88.29 to 93.00 % and Ban Lan Khoi's box has 95.57 to 98.86 %. The level of sweetness is unstable. The sweetness of the fruits from Ban Lan Khoi is more valuable or higher than those from Ban Lan Na and Ban Tha Samet. The pH level is 3 from all areas. The highest concentration of tannin is found in Ban Tha Samet which is 29.7868 µg/mL and the highest concentration of xanthone is found in Ban Lan Khoi with 1040.35548 µg/mL. The correlation coefficient between temperature and relative humidity is 0.379 significant in 0.05 and the correlation coefficient between temperature and sweetness is -0.412 significant in 0.05.

INTRODUCTION

The mangosteen from Southern Thailand is famous for a reason. The cultivation of this fruit is widespread in the southern area and mostly found in the provinces of Nakhon Si Thammarat and Phatthalung. It is a plant that grows well in areas that are high in temperature and humidity. Some of its benefits are having high fiber, helps protect from diseases, and having an anti-acne effect.

If durian is the King of Fruits, the Queen is the mangosteen. Due to the covid situation, agriculturalists were not able to export even though there has been an abundance of this product. This caused the drop in its price and the agriculturalists solved this problem by selling them online instead and having them delivered directly to the buyers. To be able to provide the best quality product, this research was created.

Research Question

1. How does the color of mangosteen pericarp change after being harvested?
2. How does the level of hardness of the mangosteen pericarp change?
3. How does the temperature and humidity inside the box change?
4. How does the level of sweetness change after being harvested?
5. How does the pH level change after being harvested?
6. How is the concentration of substance in mangosteen pericarp?
7. How is the relevance of temperature, humidity, pH level, hardness and sweetness?

Research Hypothesis

1. The color of mangosteen pericarp change from green to purple and dark purple.
2. The characteristics of mangosteen pericarp change from hard to soft and to hard again.
3. Temperature and humidity in the packing box is unstable.
4. The level of sweetness of mangosteen is unstable.
5. The pH level of mangosteen is stable.
6. Tannin and xanthone are found in mangosteen.
7. The temperature in the packing box affects the sweetness of the mangosteen.

Methods and Materials

○ Study Area

- a. Ban Tha Samet Village No. 5, Tha Samet Sub-district, Cha-uat District, Nakhon Si Thammarat 80180, Thailand
 - Latitude 7.5544 N, Longitude 99.5912 E, Elevation 17 M



- b. Ban Lan Na Village No. 3, Koh Khan Sub-district, Cha-uat District, Nakhon Si Thammarat 80180, Thailand
 - Latitude 7.5421 N, Longitude 99.5706E, Elevation 22 M



- c. Ban Lan Khoi Village No. 1, Lan Khoi Sub-district, Pa Phayom District, Phatthalung 93210, Thailand
- Latitude 7.5307 N, Longitude 99.5210 E , Elevation 48 M



Materials

The materials used in this research are listed below.

1. To obtain mangosteen samples
 - Mangosteen
 - Psychrometer
 - Parcel box
 - RHS Color Chart
2. Materials and chemicals used in the extraction of substances in mangosteen pericarp
 - Dried mangosteen pericarp
 - Hot air oven
 - Mortar and pestle
 - Digital scale
 - Aluminum cup
 - Carrier bag (capacity 1 kg)
 - Beaker
 - Cylinder
 - Rubber band
 - Permanent marker
 - Ethanol 95%

3. To measure the sweetness and pH value

- Sweetness meter
- Basin
- Foam plate
- Dropper
- Beaker
- Cloth filter
- Fruit blender
- Litmus paper

Methods

1. Mangosteen Sampling

- Collected 100 mangosteen fruits through random selection.

2. Sampling of humidity and temperature

- Put the psychrometer inside the box and accurately recorded the results.

3. Measurement of color and hardness of the mangosteen pericarp

- Measured the color of the mangosteen pericarp using the RHS Color Chart
- Measured the hardness of the mangosteen pericarp by squeezing

4. Extraction of substances

- Using mortar and pestle, mashed the dried mangosteen pericarp and baked at 55 °C with a hot air oven. After baking, the pericarp was soaked in ethanol 95% in 15g : 50 ml at a temperature of 4 °C for seven days.

5. Sweetness Measurement

- Ten mangosteen fruits were collected per day from the sampling.
- Separated them per location before extracting the juice and blending or grinding the meat
- Filtered the blended meat with a white cloth.
- Used a dropper to get the extracted juice from the beaker and put it onto the sweetness measurement.
- Used the litmus paper dipped in a beaker.
- Accurately recorded the results.

6. Analysis of the mangosteen pericarp extracts

- Used high performance liquid chromatography, and accurately recorded the results.

Data Analysis

Mean values and correlation values were used in statistical data analysis.

Table 1: Result of the Mangosteen's Pericarp Color

Harvest date	Result of the Mangosteen's Pericarp Color		
	Ban Lan Na	Ban Tha Samet	Ban Lan Khoi
23-Aug-21	5GY6/10	5GY6/10	5GY6/10
24-Aug-21	5R 3/4	5R3/4	2.5R 4/6
25-Aug-21	5R 3/4	2.5R4/6	2.5R 4/6
26-Aug-21	5R 3/4	2.5R4/6	5R 3/4
27-Aug-21	5R 3/4	5R 3/4	5R 3/4
29-Aug-21	5R 3/4	5R 3/4	5R 3/4
30-Aug-21	5R 3/4	5R 3/4	5R 3/4
31-Aug-21	5R 3/4	5R 3/4	5R 3/4
1-Sep-21	5R 3/4	5R 3/4	5R 3/4
2-Sep-21	5R 3/4	5R 3/4	5R 3/4

The mangosteen changed from green (5GY6/10) to dark purple (5R 3/4) in ten (10) days after harvest.

Table 2 : Result of the Level of Hardness

Day	Result of the Level of Hardness		
	Ban Lan Na	Ban Tha Samet	Ban Lan Khoi
1	+++++	+++++	++++
2	+++	+++	+++
3	+	+	+
4	+	+	+
5	+	+	+
6	+	+	+
7	+	+	+
8	+	+	++
9	+++	+++	+++
10	+++	++++	+++

The fruit was hard during day 1 and 2 but the hardness decreased on day 8 and increased again the day after.

Table 3 : Result of Temperatures inside the parcel box

Day	Result of Temperatures inside the parcel box		
	Ban Lan Na °C	Ban Tha Samet °C	Ban Lan Khoi °C
1	30	28.86	27.86
2	29.86	29.14	28.36
3	27.92	29.17	27.58
4	27.75	28.33	27.25
5	29	29.17	27.75
6	29.92	29.42	28.67
7	29	29.83	28.67
8	28.67	29.83	28.17
9	29	29.5	28.33
10	28.5	29.17	27.75

The temperature in Ban Lan Na's box is 27.75 to 30 °C while in Ban Tha Samet's box, it is 28.33 to 29.83 °C, and Ban Lan Khoi's box has a temperature of 27.25 to 28.67 °C.

Table 4 : Result of Relative Humidity inside the parcel box

Harvest date	Relative Humidity inside the parcel box (%)		
	Ban Lan Na	Ban Tha Samet	Ban Lan Khoi
23-Aug-21	92.29	89	96.14
24-Aug-21	94.29	91.5	96.71
25-Aug-21	95.71	90.14	96.14
26-Aug-21	92	90.43	98.86
27-Aug-21	90.29	88.5	95.57
29-Aug-21	89.86	90.33	96.29
30-Aug-21	91.86	92.57	96
31-Aug-21	94.71	93	96
1-Sep-21	92.86	90.71	96.71
2-Sep-21	89.14	88.29	97.71

The relative humidity in Ban Lan Na's box is 89.14 to 95.71 %, Ban Tha Samet's box has 88.29 to 93.00 % and Ban Lan Khoi's box has 95.57 to 98.86 %.

Sweetness Level Graph

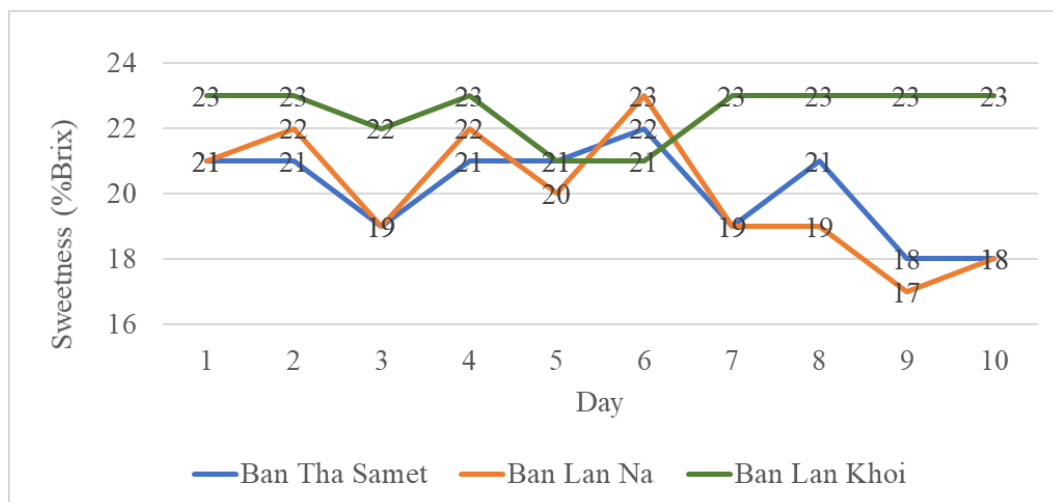


Table 5: Result of the concentration of Tannin and Xanthone

#	Location	Substance of the mangosteen pericarp (µg/mL)	
		Tannin	Xanthone
1	Ban Lan Na	6.4356	52.929
	Ban Tha Samet	32.8534	24.8219
	Ban Lan Khoi	36.37	74.6458
2	Ban Lan Na	5.9621	88.9627
	Ban Tha Samet	21.7523	50.5853
	Ban Lan Khoi	9.8273	32.7409
3	Ban Lan Na	25.6746	77.5999
	Ban Tha Samet	34.7546	70.9168
	Ban Lan Khoi	37.2874	3013.6777
<u>Average</u>	Ban Lan Na	12.6908	73.1639
	Ban Tha Samet	29.7868	48.7747
	Ban Lan Khoi	27.8282	1040.35548

The highest concentration of tannin is found in Ban Tha Samet which is 29.7868 µg/mL and the highest concentration of xanthone is found in Ban Lan Khoi with 1040.35548 µg/mL.

Table 6: Result of Correlation Coefficient, Relevance of Temperature, Relative Humidity, pH Level, Hardness and Sweetness

Correlation Coefficient		Temperature	Relative Humidity	Hardness	Sweetness
Temperature	Pearson Correlation	1	0.379*	-0.04	-0.412*
	Sig. (2-tailed)		0.039	0.833	0.024
	N	30	30	30	30
Relative Humidity	Pearson Correlation	0.379*	1	-0.182	-0.319
	Sig. (2-tailed)	0.039		0.337	0.086
	N	30	30	30	30
Hardness	Pearson Correlation	-0.04	-0.182	1	0.09
	Sig. (2-tailed)	0.833	0.337		0.637
	N	30	30	30	30
Sweetness	Pearson Correlation	-0.412*	-0.319	0.09	1
	Sig. (2-tailed)	0.024	0.086	0.637	
	N	30	30	30	30
* $P < 0.05$					

The correlation coefficient between temperature and relative humidity is 0.379 significant in 0.05 and the correlation coefficient between temperature and sweetness is -0.412 significant in 0.05.

Conclusion

1. The mangosteen's color changed from green (5GY6/10) to dark purple (5R 3/4) in 10 days after harvest.
2. The mangosteen from Ban Tha Samet is hard.
3. Ban Tha Samet has the highest temperature and Ban Lan Khoi has the highest level of humidity.
4. The sweetness for every location is different, but Ban Lan Khoi produces the sweetest fruit.
5. The pH level is 3 for all areas.
6. Ban Tha Samet has the highest average of tannin while the amount of xanthonenes is highest in Ban Lan Khoi.
7. The correlation coefficient between temperature and relative humidity is 0.379 significant in 0.05 and the correlation coefficient between temperature and sweetness is -0.412 significant in 0.05.

Significance of the Study

The gathered information can be used to properly store the fruits when being transported. Our results found evidence that the temperature and humidity inside the box can affect the overall quality of the product. These findings will help the researchers in designing and composing a parcel box where the temperature and humidity can be controlled or set.

If we are able to store the fruits properly, we can guarantee that the buyers from all around the country/world can enjoy the best-tasting quality mangosteen.

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