STUDY THE USE OF THAI WOODS FOR SMOKING ON QUALITIES OF SMOKED SAUSAGES

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Abstract – This research was to study the effect of smoking from woods planted in Thailand, such as Eucalyptus wood (*Eucalyptus camaldulensis* Dehn.) and Thai copperpod wood (*Cassia siamea* Lamk.), compared to commercial Beech wood chips on the qualities of smoked sausages. Sausaged smoked with Eucalyptus wood chips showed the comparable with the sausages smoked with commercial Beech wood chips in regard to color and sensory properties as well as total plate count during chilled storage. Therefore, the overall results suggested that the Eucalyptus wood chips can be potentially utilized as a low cost alternative to commercial Beech wood chips for smoking and other meat products in meat industry.

Key Words – Smoking, Wood chips, Sausage, Quality

I. INTRODUCTION

Smoking is one of the oldest technologies for conserving meat products. It is also defined as the process of penetration of meat products by volatiles resulting from the thermal combustion of wood [1] , [2]. The results of smoking lead to the extension of shelf-life because the smoke consists of both antimicrobial and antioxidant compounds, such as formaldehyde, carboxylic acids, and phenols [3] , [4]. The smoke for smoking of food is formed due to the partial burning of wood, especially hardwoods, such as beech, hickory and oak, but also softwood, such as pine and fir [4]. Wood consists of approximately 50% cellulose, 25% hemicellulose and 25% lignin [1]. The thermal degradation of hemicelluloses proceeds at 180-300°C, cellulose at 260-350°C, and lignin 300-500°C [5] , [6]. The pyrolysis of cellulose and hemicelluloses forms Carbonyl compounds, which produce the brown color on the surface of smoked meats. The pyrolysis of lignin, however, forms phenolic substance, resulting in the formation of antimicrobial and antioxidative compounds, and also creating good flavor and aroma of the smoked meat products [7]. Beech wood chips is ideal heat source for smoking meat products as it produces the good quality smoke and is responsible to provide smoked meat products with high acceptable color, aroma and flavor. However, an increasing demand of smoked meat products, high price of beech wood chips and uncertainty in the supply leads the researchers and manufacturer to look for alternatives. In Thailand, fast-growing local hard woods such as Eucalyptus (*Eucalyptus camaldulensis* Dehn.) and Thai copperpod (*Cassia siamea* Lamk.) are currently used to be heat sources to grilled food, however there is still limit information for smoking meat products.

The main objective of this research was to study the effects of wood chips made from woods planted in Thailand, such as Eucalyptus and Thai Copperpod, on the qualities of smoked sausages compared to commercial Beech wood chips.

II. MATERIALS AND METHODS

Preparation of smoked sausages

The basic formulation of all sausages was on average 63.8% pork, 16% back fat, 16% ice, 1.13% salt (containing nitrite 0.01%), 1.28 sugar, 0.2% sodium tripolyphophate (STPP) and 1.5% spice mix (containing pepper, celery, garlic and mace powder) [8]. The sausage meat was stuffed into collagen casings. About 5 kg of the sausages was prepared for each smoking experiment.

Smoking experiments

A Kombischränke CS 350 from Kerres Smoke-air, Germary, was used as combined smoke and cooking house. During smoking experiment, 500g of each wood chip was used. Sausages were dried for 30 min at 60°C, and then

smoked for 45 min at 65°C for each type of wood chips. The ventilator velocity in the smoking chamber was 1,400 rpm. After the smoking process, the sausages were steamed for 30 min at 75°C and then cooled for 2 min at 10°C. The cooked sausages were vacuum-packaged with Nylon/PE film and stored in a 4°C refrigerator to evaluate the shelf-life for 28 days.

Color measurements

The instrumental color of each treatment was determined by using an Ultra Scan Pro (Hunter lab). CIE L* (lightness), CIE a*(redness) and CIE b*(yellowness) were obtained using a D65 illuminant at 10˚ observation by measuring on the surface of samples.

Sensory evaluation

Hedonic scaling test was conducted by 50 panelists. The panelists consisted of students and staffs of the Kasetsart University. The sensory evaluation was performed by using a five-point hedonic scale with label ranging from "like very much (score 5) to "dislike very much (score 0)." The scales were used to assess the degree of liking of the color, aroma, flavor, bitter, texture and overall acceptability. Smoked sausage samples were covered by the lid and heated in a microwave oven 800 watt at 1 min to an internal temperature of 72℃ monitored by a pocket thermocouple. A portion of sausage (about 0.5 cm) from each sample was randomly labelled with three digit codes and presented to the panelists at room temperature. Unsalted crackers and drinking water were provided to the panelists to wash the mouth between samples.

Total plate counts

For microbial analysis, total aerobic bacteria counts were determined by plating the diluted samples onto trypticase soy agar and incubating the plates at 37°C for 48 h.

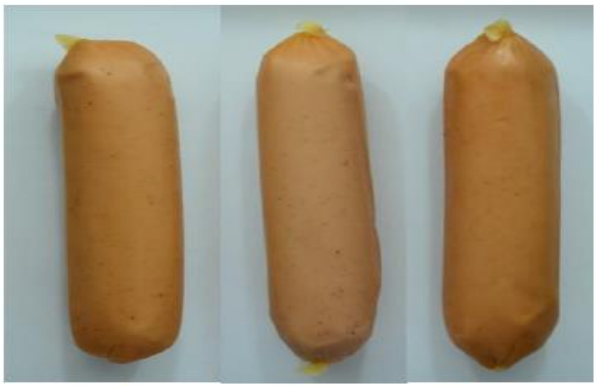
Statistical analysis

The experiment was independently performed at least in duplicate. Duplicate measurements taken on the same experimental unit were averaged for statistical analysis. Differences of means were determined in Duncan's test using the general linear model in the statistical analysis system program and means were considered significantly different at $P \leq 0.05$. The statistical analysis was performed by using SPSS version 17.0 with 95% confidence level.

III. RESULTS AND DISCUSSION

III.I. Color analysis and Sensory evaluation

Figure 1 showed the appearances of sausages after being smoked by using three different types of wood chips. Color measurement as L*(lightness), a* (redness) and b* (yellowness) of these sausages were displayed in Table 1. Sausage smoked with Thai Copperpod wood chips (L* = 54.1, a* = 10.1, b* = 22.1) provided the lighter color with the higher L*-value and lower a*- and b*-values compared to those sausages smoked with Eucalyptus (L* = 50.3, a* = 12.9, b* = 26.1) and commercial Beech wood chips (L* = 50.8, a* = 12.0, b* = 26.1) ($P<0.05$). This may be due to Beech and Eucalyptus woods contain more cellulose and hemicellulose than Thai Copperpod wood, resulting in the formation of carbonyl compounds, which affected the higher color in smoked meat products [7]. The results of sensory properties of smoked sausages with different wood chips are shown in Table 1. Sausages smoked with Eucalyptus had the highest liking score in color, while those with Thai Copperpod had the highest liking score in texture. However, overall acceptability, aroma, flavor, and bitter taste liking scores showed no significantly different among the sausages smoked with three types of wood chips.



Beech Thai copperpod Eucalyptus

Figure 1. Appearance of smoked sausage with different wood chips

Table 1 Effect of woodchip types on color and sensory parameters of smoked sausages

Traits	Woodchip types		
	Commercial Beech	Thai copperpod	Eucalyptus
Color parameter			
L*	50.83^{b}±0.61	54.05^{a}±0.59	50.32^{b}±0.41
a*	12.02^{b}±0.49	10.06^{c}±0.27	12.94^{a}±0.19
b*	26.14^{a}±0.07	22.14^{b}±0.16	26.09^{a}±1.46
Sensory parameter			
Overall ^{ns}	3.67 ±0.77	3.87 ± 0.67	3.84 ± 0.85
Color	3.93^{ab} ± 0.66	3.76^{b} ± 0.85	4.08^{a} ± 0.73
Aroma ^{ns}	3.73 ± 0.81	3.85 ± 0.91	3.69 ± 0.80
Flavor ^{ns}	3.90 ± 0.82	3.91 ± 0.79	3.76 ± 0.75
Bitter ^{ns}	3.91 ± 0.95	3.96 ± 0.92	4.10 ± 1.08
Texture	3.37^{b} ± 1.17	3.84^{a} ± 0.92	3.59^{ab}±1.27

$^{a-c}$Means within row with different superscripts are significantly different (P<0.05).
^{ns}Not significance difference

III.II. Shelf-life of smoked sausage during chilled storage

For shelf life of smoked sausage, smoking had an effect on antimicrobial due to the smoke contained phenolic substances which could reduce the growth of microbials [8]. Total plate count (TPC) during 28-day storage revealed the differences among three sausage samples smoked with different types of wood chips (Figure 2). It was revealed that sausages were not spoiled after the storage for 28 days. TPC values throughout 28 days of storage were less than 3.5 log CFU/g which were not exceed the value determined by Thai official general hygienic requirement (<5 log CFU/g). It was noticed that sausages that contained higher color from Beech and Eucalyptus wood chips were less in the amount of microbials than Thai Copperpod wood chips, which had lower color.

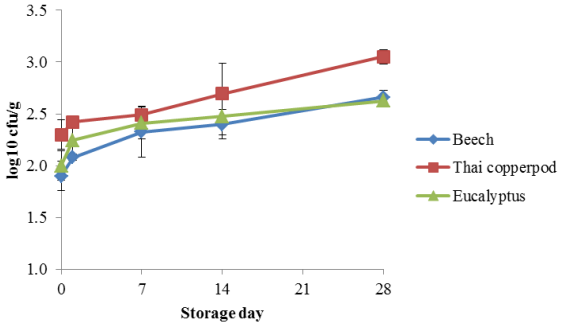


Figure 2. Effect of woodchip types on total plate count (TPC) of smoked sausages

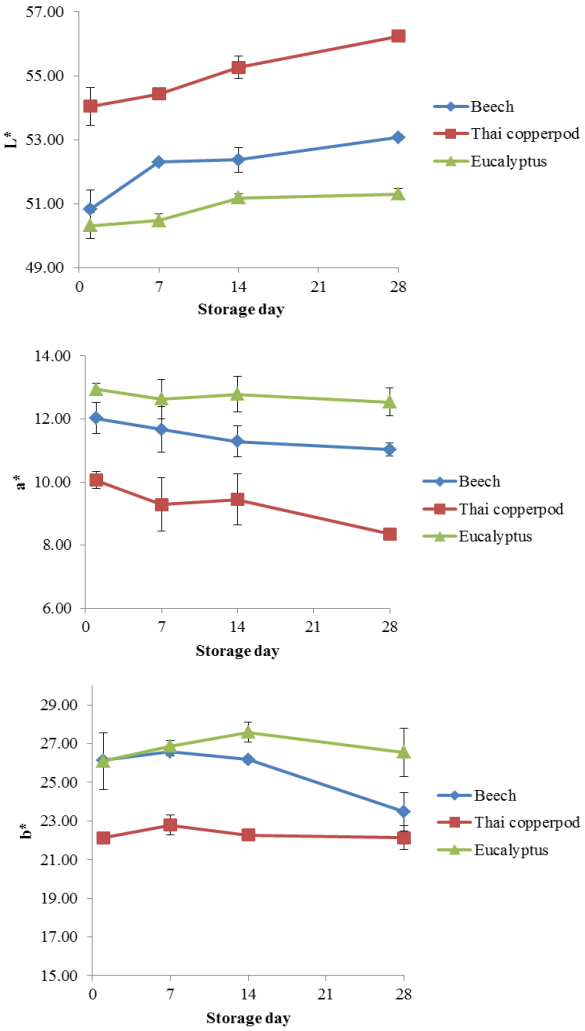


Figure 3. Effect of woodchip types on color parameters (L*, a* and b*)of smoked sausages

Figure 3 showed the color of smoked sausages during the 28 days of storage. The results of this research was relevant to Kramlich *et al.* [9], stating that the smoked sausage reduce their color during refrigerated storage because the pigments inside the sausage had been photo-oxidized by exposure to light. The result showed that L* (lightness) significantly increased in all treatments, brighter but lower in color. The a* (redness) significantly decreased, lower in red during the storage period. The b* (yellowness) was likely to decrease during the storage period. It was noticed that sausages smoked with Eucalyptus wood chips were more constant in color, compared to Beech wood chips.

IV. CONCLUSION

Smoking extends the storage of smoked sausages and adds good flavor and aroma. The use of Eucalyptus wood chips provided good qualities (color and overall acceptability) and shelf-life of smoked sausage comparable to commercial Beech wood chips. This research proposed that Eucalyptus planted in Thailand has potential to be used instead of imported Beech in order to reduce the import of Beech wood chips from overseas.

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REFERENCES

1. Pöhlmann, M., Hitzel, A., Schwägele, F., Speer, K., & Jira, W. (2012). Contents of polycyclic aromatic hydrocarbons (PAH) and phenolic substances in Frankfurter-type sausages depending on smoking conditions using glow smoke. Meat Science 90: 176-184.

2. Stumpe-Vīksna, I., Bartkevičs, V., Kukāre, A., & Morozovs, A. (2008). Polycyclic aromatic hydrocarbons in meat smoked with different types of wood. Food Chemistr 110 : 794-797.

3. Kim, H.-W., Choi, J.-H., Choi, Y.-S., Kim, H.-Y., Lee, M.-A., Hwang, K.-E., Song, D.-H., Lee, J.-W., & Kim, C.-J. (2014). Effects of kimchi and smoking on quality characteristics and shelf life of cooked sausages prepared with irradiated pork. Meat Science, 96: 548-553.smoking conditions using glow smoke. Meat Science 90: 176-184.

4. Gómez-Estaca, J., Gómez-Guillén, M. C., Montero, P., Sopelana, P., & Guillén, M. D. (2011). Oxidative stability, volatile components and polycyclic aromatic hydrocarbons of cold-smoked sardine (Sardina pilchardus) and dolphinfish (Coryphaena hippurus). LWT - Food Science and Technology 44: 1517-1524.

5. Stołyhwo, A., & Sikorski, Z. E. (2005). Polycyclic aromatic hydrocarbons in smoked fish – a critical review. Food Chemistry 91: 303-311.

6. Hosoya, T., Kawamoto, H., & Saka, S. (2007). Cellulose–hemicellulose and cellulose–lignin interactions in wood pyrolysis at gasification temperature. Journal of Analytical and Applied Pyrolysis 80: 118-125.

7. Tóth, L., & Potthast, K. (1984). Chemical Aspects of the Smoking of Meat and Meat Products. In E. M. M. C.O. Chichester & B. S. Schweigert (Eds.), Advances in Food Research, vol. Volume 29 (pp. 87-158): Academic Press.

8. Hitzel, A., Pöhlmann, M., Schwägele, F., Speer, K., & Jira, W. (2013). Polycyclic aromatic hydrocarbons (PAH) and phenolic substances in meat products smoked with different types of wood and smoking spices. Food Chemistry 139: 955-962.

9. Kramlich, W.E. , Pearson, A.E., & Tauber, F .W. (1980). Processed Meats. The AVI Publishing Co., Inc., Westoprt, Connecticut. 348p.