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Effect of Pork Belly and Broiler Chicken Meat on the Quality of Herb Sai Oua (Spicy Thai Herb Sausage)

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This research aimed to study the effect of using pork belly and different parts of broiler chicken meat on the quality of Herb Sai Oua (Spicy Thai Herb Sausage). The experiment was divided into 5 groups depended on meat material that consisted of pork belly (control), chicken filet, chicken breast, chicken thigh and chicken drumstick to produce Herb Sai Oua. The experimental design used in this experiment was Completely Randomized Design (CRD). After the production, the Herb Sai Oua was analyzed the % cooking loss, the colour as indicated by L* (lightness) a* (redness) b* (yellowness) color system, water activity (a_w), proximate analysis (moisture content, protein, fat, fiber, ash and energy), sensory evaluation [Randomized Completely Block Design (RCBD)] and the production cost. The results showed that % cooking loss after cooking of the Herb Sai Oua using pork belly was the highest and the Herb Sai Oua using chicken filet was the lowest when compared with the other groups ($P<0.05$). The Herb Sai Oua using pork belly had the lowest in L* value but the highest in a* value ($P<0.05$). The Herb Sai Oua using chicken breast had the highest in b* value but the sample from chicken drumstick had the lowest in b* value ($P<0.05$). For the a_w of the Herb Sai Oua in every groups showed the value between 0.954 - 0.986. The highest moisture content and protein were detected from the Herb Sai Oua using chicken filet but the fat percentage was the lowest when compared with the other groups ($P<0.05$). The Herb Sai Oua using pork belly was the highest in fat percentage and energy ($P<0.05$). Every Herb Sai Oua had fiber percentage between 0.75 - 1.79 ($P<0.05$). The Herb Sai Oua using chicken filet had the highest ash content ($P<0.05$). The sensory evaluation was conducted using the different characteristics consisted of the appearance, color, odor, texture, taste and overall acceptance. The consumers liked the Herb Sai Oua using broiler chicken meat more than the pork belly. The highest overall acceptance was obtained from the Herb Sai Oua using chicken thigh ($P<0.05$). The cost of non-cooking Herb Sai Oua 1 kilogram of meat material, the Herb Sai Oua using pork belly had the highest cost and the Herb Sai Oua using chicken breast had lowest cost.

Keywords: pork belly, parts of broiler chicken meat, quality of Herb Sai Oua

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Introduction

Herb Sai Oua is a grilled pork sausage which is a local food in the North of Thailand. It is well known product to buy as a tourist souvenior. Thai Industrial Standards Institute (2004) specified that Herb Sai Oua is made from pork and pork belly, seasoning with some flavoring ingredient or herb (salt, sugar, soy sauce, dried-chilli, lemon grass, garlic, onion, turmeric and kaffir lime leaf), mixs together, puts in clean natural casing or artificial casings and cooks. One important ingredient in Sai Oua is herbal plant that has nutrition and medicinal properties. Sai Oua is normally produced by using more than approximately 50% fat content that risk for consumers. The broiler chicken meat is alternative raw material to produce Sai Oua because of its desirable nutritional characteristics, such as high protein, low fat and relatively high concentrations of polyunsaturated fatty acids (PUFAs) compared to beef or pork (Brenes and Roura, 2010). However, the quality in different part of meat is different (Sethakul, 1996; Sethakul, 1997; Castigliego, 2012). Therefore, this research is focused on the production of Sai Oua by using pork belly as a raw material compare to the use of broiler chicken meat (chicken filet, chicken breast, chicken thigh and chicken drumstick). It would be a good way to produce healthy food Sai Oua and can be produced for Halal market.

Objectives: To study the physical and chemical quality, consumer satisfaction and production cost of Herb Sai Oua that uses pork belly and different part of broiler chicken meat.

Materials and methods

Raw material preparation

Pork belly, chicken filet, chicken breast, chicken thigh and chicken drumstick were bought from Siam Makro Public Company Limited, Chanthaburi. Broiler chicken was deboned and ground using a grinder.

Herb Sai Oua preparation

Herb Sai Oua was prepared by using ground meat which was reduced the temperature in refrigerator. The experiment divided into 5 treatment groups composed of pork belly (control), chicken filet, chicken breast, chicken thigh and chicken drumstick. 2 kg of each prepared meat was mixed with ingredients and chilli paste according to Sai Oua formula: meat (84.39%), salt (0.84%), fish sauce (0.84%), monosodium glutamate (0.42%), sugar (0.42%), chilli paste (5.49%), sliced kaffir lime leaf (2.11%), sliced lemon grass (5.49%). The

composition of chilli paste were dried-chilli (17.28%), galangal (3.70%), galic (12.35%), onion (19.75%), kaffir lime skin (7.41%), lemon grass (19.75%), turmeric (4.94%), fingerroot (3.70%), black pepper (3.70%) and shrimp paste (7.42%). All ingredients and meat were mixed well until meat was sticky. The meat mixture was divided into 3 batchs approximately 700 g per bacth. Then, the mixture was stuffed in pork casing with approximately 100 g per package (Figure 1). The prepared Sai Oua was cooked in an oven (CO-708; OTTO, Thailand) at temperature 200 °C for 20 min (flip over after 10 min). Sai Oua was cooked when the internal temperature reached 69-72 °C.

Study of cooking loss

Cooking loss of Herb Sai Oua in each treatment group was determined by weighting Sai Oua before (C1) and after cooking (C2). The cooking yield was calculated as follows: % cooking loss = (C1-C2)/C1 x 100

Study of color

Color values as lightness, L*, redness, a* and yellowness, b* of Herb Sai Oua were measured randomly three times internally using a color reader (CR-410, Konica Minolta Sensing Inc., Japan).

Chemical composition analysis

The chemical composition analysis of Herb Sai Oua, including water activity (a_w) by water activity analyser (MS1 AW ; Novasina, Switzerland), moisture, protein, fat, fiber and ash according to AOAC methods (2000), calorific value by bomb calorimeter (IKA, Germany)

Sensory evaluation

Sensory attributes of Herb Sai Oua were determined by 50 panelists using 9- point hedonic scale (from 1 = dislike extremely to 9 = like extremely).

Production cost calculation

Calculated Herb Sai Oua production cost from the price of meat and ingredient. The production cost of uncooked Sai Oua per 1 kg of used meat.

Statistical analysis

The experimental design was a Completely Randomized Design (CRD) for properties of Sai Oua and Completely Randomized Block Desnig (RCBD) for sensory evaluation. All the data were subjected to analysis of variance (ANOVA) and comparisons of means were carried out by Duncan's multiple rang test, considering differences significant whe $p<0.05$.

Results and Discussion

Effect of cooking loss

The results of cooking loss, color and chemical properties are shown in Table 1, the % cooking loss of cooked Sai Oua using pork belly was highest (35.20%) and significantly different ($P<0.05$) from Sai Oua using chicken filet (12.17%). Cooking loss of Herb Sai Oua made from chicken breast (19.73%), chicken thigh (23.06%) and chicken drumstick (20.90%) were not significant different.

From the results could explain that pork belly had fat content more than the broiler chicken. Fat content in Sai Oua made from pork belly may loss when Sai Oua was cooked. On the other hand, chicken filet had low fat content and high in protein, this may result in low cooking loss after cooking. Honikel and Wellhauser (1993) reported that pork belly had fat content approximately 21.10% and Sethakul (1997) reported that chicken filet had fat content only 0.5%.

Effect of color

The internal color of cooked Sai Oua (Figure 2) made from different meat were significant. The highest L* value was detected in Sai Oua from chicken breast equal to 63.62 which was not significantly different ($P>0.05$) from Sai Oua made from chicken filet equal to 63.47 but significantly different ($P<0.05$) from Sai Oua made from the other parts of chicken meat. Sai Oua from pork belly had L* value lower than using chicken meat because the intensity color (dark red) of pork belly. It revealed that Sai Oua made from pork belly had highest a* value and Sai Oua from chicken breast had highest b* value when compared to Sai Oua that using other meat. It has been reported that the difference in color shades, intensity, and stability of meats of different origins is the complex synergism of many pre- or postharvesting factors. Some of the preharvesting factors are intrinsically associated with the animal, such as

species, breed, age, sex, muscle type, whereas some others depend on extrinsic conditions, such as diet, housing system, environmental conditions, stress associated to transport, or to any other preslaughter and slaughtering conditions (Sethakul, 1996; Sethakul, 1997; Castigliego, 2012). The report of Sethakul (1996) indicated that the chicken breast and chicken filet meat are white (so calls white muscle) but chicken thigh and chicken drumstick meat are red (so calls red muscle).

Table 1. Effect of using pork belly and different parts of broiler chicken meat on the physical and chemical properties of Herb Sai Oua (mean ±SD)[1/]

study list	Treatment				
	Pork belly (control)	**Chicken filet**	**Chicken breast**	**Chicken thigh**	**Chicken drumstick**
Cooking loss (%)	35.20 ±5.54^{a}	12.17 ±2.90^{c}	19.73 ±4.89^{b}	23.06 ±1.34^{b}	20.90 ±3.90^{b}
L* (Lightness)	50.46 ±0.87^{c}	63.47 ±0.81^{a}	63.62 ±0.98^{a}	56.09 ±0.69^{b}	55.58 ±1.05^{b}
a* (Redness)	4.75 ±0.26^{a}	2.98 ±0.03^{c}	2.17 ±0.47^{d}	3.28 ±0.28^{bc}	3.81 ±0.37^{b}
b* (Yellowness)	21.92 ±1.32^{c}	23.99 ±0.30^{ab}	25.49 ±0.67^{a}	22.66 ±1.25^{bc}	21.73 ±0.96^{c}
a_w (Water activity)	0.954 ±0.005^{c}	0.966 ±0.002^{b}	0.969 ±0.002^{b}	0.983 ±0.002^{a}	0.986 ±0.003^{a}
Moisture content (%)	48.19 ±1.21^{d}	68.51 ±1.03^{a}	63.09 ±0.89^{c}	65.76 ±1.40^{b}	64.02 ±0.82^{c}
Protein (%)	15.87 ±0.55^{d}	21.68 ±0.96^{a}	20.50 ±0.35^{b}	17.42 ±0.88^{c}	17.30 ±1.30^{c}
Fat (%)	23.06 ±1.97^{a}	0.53 ±0.20^{d}	4.84 ±1.55^{c}	3.51 ±0.47^{c}	8.88 ±1.15^{b}
Fiber (%)	1.79 ±0.75^{a}	1.44 ±0.34^{ab}	0.75 ±0.19^{b}	1.33 ±0.15^{ab}	0.81 ±0.14^{b}
Ash (%)	2.79 ±0.06^{ab}	2.81 ±0.10^{a}	2.68 ±0.07^{b}	2.42 ±0.13^{c}	2.47 ±0.11^{c}
Energy (cal/g)	6707 ±185.41^{a}	4765 ±40.02^{d}	5806 ±62.74^{c}	6073 ±64.09^{b}	5845 ±53.73^{c}

1/: Means in the same row with different superscripts differ significantly (P<0.05)

Effect of a_w

The a_w of Sai Oua from pork belly and chicken meat were significantly different (P<0.05). The highest a_w was observed from Sai Oua made from chicken drumstick equal to 0.986. It has been reported that a reduction in a_w can reduce microbial growth in meat products. Most bacteria will growth if the a_w is 0.98or greater (Frazier and Westhoff, 1998). As the a_w decreases, the viability of bacteria decreases due to a reduction of nutrients flowing to the bacteria, a reduction in toxins moving away, and limited ability for the bacteria to move. While many bacteria will not be able to grow at a_w values below 0.86, some halophilic bacteria can grow in a matrix with a a_w that is as low as 0.75

Figure 1. Uncooked Sai Oua

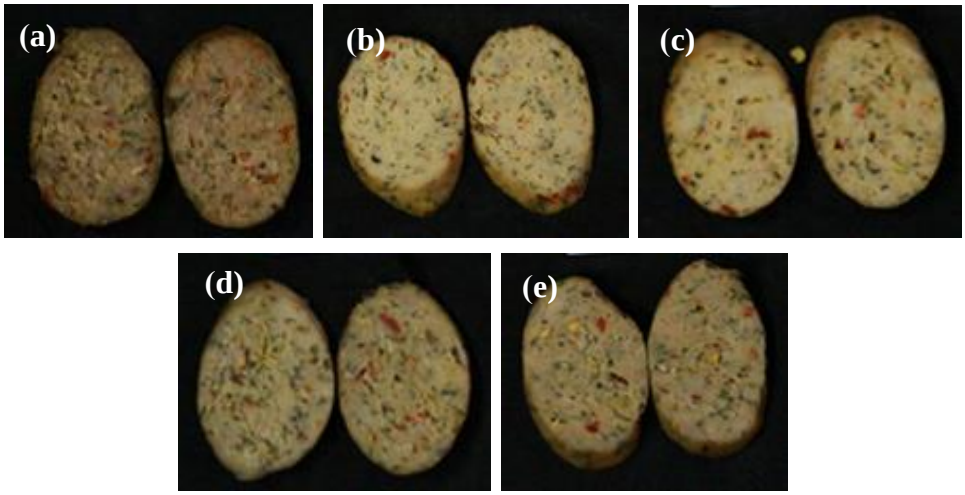

Figure 2. Characteristic of internal surface of Sai Oua using pork belly and different parts of broiler chicken meat: pork belly (a), chicken filet (b), chicken breast (c), chicken thigh (d) and chicken drumstick (e)

(Troller *et al.*, 1984). Some yeast and molds will be able to grow at a_w values of 0.60. Thus, the surface of smoked meats or dried products may have some mold growth but will not support pathogenic bacteria. Food with a a_w below 0.5 are generally considered stable in regards to microbial growth (Herring and Smith, 2012). However, Sai Oua made in this research had a_w around 0.954-0.986 which was suitable for microorganism growth, this would be easy to rotten and shoten storage. Therefore, Sai Oua should be kept in refrigerator with low temperature.

Chemical compositon

It has been found that Sai Oua made from chicken filet had highest moisture equal to 68.51%. The result showed that Sai Oua made from pork belly had lowest moisture equal to 48.19%, this may occure from the loss of fat after cooking. Protein content was detected in Sai Oua made from chicken filet more than others. Sai Oua made from pork belly had lowest protein as reported by Honikel and Wellhauser (1993) that pork belly had only 17.80% of protein content which was lower than observed in boiler chicken Khuenklang *et al*. (2014). The highest fat content was found in Sai Oua made from pork belly equal to 23.06%. Some reports showed that pork belly had fat content approximately 21.10%, while the chicken meat had fat content different in each part between 0.5-15.0% (Honikel and Wellhauser, 1993; Sethakul, 1997). Fiber content and ash content were similar in every treatment, the value was between 0.75 - 1.79 and 2.42 - 2.81, respectively. Sai Oua made from pork belly had calorific value higher than others, equal to 6707 cal/g.

Sensory evaluation

From the results in Table 2, Sai Oua made from broiler chicken meat parts were more acceptable than Sai Oua made from pork belly in every attributes. The overall acceptability scores of Sai Oua made from broiler chicken meat ranged from 6.58 to 7.12 with maximum acceptability obtained when using chicken thigh. The obtained result consistent with the report by Sethakul (1996) that the muscle from different part of animal had different quality.

Table 2. Sensory evalution score of Sai Oua using pork belly and different parts of broiler chicken meat (mean ±SD)[1/]

Attribute	Treatment				
	pork belly (control)	chicken filet	chicken breast	chicken thigh	chicken drumstick
Appearance	5.92 ±1.61[b]	6.64 ±1.50[a]	6.82 ±1.12[a]	6.56 ±1.33[a]	6.72 ±1.34[a]
Color	6.00 ±1.71[b]	6.56 ±1.54[a]	6.74 ±1.14[a]	6.70 ±1.15[a]	6.66 ±1.27[a]
Odor	5.80 ±1.76[b]	5.86 ±1.80[b]	6.84 ±1.28[a]	6.78 ±1.46[a]	6.48 ±1.82[a]
Taste	5.22 ±1.99[b]	5.62 ±1.78[b]	6.34 ±1.55[a]	6.78 ±1.62[a]	6.44 ±1.83[a]
Texture	5.32 ±2.09[b]	5.64 ±1.92[b]	6.38 ±1.81[a]	6.56 ±1.83[a]	6.64 ±1.75[a]
Overall acceptance	5.90 ±1.89[c]	6.58 ±1.46[b]	6.86 ±1.34[ab]	7.12 ±1.44[a]	6.94 ±1.38[ab]

1/: Means in the same row with different superscripts differ significantly (P<0.05)

Production Cost

The production cost of using 1 kg of pork belly and broiler chicken meat to produce uncooked Sai Oua is shown in Table 3. The result revealed that the production cost of uncooked Sai Oua from pork belly was approximately 137 Baht that was higher than other. The production cost of Sai Oua made from chicken breast was lowest.

When considering the production cost and consumer satisfaction, chicken breast is recommended to use for production of Sai Oua.

Table 3. Effect of Sai Oua using pork belly and different parts of broiler chicken meat on production cost per 1 kg of meat

Raw material (Baht)	Treatment				
	Pork belly (control)	Chicken filet	Chicken breast	Chicken thigh	Chicken drumstick
Meat 1 kg [1/]	120	95	77	81	92
Ingredient and other raw material[2/]	17	17	17	17	17
Production cost[3/]	137	112	94	98	109

1/: Price of some part of deboned meat per 1 kg whole meat.
2/: Price of ingredient and other raw material.
3/**:** Production cost for producing uncooked Sai Oua per 1 kg meat

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