

Development of Potato Chips (Alou) with Northern Thai Green Chili Paste (Nam Phrik Noom) Flavor

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Abstract

The aim of this research was to develop the product of potato chips with northern Thai styled green chili paste flavor which is acceptable for adolescents and adults. This product consists of 91.8% potato chips and 8.2% green chili powder. Proximate analysis of fresh potato, dried potato, and fried potato chip samples was carried out. Prototypes of green chili paste were developed by comparing with two well-known brands in Chiang Mai province, and the most suitable formulation was used for developing the product. The processes of preparing green chili powder of two well-known brands in Chiang Mai province were the same as that for the prototype, with a heating time at 60°C of 12 h. As far as the sensory analysis results are concerned, the mean scores for overall liking and consumer acceptability of the prototypes were 5.8±1.4% and 95%, respectively. As for the physical qualities of the product, it was found that lightness was 53.86±0.01, redness was 0.28±0.03, yellowness was 24.91±0.59, and water activity was 0.35. The results indicate that the optimum formula consisted of fresh green chili, garlic, shallot, and fish sauce at 75%, 10%, 10%, and 5%, respectively.

Keywords: Potato chips, Northern Thai green chili paste, Spunta potato

1. Introduction

Potato chips are considered as a preferred snack food the world over due to the palatable taste and ease of preparation. Of the total quantity of potatoes produced in Thailand, about 90% is devoted to processing (as chips and snack foods), with the remaining 10% used for fresh consumption. Frito Lay is the largest potato processing company in Thailand, with a market share of 70–80%. The chip flavors include salty, salty and sour, barbeque, and cheese and onion, as well as Thai flavors consisting of seafood, crab curry, hot chili squid, shrimp, lobster, Nam-tok, and Tom Yum Goong (Kittipadakul *et al.*, 2016). In Thailand, potatoes are mostly produced in the northern part of the country. The potato growers in the country are acquainted with the contract system of the private sector. The two major varieties of potatoes planted in northern Thailand are “Atlantic,” which requires a shorter season and is currently the most popular chip processing cultivar, and “Spunta,” which is found to be the highest in yield and is usually produced and sold in the domestic market for fresh consumption.

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The leftover Spunta potatoes from fresh markets and Atlantic potatoes from chip processing which are collected by agents and sold to local potato chip processing plants are called “alou” or “munkalaya” in Thai language (Wongwiwat, 2012). The green chili paste that is prepared in northern Thai style is called “Nam Phrik Noom” (spicy green chili dip) in Thai language; it is a local food in the northern part of Thailand and forms a crucial part of the traditional knowledge of the local people in the community (Mesomboonpoonsuk, 2011). Nam Phrik Noom is made of roasted chili and shallot with the skin peeled off after roasting; it has a unique aroma from desirable volatile compounds such as 2-methylbutanoate, 4-methylpentanoate, and diallylsulfide, and their aroma increases the most when enhanced by thermal processes. (Apichartsrangkoon *et al.*, 2013). The chip with Northern Thai green chili paste flavor has not yet been developed. The advantages of this research are the new local food product as a tourist attraction was developed and the value of alou was increased. The objective of this study was to develop a product of alou with a green chili paste flavor in northern Thai style which would be suitable for consumers in the local area and tourists as a tourist attraction.

2. Materials and Methods

2.1 Study of production of potato chips (Alou) with Northern Thai green chili paste flavor

2.1.1 Potato chips

Potato varieties, Spunta which were grown in Chiang Mai province, Thailand, were shifted to the laboratory. The potatoes were washed, sorted, and graded into homogenous lots. The peeled tuber was sliced (1.2–1.5 mm thick) by hand, washed, and boiled in 1.5% NaCl₂ solution at 100°C for 10–15 minutes; allowed to drip off; and dried in the sun before frying. After drying, the chips were fried in an electric fryer at 180–185°C for 3 min using palm oil. The pre and post products through the processing are shown in Figure 1.

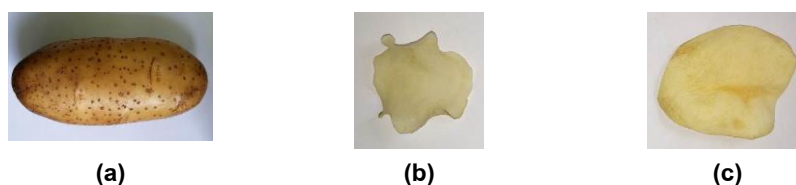


Figure 1 The variety of Spunta (a); dried potato chip (b); and fried potato chip (c)

2.1.2 Prototypes of northern Thai green chili powder

Northern Thai green chili powder was produced by blanching fresh green chili (1,500 g) in 10% NaCl₂ solution at 80°C for 5 min and then drying garlic (200 g) and shallots (200 g) at 300°C for 15 min. After that, the peeled garlic and shallots were seasoned with fish sauce (70 g), and all the ingredients were blended together. This mixed ingredient was poured into trays and placed in an oven at 60°C for 12 h and then ground into a fine powder using a blender. The prototype of the green chili powder was compared with two well-known northern Thai green chili products which were blended and dried for the analyses of physical and chemical properties and for sensory evaluation.

2.2 Physical and chemical analyses

AOAC (2005) was used to determine the content of moisture, ash, protein, fat, carbohydrate, and fiber of the potato, dried potato, and potato chip samples. Changes in the diameter of the potato, dried potato, and potato chip samples through the process were also measured. After the drying of the green chili paste, the powder samples of two well-known brands (B1 and B2) and the prototype samples (P) were placed in an oven at 105°C until a constant weight was reached for estimating the moisture content, according to the AOAC method. The color values of the green chili powder of B1, B2, and the P samples were measured as L*-value, a*-value, and b*-value on the Hunter scale using a Minolta colorimeter.

2.3 Experimental Design

Completely randomized design (CRD) was used to find the optimum amount of the green chili powder. The factor was varied at 2 levels as 0 g and 2 g of green chili powder coated chips with oil by using food oil spray and with no oil in each product (B1, B2, and P). Chips were thoroughly mixed with green chili powder in tumble drum. Factors of green chili powder with and without oil coating were chosen for sensory analysis. The average recovery percentages of the coated chips with and without oil coating were calculated by using the equation

$$\% \text{ recovery} = \left[\frac{\text{(certain amount of green chili powder (2g) at before mixed with chips (100 g) - (retained amount of green chili powder after mixing))}}{\text{(retained amount of green chili powder after mixing)}} \right] \times 100.$$

2.4 Sensory evaluation

Fifty-five panelists including students and faculty members who were habitual consumers of potato chips and green chili paste were selected as judges for the sensory evaluation. The judges were requested to record their degree of preference for flavor, taste, color, and overall liking according to the 9-point hedonic scale. For the prototype products of green chili powder, sensory evaluation was carried out using a 9-point hedonic scale together with a 9-point “just about right” scale. The hedonic scale ranged from 1, representing

“extremely dislike,” to 9, representing “extremely like. “The “just about right” scale ranged from “Too weak for flavor and taste” to “Too strong for flavor and taste”. For product development, the 9-point hedonic scale was used with 55 panelists for the same sensory characteristics mentioned above. The products, namely coated chips with oil and with no oil which were mixed with green chili powder were evaluated by 55 panelists for the characteristics of color, flavor, taste, and overall liking. The samples were served in a randomized order in a zip pack and coded with three random digits.

2.5 Statistical analysis

The means and standard deviations were calculated in the experiment. ANOVA and comparison of the differences in the means were carried out using Duncan’s new multiple-range test, at $P < 0.05$.

2.6 Packaging design

The packaging design and development were done by following the requirements of the manufacturer of this product.

3. Results and Discussion

3.1 Physical and chemical analyses

The dried potato chip and the fried potato chip samples were found to be high in the percentages of protein, fat, carbohydrate, fiber, and ash than fresh potato samples. In contrast, the percentage of moisture content of fresh potato samples was higher than the other two types of samples. The percentage of fat in the fried potato chips was found to have increased dramatically when compared with the fresh potato and the dried potato samples because of the uptake of oil by the dried potato chips during frying in the electric fryer. (Table 1)

Table 1 Proximate analysis of fresh potato, dried potato chip, and fried potato chip samples

Proximate Analysis (n = 2)	Protein (%)	Fat (%)	Carbohydrate (%)	Fiber (%)	Moisture Content (% Dry Matter)	Ash (%)
Fresh Spunta potato	1.20	0.10	16.52	0.46	80.76	0.96
Dried potato chip	5.28	0.31	77.98	1.74	12.32	2.37
Fried potato chip	3.48	19.95	72.85	1.39	1.00	1.33

3.2 Product development

Prototypes of green chili powder in northern Thai style were developed by comparing with two well-known brands in the Chiang Mai province. In Table 2, the results of the physicochemical analyses of the three types of green chili powder in northern Thai style are presented; these results were used to evaluate the most appropriate prototype formulation.

The developed prototype was found to have the highest percentage yield (18.20%) when compared with the other two products (B1 and B2). Upon comparing the concentrations of moisture content of the three products, it was found that the moisture content values of B1, B2 and P were 4.3, 4.4, and 4.5, respectively. The highest a_w concentration was registered by B1 (0.365), followed by P (0.350) and B2 (0.344).

The color of the green chili powder is significance factor as the color is primarily associated with consumer acceptance (Srisajjalertwaja *et al.*, 2012). Color values (L^* , a^* and b^*) of B1, B2, and P were observed to have changed through the baking process. The colors of all the products were darker, less green, and more yellow. L^* -values correspond to the lightness of the green chili powder. The L^* -values of B1, B2, and P were 43.67 ± 0.08 , 49.14 ± 0.29 , and 53.86 ± 0.01 , respectively. The greenness of the green chili powder is measured by its a^* -value. The a^* -values of B1, B2, and P were 3.47 ± 0.04 , 4.30 ± 0.05 , and 0.28 ± 0.03 , respectively. The yellowness of the green chili powder is measured by its b^* -value. The b^* -values of B1, B2, and P were 16.25 ± 0.11 , 21.83 ± 0.14 , and 24.91 ± 0.59 , respectively. The product P had lower a^* -values than products B1 and B2, and higher L^* -values and b^* -values than the other two products. From the results, it can be suggested that the yellowness of the product P developed faster than B1 and B2. From this result, it can be explained that high values of drying air temperature affect the color of the dried product due to a non-enzymatic browning reaction (Phoungchandang *et al.*, 2008).

From Table 3, it is clear that the average recovery percentage of green chili powder on coated chips with oil of B1, B2, and P was 5.7%; this can be compared with that of coated chips with no oil. The average recovery percentages of the coated chips with oil of products B1, B2, and P were helped to increase by the oil coating to become 0.4%, 16.4%, and 0.4%, respectively.

Table 2 Physicochemical analyses of northern Thai green chili powder

Sample	% yield	Color analysis			A_w	Moisture Content (% Dry Matter)
		L*	a*	b*		
Brand 1(B1)	17.04%	43.67±0.08	3.47±0.04	16.25±0.11	0.365	4.3
						
Brand 2 (B2)	17.12%	49.14±0.29	4.30±0.05	21.83±0.14	0.344	4.5
						
Prototype (P)	18.20%	53.86±0.01	0.28±0.03	24.91±0.59	0.350	4.4
						

Table 3 Adhesiveness and dispersion of green chili powder in northern Thai style on chips

Sample	Coated chips with no oil	Coated chips with oil
Brand 1 (B1)		
Brand 2 (B2)		
Prototype (P)		

3.3 Sensory evaluation of developed product

The results for overall liking revealed that the prototype with no oil coating (P) had the most appreciated sensorial score, with statistical significance (Table 4). Flavor, or the volatile component, is often described as spiciness from the capsaicinoids in the case of green chili paste in northern Thai style, and it is an important part of the sensorial attributes for the consumer's appreciation. A minor ingredient in Nam Phrik Noom was fish sauce, a flavor enhancer (Srisajjalertwaja *et al.*, 2012). Other ingredients such as roasted garlic and shallot are also potentially affected to the flavor and volatile compounds of product.

Capsaicinoids are alkaloids that include capsaicin and dihydrocapsaicin which are responsible for more than 90% of the pungency of the capsicum species (Kosuge and Furata, 1970). Flavor is the sensory impression of food detected by the blending of the senses of taste and smell. It is the overall resultant impression derived by the taste buds in the mouth and the aroma detected by the olfactory epithelium in the nose (Abbasi *et al.*, 2015). The volatile components associated with flavor, including hydrocarbons, esters, and alcohols, are found in large amounts in fresh green chili, whereas other volatile classes such as aldehydes, ketones, sulfur-containing compounds, furans, and pyrazine are present in lesser quantities (Srisajjalertwaja *et al.*, 2012).

The other important sensorial attributes of the green chili paste are color, appearance, and aroma (Srisajjalertwaja *et al.*, 2012). The highest scores for the products in terms of color and flavor were obtained for the P: coated chips with oil and the P: without oil coating samples. The prototype product had the highest score in taste and color, as well, with statistical significance. This can be explained by the fact that green chilies were blanched before baking, and that must have helped to preserve the color and flavor of all the prototype samples and helped prevention of enzymatic browning reaction (Ioannou and Ghoul, 2013). According to the panelists, no significant difference was observed between the coated chips with oil (B1, B2, and P coated chips with oil) and the coated chips with no oil (B1, B2, and P) with regard to all the sensorial attributes.

3.4 Packaging design

The developing of the packaging design for this product was carried out by using a metalized material which would help protect the product from the permeability of oxygen, humidity, and light. The product details have been shown on the package by means of food laws and regulations of Thailand, including nutrition facts, net weight, manufacturing date, and expiration date.

Table 4 Average recovery percentage of green chili powder in northern Thai style on chips

Sample	Coated chips with oil			Coated chips with no oil		
	Total powder	Remaining	%	Total	Remaining	%
	(g)	Powder (g)	recovery	powder (g)	powder (g)	recovery
B1	8.2 ± 0.2	4.3 ± 0.3	53.30	8.3 ± 0.3	4.4 ± 0.1	52.80
B2	8.2 ± 0.1	6.4 ± 0.5	78.80	8.2 ± 0.2	5.1 ± 0.3	62.50
P	8.4 ± 0.2	4.2 ± 0.2	50.60	8.1 ± 0.2	4.1 ± 0.6	50.20

Note: data express in mean +- standard deviation with triplicates

Table 5 Sensory analysis of green chili powder in northern Thai style coated chips with oil and without oil

Sample	Sensory Evaluation			
	Overall liking	Color	Flavor	Taste
B1: coated chip with oil	5.5±1.6 ^b	5.2±1.8 ^b	5.0±1.4 ^c	5.7±1.6 ^{ab}
B1: without oil coating	5.7±1.5 ^b	5.5±1.7 ^b	5.4±1.5 ^{bc}	5.4±1.8 ^b
B2: coated chip with oil	5.8±1.5 ^b	5.8±1.7 ^b	5.5±1.5 ^{bc}	5.4±1.6 ^b
B2: without oil coating	5.7±1.4 ^b	5.7±1.5 ^b	5.1±1.3 ^c	5.6±1.5 ^b
P: coated chip with oil	6.1±1.5 ^{ab}	6.1±1.7 ^{ab}	5.9±1.5 ^{ab}	6.1±1.5 ^{ab}
P: without oil coating	6.4±1.3 ^a	6.0±1.6 ^{ab}	6.3±1.5 ^a	6.3±1.7 ^a

Note: Means followed by the same letter in columns and rows are not significantly different ($p>0.05$).

Remark: B1 = Brand 1, B2 = Brand 2, and P = Prototype.

4. Conclusion

A product of potato chip (alou) with green chili paste flavor in northern Thai style was developed, which is suitable for consumers in the local area and tourists as a tourist attraction. From the sensory evaluation, it was shown that the prototype sample had the highest score in the sensorial attributes of overall liking, flavor, and taste. The highest score as regards the attribute of color was registered by the prototype of coated chips with oil, which was followed by the prototype of coated chips with no oil. The most appropriate formulation of the prototype was chosen. This product consists of 91.8% potato chip and 8.2% green chili powder, and it has a high score in taste, with statistical significance.

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