

Production of Longan Powder Using Hot Air Drying for Sprinkling on Nama Chocolate

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Abstract

The aim of this study was to determine the optimal drying condition for longan powder using hot air and the suitable amount of maltodextrin to act as an anticaking agent in longan powder production. Longan powder was produced from semi-dried longan, containing a moisture content of approximately 11%. The drying experiments were carried out at temperatures of 60, 95, 100, and 105°C for durations of 80, 85, and 90 min. The obtained longan powder was subsequently used for sprinkling on nama chocolate. Analysis of the physical and chemical properties and sensory evaluation of the products were conducted. The results of this study showed that the optimal drying condition for longan powder was found at a hot air-drying temperature of 100°C for 90 min. The suitable amount of maltodextrin for anticaking of the longan powder was 10% by weight of the product. According to the consumer panel (n = 50) evaluation of longan powder sprinkled on nama chocolate, it was found that the medium liking score was 42% (mean score = 6.60 ± 1.22) for the appearance and 34% (mean score = 6.36 ± 1.42) for the odor. The “very like” score was 62% (mean score = 7.78 ± 0.76) for the taste and the overall liking score for the samples was 58% (mean score = 7.56 ± 0.80). Out of the 50 participating consumers, 86% accepted and were willing to buy the product.

Keywords: Hot air drying, Maltodextrin, Longan powder, Nama chocolate

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1. Introduction

Longans (*Dimocarpus longan* Lour.) are a type of commercial fruit grown in the northern part of Thailand. They are very famous for their deliciously sweet and thick flesh, longan production in the market has continuously increased. Therefore, the price has decreased drastically (Kulwattanaporn, 2004). Dried longan flesh is widely consumed as dried fruit. It was used to solve this problem. Hot air dryers are most often used for the production of dried, whole longans. The brown to dark brown flesh is the main problem regarding the dried longan product. An increase in the brown color, due to an enzymatic browning reaction, might occur because of inappropriate harvesting that results in damaged longans (Tassanaudom and Kengkhetkit, 2009). Thus, the objective of this research was to develop a new dried longan product with brown flesh to add value to this fruit, and to find the optimal drying condition for longan powder by hot air drying and a suitable ratio for maltodextrin, which acts as an anticaking agent (Adhikarii *et al.*, 2004) during longan powder production for sprinkling on nama chocolate. (Japanese version of traditional French ganache). Nama ("fresh") chocolate is a delectable mixture of chocolate and cream prized by chocolate aficionados around the world (Hirofumi, 2011).

2. Materials and Methods

The longan fruit cultivar Edor was obtained from San-pa-tong, in the Chiang Mai province of Thailand. Before use in the experiment, the longan was stored in a refrigerator at 4°C.

2.1 Longan powder and Nama chocolate preparation

Dried longan samples were eventually placed in trays and placed in a hot air oven at various temperatures of 95, 100 and 105°C for various times for 80, 85 and 90 min. Subsequently, the sample were ground into a powder by use of a blender and passed through 100 mesh sieves to result a fine powder. To the longan powder samples, maltodextrins (Dextrose Equivalent = 10) were added at concentrations of 10%, 20% and 30%. The experimental design was a 3x3 factorial in CRD with triplicate to study the most appropriate formula for sprinkling on nama chocolate. All longan powder samples were blended and stored in a dry place until analysis of the physical and chemical properties.

2.2 Physical and Chemical analyses

AOAC (2005) was used to determine the moisture, ash, protein, fat, carbohydrate and fiber content of the semi-dried longan samples. After drying of the longan powder samples: control (L1), longan powder+10% maltodextrins (L2), longan powder+20% maltodextrins (L3) and longan powder+30% maltodextrins (L4), the samples were placed in an oven at 105°C until a constant weight was reached, in order to estimate the moisture content, according to

the AOAC method. The color values for all the longan powder samples from the L1, L2, and L3 samples were measured as L-value, a-value, b-value, chroma-value, and hue-value on the Hunter scale using a Minolta colorimeter (Konica Minolta, CR-400 Series). The %degree of caking (GEA Niro, 2005), total density (Jinapong *et al.*, 2008), and degree of angle repose (θ) (Shittu and Lawal, 2007) were also measured.

2.3 Product development

Plain chocolate was melted at 60°C and cooled to 30°C. Further, the chocolate was poured into a polycarbonate mold and left at 4°C for 24 h. The Nama chocolate product was prepared based on the commercial formula that was kindly provide by the Narak coffee shop, Chiang Mai, Thailand. The most suitable formula for longan powder was primarily chosen based on the results of the color analysis and sensory evaluation.

2.4 Sensory Analysis

Thirty panelists, who were habitual consumers of nama chocolate and longan powder products, were selected as judges for the sensory evaluation. The judges were requested to record their degree of preference for the flavor, taste, sweetness, bitterness, color, aggregation, and overall liking, according to the 9-point hedonic scale. For the prototype products of nama chocolate sprinkled with longan 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 “dislike extremely”, to 9, representing “like extremely”. The “just about right” scale ranged from “too weak flavor” to “too strong flavor”. For product development, the 9-point hedonic scale was used with 55 panelists for the same sensory characteristics mentioned above. The products were also evaluated by 50 panelists for product acceptance and likelihood to purchase this product in the future. All samples were served in a randomized order in a zip pack and coded with three random digits (Viriyajaree, 1992).

2.5 Statistical Analysis

The means and standard deviations were calculated for the results of the experiments. ANOVA and comparison of the differences of the means were carried out using Duncan’s new multiple-range test, at $p < 0.05$ by use the SPSS software program version 15.

3. Results and Discussion

3.1 Physical and chemical analyses

The physical and chemical analyses of the dried longan are presented in Table 1. The longan powder samples, dried at 95°C for 80 min, were found to have the highest moisture content, when compared with the other samples (as shown in Table 2). Upon comparison of the water activity values of the samples, it was found that the water activity values ranged from 0.37 ± 0.00 to 0.46 ± 0.01 . The highest L^* value was registered from the 100×90 treatment (39.26 ± 0.68), followed by the 10×80 treatment (38.16 ± 1.41) and the 105×85 treatment (36.83 ± 1.27) (Table 2). Total densities (g/mL) of the samples were found to range from 0.53 ± 0.01 to 0.81 ± 0.02 . The color of the longan powder is of significance, as the color is primarily associated with consumer acceptance (Tassanaudom and Kengkhetkit, 2009; Chunthaworn *et al.*, 2011). The color values (L , a^* , b^* , chroma, and hue) of the samples were observed to have changed during the drying process. The colors of all the products were more intense. In general, higher drying air temperatures affect the color of the dried product, because of a non-enzymatic browning reaction (Phoungchandang *et al.*, 2008). According to the L^* -value and the a_w value, the optimal drying condition for longan powder by a hot air dryer was 100°C for 90 min. In Table 3, the L -values correspond to the lightness of the green chili powder. The L -values of L1, L2, L3 and L4 were 46.68 ± 0.33 , 48.75 ± 0.09 , 50.13 ± 0.14 , and 50.84 ± 0.24 , respectively. The redness of the samples was measured by the a^* -value. The a^* -values of L1, L2, L3 and L4 were 9.89 ± 0.25 , 9.92 ± 0.07 , 9.36 ± 0.18 , and 8.13 ± 0.12 , respectively. The yellowness of the samples was measured by the b^* -values. The b^* -values of L1, L2, L3 and L4 were 18.77 ± 0.27 , 18.89 ± 0.11 , 17.71 ± 0.57 , and 15.59 ± 0.14 , respectively. The hue colors of the samples did not differ significantly ($p>0.05$). The chroma value decreased as the maltodextrin concentration increased. The hue angle range was within the 90° region, which suggests an apparent reddish yellow color (Pedisic *et al.*, 2009). The L2 was chosen for product development. L2 had lower L^* -values than L3 and L4 and higher a^* -values and b^* -values than L3 and L4. From the results, it can be suggested that the redness and yellowness of L2 were suitable for the developed product (L5), as shown in Figure 1.

Table 1 Physical and chemical analyses of dried longan samples.

Physical and Chemical analyses	Mean±S.D.
Moisture Content (%)	11.16±0.33
Water activity (a_w)	0.609±0.0015
Ash (%)	4.47±0.03
Fat (%)	0.70±0.02
Fiber (%)	0.84±0.04
Protein (%)	4.98±0.09
L^*	32.47±1.05
a^*	1.87±0.64
b^*	3.45±0.41
Hue (h°)	62.00±0.75
Chroma (C^*)	3.94±0.59

Table 2 Physical and chemical characteristics of longan powder samples.

Treatment	L^*	a^*	b^*	Chroma	Hue	a_w	Moisture content (%)	Total density (g/mL)
Temperature								
95	33.91±0.88 ^b	3.14±0.91 ^b	4.00±0.96 ^b	5.16±1.25 ^b	52.57±2.76 ^b	0.44±0.02 ^a	3.42±0.39 ^a	0.55±0.02 ^c
100	36.60±2.17 ^a	4.96±1.30 ^a	6.62±1.85 ^a	8.28±2.25 ^a	23.02±1.30 ^{ab}	0.42±0.01 ^b	2.68±0.38 ^b	0.67±0.04 ^b
105	37.11±1.28 ^a	4.50±1.27 ^a	6.38±1.70 ^a	7.83±2.11 ^a	54.88±1.45 ^a	0.38±0.02 ^c	1.75±0.44 ^b	0.77±0.03 ^a
Time								
80	35.33±2.38 ^b	3.64±0.76 ^b	5.52±2.24 ^{ab}	6.96±2.67 ^{ab}	53.72±2.85 ^a	0.43±0.03 ^a	3.09±0.72 ^a	0.63±0.09 ^c
85	35.51±1.58 ^b	3.65±1.10 ^b	5.09±1.32 ^b	6.31±1.60 ^b	53.55±1.53 ^a	0.40±0.03 ^b	2.36±0.80 ^b	0.66±0.09 ^b
90	36.78±2.05 ^a	5.33±1.50 ^a	6.38±0.05 ^a	7.98±2.49 ^a	53.19±2.03 ^a	0.40±0.03 ^b	2.40±0.72 ^b	0.69±0.10 ^a
Temperature x Time								
95 x 80	33.27±0.82 ^e	2.80±0.35 ^c	3.37±0.92 ^e	4.51±1.36 ^d	52.21±3.64 ^b	0.46±0.01 ^a	3.91±0.64 ^a	0.53±0.01 ^h
95 x 85	33.74±0.65 ^e	2.68±1.07 ^c	3.75±0.26 ^{de}	4.68±0.41 ^{cd}	53.29±1.67 ^{ab}	0.43±0.00 ^b	3.09±0.22 ^b	0.58±0.01 ^g
95 x 90	34.73±0.57 ^{de}	3.96±0.74 ^{bc}	4.91±0.93 ^{cde}	6.27±1.20 ^{cd}	52.21±3.64 ^b	0.43±0.01 ^b	3.26±0.11 ^b	0.57±0.02 ^g
100 x 80	34.58±0.87 ^{de}	4.15±0.60 ^{bc}	5.40±0.48 ^{cd}	6.81±0.75 ^{cd}	52.61±1.75 ^{ab}	0.43±0.01 ^b	3.12±0.15 ^b	0.63±0.01 ^f
100 x 85	35.96±0.51 ^{cd}	4.25±0.48 ^{bc}	5.54±0.57 ^{cd}	6.91±0.73 ^{cd}	52.53±1.34 ^{ab}	0.42±0.00 ^{bc}	2.64±0.10 ^c	0.67±0.01 ^e
100 x 90	39.26±0.68 ^a	6.50±0.88 ^a	8.91±1.13 ^a	11.03±1.40 ^a	53.91±0.33 ^{ab}	0.40±0.00 ^{cd}	2.29±0.17 ^d	0.72±0.01 ^d
105 x 80	38.16±1.41 ^{ab}	3.96±0.45 ^{bc}	7.81±2.45 ^{ab}	9.57±2.62 ^{ab}	56.34±0.85 ^a	0.40±0.00 ^d	2.26±0.18 ^d	0.74±0.01 ^c
105 x 85	36.83±1.27 ^{bc}	4.02±1.13 ^{bc}	6.01±1.52 ^{bc}	7.26±1.90 ^{bc}	54.83±0.77 ^{ab}	0.37±0.00 ^e	1.34±0.13 ^f	0.77±0.01 ^b
105 x 90	36.34±0.51 ^c	5.53±1.63 ^{ab}	5.34±0.42 ^{cde}	6.65±0.61 ^{cd}	53.45±0.92 ^{ab}	0.38±0.02 ^e	1.64±0.22 ^e	0.81±0.02 ^a

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

Table 3 Physical and chemical analyses of longan powder mixed with various concentrations of maltodextrin

Physical and Chemical analyses	% Maltodextrin (w/w)			
	0 (L1)	10 (L2)	20 (L3)	30 (L4)
Moisture content (%)	3.80±0.05 ^c	4.15±0.19 ^b	4.16±0.19 ^b	4.45±0.14 ^a
Water activity (a_w)	0.27±0.003 ^d	0.28±0.005 ^c	0.29±0.002 ^b	0.30±0.003 ^a
Total density (g/ml)	0.63±0.02 ^c	0.67±0.01 ^b	0.68±0.02 ^b	0.72±0.01 ^a
L [*]	46.68±0.33 ^d	48.75±0.09 ^c	50.13±0.14 ^b	50.84±0.24 ^a
a [*]	9.89±0.25 ^a	9.92±0.07 ^a	9.36±0.18 ^b	8.13±0.12 ^c
b [*]	18.77±0.27 ^a	18.89±0.11 ^a	17.71±0.57 ^b	15.59±0.14 ^c
Hue ^{ns}	62.32±0.09	62.46±0.16	62.13±0.49	62.44±0.15
Chroma	21.32±0.53 ^a	21.36±0.13 ^a	20.03±0.58 ^b	17.58±0.18 ^c
Degree of caking (%)	9.78±0.82 ^a	3.59±0.92 ^c	5.08±0.33 ^b	5.30±0.18 ^b
Degree of angle repose (θ)	38.00± 1.00 ^a	35.33± 0.58 ^b	34.83± 0.76 ^b	31.83± 0.29 ^c

Note: a,b,c means followed by the same letter in columns and rows are not significantly different ($p>0.05$)

3.2 Sensory evaluation of the developed product

The results for overall liking from the panelists ($n = 30$) revealed that the longan powder with 10% maltodextrin had the most appreciated sensorial score for color and aggregation with statistical significance (see Table 4). However, there were no statistical differences found in the sensorial scores for odor, sweetness, bitterness and taste at all maltodextrin concentrations. L2 had a higher of degree of angle response than L3 and L4 and lower of degree of caking than L3 and L4.

The consumer panels ($n = 50$) evaluated the samples of longan powder sprinkled on nama chocolate. The medium liking score was 42% (mean score = 6.60 ± 1.22) for the appearance and 34% (mean score = 6.36 ± 1.42) for the odor. The “very like” score was 62% (mean score = 7.78 ± 0.76) for the taste, and the overall liking score of the samples was 58% (mean score = 7.56 ± 0.80). The product also obtained 86% product acceptance and the consumer decision to buy this product. The reasons behind the purchasing decision for this product were new product, tastes good, and tourist attraction souvenir at 76%, 72% and 60% respectively (Figure 2).

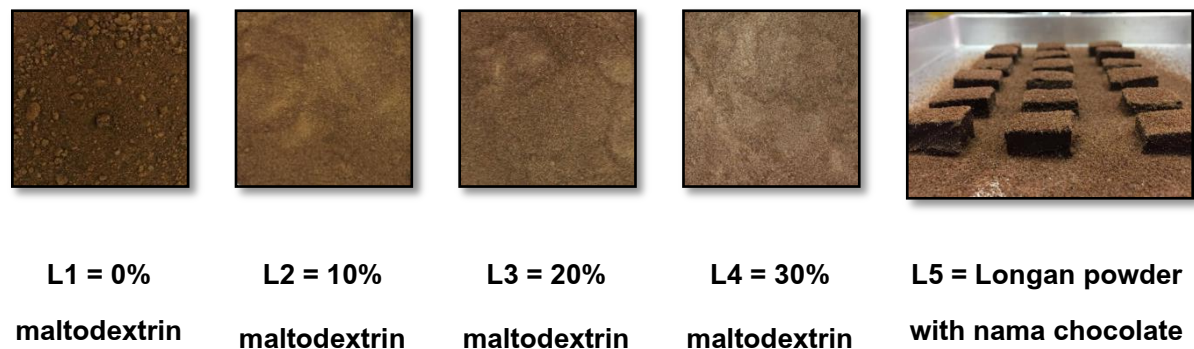


Figure 1 Longan powder at various maltodextrin concentration and the developed product

Table 4 Sensory analysis of longan powder with various maltodextrin concentrations

%Maltodextrin	Color	Odor ^{ns}	Sweet ^{ns}	Bitter ^{ns}	Taste ^{ns}	Aggregation	Overall liking
0 (Control)	6.70±1.92 ^a	5.97±1.33	6.13±1.33	5.60±1.52	5.93±1.36	6.07±1.44 ^b	6.13±1.38 ^b
10	6.67±1.21 ^a	6.23±1.31	6.23±1.28	5.40±1.59	6.13±1.17	6.83±1.15 ^a	6.73±1.20 ^a
20	5.90±1.24 ^b	6.27±1.17	6.40±1.13	5.67±1.56	6.23±0.97	6.70±1.44 ^a	6.30±1.09 ^{ab}
30	5.90±1.32 ^b	6.17±1.29	6.40±1.25	5.60±1.61	6.30±1.15	6.70±1.21 ^a	6.40±0.89 ^{ab}

Note: a,b,c means followed by the same letter in columns and rows are not significantly different ($p>0.05$)

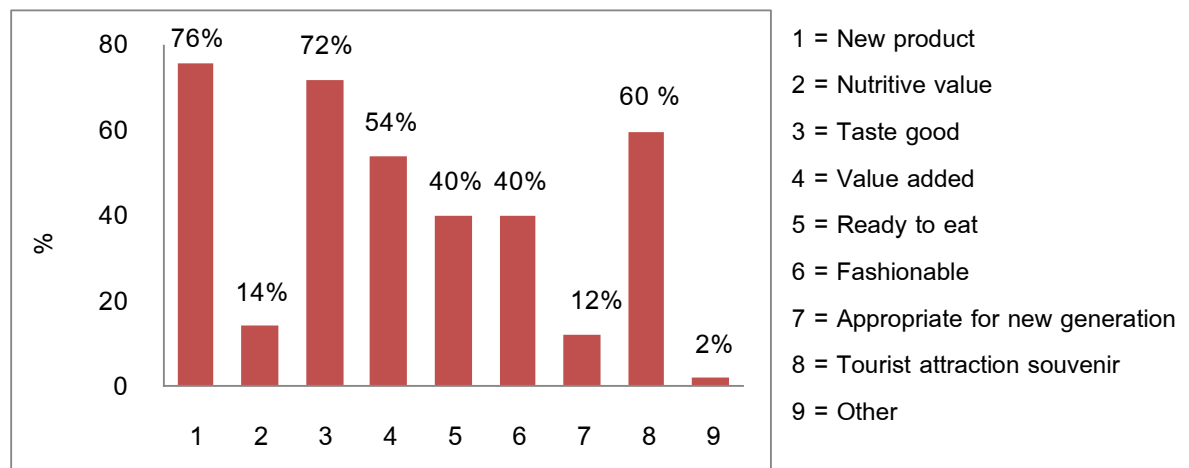


Figure 2 Purchasing reasons for consumers

4. Conclusion

Nama chocolate and longan powder were mixed with Japanese and Thai styles to develop a new product, which is suitable for consumers in the local area as well as serves as an attraction for tourists. The optimal drying condition for longan powder by hot air drying was 100°C for 90 min. The suitable ratio for maltodextrin which acts as an anticaking agent for the longan powder, was 10% maltodextrin. Results from 30 untrained panelists showed that the attributes color, odor, sweetness, bitterness, taste, aggregation, and overall preference for L2 (10% maltodextrin) received score of “like slightly” to “like moderately” with values of 6.67 ± 1.21 , 6.23 ± 1.31 , 6.23 ± 1.28 , 5.40 ± 1.59 , 6.13 ± 1.17 , 6.83 ± 1.15 and 6.73 ± 1.20 respectively, and these values were significantly different ($p \leq 0.05$). The new product also obtained 86% product acceptance and likelihood purchase this product.

Acknowledgements

This research was funded by the Faculty of Agro-Industry at Chiang Mai University in Chiang Mai, Thailand.

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