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Preparation, Nutrition Analysis, and Sensory Evaluation of Stingless Bee Honey Candy

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ABSTRACT

Honey of stingless bee has been reported a variety of biological activities, such as antioxidant, anti-inflammatory, antimicrobial, and anticancer, and nutritional contents. The high moisture content of stingless bee honey can cause the fermentation process and affect honey quality. Previously, most of the candy preparations used sugar and syrup as the main ingredients, which can lead to tooth decay and diabetes. Thus, the object of this research was the development of stingless bee honey candy, and its nutrition and sensory were analyzed. Isomalt was used as a bulking agent for this study. The stingless bee honey candy was prepared by mixing honey with isomalt in a ratio of 90:10-10:90 (w/w) with heating at 70-80°C for <60 min. The result showed that the ratio of honey with isomalt at 20:80 (B), 30:70 (C), and 40:60 (D) was suitable preparation of candy. In addition, the sensory evaluation of B-D displayed good agreement. The calories in candies (B-D) showed in the range of 397-398 cal/100g.

KEYWORDS: Stingless bee honey, Candy, Nutrition analysis, Sensory evaluation

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1. INTRODUCTION

Nowadays, the development of foods is growing rapidly with creative ideas that consumers pay more attention to nutritional value and health (Jacobs and Steffen, 2003; Sahlan et al., 2019). Therefore, ingredients are essential to the development of healthy food products.

Honey of stingless bees is produced from the nectar of flowers by stingless bees (Meliponini Tribe, Apidae family) which is an alternative source of natural food products (Michener, 2004; Rao, 2016). It displayed a wide range of biological, such as anti-microbial, anticancer, anti-inflammatory, antioxidant activities and also has a wound-healing effect (Almeida et al., 2013; Rao, 2016). Moreover, it also contains a variety of amino acids, vitamins (A, B1, and B2), minerals (calcium, sodium, potassium, magnesium and iron), and organic acids (malic, tartaric, citric, lactic and oxalic) (Alvarez-Suarez et al., 2013; Brodschneider and Crailsheim, 2010; Sahlan et al., 2019) Honey has been used as an ingredient in a wide range of benefits, one of which is a candy product (Alvarez-Suarez et al., 2013; Sahlan et al., 2019).

As previously reported, the main ingredient in candy is sugar, which is the leading cause of tooth decay and diabetes. Today, there are a variety of sugar substitutes,

one of which is isomalt (Jaggi et al., 2020). It acts as a bulking agent, an anti-caking agent, and does not increase blood glucose or insulin levels. Additionally, it does not promote tooth decay (Grembecka, 2015; Jaggi et al., 2020)

Thus, the object of this research was the development of stingless bee honey candy as an alternative source of products without sugar that may cause tooth decay and diabetes, and its nutrition and sensory were analyzed.

2. MATERIALS AND METHODS

2.1 Samples

Stingless bee honey (*Heterotrigona itama*) was collected from Pase Yawo sub-district, Sai Buri district, Pattani, Thailand in January 2019. The honey was filtrated using a thin white cloth and kept at 4°C before studies.

2.2 Preparation of stingless bee honey candy

There are 9 formulations for preparing candy, consisting of formula A, B, C, D, E, F, G, H, and I. Honey was mixed with isomalt with a ratio of 10:90, 20:80, 30:70, 40:60, 50:50, 60:40, 70:30, 80:20, and 90:10 w/w (shown in Table 1) and heated at 70-80°C for 55-60 min. The mixture was poured into candy molds and refrigerated for 15-30 min. The candies were further analyzed for their nutritional value and sensory test.

Table 1 Formulation for preparing all 9 stingless bee honey candies

Formulation	Percentage of stingless bee honey	Percentage of isomalt
A	10	90
B	20	80
C	30	70
D	40	60
E	50	50
F	60	40
G	70	30
H	80	20
I	90	10

2.3 Nutrition analysis of stingless bee honey candy

The nutrition analyzes of honey and candies were done in triplicate for protein, fat, moisture, and ash contents. The methods described in AOAC (2000). Carbohydrate content was calculated using the standard equation (%Carbohydrate = 100%-%protein+%fat+%ash+%moisture). Energy evaluation was calculated by multiplying the protein, carbohydrate, and fat with the factors 4, 4, and 9, respectively (AOAC, 2000). Determination of moisture content: the empty dish and lid were dried in the hot air oven at 105°C for 3 h, then transferred to the desiccator to cool and weigh. Two grams of sample were weighed into the dish. It was dried in the hot air oven at 105°C for 3 h. After drying, it was transferred to the desiccator to cool. Then the dish and its dried sample were reweighed. Calculation of moisture content was followed (1).

$$\text{Moisture}(\%) = ((W1-W2)/W1) \times 100 \quad (1)$$

Where: W1 = weight (g) of sample before drying

W2 = weight (g) of sample after drying

Determination of ash content: The crucible and lid were placed in the furnace at 550°C for 30 min, then transferred to the desiccator to cool and weigh. Two grams of the sample were weighed into the crucible. It was dried in the hot air oven at 135±2°C for 30 min and burned in the furnace at 550°C for 6 h. After that, it was transferred to the desiccator to cool. Then it was reweighed. Calculation of ash content was followed (2).

$$\text{Ash}(\%) = (\text{Weigh of ash}/\text{Weigh of sample}) \times 100 \quad (2)$$

Determination of fat content: The beaker was dried in the hot air oven at 100±2°C for 30 min, then transferred to the desiccator for 30 min and weighed. One gram of the sample was weighed into the beaker. The sample was dissolved with 10 mL of distilled water. The solution was transferred into a separatory funnel. Then, 1.23 mL of ammonium solution, 10 mL of ethyl alcohol, and 25 mL of diethyl ether were

added. After that, it was shaken for 1 minute. And, 25 mL of Petroleum ether was added then shaken for 1 minute. The upper level of the sample was aliquoted and extracted with 1 mL of ethyl alcohol, 15 mL of diethyl ether, and 15 mL of petroleum ether two more times. An aliquot of the upper sample was added to the beaker. It was dried in the hot air oven at 100±2°C for 2 h, then transferred to the desiccator for 30 min and weighed. The sample was reweighed. Calculation of fat content was followed (3).

Fat(%) = (Weigh of fat/Weigh of sample) x 100 (3)

Determination of protein content: Two grams of sample were added to Kjeldahl flask. Then, 2 grams of CuSO4 and K2SO4 in ratio of 1:10 and 25 mL were added. It was digested at 400°C. After the sample cools, 10-15 mL of distilled water and 40-50 mL of NaOH (40 %w/w). Then, the sample is distilled while the 20-25 mL of boric acid (4% w/w) and indicator are in a receiving flask. After that, the solution was titration with 0.1 N HCl. Calculation of protein content was followed (4).

Protein(%) = (V1-V2)x(14.007)xNx100/mg of Sample (4)

Protein (%) = %Nitrogen x 6.25

Where: V1 = The amount of hydrochloric acid used in the titration of the sample

V2 = The amount of hydrochloric acid used in the titration of the blank sample

N = Concentration of hydrochloric acid

2.4 Sensory evaluation of stingless bee honey candy

Fifty untrained panelists were asked to evaluate the sensory attributes. Different attributes viz. color, taste, aroma, flavor, consistency, sourness, and overall preference were rated based on a 9-point hedonic scale ranging from 1 to 9 (Lim, 2011).

2.5 Statistical analysis

All experimental data were subjected to ANOVA followed by Duncan's multiple range test (DMRT) with a p-value of 0.05 ($p<0.05$).

3. RESULTS AND DISCUSSION

The preparation of the stingless bee honey candies of this study found that the suitable ratio of honey and isomalt were 20:80 (B), 30:70 (C), and 40:60 (D) at 70-80°C for 30-45 min. The characteristic of all formulations is reddish brown like stingless bee honey color. It may involve the advantage of isomalt which is no browning reaction occurs during boiling (McNutt and Sentko, 2003) as shown in Figure 1. In 2019, Sahlan et al. reported on the preparation of honey candies containing water, sugar syrup, and honey, the maximum honey content ratio that can be prepared as a candy was 29% (Sahlan et al., 2019). Compared to this study, candies with a higher ratio of honey were prepared, with a maximum of 40 %. Thus, preparing stingless bee honey candies that use a mixture of honey and isomalt may be a healthier candy alternative.

Figure 1 The visual appearance of stingless bee honey candy of B, C, and D formulation

Nutrition Analysis of stingless bee honey candies is given in Table 2. The energy values of All candies were not significantly different ($p<0.05$). Although the mix ratio of each formula (B, C, and D) was different. All candies did not appear fat content. The moisture, protein, and ash contents of all candies increased the amount of stingless bee honey. In contrast, candy's carbohydrate content decreases with the amount of isomalt. In 2019, the nutritional values of three types of honey candy were reported: 1) Klanceng honey candy, 2) randu honey candy, and 3) forest honey

candy, which had an energy value in the range of 397.28 - 398.68 kcal. /100g, a protein range of 0.18 - 0.36 (g/100g) and a carbohydrate range of 99 - 99.31 (g/100g), and had no fat content (Sahlan et al., 2019). In 2021, Baka et al. reported a nutritional analysis of stingless bee honey candy which had an energy value of 395.45 kcal. /100g, a protein at 0.03 g/100g, and a carbohydrate at 98.47 g/100g and had no fat content (Baka et al., 2021). Compared to research results, carbohydrate content and energy value are similar. But the protein content gave a higher value, probably because of the protein content of ingredients and honey of bee species. In addition, when comparing the nutritional value of all candies with raw honey, they showed significantly higher protein content ($p<0.05$). This formulation may be useful for honey candy preparation.

Table 2 Nutrition Analysis of stingless bee honey candies (Formula B, C, and D)

Nutrition	Raw Honey	Stingless bee honey candies		
		Formula B	Formula C	Formula D
Moisture content (g/100g)	30.47±0.95^{a}	0.44±0.24^{b}	0.46±0.10^{bc}	0.48±0.16^{c}
Protein content (g/100g)	0.52±0.00^{e}	0.55±0.00^{b}	0.73±0.05^{c}	0.91±0.05^{d}
Carbohydrate content (g/100g)	68.70±0.94^{a}	98.95±0.23^{c}	98.75±0.14^{bc}	98.53±0.20^{b}
Fat content (g/100g)	ND	ND	ND	ND
Ash content (g/100g)	0.32±0.01^{c}	0.05±0.00^{a}	0.06±0.00^{ab}	0.07±0.01^{b}
Energy value (kcal./100g)	276.85±3.76^{a}	397.79±0.64^{b}	397.94±0.41^{b}	398.01±0.94^{b}

The values with different superscript letters in a column are significantly different ($p<0.05$).

ND = not detected

Sensory testing of all 3 formulas of honey candies (B, C, and D) found that the odor test gave an intermediate rating that may need to be developed by adding natural scents with essential oils (Irshad et al., 2020). For Formula C, all ratings were in the range of 5-6, possibly due to the higher honey content ratio than the other formulations and resulting in lower overall preference ratings than Formula A with a significant difference ($p<0.05$) (shown in Table 3). However, all 3 formulas can be used to prepare honey in the form of candies, which may need to be developed with the addition of natural raw materials to further increase the sensory rating.

Table 3 Sensory testing values of candy formulas (B, C, and D)

Sensory evaluation	Stingless bee honey candies		
	Formula B	Formula C	Formula D
Color	7.07±1.31^{a}	7.20±1.27^{a}	6.27±1.46^{b}
Smell^{ns}	5.77±1.65^{a}	5.77±1.85^{a}	5.23±1.94
Flavor^{ns}	6.40±1.50	6.10±2.02	5.63±1.85
Texture	7.00±1.64^{a}	6.57±2.08^{ab}	6.00±1.76^{b}
Characteristic	6.80±1.86^{a}	6.53±2.05^{ab}	5.60±2.28^{b}
Overall prederence	6.87±1.55^{a}	6.57±1.77^{ab}	5.83±1.95^{b}

The values with different superscript letters in a row are significantly different ($p<0.05$).

^{ns} means not significantly different ($p>0.05$).

4. CONCLUSION

Honey stingless bees are a healthy product from natural. It can be prepared as candy with a high honey content. To prepare candies from a mixture of honey and isomalt, a ratio of 20-40% of honey can be used. In addition, the nutritional value of honey candy is higher than honey. It may be an alternative healthy honey candy product. However, the formulation may need to be revised to obtain additional sensory evaluation values and further stability and shelf-life studies may be required.

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