

The Effect of Age on Milk Yield and Milk Composition in Saanen Dairy Goats

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Abstract: The goals of this study were to determine the weekly milk production of Saanen goats at UniSZA Pasir Akar Farm, and to evaluate milk production and composition in three age groups. From January 2021 to May 2021, a study was conducted at the UniSZA Pasir Akar Farm in Besut, Terengganu. Ninety goat milk samples were collected and stored in sterile falcon tubes. Milk samples were stored in an insulated box at 5 °C before being transported to the laboratory and stored at -20 °C until further analysis. Milk samples were analyzed in four replicates for each sample group using the Milkotester. The one-way analysis of variance (ANOVA) method was used to analyze raw data among age groups, with $p < 0.05$ indicating a significant difference. The highest milk yield was produced by four-year-old goats (943.9 g/d), followed by three-year-old goats (850.5 g/d) and two-year-old goats (571.1 g/d), respectively. Solid non-fat (SNF), protein, and lactose content showed the highest in percentage in the 3-year old group, at 7.80%, 2.80%, and 4.27%, respectively. However, the fat content revealed an unusual pattern, with 2.87%, 2.77%, and 3.33% representing 2, 3 and 4 years old. This occurred due to other factors such as feed, breed, and age. In conclusion, this study found a significant difference in milk yield and composition across three age groups. However, this is only a preliminary result based on a small number of animals and a short study period. Future studies will perhaps, use larger sample sizes and parameters to validate the current result.

Key words: Age, dairy goats, milk composition, milk production, Saanen goats.

1. Introduction

The goats are domesticated animals that can produce milk aside from cattle. Mondial population of dairy goats is about 700 million, 95% of which located in developing countries. Anglo-nubian, British alpine, Toggenburg, and Saanen are the most common breeds of dairy goats [1]. Expansion in dairy goat farming has led to the increase of milk-based products, providing sustainable livelihoods in rural and limited resources areas and enabling them to sustain their lives and economy [2]. The spread of dairy breeds throughout the world has also improved the food quality and the ability of the goat breeds to live under harsh climates and environments [3].

Goat milk has a similar composition to cow milk, but the unique traits of goat milk make it suitable for

dietary consumption and medical treatments [4]. Previous reports documented that goat milk had better nutrition because it is easy to digest and healthy [1, 5, 6]. Milk composition values varied based on genetic or environmental factors such as parity (age), nutrition, the season of kidding, stage of lactation, body weight, udder size, and environmental temperature to the milk production and milk composition in dairy goats [7-12]. Due to differences in the composition of milk, the product may show varied nutritional and medicinal properties [13]. Zoa-Mboé *et al.* [14] stated that in Saanen milk composition, the percentage of fat and protein values elevated during one to two years old goats before these values began to decline. There is a lack of study to show a relationship between goat age and milk production and composition.

In Malaysia, ruminant industries are small, still lag behind other major livestock industries, and still depend on other countries to be imported. Saanen goat

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is one of the small ruminant dairy goat breeds imported to Malaysia because of their adaptability and performance of high milk production by the government to increase goat milk in the industry [4]. According to Khandoker *et al.* [15], goats play a pivotal role in Malaysian farming, both commercially and economically. Commercial farmers reared goats for meat production, while local and small farmers usually kept goats for meat and milk production as their source of income.

Identifying the optimal age for Saanen goats to produce the most and high quality milk provides valuable information for local producers and breeders. Here we have studied weekly milk production of Saanen goats at UniSZA Pasir Akar Farm and evaluated the milk production and composition in three different groups of age. This study can help to determine best age to have the best quality of goat milk, which can fulfill the satisfaction of the market demand.

2. Materials and Methods

2.1 Animal Selection

This study was conducted at UniSZA Pasir Akar Farm, Besut, Terengganu, Malaysia. A total of 15 healthy Saanen goats, with body condition score (BCS) 2 to 3, which had symmetrical udder characteristics were selected for this study. The Saanen goats were fed 3-4 kg of concentrates in the morning and *Brachiaria humidicola* grass (89% dry matter (DM)) in the afternoon. The Saanen goats were raised in a system of intensive housing with limited access to the land. As a result, the farm worker is responsible for feeding and watering the animals. These goats are divided into three different groups ($n = 5$), which represent age 2 (first parity), 3 (second parity), and 4 (third parity) years old, respectively. Ear tags, BCS, and health status are all recorded.

2.2 Sample Collection

Raw milk samples were collected by hand milking

at 9 am once a week before milking started for all goats. And 15 mL of raw milk of each goat was collected in the Falcon tube and stored at $-80\text{ }^{\circ}\text{C}$ until further analysis.

2.3 Sample Preparation and Analysis

Milkotester Ultrasonic Milk Analyzer (Bulgaria) was used to determine the milk composition. Before pouring samples in the cup of Milkotester, they have been thawed and stirred completely. The cup containing the milk sample was placed in a slot, and the milk composition was calculated using a probe dipped in the milk sample under Option of “small ruminant” of Milkotester. After a few seconds, the result was shown on the Milkotester screen. The samples were re-run four times before being replaced with a new sample.

2.4 Data Management and Statistical Analysis

Microsoft Excel spreadsheet was used to manage and record raw data obtained from sampling and analysis. Descriptive data, such as percentage of protein and fat, were used to summarize the proportion of milk composition using one-way analysis of variance (ANOVA) to see composition differences among ages of each group. The milk composition values were evaluated through standard deviation (SD) and $p < 0.05$ was considered significant.

3. Results and Discussion

3.1 Analysis of Milk Yield and Milk Composition of the Saanen Goat at Different Age

Table 1 summarizes a compilation of milk yield and milk composition results from three age groups: two, three, and four. Among these age categories, each parameter was compared. At the same time, separate parameters (milk yield or milk composition) are represented in the figure below. Fig. 1 shows the milk yield slowly decreasing as the lactating week increases. The four years old Saanen goats had the

highest milk yield (943.9 g/d) compared to other groups; three years old (850.5 g/d) and two years old does (571.1 g/d). A previous study showed that Saanen goats had steady increases in milk production as the ages increased [16]. According to Dagnaw *et al.*

[1] goats usually reach the peak of lactation between 4 years old to 8 years old of ages. The increase in milk yield was due to the increasing volume of alveoli and past alveoli that is not fully regressed, contributing more to the milk production [17].

Table 1 Milk yield and milk composition of Saanen goats at different age.

Age	Parameters measured				
	Milk yield (g/d)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)
2	571.1 ^b ± 89.7	2.87 ^b ± 0.10	7.78 ^a ± 0.04	2.80 ^a ± 0.00	4.23 ^a ± 0.03
3	850.5 ^a ± 155.0	2.77 ^b ± 0.06	7.80 ^a ± 0.03	2.80 ^a ± 0.00	4.27 ^a ± 0.03
4	943.9 ^a ± 168.0	3.33 ^a ± 0.06	7.53 ^b ± 0.11	2.77 ^a ± 0.03	4.1 ^a ± 0.06

Mean ± SD values within a column with different superscripts of “a” and “b” represent the significant differences. Same alphabet indicates no significant differences in parameters. SNF: solid non-fat.

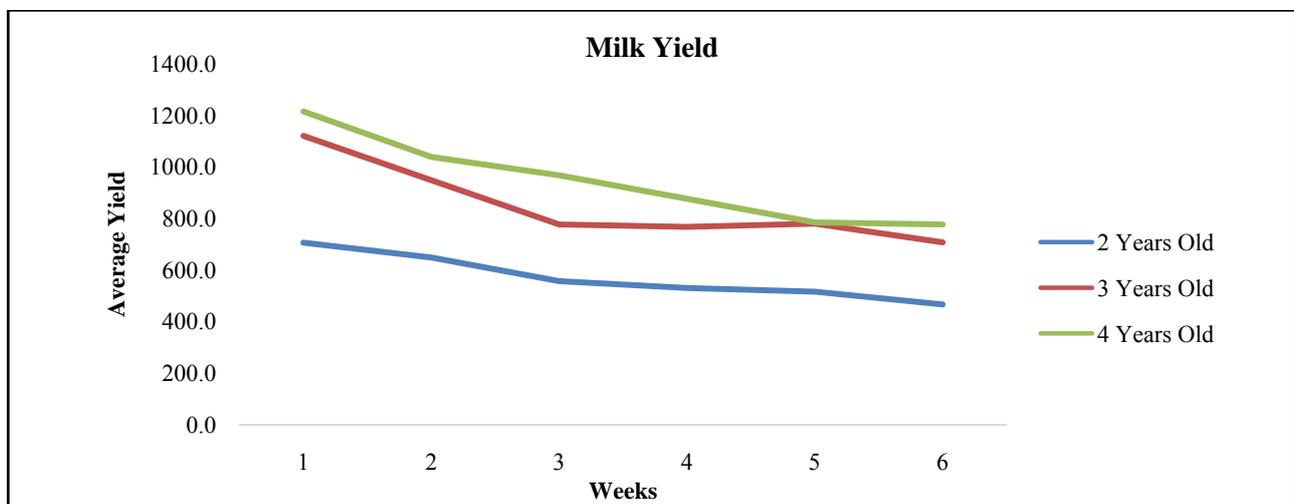


Fig. 1 Saanen milk yield at different age.

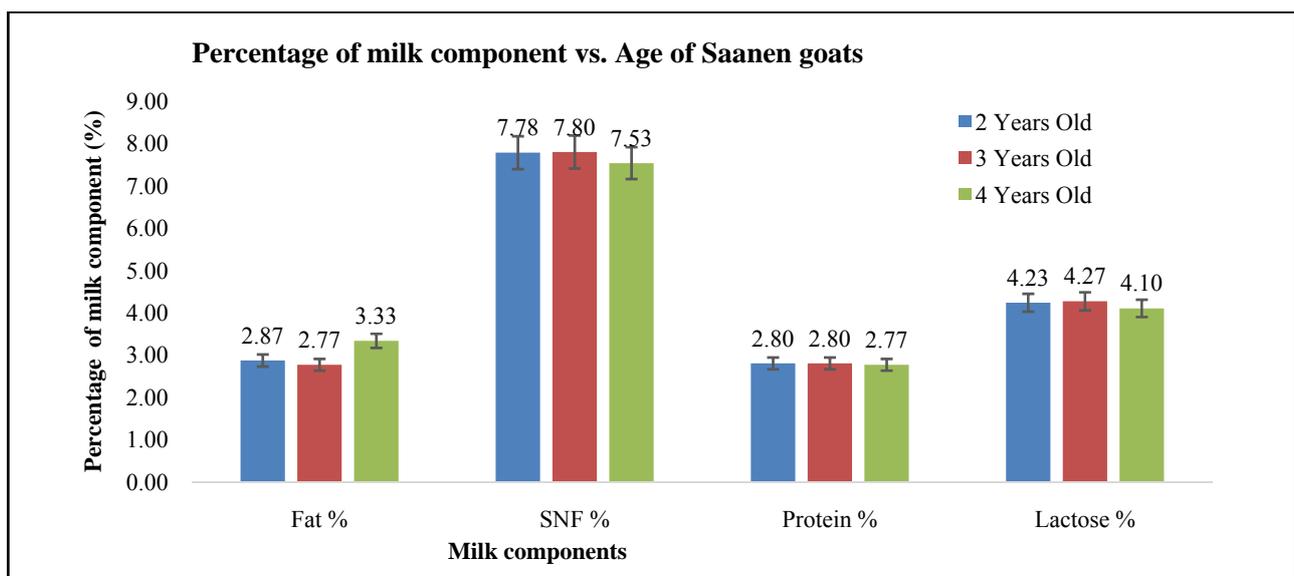


Fig. 2 Milk composition of Saanen goat at different age.

The result showed significant differences ($p < 0.05$) in milk yield of two years old Saanen goats compared to three and four years old ones. Based on the result, the milk yield increases by each year. The increase in milk yield with the advancement in age of the goat agreed with the study by Muller [18], who reported does which kidded at a younger age had a lower milk yield compared to those with higher age. According to Ferro *et al.* [19] Saanen goat produces 2.55 kg of milk per day on average. The difference in yield is due to Ferro and co-workers using different formulating diets and nutritional balance given to the goat.

The milk composition of Saanen goats at three different ages is shown in Fig. 2. Four years old goat has the highest content in fat 3.3%, followed by two years old 2.87% and three years old, which is 2.77%. According to Mioč *et al.* [16] Saanen goat has a lower fat content of 3.25% compared to British Alpine Breed. The current result indicated that four-year-old fat content had reached an agreement with Mioč *et al.* [16]. Meanwhile, for two and three years old, the fat content was low compared to Mioč *et al.* [16] who consider the outside factors such as feed and distinct differences in fat composition between breeds [1]. However, a study in 1997 revealed that younger goats produce low fat content compared to older (over three years old) goats. This situation explains why four years old had the highest fat content compared to two and three years old goats [14].

For SNF content, the value obtained for two, three and four years old was 7.78%, 7.80% and 7.53%, respectively. According to Ferro *et al.* [19] the SNF content of Saanen goat is 11.52%, which is higher than the current result. On the contrary, a study in 2009 reported SNF values in Saanen and Alpine dairy goats were 7.66% and 7.42%, respectively [20] and this result was almost similar to the present findings. According to a recent study, the hot temperature is a significant factor that causes low SNF values in Saanen dairy goats [21].

The protein contents are pretty similar, which is

2.80% of protein for both two and three years old. Four-year-old goats have lower protein content, which is 2.77%, but the content is still in the range of non-significant differences between each other. According to Mioč *et al.* [16] Saanen goat has 3.01% protein content, which is significantly higher than the results. Low protein content may result from storing the sample in the freezer for a certain period and error during conducting the sample preparation [22].

The lactose content from the result does not have any significant difference between each of the years. According to Silanikove *et al.* [3] goat milk has an average of 4.1% lactose compared to cattle, which has an average of 4.7%. Three-year-old Saanen goat has a slightly higher lactose content, 4.27%, followed by 4.23% of two years old and 4.1% of four years old.

4. Conclusion

In conclusion, age is one of the main factors affecting milk yield and milk composition in Saanen dairy goats. The milk yield increased significantly as the age of Saanen goats progressed. This showed high milk production during the first two weeks of the lactation period, and this pattern constantly differed in milk yield among the group of ages as milk production declined. Evaluation of milk composition showed that two and three years old goats do not have any significant difference in terms of fat, SNF, protein and lactose. As for four-year-old goats, there are distinct differences in composition where the fat content is extremely high. In the future, larger sample sizes are required, and more parameters will be involved to validate and seek more potential of Saanen dairy goat milk.

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References

- [1] Dagnaw, G., Mebrat, A., Wubie, A., and Kendie, H. 2016. "Review on Goat Milk Composition and Its Nutritive Value." *Journal of Nutrition and Health Sciences* 3 (4): 401-501.
- [2] Miller, B. A., and Lu, C. D. 2019. "Current Status of Global Dairy Goat Production: An Overview." *Asian-Australasian Journal of Animal Sciences* 32 (8): 1219-32.
- [3] Silanikove, N., Leitner, G., Merin, C., and Prosser, C. G. 2010. "Recent Advances in Exploiting Goat's Milk: Quality, Safety and Production Aspects." *Small Ruminant Research* 89: 110-24.
- [4] Aliah, Z. M., Rashidah, S., Jinap, S., Anis, S. M., and Intan, H. I. 2019. "Chemical and Mineral Composition of Raw Goat Milk as Affected by Breed Varieties Available in Malaysia." *International Journal of Food Properties* 22 (1): 815-24.
- [5] Roy, D., Ye, A., Moughan, P. J., and Singh, H. 2020. "Composition, Structure, and Digestive Dynamics of Milk from Different Species—A Review." *Frontiers in Nutrition* 7: 577759. doi: 10.3389/fnut.2020.577759.
- [6] Terry, P. H., and Snow, K. 2013. "The Effects of Goat Milk versus Cow Milk on the Physical and Sensory Characteristics of Ice Cream." *Journal of the Academy of Nutrition and Dietetics* 113: A59.
- [7] El-Tarabany, M. S., El-Tarabany, A. A., and Roushdy, E. M. 2018. "Impact of Lactation Stage on Milk Composition and Blood Biochemical and Hematological Parameters of Dairy Baladi Goats." *Saudi Journal of Biological Sciences* 25: 1632-8.
- [8] Eydurán, E., Yılmaz, İ., Kaygısız, A., and Aktaş, Z. M. 2013. "An Investigation on Relationship between Lactation Milk Yield, Somatic Cell Count and Udder Traits in First Lactation Turkish Saanen Goat Using Different Statistical Techniques." *Journal of Animal and Plant Sciences* 23: 956-63.
- [9] Idamokoro, E. M., Gunya, B., and Aliber, M. 2019. "Farmers' Perception and Willingness to Consume Goat Milk and Goat Milk Products: A Case Study of the Central Eastern Cape, South Africa." *Pastoralism* 9 (1): 3.
- [10] Min, B. R., Hart, S. P., Sahlu, T., and Satter, L. D. 2005. "The Effect of Diets on Milk Production and Composition, and on Lactation Curves in Pastured Dairy Goats." *Journal of Dairy Science* 88: 2604-15.
- [11] Mioč, B., Sušić, V., Zvonko, A., Zvonimir, P., Vnucec, I., and Kasap, A. 2011. "Study on Birth Weight and Pre-weaning Growth of Croatian Multicolored Goat Kids." *Veterinarski Arhiv* 339: 339-47.
- [12] Salari, F., Altomonte, I., Ribeiro, N. L., Ribeiro, M. N., Bozzi, R., and Martini, M. 2016. "Effects of Season on the Quality of Garfagnina Goat Milk." *Italian Journal of Animal Science* 15: 568-75.
- [13] Lajpat, L., and Rathee, R. 2017. "A Review on Health Promoting Aspects of Goat Milk." *Pharma Innovation Journal* 6 (12): 5-8.
- [14] Zoa-Mboé, M. C., Detilleux, J. C., Kebers C., Farnir, F. P., and Leroy, P. L. 1997. "Effects of Parity, Breed, Herd-Year, Age, and Month of Kidding on the Milk Yield and Composition of Dairy Goats in Belgium." *Journal of Animal Breeding and Genetics* 114 (1-6): 201-13.
- [15] Khandoker, M., Afini, N., and Azwan, A. 2018. "Productive and Reproductive Performance of Saanen Goat at AZZahra Farm of Sandakan in Malaysia." *Bangladesh Journal of Animal Science* 47: 1-12.
- [16] Mioč, B., Zvonimir, P., Vnucec, I., Barać, Z., Sušić, V., Samarzija, D., and Vesna, P. 2008. "Factors Affecting Goat Milk Yield and Composition." *Dairy* 58: 305-13.
- [17] Lérias, J. R., Hernández-Castellano, L. E., Suárez-Trujillo, A., Castro, N., Poulis, A., and Almeida, A. M. 2014. "The Mammary Gland in Small Ruminants: Major Morphological and Functional Events Underlying Milk Production—A Review." *Journal of Dairy Research* 81 (3): 304-18.
- [18] Muller, C. J. C. 2005. "Genetic Parameter Estimation and Breeding Plans for the South Africa Dairy Goat Herd." In *Proceedings of the 7th World Congress on Genetics Applied to Livestock Production*, August 2005, Montpellier, France, 1: 52-5.
- [19] Ferro, M. M., Tedeschi, L. O., and Atzori, A. S. 2017. "The Comparison of the Lactation and Milk Yield and Composition of Selected Breeds of Sheep and Goats." *Translational Animal Science* 1 (4): 498-506.
- [20] Marenjak, T., Poljicak-Milas, N., Pirsljin, J., Beer Ljubic, B., and Milinković-Tur, S. 2009. "Oxidative Stability and Quality of Raw Saanen and Alpine Goats Milk." *Archives Animal Breeding* 52: 637-46.
- [21] Noor Syaheera, I., and Farida Hani Ahmad, T. 2021. "Evaluation of Milk Production and Milk Composition at Different Stages of Saanen Dairy Goats." *Journal of Agrobiotechnology* 12 (1S): 204-11.
- [22] Bruzantin, F. P., Daniel, J. L. P., Da Silva, P. P. M., and Spoto, M. H. F. 2016. "Physicochemical and Sensory Characteristics of Fat-Free Goat Milk Yogurt with Added Stabilizers and Skim Milk Powder Fortification." *Journal of Dairy Science* 99 (5): 3316-24.