AN ANTIOXIDANT THAI SPONGE CAKE SUPPLEMENTED FROM SESBANIA FLOWER POWDER.

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ABSTRACT

The objective of this research is to develop Thai sponge cake from Sesbania flower powder. Sesbania flower is a source of calcium, phosphorus, fiber and vitamins. When studying the type of bioactive substances in Sesbania flower powder in the group of carotenoids; it is found that carotene substances; including lutein, zeaxanthin and beta carotene, were equal to 29,947.94, 620.03 and 1,555.98 micrograms per 100 grams respectively. When studying the standard recipes of Thai sponge cake from the sensory quality assessments using the 9-point hedonic scale found that the accepted standard recipe of the Thai sponge cake consists of 240 grams of duck egg, 180 grams of chicken eggs, 180 grams of flour for baking cakes and 180 grams of granulated sugar. Then, the standardized recipes are selected to supplement Sesbania flower powder at the level of 20, 40 and 60 percent of wheat flour weight. The assessment of sensory quality test showed that the 20% of wheat flour supplemented with Sesbania flower powder; there are most preference scores when comparing the color values of Thai sponge cake with Sesbania flower powder found that when the amount of Sesbania flower powder increased; this results in the brightness (L*) and the red (a*) decreasing with the values of 44.09 and 2.40 respectively, while the yellow (b*) tends to increase with the value of 21.26 which has the difference between the controlled recipe with statistically significant ($p \leq 0.05$). When analyzed for physical quality, it is found that increasing the amount of Sesbania flower powder in Thai sponge cake resulted in the hardness, toughness and chewiness tends to increase. The flexibility and cohesiveness tends to decrease. When analyzing the chemical properties of Thai sponge cake with Sesbania flower powder, it is found that the Thai sponge cake supplemented with Sesbania flower powder contained protein, fat, dietary fiber, ash, moisture and carbohydrates equal to 9.45, 5.23, 2.64, 1.16, 33.94 and 52.42 respectively, and there are beta carotene 319.10 microgram /100 grams. The development of the Thai sponge cake supplemented with Sesbania flower powder is a guideline to increase healthy nutrition especially fiber-food and beta-carotene obtained from Sesbania flower.

Keywords: Thai sponge cake, Sesbania flower powder, and beta carotene.

INTRODUCTION

Thai sponge cake is a dessert that has developed from making Thai desserts, organized in the same group as western desserts, khanom farang kudi chin, Thai eggs cake and khanom phing. Thai dessert is a unique, traditional and Thai cultural heritage. It has physical and sensory characteristics which are unique.(Tidarat Sanphom and Jiraporn Weenuttranon, 2018)[1]. Raw materials used steaming methods are chicken eggs, wheat flour, granulated sugar, food coloring and flavoring agents, can be garnished with raisins, golden strands (Foi Thong) or red eggplant (Yingsak Jonglert Jesadawong, 2000)[2]. From

the main ingredient of Thai sponge cake lack of nutrients such as fiber, calcium, phosphorus, iron, and vitamins that are essential to the body (Napha lila-suphaphong, 2013)[3]. Therefore, the development of healthy Thai sponge cake is in demand from consumers.

Sesbania flower or Sesbania is a plant that resembles a shrub or a small herbaceous plant, aged 1 year, with a height of about 1 to 4 meters, found naturally. It is usually found in areas with waterlogged around the river basin, along the swamp, canal, swamp. For Sesbania, which is used as a food, is Sesbania or Sesbania flower popularly eaten with chili paste. In addition to being prepared as a food, it can also be used to make desserts (Napha lila-suphaphong, 2013)[3]. In term of nutritional value, Sesbania flower has a lot of calcium, phosphorus, fiber and vitamins and medicinal properties, therefore, there are people who use Sesbania flower for research. According to the survey of Sesbania flower plant for distribution, most of the problems of raw materials are oversupply, the price is low and spoilage (Watcharasak Chakkij, 2016)[4], the average price of Sesbania flower on a monthly basis is likely to decrease from the beginning of the year is January, the price of Sesbania flower is 120 baht per kilogram, in May priced at 70 baht per kilogram (Si Mum Mueang Market, 2018)[5].

Therefore, the research aims to study Thai sponge cake by using Sesbania flower powder to increase the nutritional value of Thai sponge cake as an alternative for consumers who are turning to more health. As well as adding value to agricultural raw materials and can be applied to the household industry level.

METHODOLOGY

1. To study the types of the bioactive compounds in Sesbania flower powder

The making process of Sesbania flower powder according to the methods of adapted from Watcharasak Chakakit (2016) [4] by picking the eatable part of Sesbania flower; then washed thoroughly; rest to drain then Sesbania flower was dried in a tray dryer at a temperature of 50 degrees Celsius for 8 hours; then grinded into powder with a leaf grinder in order to have a particle size of 60 mesh ; packed in an aluminum foil bag tightly and closed the bag. After that, 100 grams of Sesbania flower powder were analyzed for bioactive substances in the carotenoids group in accordance with the method of Speek AJ.et al. (1986)[6].

2. To study the standard recipes of Thai sponge cake.

Studied the standard recipes of Thai sponge cake obtained from Rumpa Siriwong (2009)[7], Rungtiwa Wongpaisanrit (2010)[8] and Chanya Suban (1989)[9] as standard recipes, and then tested for sensory quality assessment used 9 point Hedonic Scale. There were 60 tested participants who were students of Suan Sunandha Rajabhat University. The sensory quality assessment included appearance, color, odor, taste, texture and overall preference; the experiment design was the randomized complete block design (RCBD), Analysis of Variance (ANOVA), and compares the differences between the means using Duncan's New Multiple Range Test at 95% confidence levels.

3. To study the amount of Sesbania flower powder supplemented with Thai sponge cake

The standard recipes of Thai sponge cake from the experiment were modified to supplement the amount of Sesbania flower powder at the level of 20, 40 and 60 percent of the wheat flour weight; select the appropriate amount by analyzing physical properties as follows.

The color values are measured by Hunter lab; used to display the results in terms of luminosity (L*), red (a*) and yellow (b*). The physical properties of Thai sponge cake

supplemented with Sesbania flower powder that were analyzed to determine the physical quality of Thai sponge cake by using a texture analyzer. The evaluated values are the hardness, springiness, chewiness, cohesiveness and gumminess.

The experimental design was Completely Randomized Design (CRD), analysis of statistical variance, and compared the difference between the averages by Duncan's New Multiple Range Test method at the 95% confidence level.

4. To study the chemical properties of the Thai sponge cake supplemented with Sesbania flower powder.

Thai sponge cake supplemented with Sesbania flower powder were analyzed for nutritional value, including protein, fat, moisture, ash content, dietary fiber according to the method of AOAC (2016)[10] and the analysis of beta-carotene (β-carotene) according to the method of Speek AJ. et al. (1986)[6].

RESULTS

1. The study result of the types of bioactive compounds in Sesbania flower powder.

The results of the study of the type of bioactive compounds in the group of carotenoids of Sesbania flower powder that have been dried at 50 degrees Celsius for 8 hours showed that the carotene group is Lutein, C Xanthine and beta carotene are 29, 947.94, 620.03 and 1,555.98 micrograms per 100 grams. The bioactive compounds are found in yellow pigment. This is consistent with the research of Murkovic et al. (2002)[11] with the study of carotenoids in different pumpkin species; it found that pumpkin with orange has a lot of beta carotene, and the pumpkin that is yellow in color is high lutein which has antioxidant properties, in accordance with the research of Palozza et al. (2006)[12] found that beta carotene is an initial substance in the synthesis of vitamin A and has antioxidant properties as shown in Table 1.

Table 1
Chemical compositions of Sesbania flower powder 100g

Carotenoid profile	**Quantity (microgram)**
Lutein	29,947.94
Zeaxanthin	620.03
Beta-carotene	1,555.98

2. The study results of the standard recipes for Thai sponge cake

Thai sponge cake recipes showed that the 3 standard recipes had an effect on the appearance, odor, taste, texture and overall preference score with statistical significance ($p \leq 0.05$) but without affecting the color's preference score with statistical significance ($p > 0.05$). Considering the appearance, the recipe 1 and 2 had the preference scores in the mid preference level and the recipe that 3 has the least preference score due to the fact that the recipe 3 contains less sugar than recipes 1 and 2; it may make the Thai sponge cake look less flaky and the texture of the Thai sponge cake is dry. This is consistent with Chittana Chaemmek and Onanong Naiwikul (2011)[13], indicating that the amount of sugar affects the quality of the cake. The amount of sugar in the recipe is too small and will cause the cake to be reduced. The texture of the cake is dry, hardened, but considering the odor, taste, texture, and overall preference, it is found that recipes 1 and 3 have more preference scores than

recipe 2. Due to the process of making the Thai sponge cake no.2, there was not sifting, the flour may cause the dough to rise unevenly and the texture is tight.

Therefore, from the selection of standard recipes of the Thai sponge cake; selected the standard recipe 1 as the appropriate recipe for bringing to produce Thai sponge cake supplemented with Sesbania flower powder; the standard recipe 1 contains 240 grams of duck eggs, 180 grams of chicken eggs, 180 grams of flour for baking cakes, 360 grams of granulated sugar, due to its appearance, odor, color, taste, texture and overall preference are in the criteria of moderate preference score as shown in Table 2.

Table 2
The results of sensory quality evaluation of the three standard recipes of Thai sponge cake.

Sensory Characteristic	Standard Recipe		
	1	2	3
Appearance	7.61 ± 0.94^{a}	7.43 ± 0.88^{a}	6.88 ± 0.90^{b}
Color ^{ns}	7.50 ± 1.17	7.46 ± 1.03	7.30 ± 1.03
Odor	7.96 ± 0.84^{a}	7.53 ± 0.76^{b}	7.68 ± 0.92^{ab}
Taste	7.65 ± 1.14^{a}	7.15 ± 1.02^{b}	7.36 ± 1.02^{ab}
Texture	7.41 ± 1.18^{a}	6.43 ± 0.74^{c}	7.03 ± 0.88^{b}
Overall	7.73 ± 1.02^{a}	6.91 ± 0.82^{c}	7.36 ± 0.93^{b}

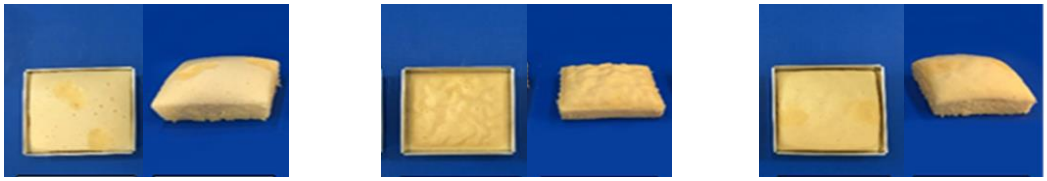
Notes; letters that are different in the horizontal indicate the distinct average were statistically significant at 95% confidence level.

Mean ± standard deviation

$^{a,b,c\cdots}$ Means with the different letters are significantly different ($p\leq0.05$).

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

Figure 1
Characteristic of standard recipe of 3 Thai sponge cake.



Recipe 1 **Recipe 2** **Recipe 3**

3. The study results of the study on the amount of Sesbania flower powder supplementation in the Thai sponge cake.

When analyzing the color quality of the Thai sponge cake with Sesbania flower powder in different amounts from 20, 40 and 60 percent of the wheat flour weight, it was found that the amount of supplementation had significant effected on the brightness (L *), the red (a *) and the yellow (b *) ($p\leq0.05$), with the L *, a * trend decreased and b * value tended to increase when compared to the controlled recipe; this resulted in more yellowish Thai sponge cake, because in the Sesbania petals contains carotenoids, especially beta carotene, which is the main yellow substance. This is consistent with the research of Supitchaya kamkom (2016)[13], the color value of the Sesbania butter cookies has been found to decrease L *, a *, while the b * values increase when the level of Sesbania flower powder increased. This makes butter cookies yellow to dark brown in color. In addition, in accordance with the research of Kessara Manantaphong et al., (2011)[15], it was found that

the addition of lotus (Nelumbo nucifera) in bread increased the yellow color of the bread as shown in Table 3.

Table 3
The results of color tests of Sesbania flower powder supplementation in Thai sponge cake.

Color Value	Quantity Ratio of amount of Sesbania flower powder (%)			
	Control	20	40	60
Brightness (L*)	56.33±0.21[a]	44.09±0.36[b]	38.84±0.08[c]	37.19±0.09[d]
Red (a*)	4.42±0.10[a]	2.40±0.25[d]	3.23±0.15[c]	3.43±0.09[b]
Yellow (b*)	15.66±0.26[c]	21.26±0.15[b]	22.90±0.23[a]	22.87±0.16[a]

Notes; letters that are different in the horizontal indicate the distinct average were statistically significant at 95% confidence level.

Mean ± standard deviation

[a,b,c] Means with the different letters are significantly different ($p \leq 0.05$).

When analyzing the amount of Sesbania flower powder supplementation in Thai sponge cake with the Texture analyzer as shown in Table 4, it was found that the amount of Sesbania flower supplementation in Thai sponge cake had a significant effect on the texture value ($p \leq 0.05$). The result showed that Sesbania flower powder in Thai sponge cake resulting in hardness, ductility; and the energy to chew tends to increase; the flexibility and cohesiveness tends to decrease because Sesbania flower powder affects Thai sponge cake; adding more quantity makes Thai sponge cake more firm texture, crumbly texture, and uses more energy to chew.

Table 4
The results of physical examination of Sesbania flower powder supplementation in Thai sponge cake using a Texture Analyzer.

Textural properties	Sesbania flower powder quantity per wheat flour (percent)			
	Control	20	40	60
Hardness	830.65±77.54[c]	1045.26±127.20[cb]	1221.60±251.89[b]	1706.39±408.59[a]
Springiness	0.90±0.01[a]	0.83±0.11[ab]	0.78±0.10[b]	0.74±0.14[b]
Chewiness	0.84±0.01[a]	0.81±0.02[b]	0.78±0.04[bc]	0.76±0.04[c]
Cohesiveness	700.22±62.85[c]	841.69±82.99[ab]	943.85±157.95[b]	1275.98±253.47[a]
Gumminess	633.50±62.66[b]	705.08±142.54[b]	753.79±213.71[ab]	967.69±351.42[a]

Notes; letters that are different in the horizontal indicate the distinct average were statistically significant at 95% confidence level.

Mean ± standard deviation

[a,b,c] Means with the different letters are significantly different ($p \leq 0.05$).

The results of the sensory quality assessment of Thai sponge cake supplemented with Sesbania flower powder as shown in Table 5; there are three different levels of volume, 20, 40, and 60 percent of wheat flour showed that the amount of Sesbania flower powder increased comparing with the controlled recipe. This affects the preference score of appearance, color, odor, taste, texture and overall preference with statistically significant difference ($p \leq 0.05$). When adding with the increased amount of Sesbania flower powder would make the Thai sponge cake obtained the appearance and color are acceptable to the tester. Because Sesbania flower powder contains carotenoids, which have a darker yellow color. In addition, it also affects the texture quality; the Sesbania flower powder has an effect on the puffiness of the Thai sponge cake. This is consistent with the research of Wannipa

Phanitkornkun (2014)[16] that supplementing Sesbania flower powder in sandwich bread products; when considering physical quality found that supplementing Sesbania flower powder make the product have more dietary fiber affecting the structure of the Thai sponge cake, resulting in the bread having more firmness, texture, and she also found that Sesbania fortified bread flour powder has a higher yellow color from Sesbania flower. But when considering the scores for odor, taste, texture and overall preference, it was found that when the amount of Sesbania flower supplementation increased, the preference scores tended to decrease. Sesbania flower has high fiber content which the porous fibers consist of cellulose and hemicellulose can be inserted between the starch granules, which have good combination properties resulting in decreased swelling and increasing the amount of the dried Sesbania flower powder. The amount of wheat flour affects the protein in the wheat flour; this factor affects the texture structure of the Thai sponge cake supplemented with Sesbania flower powder Mudgil D., et al., (2017)[16].

Therefore, from the above test results, the researchers selected the amount of 20 percent Sesbania flower powder as an appropriate amount for Thai sponge cake, this resulted in a Thai sponge cake shaped and the texture is not different from the controlled recipe.

Table 5
Sensory characteristics of Sesbania flower powder supplementation in Thai sponge cake.

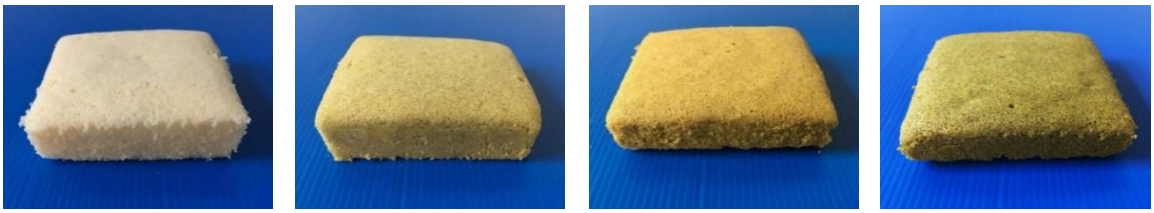
Sensory characteristics	Sesbania flower powder quantity per wheat flour (percent)			
	Control	**20**	**40**	**60**
Appearance	7.12 ± 0.93^{a}	6.32 ± 0.79^{b}	6.40 ± 0.85^{b}	6.78 ± 1.03^{a}
Color	7.26 ± 1.10^{a}	5.88 ± 0.84^{c}	6.40 ± 0.88^{b}	7.20 ± 1.06^{a}
Odor	5.86 ± 0.80^{c}	6.74 ± 1.08^{a}	6.40 ± 0.92^{ab}	6.12 ± 1.00^{b}
Taste	5.76 ± 0.68^{c}	6.66 ± 1.23^{a}	6.24 ± 0.84^{b}	6.10 ± 0.83^{bc}
Texture	6.28 ± 0.99^{b}	6.98 ± 1.02^{a}	6.18 ± 0.94^{b}	5.28 ± 0.51^{c}
Overall	6.50 ± 0.81^{b}	6.86 ± 0.90^{a}	6.44 ± 0.73^{b}	6.14 ± 0.35^{c}

Notes; letters that are different in the horizontal indicate the distinct average were statistically significant at 95% confidence level.

Mean ± standard deviation

^{a,b,c} Means with the different letters are significantly different ($p\leq0.05$).

Figure 2
Characteristic of Sesbania flower powder supplementation in Thai sponge cake at 20%, 40%, 60% and control



Control **20 Percent** **40 Percent** **60 Percent**

3. The study results of the chemical properties of Thai sponge cake supplemented with Sesbania flower powder.

The analysis results of the chemical properties found that Thai sponge cake supplemented with Sesbania powder has been selected; resulting in Thai sponge cake consists of fat, ash, moisture and carbohydrates equal to 5.23, 1.16, 33.94 and 52.42 grams/100 grams, respectively; which is close to the controlled recipe. The addition of Sesbania flower powder in Thai sponge cake made the protein, fiber and beta carotene increased to 9.45, 2.64 grams and 319.10 micrograms /100 grams, respectively, because the Sesbania flower powder contains high dietary fiber and beta carotene. This is consistent with the research of Suwanna Kitphakorn, Hatairat Plaimast and Somporn Wangsoongnoen (2010)[18], which has used Sesbania flower powder for testing the nutritional value, it found that Sesbania flower powder contained a lot of dietary fiber and beta-carotene, followed by lutein and beta-crypto-xanthine. Moreover, it is also consistent with the research of Supitchaya kumkom (2016)[13] that studied the butter cookies with the Sesbania powder in comparison with the controlled butter cookies recipe; it was found that the supplementation of Sesbania flower powder made of dietary fiber and beta carotene increased when increasing Sesbania flower powder.

Therefore, the development of the Thai sponge cake supplemented with Sesbania flower powder is an added nutritional value, dietary fiber and beta-carotene, as well as being able to be eaten as a healthy snack is an alternative to consumers, in addition, it will help create opportunities and potential for the health food industry.

CONCLUSION AND FUTURE WORK

1. The study results of the types of bioactive compounds in Sesbania flower powder.

The study results of the type of bioactive compounds in the carotenoids group of Sesbania flower powder that have been baked at 50 degrees Celsius for 8 hours showed that the carotene group is Lutein, C Xanthi and beta carotene are 29,947.94, 620.03 and 1,555.98 micrograms per 100 grams respectively.

2. The study results of the amount of Sesbania flower supplementation in Thai sponge cake.

The test results on the amount of Sesbania flower supplementation in Thai sponge cake showed that 20%, 40% and 60% of wheat flour; then bring it to assess the sensory quality, physical properties and color values. The result showed that the weight 20% of wheat flour supplemented with the Sesbania flour was the most accepted recipe. This makes Thai sponge cake shaped and fluffy; its texture is not different from the controlled recipe.

3. The study results of the chemical properties of Thai sponge cake supplemented with Sesbania flower powder.

Chemical properties analysis results, it is found that the selected Sesbania flower powder resulted in the amount of fat, ash, moisture and carbohydrates equal to 5.23, 1.16, 33.94 and 52.42, respectively. The addition of Sesbania flower powder in Thai sponge cake resulted in the nutritional value of protein, dietary fiber and beta-carotene levels increased because Sesbania powder has a high content of dietary fiber and beta-carotene. Therefore, the development of Thai sponge cake supplemented with Sesbania flower powder is an added nutritional value, especially dietary fiber and beta carotene; this also includes being able to be eaten as a healthy snack and is an alternative for consumers.

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