EFFECTS OF SUBSTITUTION OF WHEAT FLOUR WITH SANGYOD RICE FLOUR AND SUPPLEMENTED WITH CARROT POWDER ON COLOR AND SENSORY QUALITIES

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Abstract.

The objective of this research was to investigate the effect of substitution of wheat flour with Sangyod rice (Oryza Sativa L.) flour and supplemented with carrot powder on color and sensory qualities of pasta product. Five pasta formulae were prepared by substituting wheat flour with 0% (control), 25%, 50%, 75%, and 100% Sangyod brown rice flour and analyzing their quality attributes. The results of pasta formula development indicated that increasing the amount of Sangyod brown rice flour resulted in decreasing lightness (L*) and yellowness (b*), while the redness (a*). There, the appearance of products became darker. The scores of all sensory attributes significantly decreased ($P<0.05$) with an increase in the amount of Sangyod rice flour, whereas the odor and texture scores of pasta substituted with 25% Sangyod rice flour were higher than those of control (100% wheat flour), 50%, and 75%, respectively. The substitution of wheat flour with 25% Sangyod rice flour was found to be the most suitable ratio for pasta production. The effects of the addition with different levels of carrot powder (5, 10, 15, and 20%w/w) of pasta have been studied. An increase of the carrot powder decreased L* and a* value. The sensory evaluation indicated that all treatments obtained an overall liking score of 6.78-7.02 (like slightly-like moderately). The study suggested that the levels of 15% w/w carrot powder could be a desirable use to produce healthy. The developed pasta with an overall liking score of more than 7.00 was considered acceptable.

Keywords: Pasta, Sangyod rice flour, Carrot powder, Color, Sensory evaluation

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Introduction

Pasta is a wheat-based food consumed worldwide due to its low cost, versatility, flavor and nutritional value. Its main constituents are carbohydrates (essentially starch) and proteins, besides small fractions of lipids, minerals, vitamins, dietary fibers and phenolic compounds. Durum wheat semolina is the preferred raw material to yield quality pasta (de Borba *et al*., 2021). Wheat flour is the most common raw material for pasta production. Because wheat flour contains gluten, new research is being developed to find alternatives that meet the technological and sensorial standards of the regular pasta, providing economic benefits and meeting the needs of a fraction of population with food restrictions and celiac diseases. Besides the celiac consumers, in recent years, the glúten-free products presented growth in

demand from the general consumers that aim for a healthier diet (Silva *et al*., 2019). Thus, a suitable alternative could be rice flour. Rice flour is a gluten-free product with relevant properties for the food industry. Therefore, in addition to its low cost and high availability, it can be used to change or control characteristics.

Sanyod rice (*Oryza Sativa* L.) is a local rice of Phatthalung province. In 2006, Sangyod rice was certified by Geographical Indications Protection Act 2003 in the product of Geographical Indication (GI) or GI rice under the name of "Sangyod Muang Phatthalung". Sangyod Muang Phatthalung rice is also the first GI food of Thai rice. It is considered to be the first rice breed to receive full community protection (Chaichana *et al*., 2014). Sangyod rice has hay-colored husk, while the brown rice is red to dark red in color within one grain, and the milled rice is a mixture of white and reddish pink in color. The grain shape is small. Sangyod rice is valued for its nutrient levels such as iron, vitamin B, niacin, and antioxidants. Moreover, Sangyod rice showed anti-inflammatory activity in an in vitro study (Department of Health, 2004).

Carrot (*Daucus carota* L.) is a nutritious root vegetable (seasonal crop), which is not available throughout the year. Drying the carrot could be an efficient way to extend its shelf- life. Carrots are known as a multinutritional food source and are rich in natural bioactive compounds, such as phenolics, carotenoids, polyacetylenes, and ascorbic acid, fiber, and minerals. As a result, carrots can be used as a functional ingredient in any product to increase the biological and nutritional values (Kamel *et al*., 2023). Carrot, being a good source of phytochemicals (e.g., carotenoids), is associated with reducing the risk of cardiovascular disease and cancer.

Therefore, this work aimed to the effect of substitution of wheat flour with Sangyod rice (*Oryza Sativa* L.) flour and supplemented with carrot powder on color and sensory qualities of pasta product. In order to provide an alternative product for general consumers who prioritize health, both in terms of increasing nutritional value and adding value to products with main ingredients sourced from Thailand in the future.

Methods

Materials

Sangyod Phatthalung rice was purchased from Farmer's Group (Phatthalung, Thailand). Sangyod rice was finely ground using a hammer mill to achieve a smooth texture. The Sangyod rice flour was sieved through a 100-mesh and packed in polyethylene packs. The 100% carrot powder was purchased from Kor Ngern Organic Farm Co., Ltd, Nong Bua Lamphu, Thailand.

Study of substitution of wheat flour with Sangyod rice flour of pasta

The process of control pasta formulation (control) starts by combining wheat flour (450 g), eggs (115 g), salt (7 g), and olive oil (10 g) in a food mixer at medium speed. Then, gradually add cold water (113 g) and knead until the wheat flour and other ingredients are well combined. Knead for approximately 3 minutes until the dough forms a cohesive ball. Let the dough rest for 30 minutes, then take the rested dough and pass it through a pasta rolling machine to form noodles with a length of 15 cm and a thickness of 3 mm. When analyzing the quality, cook the noodles by boiling them in water at a temperature of 95°C for 5 minutes, then immediately transfer them to cold water (Weenuttranon ,2022). As for the pasta that uses

Sangyod rice flour as a substitute for wheat flour, follow the same procedure as the control sample. Mix the wheat flour and Sangyod rice flour together before adding them to the food processor. Five pasta formulas were prepared by substituting wheat flour with different levels of Sangyod rice flour: 0% (control), 25%, 50%, 75%, and 100%. The quality attributes of these formulas were analyzed.

Study on the quantity of carrot powder supplementation in pasta made from Sangyod rice flour

The appropriate ratio of wheat flour and Sangyod rice flour was used to vary the carrot powder content (5, 10, 15, and 20 %w/w) to compare with the control sample. To prepare the ingredients, carrot powder was sifted together with wheat flour and Sangyod rice flour. The carrot powder that was obtained was then utilized in the production of pasta using method 2.2.

Quality determination

Color

The color of the samples was measured using a Hunter Lab (Hunter Lab, ColorFlex, USA), which measures three parameters: lightness (L*), red-green (a*), and yellow-blue (b*).

Sensory evaluation

The sensory evaluation was conducted. A total of 30 untrained panelists were recruited from Suan Sunandha Rajabhat University in Bangkok, Thailand. A 9-point hedonic scale was used, where a score of 1 = not like very much, 5 = neither like nor dislike, and 9 = like extremely. This scale was used to determine the most acceptable product. The formulation that received the highest score was selected for the consumer acceptability test.

Statistical analysis

Experimental data were carried out using the completely randomized design (CRD) in color values and the randomized complete block design (RCBD) in sensory evaluation. The data were analyzed using analysis of variance facilitated by the IBM SPSS® version 23 software (IBM SPSS Inc., USA). Duncan's multiple range test was used to determine multiple comparisons of mean values with a statistically significant difference established at $P \leq 0.05$.

Results and Discussion

Effect of substitution of wheat flour with Sangyod rice flour of pasta

The color values of substitution of wheat flour with Sangyod rice flour of pasta with different levels: 0% (control), 25%, 50%, 75% and 100% were presented in Table 1 and Figure 1. Lightness (L*), redness (a*) and yellowness (b*) of substitution of wheat flour with Sangyod rice flour were statistically increased corresponding with substitution levels ($p \leq 0.05$). The results of pasta formula development indicated that increasing of the amount of Sangyod rice flour resulted in decreasing in L* and b*, while the a*. There, the appearance of products became darker. Color changes of pasta have mostly been explained by Maillard browning and pigment diffusion.

Sensory evaluation of substitution of wheat flour with Sangyod rice flour of pasta with different levels: 0% (control), 25%, 50%, 75% and 100% were presented in Table 2. The scores of all sensory attributes significantly decreased ($P<0.05$) with an increase in the amount of Sangyod rice flour whereas odor, and texture scores of pasta substituted with 25% of Sangyod rice flour were higher than that of control (100% wheat flour), 50%, and 75%, respectively. The substitution of wheat flour with 25% Sangyod rice flour was found to be the most suitable ratio and would be developed for the following purpose.

Table 1: Color of substitution of wheat flour with Sangyod rice flour of pasta

Qualities	The level of substitution of wheat flour with Sangyod rice flour (%)			
	Control	25	50	75
Lightness (L*)	55.66±1.49[a]	54.80±1.40[a]	38.22±1.43[b]	35.08±3.74[b]
Redness (a*)	2.08±0.11[c]	5.62±0.24[b]	5.08±0.58[b]	7.34±0.57[a]
Yellowness (b*)	16.77±0.63[a]	9.22±0.58[b]	5.45±0.66[d]	7.19±0.63[c]

SD with different lowercase superscripts in each low are significantly ($p \leq 0.05$) different.

Table 2: Sensory evaluation of substitution of wheat flour with Sangyod rice flour of pasta

Sensory attributes	The level of substitution of wheat flour with Sangyod rice flour (%)			
	Control	25	50	75
Appearance	7.54±1.01[a]	7.26±1.17[ab]	7.04±1.22[bc]	6.74±1.22[c]
Color	7.44±1.10[a]	7.18±1.25[b]	6.86±1.22[b]	6.86±1.42[b]
Odor	6.08±1.36[b]	6.62±1.35[a]	6.52±1.35[ab]	6.54±1.55[ab]
Taste	6.82±1.38[a]	6.84±1.20[a]	6.38±1.19[ab]	6.20±1.57[b]
Texture	7.22±1.20[a]	7.14±1.17[a]	6.66±1.31[b]	6.14±1.59[c]
Overall liking	7.42±1.07[a]	7.18±1.20[ab]	6.84±1.20[b]	7.04±1.47[ab]

SD with different lowercase superscripts in each low are significantly ($p \leq 0.05$) different.

Figure 1: Characteristic of substitution of wheat flour with Sangyod rice flour of pasta

Contro **25%** **50%** **75%**

Effect of carrot powder supplementation in pasta made from Sangyod rice flour

The addition with different levels of carrot powder (5, 10, 15, and 20 %w/w) of pasta made from Sangyod rice flour compared with the control had significant effect on the L *, a * and b * ($p \leq 0.05$) as shown in Table 3 and Figure 2. The results demonstrated that addition of carrot powder to the formulation significantly resulted in decrease in L* values and a* values which could be arisen from carotene content of carrot. The sensory attributes of the control and developed pasta were scored for appearance, color, color, odor, taste, texture, and overall liking (Table 4). The sensory evaluation indicated that all treatments obtained an overall liking score of 6.78-7.02 (like slightly- like moderately). The study suggested that the levels of 15% w/w carrot powder could be a desirable use to produce healthy. It is worthy to note that the mean scores for all sensory attributes of the developed pasta was higher than 7, which means its sensory properties were considered to be acceptable.

Table 3: Color of carrot powder supplementation in pasta made from Sangyod rice flour

	Carrot powder (% w/w)				
Qualities	Control	5	10	15	20
Lightness (L*)	55.66±1.49^{a}	42.48±0.14^{d}	51.51±1.55^{b}	50.36±1.59^{b}	47.97±0.53^{c}
Redness (a*)	2.08±0.11^{d}	4.96±0.09^{c}	6.22±0.26^{a}	6.11±0.56^{a}	5.58±0.13^{b}
Yellowness (b*)	16.77±0.63^{a}	6.49±0.16^{b}	16.30±0.87^{a}	17.66±1.93^{a}	15.98±0.41^{a}

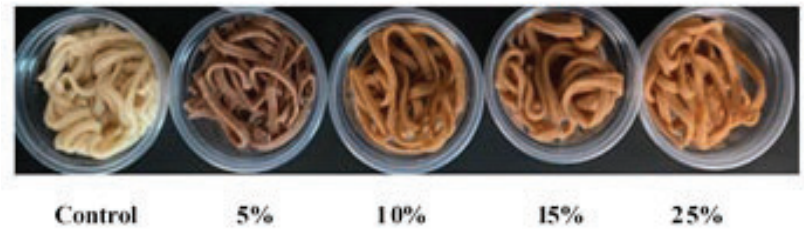
SD with different lowercase superscripts in each low are significantly ($p \leq 0.05$) different.

Table 4: Sensory evaluation of carrot powder supplementation in pasta made from Sangyod rice flour

Sensory attributes	Carrot powder (% w/w)				
	Control	5	10	15	20
Appearance	7.74±1.04[a]	7.04±1.33[b]	7.14±1.26[b]	6.84±1.31[b]	6.80±1.51[b]
Color	7.60±1.32[a]	7.06±1.28[b]	7.04±1.30[b]	7.10±1.16[b]	6.88±1.33[b]
Odor [ns]	7.00±1.24	6.72±1.26	6.88±1.30	6.96±1.29	6.70±1.38
Taste [ns]	7.10±1.46	6.78±1.68	6.90±1.72	6.82±1.50	6.72±1.79
Texture	7.76±1.09[a]	7.00±1.37[b]	6.94±1.39[b]	6.80±1.38[b]	6.68±1.42[b]
Overall liking	7.32±1.33[a]	6.90±1.58[ab]	6.98±1.77[ab]	7.02±1.55[ab]	6.78±1.84[b]

SD with different lowercase superscripts in each low are significantly ($p \leq 0.05$) different

Figure 2: Characteristic of carrot powder supplementation in pasta made from Sangyod rice flour



Conclusion

Sangyod rice and carrot offer numerous nutritional and health benefits. This study aimed to examine the impact of substituting wheat flour with Sangyod rice flour and incorporating carrot powder on the color and sensory qualities of pasta. The results showed that increasing the proportion of Sangyod rice flour resulted in a darker appearance of the pasta, with decreased lightness and yellowness values, and increased redness. The addition of carrot powder influenced both the color and sensory attributes of the pasta. Sensory evaluations indicated that a 15% w/w level of carrot powder was identified as ideal for producing healthy pasta. These findings provide valuable insights for enhancing the nutritional value and sensory quality of pasta products, and the identified challenges will contribute to further improvements in the quality of gluten-free rice pasta.

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