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Utilization of Soymilk Residue for Wheat Flour Substitution in Gyoza Skin

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***Abstract*—**Soymilk residue is obtained as a byproduct from soymilk and tofu production with little economic value. It contains high protein and fiber as well as various minerals and phyto-chemical compounds. The objective of this research was to substitute soymilk residue for wheat flour in gyoza skin in order to enhance value of soymilk residue and increase protein and fiber content of gyoza skin. Wheat flour was replaced with soymilk residue from 0 to 40%. The soy milk residue prepared in this research contains 26.92%protein, 3.58% fiber, 2.88% lipid, 6.29% ash and 60.33% carbohydrate. The results showed that increasing soymilk residue decreased lightness (L*value), tensile strength and sensory attributes but increased redness (a*), yellowness (b*), protein and fiber contents of product. The result also showed that the gyoza skin substituted with 30% soymilk residue was the most acceptable ($p \leq 0.05$) and its protein and fiber content increased up to 45 % and 867 % respectively.

***Keywords*—**Gyoza skin, sensory, soymilk residue, wheat flour.

I. Introduction

GYOZA is a popular Japanese food which is also known as Jiaozi in China or potsticker in North America. It is widely consumed in many Asian countries. Gyoza typically consists of a ground meat and/or vegetable filling wrapped into a thinly rolled piece of dough. The wrapper dough is prepared from wheat flour as major ingredient. Gyoza (common name for Thais) is usually eaten with a soy-vinegar dipping sauce and/or hot chili sauce. In Thailand, both pan-fried and steamed gyoza are very popular as a street food, appetizer, or ready to eat food sold in supermarket.

Soymilk residue is a byproduct obtained from soymilk and tofu production and is mostly sold for animal feed due to its high protein content. However, residue from small scale producers were disposed due to their small volume which was not worth to collect for selling. One hundred and ten grams of soymilk residue is produced from one hundred gram of soybean through soymilk production. Soy milk residue contains 24-28% protein, 8-12% fat, 40-44% water insoluble fiber, 12-15% soluble dietary fiber various minerals and phyto chemical compounds. The protein extracted from soymilk residue has good nutritional quality [1]. Therefore, the utilization of soy milk residue in human food might be a good way to enhance the value of itself. The soymilk residue used as a substitute for wheat flour had been studied in various products such as cookies, Tong-muan (Thai snack), dried udon and fresh egg noodle [2] and [3]. Substitution of wheat flour with soy meal at 0-30% in fresh egg noodle decreased tensile strength, color (L* and b*) but increase color (a* value), protein and fiber content as soymeal content increased. Noodle substituted with 25% soymeal and added with 0.2% commercial gum (Isagum®) was the most acceptable [3]. Therefore, the aim of this study was to increase the protein and fiber content in gyoza skin by substituting wheat flour with little economic value soymilk residue from a small scale production.

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II. Materials and Method

A. Preparation of Soymilk Residue

Soybean (Raithip), purchased from supermarket in Bangkok, was soaked in water for 12 hour and grounded with water by electric home food grinder (Central, Thailand). Soymilk pulp was dried in a hot air oven at 70° C for 2.5 hour until the moisture content was less than 8%. Then it was blended by blender (Moulinex, DPA141, USA) and sieved through a 100-mesh screen. The dry soymilk residue was kept in sealed container at room temperature for further use.

B. Proximate Composition of Wheat Flour and Soymilk Residue

Soymilk residue and wheat flour (kite brand) were analyzed for moisture, protein, fat, fiber, carbohydrate and ash according to standard methods of AOAC [4].The analyses were done in duplicate.

C. Effect of Soymilk Residue on Physico-Chemical and Sensory Properties of Gyoza Skin

Gyoza doughs were prepared from 56.34% wheat flour, 5.64 % vegetable oil, 0.46 % salt and 37.56% water. Soymilk residue was substituted wheat flour in the formula at level of 0-40% of total flour used. The color of dough was measured by using colorimeter (Hunter Lab, Color Quest XE, USA). Tensile strength of cooked gyoza skin was measured by using texture analyzer (Lloyd Instrument, TA plus, UK). The protein and fiber content of the skin doughs were analyzed according to AOAC method [4]. All measurements were done in 10 replicates and the analyses were performed in triplicates. The experiments were done in duplicate.

Skin doughs were steamed at 100 °C for 10 minutes and cooled down before serving randomly to 30 panelists. The samples were evaluated for color, odor, softness, elasticity, and total acceptability using a 9-point hedonic scale (1=extremely dislike and 9=extremely like).

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III. Results and Discussion

A. Proximate Composition of Wheat Flour and Soymilk Residue

Table I presents the proximate composition of wheat flour and soymilk residue obtained in this study. The soymilk residue prepared contained protein, fiber, lipid and ash much higher than wheat flour.

TABLE I
PROXIMATE COMPOSITION OF WHEAT FLOUR AND SOYMILK RESIDUE

Composition	Wheat flour (% in dry basis)	Soymilk residue (%in dry basis)
Protein	11.48	26.92
Fiber	0.17	3.58
Lipid	0.85	2.88
Ash	0.4[6]	6.29
carbohydrate	86.56	60.33

Table II also showed that protein content of soymilk residue was high and agreed with [1] and [5] but greater than those of [6] and [8]. However, other compositions were different especially fiber content was much lower than those of [1], [6], and [7].The differences might come from variety of soybean, ratio of water and soy, temperature of water, and processing method [9].

TABLE II
PROXIMATE COMPOSITION OF SOYMILK RESIDUE

Composition	Amount(%) dry basis					
Protein	24-28	28.0	18.2-32.2	39.3	16.1	26.92
Fiber	52-57	-	9.1-18.6	43.1	-	3.58
Lipid	8-12	9.3	6.9-22.21	23.3	3.1	2.88
Ash	-	-	-	2.6	4.3	6.29
Carbohydrate	-	5.0	-	-	52.6	60.33
	[1]	[5]	[6]	[7]	[8]	This study

B. Effect of Soymilk Residue on Gyoza Skin Properties

Table III shows that the tensile strength of Gyoza skin and lightness (L*) of dough decreased while the redness (a*) and yellowness (b*) of dough increased as the level of soymilk residue increased. The tensile strength decrease may cause by the decrease of gluten and the incorporation of soy protein between gluten and water which interrupted the formation of a strong gluten network [10]. The result agreed with those reported on dried udon and fresh egg noodles [3].

TABLE III
PHYSICAL PROPERTIES OF DOUGH AND GYOZA SKIN SUBSTITUED WITH SOY MILK RESIDUE

Soymilk Reasidue (%w/w)	Tensile strength(N)	L*	a*	b*
0	0.11^{a}	72.11^{a}	0..50^{c}	11.60^{b}
10	0.10^{a}	70.76^{ab}	0.54^{c}	11.86^{b}
20	0.08^{b}	69.76^{ab}	0.71^{b}	12.52^{b}
30	0.05^{c}	68.65^{b}	0.76^{b}	15.59^{a}
40	0.04^{c}	64.48^{c}	0.86^{a}	17.11^{a}

Mean with different letters in the same column indicate significant differences ($p<0.05$).

Table IV shows that the protein and fiber content of gyoza skin increased up to 63 % and 1,167 % when 40 % of soy milk residue was added because it had a higher protein and fiber content than wheat flour.

TABLE IV
PROTEIN AND FIBER CONTENT OF GYOZA SKIN SUBSTITUTED WITH SOYMILK RESIDUE

Soymilk residue (%W/W)	Protein (% wet basis)	Fiber (% wet basis)
0	5.80^{e}	0.06^{e}
10	6.65^{d}	0.19^{d}
20	7.58c	0.39^{c}
30	8.42^{b}	0.58^{b}
40	9.48^{a}	0.76^{a}

Means with different letters in the same column indicate significant differences ($p<0.05$).

Table V represents the sensory 9 point hedonic score test on total acceptability of cooked gyoza skin. It was found that all attributes decreased as the soy milk residue content increased. The maximum soy meal substitution accepted by the panelists at a moderate satisfaction was 30 % though color and odor score were low due to darker color and strong beany odor. This level of substitution is higher than those reported on dried udon and fresh egg noodle [3].

TABLE V
SENSORY ATTRIBUTES OF GYOZA SKIN SUBSTITUTED WITH SOYMILK RESIDUE

Soymilk residue (%w/w)	Color	Odor	Softness	Elasticity	Total acceptability
0	7.60^{a}	7.47^{a}	7.87^{a}	7.73^{a}	8.47^{a}
10	7.53^{a}	6.67^{b}	7.27^{b}	6.93^{b}	7.67^{b}
20	6.67^{b}	6.27^{b}	7.07^{bc}	6.67^{bc}	7.00^{b}
30	5.87^{c}	5.87^{c}	6.57^{cd}	6.13^{cd}	6.27^{c}
40	5.60^{c}	5.40^{d}	5.80^{d}	5.53^{d}	5.53^{d}

Means with different letters in the same column indicate significant differences ($p<0.05$).

IV. Conclusion

Soymilk residue obtained from homemade soymilk and/or small scale production could be utilized to substitute wheat flour up to 30 % in gyoza skin to increase protein and fiber content with a moderate consumer satisfaction. Further study on improvement of texture and sensory properties of gyoza skin containing higher soymilk residue content should be carried out to increase consumer acceptability.

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