# The Development of Choux Cream Filling Products from Cassava

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**KEYWORDS**
Cassava, Filling, and choux cream filling

**ABSTRACT:**
Cassava is an economic crop in Thailand. At present, the value of cassava is likely to decrease significantly. This research aims to study the use of the Ha-Na-Tee cassava breed to be developed as a choux cream filling product to establish opportunities and value added to cassava produced in Thailand. Study the development process of filling products by using as much cassava as possible at 40, 60, and 80% of the total weight, and assess the quality of choux cream filling products by analyzing physical, chemical, and sensory properties. The result showed that an increasing the amount of cassava gave the dark color, which is consistent with a significant decrease in lightness (L*), While redness (a *), yellowness (b *), and chroma (C *) significantly increased ($p < 0.05$). The result also found that a higher amount of cassava increased firmness, consistency, and cohesiveness values were significantly higher than the control sample (CCFC) ($p<0.05$)—sensory evaluation using a 9-point hedonic scale. The result showed that the samples using cassava at 60% (CCF-60) accepted high scores in appearance, color, odor, taste, texture, and overall linking. This research shows that cassava has the potential to increase the opportunity to develop into choux cream filling products and can be used as food ingredients. Cassava is an opportunity to develop into other types of confectionery products, which should be further studied.

## 1. Introduction

Cassava is a food crop for humans around the world, including Thailand. It is grown in every region in Thailand. Especially in the eastern region, Northeast, and upper northern regions, cassava is a plant that can grow on many types of soil. Resistant to drought conditions well. Cassava production in 2019 will be released to the market from January to March 2019 with a quantity of 20.08 million tons, approximately 67 percent of the total production (Montira et al., 2019). Cassava is a raw material in many industries, such as food, animal feed, and other substances. For sweeteners, chemicals, and energy, domestic demand is approximately 25-30 percent, while the other 70-75 percent is exported. in the form of cassava lines, cassava pellets, cassava slices, cassava flour, and modified cassava flour. Exports of cassava products decreased by 4.58 percent to a value of 98,585 million baht, estimated in October 2018 (Office of Agricultural Economics, 2018). Cassava has nutritional value that provides a high amount of energy. Most of the energy comes from starch, and resistant starch was found to contain 5.7-7.07 percent (Ogbo& Edith, 2015). The resistant starch is not digested and absorbed in the stomach and small intestine. It can pass through the large intestine. To provide food for natural prebiotic microorganisms to stimulate healthy probiotic microorganisms, which is beneficial to the human body, including helping to balance the digestive system. Produces short-chain cassava fatty acids and stimulates the immune system (Dhingra et al., 2012)

Over the past several years, consumers have been interested in innovative, healthy, ready-to-eat food products. Choux cream is a baked product classified in the pastry group. The main ingredients are wheat flour, fat, milk, and eggs. It is spherical and has cracks around which are caused by the expansion of steam, making it shaped like a cauliflower. The inside is hollow to hold various flavored

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fillings. The most popular filling used is custard cream. It is a creamy, moist filling made from ingredients consisting of eggs, fresh milk, sugar, salt, and flour, mixed and heated until the mixture is cooked and thickened (Rinsky& Laura, 2009).

The most common use of cassava is conversion into flour, replacing some wheat flour in baked goods. Phanit and Witchuda (2013) studied cassava flour and partially substituted wheat flour in the production of butter cookies. It was found that cassava flour could be used as a substitute for wheat flour at a maximum of 70 percent, consistent with Benjaporn et al. (2003), who reported that crispy pies produced by cassava flour substituted for wheat flour. It can be substituted at a maximum of 30 percent, which is the most accepted. However, there have been few reports of the use of whole ripe cassava tubers to be developed as a food product. This research aims to examine the quality of choux cream filling by analyzing the physical and chemical properties and evaluating sensory testing of choux cream filling developed with cassava to increase the opportunity for development into food products.

## 2. Research Methodology

This is a quasi-experiment research.

### 2.1 CassavaPreparation

1)Use cassava Ha-Na-Tee breed for the experiment; 2) Bring fresh cassava from the market; 3) Rinse thoroughly with tap water to remove any debris; 4) Peel the skin and wash it thoroughly again; 5) Cut cassava into pieces of similar size, approximately 3×3 centimeters. 6) heat with boiling steam (95-98 degrees Celsius) on an electric stove for 30 minutes; 7) Grind with a chopper for 1 minute. It is ready for choux cream filling production.

### 2.2 Preparing the choux cream shell

Ingredients for preparing the choux cream shell (Chetanipat, 2017) include all-purpose wheat flour 19.47%, baking powder 0.39%, clean water 32.09%, salt 0.13%, fresh butter 12.84%, eggs 35.30%. Mix wheat flour and baking powder to prepare the choux cream shell, sift, and prepare. Then heat fresh butter, clean water, and salt until boiling; then add the prepared sifted flour, stir until the dough is cooked and does not stick to the container, then rest until the dough is warm. Add the eggs and mix well until it has a smooth appearance. Then, scoop the dough into a piping bag and pipe into round shapes about 1.5 centimeters in diameter, spaced about 5 centimeters apart, onto a baking sheet lined tray, bake at 180 degrees Celsius for about 15 minutes, until the dough has expanded and cooked through, remove from the oven and let cool, stuff the filling and sed to quality analysis.

### 2.3 Preparing the choux cream filling

Making choux cream filling as a controlled sample: Use the heating method by stirring the ingredients in the container and touching the hot steam to cook the ingredients (double boiler) (Gisslen, 2017). Begin by mixing sugar, salt, and cornstarch. Add eggs one at a time and mix well. Add condensed milk, bland, water, and vanilla scent. Heat the mixture until it thickens. Lift and add fresh butter. Let it cool down, and add the cream. Mix well and then put in choux cream shells for quality analysis.

#### 2.3.1 Preparation of control sample choux cream filling

Prepare a control sample of choux cream filling ingredients. which includes Sugar 9.42%, salt 0.16%, corn starch 4.71%, eggs 17.27%, evaporated milk 23.55%, water 23.55%, vanilla flavor 0.16%, fresh butter 5.49%, fresh cream 15.70%.

#### 2.3.2 Preparation of control sample choux cream filling

Prepare a control sample of choux cream filling ingredients, which includes sugar 9.42%, salt 0.16%, corn starch 4.71%, eggs 17.27%, evaporated milk 23.55%, water 23.55%, vanilla flavor 0.16%, fresh butter 5.49%, fresh cream 15.70%.

Making choux cream filling as a controlled sample starts with mixing all the ingredients and blending it in a food processor with speed number 5 for 2 minutes until all ingredients are fine and uniform. Then, pour the mixture into the pan and heat it with medium fire until thick. It has similar characteristics to the control formula: add fresh butter, wait until it is excellent, add cream, mix well, and put in choux cream shells for quality analysis.

**2.4 Quality Analysis**

**2.4.1 Physical Analysis**

2.3.3.1 Measure color values of the CIE L* a* and b* systems with a colorimeter by the brightness value L* (has a value of 0-100, where 0 means the object is dark, 100 means the object is light), a* (+ means the object is red, - means the object is green) and b * (+ means the object is yellow, - means the object is blue) Calculate and report the results of the true color value, namely the color saturation value (Chroma, C*), which will be the true color value of the calculated sample. by Chroma = (a*2+b*2)1/2 (Jha, 2010)

2.3.3.2 Texture analysis Texture Profile Analysis (TPA) was performed with a texture measuring device with a back extrusion attachment measuring device, size 35 mm., probe speed 10 mm. per second, and the sample compression distance equaled 80% of the sample's initial height. The measurement was repeated threetimes, recording the Firmness, Consistency, and Cohesiveness values, modified according to Agudelo's method (Agudelo et al., 2014).

**Table 1:** Control sample choux cream filling and cassava choux cream filling recipes.

| Ingredients | Controlled Choux Cream Filling | Samples* | | |
|---|---|---|---|---|
| | | CCF-40 | CCF-60 | CCF-80 |
| Sugar | 60 | 60 | 60 | 60 |
| Salt | 1 | 1 | 1 | 1 |
| Corn Flour | 30 | - | - | - |
| Egg | 110 | - | - | - |
| Condensed Milk | 150 | 150 | 150 | 150 |
| Water | 150 | 150 | 150 | 150 |
| Vanilla Favor | 1 | 1 | 1 | 1 |
| Streamed cassava | - | 199 | 298 | 398 |
| Butter | 35 | 35 | 35 | 35 |
| Cream | 100 | 100 | 100 | 100 |

* Choux cream Filling-CCFCand Cassava Choux cream Filling three levels,40% (CCF-40), 60% (CCF-60) and 80% (CCF -80) of total weight

**2.4.2 Chemical analysis and nutritional value**

Chemical property analysis, moisture content with a Hot air oven, protein content with a protein analyzer, cassava wax with a cassava wax analyzer, and coarse fiber with a coarse dietary fiber analyzer. and the amount of ash used in the kiln, the amount of carbohydrates is calculated from [100-(moisture + protein + cassava wax + coarse dietary fiber + ash)]

Energy [kilocalories (kcal)/100 grams] = (percentage of protein content×4)+(percentage of carbohydrate content×4)+(percentage of cassava wax×9)

**2.5 Sensory testing**

Thirty panelists who were familiar with choux cream products using a randomized balanced serving plan (Kemp et al., 2009) assessed product characteristics in terms of appearance, color, aroma, taste, texture, and overall liking by a 9-point hedonic scale, where 9 points mean like the most and 1 point means dislike the most (Nicolas et al., 2010), compared with a set of control samples.

**2.6 Experimental planning and statistical Analysis**

Examples of choux cream products and cream choux filling developed by steamed cassava for physical and chemical quality. Statistical Analysis was planned using a completely randomized design (CRD). The experiment was repeated three times. Statistical variance was analyzed by Analysis of variance, ANOVA to find the mean and difference. Difference of the means using Duncan's multiple range test (DMRT) at a significant confidence level of 0.05. As for the sensory quality test. The experiment was planned using a Randomized Complete Block Design (RCBD). The statistical variance was analyzed using Analysis of variance, ANOVA, and the mean difference was compared using Duncan's multiple range test (DMRT) at a significant confidence level of 0.05.

## 3 Results and Discussion

### 3.1 Cassava preparation results

The Cassava Ha-Na-Tee breed is a sweet cassava variety with a low cyanide content of 64.46 mg/kg (Sumet et al., 2017). Fresh cassava tubers have a white flesh color. When steamed, the moisture content is high. The cooked cassava flesh is yellow due to the Maillard reaction resulting from the cassava tubers having protein and carbohydrates. It is a chemical component that promotes a non-enzymatic browning reaction during heating during steaming. Browning reactions occur between reducing sugars and amino acids or other nitrogenous compounds, with heat being the catalyst. As a result of this reaction, the color and flavor of the product may be improved or reduced (Villière et al., 2015). The chemical composition of cassava is mainly carbohydrates. Indicates the amount of starch that plays a vital role in the characteristics of food. Cassava contains 88.9-89.23% starch, 21.01-22.5% amylose, and 77.-79.0% amylopectin (Abioye et al., 2017). These components were used. In the food industry, from the household to the industrial level. It is used to add stability to food. Physical characteristics and chemical composition of the cassava Ha-Na-Tee breed are shown in Table 2

**Table 2**: Physical Characteristics and Chemical Composition of Cassava Ha-Na-Tee breed (n=3)

| **Physical Characteristics and Chemical Composition *** | | | |
|---|---|---|---|
| **Physical Characteristics** | | **Chemical Composition(%)** | |
| Brightness value(L*) | 84.31±0.17 | Moisture | 65.31±0.51 |
| Red-Greenvalue(a*) | -6.16±0.12 | Protein | 1.64±0.12 |
| Yellow-Blue value(b*) | 31.85±0.17 | Cassava was | 0.46±0.17 |
| Color freshness (C*) | 32.44±0.14 | ash | 1.33+0.21 |
| Water($a_w$) | 0.96±0.07 | coarse dietary fiber | 2.67±0.17 |
| | | carbohydrate | 28.61+0.61 |

* Data were presented in format ofMean±SD with 3 times repeated experiments

### 3.2 Quality of Choux Cream Filling

#### 3.2.1 Colors of Choux Cream

Development of cream choux filling using cassava found that increasing the amount of cassava resulted in a significant decrease in the brightness value (L*) of the sample ($p<0.05$), with the value decreasing between 88.74 and 77.66. While the red value (a*) increased significantly ($p<0.05$), it became hostile, indicating that the sample had a color approaching green shades. The values increased between -4.36 and -3.75. For the yellow color (b*), the values increased significantly ($p<0.05$) and were non-negative, indicating that the samples were closer to the shade of yellow. It increased between 27.32 and 37.41, and the color intensity value (C*) increased significantly ($p<0.05$) between 27.82 and 37.56 (Table 3). Compared with the control sample (CCFC), the color intensity value of the cassava cream choux filling is in shades of yellow, but it lacks brightness and is pale. The color of the choux cream filling results from the Maillard reaction (Martins et al., 2001) while heating and stirring. This is a browning reaction due to increased protein components from evaporated milk, carbohydrates from sugar, and cassava (Table 1), which affected the color of the choux cream filling.

#### 3.2.2 texture of choux cream filling

The addition of cassava to all levels of choux cream filling resulted in a significant ($p<0.05$) increase in the textural characteristics in terms of firmness, stability, and cohesion ability, with the control sample (CCFC) as shown in Table 3. This results from the starch in cassava, namely amylose and amylopectin, combined with water and other liquids in the choux cream filling ingredients. A gathering occurred. When heated, starch granules will form. Gelatinization causes changes in the molecules of the starch granules. The water molecule will bind to the amylose molecule and amylopectin, increasing viscosity. Irreversible swelling occurs. The amylose molecule is small. It will fall out of the swollen powder granules. This causes the inside of the starch granules to have a high concentration of amylopectin molecules (Ayetigbo et al., 2018), which results in a firmer texture.

When the temperature of the choux cream filling cools, a retrogradation process will occur. The internal structure of the choux cream filling sample had an orderly rearrangement of amylose with double helix hydrogen bonds in a crystalline form, and the separation of water or moisture made the structure stronger than before. It forms a gel that looks like a three-dimensional fibrous network (Pérez et al., 2009). Therefore, the value of firmness, stability, and ability to stick together has increased when the quantity of cassava increases.

**Table 3:** Physical properties of control and cassava choux cream filling samples.

(n=3)

| Physical properties | choux cream filling samples | Examples* | | |
|---|---|---|---|---|
| | | **CCF-40** | **CCF-60** | **CCF-80** |
| Physical properties- Colors | | | | |
| Brightness value(L*) | 88.74±0.04**[a***] | 85.06±0.08[b] | 81.97±0.56[c] | 77.66±0.05[d] |
| Red-Greenvalue(a*) | 0.12±0.02[a] | -4.63±0.04[d] | -4.17±0.17[c] | -3.75±0.04[b] |
| Yellow-Blue value(b*) | 27.82±0.03[c] | 27.32±0.03[d] | 31.17±0.03[b] | 37.41±0.03[a] |
| Color freshness (C*) | 27.82±0.03[c] | 27.71±0.03[d] | 31.46±0.05[b] | 37.61±0.04[a] |
| Physical properties- Sensory | | | | |
| Firmness value (g) | 236.07±0.07[d] | 279.16±0.04[c] | 298.45±0.54[b] | 343.06±0.07[a] |
| Stability value (g.sec) | 3,664.75±0.03[d] | 3,909.34±0.03[c] | 4,055.04±0.03[b] | 4,688.87±0.05[a] |
| Agglomeration ability value (g) | 275.51±0.06[d] | 595.49±0.04[c] | 596.84±0.03[b] | 598.05±0.02[a] |

* Examples of control sample choux cream filling (Choux cream Filling-CCFC) and cassava choux cream filling (Cassava Choux cream Filling) at three levels: 40 percent (CCF-40), 60 percent (CCF-60) and 80 percent ( CCF-80) of the total weight of the mixture.

** Data are presented as Mean± SD. Experiments were repeated three times.

***Different letters horizontally differ significantly at the 95 percent confidence level ($p<0.05$).

### 3.2.3 Chemical composition and nutritional value of choux cream filling

Using cassava to develop the choux cream filling product found that when the amount of cassava increased, the moisture, ash, protein, and dietary fiber in the choux cream samples increased significantly ($p<0.05$) at every level of increased cassava, as shown in Table 4. The chemical composition of cassava is shown in Table 2. Sule et al. (2017) reported cassava contains 2.08-2.55% ash and 2.55% coarse dietary fiber. 3.47-3.65% protein 1.85-2.17% (Sule et al., 2017).The increase in ash, protein, and dietary fiber content is, therefore, related to the increased cassava content. However, the protein content was still low when compared to the control cream choux filling sample because it contained eggs which have a high amount of protein. The amount of cassava wax was similar. At every level, cassava increased, but less than the control formula, and the carbohydrate content of the cream choux filling samples decreased significantly ($p<0.05$). The carbohydrate content decreased due to the increase in other chemical components. Therefore, there is a relationship resulting in the number of carbohydrates decreasing based on the chemical composition of the cassava cream choux filling; it was characterized by increased amounts of ash and dietary fiber compared to the control choux cream filling sample.

**Table 4:**Chemical composition of control cassava choux cream filling samples.

(n=3)

| Chemical composition **(%)** | control cassava choux cream filling samples | **Samples*** | | |
|---|---|---|---|---|
| | | **CCF-40** | **CCF-60** | **CCF-80** |
| moisture | 46.18±0.04**$^{d***}$ | 63.77±0.02$^{c}$ | 64.45±0.03$^{b}$ | 65.26±0.04$^{a}$ |
| protein | 6.24±0.04$^{a}$ | 1.50±0.03$^{d}$ | 1.75±0.03$^{c}$ | 1.95±0.02$^{b}$ |
| wax cassava | 15.32±0.04$^{a}$ | 0.36±0.02$^{b}$ | 0.38±0.02$^{b}$ | 0.37±0.01$^{b}$ |
| ash | 0.97±0.02$^{d}$ | 1.10±0.05$^{c}$ | 1.21±0.02$^{b}$ | 1.31±0.02$^{a}$ |
| dietary fiber | 0.98±0.01$^{d}$ | 2.10±0.01$^{c}$ | 2.27±0.04$^{b}$ | 2.37±0.01$^{a}$ |
| carbohydrate | 30.31±0.02$^{b}$ | 31.22±0.07$^{a}$ | 29.94±0.05$^{c}$ | 28.75±0.04$^{d}$ |

* Examples of control sample choux cream filling (Choux cream Filling-CCFC) and cassava choux cream filling (Cassava Choux cream Filling) at three levels: 40 percent (CCF-40), 60 percent (CCF-60) and 80 percent ( CCF-80) of the total weight of the mixture.
** Data are presented as Mean±SD. Experiments were repeated three times.
***Different letters horizontally differ significantly at the 95 percent confidence level ($p<0.05$).

The increase in cassava increased dietary fiber content. In addition to affecting the quality of the cassava choux cream filling, it is also effective as a health product. This is because consumers will receive less total energy, as shown in Table 5, compared to the control sample of choux cream filling. Dietary fiber plays a role in good health. In addition to the high amounts of carbohydrates in cassava, resistant starch is also found. Generally, resistant starch in cassava contains 6.06-2.055% (Abioye et al., 2017), which has health properties that benefit human health. Dietary fiber and resistant starch are not digested and absorbed in the stomach and small intestine. It passes into the large intestine to feed the natural probiotic microorganisms and results in the fermentation process to produce short-chain cassava acid. This may help reduce the risk of colon cancer and strengthen the body's immune system (Dhingra et al., 2012)

**Table 5:**Nutritional value of control cassava choux cream filling samples.

(n=3)

| Nutritional value **(kcal)** | control cassava choux cream filling samples | **Samples*** | | |
|---|---|---|---|---|
| | | **CCF-40** | **CCF-60** | **CCF-80** |
| carbohydrate | 121.23±0.06$^{b}$ | 124.88±0.28$^{a}$ | 119.77±0.19$^{c}$ | 114.98±0.14$^{d}$ |
| protein | 24.97±0.14$^{a}$ | 6.01±0.11$^{d}$ | 6.98±0.08$^{c}$ | 7.8±0.07$^{b}$ |
| wax cassava | 137.91±0.32$^{a}$ | 3.21±0.14$^{b}$ | 3.45±0.52$^{b}$ | 3.36±0.05$^{b}$ |
| total energy | 284.11±0.33$^{a}$ | 134.09±0.27$^{b}$ | 130.21±0.23$^{c}$ | 126.15±0.13$^{d}$ |

* Examples of control sample choux cream filling (Choux cream Filling-CCFC) and cassava choux cream filling (Cassava Choux cream Filling) at three levels: 40 percent (CCF-40), 60 percent (CCF-60) and 80 percent ( CCF-80) of the total weight of the mixture.
** Data are presented as Mean±SD. Experiments were repeated three times.
***Different letters horizontally differ significantly at the 95 percent confidence level ($p<0.05$).

### 3.2.4 Acceptance of Choux Cream Filling

The sensory quality evaluation scores of the choux cream filling samples ranged from 7.28 to 8.23, with liking at a moderate to liking level. Table 6 shows the scores for appearance, odor, taste, texture, and overall liking characteristics. The liking level of the Cassava CCF-60 choux cream filling sample was not significantly different ($p>0.05$) compared to the control sample. However, when the amount of cassava was increased in the CCF-80 sample, it was found that in every characteristic, there was a significant decrease in acceptability scores ($p<0.05$), except for appearance, there was no significant difference in likeability ($p>0.05$ )when compared with the control sample. The addition of cassava affected the color characteristics of the choux cream filling samples. This resulted in the color of the sample becoming less vivid, corresponding to the lowest acceptance score. However, the CCF-

80 cream choux filling sample, although most cassava, was used to develop the choux cream filling product. However, it received lower liking scores than the CCF-60 cream choux filling sample.

**Table 6:** Acceptance of control samples of choux cream filling and cassava cream choux filling samples.

(n=3)

| Characteristics | control samples of choux cream filling | Examples* | | |
|---|---|---|---|---|
| | | **CCF-40** | **CCF-60** | **CCF-80** |
| Appearance | 7.95±0.51$^{ab}$ | 7.85±0.56$^{ab}$ | 8.05±0.55$^{a}$ | 7.83±0.40$^{b}$ |
| color | 7.99±0.43$^{b}$ | 7.80±0.40$^{bc}$ | 8.23±0.57$^{a}$ | 7.77±0.56$^{c}$ |
| smell | 7.98±0.47$^{a}$ | 7.57±0.43$^{b}$ | 7.95±0.44$^{a}$ | 7.48±0.41$^{b}$ |
| taste | 7.95±0.52$^{a}$ | 7.48±0.53$^{b}$ | 8.00±0.54$^{a}$ | 7.28±0.51$^{b}$ |
| Texture | 7.91±0.44$^{a}$ | 7.48±0.55$^{b}$ | 7.90±0.52$^{a}$ | 7.37±0.56$^{b}$ |
| Total liking | 8.09±0.48$^{a}$ | 7.50±0.44$^{b}$ | 8.10±0.43$^{a}$ | 7.32±0.46$^{b}$ |

* Examples of control sample choux cream filling (Choux cream Filling-CCFC) and cassava choux cream filling (Cassava Choux cream Filling) at three levels: 40 percent (CCF-40), 60 percent (CCF-60) and 80 percent ( CCF-80) of the total weight of the mixture.

** Data are presented as Mean±SD. Experiments were repeated three times.

***Different letters horizontally differ significantly at the 95 percent confidence level ($p<0.05$).

## 4 Conclusion

The use of cassava to develop a choux cream filling product can be used at a maximum amount of 60%, which received the highest liking score, no different from the control sample. It also has the effect of increasing the amount of coarse dietary fiber and ash rose. If the amount of cassava is increased, it will affect the quality of the cream choux filling in terms of color. However, the effects of other cassava preparation methods should be studied. To help improve various qualities of choux cream filling or other types of products, they have the potential to be new food products and healthy products.

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## 6 References

JetniphatBunyasawat. 2017. **Bakery**. Odeon Store, Bangkok.

BenjapornMeekoh, HathairatRimkeeree, PenkwanChompreeda and SumonratChuenput. 2003. Cassava flour is used as a replacement for wheat flour in crispy pies. Pages 200-235. In **the 41stKasetsart University Academic Conference: Agro-Industry Branch**. Kasetsart University Bang Khen Campus, Bangkok.

Phanit Rujirapisit and WichudaSangkaew. 2013. Effects of using cassava flour instead of wheat flour in producing butter cookies. **Journal of Agricultural Science. 44(2)(Special)**: 273-276.

MontiraPhromphittayayuth, ApisaraPapassornsiri and JirayuChariamphun. 2019. cassava, pp. 24-25. **Journal of Agricultural Economics. Office of Agricultural Economic Research,** Bangkok.

Royal Gazette. 1998. **Announcement of the Ministry of Public Health (No. 182) B.E. 2541 regarding nutrition labels**. Royal Gazette, general edition, volume 115, section 47 D., pages 23–26.

Bureau of Agricultural Economic Research Ministry of Agriculture and Cooperatives. 2018. **Situation of important agricultural products and trends in 2019**. Office of Agricultural Economic Research, Bangkok.

SumetMaskhao, Siwilai Sirimangkararat, DueanpenWongson and WeerasakSaksirirat. 2017. Effects of cassava varieties with different cyanide content on growth, consumption, and production of Eri silk in winter. **KKU Science Journal 45(2)**: 379-391.Abioye, V.F., I.A. Adeyemi, B.A. Akinwande, P. Kulakow and B. Maziya-Dixon. 2017. Effect of steam cooking and storage time on the formation of resistant starch and functional properties of cassava starch. **Cogent Food & Agriculture**. 3(1): 1-11.

Agudelo, A., P. Varela, T. Sanz and S.M. Fiszman. 2014. Native tapioca starch as a potential thickener for fruit fillings. Evaluation of mixed models containing low-methoxyl pectin. **Food Hydrocolloids**. 35: 297-304.

AOAC. 2000. **Official Method of Analysis of AOAC International**. 17thed. The Association of Official Analytical Chemistry. Maryland, the United States of America.

Ayetigbo, O., S. Latif, A. Abass and J. Müller. 2018. Comparing characteristics of root, flour and starch of biofortified yellow-flesh and white-flesh cassava variants, and sustainability considerations: A review. **Sustainability**. 3: 1-32.

Dhingra, D., M. Michael, H. Rajput and R. T. Patil. 2012. Dietary fiber in foods: a review. **Journal of Food Science and Technology**. 49(3): 255–266.

Gisslen, W. 2017. **Professional baking**. 7th ed. John Wiley and Sons, the United States of America.

Jha, S. N. 2010. Color measurements and modeling, pp. 17–40. *In* Jha, S. N., eds. **Nondestructive Evaluation of Food Quality: Theory and Practice**. Springer-Verlag Berlin Heidelberg, the United States of America.

Kemp, S. E., T. Hollowood and J. Hort. 2009. **Sensory evaluation: A practical handbook**. John Wiley and Sons, the United States of America.

Martins, S. I. F. S., W. M. F. Jongen and M. A. J. S. Van-Boekel. 2001. A review of Maillard reaction in food and implications to kinetic modelling. **Trends in Food Science and Technology**. 11: 64-373.

Nicolas, L., C. Marquilly and M. O'Mahony. 2010. The 9-point hedonic scale: Are words and numbers compatible. **Food Quality and Preference**. 21: 1008–1015.

Ogbo, F. C. and E. N. Okafor. 2015. The resistant starch content of some cassava-based Nigerian foods. **Nigerian Food Journal**. 33: 29–34.

Pérez, S., P. M. Baldwin and D. J. Gallant. 2009. Structural features of starch granules I, pp. 149-192. *In* BeMiller, J. N. and Roy L. W., eds.**Starch: Chemistry and Technology**. 3rd ed. Elsevier Inc, the United States of America.

Rinsky, G. and L. H. Rinsky. 2009. **The Pastry chef 's companion: a comprehensive resource guide for the baking and pastry professional**. John Wiley & Sons, the United States of America.

Rujirapisit, P.and W. Sangkaeo. 2013. Effect of substituting cassava flour for wheat flour in butter cookies. **Agricultural Science Journal**. 44(2)(Suppl.): 273-276.

Sule, S., V. O. Offiah and K. S. Orjime. 2017. Chemical composition of chips from selected cassava varieties in Makurdi, Benue State. **Research Journal of Food and Nutrition**. 1(1): 29-33.

Villière, A., S. L. Roy, C. Fillonneau, F. Guillet, H. Falquerho, S. Boussely and C. Prost. 2015. Evaluation of aroma profile differences between sué, sautéed, and pan-fried onions using an innovative olfactometric approach. **Flavour**. 24(4): 1-19.