Diversity of milk traits in 25 goat breeds

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Abstract. Goats are livestock that is mostly raised by small farmers in Indonesia because they are easier to raise. Apart from having the potential to become meat, several breeds of which are kept as milk-purpose. Milk traits of each breed differ from one another. Therefore, this study tried to observe genetic differences of 25 goat breeds with statistical approach. Information about milk traits from 25 goat breeds is obtained from published journal. Multidimensional preference analysis and average linkage cluster analysis were performed using SAS 9.4 to determine the differences in goat breeds from three traits, namely milk yield, fat content, and protein content. Multidimensional preference analysis was able to see the advantages of breeds from the three observed traits. Goat breeds with superior milk yields are Saanen, Camosciata delle Alpi, and Charmoisée. Sarda Primitiva, Sarda, Etawah Grade have high fat content in milk. In addition, Arsi-Bale and Somali have high protein content. Average linkage cluster analysis is able to observe the genetic relationship of goat breeds based on three traits. According to average linkage cluster analysis, we found four clusters for goat breeds in this study. With existing statistical approaches, we can evaluate genetic diversity in milk traits.

1 Introduction

Goats are livestock that are widely used as a producer of meat, milk, and skin in the world. Goat milk is a food ingredient that is used for human health. Goat's milk has a niche market because the price is more expensive than cow's milk. Moreover, goat's milk has more benefit than cow's milk in some important nutrients: vitamin A, niacin, choline, and inositol [1]. The quality of milk is highly dependent on the type of feed used in dairy farming [2]. The quality of milk can be determined from value of protein and fat. Furthermore, goat milk has been an important food of human nutrition, because of the greater similarity of goat milk to human milk, softer curd formation, higher proportion of small milk fat globules, and different allergenic properties compared with cow milk [3].

In the world many goat breeds are developed for high milk production or high fat content depending on the use in making dairy products. Crosses with superior breeds are mostly done to increase the productivity of local goats that are more adaptive to the environment. In the world, Saanen is a popular breed known as a goat breed with high productivity, but other breeds need to be explored, especially for the milk trait. Saanen had higher milk yield compared to Alpine and Nubian for 305 days of lactation [4]. Among the Mediterranean goats, Murciano-Granadina goats had the highest milk yield, fat, and

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protein contents compared to Maltese, Sarda, and Sarda Primitiva [5]. In addition, there are many dairy goat breeds that have not been explored properly to create crossbreeding programs with local goats. Therefore, this study was conducted to explore the diversity of milk traits, especially milk production, fat content, and protein content.

2 Materials and methods

This research used the data of 25 breeds from nine published journal (Table 1). The observed variables were milk production, fat content, and protein content. All unit measures are equated in this study.

Table 1. Dataset of milk traits in this study

No	Breed	Milk Yield (kg/d)	Fat Content (%)	Protein Content (%)	Reference
1	Alpine	2.08	3.47	3.08	[6]
2	Anglo-Nubian	0.90	3.71	3.29	[7]
3	Arsi-Bale	1.13	5.15	4.80	[8]
4	Barbari	0.59	4.66	4.04	[9]
5	Boer	1.41	4.70	4.05	[8]
6	Camosciata delle Alpi	2.57	4.07	3.50	[5]
7	Canaria (Canary)	0.79	3.96	3.72	[7]
8	Charmoisée	2.55	3.40	2.84	[7]
9	Cross (Toggenburg x Arsi-Bale)	0.93	3.65	4.08	[8]
10	Damascus	1.88	4.46	3.82	[7]
11	Etawah Grade	0.46	5.57	4.19	[10]
12	Girgentana	0.70	3.93	3.48	[7]
13	Jamunapari	0.87	4.81	3.75	[9]
14	Malagueña	1.47	5.49	3.40	[7]
15	Maltese	1.83	4.05	3.35	[5]
16	Murciano-Granadina	2.18	4.48	3.46	[5]
17	Nordic	1.92	4.28	2.87	[7]
18	Polish White	1.38	3.38	3.12	[8]
19	Saanen-Croatia	2.63	3.25	3.01	[6]
20	Saanen-Italy	2.79	3.8	3.40	[5]
21	Sapera	1.55	6.00	2.87	[11]
22	Sarda	0.95	5.32	3.98	[5]
23	Sarda Primitiva	0.87	5.83	4.09	[5]
24	Somali	0.85	4.90	4.34	[8]
25	Toggenburg	1.82	3.37	2.96	[7]

Multidimensional preference analysis (MDPREF) and average linkage cluster analysis were performed using SAS 9.4 with PROC PRINQUAL and PROC CLUSTER, respectively. Multidimensional preference analysis is a principal component analysis which aims to

project the high-dimensional ranking data into biplot. average linkage cluster analysis is a group analysis method that construct a hierarchical group of data by calculating the distance between two cluster which is referred to as the average distance where the distance is calculated on each cluster. Both of these analyzes to compare the diversity of the milk traits.

3 Results and discussion

Based on multidimensional preference analysis, milk yield, protein content, and fat content have no correlation shown in the opposite direction (Fig. 1). Saanen from Italy, La Mancha, Saanen from Croatia, Camosciata delle Alpi, Charmoisée, Murciano-Granadina, and Alpine are dairy goat breeds that have high milk production. In Indonesia, crosses of Saanen and Etawah Grade (Sapera) are carried out to obtain a breed with high milk production with tropical climate resistance [12]. In Brazil, Saanen and Anglo-Nubian breeds were crossed in an effort to strengthen the rusticity [13]. Sapera has a higher production than Etawah Grade [10, 11] and has a higher fat content than Saanen [6, 10, 12]. Sapera, Sarda Primitiva, and Etawah Grade have a higher fat content among other breeds.

According to average linkage cluster analysis, we found four cluster 1 (Sapera and Malagueña), cluster 2 (Sarda, Sarda Primitiva, Etawah Grade, Boer, Somali, Jamunapari, Barbari, Arsi-Bale), cluster 3 (Cross, Girgentana, Canaria, Anglo-Nubian), and cluster 4 (Nordic, Maltese, Murciano-Granadina, Damascus, Saanen-Croatia, Charmoisée, Saanen-Italy, Camosciata delle Alpi, Polish White, Toggenburg, Alpine) (Fig. 2). Cluster 4 is breeds with high milk yield. On the other hand, cluster 2 is breeds with high protein content. Ruminant milk contained 95 % of the proteins that are synthesized from six structural genes that encode well characterized proteins, the whey proteins, and the caseins [14]. Cluster 1 has high fat content. On the other hand, cluster 3 has moderate fat and protein content. This findings found high diversity of milk traits in 25 breeds.

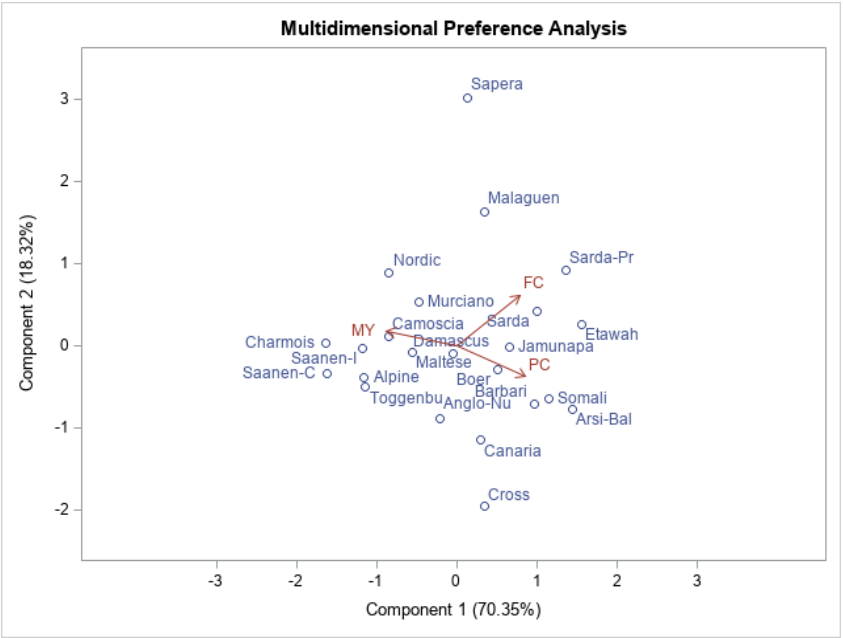

Fig. 1. Multidimentional preference analysis of 25 goat breeds based on milk yield (MY), fat content (FC), and protein content (PC).

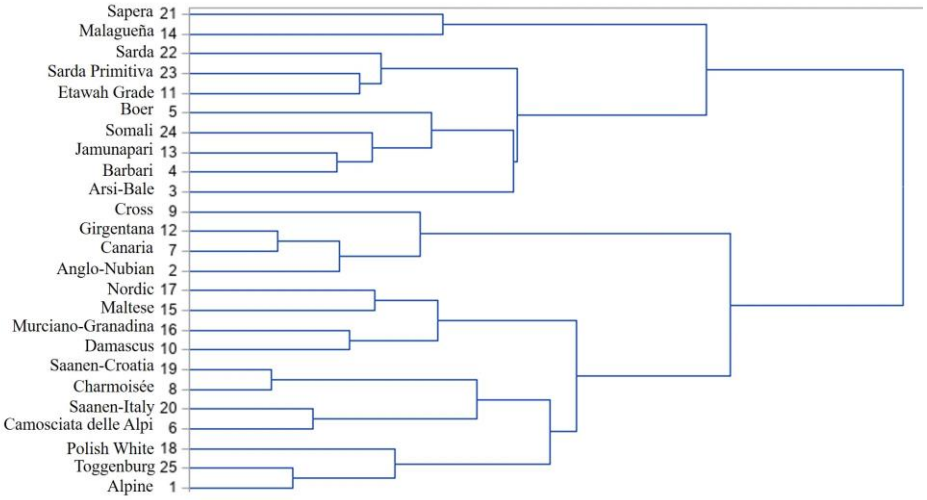

Fig. 2. Average linkage cluster analysis of 25 goat breeds.

4 Conclusion

The dairy goats in this study have various milk traits. The milk traits do not have a positive correlation with other properties. Based on this research, the dairy goat crossing program can increase productivity such as Sapera.

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