

The Use of Job's Tear (*Coix lacryma-jobi* L.) Flour to Substitute Cake Flour in Butter Cake

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Abstract

Job's tear flour was produced by using wet milling method. The soaked job's tear grains were blended with water using the ratio of grains to water as 1:10. The paste was filtered and then dried in an oven at 40°C. After grinding to powder, some chemical properties of Job's tear flour were analyzed. The flour was higher in protein (10.9 %) and fiber contents (0.85 %), conversely, lower swelling power (11.0 %). The flour was used to replace the cake flour as 20, 40 and 60% in the formula of butter cake. Twenty percent of the flour obtained the highest scores for Just About Right test, resulting in only two attributes as texture and sweetness needed to be improved. Three levels of flour as 10, 15 and 20% were studied as well as three levels of sugar, 175, 180 and 185 g. The butter cake made by using 15% Job's tear flour and 175 g sugar obtained the highest preference scores. This product was also remarkably accepted by the consumers (87%), with the preference score of 7.3. There was also a potential market for this product, with 73% of consumers willing to buy. Additions of Job's tear flour tended to increase fiber and protein contents, although it affected the texture of the product.

Keywords: *Job's tear, butter cake, flour, consumer acceptance.*

1. Introduction

Job's tears (*Coix lacryma-jobi* L.), commonly known as coix, are originally from India and now are native to South East Asia region such as China, Japan, the Philippines, Burma, and Thailand. Their seeds have been used to make a variety of products. The mature seeds after de-hulling and cleaning are boiled and eaten with cooked rice. The pounded flour is sometimes also mixed with water and taken as such as cooling drink like barely or flour water. Raw kernels are used as peanut. Job's tear is used by the Garo, Karbi and Naga tribes for brewing of beer from the pounded grains (Burkill 1935), as well as, it can be used in ornamental purpose, rosaries and necklace. In China it is used as traditional medicine and supplementary medical food. In Thailand the seed coat is removed and the seeds are consumed whole. The seeds are also boiled with water to produce beverage product, which is available in the market as an alternative healthy food. The beneficial effects of Job's

tears are reducing liver fat accumulation, protecting from tumor stimulating compounds, protecting against viral infection, reducing allergic reaction, reducing coronary artery disease and atherosclerosis and reducing osteoporosis (Chang *et al.* 2003; Hung and Change 2003; Chun *et al.* 2004; Yu *et al.* 2011). In addition, Job's tear grain can be polished and milled as flour and used as food ingredients in many kinds of products. Application of this flour in bakery products is also of interest. Due to the lack of gluten, dough made from Job's tear flour will not be raised. A good mixture in bakery products is 70% wheat flour and 30% Job's tear flour. Many studies reported the use of Job's tear flour in cookies and bread (Chawakorn 2006; Cheappensuk 2006; Reungkajorn *et al.* 2007), whereas the use of this flour in butter cake has been studied earlier only by Kutschera (2011). Therefore, this contribution aims to report the use of Job's tear flour to replace wheat flour in butter cake. Consumer acceptance of butter cake containing Job's tear flour is also investigated.

2. Materials and Methods

2.1 Preparation of Job' tear flour

Dried Job's tear seeds were washed, and then soaked in water for 8 h. After soaking the seeds were blended with water by using the ratio of water to seed as 10:1. The water was then drained through a canvas cloth to retain the flour. The flour was then dried at 40°C in an air drier oven for 8 h. The flour was ground and kept in a tight container.

2.2 Preliminary formulation of butter cake containing Job's tear flour

Butter cake was produced by using the following ingredients: 120 g butter, 185 g ground sugar, 3 g salt, 13 g milk powder, 120 g egg, 120 g water, 2 g vanilla powder and 200 g cake flour. The cake flour was replaced by using different amounts of Job's tear flour as 20, 40 and 60%, respectively, while, 100% cake flour is a control.

Sensory analysis was evaluated using preference test with 9-point Hedonic score and 15 panelists. The results were statistically analyzed and used for the further steps.

2.3 Formulation of butter cake containing Job's tear flour

2.3.1 Just About Right Test (JAR)

Formulation butter cake containing Job's tear flour was carried out by using Just About Right test (JAR) with 15 panelists. Two attributes as the amount of Job's tear flour and sugar were needed to be adjusted.

2.3.2 Preference Test

The amounts of Job's tear flour were adjusted as 10, 15 and 20%, respectively, as well as the amounts of sugar as 175, 180 and 185 g, respectively. The samples were analyzed by using 9-point hedonic scale and 15 panelists.

2.4 Consumer acceptance test

The consumer acceptance was conducted in eight public places, four places in Bangkok and four places in suburbs of Bangkok. One hundred consumers, who like butter cake, were voluntarily selected without compensation. They were asked to answer a questionnaire and scored the products based on their preferences.

2.5 Chemical analysis

Butter cake containing Job's tear flour and control were chemically analyzed for moisture, fiber and protein contents. The chemical properties of Job's tear flour was also investigated as moisture content, fiber content, protein content and swelling power in comparison with cake flour.

2.6 Statistical analysis

A randomized complete block design (RCBD) with three replications was used in this experiment. Means comparison was analyzed using Duncan's Multiple Range Test.

3. Results and discussion

3.1 Production of Job's Tear flour

Dried Job's tear grains were soaked in water and wet milled by using the ration of water to grain as 10:1. The sludge of flour after water was removed was dried in the oven at 40°C and then ground into powder. The percentage of yield was 77%. The job's tear flour was chemically analyzed compared with cake flour. The result was shown in Table 1.

It was recognized that the moisture content of Job's tear flour was significantly ($p < 0.05$) lower (4.3%) than that of cake flour (8.1%) due to freshly flour production of Job's tear flour, whereas, the cake flour used might absorb the moisture from the environment because of long time of production. Dechkunchon and Thongngam (2007) also reported the moisture content of Job's tear flour as 9.9%, which was similar to that of Thassanee (1987).

Table 1. Some chemical properties of Job's tear flour and cake flour.

Type	Moisture (%)	Fiber (%)	Protein (%)	Swelling Power (%)
Job's tear flour	4.3 ^a	0.85 ^a	10.9 ^a	11.0 ^b
Cake flour	8.1 ^b	0.79 ^a	6.9 ^b	13.0 ^a

* The same letters mean there were no significantly different at $p < .05$.

The protein content of Job’s tear flour was also remarkably higher than that of cake flour, which would be the benefit when it was added to replace cake flour in the formula of butter cake, leading to higher protein content of butter cake. The protein content of this flour was lower than those of Chaisiricharoenkul *et al.* (2011), Dechkunchon and Thongngam (2007) and Thassanee (1987), which were 13.54, 13.03 and 14.78%, respectively.

For swelling power, it was noticed that the swelling power of cake flour was significantly ($p < 0.05$) higher than that of Job’s tear flour due to its lower protein content. High protein content Job’s tear flour might enhance the molecular interaction between protein and protein or protein and starch. The hydration of water might be restricted, resulting in lower swelling volume of starch granules (Hamaker and Griffin 1993). With lower swelling property, replacing of Job’s tear flour in the butter formula might result in dried or hard texture of butter cake when it was used. The swelling power of Job’s tear flour was 11.0%, which was similar to that of Chaisiricharoenkul *et al.* (2011).

Although the fiber content of Job’s tear flour and cake flour were not statistically different, Job’s tear flour tended to have slightly higher than that of cake flour. This might be benefit to the consumers. This fiber content (0.85%) was higher than those of Dechkunchon and Thongngam (2007) and Thassanee (1987), which were 0.67 and 0.23%, respectively.

3.2 Preliminary formulation of butter cake containing Job’s tear flour

The preliminary formulation of butter cake containing Job’s tear flour was performed by using Job’s tear flour to replace cake flour in the formula as 0, 20, 40 and 60%. The butter cakes were sensory analyzed using 9-point hedonic scale and 15 panelists. The result was shown in Table 2.

It was noticed that replacing cake flour with Job’s tear flour more than 20% strongly affected the sensory properties of the products. The preference scores of all attributes were

significantly ($p < 0.05$) reduced by 1 or 2 scores. Simultaneously, butter cake containing 20% Job’s tear flour obtained the preference scores of all attributes similar to those of control (0%), which were 7.3, 7.7, 7.2, 7.6 and 7.7 for appearance, color, texture, flavor and overall, respectively. Therefore, the 20% Job’s tear flour was used for the further experiment.

Table 2. The preference scores of butter cakes produced by using different levels of Job’s tear flour.

Flour (%)	Product Attributes				
	Appearance	Color	Texture	Flavor	Overall
0	7.3 ^{a*}	7.7 ^a	7.2 ^a	7.6 ^a	7.7 ^a
20	7.2 ^a	7.4 ^a	7.3 ^a	7.5 ^a	7.5 ^a
40	6.4 ^{ab}	6.4 ^b	6.5 ^b	6.7 ^b	6.7 ^b
60	5.6 ^b	5.7 ^c	6.0 ^c	6.6 ^b	6.1 ^c

* The same letters mean there were no significantly different at $p < 0.05$.

3.3 Formulation of butter cake containing Job’s tear flour

Butter cakes containing 20% Job’s tear flour were produced and subjected for Just About Right test with 30 panelists in order to formulate the suitable formula of butter cake containing Job’s tear flour. There were 5 attributes used for analysis as flavor, texture, sweetness, crust color and crumb color. The result was shown in Table 3.

Table 3. Just about right test with 30 panelists of butter cake containing 20% Job’s tear flour.

Attributes	Percentage of Response				
	Mode rately too less	Some what too less	Ju st Ri ght	Some what too much	Moder ately too much
Flavor	0	7	93	0	0
Texture	0	7	60	20	13
Sweetness	0	13	60	27	0
Crust Color	0	7	93	0	0
Crumb Color	7	13	80	0	0

Although, there were high percentages of just right in all attributes (more than 50%), it was noticed that addition of Job's tear flour strongly affected to texture. The hard texture of product was detected, which might be caused by low swelling powder of Job's tear flour, leading to less absorbed water in the structure of cake. Moreover, the sweetness of the product should be adjusted due to 27% of the panelists rated "somewhat too much". Therefore, the level of Job's tear flour used was firstly reduced to 10, 15 and 20% and the level of sugar used was also secondly reduced to 175,180 and 185 g. The results were shown in Tables 4 and 5.

Addition of Job's tear flour at 15 and 10% were not significantly ($p < 0.05$) different with the texture scores of 7.1 and 7.3, respectively. It was implied that reducing the amount of Job's tear flour provided softer texture of the products, which was affected by low swelling power of Job's tear flour. Therefore, 15% was chosen for the further experiment for the maximum use of Job's tear flour in butter cake. In addition, reduction of sugar content provided the highest score as 7.0 for sweetness of butter cake, which was chosen for the further experiment.

Table 4. The preference scores of texture of butter cake produced by using different levels of Job's tear flour.

Job's Tears flour (%)	Texture
20	6.6 ^{b*}
15	7.1 ^a
10	7.3 ^a

* The same letters mean there were no significantly different at $p < 0.05$.

Table 5. The preference scores of sweetness of butter cake produced by using different levels of sugar.

Sugar (g)	Sweetness
185	6.5 ^{b*}
180	6.7 ^{ab}
175	7.0 ^a

* The same letters mean there were no significantly different at $p < 0.05$.

3.4 Consumer acceptance

The butter cakes were produced by using the following ingredients as 120 g butter, 175 g ground sugar, 3 g salt, 13 g milk powder, 120 g egg, 120 g water, 2 g vanilla powder and 170 g cake flour and 30 g Job's tear flour. After baking, the consumer acceptance was performed using a hundred consumers. They were given a set of questionnaire to answer before the samples were given to test for their preferences. Consumer demographic, consumer behavior data were also collected.

Male (52%) and female (48%) were participated in this test with the age in the range of 21-25 (85%), followed by 15-20 (37%). The majority of the participants were students (75%) while the second largest group consisted of employees with 15%. Most people had no income (41%), while another 22% made less than 10,000 Baht/month and 22% received income from 10,000 to 20,000 Baht/month. A few (15%) of the participants received more than 20,000 Baht/month. Most of the consumers consumed butter cake (82%) with less than once a week (52%). Some consumers consumed 2-3 times a week (24%). Few people consumed it once a week (16%) and even fewer consumers consumed it every day (7%) (The result was not shown.).

Most of the people (64%) were already familiar with the taste of Job's tears, while 36% of them had never tasted it before. The location at which most people bought butter cakes were the local bakery (32%), supermarkets (30%) and shopping malls (27%). The least amount of people bought butter cakes at convenient stores (22%).

After the butter cakes containing Job's tear flour were served, it was noticed that most of the consumers (87%) moderately like the product with the scores of 6.8, 7.3, 7.8 and 7.3 for texture, odor, color and overall, respectively (Fig. 1). It was recognized that the addition of Job's tear flour as low as 15% still affected the texture of the product. Conversely, only 13% of consumer rejected this product, which was implied that there was a potential market for this product (Fig. 2).

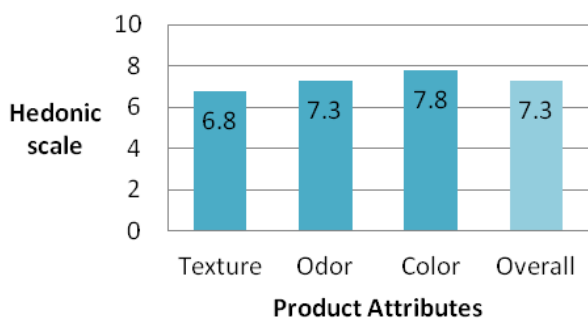


Fig. 1. Average product attributes scores.

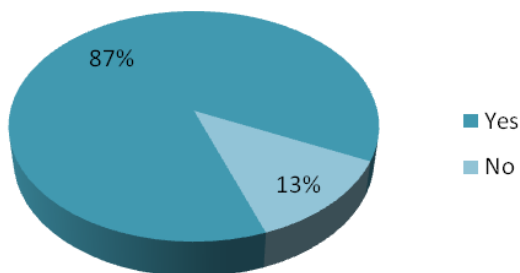


Fig. 2. Amount of surveyed people who liked the product.

For the price of one cup cake, 36.7% consumer preferred 10-15 Baht, while some consumers (33.7%) were willing to pay 15-20 Baht and 23.1% of people suggested a price lower than 10 Baht. Only 5.8% of the consumers were willing to pay more than 20 Baht. Seventy five percent of the consumers were willing to buy the product. On the other hand, only 6% of the consumer rejected the product with the reasons of “It’s too dry” and “I don’t like the taste”.

3.5 Some chemical properties of butter cake

Some chemical properties as moisture, total solid, fiber and protein contents were analyzed. The result was shown in Table 6.

Table 6. Some chemical properties of butter cakes produced by using cake flour and Job’s tear flour.

Type	Moisture (%)	Total solid (%)	Fiber (%)	Protein (%)
Cake flour	11.3 ^a	88.7 ^b	0.24 ^a	5.3 ^a
Job’s tear flour	9.7 ^b	90.3 ^a	0.31 ^a	5.8 ^a

* The same letters mean there were no significantly different at $p < 0.05$.

It was noticed that addition of Job’s tear flour significantly ($p < 0.05$) influenced the moisture and total solid contents of butter cakes. The presence of Job’s tear flour reduced moisture content by approximately 1.6%, due to lower swelling power of Job’s tear flour. Conversely, total solid of butter cake made by using Job’s tear flour remarkably increased by approximately 2.0%. Although, fiber and protein contents of butter cake made by using cake flour and Job’s tear flour were not statistically different, the butter cake made by using Job’s tear flour tend to have higher fiber and protein contents due to only 15% Job’s tear was used in the formula. This implied that addition of Job’s tear flour increased the nutritional value of the product.

4. Conclusion

Some chemical properties of Job’s tear flour were 4.3% moisture, 0.85 % fiber, 10.9% protein and 11.0% swelling power. The presence of Job’s tear flour in the butter cake formula remarkably influenced the texture of the product. The suitable amount of Job’s tear flour for butter cake production was 15%, providing butter cake with 9.7% moisture, 90.3% solid, 0.31% fiber and 5.8% protein. Most of the consumers (87%) accepted the product with the preference scores of texture, odor, color and overall as 6.8, 7.3, 7.8 and 7.3, respectively. Additions of Job’s tear flour tended to increase fiber and protein contents of the product.

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