DRAGON FRUIT (HYLOCERCUS POLYRHIZUS AND HYLOCERCUS UNDATU) PEEL WASTE AS ANTIOXIDANT ON QUALITY IN PASTA PRODUCT,*

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Abstract.

Dragon fruit peel is usually considered waste, yet it can be explored as a potential source of natural functional food ingredient that is a treasure for the health. The antioxidant activity of white (*Hylocereus undatus*) and red (*Hylocereus polyrhizus*) dragon fruit peel powder was determined total antioxidant activity (DPPH). The results showed that the total antioxidant activity in white and red dragon fruit peels powder were 566.75 mgAA and 274.80 mgAA, respectively. The suitable amount of dragon fruit peel powder for pasta was determined at levels of 5%, 10%, and 15% w/w. The results indicated that the optimal content for making pasta was 15% w/w of dragon fruit peel powder. The texture quality of thepasta indicated that the tensile strength and distance decreased as the amount of dragon fruit peel powder increased. The 5-15% w/w dragon fruit peels powder had liking scores of all sensory attributes at like moderately-like very much. However, an increase of dragon fruit peels powder caused a decrease in lightness (L*) and yellowness (b*), while an increase in redness (a*) compared to the control. The developed pasta based on 100 g contained total antioxidant activity 45.25 mgAA, total energy 152.01 kcal, moisture 67.80 g, carbohydrate 20.68 g, fat 5.17 g, protein 5.69 g, and ash 0.66 g. These findings suggest that dragon fruit peel waste is a sustainable and healthier ingredient that can improve the antioxidant capacityof pasta products.

Keywords: Dragon fruit peel powder, Antioxidants, Physical, Nutritional value, and Pasta

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Introduction

Dragon fruit (Pitaya or *Hylocereus undatus*) is an economically important fruit in Thailand that is popularly consumed, resulting in a significant amount of discarded peels after consuming the pulps (Ferreres *et al*., 2017). It is considered another type of fruit with high potential for both domestic consumption and export to international markets. Dragon fruitpulp has high fiber content and beneficial vitamins for the body (Le Bellec *et al*., 2006; Nurliyana *et al*., 2010). Utilization of dragon fruit are often limited to its flesh, whereas the peel was rich in antioxidants. The peel of dragon fruit contains a red or magenta-colored pigment called betalain, specifically betacyanin, which has antioxidant properties (Wybraniec *et al*., 2001; Wybraniec & Mizrahi, 2002). The pigment can dissolve well and provide a red color at pH 3–7, but the effect of pH on the stability of betacyanin depends on other factors such as oxygen and temperature (Harivaindaran *et al*., 2008). Dragon fruit peel contains beneficial substances for health, nutritional value, and medicinal properties that are greater than those of the flesh of the fruit. For example, the sticky substance in the peel of dragon fruit, which consists of complex polysaccharides, has the benefit of reducing low- density lipoprotein (LDL) cholesterol and triglycerides in the bloodstream. It also contains vitamin C, phosphorus, protein, and calcium, which stimulate the body's functions and help prevent high blood pressure (Boonmee, 2019).

Pasta is a widely consumed type of noodle product, popular both in Western and Eastern regions. It can be considered a main meal (Weenuttranon, 2022). It is composed primarily of carbohydrates, specifically starch, and comes in various shapes such as round, flat, sheet, and tube (Gulia *et al*., 2014). Due to its popularity, pasta has become a staplefood in many countries, leading to an increased global consumption of pasta products. As a result, pasta has become an interesting product for improving its nutritional value and developing it as a healthy food product (Limroomgreungrat *et al*., 2017). Therefore, the use of colorants in pasta products is an effort of product diversification. Besides being used as a natural coloring agent, this peel extract is also used to improve nutritional value of the expected product.

Objectives

1) To produce pasta supplemented with dragon fruit peel powder to enhance itsnutritional value

2) To utilize the remaining peel as an income source for farmers and provide a newalternative for health-conscious consumers

Methods

Dragon fruit peel powder preparation

The process of making dragon fruit peel powder, according to the modification method by Pichayajittipong, (2013) involves two species of dragon fruit peel with a thickness of approximately 3 mm. The peels are then cut into pieces with dimensions of 3x20 mm^2. They are dried in a tray dryer at 50°C, and 18 hours. After drying, the peels are ground into powder and sieved through a 100-mesh sieve. The dragon fruit peel powder, weighing100 grams, is then analyzed for total antioxidant activity (DPPH) according to Katsuke (2004)

Pasta manufacture

Pasta formulation was developed and modified according to Weenuttranon (2022). It consisted of wheat flour (280 g), salt (4 g), egg (60 g), and water (40 g) were used to determine the amount of dragon fruit peel powder supplementation at levels of 5%, 10%, and 15% weight per weight (w/w). The process of making formulation pasta involves mixing wheat flour, salt, and eggs together until well combined. Water is added slowly while kneading until the dough forms a smooth surface and does not stick to the hands. Then, the dough is allowed to rest at a temperature of 27±2°C for 1 hour. After that, the dough is rolled into thin sheets approximately 1 mm thick using a rolling pin. The sheets are then cut into lengths of 12 cm and widths of 7 cm. Next, the pasta is pressed using a pasta press to obtain pasta strands. Finally, boil until cooked for quality assessment.

Physical properties

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*).

Texture qualities:

Texture qualities were analyzed in a TAXT2i Texture Analyzer (Stable Micro Systems,UK). Pasta was cooked to each sample and ten measurements were carried out after cooling them with natural water for a few seconds; their mean values and standard deviations were reported. From the tensile strength (g) and distance (mm) were analyzed (Milde et al., 2021)[13].

Sensory evaluation

The sensory evaluation was conducted according to Larmond (1997). 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.

Nutrition values studied

The developed pasta was determined in terms of nutritional value: moisture content, protein, fat, ash, and total energy according to AOAC (2019). Carbohydrate content (%) was obtained from the calculation of 100 minus the sum of moisture, protein, fat, and ash. The total antioxidant activity (DPPH) of developed pasta was determined according to the method of Katsuke (2004).

Statistical analysis

Experimental data were carried out using the completely randomized design (CRD) in physical properties 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

Study of antioxidants in the powder of white and red dragon fruit peel.

The analysis of dragon fruit peel powder from both white and red varieties revealed antioxidant activity using the DPPH method (Table 1). It was found that the antioxidant content in white dragon fruit peel powder was measured at 566.75 mgAA with a moisture content of 5.02 g, while in red dragon fruit peel powder, it was measured at 274.80 mg/g with a moisture content of 4.52 g. These findings indicate that the white dragon fruit peel powder contains a higher quantity of antioxidant activity compared to the red peel. Several research studies have consistently indicated that both white and red dragon fruit peel are a source of antioxidants. Nurliyana *et al* (2010) reported that phenolic compounds have been identified in plants and are known for their significant antioxidant properties, which are higher in the peel compared to the pulp of the fruit.

Table 1: Antioxidant compositions of dragon fruit peel powder 100 g of dry sample.

Antioxidants composition	White dragon fruit peel powder	Red dragon fruit peel powder
Moisture (g)	5.02	4.52
Total antioxidant activity (DDPH) (mgAA)	566.75	274.80

Study of the amount of supplementation of dragon fruit peel powder in pasta.

The color of *supplementation of dragon fruit peel powder in pasta at different levels* 5%, 10%, 15% w/w and the control formulation (Table 2). It's found that the amount of supplementation had a significant effect ($p \leq 0.05$) L* and b* values showed a decreasing trend, while the a* value showed an increasing trend compared to the control formulation. This is because the increased supplementation of dragon fruit peel powder resulted in a color change in the fresh pasta, aligning with the presence of red-colored pigments, specifically betacyanins, which provide a red coloration. Consistent with the research of Charoenphun & Kwanhian (2018), the results showed that the addition of jackfruit waste flour had a significant effect on the quality of gluten-free pasta. Increasing the amount of jackfruit flesh flour resulted in increased intensity and a higher value of a* (redness) in the color of the pasta, which was statistically significant. The intensity of the pasta had a yellow to orange huecorresponding to the amount of flour from jackfruit flesh. This may be due to the presence of carotenoids in

jackfruit flesh, as reported by Wisutiamonkul *et al*. (2017), such as betalains,a group of pigments that provide red coloration, and the brightness value of the pasta decreased after cooking compared to before cooking. This could be attributed to the heateffect on the color change of the component substances.

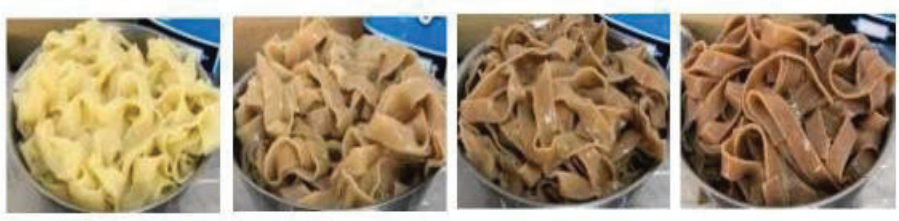
Supplementing dragon fruit peel powder in pasta at different levels and measuring its effect on the textural quality of the pasta using a texture analyzer (Table 2), it was found that the amount of supplementation had a significant effect ($p \leq 0.05$) on the distance and tensile strength, showing significant differences. There was a decreasing trend in these parameters when adding dragon fruit peel powder in increased proportions. This is because dragon fruit peel powder contains fibers that absorb water, affecting the starch content of the pasta. As a result, the starch quantity decreases, leading to a less rigid pasta structure. This finding is consistent with the research by Suksomboon *et al*. (2017), which showed that increasing the amount of ink powder resulted in decreased tensile strength, possibly due to the powder interfering with the structure of starch and protein, resulting in a weaker bond between strandsand decreased strength. Additionally, during the boiling process, the internal structure of the strands becomes more fragile.

Table 2: Physical properties of pasta supplementation with dragon fruit peel powder

Treatments	L*	a*	b*	Tensile Strength (g)	Distance (mm)
Control	78.13 ± 0.66^{a}	3.85 ± 0.17^{d}	24.26 ± 0.91^{a}	28.76 ± 4.9^{a}	26.00 ± 5.67^{a}
5%	63.34 ± 2.00^{b}	7.35 ± 0.65^{c}	22.53 ± 0.16^{a}	17.52 ± 4.43^{bc}	24.98 ± 4.29^{a}
10%	56.60 ± 1.21^{c}	8.16 ± 0.28^{b}	19.88 ± 0.51^{b}	20.38 ± 3.62^{b}	14.66 ± 2.08^{a}
15%	51.68 ± 0.16^{d}	9.06 ± 0.24^{a}	19.03 ± 1.54^{b}	12.44 ± 3.10^{c}	8.04 ± 2.11^{c}

Remark : L*: lightness. a*: red to green. b*: yellow to blue $^{a,b,c\cdots}$Mean ± SD with different lowercase superscripts in each column are significantly ($p \leq 0.05$) different

Figure 1: Characteristic of dragon fruit peel powder (control, 5%, 10%, 15% w/w) in pasta



Control 5% 10% 15%

Sensory evaluation using a 9-point hedonic scale (Table 3) showed that the content of dragon fruit peel powder not significantly affected the appearance, color, odor, taste, texture, and overall liking of the pasta ($p>0.05$). The addition of dragon fruit peels powder (5-15% w/w) had liking scores of all sensory attributes at like moderately-like very much, which was close to the control. These results were consistent with the color values. This is because the dragon fruit peel powder contains a higher amount of fiber, resulting in better gelatinization compared to pasta without the addition of dragon fruit peel powder. This finding is consistent with the research by Nanthachai (2013) on the sensory evaluation of mango powder- fortified and non-fortified noodles. They found no significant differences in odor, taste, or overall liking, while there were differences in texture. Noodles made with mango powder as a substitute for wheat flour had a higher fiber content and a stickier texture compared to noodleswithout mango powder, indicating better gelatinization due to the addition of mango powder as a wheat flour substitute.

Table 3: Sensory evaluation of pasta supplementation with dragon fruit peel powder

Treatments	Appearance^{ns}	Color^{ns}	Odor^{ns}	Taste^{ns}	Texture	Overall liking^{ns}
Control	7.93±0.90	7.93±0.98	7.33±1.12	7.26±1.14	7.63±1.12	7.56±1.00
5%	7.93±0.82	8.03±0.76	7.83±0.87	7.70±1.08	7.86±1.00	7.96±0.76
10%	7.86±0.93	7.83±0.69	7.66±0.95	7.36±1.12	7.23±0.97	7.66±0.75
15%	7.96±0.96	7.76±0.85	7.46±1.07	7.33±1.15	7.46±1.04	7.73±0.98

Notes; Mean ± SD with different lowercase superscripts in each column are significantly ($p \leq 0.05$) different

Study of the *nutritional values* of pasta supplemented with dragon fruit peel powder.

The developed pasta product based on 100 g contained antioxidant (DPPH) 45.25 mgAA, total energy 152.01 kcal, moisture 67.80 g, carbohydrate 20.68 g, fat 5.17 g, protein 5.69 g, and ash 0.66 g. The antioxidant activity (DPPH radical scavenging activity) was 45.25 mgAA/100g (Table 4). These findings are consistent with previous reports demonstrating that the addition of dragon fruit peel powder to various food products, including mantou, noodles, bread, and cookies, can increase betacyanin and polyphenol content, as well as antioxidant capacity. These compounds are well known for their potent antioxidant properties and have been reported to exhibit a wide range of health benefits, including anti-inflammatory, antimicrobial, and anticancer effects (Jiang *et al*., 2021).

Table 4: Nutritional values of pasta supplementation with dragon fruit peel powder

Nutritionalvalues	**Developed pasta 100 g**
Energy (kcal)	152.01
Moisture (g)	67.80
Carbohydrate (g)	20.68
Fat (g)	5.17
Protein (g)	5.69
Ash (g)	0.66
DPPH (mgAA)	45.25

Conclusions

The utilization of dragon fruit peel can be done through application of dragon fruit peel on food products. Sensory evaluation of fresh pasta fortified with dragon fruit peel powder indicated that a 15% w/w concentration was suitable for achieving high sensory scores in the fortified pasta. The amount of fortification had an effect on the tensile strength and distance, showing a decreasing trend when adding dragon fruit peel powder in higher proportions. This resulted in a decrease in the stickiness of the fresh pasta and affected the color quality of the fortified pasta. The fortification level had an impact on the brightness value (L*), redness value (a*), and yellowness value (b*) of the pasta. The L* and b* values showed a decreasing trend,

while the a* value showed an increasing trend. The addition of dragon fruit peel powder increased the presence of antioxidant compounds. Therefore, the development of pasta products with fortification aimed to enhance nutritional value and provide a healthy food alternative for consumers.

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