FATTY ACID COMPOSITION OF PON YANG KHAM BEEF TALLOW

P. Pongpaew[1], W. Klaypradit[2], P. Srikalong[1], P. Ingkasupart[1] and S. Kerdpiboon[1*]
[1]Faculty of Agro-Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand.
[2]Department of Fishery Products, Faculty of Fisheries, Kasetsart University, Bangkok, 10900, Thailand.
*Corresponding author email: soraya.ke@kmitl.ac.th

I. INTRODUCTION

Pon Yang Kham cattle had been recognized as one of the best fattening beef cattle for consumption in Thailand. The cattle were controlled in breeding, feeding, maturity, and surrounding to achieve high marbling score to beef. The beef cut retails were sold at an expensive price for premium steak because of its high marbling score. However, the tallow was sold at a low price due to the limitation of tallow application in Thailand. This tallow probably had dominant feature and high nutrition because of breeding, treatment and feeding system. Pon Yang Kham cattle were fed with chemical-free, natural feedings such as grain, rice bran, rice straw, grass, cassava, palm kernel meal, urea, salt, shell, limestone, rock phosphate and molasses for positive palatability of beef [1]. The different foods for feeding led to distinct fatty acid composition [2]. Moreover, the fatty acid composition related to the quality assessment of meat [3] such as firmness, shelf life (lipid and pigment oxidation) and flavour [4]. The fatty acid compositions of meat had been widely researched [5,6] and used for its application. Fatty acid composition determination of Pon Yang Kham beef tallow could be advantages for further study. This research thus determined the fatty acid composition of Pon Yang Kham beef tallow.

II. MATERIALS AND METHODS

Twelve crossbreed cattle of Charolais × Limousin × Simmental (*Bos taurus*) were achieved from Pon Yang Kham farm in Sakon Nakhon Province, Thailand. The age of cattle was about 3-4 years old and the average weight to be slaughtered was 650-700 kilograms. The subcutaneous fat was trimmed, vacuum packed cooled to 4^{o}C and transported to livestock cooperatives Pon Yang Kham Co., Ltd., Bangkok, Thailand (duration time of 12 h) and kept at -10^{o}C until preparation. The trimmed fat was then ground, heated at 90-100°C and filtrated the residues. After that, beef fat was kept in the dark bottle, flushed nitrogen and frozen at -10°C until composition analysis. Fatty acid profile analysis was undertaken following the method described in Shun and Yun [7]. Gas chromatographic analyses of FAME was performed with an Agilent 7890A gas chromatograph (Agilent Technologies Inc., Palo Alto, Ca, USA) fitted with a flame ionization detector. The FAME were separated on a HP-88 (100 m × 0.25 mm × 0.2μm film thickness, Supelco, Bellefonte, PA, USA). The chromatographic conditions were as follows: the initial column was incubated at 140°C for 5 min and the temperature increased by 4°C /min until reaching 240°C. Then a temperature of 240 °C was maintained for 15 min. The injection port and detector were maintained at 260°C and 280°C, respectively. The sample was automatically introduced into the injector port (volume of 1 μL). The constant flow rate for the carrier gas (nitrogen) was set at 1 mL/min. Identification of the fatty acid methyl ester was determined by running reference standards of known methyl esters. Fatty acids were expressed in percentage of the sum of identified fatty acids (%wt).

III. RESULTS AND DISCUSSION

The composition of the fatty acids was presented in Table 1. Pon Yang Kham tallow consisted mainly of oleic acid, palmitic acid and stearic acid. The result was in correspondence with Angus, Australian, Brahman, Wagyu and Hanwoo varieties [1] and Charolais × Thai native cattle cross-breeds (75%:25%) [8]. Pon Yang Kham tallow had oleic acid, palmitic acid, stearic acid of 40.05%, 24.39% and 10.81%, respectively. The fatty acids composition was in the same trend as fatty acids in Charolais cross-breeds of 36.62%, 24.11% and 19.36%, respectively [8]. High levels of oleic acid consisted of dietary and production factor that enhanced the conversion of stearic acid to the oleic acid such as oleic acid produced by the Δ9 desaturase in animal tissues to convert saturated fatty acids to monounsaturated fatty acids. Thus, the fat softness would be increased, [2]. This phenomenon was supported by the result in Table 1 that Pon Yang Kham tallow had MUFA of 47.91% higher than that Charolais cross-breeds tallow of 40.38%, respectively. Moreover, Pon Yang Kham tallow had a PUFA to SFA ratio of around 0.06 lower than that Charolais cross-breeds tallow of 0.19 [8]. Department of Health in the UK [9] recommended the ratio of PUFA to SFA should be increased to above 0.5 [4, 9]. In addition, Pon Yang Kham tallow had saturated fatty acids lower than that Charolais cross-breeds tallow of 40.94% and 50.06%, respectively. SFA consisted mainly of palmitic acid, stearic acid and myristic acid, while USFA consisted mainly of oleic acid, palmitoleic acid, myristoleic acid and linolelaidic acid. Saturated fatty acids had been implicated

in various cancers and coronary heart disease [4]. For this reason, consumption of Pon Yang Kham was better for health concern.

Table 1 Fatty acids composition of Pon Yang Kham beef tallow

Fatty acid	Percentage
12:0, Lauric acid	0.22 ± 0.00
14:0, Myristic acid	4.60 ± 0.03
14:1, Myristoleic acid	1.71 ± 0.02
15:0, Pentadecanoic acid	0.36 ± 0.00
16:0, Palmitic acid	24.39 ± 0.13
16:1, Palmitoleic acid	5.28 ± 0.03
17:0, Heptadecanoic acid	0.55 ± 0.01
17:1, Heptadecenoic acid	0.59 ± 0.00
18:0, Stearic acid	10.81 ± 0.07
18:1, n-9 Oleic acid	40.05 ± 0.23
18:2, n-6t Linolelaidic acid	1.55 ± 0.01
18:2, n-6c Linoleic acid	0.85 ± 0.01
20:1, Eicosenoic acid	0.23 ± 0.00
22:1, n-9 Erucic acid	0.06 ± 0.00
20:4, n-6 Arachidonic acid	0.04 ± 0.00
Unidentified	8.70 ± 0.47
Saturated fatty acids (SFA)	40.94 ± 0.19
Unsaturated fatty acids (USFA)	50.36 ± 0.29
Monounsaturated fatty acids (MUFA)	47.91 ± 0.28
Polyunsaturated fatty acids (PUFA)	2.45 ± 0.02

Fatty acids are reported as percentages of total fatty acids.

IV. CONCLUSION

Tallow of Pon Yang Kham beef cattle was composed of 50.4% USFA and 40.9% SFA. USFA consisted mainly of oleic acid, palmitoleic acid, myristoleic acid and linolelaidic acid, while SFA consisted mainly of palmitic acid, stearic acid and myristic acid. MUFA was a major source of tallow. Moreover, PUFA was also found in the tallow. This would be a health benefit for further research to apply this tallow in food application.

ACKNOWLEDGEMENTS

This research is supported by the Thailand Research Fund (TRF). The authors are grateful for livestock cooperatives Pon Yang Kham Co., Ltd., Thailand for supporting raw material.

REFERENCES

1. Thailand international development cooperation agency. (n.d.). Thailand's best practices and lessons learned in development. Bangkok: Ministry of foreign affairs.
2. Smith, S. B., Gill, C. A., Lunt, D. K. & Brooks, M. A. (2009). Regulation of fat and fatty acid composition in beef cattle. Asian-Australasian Journal of Animal Sciences. 22: 1225-1233.
3. Piao, S., Okura, T., & Irie, M. (2018). On-site evaluation of Wagyu beef carcasses based on the monounsaturated, oleic, and saturated fatty acid composition using a handheld fiber-optic near-infrared spectrometer. Meat Science. 137: 258-264.
4. Wood, J. D., Richardson, R. I., Nute, G. R., Fisher, A. V., Campo, M. M., Kasapidou, E., Sheard, P. R. & Enser, M. (2003). Effects of fatty acids on meat quality: A review. Meat Science. 66: 21-32.
5. Gebrehawerya, B. M., Frank, J. M., Mark, M., Edward, G. O., Ian, R. R., Nigel, P. B. & Aidan, P. M. (2017). Fatty acid, volatile and sensory characteristics of beef as affected by grass silage or pasture in the bovine diet. Food Chemistry. 235: 86-97
6. Raes, K., Balcaen, A., Dirinck, P., Winne, A. D., Claeys, E., Demeyer, D. & Smet, S. D. (2003). Meat quality, fatty acid composition and flavor analysis in Belgian retail beef. Meat Science. 65: 1237-1246.
7. Shun, N. & Yun, Z. (2011). Analysis of fatty acids in infant formulas using an Agilent J&W HP-88 capillary GC column. Agilent Technologies. 1-7.
8. Chaiwang. N., Jaturasitha. S., Sringam. K., Wicke. M. & Kreuzer. M. (2015). Comparison of the fatty acid profile of the meat of crossbreds with 75% Charolais blood proportion and Thai indigenous Upland Cattle. Chiang Mai University Journal of Natural Sciences. 14(2): 199-205.
9. Department of Health. (1994). Nutritional Aspects of Cardiovascular Disease. Report on Health and Social Subject No. 46. London: HerMajesty's Stationery Office.