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The Development of Khanom-Pum with Sangyod Rice Replacement

Krittin Chumkaew* Orawan Phuenjcome & Chaiyasit Punfujinda

Department of Food and Nutrition, Faculty of Home Economics Technology, Rajamangala University of Technology Thanyaburi, Pathumthani 12110, Thailand

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Abstract

The objectives of this research were to develop a basic recipe of Khanom-Pum and investigate the proper amount of Sangyod rice suitable for cooking Khanom-Pum. In addition, physical quality, chemical analysis and customers' acceptance of the Khanom-Pum were studied. The results indicated that the proper basic recipe consisted of rice flour, liquid Palmyra palm sugar, and water with the following proportion 24%, 40% and 36%, respectively. The best recipe of Khanom-Pum was 50% replacement with Sangyod rice. Hardness and lightness value (L*, a*, b*) decreaed with increasing the levels of Sangyod rice. The chemical analysis of the Khanom-Pum was 50% covered moisture, protein, fat, fibers, ash and carbohydrates in the following percentage of 1.47, 48.03, 0.12, 1.34, 0.76 and 48.28, respectively and vitamin B1 was 1.06 mg per 100 g. The Khanom-Pum with 50% Sangyod rice flour had more fibers and vitamin B1 than in the basic recipe. In terms of customer acceptance, there were 100 respondents. The results revealed the level of overall satisfaction was at the high level. Regarding future purchase, 94% would buy the product if the product was available in the market. Approximately 75% reasoned that the Khanom-Pum was healthy and 80% accepted the product at the highest level.

Introduction

Khanom-Pum is one type of local Southern Thai desserts, and it is developed from local wisdom and named differently in various local areas such as Khanom-Jok in Pattanee Province, Khanom-Khuen in Nakhorn Si Thammarat Province and Khanom-Pum in SongKhla and Pattalung Province. Khanom-Pum is not widely sold, and it can be seen only in local markets. The main ingredients of Khanom-Pum are rice flour and sugar. Sugar that is frequently used is Palmyra palm sugar found in local areas. It makes the dessert aromatic and provides a natural color as in Palmyra palm sugar. The cooking methods start with soaking rice, grounding it and leaving it for natural fermentation from natural yeast. Then, it is poured into small confection cups and streamed until Khanom-Pum is well cooked. The dessert's shape is like a cup. Its flavors are a combination of sweetness and

* Corresponding Author
e-mail: krittin_c@rmutt.ac.th

sourness. The dessert is aromatic, soft and gummy. It is always served as snacks sprinkled with grated coconut and seasoning salt to add more flavors. Cooking Khanom-Pum requires similar cooking methods and ingredients of Tuay Foofound in the central areas of Thailand since the main ingredients are rice flour and sugar (Maneesri, 2006).

Sangyod rice is a type of local rice variety under Royal Projects in Patthalung Province. Her Majesty Queen Sirikit gave an order to Patthalung Rice Research Center to develop this rice variety. It has been grown since 2000 (Patthalung Rice Research Center, 2010) Sangyod rice is slender with light grains and has been grown for more than a hundred years. When compared with other rice varieties, the color of its seed coat is a mixture between white and red or dark red color. Rice hulls are straw-colored. The color of brown rice is a mixture of white and red. Its grain is 6.53 mm long and 1.75 mm wide. It contains 14.23% of amylose content, which makes the rice soft and gummy when heated (Saetan, 2010). Moreover, Patthalung Sangyod rice was certified as a product of geographical wisdom in 2006 as GI rice according to the Act on Protection of Geographical Indication B.E. 2549 (Rice Product Development Division, 2010).

There has been an increase in using Sangyod rice in the form of rice flour in more food products to increase nutritional values. Previous studies have indicated that Sangyod rice contains a large amount of Anthocyanin and fiber (Kaewthanon et al., 2015). The replacement of Sangyod rice flour into Khanom-Pum, the unique dessert of the south, helps to add value and to promote this particular dessert. Moreover, the proper amount of Sangyod rice for cooking Khanom-Pum and the physical quality, chemical analysis and customers' acceptance were determined in this research.

Materials and methods

1. The Selection of basic recipes of Khanom-Pum

Three basic recipes of for Khanom-Pum were chosen for this experiment. The different ingredients of each recipe are shown in Table 1. The cooking methods start from mixing rice flour with liquid Palmyra palm sugar, adding water, stirring the mixture and leaving the mixture at a temperature ranging from 28 to 30o C. The mixture of Recipe 1 was left for one night. The mixture of Recipe 2 was left for six hours. The mixture of Recipe 3 was left for 10 hours. When bubbles appeared, the mixture from each recipe was steamed in a Chinese steamer with different durations. Recipe 1 was steamed for 20 minutes. Recipe 2 was steamed for 15 minutes. Recipe 3 was steamed for 25 minutes. After Khanom-Pum from each recipe cooled down they were taken out from the small confection cups.

Next, there was a sensory evaluation covering the following aspects: appearance, color, smell, overall flavor, hardness and overall satisfaction with 30 consumers using 9 - Points Hedonic Scale (1 = dislike extremely and 9 = like extremely). The highest average score of the recipe was selected for cooking the Khanom-Pum with Sangyod rice replacement.

Table 1 There basic recipes of the Khanom-Pum

Ingredients	Recipe 1 (%)	Recipe 2 (%)	Recipe 3 (%)
Rice flour	21	31	24
Liquid Palmyra palm sugar	44	31	40
Water	35	38	36
Total	100	100	100

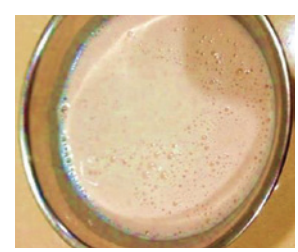
Sources: Recipe 1 (Ritthisak, 2014), Recipe 2 (Kaewboonchu, 2014), Recipe 3 (Poodkhong, 2014)

2. Effect of Sangyod rice levels on Khanom-Pum qualities

2.1 The preparation of Sangyod rice started with rinsing the rice and soaking it in the water with the proportion of 1: 1 for 4 hours. Then the rice and the water were blended together until the mixture was soft and smooth. The mixture was measured according to each recipe.

2.2 To study the proper amount of Sangyod rice for replacing the Khanom-Pum in each recipe, the factor used was four different amounts of Sangyod rice in the proportion of Sangyod rice flour as follows 0: 100, 25: 75, 50: 50 and 75: 25. The cooking steps shown in Fig. 1 were conducted from Recipe 3 in Table 1 was used.

(1) Soak the Sangyod rice



(2) Grind the soaked rice until it is fine

(3) The ingredients of Khanom-Pum

(4) Mix the rice flour with liquid Palmyra palm sugar

(5) Stir the mixture and add the blended Sangyod rice

(6) Add the water and stir the mixture well

(7) Ferment it for 10 hours until there are some bubbles

(8) Steam the flour in a Chinese steamer for 25 minutes

(9) The Khanom-Pum with Sangyod rice replacement

Fig. 1 Cooking methods of Khanom-Pum with Sangyod rice replacement

3. The analysis of food quality and chemical compositions

The four recipes of the Khanom-Pum with Sangyod rice replacement were analyzed as follows.

3.1 Sensory evaluation was conducted with consumer's preference in the following aspects: appearance, color, smell, overall flavor, hardness and overall satisfaction using 9- Points Hedonic Scale (1 = dislike extremely and 9 = like extremely), resulting in the highest preferred recipe.

3.2 The physical properties of Khanom-Pum were analyzed. Texture analysis was determined by a texture analyzer (TA-XT plus, Stable micro system, UK) by using a 25 mm diameter P36R cylindrical probe to press on the sample with a double-cycle program. The speed of compression was 1 mm/sec for 50 percent of the sample height. The second compression was 15 seconds after the first one. Results were reported as values of hardness and springiness. (Sinchaipanit et al., 2017). The color values (L* a* and b*) were determined by a chromameter (Minolta Co., Ltd, Osaka, Japan).

3.3 The chemical analysis covered moisture, protein, ash, fat, fibers carbohydrates (AOAC, 2000) and Vitamin B1 (Batifoulier et al., 2005). The Khanom-Pum with Sangyod rice replacement, with the highest acceptance, was analyzed and compared with basic Recipe at the ratio of 0: 100 (Sangyod rice 0%: rice flour 100%)

4. Customer acceptance analysis

To understand customer acceptance, there were 100 participants who were university students and university staff of Rajamangala University of Technology Thanyaburi. They were randomly selected and were given a questionnaire covering three sections as follows. The first section covered demographic data such as gender, age, educational levels, occupation and monthly income. The second part was related to sensory evaluation covering appearance, color, smell, overall flavor, hardness and overall satisfaction using 9- Points Hedonic Scale (1 = dislike extremely and 9 = like extremely) with Central location test. The third part was consumers' decision such as purchase intent, reasons for purchase intent and product acceptance.

5. Statistical analysis

The analysis of variance (ANOVA) was conducted to determine whether there were any statistically significant differences using Duncan' New Multiple Rang Test (DNMRT) with confidence interval of 95% (Vanidbhuncha, 2007) and using SPSS for Windows.

Results and discussion

1. The basic recipes

Table 2 shows that in the following aspects: appearance, color and smell, the scores of Recipe 1 and 3 were different from Recipe 2 since Recipe 1 and 3 contained the similar ingredients and cooking steps except the fermentation duration and steaming duration. This led to the similar Khanom-Pum. However, Recipe 2 contained more rice flour than the other two recipes, leading to gummy dough and less duration in fermentation and steaming than Recipe 1 and 3 could lead to a harder Khanom-Pum. The less amount of liquid Palmyra palm sugar than the other recipes made the smell not as aromatic as it should be. In terms of over flavor, hardness and overall satisfaction, the scores of the three recipes were different ($p \leq 0.05$). Recipe 3 had the highest score in all aspects and overall satisfaction. Hence, Recipe 3 was chosen for developing the Khanom-Pum with Sangyod rice replacement.

Table 2 Preference scores of the three recipes of the Khanom-Pum

(n=30)

Sensory evaluation	Khanom-Pum		
	Recipe 1	Recipe 2	Recipe 3
Appearance	$7.44^{a}\pm1.14$	$6.59^{b}\pm1.06$	$7.86^{a}\pm0.96$
Color	$7.87^{a}\pm1.16$	$6.78^{b}\pm0.96$	$7.94^{a}\pm0.72$
smell	$7.51^{a}\pm1.25$	$7.03^{b}\pm0.95$	$7.84^{a}\pm0.62$
Overall flavor	$7.23^{b}\pm1.26$	$6.59^{c}\pm1.30$	$8.13^{a}\pm0.73$
Hardness	$7.06^{b}\pm1.66$	$6.60^{c}\pm1.28$	$8.17^{a}\pm0.48$
Overall satisfaction	$7.33^{b}\pm1.37$	$6.78^{c}\pm0.95$	$8.22^{a}\pm0.50$

Remark : Different superscript in the same column indicate statistical difference among mean values at the 95% confidence level ($p \leq 0.05$)

2. Effect of Sangyod rice levels on the Khanom-Pum qualities

The optimal recipe, Recipe 3, was used to cook Khanom-Pum. Then there was a sensory evaluation for the four levels. Table 3 reveals that in terms of appearance and color, the sample of Sangyod rice: rice flour at the ratio of 0: 100 was different ($p \leq 0.05$) from that of 25: 75, 50: 50 and 75: 25 because Sangyod rice replacement added more color to the Khanom-Pum, affecting the appearance of the Khanom-Pum. In terms of smell, overall flavor and overall satisfaction, the samples at the ratio of 0: 100 and 50: 50 differed from those of 25: 75 and 75: 25 ($p \leq 0.05$). As a result, The sample at the ratio of 50: 50 was selected as the most widely accepted when compared with that of 0: 100 in terms of chemical analysis.

Table 3 Preference scores of the four recipes of the Khanom-Pum

(n=30)

Sensory evaluation	Khanom-Pum (Sangyod rice: rice flour)			
	0: 100	25: 75	50: 50	75: 25
Appearance	$7.30^{a}\pm1.21$	$6.47^{c}\pm0.83$	$6.89^{b}\pm0.60$	$6.80^{bc}\pm1.39$
Color	$7.33^{a}\pm1.06$	$6.32^{c}\pm0.90$	$6.90^{b}\pm0.76$	$6.62^{bc}\pm0.35$
smell	$7.41^{a}\pm1.21$	$6.75^{b}\pm0.83$	$7.35^{a}\pm0.60$	$6.75^{b}\pm1.39$
Overall flavor	$7.34^{a}\pm1.25$	$7.15^{b}\pm1.09$	$7.27^{a}\pm0.71$	$7.17^{b}\pm0.22$
Hardness	$7.35^{a}\pm1.47$	$6.95^{ab}\pm1.12$	$7.29^{a}\pm0.50$	$6.88^{ab}\pm0.42$
Overall satisfaction	$7.57^{a}\pm1.25$	$7.21^{b}\pm0.84$	$7.50^{a}\pm0.56$	$7.17^{b}\pm0.53$

Remark : Different superscript in the same column indicate statistical difference among mean values at the 95% confidence level ($p \leq 0.05$)

3. Khanom-Pum quality

In studying food physical quality, the study focused on the texture analysis and color values. The samples at the ratio of 0: 100, 25: 75, 50: 50 and 75: 25 were analyzed. Table 4 shows that hardness of 0: 100 and 25: 75 were different from those of 75: 25 ($p \leq 0.05$). The value of hardness decreased when there was a higher amount of Sangyod rice. Springiness of the four samples was not significantly different ($p > 0.05$). Regarding color values, lightness (L*) and redness (a*) of 0: 100, 25: 75 and 50: 50 were significantly different from those of 75: 25. While yellowness (b*) of all four samples were different from one another ($p \leq 0.05$). The color values decreased when there was an increase in an amount of Sangyod rice. This result was similar to the result of Tanasombun & Pichaiyongvongdee (2017) in that the color values (L* a* b*) decreased in tofu salad dressing with rice flour gel replacment since the rice flour gel was opaque.

Table 4 Scores of food physical quality of four different amounts of Sangyod rice used in replacing rice flour

(texture properties n=4, color n=3)

Sangyod rice: rice flour	Food Physical quality				
	Hardness (kgf)	Springiness^{ns} (mm)	L*	a*	b*
0: 100	$13.87^{a}\pm0.14$	1.70 ± 0.22	$23.83^{a}\pm1.44$	$7.86^{a}\pm0.81$	$15.33^{a}\pm0.75$
25: 75	$13.10^{ab}\pm0.28$	1.64 ± 0.33	$22.93^{a}\pm1.25$	$7.73^{a}\pm0.25$	$12.80^{b}\pm0.26$
50: 50	$12.12^{b}\pm0.57$	1.48 ± 0.12	$22.10^{a}\pm0.55$	$6.66^{ab}\pm0.92$	$10.73^{c}\pm0.80$
75: 25	$8.15^{c}\pm1.40$	1.37 ± 0.29	$17.10^{b}\pm1.30$	$5.93^{b}\pm0.55$	$8.33^{d}\pm0.17$

Remark : Different superscript in the same column indicate statistical difference among mean values at the 95% confidence level ($p \leq 0.05$)
^{ns} letters mean that there was no statiscally significant difference ($p > 0.05$).

The chemical analysis covered protein, moisture, fibers, ash, carbohydrates and Vitamin B1. The sample of 0: 100 (Basic recipe of Khanom-Pum) was compared with that of 50: 50 (the Khanom-Pum with replacing 50 % of rice flour with Sangyod rice) as in Table 5. It can be seen that chemical qualities such as the amount of fibers and vitamin B1 of the sample of 0: 100 had statistically significant difference from that of 50: 50 ($p \leq 0.05$). The sample of 50: 50 contained a high fiber and vitamin B1, indicating that Sangyod rice contains higher fiber and vitamin than the native rice the 50 % Sangyod rice replacement led to an increase in fiber and vitamin B1 at 1.31% and 1.02 mg/100 g, respectively. This result shows that the higher amount of Sangyod rice replacement, the higher amount of fibers and Vitamin B1, which is similar to the result of Tinakorn Na Ayutthaya et al. (2018) in that a higher amount of brown rice flour on sponge cake recipe led to larger number of fibers in the cake.

Table 5 Comparison of chemical compositions of the Khanom-Pum 0: 100 and 50: 50

(n=30)

Chemical compositions	Khanom-Pum (Sangyod rice: rice flour)	
	0: 100	50: 50
Protein (%) ^{ns}	1.51±0.03	1.47±0.07
Moisture (%) ^{ns}	47.11±0.22	48.03±0.28
Fat (%) ^{ns}	0.07±0.40	0.12±0.40
Fibers (%)	0.03^{b}±0.02	1.34^{a}±0.34
Ash (%) ^{ns}	1.03±0.03	0.76±0.36
Carbohydrates (%) ^{ns}	50.25±0.25	48.28±0.33
Vitamin B1 (mg/100 g)	0.04^{b}±0.04	1.06^{a}±1.06

Remark : Different superscript in the same column indicate statistical difference among mean values at the 95% confidence level ($p \leq 0.05$)
^{ns} letters mean that there was no statiscally significant difference ($p > 0.05$).

4. Consumer acceptance of the Khanom-Pum with Sangyod rice replacement

The analysis of customer acceptance among 100 questionnaire respondents showed that most of the respondents were female, accounting for 69%. Approximately 36% were 15-24 years old and half of them possessed bachelor's degree. Roughly 52% were university students and 54% earned from 5,001 to 10,000 baht a month.

The analysis of sensory evaluation of the consumers towards the Khanom-Pum with Sangyod rice replacement is shown in Fig. 2 below. Fig. 2 reveals the average score of all six aspects was at moderate level. It could be explained that the Khanom-Pum with Sangyod rice replacement had an unattractive color. The Khanom-Pum were brown and had brown spots from Sangyod rice. In fact, the Khanom-Pum with Sangyod rice replacement are different from Khanom-Pum with rice flour in central parts of Thailand in that the former is gummy yet soft while the latter is fluffy and soft. This could have an effect on the consumers' satisfaction scores. However, the mean score of overall satisfaction was at the high level. If Khanom-Pum with Sangyod rice replacement was available in the market, 94% of the respondents would buy the product and 75% of them reported that the Khanom-Pum was healthy. Approximately 80% accepted the product at the highest level.

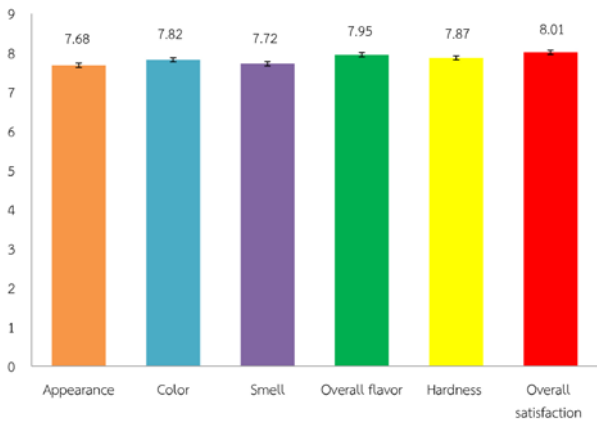


Fig. 2 Average scores of product acceptance of Khanom-Pum with Sangyod rice replacement

In developing the Khanom-Pum with Sangyod rice replacement, there were three levels of replacement 25%, 50% and 75%. The 50% replacement gave the highest score for sensory evaluation because of the proper amount of Sangyod rice, the maintenance of flavor and appearance of Khanom-Pum.

The hardness value decreased when the levels of Sangyod rice increased. This result was similar to the result of Lekjing et al. (2019) which focused on the effects of replacing wheat flour with Sangyod brown rice flour in snack products. Sangyod rice has 14.23% of amylose content (Saetan, 2010). This leads to a gummy and soft rice quality after being cooked,and this keeps the consistency of the cooked dough (Patthalung Rice Research Center, 2010). Moreover, using Sangyod rice in the form of frehly milled flour tends to have an effect on lower water absorption (Dechkulchorn, 2006) and that can affect softness and hardness of Khanom-Pum with Sangyod rice replacement.

Lightness (L*), redness (a*) and yellowness (b*) decreased when there was an increase in the amount of Sangyod rice. In fact, Sangyod rice has white with light red color hulls or dark red hulls (Patthalung Rice Research Center. 2010) and Sangyod rice has pigmnets such as anthocyanin, one component of Sangyod rice flour. Anthocyanin can decompose when receiveing heat, oxygen and light (Chanthachot, 2013). When Sangyod rice is added into products, such producst will have darker colors.

The Khanom-Pum with Sangyod rice replacement was more nutritional. It provided 1.31% more fibers and 1.02 mg/100 g of vitamin B1 when compared with the basic recipe. In fact, Sangyod rice contains more fibers and vitamin B1 than rice flour (Bureau of Nutrition, 1992). From the research of Chadakarn & Chanthawong (2011) in developing cookies with replacing wheat flour and grains with 20 % Sangyod rice replacement increased nutritional values of the cookies and the consumers accepted the product. Phadungsilp (2011) studied the effect of Sangyod rice flour fortified in Khanom Thuay-Fu. The research focused on a various amount of Sangyod and native rice flour at 50:50, 75:25 and 100:0. The research found that 50:50 of fortified was the highest acceptance. The sample showed increased energy value, total protein content, crude fiber, and vitamin B1 and B2 meanwhile low total carbohydrate content. The result yielded the same result as that of Phadungsilp et al. (2012) who conducted a study investigating the replacement of Sangyod rice powder into twist stick. According to Phadungsilp et al. (2012), the twist stick with 50% Sangyod rice replacement had more fibers and vitamin B1 than the stick with 100% rice powder. Rujirapisit et al. (2012) studied nutritional values of 9 species of rice and discovered that Sangyod rice provided lower energy. Moreover, Kaewthanon et al. (2015) reported that Sangyod rice was more nutritional. In fact, Sangyod rice contains more Niacin, vitamin B1 and vitamin B2 as well as other minerals such as calcium and phosphorus. The red color of Sangyod rice is a coloring substance belonging to anthocyanin, a subgroup of flavonoids, which has antioxidant properties (antioxidant) to slow down aging process and reduce risks of diseases such as heart disease and cancer.

In terms of customer acceptance, the results revealed that 94% of the respondents stated that they would buy the product because it was healthy. This result was the same as Chanthachot (2013), who conducted a study about the development of Sangyod brown rice noodels with egg white. The consumers in Chanthachot's study reported that they were interested in the product because of the overall flavor and higher nutritional values. Also, the results of this studied support those of Komchadluek (2017) in that modern consumers pay more attention to their own health and those consumers tend to choose food that is healthy. Results of other polls reveal that 89% of consumers want to purchase healthy food and will make a purchase decision for products with sustainable manufacturing process. This will lead future food and drink producers to use natural ingredients such as protein from plants, natural dyes which give both colors and nutritive values, which is beneficial for consumers' health.

Conclusion

The optimal recipe of the Khanom-Pum with Sangyod rice replacement consists of 12% of rice flour, 12% of Sangyod rice, 40% of liquid Palmyra palm sugar and 36% of water. The Khanom-Pum with Sangyod rice replacement was round due to the circle shape of the small confection cups. Its surface was fluffy and crackly. It was aromatic due to liquid Palmyra palm sugar and Sangyod rice. Also, it was sweet, soft and sticky. This recipe was evaluated in terms of sensory evaluation covering appearance, color, smell, overall flavor, hardness and overall satisfaction, resulting in a moderate level. This recipe provided the following nutritional values: 1.47% protein, 48.03% moisture, 0.12% fat, 1.34% fibers, 0.76% ash, 48.28% carbohydrates and 1.06 mg/100 g vitamin B1. Sangyod rice replacement has an effect on a larger amount of fibers and vitamin B1 in Khanom-Pum. In terms of customer acceptance towards the particular recipe, it was accepted at the highest level.

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