

Research Name: The diversity of food plants and the variants which affect the sweetness in the honey from the Asiatic honey bee and the Giant honey bee from the area of Khao Bantad Range in south of Thailand.

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Abstract

The objective of this research is to study the diversity of food plants for bees, the moisture and the pH level which affected the quality of sweetness in the honey. Honey samples were collected from 4 districts in the area of Khao Bantad Range, south of Thailand which are; Khuan Khanun District, Sri Banphot District, Paphayom District (Phatthalung Province) and Cha-uat District (Nakhon Si Thammarat Province). There are 2 types of honey samples from each area which are; 1. Honey from the Giant honey bee (*Apis dorsata fabricius*) 2. Honey from the Asiatic honey bee (*Apis cerana Fabricius*). A total of 13 samples were tested to check the quality, using the process of Scanning Electron Microscope (SME) to determine type and amount of pollen in the honey.

The result from the study indicates that there are 9 families of pollen in honey from the Giant honey bee and the Asiatic honey bee which are; Malvaceae, Fabaceae, Rubiaceae, Dipterocarpaceae, Myrtaceae, Sterculiaceae, Palmae, Oxalidaceae and Moringaceae. Regarding the quality of moisture, the result shows that the moisture in the honey from Asiatic honey bee is at average 22.78% and in the honey from the Giant honey bee is 24.45%. The result in moisture from all samples shows that their quality in moisture is higher than the standard of local products. Regarding the sweetness, the result shows that the honey from the Asiatic Honey bee has an average sweetness level at 80.21 Brix and the average sweetness level in the honey from the Giant honey bee is at 78.88 Brix. According to the study about correlation between the sweetness, the moisture, the pH scale and the amount of pollen's types in the honey from the Asiatic Honey Bee and the Giant Honey Bee, the result indicates that the honey from the Asiatic Honey Bee has a negative correlation with the moisture at statistical significance 0.001 ($r=-0.936$, $P<0.001$),

and there is a positive correlation with the amount of pollen's types at statistical significance 0.005 ($r=0.813$, $P<0.005$), but there is no correlation with pH scale 0.05 ($r=-0.002$, $P>0.005$).

The sweetness of the honey from the Giant honey bee has a negative correlation with the moisture at statistical significance 0.005 ($r=-0.810$, $P<0.005$), and there is a negative correlation with pH at statistical significance 0.005 ($r=-8.01$, $P<0.005$), but there is no correlation with the amount of pollen's types at statistical significance 0.05 ($r=-0.002$, $P>0.005$)

Keyword: pollen's types, Asiatic Honey Bee, Giant Honey Bee, quality of honey

Introduction

Phatthalung and Nakhon Si Thammarat provinces are adjacent to the Nakhon Si Thammarat Range or known as Bantad mountains range which consisted of abundant forests. During March to May or during the 5th lunar month of every year, local villagers would hunt for wild honey from the forest, or those who farm honey bee would also harvest the honey for sell. Therefore the wild honey from the Giant honey bee and the farmed honey from the Asiatic honey would become the popular especially fructose and also prebiotics and antioxidants. It is also an ingredient in various medicines, especially honey, which has anti-inflammatory, antiviral and antibacterial effects.

The research team noticed that honey in each area has different colors and flavors. Based on studying from academic articles such as a research by Supalak Paisarn which indicates that in dark honey, the level of antioxidant content is higher than honey in light colors. And according to the research by Ismae Chelong and his team the result indicates that in each area, honey contains different types and amounts of pollen. The types of pollen found in honey can identify the dietary plant types of bees and indicate the diversity of plants in that specific area

The research team interested in studying the environment such as; air temperature, rainfall and plant species in the foraging perimeter of bees in correlation to the quality of honey in matters of sweetness, moisture, pH scale, types of pollen, and antioxidant in the honey. Therefore this set of information could be benefit to locals who are interested in farming honey bee and would help adding value to local products from the communities in Phatthalung Province and Nakhon Si Thammarat Province.

Research Questions.

1. Are the diversities of food plants for bee from each area different? How?

2. Does the quality honey meet the quality standard of the local products so as the Food and Agriculture Organization of the United Nations?
3. Does the pollen have a correlation with the quality of sweetness in honey? (sweetness, moisture, pH scale)

Hypothesis

1. The diversities of food plants from each area are different.
2. The quality of honey meets the standard of the local products so as the Food and Agriculture Organization of the United Nations.
3. The pollen has a correlation with the quality of sweetness in honey (sweetness, moisture, pH scale).

Materials and Methods

1. Study site

The process used in this research, the researchers studied honey from 4 districts includes Khuan Khanun District, Si Banphot District, Paphayom District (Phatthalung Province) and Cha-uat District (Nakorn Si Thammarat Province) using 2 types of honey; 1.)honey from the Giant honey bee 2.)honey from the Asiatic honey bee.

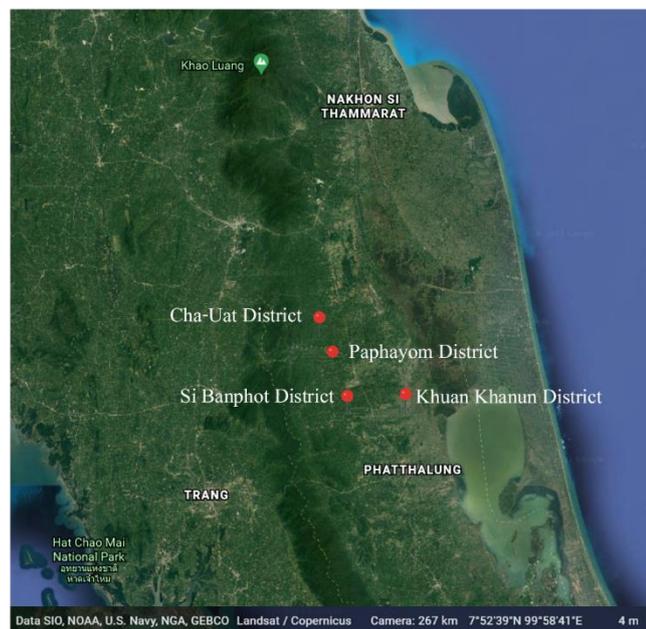


Figure 1: Study side four districts include khuan Khanun District, Si Banphot District, Paphayom District, Phatthalung Province and Cha-Uat District, Nakorn Si Thammarat Province

2. Timeline and deciding sample sites

the researchers collected honey from four study locations and collected 2 types of honey from each location which are; 1) honey from the Giant Honey Bee, aged 4 years collected in 2017, and 2) honey from the Asiatic honey bee, aged 1 year collected in 2020.

3. quality analysis of honey and pollen in honey

The analysis of honey's quality and pollen in the honey. Honey from 4 locations were collected to be analyzed for the honey's quality and the pollen in the honey. Materials used in the process are as shown in Table 1. (Table 1)

Table 1 The device is used to analyze the quality of honey and pollen.

Honey Measuring Device	Pollen Inspection Equipment in Honey
Brix	Scanning Electron Microscope (SEM)
pH paper	Gold-Paltering Machine
Balmometer	Vortex Mixer
Dropper	Auto Micro Pipette
Small Glass Bottle	Pollen Guide for flowering plants
	Stub
Honey Measuring Device	Pollen Inspection Equipment in Honey
	Stub for Gold-Paltering Machine
	Test Tube
	Filter paper

4. Method

4.1 Specify 4 study areas.

4.2 Collect 2 types of honey samples from the 4 specific areas includes Khuan Khanun District, Si Banphot District, Paphayom District and Cha-uat District.

4.3 Test the qualities of honey in matter of 1) the moisture, using the Balmometer 2) the sweetness, using the Brix 3) pH Value, using pH paper test.

4.4 Prepare honey for the study using the electron telescope to identify honey's type and pollen in the honey.

5. Statistical analysis

Program SPSS Version 22 were used for the statistical data analysis.

5.1) Analyzing the difference between the quality of honey cavity and Asiatic Honey Bee in the Bantad Mountains (Nakorn Si Thammarat Mountains). Southern Thailand using average test statistics.

5.2) Find the correlation between sweetness and moisture Values, pH Value and pollen species(Families) of Asiatic Honey Bee and Giant Honey Bee in the Bantad Mountains, Southern Thailand Using Pearson correlation test statistics

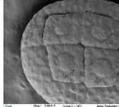
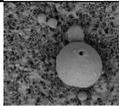
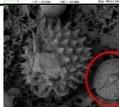
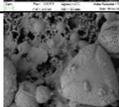
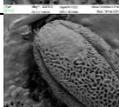
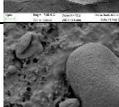
Research results

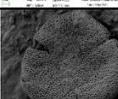
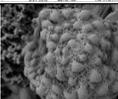
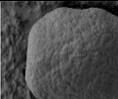
1. Types of food plants Asiatic Honey Bee and Giant Honey Bee in Ban tad Mountains, Southern Thailand

Types of food plants in the area of Bantad Mountain Range in the south of Thailand

The study's result showed that there are 13 types of food plants for the Asiatic honey bee; Malvaceae ,Leguminosae Mimosoideae,Rubiaceae, Diptero carpoceae, Myrtaceae, sterculiaceae, Palmae, Oalidaceae, and Moringaceae Paphayom. Of which 11 were found in Paphayom area; Malvaceae Leguminosae Mimoso ideae 2 family of (๗๓๕๖๗) Rubiaceae, Dipterocarpaceae, Malvaceae, sterculiaceae, Palmae, oxalidaceae, Moringaceaeand. And the study also showed that there are 11 types of food plants for the Giant honey bee; Malvaceae Leguminosae Mimoso ideae 2 types, Rubiaceae, Dipterocarpaceae, Malvaceae, sterculiaceae, Palmae, oxalidaceae, Moringaceaeand (Table 1)

Table 1 Types of food plants Asiatic Honey Bee and Giant Honey Bee in Ban tad Mountains, Southern Thailand

The pollen	Magnification	Surface size	Families	Asiatic Honey Bee				Giant Honey Bee			
				Paphayom District	Kuan Khanun District	Sri Bunphot District	Cha-Uat District	Paphayom District	Kuan Khanun District	Sri Bunphot District	Cha-Uat District
	3,000x	2 μm	Malvaceae	✓	✓						
	3,000x	10 μm	Leguminosae-Mimosoideae	✓			✓			✓	✓
	1,000x	10 μm	Rubiaceae	✓							
	3,000x	2 μm	Dipterocarpaceae	✓							
	3,000x	2 μm	Myrtaceae	✓	✓	✓	✓		✓		✓
	3,000x	2 μm	Sterculiaceae	✓	✓		✓		✓		✓
	7,000x	1 μm	Fabaceae	✓			✓		✓		✓
	2,000x	2 μm				✓					

The pollen	Magnification	Surface size	Families	Asiatic Honey Bee				Giant Honey Bee			
				Paphayom District	Kuan Khanun District	Sri Bunphot District	Cha-Uat District	Paphayom District	Kuan Khanun District	Sri Bunphot District	Cha-Uat District
	1,500x	10 μm				✓					
	5,000x	2 μm									✓
	500x	10 μm						✓			
	3,000x	2 μm	Palmae	✓		✓		✓			✓
	3,000x	2 μm	Oxalidaceae	✓			✓	✓			
	2,500x	2 μm	Moringaceae	✓				✓			
	5,000x	1 μm		✓							
	2,000x	2 μm						✓			✓
	3,000x	2 μm						✓			

The pollen	Magnification	Surface size	Families	Asiatic Honey Bee				Giant Honey Bee			
				Paphayom District	Kuan Khanun District	Sri Bunphot District	Cha-Uat District	Paphayom District	Kuan Khanun District	Sri Bunphot District	Cha-Uat District
Total types of food plants				11	4	3	5	4	5	1	7

2. The qualities of honey from the Giant honey bee and the Asiatic honey bee in the area of Bantad Mountain Range in the south of Thailand.

The result from the study indicated that the qualities of the honey from the Asiatic honey bee are; Average Moisture 22.78%, Average Sweetness 80.21 Brix. And the quality found in the honey from the Giant honey bee are; Average Moisture 24.45%, Average Sweetness 24.45 Brix (Table 2)

The study applied the method of statistic to compare the difference in the qualities of moisture, sweetness and pH scale. The result showed that the moisture level of the honey from the Giant honey bee is higher than the moisture of the honey from the Asiatic honey bee at Statistical significance level 0.05 ($t_{22} = 1.915, P > 0.05$). For Sweetness and pH scale they are not different at Statistical significance level 0.05 (Sweetness: $t_{22} = 1.573, P > 0.05$; pH Value: $t_{22} = 1.915, P > 0.05$)

Table 2 Quality of Asiatic Honey Bee and Giant Honey Bee

Types of Bee	Study site	Moisture (%)	Average	Sweetness (Brix)	Average	pH Value	Average
Asiatic Honey Bee	PaPhayom District	21.07±0.07	22.78±0.05	82.83±0.17	80.21±0.04	5.00±0.00	5.00±0.00
	Khuan Khanun District	25.33±0.03		77.50±0.00		5.00±0.00	
	Si Banphot District	23.24±0.03		79.50±0.00		5.00±0.00	
	Cha-Uat District	21.47±0.07		81.00±0.00		5.00±0.00	
Giant Honey Bee	PaPhayom District	22.87±0.03	24.45±0.05	81.67±1.67	78.88±0.55	4.00±0.00	4.75±0.01
	Khuan Khanun District	24.93±0.07		77.83±0.17		5.00±0.00	
	Si Banphot District	25.23±0.03		77.83±0.17		5.00±0.00	
	Cha-Uat District	24.77±0.07		78.17±0.17		5.00±0.00	

3. The correlation between sweetness, moisture, pH scale and number of Pollen (families) at Ban tad mountains Southern, Thailand

The result from the study about the correlation between sweetness, moisture, pH scale and number of type of Pollen (family) in Asiatic honey and Giant honey at Ban tad mountains Southern Thailand indicated that, the sweetness in Asiatic honey have negative correlation with moisture at a statistical significance level of 0.001 ($r=0.963, P < 0.001$) and have positive correlation with number

of type of Pollen (Family) at a statistical significance level of 0.005 ($r=0.813$, $P<0.005$) but there is no correlation with pH scale at statistical significance level at 0.005 ($r=0.002$, $P>0.005$).

The result also showed that, the sweetness in honey from the Giant honey bee has a negative correlation with moisture at a statistical significance level of 0.005 ($r=0.810$, $P<0.005$) and there is a negative correlation with pH Value at statistical significance level of 0.005 ($r=0.801$, $P<0.005$) but there is no correlation with number of types of Pollen (family) at statistical significance level of 0.05 ($r=0.002$, $P>0.005$)

Table 3 The correlation between sweetness with moisture pH value and number of Pollen (family)

Sweetness		Moisture	pH Value	number of Pollen (family)
Asiatic Honey Bee	Pearson Correlation	-.963**	0.958	.813**
	Sig. (2-tailed)	.000	0.875	.001
	N	12	12	12
Giant Honey Bee	Pearson Correlation	-.810**	-.801**	-.002
	Sig. (2-tailed)	.001	.002	.994
	N	12	12	12

Conclusion and Discussion

The result of the study indicated that a number of types of pollen in the Asiatic Honey and Giant Honey were found 9 families, includes Malvaceae, Fabaceae, Dipterocarpaceae, Myrtaceae, Sterculiaceae, Palmae, Oxalidaceae and Moringaceae. It's consistent with Shubharani's Research and His team. Were found 39 families, and it's the same types of pollen in our research 5 families include Malvaceae, Fabaceae, Rubiaceae, Myrtaceae and Oxalidaceae. And it's consistent with Ismae's Research Shelong and his team. Were found 28 families. It's the same types of pollen in our research 5 families include Malvaceae, Fabaceae, Myrtaceae, Rubiaceae, Myrtaceae and Oxalidaceae. The result indicated that in the area of 4 districts near the Bantad Mountains, Southern Thailand, there is diversity in types of food plant for the Giant Honey and the Asiatic Honey.

Regarding the quality of moisture in samples honey from the study site, the result showed that the moisture level is higher than standard of Honey from Local Product which the standard was set at 21% compare to the weight and the standard from Food and Agriculture Organization of the United Nations (WWW.fao.org) was set at 20% compare to the weight. According to the beekeeper, (Mr. Veerapol

Wongchaem) who provided information, stated that most honey has a high moisture content. If it is to be exported, it must be evaporated to reduce moisture according to the standards of each country, such as European countries. 20% moisture required in Asia, such as Taiwan Requires the Moisture of 21% Consumers generally do not take moisture into account. But if the honey is harvested with higher moisture than the standard, the pH scale might be decrease which occurs in the fermentation process, and if the lid is tightly closed, an explosion may occur.

Regarding the quality of sweetness, the result showed that in the sweetness of Giant there is positive correlation with number of types of pollen at statistical significance 0.005 ($r=0.813$, $P<0.005$). It means that if there is a high number of a type of pollen, the sweetness would be high too. And were found that the sweetness has a negative correlation with the moisture at statistical significance 0.001 ($r=-0.963$, $P<0.001$). It means that if the honey has high moisture level, the sweetness would be low. At the same time, the Giant Honey has a negative correlation with the moisture at statistical significance 0.005 ($r=-0.810$, $P<0.005$).

The sweetness of Giant Honey has a negative correlation with the pH Value at statistical significance 0.005 ($r=-0.810$, $P<0.005$). That means if the honey has high quality of sweetness, the quality pH scale would be low.

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Reference

Faculty of Natural Resources, Prince of Songkla University. Plant database (Durian). February 2021, available at <http://gg.gg/oguj5>

The Botanical Garden Organization(2011). February 2021 available at <http://gg.gg/oguky>

Supalak Paisarn Waililak University. General information of honey. February 2021, available at <http://gg.gg/ogq1c>

Pranom . Flower Plant's Pollen.

Khon Kaen: Klungnana Vitthaya Press

Ismae Chelong, Muhammadtayudin Bahakheeree,

Accuweather, Air Temperatur.February 2021, available at <https://www.accuweather.com/>

Shubhrani,R., Roopa, P., & Sivaram,V. (2013). POLLEN MORPHOLOGY OF SELECTED BEE FORAGE PLANTS

World weather oline().Weather.February 2021, available at <https://www.worldweatheronline.com/>