

Quality of Raw Goat Milk in Lower Southern Thailand

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Abstract:

This research aimed to evaluate the quality of raw goat milk such as milk composition (fat, protein, lactose, total solid, solid not fat, mineral, freezing point and specific gravity) and bacterial contamination (total plate count and coliform count) in three lower southern border provinces (Narathiwat, Pattani and Yala), Thailand. Data were randomly collected from 36 dairy goats within 8 local goat farms. The results showed that comparing the differences in milk composition in all three provinces, it was found that fat, total solid, freezing points and specific gravity were significant differences among treatments ($P < 0.05$). Narathiwat province had the highest fat of $6.41 \pm 1.08\%$ and total solid of $15.23 \pm 1.19\%$. Additionally, the number of total plate count of goat milk in Narathiwat, Pattani and Yala provinces were 3.59 ± 0.14 , 4.02 ± 0.85 and $4.41 \pm 0.72 \log_{10} \text{CFU/mL}$, respectively. Coliform count was not detected in goat milk samples from all provinces. However, all milk composition traits found that the most of farms passed the Thai Agricultural Commodity and Food standards (TACF) and bacterial contamination of goat milk was lower the legal standard of TACF. These findings suggested that a sustainable manner for dairy goat farmers in these areas still needed to support for improvements of daily goat production in Lower Southern Thailand.

Keywords: bacterial contamination, dairy goat, milk quality

I. INTRODUCTION

Goat milk is becoming more interesting for people who care about their health because it has better nutritional profile as compared to cow milk. Goat milk contains less Alpha-S1 casein, resulting in fewer chances to be allergic. Moreover, it has smaller fat molecules, which are easy for the body to absorb. (14). Nowadays, goat milk is a one of popular daily product, especially the southern region of Thailand. The demand of goat milk is increasing leads to high number of goat farmers, who raise goat for both meat and milk. Although, raising goat is not recognized as the main careers for these farmers.

According to the statistics from the Department of Livestock Development in 2019, there were three biggest provinces producing goat meat and goat milk including Yala, Pattani and Narathiwat. In these regions, there were proximately 169,533 goats, belonged to 33,307 goat farmers, in which Yala has 2,804 dairy goats and 371 goat farmers, Pattani has 488 goats and 94 goat farmers, and Narathiwat has 224 goats and 56 goat farmers respectively (4). The reason for the high demand on goat milk in these provinces could

be explained by the high number of Muslims who prefer to use goat products in holy Islamic rituals whereas cow products are prohibited. In conclusion, goats are very obviously and always demanded by those people.

The dairy goats are considered as small ruminants and easy to take care. A female goat always give twin off springs yearly, makes it become more interesting, especially for small scale farmers. Furthermore, the dairy goats that are popular in the regions of those 3 provinces appear to be only 2 breeds: (1) cross-breed between Saanen and native, and (2) cross-breed between Saanen hybrid and Angonubian. Those 2 breeds stand out for their good persistence against harsh environment and good amount/or quality of meat and milk. The Saanen breed normally can produces 2.2 kg of milk daily for a period of 200 days (4).

There is a fact that the more amount of milk selling on the markets, the higher percentage of unhealthy contaminated products have been recognized by local quality controllers. The problem mainly sourced from two parameters: milk composition and bacterial contamination. Milk composition includes water, protein, fat and lactose and some micro components such as minerals, vitamins and enzyme (17). In the aspect of bacterial contamination, the total plate count including *E-coli* and Coliform counts must not exceed the Thai Agricultural Commodity and Food standards. The main reasons that make the quality of the goat milk under the standard are the lack of knowledge and technique to produce milk of goat farmers that they cannot control the quality of the milk. In addition, the farmers cannot manage the goat milking processes well enough (12, 16).

In conclusion, in order to control the quality of goat milk in the 3 southern provinces, enable them to pass the Thai Agricultural Commodity and Food standards, raw milk and pasteurized milk in the regions need to be sampled randomly and analyzed for both milk composition and bacterial contamination. Besides, samples of goat feed also need to be analyzed to access the effects of feed nutrition on goat milk in the regions. Finally, all the results should be given back to discuss with farmers in order reveal the cause of problem and find out the solution for goat milk production in the regions. These procedures will also help encourage the farmers to pay more attention on the quality of the goat milk. Thus, the objectives of this study were to evaluated milk composition and bacterial contamination of goat milk from three provinces (Yala, Pattani and Narathiwat) of Thailand.

II. MATERIALS AND METHODS

Study Area and Data Collection

The study was performed on dairy goat farms at Pattani, Narathiwat and Yala provinces in lower southern part of Thailand. Collection of data was at the individual animal records and randomly sampled from the study areas. There were 36 dairy goats from 8 farms in dataset. The Yala province contained a total of 16 dairy goats from 5 farms. The Pattani province had 15 dairy goats from 5 farms and the Narathiwat province had 5 dairy goats from 1 farm. Milk quality was collected from every farm daily from January 1, 2019 until March 31, 2019.

Animals and Management

Animal were crossbred with Saanen (87.5%). Ranging of age and anatomy of dairy goats in the study shown in Figure 1 (adapted from (3)). The dairy goats in these farms were reared semi-intensively. Milk was collected once daily (at 7:00am) manually rather than machine. All animals were vaccinated against

Foot and Mouth disease and treated their goats with antihelmintics twice a year. Antibiotics were typically given to treat infections. The teats of the goats were dipped by an antiseptic after finished milking (100%). All farms used the CMT test to determine the mastitis.

Feeding and nutritional management of dairy goat varied among seasons. Grasses fed to animal in these areas such as *Leucaena leucocephala*, (*Leucaena*) *Hemarthria compressa*, (Whip grass) *Erythrina fusca* Lour (Coral tree) and *Pennisetum purpureum* (Napier) by cut and carry method. Concentrate feed was used to supplement forages. Chemical composition of forages and concentrate in this study were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) organic matter (OM) and nitrogen free extract (NFE) content according to methods of (1) and shown in table 2 and 3. Drinking water was provided *ad libitum*. The amount of concentrate fed to goats depended largely on the amount of milk produced by individual goats. Generally, 1 kg of concentrate was fed for each 2 kg of milk produced.

Traits and Data Preparation

The quality of raw goat milk traits were milk composition (fat, protein, lactose, total solid, solid not fat, mineral, freezing point and specific gravity) and bacterial contamination (total plate count and coliform count). All samples were kept in plastic bags and were tested within 6 hours at the laboratory of the Department of Animal Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, Thailand. The quality of samples was tested in certain categories of the TACF, such as the platform test that is usually practiced on goat milk. Composition of milk such as fat, protein, lactose, total solid, solid not fat, mineral, freezing point and specific gravity were measured by lactometer. The total plate count and Coliform counts were determined by pour plate method with plate count agar (Difco™) and McConkey agar (Difco™), respectively. The plates were incubated at 37°C for 24 hours. The detection limit was at 1.0×10^6 cfu/ml. Indirect methods, such as resazurin and methylene blue, were not conducted in this work.

Statistical Analysis

All data from milk composition traits were analyzed by the analysis of variance (ANOVA), differences were compared among means of the three provinces by Duncan's new multiple range test (DMRT) using the procedures of the Statistical Analysis System Institute (13).

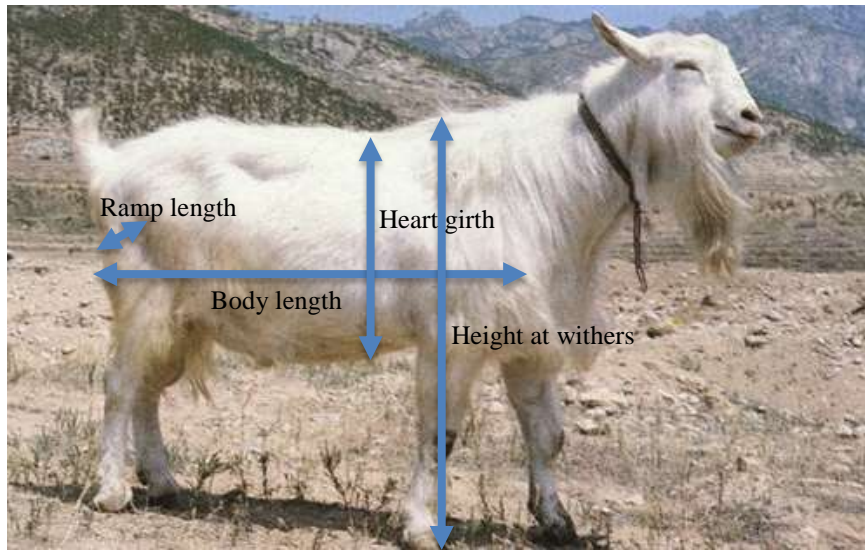


Fig 1: Position of measurements (height at withers, body length, heart girth and rump length)

Table 1 Ranging of age and anatomy dairy goats in three southern provinces

Provinces	Age (years)	Body weights (kg)	Height at withers (cm)	Body length (cm)	Heart girth (cm)	Rump length (cm)
Pattani	2.00-3.00	37.29-45.50	57.86-73.25	61.57-74.25	77.71-90.75	12.00-13.57
Yala	1.50-3.00	38.83-43.29	68.17-74.00	69.33-78.00	81.17-88.00	10.00-13.00
Narathiwat	3.00-3.10	40.12-42.21	40.60-59.12	61.76-63.00	68.00-75.00	12.00-13.00

Table 2 Chemical composition of forages (*Leucaena leucocephala*, *Hemarthria compressa*, *Erythrina fusca* Lour. and *Pennisetum purpureum*) in three southern provinces

Forages	DM	CP	EE	CF	OM	NFE
<i>Leucaena leucocephala</i>	27.2	25.34	2.67	22.54	92.57	40.09
<i>Hemarthria compressa</i>	58.48	6.10	1.4	29.95	95.46	58.01
<i>Erythrina fusca</i> Lour.	48.84	20.62	1.12	19.09	91.66	50.83
<i>Pennisetum purpureum</i>	17.67	7.26	1.43	30.36	88.00	54.73

Table 3 Chemical composition of concentrate (soybean meal, soybean hull, soybean milk residue and commercial concentrate) in three southern provinces

Concentrates	DM	CP	EE	CF	OM	NFE
Commercial concentrate	93.62	22.67	4.3	7.87	92.06	57.22
Soybean meal	95.47	51.84	1.47	5.7	91.88	32.87
Soybean hull	11.45	13.74	2.15	28.89	95.36	50.58
Soybean milk residue	13.96	25.23	11.61	7.05	95.43	51.54

III. RESULTS AND DISCUSSION

Table 4 showed the analyzed results of fat, protein, lactose, total solid, solid not fat, minerals, freezing point and specific gravity of goat milk in three lower southern provinces. Fat from goats in Narathiwat province was ($6.41 \pm 1.08\%$) significant higher ($P < 0.05$) than Pattani and Yala provinces (4.65 ± 1.18 and $3.33 \pm 1.24\%$, respectively). These values were close to the results from (5) who reported that fat from goat was ranged from 3.00-6.00%. Moreover, (16) found that ranged from 2.04-3.72% (average $3.31 \pm 1.13\%$). However, there are also distinct breed differences in fat composition. Protein content of goat milk in this study varied from 3.16-3.46%. This result is similar to the results from (6) who revealed the protein content in goat milk ranged from 2.60% to 4.10%. Total solid in milk goat from Pattani and Narathiwat provinces was significantly higher than that from Yala province ($P < 0.05$). The differences in quality and quantity of goat milk might be influenced by many factors, such as, feeds, genetics, season and stage of lactation (6, 16). According to (15), the parameter of fat ($\geq 3.25\%$), protein ($\geq 3.1\%$), total solid ($\geq 11.4\%$), solid not fat ($> 8.25\%$) and freezing point (< -0.530) were classified follow the standard levels of TACF (15). The results in this study showed that milk goat composition in Narathiwat, Pattani and Yala provinces passed this standard of TACF. All milk composition traits were likely influenced by sufficient feedstuff because most farms had enough forage (Leucaena, Whip grass, Coral tree and Napier grass) and supplement with commercial concentrate and by products from soybeans (soybean meal, soybean hull and soybean milk residue) to feed their goats. Moreover, feeding on Leucaena leaves, a tropical legume, resulted in higher weight gain for goats compared with those fed without tree leaves (10). This study showed the feedstuff, commercial concentrate and by products from soybeans are good sources for goat performance resulting in high milk quality. Moreover, there are many factors that effect on milk quality and production for ruminants such as body weight and milk yield, age, udder size and shape, growth, litter size, season of kidding, nutrition, temperature, disease, milking process and storage, sanitation management and breed (8, 9, 11, 18).

The freezing point indicates the adulteration of the milk with water. In this study the freezing point in of goat milk from Yala province was ($-0.596 \pm 0.033^\circ\text{C}$) significantly higher than those from Narathiwat ($-0.601 \pm 0.01^\circ\text{C}$) and Pattani provinces ($-0.627 \pm 0.029^\circ\text{C}$; $P < 0.05$). According to the standard level, the

freezing point should be bellow -0.520°C . (7) reported that the freezing point of goat milk ranged from -0.540°C to -0.570°C . The specific gravity of goat milk from Yala (1.028 ± 0.004) and Narathiwat provinces (1.022 ± 0.0013) was significantly higher than that from Pattani province (1.026 ± 0.0032 ; $P<0.05$). However, the average of goat milk from the whole region was in the standard levels (1.028 - 1.032 at 20°C).

Bacterial Contamination

The total plate count of raw goat milk in Yala province ranged from 3.55 ± 0.74 to 5.07 ± 0.03 log cfu/ml while the results from Pattani and Narathiwat province altered from 4.19 ± 0.90 to 4.65 ± 0.51 and from 3.16 ± 0.65 to 3.58 ± 0.14 log cfu/ml, respectively. The results also showed that coliform was not detected in milk goat from all farms (Figure 2; Table 5). However, the total plate count (<5.3 log cfu/ml) and coliform count (<3.0 log cfu/ml) in milk goat samples met normal TACF standard. All of the samples were in the standard quality on low bacterial contamination and most of them were classified as good quality (less than 4.699 log cfu/ml). Coliform counts as thousands colony forming unit (cfu) per milliliter may indicate a problem of dirty goats being milked, an unclean udder, unsanitary milking practices or milk contamination in the container. The number and types of microorganism present in milk depended on the microbial quality, the conditions under which the milk produced, temperature and duration of storage (2). Moreover, (16) reported that the quality of raw goat's milk from 5 farms in lower southern Thailand contaminated coliform bacteria and antibiotic residue. However, this study showed most farmers had good hygienic practices while milking. These results were similar to those reported by (11, 19) who reported that the high contamination found here is likely be related to low hygienic level in farms. The result suggested that farmers should seriously consider processing of raw milk. Not only milk production of several dairy goat breeds but also sensory characteristics on milk and its compositions should be studied in order to improve quality and quantity of goat milk (9). Thus, improving management and health care of dairy goat to reduce and maintain bacterial contamination below the recommended maximum should be a priority for farmers.

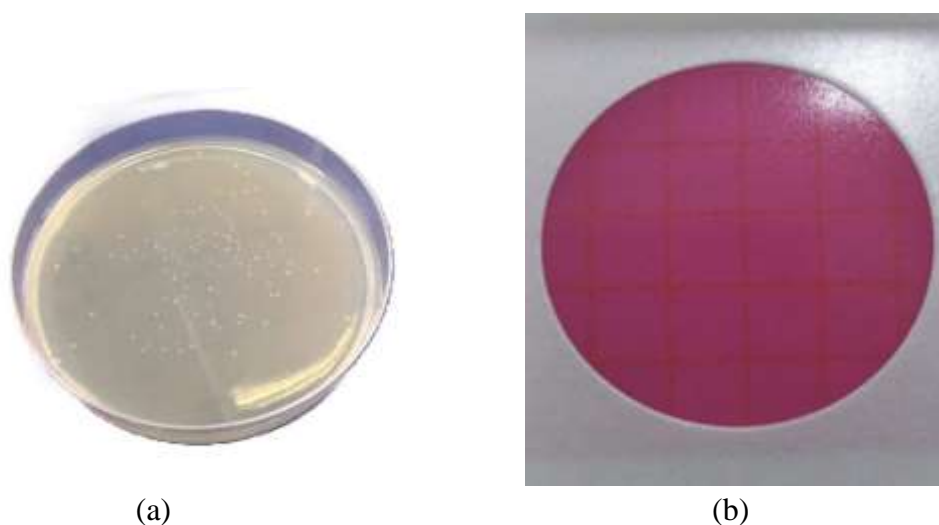


Fig 2: (a) Total plate count and (b) Coliform count

Table 4 Mean of composition, freezing point and density of goat milk samples in lower southern provinces

Milk composition	Provinces			P-value
	Yala (n=16)	Pattani (n=15)	Narathiwat (n=5)	
Milk fat (%)	3.33±1.24 ^b	4.65±1.18 ^b	6.41±1.08 ^a	<0.01
Milk protein (%)	3.35±0.48	3.46±0.59	3.16±0.10	0.28
Lactose (%)	4.93±0.72	4.97±0.51	4.70±0.15	0.50
Total solid (%)	12.08±1.97 ^b	14.12±1.38 ^a	15.23±1.19 ^a	<0.01
Solid not fat (%)	1.43±9.05	9.38±0.81	8.77±0.29	0.70
Mineral (%)	0.97±0.07	1.035±0.01	0.96±0.03	0.05
Freezing point (°C)	-0.596±0.033 ^a	-0.627±0.029 ^b	-0.601±0.01 ^b	0.04
Specific gravity	1.028±0.004 ^a	1.026±0.0032 ^a	1.022±0.0013 ^b	<0.01

^{a,b}Different superscript letters within each row are significantly different (P<0.05)

Table 5 Total plate count (log 10 cfu/ml) and coliform count (log 10 cfu/ml) in lower southern provinces

Parameters	Provinces		
	Yala (n=5)	Pattani (n=2)	Narathiwat (n=2)
Total plate count (log 10 cfu/ml)	5.07±0.03	4.19±0.90	3.58±0.14
	3.55±0.74	4.65±0.51	3.16±0.65
	4.76±0.10	-	-
	4.11±0.77	-	-
	4.24±0.85	-	-
Coliform count (log 10 cfu/ml)	Not detected	Not detected	Not detected
	Not detected	Not detected	Not detected
	Not detected	Not detected	Not detected

Not detected	Not detected	Not detected
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Not detected	Not detected	Not detected
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IV. CONCLUSION

Fat and total solid of goat milk in this study varied across three provinces ($P < 0.05$). Narathiwat province had higher milk fat and total solid than Pattani and Yala provinces. The total plate count in all farms ranged from 3.16 ± 0.65 to $5.07 \pm 0.03 \log_{10} \text{CFU/mL}$ and coliform count was not found in milk samples. This study revealed that milk composition and bacterial contamination of goat milk met the standard quality by TACF.

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