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Development of soft cookie from pregelatinized banana flour and germinated brown rice

Leelwat, B.*, Jaengarunjiramanee, N. and Pischom, A.

Department of Food Science and Technology, Faculty of Science and Technology, Thammasat University, Thammasat University Center of Excellence in Food Science and Innovation, Pathum Thani, Thailand.

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Abstract The soft cookie from pregelatinized banana flour and germinated brown rice was developed by studying the optimum ratio between pregelatinized banana flour and germinated brown rice. The optimum ratio between pregelatinized banana flour and germinated brown rice (80:20 by weight) was determined by pasting characteristic and solubility property. The selected ratio of mixed flour was subsequently substituted to wheat flour as 0, 50, 75 and 100 percent in soft cookie formula. The sensory evaluation was performed and the result showed that 75 percent substitution in soft cookies got the highest overall acceptability among the others and the texture of soft cookie showed the hardness of 0.270 $\pm$0.03 gram force. After that the optimum percentage of sugar was studied by varying the reduction of sugar percentage from the standard formula as 10, 20, and 30 percent. The results showed that 30 percent of sugar reduction got the highest overall acceptability from sensory evaluation. The texture of soft cookie showed the hardness of 1.205 $\pm$ 0.30 gram force and specific volume of 1.902 cm^3/g. The consumer's decision purchasing and consumer acceptance test using 80 general participants were conducted and the results showed that 31.3% of consumers will definitely buy the products. Additionally, the consumers gave the hedonic score in terms of appearance, colors, and flavor as like slightly to like moderately and in the attributes of taste, texture, and overall acceptability were scored as like very much to like extremely.

Keywords: Soft cookie, Banana, Germinated brown rice, Pregelatinize, Drum drying

Introduction

Golden bananas are fruits from the Musaceae family. It provides energy, and high nutrition, and contains natural sugars such as glucose, fructose, and sucrose, as well as dietary fiber, vitamins, and minerals (Bjarnadottir, 2018). This kind of banana is one of the the most important economic crops in Thailand. The banana plant can be grown in tropical or subtropical climates and produces fruits throughout the growing year. For the time of every year, there

* **Corresponding Author:** Leelwat, B.; **Email:** jafood@hotmail.com

are oversupplies of golden bananas that cause too low prices in the market, and there are sometimes excessive yields in domestic consumption and export markets due to a short shelf life of 5-7 days, which results in enormous economic losses. Therefore, a way that can solve this problem is to preserve the over supply of bananas by processing the overripe banana or banana leftover into banana powder (Phongkitwithoon *et al*., 2001). The processing of overripe banana into banana powder is difficult as the high natural sugar content (Mohapatra *et al*., 2011) contributed to the stickiness of the dried banana powder. The stickiness problem of banana powder can be solved by adding ingredients of high molecular weight to increase glass transition temperature of the mixture. The ingredients of high molecular weight used are carbohydrate group such as starch (Nurhadi *et al*., 2012). Therefore, germinated brown rice was used as a drying aid and also enhances the nutritional value of product.

Germinated brown rice is produced by soaking the whole kernel of brown rice to germinate into white blotches on the kernel. The water helps stimulate the enzyme within the rice grain. During the process of germination, several biochemical processes take place due to the activation of various enzymes. These processes lead to changes in the nutritional and chemical compositions of germinated rice (Moongngarm *et al*., 2014). Until it becomes a smaller molecule of carbohydrate compound and reducing sugar. It also found the accumulation of important chemicals such as Gamma-Orazynol that reduce cholesterol levels, reduce narrow blood vessel and anti-inflammatory. Tocopherol is an antioxidant, it prevents cancer and contains tocotrienol, dietary fiber, etc (Ito and Ishikawa, 2004). The method for producing banana powder used is drum drying, this method could reduce drying time and produce better qualities (Chin and Therdthai, 2018). By an aqueous slurry of the starch is passed over heated rollers which raise the temperature of the slurry above the gelatinization point of the starch while also evaporating the water therefrom, to ultimately yield dry and solid particle of pregelatinized starch (Marotta *et al*., 1972). Pregelatinized starch (also known as "Alpha Starch" in the commercials) is a modified starch obtained by physical modification by heat treatment. The gelatinized starch can be considered as cooked starch in which the structure of the starch granules has been broken. As a result, water absorption and solubility were improved, and instant viscosity is achieved, making it more versatile and convenient to use than raw flour, which is used in bakery products like cakes to absorb water, retain air bubbles, provide moisture and volume, and give the cake a consistent appearance (Apichachan, 2004).

Therefore, the research aimed to develop soft nutritious cookies from benefical nutrients from pregelatinized banana flour and germinated brown rice by studying the optimum ratio between Golden banana and germinated brown rice to produce a mixed powder of banana and germinated brown rice using a drum dryer and by studying the optimum ratio between wheat flour and the mixed powder to produce soft banana cookies. Furthermore, the reduction of sugar content from the standard soft cookie formulation was investigated, because the sweetness of the added sugar can be replaced by the sweetness of the natural sugar from the golden banana powder.

Materials and methods

Golden banana (Talad Thai, Pathumtani Province), gaba jasmine rice (Pin Nguen from Ake Rice Mill CO., LTD), all-purpose flour (Waw from United Flour Mill Public Co., LTD), unsalted butter (Orchid from The Thai Dairy Indrustry Co., LTD), egg (CP from CPF (Thailand) Public Co., LTD.), pure refine sugar (Mitr Phol from Mitr Phol Sugar Co., LTD.), brown sugar (Wangkanai from Sugar T.N. Industry Co., LTD), iodized refined salt (Prung Trip from Thai Refine Salt Co., LTD), baking Soda (McGarrett from JR F&B Co., LTD.) and vanilla flavor (Winner's from Winner Group Enterprise Co. LTD) were used in the experiments.

The mixed powder of golden banana and germinated brown rice flour preparation

The three ratios of golden banana to germinated brown rice of 90:10, 85:15, and 80:20 by weight were studied to develop the optimum mixed powder formulation. The golden bananas were boiled in hot water for 5 minutes at 95 ^{o}C, then cooled, peeled, and blended with germinated brown rice suspension prepared by dissolving germinated brown rice flour in hot water at 70 ^{o}C. After that, all the formulations were dried with a drum dryer (DOFM 19-26, Owner Foods Machinery, THAILAND) at 140 ^{o}C, 40 millimeters gap distance between rollers, and speed 0.6 rpm. The pasting and solubility properties of the mixed powder of golden banana and germinated brown rice was analyzed using Rapid Visco Analyzer (TechMaster, Perten instruments, SWEDEN.The experimental design was a completely randomized design (CRD) with two replications for each. The results were reported as the mean value with a standard deviation. Statistic was analyzed using SPSS for Windows and Duncan’s multiple range test (DMRT) was used for comparing the differences among mean values at the 95% confidence level ($p<0.05$).

Soft cookies preparation

The standard soft cookie was prepared by following the soft cookie formulation of Lindsay (2015) with some modification. The optimum ratio of golden banana flour to germinated brown rice flour was chosen to replace wheat flour in the standard soft cookie formula by substituting in the ratio of 50, 75, and 100% (by weight of wheat flour). The mixed powder of golden banana and germinated brown rice was mixed with wheat flour and other ingredients such as melted butter, eggs, sugar, brown sugar, baking soda, salt, and vanilla flavor by a food mixer (800-B, Spar Mixer, Taiwan). The cookie dough was then refrigerated for 15 minutes at 4 ℃ and baked for 8 minutes at 170 ℃. Afterwards, the cookie samples were allowed to cool at room temperature (25 ℃) and these samples were packaged in polyethylene bags until analyzed.

The optimum substitution percentage of golden banana and germinated brown rice mixed powder to wheat flour from the previous experiment was performed to study the reduction of sugar percentage from the standard soft cookie formulation by10, 20, and 30% (by weight of sugar).

The experimental design was a completely randomized design (CRD) with two replications for each. The results were reported as the mean value with standard deviation. Statistic was analyzed using SPSS for Windows and Duncan's multiple range test (DMRT) was used for comparing the differences among mean values at the 95% confidence level ($p \leq 0.05$).

Pasting properties of golden banana and germinated brown rice flour mixed powder

The pasting properties of the mixed powder of golden banana and germinated brown rice flour at various ratios were analyzed according to AACC (1995). A Rapid Visco Analyzer TechMaster (Perten Instruments, Sweden) was used to measure the peak viscosity, trough viscosity, breakdown viscosity, final viscosity, and setback from hold.

Solubility properties of golden banana and germinated brown rice flour mixed powder

The water solubility was determined according to Nadeem *et al.* (2011) with some modification. 1 g of samples (W_1) were added to 100 mL of hot water at 70 ℃, and the mixture was agitated for 5 minutes with a magnetic stirrer at 600 rpm. The solution was then centrifuged at 3000xg for 5 min. The supernatant was transferred to a pre-weighed aluminium moisture can and dried in an oven for 24 hours at 105 ℃ until it reached a constant weight (W_2). The solubility percentage was calculated using the following equation:

$$\text{The solubility percentage} = W_2 / W_1 \times 100$$

Texture properties of soft cookies

Texture profile analysis was performed to evaluate the texture of the soft cookies using a Texture Analyzer TA-XT2i (Stable Microsystem, UK), equipped with knife edge (HDP/BS), and a 25 kg load cell. Texture analyzer settings were: measure force in compression mode, pre-test speed 1.5 mm/s, test speed 2.0 mm/s, post-test speed 10.0 mm/s, distance 5.0 mm, and trigger force 25 g. Three measurements were performed for each sample.

Spread ratio of soft cookies

A Vernier Caliper (0.02 mm, Mitutoyo, Japan) was used to measure the dimensions (diameter and thickness) of the cookie samples. The spread ratio was calculated using the following equation:

Spread ratio = Diameter (D) / Thickness (T)

Specific volume of soft cookies

The specific volume of soft cookies was determined according to the method of Chueamchaitrakun (2011). The cookies volume was determined by the displacement of sesame seeds in a 1000 mL graduated cylinder, and the cookie weight was determined using an analytical balance. The specific volume was calculated using the following equation:

$$\text{Specific volume } \left(\frac{\text{cm}^3}{\text{g}}\right) = \frac{\text{volume of soft cookie sample}}{\text{Weight of soft cookie sample}}$$

Color of soft cookies

Color measurement was performed using colorimeter (Hunter Lab model Colorflex45/0, USA). The color measurements were determined according to the CIELAB system and was expressed as L* (100 = white; 0 = black), a* (+, redness ; -, greenness), and b* (+, yellowness ; -, blueness).

Sensory evaluation

Sensory evaluation was performed to select the best formulation using a 9-point Hedonic scale test of 30 people. Each panelist was asked to rate the liking of quality attributes according to appearance, color, flavor, teste, texture, general liking of each sample using a 9-point hedonic scale (1 =dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither dislike nor like, 6=like slightly, 7= like moderately, 8 = like very much and 9 = like extremely). 1 piece (8 grams) of soft cookies was served for each panelist at room temperature, along with water to rinse the palate between samples.

The consumer's decision purchasing test

A total of eighty consumers were used to conduct the consumer's purchasing decisions test. Each participant received a consumer acceptance questionnaire, a cookie sample, and information about the healthy benefits of soft cookies from golden banana and germinated brown rice.

Results

The pasting properties of the mixed powder of golden banana and germinated brown rice flour at various ratios were illustrated in Table 1. The pasting properties of the mixed powder with different ratios of golden banana and germinated brown rice flour showed significant differences in peak viscosity, trough viscosity, final viscosity, and setback from hold ($p \leq 0.05$). The golden banana to germinated brown rice solution with an 80:20 weight ratio exhibited the highest final viscosity. However, there were no significant differences in the solubility properties of the blended powder ratios (Table 2) ($p > 0.05$). As a result, an 80:20 weight ratio of golden banana to germinated brown rice solution was chosen for continued study in order to determine the best substitution ratio of blended powder to wheat flour in the standard soft cookie formula.

Table 1. Pasting properties of golden banana and germinated brown rice flour mixed powder in different ratios

Sample[/1]	Mean (cP) ± standard deviation				
	Peak viscosity	Trough viscosity	Breakdown viscosity [ns]	Final viscosity	Setback from hold
90:10	$49.25^{b} \pm 3.89$	$42.50^{c} \pm 0.00$	6.75 ± 3.89	$71.25^{c} \pm 3.18$	$28.75^{c} \pm 3.18$
85:15	$69.75^{b} \pm 9.55$	$64.25^{b} \pm 6.72$	5.50 ± 2.83	$124.25^{b} \pm 21.57$	$60.00^{b} \pm 14.85$
80:20	$106.00^{a} \pm 11.31$	$95.25^{a} \pm 7.42$	10.75 ± 3.89	$194.75^{a} \pm 5.30$	$99.50^{a} \pm 2.12$

[a,b,c,..] Mean values in a column with different letters are significantly different ($p \leq 0.05$)
[ns] Mean values are not significantly different ($p > 0.05$)
[/1] golden banana: germinated brown rice solution

Table 2. Solubility properties of golden banana and germinated brown rice flour mixed powder in different ratios

golden banana: germinated brown rice solution	Solubility[ns]
90:10	63.34 ± 0.37
85:15	64.60 ± 9.83
80:20	70.07 ± 4.36

[ns] Mean values are not significantly different (p > .05)

The texture properties of soft cookies from various ratios of golden banana and germinated brown rice flour mixed powder in substitution of wheat flour showed significant ($p \leq 0.05$) differences in hardness. The soft cookies substituted with 75% of the mixed powder had the lowest hardness (Table 3), and it also obtained the highest overall acceptability score among the others (Table 4). As a result, a formula that substituted wheat flour with 75% of the mixed powder was chosen for future studies to lower the sugar content of standard soft cookies to the lowest possible level.

Table 3. Texture properties of soft cookies from various ratios of golden banana and germinated brown rice flour mixed powder in substitution of wheat flour

Sample[/1]	Hardness (g_f)
Control (100% Wheat flour)	0.479[a] ± 0.00
50% (GB+GBR)	0.332[bc] ± 0.05
75% (GB+GBR)	0.270[c] ± 0.03
100% (GB+GBR)	0.457[ab] ± 0.09

[a,b,c,..] Mean values in a column with different letters are significantly different ($p \leq .05$)
[/1] GB: golden banana flour, GBR: germinated brown rice flour

Table 4. Sensory evaluation of soft cookies from various ratios of golden banana and germinated brown rice flour mixed powder in substitution of wheat flour

GB+GB[/1] (%)	Appearance [ns]	Color	Flavor	Taste[ns]	Texture	Overall acceptability
50	7.30 ± 1.51	6.93[ab] ± 1.62	7.53[a] ± 1.28	7.33 ± 1.32	7.37[ab] ± 1.56	7.47[b] ± 1.17
75	7.07 ± 1.62	7.03[a] ± 1.59	7.37[ab] ± 1.50	7.60 ± 1.52	7.83[a] ± 1.12	7.90[a] ± 1.16
100	6.83 ± 1.56	6.47[b] ± 1.53	6.93[b] ± 1.62	7.20 ± 1.49	7.20[b] ± 1.67	7.10[b] ± 1.32

[a,b,c,..] Mean values in a column with different letters are significantly different ($p \leq .05$)
[ns] Mean values are not significantly different (p > .05)
[/1] GB: golden banana flour, GBR: germinated brown rice flour

The texture properties of soft cookies from various percentage of sugar reduction were significant ($p \leq 0.05$) differences in hardness (Table 5), it could be observed that the higher the percentage of sugar reduction, the higher the hardness of soft cookies. The physical properties of soft cookies, including spread ratio, specific volume, and color (L*, a* and b*) were shown in Table 6. According to the Table 6, the physical properties of soft cookies from various percentage of sugar reduction was significant ($p \leq 0.05$) differences to the control formula. The soft cookies with reducing sugar content in the formulation exhibited a decrease in spread ratio, specific volume, and color (L*, a* and b*) as compared with the control formula.

The sensory evaluation of soft cookies from various percentages of sugar reduction was shown in Table 7. The sensory evaluation score showed significant ($p \leq 0.05$) differences in all attributes. The hedonic score in terms of appearance, colors, and flavor was like slightly to like moderately, and in the attributes of taste, texture, and overall acceptability was like very much to like extremely. The soft cookies with 30% sugar reduction got the highest sensory evaluation score in all attributes. Therefore, this percentage was chosen to be the optimum formula of soft cookie from pregelatinized banana flour and germinated brown rice.

Table 5. Texture properties of soft cookies from various percentage of sugar reduction

Reduction of sugar (%)	**Hardness (g_f)**
Control	$0.270^{c} \pm 0.03$
10	$1.533^{a} \pm 0.44$
20	$1.130^{b} \pm 0.29$
30	$1.205^{b} \pm 0.30$

[a,b,c,..] Mean values in a column with different letters are significantly different ($p \leq 0.05$)

Table 6. Physical properties of soft cookies from various percentage of sugar reduction

Reduction of sugar (%)	**Spread ratio (D/T)**	**Specific volume (cm^3/g)**	**Color**		
			L*	**a***	**b***
Control	$3.00^{a} \pm 0.01$	$2.72^{a} \pm 0.01$	$36.97^{a} \pm 0.17$	$12.33^{a} \pm 0.32$	$21.76^{a} \pm 0.41$
10	$2.80^{b} \pm 0.03$	$2.64^{b} \pm 0.01$	$33.89^{b} \pm 0.18$	$10.74^{b} \pm 0.08$	$20.53^{b} \pm 0.26$
20	$2.48^{c} \pm 0.01$	$2.55^{c} \pm 0.01$	$34.47^{b} \pm 0.14$	$10.56^{b} \pm 0.14$	$20.94^{ab} \pm 0.33$
30	$2.38^{d} \pm 0.02$	$1.90^{d} \pm 0.03$	$33.77^{b} \pm 0.30$	$10.20^{b} \pm 0.16$	$20.26^{b} \pm 0.37$

[a,b,c,..] Mean values in a column with different letters are significantly different ($p \leq 0.05$)

Table 7. Sensory evaluation of soft cookies from various percentage of sugar reduction

Reduction of sugar (%)	Appearance	Color	Flavor	Taste	Texture	Overall acceptability
0	6.83[b] ±1.56	6.47[b] ±1.53	6.93[b] ±1.62	7.20[b] ±1.49	7.20[b] ±1.67	7.10[c] ±1.32
10	7.93[a] ±1.08	7.63[a] ±1.43	7.27[ab] ±1.70	7.10[b] ±1.83	7.07[b] ±1.62	7.23[bc] ±1.30
20	7.83[a] ±1.18	7.73[a] ±1.36	7.67[a] ±1.47	7.83[a] ±1.23	7.43[ab] ±1.48	7.65[ab] ±1.03
30	7.83[a] ±1.09	7.77[a] ±1.29	7.90[a] ±1.21	8.13[a] ±1.04	8.00[a] ±1.26	8.10[a] ±0.80

[a,b,c,..] Mean values in a column with different letters are significantly different ($p \leq 0.05$)
[ns] Mean values are not significantly different ($p > 0.05$)

The consumer's decision purchasing of soft cookies from pregelatinized banana flour and germinated brown rice was illustrated in Figure 1. According to the findings, 50% of consumers may buy the product, followed by 31.3 percent who will definitely buy the products, 17.5 percent who may or may not buy the products, and 1.2 percent who will not buy the products.

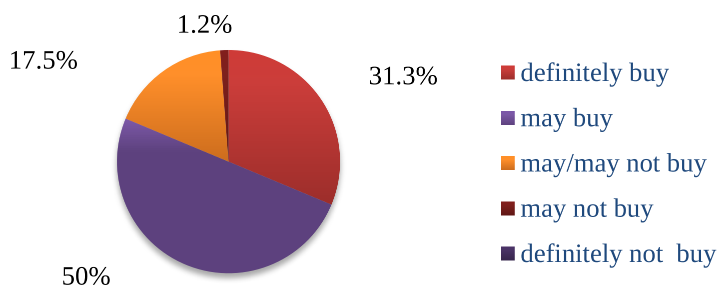

Figure 1. The purchase decisions of soft cookies from pregelatinized banana flour and germinated brown rice

Discussion

The mixed powder from three percentage ratios of golden banana and germinated brown rice solution of 90:10, 85:15, and 80:20 by weight were investigated for the pasting characteristic. The results revealed that the final viscosity increased as the ratio of germinated brown rice flour increased because germinated brown rice flour contained medium amylose content (21.78%) (Musa *et al.*, 2011), which has the ability to retrograde after cooling. This was in accordance with the findings of Sasaki *et al.* (2000) in that amylose content correlated significantly with final viscosity (r = 0.916). However, the pasting temperature of the mixed powder cannot be determined because the mixed flour slurry was being dried in a drum dryer, which exposes the granules to intense heat, causing loss of granular structure and birefringence (Kananurux and Thongngam, 2009). Therefore, the viscosity after the second heat treatment by the Rapid Visco Analyzer (RVA) for viscosity analysis was insufficient. Although the solubility properties of golden banana powder and germinated brown rice flour were not significantly different ($p>0.05$), the solubility tended to increase as the ratio of germinated brown rice solution increased, with the formula containing 20% germinated brown rice solution having the highest solubility. To control the shape of the dough and prevent excessive spreading during baking, the mixed flour used to make soft cookies should have a high final viscosity. Therefore, the ratio of golden banana to germinated brown rice solution of 80:20 by weight was chosen for further studying to determine the optimum formulation of the mixed powder used to substitute wheat flour in standard soft cookie formula.

The substitution of wheat flour with the mixed powder of golden banana and germinated brown rice flour in the soft cookie formula was varied to four different percentages of 0, 50, 75, and 100 by weight. The soft cookie properties from the substitution were subsequently investigated. Because pregelatinized flour is effective in water absorption, the hardness of the soft cookies was reduced when wheat flour was replaced with the mixed powder of golden banana and germinated brown rice flour, compared to the control (Wadchararat *et al*., 2006; Apichachan, 2004), resulting in a softer texture. Praditdoung (1977) also reported that pregelatinize flour was used as an ingredient in cake mixes to improve water absorption and air bubbles retention, as a result, the cake was well moist. Therefore, the control formula of soft cookie (100% wheat flour) showed the highest hardness due to the structure of the gluten-containing wheat flour. Owing to the stickiness caused by the natural sugars in the banana, such as glucose, fructose, and sucrose, the 100 percent substitution of wheat flour with mixed flour had the highest hardness compared to the 50 percent and 75 percent substitutions of wheat flour (Bjarnadottir, 2018). The sensory evaluation of soft cookies made with different ratios of wheat flour substituted by mixed flour revealed no significant differences in appearance and taste ($P>0.05$). In terms of color, texture, and overall acceptability, the soft cookie formula with a 75 percent replacement of wheat flour for mixed flour received the highest score among the others. The overall acceptability score was 7.10 ± 1.32 which is in the range of like moderately to like very much. Therefore, this 75% substitution of wheat flour with the mixed flour was chosen to further study the reduction of sugar content of the standard soft cookie formulation.

Because the mixed powder contained the sweetness from natural sugar from the golden banana, the four various levels of sugar reduction (0, 10, 20, and 30% by weight) from the standard soft cookie formula were investigated. The texture analysis of soft cookies with different levels of sugar reduction demonstrated that as the sugar content was reduced, the hardness of the cookies increased as compared to the control formula. The soft cookie with the 10% sugar reduction exhibited the highest hardness compared to the 20% and 30% sugar reductions because higher sugar content improved water absorption (Silva *et al.*, 2009). As a result, the amount of available water in the system decreased, so that the other ingredients, such as starch had less available water to absorb. Consequently, some of the starch granule remained in their native condition during baking process and did not form a continuous structure (Kulp *et al*., 1991). Apart from that, proteins do not aggregate and hydrate enough to form gluten network (Chevallier *et al*., 2002). The physical properties of soft cookies, in terms of spread ratio, decreased as the sugar content decreased because the ingredients other than sugar such as proteins absorbed less water, resulting in viscous cookie dough that could not spread while baking in the oven. This finding was in accordance with Premprasopchok *et al*. (2015) in that the increasing of banana ratio in the granulated sugar substituted banana cookies, the spread ratio was significantly decreased ($p \leq 0.05$). Also, when the sugar content was reduced, the specific volume of the cookies decreased due to fewer porous structure of soft cookies. It can be explained that sugar can incorporate air into the cookie dough mixture during mixing and provide properties that contribute to the creation of a smooth, smooth texture and good volume (Jiamjariyatam, 2008). Because soft cookies with lower sugar content have a lower spread ratio than the control formula, the control formula therefore revealed higher lightness (L*) than the decreased sugar formula in color values of soft cookies. Soft cookie spreadability, which is related to the porous structure of the cookies, would affect light reflection of the cookie colors and may be the reason of the increased lightness (L*). Premprasopchok *et al*. (2015) also reported that reducing the sugar and increasing the bananas affected the structure of the cookies, thereby affecting their lightness value. Because sugar in baking products interacts chemically during baking, the maillard reaction and caramelization, the control formula showed a higher redness (a*) than the decreased sugar formula (Purlis, 2010). Therefore, higher sugar content in baked products resulted in a darker brown surface. The sensory evaluation of soft cookies made with varied decreased sugar percentages indicated no significant differences in flavor ($p > 0.05$). The three sugar reduction formulas, on the other hand, scored higher than the standard formula in terms of appearance, color, taste, texture, and overall acceptability. In terms of color, flavor, texture, and overall acceptability, the sugar reduction of 30% by weight formula received the highest score. The overall acceptability score was 8.10± 0.80, ranging from like very much to like extremely.

The consumer's decision purchasing of soft cookies from pregelatinized banana flour and germinated brown rice using 80 general participants revealed that 100% of consumers accepted the product and 31.3% of consumers will definitely buy the products, 50% of consumers may buy the products, 17.5% of consumers may or may not buy the products, 1.2% of consumers will not buy the products and there are no consumers who decided not to buy the products.

In summary, the optimum formulation for producing soft cookies from golden banana flour and germinated brown rice flour is the golden banana mixed with germinated brown rice solution with a ratio of 80:20 by weight and pregelatinized using a drum dryer at 140 ℃. The 75% mixed powder replaced wheat flour and reduced the sugar content of the standard soft cookie formula by 30%, resulting in a nutritious soft cookie with the natural sweetness of golden bananas and healthy ingredients from germinated brown rice that received the highest overall acceptability from sensory evaluation.

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