**Potency of Culled Saanen Crossbred Goat in Supplying Raw Meat for**

**Traditional Thai Butchery**

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**ABSTRACT**

Potency of culled Saanen meat to replace the suplay of yearling Boer goat meat was evaluated. Selected muscles from leg and shoulder cuts of such goat breeds were sampled and analysed for their nutritional, physicochemical, and sensory evaluation. Meat samples from culled Saanen crossbred goat exhibited higher values in protein, collagen, and MUFA (*p<*0.05) than those of Boer crossbred, while lower values in ash, soluble collagen, and SFA were obtained (*p<*0.05). Meat from culled Saanen crossbred goat revealed higher cook loss, shear force, and redness compared to those of a yearling Boer crossbred goat (*p<*0.05). In sensory evaluation result, the panels could detect the differences between raw meat characteristics of these goat breeds (*p<*0.05) within the same muscle. However, the panels could not distinguish the difference between breeds in leg meat after cooked (*p≥*0.05). Shoulder meat of Saanen goat had less acceptance level compared to other samples (*p<*0.05) particularly on its texture and taste quality. In summary, shoulder cut of culled Saanen crossbred goat exhibited a well-intentioned potency to substitute the supply of meat from yearling Boer crossbred goats. Nevertheless, pre-treatment might be applied to leg cut of Saanen crossbred goat to solve less acceptance level of its textural and taste characteristics.

***Key words:*** *Saanen goat, Boer goat, goat meat quality, goat meat composition, microstructure of goat meat*

**ABSTRAK**

Potensi daging kambing Saanen tua untuk mensubstitusi suplai daging kambing Boer telah dievaluasi. Otot dari bagian kaki dan bahu kedua breed kambing tersebut dianalisis untuk melihat kandungan nutrisi, sifat fisikokimia, dan penilaian sensorinya. Dari penelitian didapatkan bahwa kandungan protein, kolagen, MUFA daging kambing Saanen lebih tinggi daripada kambing Boer, sedangkan kadar abu, kolagen terlarut, dan SFA-nya lebih rendah. Susut masak, shear force, dan redness daging kambing Saanen lebih tinggi daripada daging kambing Boer. Pada penilaian sensori, panelis dapat membedakan daging mentah dari kedua breed kambing pada dua bagian karkas, tetapi panelis tidak dapat membedakan daging kaki diantara kedua breed kambing setelah dimasak. Daya terima panelis terhadap daging bahu paling rendah dibandingkan sampel lainnya terutama terkait dengan kualitas tekstur dan rasanya. Dapat disimpulkan bahwa daging bagian bahu kambing Saanen berpotensi sebagai alternatif pengganti daging kambing Boer. Sementara itu, daging bagian kaki kambing Saanen memerlukan perlakuan lanjutan untuk mengatasi daya terimanya yang rendah terkait sifat tekstur dan rasanya.

***Key words:*** *kambing Saanen, kambing Boer, kualitas daging kambing, komposisi daging kambing, mikrostruktur daging kambing*

**INTRODUCTION**

In Thailand, goat is an alternative livestock that increasingly raises for meat and milk purposes. From statistics, the number of goats increased about 23.2% from 380,277 heads in the year 2010 to 468,377 heads in the year 2014 (DLD, 2015). The increasing growth rate of the goat population reflects the increase in the local demand for goat’s meat and milk. The preference in goat products is not only found among the Muslim communities, but also in Thai-Chinese communities (Wattanachant, 2008). However, due to the Thai native goat had less performance than the crossbred and pure bred goat (Supakorn *et al*., 2011; Anothaisinthawee *et al*., 2012b), several exotic breeds such as Boer, Anglo-Nubian, Sannen were imported to upgrade Thai goat breed by the Department of Livestock Development Thailand. Among various breeding programs, Boer crossbred, either with Anglo-Nubian-Thai native or with Thai native goats, is one of most accepted meat-type goat in Thailand. This was due to the Boer crossbred goat performed better live weight gain and provided a better carcass yield than other exotic crossbred and native goats (Anothaisinthawee*et al*., 2010; Anothaisinthawee *et al*., 2012a; Anothaisinthawee *et al.*, 2012b). Thus, this Boer crossbred is being a choice and a popular goat breed for goat meat butchery.

From 2009 to present, demand of goat meat was generally increased while number of meat goat is not sufficient to slaughter for goat meat consumption. Thus, to substitute the consumer needs, meat from dairy goat, particularly Saanen, is used to compensate the meat for the meat goat. Although Saanen is a dairy type goat with a higher growth performance and milk yield (Anothaisinthawee *et al.,* 2012a; Bungsrisawat & Tumwasorn, 2013), meat from both buck and culled doe Saanen are commonly supplied to the local butcher. However, meat from culled Saanen does might be less tender as the age older. In fact, it should be highlighted that traditional consumers in the market did not pay intense attention to various slaughtering ages, sexes, feedings, or environmental conditions influencing meat quality.

The objective of this study was to compare nutritional, physicochemical, and sensory attributes of meat between Saanen crossbred and Boer crossbred goats. Information obtained from this study would be benefit for consumers, butchers, producers, and researchers to see the possibility of culled Saanen does as goat meat alternative. In addition, it could also be consideration to decide appropriate pre-treatment for culled Saanen goat for meat products if needed. Moreover, some variation among various muscles within similar goat breed could be obtained. Thus, it was important to determine meat characteristics between selected muscles in leg and shoulder.

**MATERIALS AND METHODS**

**Materials**

Four 5-year-old Saanen crossbred (87.5% Saanen x 12.5% Thai native) and four 1-year-old Boer crossbred (75% Boer x 12.5% Anglo-Nubian x 12.5% Thai native) goats were obtained from Sitichai Dairy Goat Farm, Sadao, Songkhla, Thailand. Saanen crossbred goats were raised in intensive system, while semi-intensive system was applied to Boercrossbred goat with 3-5 hour/day exposed to paddock. *Adlibitum* roughed grass was provided for both breeds by cut and carry, while 2.5% and 1.5% concentrate feed for Saanen crossbred and Boer crossbred goats, respectively. The animals were slaughtered in Meat Lab, Department of Animal Science, Faculty of Natural Resources, Prince of Songkla University, Hat Yai district, Songkhla province.

The slaughtering procedure was following the guidelinesenlightened in TAS 8400-2007 (TAS, 2007) and TAS 9040-2013 (TAS, 2013). After dressing the carcass using the skinning method, the carcass obtained was stored at 4°C/18 hours for aging. Then, meat from leg cut *(biceps femoris* and *semitendinosus*) and shoulder cut (*supraspinatus* and *infraspinatus*) were selected for analyses. *Biceps femoris* and *supraspinatus* representing samples used for physicochemical analyses and sensory evaluation, while *semitendinosus* and *infraspinatus* representing samples used for fatty acid profiles determination.

**Methods**

**Proximate analysis.** Proximate analysis was conducted based on the guidelines of the AOAC (2000). Moisture was examined using oven drying, protein was measured using Khjehdahl, fat was investigated using soxhlet, and ash was obtained using dry ashing.

**Total collagen.** An acid hydrolysis method was applied to hydrolyse the protein from the sample as described by Palka (1999). HCl 6N was used to hydrolyse 0.5 gram minced sample using an oil bath (110°C) for 24 hours. After reaching ambient temperature, an activated charcoal-clarification, filtration, neutralization, and distilled water-dilution were conducted. After that, hydroxyproline was determined following the method explained by Bergman & Loxley (1963). The hydroxyproline content in sample was measured at wavelength 558nm using a UV-spectrophotometer (UV-1700 PharmaSpec, Shimadzu Corporation, Japan). A-7.25 factor conversion was multiplied with hydroxyproline to convert obtained diluted collagen into mg/g meat sample.

**Soluble collagen.** The extraction of meat soluble collagen was prepared following the procedure explained by Liu *et al*. (1996). A total of 2 grams minced meat was mixed with 25% Ringer solution using a homogenizer (WiggenHauser®, Germany) for 1 min. A heating procedure of the homogenate in a water bath at 77°C for 70 min was applied. Then, the centrifugation of heated homogenate at 2300xg/30 min/4°C was conducted. Supernatant obtained from centrifugal separation was collected. The precipitate was extracted again as the same manner explained. After that, the latter obtained supernatant was combined with the former one. The hydrolysis procedure was following the same method as explained in total collagen hydrolysis. The result of soluble collagen was reported as a percentage of total collagen.

**Fatty acid composition.** Lipid extraction was prepared for fatty acid determination as the method described by Bligh & Dyer (1959). Then, extracted lipid esterified into fatty acid methyl esters (FAME) (Jham *et al.*, 1982). After that, fatty acid methyl esters were determined using Gas Chromatograph, 7890 (Agilent Technologies, USA) based on Gas Chromatography–Flame Ionization Detector technique.

**pH.** pH determination was measured using the guidelines explained by Wattanachant (2003). A total of five gram samples was mixed with 25 ml deionized water using a homogenizer (WiggenHauser®, Germany) for 1 min. A digital pH meter (SevenGo S62-FK2 Mettler Toledo, Switzerland) was used to measure the pH of the homogenate.

**Myoglobin.** An adapted method from Krzywicki (1982) was conducted on myoglobin content determination. The absorbance was determined at 572, 565, 545, and 525 nm using a UV-spectrophotometer (Libra S22 Biochrom, England). The total myoglobin content (Mmol/L) was calculated using the following formula:

Total myoglobin = (-0.1666R1 + 0.086R2 + 0.088R3 + 0.099) x A525

where R1, R2, and R3 are symbolised of A572/A525, A565/A525, and A545/A525, respectively.

A-16824 Da as molecular weight of goat myoglobin (Suman *et al*., 2009; Suman & Joseph, 2013) was multiplied with obtained myoglobin content to convert the result from Mmol/L of diluted myoglobin into mg/gram of meat sample.

**Drip loss and cook loss.** Stainless steel surgical blade (Feather Safety Razor co ltd., Japan) was used for sizing meat sample into 2x1x0.5 cm. For drip loss determination, the sample was blotted with multipurpose towel paper and weighed before moved into a sealed plastic bag (size 4x6 cm). Then, the covered sample was stand on refrigerated temperature (4°C) for 24 hours. After that, the sample moved, blotted, and weighed again as conducted in the initial preparation. Finally, drip loss was determined based post weight and initial weight of sample measured and reported in percentage.For cook loss determination, sealed-plastic bag samples were heated on a water bath (80°C) for 10 min. After that, heated sample was cooled, blotted and weighed as performed on the beginning preparation. Calculation of cook loss was similar to that of drip loss (Wattanachant, 2005).

**Texture.** Sizing procedure of sample was conducted as the same manner prepared for drip loss and cook loss. Texture of sample was determined using a texture analyser (TA-XTplus Stable Micro System Texture Analyser, UK). A-2 mm/s cross head speed and a-50 kg load cell was fixed on such instrument. Score obtained after a Warner-Bratzler blade cut the sample representing shear force of sample (Dawson *et al*., 1991).

**Color.** A Huntarlab colorimeter (Hunterlab ColorFlex, Virginia) was used to determine the color of sample. A black glass and a white standard tile were used to standardize the instrument before applied for color measurement, respectively. Color was reported into lightness (L\*), redness (a\*), and yellowness (b\*) as used in International Commission on Illumination (CIE) system.

**Microstructure.** Microstructure determination was conducted using the method xplained by Palka & Daun (1999) with slight modification. A sizing procedure of meat into 1x0.5x0.5 cm was applied carefully using similar razor blade used in sample preparation for drip loss, cook, loss, and texture analyses. The specimen, then, fixed in 0.1 M phosphate buffer pH 6.5 containing 2.5% glutaraldehyde. After 2 hours room temperature fixation, a rinsing procedure using distilled water was applied. Every 1 hour, then, a gradual dehydrated procedure using 25%, 50%, 70%, 95%, and absolute ethanol of specimen were conducted. The latter procedure were applied twice. A nitrogen-short dipping procedure was direct in conducted on specimen before a thin-cutting process using razor blade was performed. After remaining non solid substance was removed using critical point dryer (Polaron CPD7501, East Sussex, UK), the thin fragment were placed on an aluminium stubs and then a gold coating procedure was applied using sputter coater (West Chester, PA, USA). Then, the photograph of sample was taken using a SEM on 10 kV accelerating voltage. A 500x (cross section) and a 10.000x (longitudinal section) magnification were used. Afterward, muscle fibre diameter and sarcomere length were determined using planimeter and vernier caliper, respectively. Fifteen measurement in each three video prints obtained were examined both for muscle fibre diameter and sarcomere length.

**Sensory evaluation.** Sensory evaluation was divided into triangle test and hedonic test following the general guidelines explained by Meilgaard *et al*. (1991). Thirty panels used both for triangle and hedonic test. Three digit number was used to code the samples served. In triangle test, the panels were served with one set of raw sample containing three meat pieces (two identical samples and one odd sample). The panel was asked to determine the odd sample. The determination of samples in triangle test conducted for both raw leg and shoulder meat. In hedonic test, samples were prepared by cooking until reach 80°C of end point temperature using boiling method. Then, plain cooked samples were served to the panels. Nine-point-hedonic scale (1 = dislike extremely, 9 = like extremely) was applied to determine the preferences level for color, texture, taste, aroma, and overall acceptances.

**Statistical analysis.** This study was conducted using complete randomized design (CRD) for physicochemical analyses. In particular for sensory preference, RCBD Randomized Complete Block Design (RCBD) was applied. Statistical data analyses of physicochemical and sensory preferences were subjected to a one way ANOVA followed by Duncan’s New Multiple Range Test using SPSS Statistics at 0.05 significant level. Significance in triangle test (0.05) was determined based on critical number (minimum) of correct answers as described by Meilgaard *et al*. (1991).

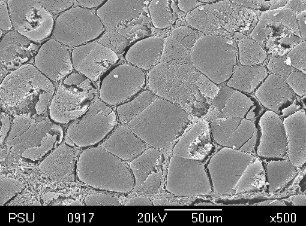
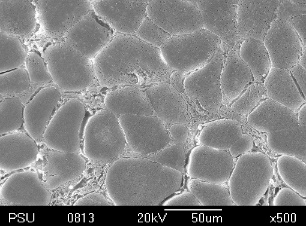
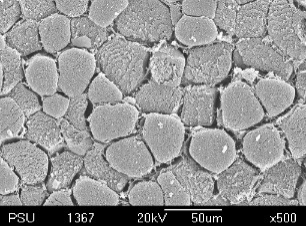
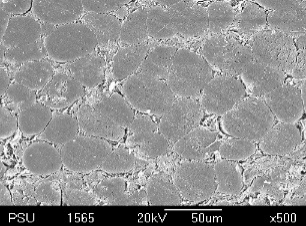
**RESULTS**

The result of nutritional composition and physicochemical characteristics of meat from yearling Boer and culled Saanen goats is presented in Table 1. Protein content of Saanen goat meat was considerably higher than that of Boer goat meat, while its intramuscular fat content exhibited a lower trend. Lower trend of fat content in Saanen meat compared to that of Boer meat was performed.Total collagen of meat from Saanen goat was higher than that of Boer goat within the same cut, while lower soluble collagen percentage of leg of Saanen goat meat was obtained. Saanen goat meat contained substantial lower saturated fatty acid (SFA) compared to Boer goat meat, while its monounsaturated fatty acids (MUFA) were higher. At the same time, polyunsaturated fatty acids (PUFA) of meat between breeds were not different.

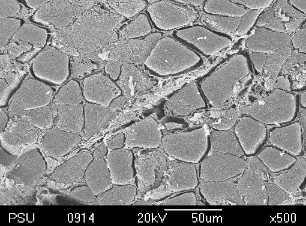
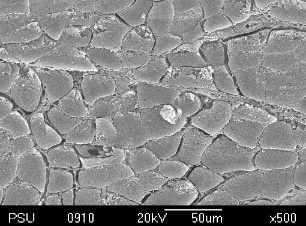
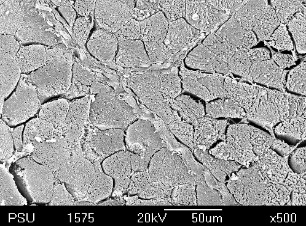
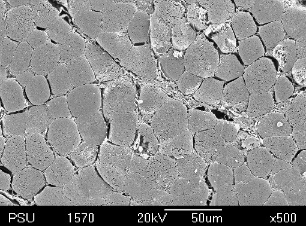
Table 1. Nutritional composition and physicochemical characteristics of meat from culled Saanen crossbred and yearling Boer crossbred goats

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | | Saanen leg | Saanen shoulder | Boer leg | Boer shoulder |
| Proximate | |  |  |  |  |
| Moisture (%) | | 77.01±0.99a | 76.79±0.50a | 76.90±0.89a | 76.69±0.54a |
| Protein (%) | | 20.19±0.89a | 19.40±0.97ab | 18.82±0.98ab | 18.54±0.53c |
| Fat (%) | | 2.32±0.69b | 2.70±0.21ab | 2.63±0.44ab | 3.22±0.43a |
| Ash (%) | | 1.05±0.01b | 1.08±0.02ab | 1.09±0.03a | 1.10±0.02a |
| Collagen | |  |  |  |  |
| Total collagen (mg/g) | | 5.96±1.72a | 5.00±0.67ab | 3.06±0.74c | 3.90±0.45bc |
| Soluble collagen (%) | | 7.34±2.59b | 11.36±4.92ab | 13.51±2.53a | 12.57±3.15ab |
| Fatty acid (% ratio) | |  |  |  |  |
| C9:0 | | 0.00±0.00a | 0.00±0.01a | 0.09±0.18a | 0.03±0.05a |
| C10:0 | | 0.06±0.02a | 0.05±0.03a | 0.24±0.27a | 0.15±0.08a |
| C11:0 | | 0.00±0.01a | 0.00±0.00a | 0.00±0.00a | 0.00±0.00a |
| C12:0 | | 0.20±0.08ab | 0.23±0.08a | 0.10±0.01c | 0.13±0.00bc |
| C13:0 | | 0.01±0.00a | 0.04±0.08a | 0.01±0.01a | 0.01±0.01a |
| C14:0 | | 2.59±0.45a | 2.73±0.44a | 2.10±0.31a | 2.43±0.32a |
| C15:0 | | 0.43±0.07a | 0.43±0.08a | 0.51±0.10a | 0.57±0.12a |
| C16:0 | | 24.94±1.86ab | 26.26±1.12a | 22.77±0.68bc | 24.23±1.05c |
| C16:1 | | 3.63±0.33a | 3.30±0.72a | 2.11±0.31b | 1.70±0.91b |
| C17:0 | | 1.06±0.20b | 1.04±0.12b | 1.51±0.24a | 1.48±0.29a |
| C18:0 | | 14.29±2.53b | 14.44±1.99b | 24.12±3.36a | 23.83±3.34a |
| C18:1 | | 46.84±1.78a | 45.24±3.22ab | 39.65±3.97b | 40.80±4.69b |
| C18:2 | | 4.83±1.41a | 5.34±2.68a | 4.52±0.48a | 2.84±2.00a |
| C18:3 | | 0.16±0.11b | 0.23±0.02b | 1.47±0.26a | 1.22±0.17a |
| C20:0 | | 0.09±0.02a | 0.04±0.06a | 0.04±0.08a | 0.07±0.27a |
| C20:1 | | 0.26±0.07a | 0.26±0.06a | 0.04±0.04b | 0.04±0.04b |
| C22:0 | | 0.04±0.05a | 0.04±0.04a | 0.04±0.05a | 0.04±0.04a |
| C22:1 | | 0.15±0.28a | 0.03±0.03a | 0.02±0.03a | 0.02±0.02a |
| C24:0 | | 0.40±0.27a | 0.30±0.37a | 0.46±0.47a | 0.32±0.28a |
| C24:1 | | 0.03±0.06a | 0.00±0.00a | 0.19±0.22a | 0.13±0.15a |
| SFA | | 44.11±1.77b | 45.60±2.51b | 52.01±4.74a | 53.27±5.06a |
| MUFA | | 50.91±1.98a | 48.83±3.88ab | 42.01±4.56b | 42.68±5.81b |
| PUFA | | 4.99±1.47a | 5.57±2.69a | 5.98±0.32a | 4.05±2.04a |
| UFA | | 55.89±1.76a | 54.40±2.53a | 47.99±4.74b | 46.74±5.07b |
| SFA/UFA | | 0.79±0.05b | 0.84±0.08b | 1.10±0.20a | 1.16±0.23a |
| Physicochemical |  |  |  |  |
| pH | 6.04±0.15a | 5.76±0.08b | 6.23±0.32a | 5.86±0.14b |
| Myoglobin (mg/g) | 11.30±1.83a | 10.63±1.78a | 9.90±1.11a | 9.93±1.16a |
| Drip loss (%) | 1.60±0.20b | 2.21±0.60a | 1.60±0.35b | 1.53±0.15b |
| Cook loss (%) | 38.75±1.03a | 38.78±0.60a | 35.87±1.62b | 35.98±0.33b |
| Shear force | 4.64±0.45a | 4.34±0.37ab | 3.83±0.46bc | 3.50±0.38c |
| L\* | 33.12±0.96b | 34.44±0.90b | 39.85±1.16a | 40.88±1.73a |
| a\* | 16.71±1.10a | 15.83±0.99ab | 15.08±0.82ab | 14.36±0.66b |
| b\* | 12.18±1.22a | 11.93±0.51a | 10.36±2.75a | 10.82±2.33a |
| Fibre diameter (μm) | 32.51±3.07a | 33.30±4.47a | 30.23±1.50a | 31.67±2.96a |
| Sarcomere length (μm) | 1.42±0.19a | 1.46±0.11a | 1.31±0.14a | 1.30±0.06a |

abcMeans within a row with different letters differ significantly (*p*<0.05)

Saanen leg-MF Saanen shoulder-MF Boer leg-MF Boer shoulder-MF   

Saanen leg-IMCT Saanen shoulder-IMCT Boer leg-IMCT Boer shoulder-IMCT

P

E

P

E

E

P

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Saanen leg-S Saanen shoulder-S Boer leg-S Boer shoulder-S

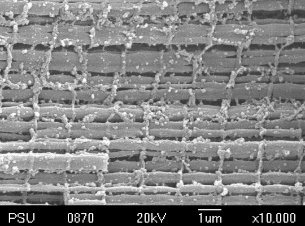
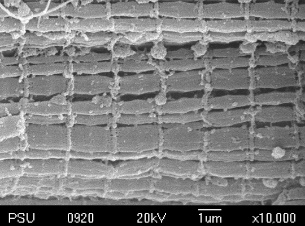
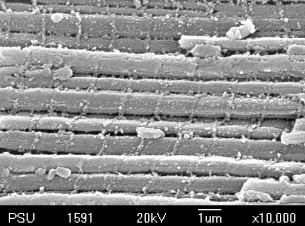
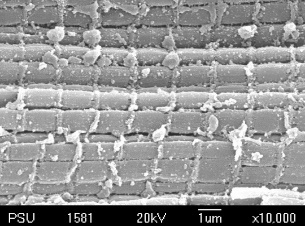
   

Figure 1. Scanning electron micrographs of longitudinal sections of leg and shoulder from culled Saanen crossbred and yearling Boer crossbred goats

Note: MF = muscle fibre, IMCT = intramuscular connective tissue, S = sarcomere, P = perimysium, E = endomysium

Table 2. Sensory evaluation of meat from culled Saanen crossbred and yearling Boer crossbred goats

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sensory evaluation | | | | |
| Triangle test | Raw leg | Raw shoulder | Cooked leg | Cooked shoulder |
| Significance | *p<*0.05 | *p<*0.05 | *p<*0.05 | *p≥*0.05 |
| Hedonic test | Boer leg | Boer shoulder | Saanen leg | Saanen shoulder |
| Color | 5.97±1.97a | 6.57±1.74a | 6.13±1.80a | 6.23±1.48a |
| Texture | 5.83±1.84b | 6.93±1.72a | 4.57±2.03c | 6.13±1.66ab |
| Taste | 5.67±1.81b | 6.53±1.28a | 5.00±1.97c | 5.77±1.81b |
| Flavor | 5.77±1.85ab | 6.13±1.80a | 5.00±2.23c | 5.77±1.68ab |
| Overall acceptance | 5.83±1.64bc | 6.73±1.28a | 5.27±1.82c | 6.07±1.48b |

abcMeans within a row with different letters differ significantly (*p*<0.05)

pH of meat was varied between cuts, while meat from the leg cuts exhibited higher pH than that of the shoulders. Cook loss and shear force of Saanen goat meat were significantly higher than those of Boer goat meat, while its lightness was significantly lower. At the same time, the myoglobin content of the samples was not much different. Non-significant differences were obtained in the microstructure of samples both fibre diameter and sarcomere length. However, higher standard deviations in Saanen goat meat than those of Boer goat meat were obtained. As could be seen in Figure 1, muscle structure of Saanen crossbred goat had thicker perimysium and endomysium compared to those of a Boer crossbred goat, especially in leg perimysium. Moreover, smaller muscle fibre near the perimysium of both breed meat was obtained.Comparable sarcomere length in all samples was observed. Smaller myofibrils with longer sarcomere length were observed in culled Saanen crossbred goat meat.

The results of sensory characteristics among goat meat samples were provided in Table 2. In triangle test, significant difference between breeds was found in raw leg, raw shoulder, and cooked leg samples, while no significance difference was obtained in cooked shoulder samples. In hedonic test, significant difference between breed and muscle cut was obtained for texture, taste, flavor, and overall acceptability. Moreover, texture and taste of leg meat from Saanen crossbred goat had least acceptance level.

**DISCUSSION**

Higher protein content obtained from Saanen samples related to the higher formation of collagen by increasing in goat age. The trend is similar with the resut between dairy cattle (22.39%) vs beef cattle (20.85) (Lizaso *et al.*, 2011). It was noticed that dairy breed reached earlier maturity than beef breed (Wondifraw et al., 2013). Maturity level of animal breed determining collagen properties. Earlier maturity animals were characterized by higher collagen deposition (Jurie *et al*., 2007). Fat deposition between breeds more associated with different deposite location of the goat type. Visually, more fat deposition of Saanen carcass could be seen in form of adipose tissue in some area between muscles as energy reserver rather than in intramuscular fat in the muscle. The phenomenon of the importance of adipose tissue as energy reserver in dairy breed was explained in Mishra *et al*. (2016).

Grain-concentrate feed provided for Saanen goat (2.5 %/day) was higher than that of Boer goat (1.5%/day). In line with previous study, cattle finished on concentrate (45.91%) presented a higher MUFA deposition compared to forage-finished (35.93%) (Duckett *et al.*, 2013). Grain-concentrate either commercial or self-manufactured by farmers was unsaturated-rich components. Deposition of unsaturated-rich components in muscle was responsible for this phenomenon.

The phenomenon occurred in pH might be related to the glycogen concentration. Glucose as source of energy stored as glycogen mostly in skeletal muscle (Ostrowska *et al*., 2015). Selected muscle in leg cut (*biceps femoris*) plays more activity movement during daily life, while selected muscle in shoulder cut (*supraspinatus*) attached near the bond and thus less active during animal movement. More active muscle used more glycogen concentration during daily activity. Thus, this condition lead to less remaining glycogen in leg cut could be converted to lactate to decrease the pH.

The older the age as in culled Saanen, the longer activity of animal and thus produce more myoglobin to bind oxygen to support the activity. At the same time, eventhough Boer were in yearling age, they have more activity due to their visit to paddock. Thus, older age and limited movement of Saanen goat makes a balance condition toward younger age and higher movement of Boer goats.This phenomenon is similar with the age and activity-related factors explained by Hernández et al. (2006).

During heating, structure of collagen would be initially denatured and shrinkaged particularly on its perimysium and endomysium. Then, collagen solubilisation gradually occurred (Chang *et al*., 2011). As a result, some water progresively come out from muscle fibre. Thus, a higher cook loss performed in Saanen goat might be related to its higher collagen content. It was also reliable that, to some degree, higher collagen percentage might be lowering myofibrillar protein percentage. Then, sample with less myofibrillar content was also going into limited ability to hold water.

A higher shear force noticed in Saanen goat meat was directly related to its collagen content. Besides, Saanen goat meat also performed less soluble collagen percentage than that of Boer goat meat particularly on leg part. This represented that Saanen leg had a higher cross linking collagen, which lead to tougher texture. In addition, thicker perimysium in Boer leg (Figure 1) was supporting this phenomenon. A research reported by Ding *et al*. (2010) also found a higher shear force in the meat from dairy goat compared to that of its crossing with Boer goats.

A slightly higher trend in fat of Saanen samples might leading to significant effect on lightness (L\*) as also noticed in positive correlation of fatness-ligtness reported by Wȩglarz (2010). Other possible factor such as variation of oxidative stability of myoglobin (Adeyemi et al., 2016) might be also reliable to elucidate higher difference in meat lightness.

Some muscle fibre in Saanen crossbred goat might be developed well and bigger as the effect of aged, while some others had limited development resulted from less mobility and thus leading to high variation of fibre diameter. At the same time, muscle fibre in the Boer crossbred goat developed in a better way by less variation size due to routine activity in wider area (paddock).As explained by Joo *et al*. (2013), total number and cross section area of fibre were related with its contractile function and fibre type composition. In addition, muscle structure of Saanen goat meat had thicker perimysium and endomysium, especially in leg perimysium.

Result in triangle test reflected that panels could detect difference of meat between breeds in both raw leg and shoulder samples. In brief, texture of sample resulted more effect in triangle test. At the same time, difference in cooked leg samples between Boer crossbred and Saanen crossbred meat also detectable. Lower soluble collagen percentage in leg Saanen representing a higher collagen crosslinking as alsofound in bulls as explained by Christensen *et al*. (2011). The more collagen crosslinking caused less collagen solubilization. Thus, the structure still tougher than Boer shoulder after cooked.Similar collagen percentage between shoulder cuts of both breeds resulted comparable cooked condition. Less perimysium in meat of shoulder cut caused more heat energy to ruptured meat structure during heating.

In hedonic score, texture and taste of leg meat from Saanen goat had least acceptance level. This was due to the tougher texture intensity obtained from such sample. Besides, the higher trend of MUFA on leg meat might be attributed to more oxidation during cooking. The difference in fatty acid composition might be the most substantial factors to explain the triangle test result in leg cooked samples.

**CONCLUSION**

Variation of MUFA, shear force and sensory attributes between goat breeds being three most important aspects to be more concerned. Meat from Saanen crossbred goat was healthier as related to its higher MUFA percentage. However, extra proper handling would be required since lipid oxidation was possibly prone to oxidized in this sample. Tougher texture resulted in selected mucle in raw leg Saanen crossbred samples revealed the comparable occurrence after cooked as implied from the result in triangle test. Shear force and fatty acids might be contributed more impact to make a difference in sensory acceptance. Meat from selected muscles of shoulder cut of Saanen crossbred could be directly used to substitute Boer crossbred meat. However, the meat from selected muscles of leg cut of Saanen crossbred goat needed pre-treatment before cooked to solve its textural and taste challenging.

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