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The Effect of Cooking Process and Shelf Life Evaluation of Retort Pouch Packed a Tradition Meat Curry "Kaoyuk"

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Abstract

Kaoyuk is a traditional meat curry of Trang province, Thailand. It is prepared as a standard recipe. A retort pouch is used because it is a convenient thermal process in which the texture and flavor should be maintained in something close to the original condition. The purpose of the research is to were investigate the effect of the pre-cooking time of Kaoyuk and the change in quality of retorted Kaoyuk after 12 months storage. The effect of the pre-cooking time of meat at 0, 60 and 120 min before retorted process were studied and the texture analyzed and a sensory evaluation undertaken. The result found that the pre-cooking time at 60 min provided the tenderest meat, the retorted Kaoyuk was softened and also more retained the sensory qualities of the original. The 60 min of pre-cooked Kaoyuk were packed in retort pouch with thermal process on F_0=11 min (118°C) and stored at room temperature (25±5°C) for 12 months. Physical properties, chemical properties, microbial properties and sensory evaluation were conducted every 3 months. Meanwhile, there was a significant decrease of pH from 5.9 to 5.46 and cutting force required was also was decreased from 8116 g force to 6320 g force whereas color L* a* b* values increased. The Free Fatty Acid value (FFA) was increased from 0.54 to 0.97 % of oleic acid and Thiobarbituric acid values (TBA) was increased from 0.64 to 1.07 mg of MDA/kg meat but no significant (P>0.05) growth of microbial and the sensory evaluation conducted from 10 trained panelists were accepted. The result showed that the retorted Kaoyuk can be store at room temperature for 12 months whilst maintaining acceptable safety and customer satisfaction levels.

Introduction

Traditional food is a central tenet of cultural heritage which links to the past of particular region. The food culture richness was presented with their ingredients and cooking methods (Kaban, 2013). Kaoyuk is a popular traditional meat curry of Trang province, which is in the southern part of Thailand. Kaoyuk is cultural food linked to celebrations and in daily life . It is often eaten at such festivals as Ching Ming festival, Chinese New Year festival and at wedding ceremonies. Kaoyuk

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is prepared from pork belly, and cooked with various spices in gravy and fried taro for 2 hours until the meats become soft, savory and crumbly. Therefore, it requires a long cooking time which is inconvenient and unsuitable for modern lifestyle. Furthermore, Kaoyuk is the product that people who visit home at Trang province and traveler buy to take back to their family. If the a form of Kaoyuk can be developed that can be stored for a longer period it will be convenient for the consumer and should increase sales volume for local products and local enterprise.

Retort food is convenient in terms of preparation via microwave or ready to eat because retort processing technology utilizes the thermal processing method, which is used for producing stable packed shelf products (Gokhale & Lele, 2014). Retort Pouch packaging material was developed using aluminum foil in different layers or a high barrier laminate package (Shah et al., 2017). Pouches are more familiar to and preferedby the customer than those packed in metal or glass due to them being lighter, more useful and more desirable for heating and preparation (Al-Baali & Farid, 2006). The product will be packed in high quality for energy server if use shorter retort time. Aside from these benefit, the products can be stored for a longer period at room temperature without refrigeration and chemical preservative (Shah et al., 2017).

However, the scientific data regarding the Kaoyuk in a retorted pouch is still scarce. Therefore, the aims of this study were to investigate the effect of pre-cooking time of Kaoyuk and evaluate retorted Kaoyuk shelf life during room temperature for 12 months.

Materials and methods

1. Materials

Pork belly, vegetables, spices and seasonings were purchased from the supermarket. Meat was brought to Food Laboratory of School of Culinary Arts, under refrigerated condition. Meat was boiled, deep fried and cut into pieces measuring 5x8.5x1 cm (W/L/D). Taro was cut in to pieces measuring 5x8.5x1 cm (W/L/D) and fried at 180°C for 5 min. The ingredients were then pre-cooked with gravy. The recipe formulation of Kaoyuk is given in Table 1. The details for producing Kaoyuk in a retort pouch are presented in Fig. 1.

Table 1 Recipe formulation of Kaoyuk

Ingredient	%	Ingredient	%
Belly pork	35.64	Chinese spice powder	0.36
Water	42.76	Chilli sauce	1.78
Salt	0.11	Pickled bean curd	1.46
Coriander root	0.25	Mono Sodium	0.14
Shalot	0.53	Glutamate	0.43
Garlic	0.53	Oyster sauce	0.18
Star anise	0.04	Soy sauce	0.14
Cinnamon	0.11	Palm sugar	0.39
Ginger	0.53	Sugar cane	14.25
Seasoning	0.36	Taro	

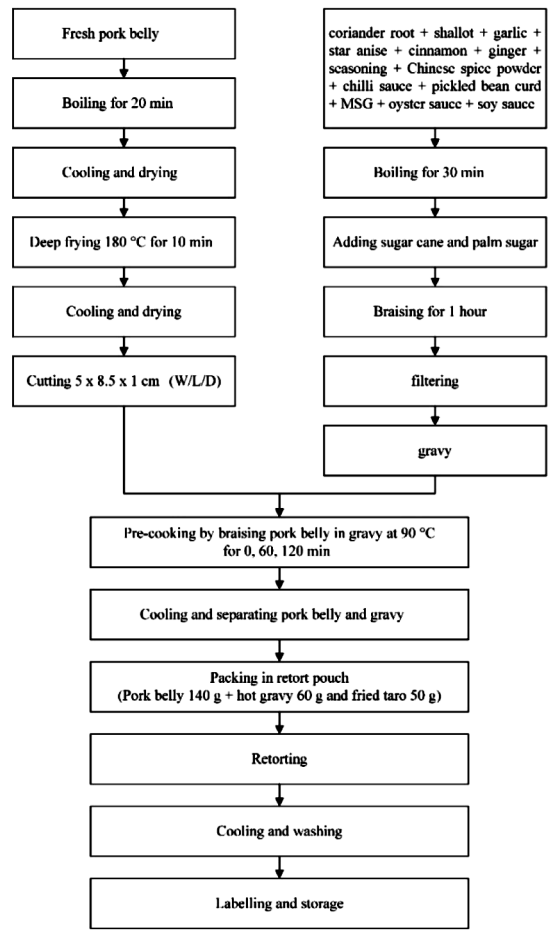

Fig. 1 The process of Kaoyuk in retort pouch

2. Packing and processing

The multilayer laminate retort pouch of dimension 132 x 200 x 28 mm. was used to pack the product. The pre-cooked meat was packed into the retort pouch manually (250 g of product: 140 g pre-cooked meat 50 g fried taro and 60 g gravy) then, a vacuum removed the

air before sealing the pouch using a sealer (Model: VM203, Audionvac). The packed and sealed pouches were carried on trays and moved into a retort vessel then sterilized in a retort (Model: A091 Fabric No. M4665 at 118°C 0.15 MPa with the F_0 = 11 mins.

3. Study of pre-cooking time

Pre-cooking time affected the texture of retorted Kaoyuk, this research needs to retain the quality of retorted Kaoyuk the same as the original unretorted food. Therefore, this study investigated three pre-cooking times; (at 90 ±5°C) 0, 60 and 120 min. The texture of meat was determined by texture analyzer and sensory evaluation was conducted by 10 trained panelists.

4. The quality change of Retorted Kaoyuk during storage

Retorted Kaoyuk which best pre-cooking time, were stored at room temperature (25±5°C) for 12 months. The retorted Kaoyuk were evaluated every 3 months by taking the meat sample to measure physical properties, chemical properties, microbial properties and sensory analysis.

4.1 Physical Properties

The color measurement of meat was determined using Hunter Lab Color Flex (Model A60-1012-312, Hunter Associates Laboratory Inc., USA). CIE L* (Lightness) a* (redness) and b* (yellowness) were measure in the surface of samples.

The texture of belly meat was determined by texture analyzer (Model: TA-XTPlus) Blade Set. Cutting Strenght was recorded in gram force.

4.2 Chemical Properties

The meat was determined pH by adding 10 g sample with 50 ml distilled water and mix for 60 s in a mixer. The pH values were determined using a digital pH meter (Mettler toledo Model: Seven Compact pH meter, S210-Bio, Switzerland), Calibrated using pH buffer 4 and pH buffer 7.

The meat, taro and gravy were determined for moisture, crude protein, crude fat and total ash with the following of standard procedures (AOAC., 1995). The carbohydrates were calculated by subtracting from 100 the percentages of crude protein, moisture, crude fat and total ash.

The Free Fatty acid (FFA) content (as Oleic acid) using titrimetric method follow AOAC 940.28 (AOAC., 2000).

The lipid oxidation of meat was analyzed by measuring Thiobarbituric acid (TBA) using method of Egan et al. (1981). Result of TBA expressed as mg of malondialdehyde (MDA)/kg of sample.

4.3 Microbial properties

Retorted Kaoyuk were analyzed from its commercial ready to eat product. The sample was determined for total viable count, *E. coli* and Coliform, Yeast and Mold count, *Staphylococcus aureus* and *Salmonella* spp. followed BAM (2001).

4.4 Sensory Analysis

The sensory evaluation of Kaoyuk was conducted from 10 trained members from School of Culinary Arts according to American Meat Science Association Guideline (AMSA, 2015). The Kaoyuk was evaluated on appearance, flavor, texture, tenderness, juiciness and overall acceptability on a 9-point scale (where, 1 = dislike extremely, 9 = like extremely). The samples were warmed before serving. The samples were in white cups coded with 3-digit numbers and served to the panelists individually in a random order.

5. Statistical analysis

The statistical analysis was done by SPSS software (SPSS Version 17; SPSS Inc., Chicago, USA). Data were analyzed by ANOVA and the means were separated using Duncan's New Multiple Range Test. The statistical significance was determined at 95% confidence level ($P<0.05$).

Results and discussion

1. Study of pre-cooking time

The meat was pre-cooked for 0, 60 and 120 min before packed and thermal processing. The texture of pre-cooked meat for 0, 60 and 120 min were 13072, 8191 and 10512 g force. These were related to panelist's sensory evaluation in Table 2 that the pre-cooked meat at 0 and 120 min required a high cutting force and were unacceptable in their texture. Pre-cooked meat at 0 min required a higher cutting force because the time made the collagen fiber shrinkage (Tornberg, 2005). A longer cooking time makes collagen soluble which causes tenderness (Hedruck et al., 1994; Shah et al., 2017). Retorted Kaoyuk was curry meat contain sugar in the gravy, if take too long heating time the meat will drip loss and replaced with sugar which makes the meat hard. Therefore, the pre-cooked Kaoyuk at 120 min was considered too tough by the sensory evaluations of the panelists. As a result, pre-cooked Kaoyuk at 60 min required a lower cutting force the same as the original and the panelists found it the most acceptable of those sampled.

Table 2 Sensory evaluation of pre-cooked Kaoyuk

Characteristics	Pre-cooking time (min)		
	0	60	120
Appearance	4.2 ± 0.79[c]	6.7 ± 0.95[a]	5.2 ± 0.79[b]
Flavor	3.1 ± 0.74[c]	6.2 ± 0.79[a]	5.5 ± 0.85[a]
Texture	3.2 ± 0.79[c]	6.3 ± 0.48[a]	4.3 ± 0.16[b]
Tenderness	2.5 ± 0.53[c]	6.5 ± 0.71[a]	5.4 ± 0.52[b]
Juiciness	3.2 ± 0.40[c]	7.1 ± 0.83[a]	5.7 ± 0.88[a]
Overall acceptance	2.4 ± 0.70[c]	6.5 ± 0.53[a]	5.5 ± 0.88[b]

Remark: [a-c] superscripts in the same row indicate significant difference (P<0.05).

2. The quality change of retorted Kaoyuk during storage

The retorted Kaoyuk which pre-cooking for 60 min was storage at room temperature for 12 months, then there were evaluated every 3 months to measure physical properties, chemical properties, microbial properties and sensory evaluation

Table 3 Physical properties of retorted Kaoyuk during storage at room temperature

Time (month)	Cutting force (g force)	color		
		L*	a*	b*
0	8116±118[a]	53.41±1.97[a]	14.083±0.39[c]	28.692±0.63[c]
3	7886±228[ab]	47.37 ±0.74[b]	19.65±0.57[d]	30.85±1.34[d]
6	7558±236[b]	41.29±1.02[c]	21.15±0.47[c]	32.82±0.97[c]
9	7056±150[c]	38.95±0.79[d]	24.38±0.57[b]	35.23±0.35[b]
12	6320±205[d]	35.23±0.91[e]	26.31±0.89[a]	38.48±0.55[a]

Remark: [a-e] superscripts in the same column indicate significant difference (P<0.05).

The texture of retorted Kaoyuk was determined as cutting force and recorded in gram force. Cutting force was significantly different for different storage time. From Table 3, the cutting force was decreased with increased storage time, this condition shown that fibrous protein was broken by heating. Furthermore, protein oxidation is the cause of the shear force value decreasing when increasing meat storage time (Devadason et al., 2014).

The color data like L*(darkness to lightness), a* (redness to green) and b* (blue to yellowness) of retorted Kaoyuk which stored at 0-12 months as given in Table 3. There was significantly decreased in L* value whereas increased in a* and b* value when increased storage time. Millard reaction between amino acid and sugar will be the cause of color changing (Bindu et al., 2007)

The proximate composition of retorted Kaoyuk were 57.1% of moisture, 10.6 of protein, 11.5 % of fat, 17.3 of Carbohydrate, 2% of ash, 1.5 % of fiber and 215 kcal of energy.

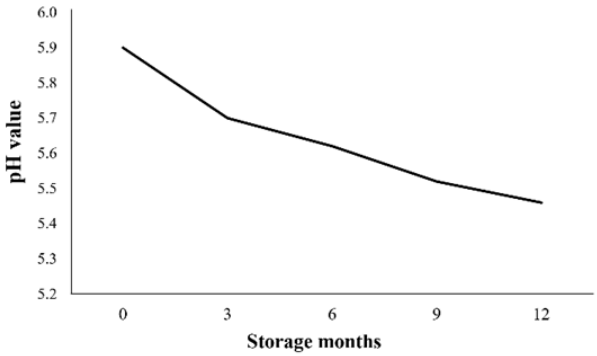

Fig. 2 The pH value change during storage time of retorted Kaoyuk

During storage, pH value of retorted Kaoyuk was decreased from 5.90 to 5.46 in 12th month (Fig. 2). The decreasing of pH is due to protein degradation and free amino acids being released. (Devadason et al., 2014). A decrease of pH value has also been observed during the storage buffalo meat blocks (Devadason et al., 2014) and retorted beef curry (Tayeh et al., 2019). Some researchers reported that the lipid oxidation is the cause pH reduction by residue oxygen because of carbohydrate or glucose of lipid components were degradation (Jang & Lee, 2012; Liu et al., 2009; Jin et al., 2002).

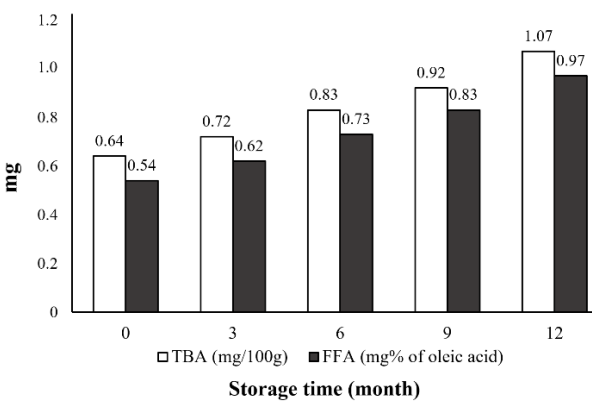

Fig. 3 Free fatty acid value and TBA value of retorted Kaoyuk

The free fatty acid (FFA) values of retorted Kaoyuk are presented in Fig. 3. Free fatty acid is the product of lipid hydrolysis, retorted Kaoyuk were in high temperature process. Therefore, the free fatty acids were generated in the high temperature. FFA values were increased significantly with increased storage time and the highest being reported in the 12th month. Similar trends were reported for retorted black clam (Bindu et

al., 2007) and retorted meat curry (Shah et al., 2017).

TBA value is a chemical spoilage indicator of meat and meat product. Lipid oxidation is the cause of TBA value, produce free radical and generate rancid flavors and odors. TBA value of retorted Kaoyuk was presented in Fig.3. Retorted Kaoyuk increased in TBA value from 0.64 - 1.07 mg malonaldehyde per kg of meat with an increase of storage time from 0^{th} - 12^{th} month as same as the TBA trend of retorted buffalo meat, (Devadason et al., 2014) retorted black clam meat curry (Bindu et al., 2007) and retorted meat curry (Shah et al., 2017).

Retorted Kaoyuk were analyzed for total viable count, *E.coli* and Coliform, Yeast and Mold, *Staphylococcus aureus, Salmonella* spp. presented in Table 4. There are less than 10 CFU/g of total viable count and *E.coli* and Coliform. There are less than 3 CFU/g of Yeast and Mold and not found *Staphylococcus aureus* and *Salmonella* spp. for 3-12 months. It indicated that microbial in retorted Kaoyuk were destroyed by thermal processing as the retorted tradition meat curry was undetected during storage for 12 months (Shah et al., 2017). Moreover, Rajan et al. (2014) reported that there were undetected growth of microbial in retorted Chettinad chicken packed in pouch during storage for 180 days.

Table 4 The microbial properties of retorted Kaoyuk during storage at room temperature (25 ±5 °C)

microbial	storage time (month)				
	0	3	6	9	12
Total viable count (CFU/g)	<10	<10	<10	<10	<10
E. coli & Coliform (MPN/g)	<10	<10	<10	<10	<10
Yeast and Mold (CFU/g)	<3	<3	<3	<3	<3
Staphylococcus aureus (CFU/g)	ND	ND	ND	ND	ND
Salmonella spp. (CFU/g)	ND	ND	ND	ND	ND

Remark: ND = not detect

When increasing the storage time to 12 months, the cutting force, color (L*) and sensory score of retorted Kaoyuk were decreased and the FFA, TBA were increased. It indicated that the quality of retorted Kaoyuk was changed during storage at room temperature because of their physical and chemical properties. However, the panelists were accepted in their sensory evaluation at the 12^{th} month of storage time as shown in Table 5. The scores for each parameter were significantly decreased with increased storage time. Although the score of appearance, flavor, texture, tenderness, juiciness and overall acceptance decreased to 5.6 hence panelists found 12 months retorted Kaoyuk was acceptable. If the retorted Kaoyuk were kept further for 18 months, it will be safe from microorganism but it may contain more rancid and become more unflavored.

Table 5 Sensory evaluation of retorted Kaoyuk during storage at room temperature

Characteristics	Storage period (month)				
	0	3	6	9	12
Appearance	8.0 ± 0.47^{a}	7.3 ± 0.48^{b}	7.1 ± 0.32^{b}	6.7 ± 0.48^{c}	6.6 ± 0.52^{c}
Flavor	8.1 ± 0.32^{a}	7.4 ± 0.52^{b}	6.4 ± 0.52^{c}	6.2 ± 0.42^{c}	6.1 ± 0.57^{c}
Texture	8.7 ± 0.48^{a}	7.9 ± 0.32^{b}	6.3 ± 0.48^{c}	6.2 ± 0.42^{c}	6.1 ± 0.57^{c}
Tenderness	8.4 ± 0.52^{a}	7.5 ± 0.53^{b}	6.6 ± 0.52^{c}	6.4 ± 0.52^{c}	6.3 ± 0.68^{c}
Juiciness	8.6 ± 0.52^{a}	7.7 ± 0.48^{b}	6.7 ± 0.48^{c}	6.3 ± 0.48^{c}	5.6 ± 0.51^{d}
Overall acceptance	8.5 ± 0.53^{a}	7.6 ± 0.52^{b}	6.4 ± 0.52^{c}	6.1 ± 0.32^{cd}	5.9 ± 0.32^{d}

Remark: $^{a-d}$ superscripts in the same row indicate significant difference ($P<0.05$).

Conclusion

The growth of demand for ready to eat meat curry product is due to several advantages. Kaoyuk, the traditional meat curry of Trang province was developed, packed and processed in retort pouch which can be store for 12 months. The studies included 2 parts, the first was the pre-cooking time which retain the retorted Kaoyuk same as original and the second was the investigation into any quality change of retorted Kaoyuk when kept in room temperature for 12 months. The result found that the pre-cooking time at 60 min is the best condition of Kaoyuk producing before sterilized with retort process. Retorted Kaoyuk was evaluate the physical properties, chemical properties and sensory evaluation in every 3 months which found that pH value and cutting force were significantly decreased whereas color value (L*), FFA and TBA value increase with the increase of storage time to 12 months. In addition Retorted Kaoyuk was safe from microorganism during storage at room temperature for 12 months, although the sensory evaluation had decreased the score but it was still within acceptable limits. Therefore, Kaoyuk has accepted a product that meeting customer need with extending shelf life on display.

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