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Research Article
Milk Production and Composition of Etawah Crossbred, Sapera and Saperong Dairy Goats in Yogyakarta, Indonesia

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Abstract

Background and Objective: In Indonesia, there are three dominant breeds of dairy goat in the hand of smallholder farmers. These are Etawah crossbred, Saanen and Sapera but the most common breed in Yogyakarta is Etawah crossbred goat. The main goal of dairy goat production is to improve traits related to milk and reproduction performance. The study aimed to compare milk production and composition of three crossbred dairy goats namely Etawah crossbred, which in Indonesia is called Peranakan Etawah (PE), Saanen-Etawah crossbred or Sapera and Saanen-Etawah Crossbred-Gembrong or Saperong raised under smallholder management in the tropical condition of Yogyakarta. **Materials and Methods:** The study was conducted in CV. Marlin Brothers dairy goat farm and in a farm belonged to a farmer group located at Turi, Sleman, Yogyakarta. Data were collected from goat in their 2nd-3rd period of lactation during 2 until 3 months after kidding. Goat feed consisted of *Pennisetum purpureum* dwarf and *Calliandra calothyrsus* added with a mixture of wheat pollard, copra meal, soybean meal, corn bran and minerals. Water was given *ad libitum*. The data obtained were statistically analyzed used one-way ANOVA ($p<0.05$). **Results:** Milk production of Saperong goat was the highest ($p<0.05$) in compared with Sapera and Etawah crossbred goats, on average were 1750.70±73.83, 1674.00±122.77 and 1340.00±76.38 mL/head/day, respectively. The total solid, lactose and milk fat of Etawah crossbred goat with average value of 15.42±0.04, 5.97±0.03 and 5.80±0.28%, respectively, were higher ($p<0.05$) than those in Sapera as 13.59±0.07, 5.59±0.02, 4.30±0.01% and Saperong milk as 13.35±0.02, 5.83±0.04, 4.25±0.035%, respectively. In the opposite, milk protein of Sapera and Saperong was higher than Etawah crossbred goat, with average of 3.71±0.03, 3.75±0.05 and 3.64±0.01% ($p<0.05$). **Conclusion:** In term of milk production, Saperong was better than Sapera and Etawah crossbred goats, but Etawah crossbred produced the best milk composition among those crossbreds of goat in small farms of tropical condition.

Key words: Milk production and composition comparison, saperong, sapera, etawah crossbred dairy goat, tropical smallholder management

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The main goal of dairy goat production is to improve traits related to milk performance. It is possible to apply stronger selection in goats than in dairy cows due to higher fertility and shorter generation interval. Nevertheless, the lack of suitable genetic evaluation system (GES) is a serious obstacle for more intensive genetic progress in dairy goats[1]. In Indonesia, the dairy goat population consists of a high percentage of small herds (less than 10 heads/farmer)[2]. Yener[3] stated that goat milk can be consumed fresh or processed into cheese, butter, ice-cream, yogurt, condensed milk, evaporated or powdered milk, kefir, cajeta, milk pudding, etc. Goats are easy to grow due to their adaptability and resistance to various conditions (heat, cold, humidity and wind excessive) and can be both manually and mechanically milked[4]. Dairy goat is a type of goat that produces milk at the rate exceeding the needs of their kids. The typical dairy goats raised by farmers in Indonesia predominantly was Etawah crossbred because it has long period adaption to tropical condition and capable to produce milk. Astuti and Sudarman[5] reported milk production of Etawah crossbred goat ranged between 0.5–1.2 L/head/day. Saanen goat was imported and intended to increase milk production. The developing Saanen goat in Indonesia leads to generate crossbred goats, such as Sapera, a result of crossing between female Etawah crossbred and Saanen buck. According to Sutama[6], purebred exotic dairy breeds and their crosses were mostly found in commercial dairy farms. A specialized breeding goat farm in West Java already produced Sapera[5]. In the research center, Sapera milk production was observed to range between 0.8-1.2 L/day[6]. Yogyakarta is one of goat milk production centers in Java Island. The population of goat in that province (404,585 heads) was less than in Central Java (4,134,034), East Java (3,328,928) and West Java (1,321,705) heads[2]. However, in Yogyakarta, goat farmers were very enthusiastic to produce and promote consuming goat milk. One effort to improve milk production has been done through cross-breeding in the farms itself. Sapera that was obtained as a result of cross breeding in the small farm was possibly low in quality due to uncertainty of genetic potential of the parental goats (buck and female), so that, it might produce uncontrolled breeding goat. Little was known about the result of this type of crossbreeding in term of production and milk composition under small farm maintenance. Milk composition was important factor to determine nutritive value.

Haenlein[7] reported that goat milk and its products have significance in human nutrition due to the unique physiological and biochemical quality characteristics of the goat milk. Related to milk composition of crossbred goat, Praharani *et al.*[8] reported that protein and fat content of Sapera goat in the research centre condition was lower than Anglo Nubian crossed. Keskin *et al.*[9] showed no significant difference of milk composition between pure breed and its crossbred of Damascus goat. A number of researchers reported production[10], composition[11] and somatic cell counts[12] of goat milk and factors affecting milk production[13], hair colour variation[14], quality[15] and the management practices[16] of dairy goat.

The study aimed to compare milk production and composition of three crossbred dairy goats namely Etawah crossbred, Saanen-Etawah crossbred or Sapera and Saanen crossbred-gembrong or Saperong under small dairy farms maintenance in the tropical conditions of Yogyakarta.

MATERIALS AND METHODS

Location research: This study was conducted in CV. Marlin Brothers dairy goat farm and in a farm belonged to a group of dairy goat farmers located at Turi, Sleman, Yogyakarta. Analysis of samples was conducted in Laboratory of Dairy Science and Milk Industry, Faculty of Animal Science, Universitas Gadjah Mada.

Animals and diets: This study used nine lactating goats for each crossbred (Etawah crossbred, Saanen-Etawah crossbred or Sapera and Sapera crossbred-gembrong or Saperong) with body weights varying between 35 and 45 kg and body condition score (BCS) 2-3. The goats were in the 2nd-3rd period of lactation. The lactation stage was 2 until 3 months. Goat feed consisted of forage (*Pennisetum purpureum* dwarf and *Calliandra calothyrsus*) and concentrates that was formulated of wheat pollard, copra meal, soybean meal, corn bran and minerals. All goats received forage and concentrate with ratio 60:40 (dry matter basis). The concentrate formula is shown in Table 1. Drinking water was given *ad libitum*. This study used several equipments to collect sample and to measure milk composition. The equipment consisted of 250 mL size bottles for taking milk samples, measuring cups and lactodensimeter for measuring milk volume and specific gravity, coolerbox and laboratory equipment for transporting and analyze milk composition.

The crossbreeding scheme of Sapera (between Etawah crossbred and Saanen goats), as shown in Fig. 1, while Saperong (between Sapera and Gembrong goats), is presented in Fig. 2.

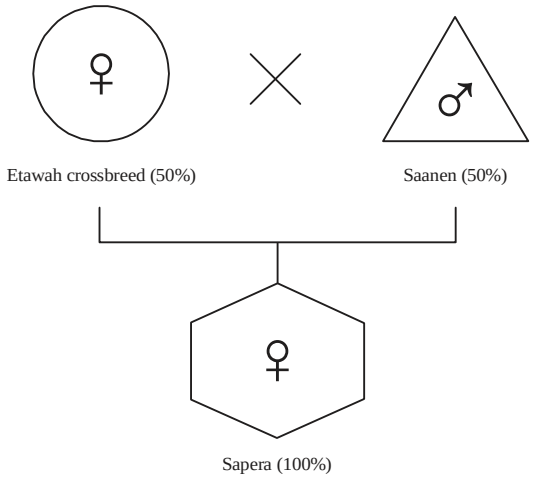

Fig. 1: Crossbreeding model between Etawah crossbred and Saanen goats

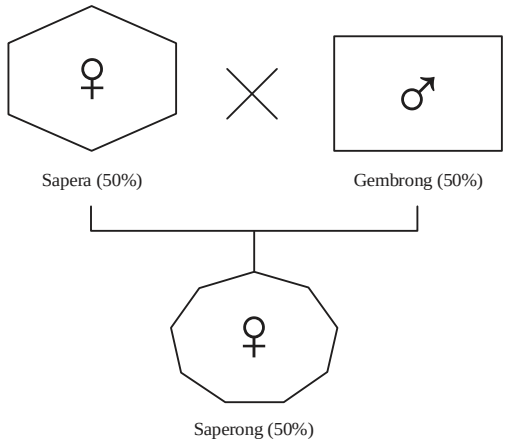

Fig. 2: Crossbreed model between Sapera and Gembrong goats

Table 1: Forage and concentrate ingredients for dairy goat

	Proportion (% DM)	
Feed ingredients	Forage	Concentrate
Pennisetum purpureum dwarf	33	-
Calliandra calothyrsus	67	-
Pollard	-	54
Copra meal	-	20
Soybean meal	-	15
Corn bran	-	10
Minerals	-	1
Total	100	100
Percentage of feeding (ratio)	60	40

Chemical composition of feed ingredients: The chemical composition of feed ingredients consists of dry matter, organic matter, crude protein, crude fibre, extract ether and total digestible nutrient was determined on *Pennisetum purpureum* dwarf, *Calliandra calothyrsus* and concentrate feeds. Nutrient compositions of forage and concentrates formula of this study are presented in Table 2.

Sampling and analysis of milk composition: Milking goat was done every day at 07:00 am and milk production was recorded daily during 30 consecutive days. Milk samples were taken once every two weeks as much as 150 mL of each goat and were subjected to determination of protein (Kjeldahl method), fat (Babcock method), lactose (Nelson method), solid non-fat and total solid contents[17].

Statistical analysis: The data obtained were statistically analyzed used one-way ANOVA with Statistical Program for Social Science or SPSS version 16.0. The significance level considered as ($p<0.05$).

RESULT AND DISCUSSION

Feed and nutrient composition: The ingredients of feed in the farms were similar to generally feed used by goat farmers around the area of this study. The main components of feed, namely *Calliandra calothyrsus* and *Pennisetum purpureum* dwarf, were palatable for goat, nutritious and easily available. Concentrates were intended to support nutrient requirement for milk production. Based on the nutritional value of feed (Table 2), goat in this study potentially meet the nutrient requirement for maintenance and milk production, so that all crossbred of goats in the farms could produce milk with composition such as their genetic potential.

Milk production: Milk production of goat is a reflection of the success of dairy farm management. The average milk production of Etawah crossbred, Sapera and Saperong goats in this study were 1,340.00±76.38, 1,674.00±122.77 and 1,750.70±73.83 mL/head/day, respectively (Table 3). The results of statistical analysis showed different values ($p<0.05$). It indicated that milk production of Sapera and Saperong were higher than Etawah crossbred goats. Figure 3 shows a comparative curve of daily milk production of three crossbred goats. The study observed short period (30 days) of lactation, so that could not explain the production persistence of goat accurately. The average milk production of Sapera in small farms of Yogyakarta was higher than crossbred between Saanen and several indigenous goats, such as with Nubian as 1.23±0.33 L/day[18] and Mamasani goat 1.31±0.12 kg/day[19]. However, milk production of Sapera still lower than pure Saanen goats which reached 1,500.00 mL/day[20]. The result of

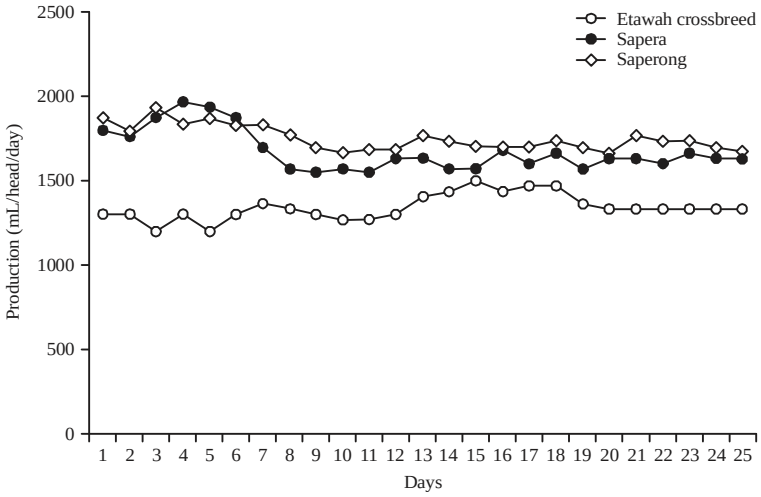

Fig. 3: Average milk production of dairy goats during the study

Table 2: Nutrient composition of forage and concentrates of diet in the study

	Feed ingredients (%)		
Analysis compositions	*Pennisetum purpureum* dwarf	*Calliandra calothyrsus*	Concentrates
DM	33.25	35.77	89.84
OM	88.10	95.85	95.07
CP	12.53	17.51	12.08
CF	23.28	13.77	9.37
EE	1.30	1.25	0.59
TDN	62.39	79.07	83.76

DM: Dry matter, OM: Organic matter, CP: Crude protein, CF: Crude fibre, EE: Ether extract and TDN: Total digestible nutrient

Table 3: Milk production and composition in Etawah crossbred, Sapera and Saperong goats

	Breed dairy goat		
Parameters	Etawah crossbred	Sapera	Saperong
Milk production (L/head/day)	1,340.00±76.38^{a}	1,674.00±122.77^{b}	1,750.70±73.83^{c}
Milk fat (%)	5.80±0.28^{a}	4.30±0.01^{b}	4.25±0,35^{b}
Milk protein (%)	3.64±0.01^{a}	3.71±0.03^{ab}	3.75±0.05^{b}
Milk lactose (%)	5.97±0.03^{a}	5.59±0.02^{b}	5.83±0.04^{c}
Solid non-fat (%)	9.62±0.33	9.28±0.07	9.60±0.33^{ns}
Total solid(%)	15.42±0.04^{a}	13.59±0.07^{b}	13.85±0.02^{c}

^{abc}: Significant ($p<0.05$), ns: Non-significant

study showed the potential of Sapera and Saperong to be developed as dairy goats in smallholder in Yogyakarta. The improvement of milk production of Sapera and Saperong genetically inherited from Saanen goat. The contribution of Gembrong goat improve milk production probably was indirectly, since Gembrong has very close genetic relationship with Etawah crossbred goat[21].

Milk composition: The results of analysis on chemical composition of milk, including fat, protein, lactose, solid non-fat and total solid are shown in Table 3.

Milk fat content: The average milk fat content of Etawah crossbred, Sapera and Saperong goats, respectively were 5.80±0.28, 4.30±0.01 and 4.25±0.35% and statistically showed significant difference ($p<0.05$). The result indicated that milk fat content of Etawah crossbred goat was higher than in Sapera and Saperong goats. The average milk fat content of Sapera and Saperong were also lower than that of Sapera in the research centre as 4.88%[22] and 5.58-6.00%[23], this might be due to the difference of feed quality (type and proportion of forage). However, Sapera milk fat was higher in compared with pure Saanen goat as 3.78%[24]

because of genetic character which hereditary received from tropical goat breed. Milk fat content of Etawah was around 4.78-5.17%[25] and in other tropical goats reached 6-9%[26].

Milk protein content: Milk protein of Etawah crossbred was lower ($p<0.05$) than Sapera and Saperong goats, respectively were 3.64±0.01, 3.71±0.03 and 3.75±0.05%, but statistically there was no significant difference between Sapera and Saperong milk protein content. The value of milk protein in Sapera goat in this study was higher than the same crossbred goat in research centre as 2.98%[8] and 2.82-2.87%[23]. The level of milk protein content of all crossbred goats in this study was higher than in purebred, which for Saanen goat was 3.13%[24] and tropical goats was 3.20%[25]. The type of feed that was provided in the small farms, especially concentrates possibility affected the high protein content of goats in this study. The proportion of concentrates as 40% of DM was considered high to provide energy that might change milk protein content. Supriyati *et al.*[23] and Never[27] reported there was a tendency of higher protein content of goat milk caused by feeding high energy concentrates and nutritious feed. According to Morand-Fehr and Sauvant[28], the effect of concentrates supplementation increased dry matter, energy, production and protein content of goat milk.

Milk lactose content: Lactose content of Etawah crossbred, Sapera and Saperong goats, respectively were 5.97±0.03, 5.59±0.02 and 5.83±0.04% and statistically showed different values ($p<0.05$). Pollott[29] explained that lactose works as determinant of milk volume, so that this component is stable in milk. The average of lactose in milk of goats in this study was in line with Mmbengwa *et al.*[30], who showed a correlation between lactose content and daily milk production, but feeding regime also affected the lactose production. Saperong goats showed the highest lactose content and milk production than another crossbred goat in the farm.

Total solid content: The total solid content of Etawah crossbred as 15.42±0.04% was higher than those in Sapera and Saperong goats as 13.59±0.07 and 13.85±0.02%, respectively ($p<0.05$). The result indicated that Etawah crossbred milk was higher in nutrient content compared with Sapera and Saperong goat milk. The total solid content of Etawah crossbred milk showed that this breed has excellence in term of nutrient content. The value of milk total solid of Etawah crossbred goat in this study was higher (13.15-14.14%) than in pure Etawah goat[25,31]. Solid non-fat (protein, lactose and ash) content in milk was not different among Etawah crossbred, Sapera and Saperong goats, respectively were 9.62±0.33, 9.28±0.07 and 9.60±0.33%. The result indicated that the percentage of milk fat was highly dominant to affect total solid value. Based on the level of total solid, goat milk in this study could be classified as premium grade milk according to Thai Agriculture Standard[20].

The study obtained the potential of crossbred goats in term of production and milk composition and their performance under smallholder farms management in the tropical condition. The study will help researchers to explore these lactating dairy goats in more aspects of productivity in tropical environments with two different seasons and further research is needed on reproduction performance, feeding management, feed and nutrient consumption, milk quality, economic analysis at under smallholder farms management and level of industry, with many populations of dairy goats.

CONCLUSION

The milk production of Saperong was better than Sapera and Etawah crossbred goats, but Etawah crossbred produced the best milk composition among those breeds of goat in tropical condition of Yogyakarta.

SIGNIFICANCE STATEMENT

The study obtained the potential of crossbred goats, namely Etawah crossbred, Sapera and Saperong goats in term of production and milk composition and their performance under smallholder farms management in the tropical condition. The study will help researchers to explore these lactating dairy goats in more aspects of productivity in tropical environments.

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