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Development of Pumpkin Powder Incorporated Instant Noodles

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Abstract

Pumpkin is rich in nutrients, low fat, provide little energy and inexpensive. It is benefit to increase the nutritional value of instant noodles. Therefore, the objective of this research was to study the effect of pumpkin powder (PP) on qualities of instant noodle. PP was added as part of instant noodle at 0, 5, 10, 15 and 20% of the whole mixture basis. The results showed instant noodle without PP had highest water absorption rate, 71.97% ($p \leq 0.05$). Instant noodles tended to increase cooking loss when increasing the PP. The addition of PP had effect on product color, L* value decrease while a* and b* values increased ($p \leq 0.05$). The ash and beta-carotene content of PP instant noodles were significantly higher than control ($p \leq 0.05$). The sensory evaluation showed that the instant noodles substitute with 10% PP had higher score than the others ($p \leq 0.05$); color, flavor, taste, texture and overall acceptance were 8.77, 8.23, 8.73, 8.33, 8.33 and 8.76, respectively.

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Beta-Carotene Content;
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Introduction

Instant noodle is a dry noodle that has already been prepared and eaten after adding hot water for 3-5 minutes. Beside the noodle there are the sachets of powdered broth and flakes of dried vegetables, meat or seafood in the package.[1] Nowadays, there are many brands of instant noodles. Most instant noodles are from Asia, such as China, Japan, Vietnam, Thailand and Korea. Meanwhile, instant noodles are popular in Europe, North America or South America because they are inexpensive, convenient and save time to eat.[2] However, it was found that instant noodles have starch as the main ingredient, therefore providing high energy. Since consumers consider that instant noodles are unhealthy food so fortified with natural and healthy ingredients could be an effective option to improving the nutritional benefits of instant noodles.[3] The studies

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of improvement noodle qualities were investigated; such as oat flour noodle, tiger nut flour noodle, buckwheat noodle, green tea noodle, and noodles added with pea protein isolate or soybean milk. The study of gluten free noodle process found that using tiger nut in combination with 0.5% xanthan gum and optimal amount of water resulted in good noodle qualities, with low cooking losses and high firmness.[4] Modified buckwheat noodles showed lower breakage ratio, higher hardness, elasticity, and total sensory score than those of raw buckwheat noodles.[5] Heat-exposed green tea powder noodles had higher surface lightness due to the loss of chlorophyll. Heat treatment was also effectively inhibited the activity of polyphenol oxidase.[6] The result of in vitro glucose release test of noodles showed that the noodles containing peanut protein had lower glucose. Moreover, the addition of protein had slightly effect on texture and sensory of the product.[7] The addition of soybean milk in noodles improved sensory and texture properties of frozen-cooked noodles better than the control8. However, there had been little study about nutritional enrichment in instant noodles. Some research found that protein in instant noodle increased while substitute refined flour with aleurone flour fraction, but it affected the cooking yield and hardness of the instant noodle.[3] The antioxidant rutin was detected in instant noodles made from wheat flours mixed with 20% buckwheat flour.[9]

Pumpkin (*Cucurbita moschata*) is a short-day plant that can be grown in both tropical and cold regions. It is rich in fiber, vitamins, minerals and beta-carotene, which are beneficial to the body. Pumpkin is considered as a healthy food. Many researches show that pumpkin polysaccharide are capable of scavenging free radicals and can be used as antioxidant.[10] Beta-carotene is classified as a group of carotenoids, which is present in vegetables and fruits that are yellow, orange, red and green. The substances in the carotenoids contain hundreds of species, but in the human blood stream there are about 20 species. Vitamin A has properties to help resist disease, because it can eliminate oxygen that damages cells in the body. In addition, the pumpkin also provides minerals such as phosphorus, which are essential nutrients for bones and teeth.[11] In Thailand, pumpkin has been utilized by modifying or fortifying other foods, however, it is not used as a main ingredient in the food industry. Research had been conducted on the processing of fresh produce into dried pumpkin and osmotic dehydrated pumpkin products to extended shelf life or used in other products, such as pastries or blenderized tube feeding.[12 – 14] The objectives of this research were to study the optimization of pumpkin added in the instant noodle and to study physical and chemical qualities and sensory evaluation of the instant noodle. Thus, it is a new option for consumers to have instant noodles that are more nutritious.

Materials and Methods

Pumpkin powder (PP)

Pumpkin was cleaned, cut into small pieces (2 × 5 inch) and soaked in a 250 ppm potassium-sulphite solution for 10 minutes. Then the pieces of pumpkin were rinsed with clean water and allow them to air dried. Pumpkins were placed in hot air oven at 65°C for 6 hours, then finely ground into powder and sifted through a 220 mesh sieve. The physical and chemical qualities of PP were analyzed such as; color, moisture, ash and beta-carotene. Color was measured by color meter (CR-10 Colorimeter Machine) and expressed as L*, a* and b* values. Moisture and ash contents were analyzed by AOAC methods.[15]

The UV-Vis spectrophotometric method was used for determination of beta-carotene content.[16]

Instant Noodle Processing

The ingredients of instant noodles in this study consist of wheat flour, PP, salt and water. Any hydrocolloids did not apply since wheat flour mixed with PP was able to build up the dough. The process of instant noodles mixed with PP was modified from Choy *et al.,*[17] All ingredients (wheat flour, PP, salt and water) were mixed and knead for 15-20 minutes. After left for 20 minutes the dough was pressed with pressing rollers. The dough was flattened with thickness of 1 mm and it was cut into width and length about 1x300 mm. The noodles were steamed for 1 minute at 100°C for starch pre-gelatinization. Noodles were put into a square shaped metal mold, deep-fried in the fryer at 160°C for 1 minute. The product was kept in 5x7 inches aluminum foil zip lock bag and stored at room temperature (30±2°C).

The Study of Optimization of Pp In the Instant Noodle

The study was carried by completely randomized design (CRD). The noodles substituted wheat flour with PP at 0, 5, 10, 15 and 20%. There were 3 replications in the experiment. Cooking loss, water absorption, tensile strength, color, moisture content, ash and beta-carotene of the noodle were investigated.[15-16, 18] Sensory evaluation of the instant noodle was held by 9-point hedonic scaling with un-trained panelists. The hedonic scale was 9 categories range from "dislike extremely (1)" to "like extremely (9)". All treatments were cooked in boiling water at 100°C for 3 minutes. Each panelist was taken 10 grams of each sample. Color, flavor, taste, texture and overall acceptance of instant noodle were evaluated by 30 panelists.

Statistical Analysis

Data analyses were conducted in triplicate. The physical and chemical data were analyzed by one-way analysis of variance (ANOVA), while sensory evaluation data was analyzed by two-way ANOVA. Compare the mean difference by DMRT method at the significant level 0.05.

Results and Discussion

Physical and Chemical Qualities of PP

Fresh pumpkin provided 85.33, 12.13, 0.32, 1.37 and 0.85% of moisture, carbohydrate, fat, protein and fiber contents, respectively. After dried process, the dried PP was yellowish-brown color. The L*, a* and b* values were 56.08, 12.78 and 60.92, respectively. Moisture and beta-carotene content of the powder were 2.56% and 1.25 mg/g, respectively. Some research reported that tray dried PP at 60°C for 9 hours had L*, a* and b* values of 63.20, 5.16 and 48.00, respectively. And moisture content of tray dried PP were 11.33%.[14] The result of a* and b* values in this research was higher than the previous study, while L* value and moisture content was lower. It was possible that temperature and air flow in this study higher than that research.

Physical and Chemical Qualities of PP Instant Noodles

Color values of instant noodles substituted with pumpkin powder at 0, 5, 10, 15 and 20% were significantly different ($p \leq 0.05$). Wheat flour noodle was light-yellow, whereas, PP noodles were dark-yellow to brown. The addition of PP at higher levels resulted in decreasing L* values and increasing a* and b* values (Table 1). Pumpkin contained beta-carotene which was a yellow to red pigment.[19] Thus increasing PP in the instant noodles, the a* and b* values of the noodles increase. Hydration and hydrocolloids had an effect on the color parameter L*, a* and b* values of cooked noodles. Tiger nut noodles had brownish color that came from the color of tiger nut (*Cyperus esculentus* L.) tubers. Noodles made with constant hydration had higher L*, a* and b* than general noodle. For example, riboflavin in aleurone flour blends caused yellowness in the flour.[3] Or noodles consist of inulin were brighter, with reddish and brownish tone.[4]

Table 1: Color (L*, a* and b* values) of instant noodles substituted with PP

PP(%)	Color value		
	L*	a*	b*
0	70.70 ± 0.64^{a}	3.15 ± 0.56^{c}	31.26 ± 1.43^{d}
5	59.32 ± 0.96^{b}	6.53 ± 0.18^{b}	35.35 ± 0.77^{c}
10	59.02 ± 0.51^{b}	11.73 ± 0.32^{a}	37.33 ± 0.74^{c}
15	56.08 ± 0.11^{b}	12.28 ± 0.38^{a}	53.32 ± 1.24^{b}
20	55.73 ± 0.89^{b}	12.78 ± 0.76^{a}	61.07 ± 0.85^{a}

The different superscript letters indicating mean of the same column are significantly differences ($p \leq 0.05$).

The appearance of PP instant noodles showed in Figure 1. Wheat flour noodle was smooth and elasticity, in contrast to PP noodle, the texture was rough and fracture. The gluten network provided cohesiveness, viscosity, and elasticity of the noodle dough.[20] The purpose of dough sheeting process was to achieve smooth dougSEh with a desired thickness and a continuous gluten matrix.[21] Instant noodle with high content on PP could not form gluten network as better as wheat flour noodle. Thus, the appearances of PP instant noodles were not good enough when compared with wheat flour noodle. This result was consistent with oat flour noodle.[21] Texture of noodle was also an important quality. Noodle with whole grain flour at high content was unable to form cohesive and viscoelastic doughs due to the weak gluten network in dough during sheeting.[21]

a b c d e

Fig.1: The instant noodles substituted with PP at different content; (a) 0, (b) 5, (c) 10, (d) 15 and (e) 20%, respectively

Table 2: Water absorption, cooking loss and tensile strength of instant noodles substituted with PP

PP (%)	Water absorption (%)	Cooking loss (%) ns	Tensile strength (N)
0	71.97±1.88[a]	0.43±1.55	15.02±2.65[a]
5	63.50±0.92[b]	0.47±1.49	13.92±1.58[b]
10	62.57±1.03[b]	0.53±2.73	13.18±2.92[b]
15	61.00±0.23[c]	0.60±1.87	12.85±1.84[c]
20	60.43±1.21[c]	0.67±1.66	12.59±3.17[d]

The different superscript letters indicating mean of the same column are significantly differences ($p \leq 0.05$).
ns = not significantly differences ($p>0.05$)

Water absorption of instant noodles substituted with PP at 0, 5, 10, 15, and 20% were 71.97, 63.50, 62.57, 61.00 and 60.43%, respectively (Table 2). Increasing PP resulted in a decrease of water absorption of the noodle ($p \leq 0.05$). Cooking loss of instant noodles was in the range of 0.43 – 0.67%. However, cooking loss of PP instant noodles tended to higher than the instant noodles used wheat flour only (Table 2). Tensile strength significantly decreased while PP was added in the noodle ($p \leq 0.05$). PP had poor water absorption property that caused the noodles absorbed less water. This result was consistent with the study of used baegu leaves and Jerusalem artichoke (*Helianthus tuberosus* L.) in noodles.[22-23] Wheat flours have the ability to establish a gluten matrix, which provides the structure of the noodle.[9] However, PP is non-gluten. So the gluten strength of noodle consisted of PP was weakened and it obstructed the network structure of the noodles. Thus, increasing PP induced the solids leaching (cooking loss) from the noodles into the cooking water.[9] Tensile strength was important property of noodle that could express the quality of ingredients and the effect of formulation. The decrease of tensile strength was found when applied PP in the noodle. This might be due to the loss of dough structure, therefore affected the elasticity of instant noodles.[22]

Moisture content, ash and beta-carotene of instant noodles substituted with PP were significantly difference ($p \leq 0.05$). PP instant noodles had lower moisture and higher ash than control. The result was consistent with the moisture analysis according to the research of Jerusalem artichoke noodles. The noodle contained Jerusalem artichoke powder had lower moisture, protein, and fat but higher ash and carbohydrates than the original noodles.[23] Moisture content was related to the water absorption index of the noodle, and it also affected the properties of noodle processing.[21] It was found that wheat flour instant noodles had the highest moisture content, whereas, the noodle contained 20% of PP was the lowest moisture content (Table 3). The moisture content of the substance had an effect on internal diffusion of solvent and grease, thus the defatting efficiency was alternative. Some research reported that the optimum moisture content of instant noodle was 6%.Therefore, inappropriate moisture content led to increase residual lipid content.[21]

Addition of PP in instant noodles caused beta-carotene increased ($p \leq 0.05$). The instant noodles substituted with 20% PP had the highest beta-carotene content of 0.078 mg/g (Table 3). The content of beta-carotene in instant noodles products depended on the concentration of PP. Obviously, beta-carotene in noodles was not too high, probably due to beta-carotene was oxidized and degraded during heat processing.[24] However, instant noodles mixed with pumpkin powder had higher nutritional value than the control.

Table 3: Moisture, ash and beta-carotene of instant noodles substituted with PP

PP (%)	Moisture (%)	Ash (%)	Beta-carotene (mg/g)
0	10.46±1.01a	2.46±0.76e	n/a
5	9.28±0.67b	2.50±0.42d	0.019±0.09d
10	8.75±0.96c	2.65±1.04c	0.025±0.12c
15	8.34±0.05b	2.72±0.88b	0.057±0.45b
20	7.90±0.77d	2.97±0.56a	0.078±0.33a

The different superscript letters indicating mean of the same column are significantly differences ($p \leq 0.05$).
n/a = not available

Sensory Evaluation of PP Instant Noodles

Figure 2 showed sensory preferences in color, flavor, taste, texture and overall acceptance of the instant noodles. Substitution of PP in instant noodles had a significant effect on the sensory test ($p \leq 0.05$). The noodles contained 10% PP had the highest score of color, flavor, taste, texture and overall acceptance (8.77, 8.23, 8.73, 8.33 and 8.76, respectively). The total gluten content was reduced when substituted with PP in the noodle. It increased hardness and loss elasticity of noodle texture.[7] The water absorption of PP noodle was reduced that also had an effect on noodle softness.[25] However, textural changes did not affect by sensory test. Sensory evaluation showed that the panels preferred instant noodle with 10% PP more than the wheat flour noodle. This result was consistent with the sensory characterization of the native and denatured pea protein isolated noodles.[7] They reported that the instrumental could detect textural changes of pea protein isolated noodle, however, it did not affect the sensory panel.[7]

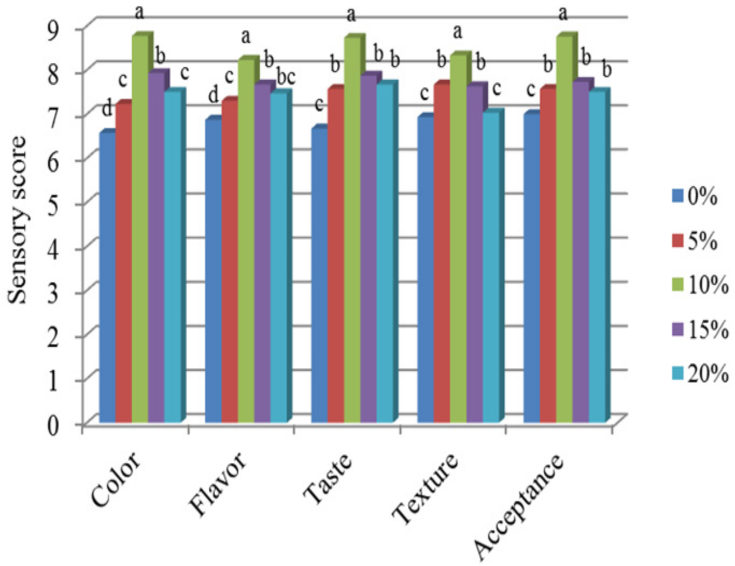

Fig. 2: Sensory evaluation of PP instant noodles was held by 9-point hedonic scaling. The different alphabets were indicated significantly differences ($p \leq 0.05$)

Conclusion

Wheat flour noodle was light-yellow, whereas, PP noodles were dark-yellow to brown. Instant noodle with high content on PP could not form gluten network as better as wheat flour noodle. Thus, the appearances of PP instant noodles were not good enough when compared with wheat flour noodle. Increasing PP resulted in a decrease of water absorption, tensile strength and moisture content of the noodle. Cooking loss of PP instant noodles tended to higher than the control. Addition of PP in instant noodles caused of increase ash and beta-carotene. The noodles contained 10% PP had the highest sensory score of color, flavor, taste, texture and overall acceptance. Thus, PP could be the option for adding nutritional value to instant noodles.

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Conflict of Interest

Authors declare that this research has no any conflict of interest.

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