

QUANTITATIVE AND QUALITATIVE VARIATION OF SAANEN GOAT MILK KEPT IN EXTENDED LACTATION FOR TWO YEARS

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Abstract

Saanen goats, specialized in milk production, improved in terms of quantity and quality (protein and fat content), are normally milked for 270-300 days with an annual production of 650-1050 l of milk / lactation and an average protein content of 2.9% and fat content of 3.2%. This study was conducted in the first goat farm in Romania that initiated prolonged lactation of goats. The research was carried out on a batch of primiparous goats, maintained in an intensive exploitation system, which after the first calving were subdivided according to milk production measured for a week. Two batches of 128 goats with a production of 3-4 liters/day and 94 goats with a production of over 4 liters/day were established. By modulating the diet and the light regime, the goats were milked continuously for 690 to 742 days, monitoring the amount of milk, protein and lipid levels on a monthly basis. Along with controlled breeding programs, prolonged lactation contributes to ensuring on the domestic market a continuity in the supply of goat's milk, throughout the year.

Key words: goats, milk quantity, prolonged lactation.

INTRODUCTION

The increasing consumer interest in goat milk and milk products has led to the development of the goat milk system and of the goat milk processing industry, as well as the modulation of goat farming systems, seasonal breeding animals, in order to ensure a constant milk production all year round. The demand for goat's milk has also increased in our country, which has directed research on selection, improvement, reproduction and exploitation systems of goats in order to make the species profitable (Osman, 2019; Sava et al., 2016).

The main ways to maximize the productive potential adopted by goat breeders in our country were: import of specialized goat breeds for milk production and raised in purebred, crossbreeding between local goats, Carpathian or Alba de Banat with import males of specialized breeds for milk (Anghel et al., 2017, 2020), application of selection and improvement of local breeds programs by adhering to the breeding programs of racial genealogical herdbook and adopting the goat breeding and maintenance systems to allow the expression of genetic value.

Among the specialized breeds for milk production, the Saanen and French Alpine goats have been imported in large numbers into our country, so that 6 farms have over 350 goat heads, according to data held by the ANCC Caprirom Genealogical Register (Caprirom, 2020). These goat breeds record with specific breeding technology, milk production of over 700 litres in 280 days of lactation, respectively an average of 946 litres of milk in 306 days lactation to Saanen breed (Capgene, 2013a) and 886 litres of milk in 295 days lactation in the French Alpine breed, in the countries of origin. (Capgene, 2013b).

Regardless of the breed structure of the goat herd, an important role in the improvement of the goats' exploitation is played by the exploitation system, respectively: ensuring sufficient and balanced rations in relation to physiological needs related to gestation, rank and level of lactation, precocity and frequency of milking. (Assan, 2014) ensuring a constant feeding ration (Legarto et al., 2014; Lefrileux et al., 2009), ensuring an age-appropriate thermal and humidity regime, ensuring appropriate housing conditions and animal density so as to avoid the stress of overcrowding. These factors

also influence the quality of milk, the rhythm and frequency of milking, the type of feeding as a composition of rations but also as a mode of administration influence the percentage of fat and protein in milk (Murney et al., 2015).

Milk production is conditioned by the external factors mentioned but also by genetic determination and individual reactivity. There are operating systems in which milking is practiced 3 times a day, obtaining a production increase of up to 10% (Lacasse et al., 2011). This method is little used, being economically inefficient in relation to the personnel, water and electricity expenses that the additional milking entails.

In order to obtain a high milk production, in addition to the genetic factor that dictates the productive level, it is possible to resort to an increase of the milking period by the early or very early weaning of the kids, immediately after calving, thus gaining 45-60 days of lactation. (IDELE, 2015).

One method of obtaining a larger quantity of milk from a lactating goat is the application of protocols for lactation maintenance for a period longer than 310 days, respectively over 450-500 days, without the females being given to the reproduction. The category of long lactations does not include females who continue their lactation between 2 seasons but who gave birth and did not have a period of 2 months of breast rest (IDELE, 2013).

This study shows the way about rentability the goat milk production in the great farms without increase the number the goats.

MATERIALS AND METHODS

The study was conducted in a farm with a herd of 1800 genetically selected Saanen dairy goats, raised in an intensive system, in permanent free housing. The females were subdivided according to the rank of lactation, physiological state and milk production, all of them having a balanced and differentiated diet according to the three subdivision criteria. The farm used mechanical milking with an automated milking station, provided with Daily milk management which records the individual quantity of milk. The farm being correlated with the dairy factory, due to economic considerations, respectively the increased need for milk during the winter, as

well as the insufficient spaces for sheltering the kids forced the adoption of the specific technology of prolonged lactation. Moreover, for Saanen goats specialized for milk production, a major problem encountered on the farm was the weaning of pregnant goats in the 3rd or 4th month of gestation, respectively at 270-310 days of lactation. For the production of prolonged lactation, only animals at the first lactation were chosen, with an average daily production of over 3 litres of milk. Milking was practiced twice a day, at 6 and 18 o'clock, the batches of goats in prolonged lactation being the first at the milking station.

Due to the increased need for milk on the farm during the winter, in previous years the counter season reproduction was practiced. Thus, the goats included in this study gave birth in December. The technology of raising the kids involves very-early weaning, so the kids are not breastfed by the goats, they receive the colostrum in the bottle. The goats are milked separately from 3 to maximum 10 days (colostrum milk) after which they are milked at the milking station, the milk being distributed to the dairy factory for human consumption.

In order to establish the productions and carry out the batches, we chose a to have a milk production control day every month.

Out of a total of 587 Saanen primiparous goats, we identified 257 goats, with a production of over 3 litres of milk/day, that entered the extended lactation program. Of these, 222 goats were the subject of the present study, completing lactation at the end of the control period. Thus, the quantity of milk in June was taken as a reference, before the beginning of the normal breeding season which could have influenced the quantity of milk. The selected goats were kept separately, in the youth stall that was not intended for breeding, in order not to come into physical and sensory contact with the males during the breeding. The two batches were set up: first batch of 128 goats with a daily milk production between 3 and 4 litres and the second batch of 94 goats with more than 4 litres of milk/day. The goats were kept separately in stalls of 64 goats (batch 1) and 98 goats (batch 2) ensuring the stable surface as well as the optimal feeding area.

The rations consisted of concentrated granulated feed for lactating goats (produced in the own

concentrated feed factory based on a Dutch recipe) in the amount of 2.8 kg of feed/ head/day for goats with 3-4 litres of milk/day and 3.2 kg of feed/head/ day for goats with more than 4 litres of milk/day. In addition, 0.8 kg of alfalfa granules and oat straw at discretion were administered. This structure of the ration did not change throughout the prolonged lactation, only the quantities from one month to another being adjusted, in relation to the quantity of milk registered, respectively with the increase or decrease of the daily production.

Another aspect that was taken into account during this study was the maintenance of a constant photoperiod regime, so that the hormonal level of the hypothalamic-pituitary-ovarian axis and implicitly the prolactin level not to be epiphyseal influenced (Chemineau et al., 2007; Tong et al., 2018).

Following the analysis of the evolution of milk production in Saanen goats, by estimating the average production, the standard deviation (STDEV) from the average and establishing the minimum and maximum values by statistical analysis in Excel, we proceeded to establish the reference periods that can provide data on the effectiveness of the application of this technology in obtaining prolonged lactation. The four periods analysed were: the period January-June when the study batches were set up, the period of 300 days (January-October) as a reference for milk production in the conditions in which these goats were mounted, the period of 450 days starting November until the weaning of all the goats studied and the entire study period of 2 years.

During the quantitative monitoring, the monthly qualitative monitoring of the collection milk was also performed. The batches of goats kept in prolonged lactation are milked first on the milking station and after they have been milked, a sample of milk was collected from the cooling tank provided with a stirrer, before entering on the milking station and the other goats that are not the subject of the study. The protein and fat levels in the milk were determined with the LACTOSCAN milk analyser.

RESULTS AND DISCUSSIONS

The variation of the quantity of milk in batch 1 differed during the 2 years, respectively 106

weeks of study, the differences being also between the 2 followed batches.

Table 1. Daily evolution of milk production in Saanen goats with production of 3-4 kg milk/head/day in first lactating year (batch 1: n = 128).

Month	Reference time	Average production	STDEV	Min.	Max.
Jan	CD*	3.491	0.271	3.020	3.982
Febr	CD	3.498	0.291	2.965	4.194
Mar	CD	3.539	0.289	3.018	4.251
Apr	CD	3.508	0.277	3.011	4.082
May	CD	3.495	0.293	2.918	4.214
June	CD	3.533	0.291	3.031	4.204
July	CD	3.524	0.295	3.019	4.280
Aug	CD	3.194	0.306	2.363	3.934
Sept	CD	3.071	0.346	2.376	3.919
Oct	CD	3.030	0.375	2.140	3.965

CD* - control day

During the first 10 months corresponding to physiological lactation for batch 1, recorded the milk production from the control day and the average daily batch production for the control months were calculated (Table 1). Thus, it is observed that the average daily production was between 3.030 +/- 0.375 kg/head/day (October of the first year) and 3.539 +/- 0.289 kg/head/day (March of the first year). The minimum production recorded during this period was 2.140 kg milk/ head/ day and the maximum was 4.280 kg milk/head/day given according to the characteristics of the breed in Saanen goats (Capgene, 2013a).

Table 2 shows the same parameters corresponding to the next 14 months of study. As shown in the data presented in the tables, the prolonged lactation in this case can be structured in two phases: the first 7 months with production close to the normal physiological lactation production followed by another 7 months in which the downward curve of lactation and weaning of goats is observed.

In the first 7 months of prolonged lactation in batch 1, respectively the interval from 300 days to 510 days, the average daily production of goats was between 2.060 +/- 0.410 kg/head/ day and 2.968 +/- 0.436 kg/head/ day with extreme individual productions of 1.047 and 3.931 kg/head/day.

In the next 7 months (510-742 days), respectively from June of the second year the milk production registered appreciable decreases, the average production being

comprised between 1.878 +/- 0.379 and 0.044 +/- 0.014 kg/head/day.

Table 2. Daily evolution of milk production in Saanen goats with production of 3-4 kg milk/head/day maintained in prolonged lactation (batch 1: n = 128)

Month	Reference time.	Average production	STDEV	Min.	Max.
Nov	CD*	2.968	0.436	1.880	3.931
Dec	CD	2.881	0.407	1.925	3.811
Jan	CD	2.717	0.369	1.895	3.702
Febr	CD	2.563	0.378	1.652	3.495
Mar	CD	2.405	0.378	1.409	3.299
Apr	CD	2.223	0.467	1.073	3.126
May	CD	2.060	0.410	1.047	3.041
June	CD	1.878	0.379	0.967	2.957
July	CD	1.763	0.415	0.734	3.024
Aug	CD	1.454	0.468	0.263	2.524
Sept	CD	1.082	0.546	0	2.334
Oct	CD	0.699	0.528	0	1.806
Nov	CD	0.274	0.037	0	1.300
Dec	CD	0.044	0.014	0	0.777

CD* - control day

Starting with August, they weaned 4 goats, in September 26 goats and in October 80 goats, a total of 14 weanings in November.

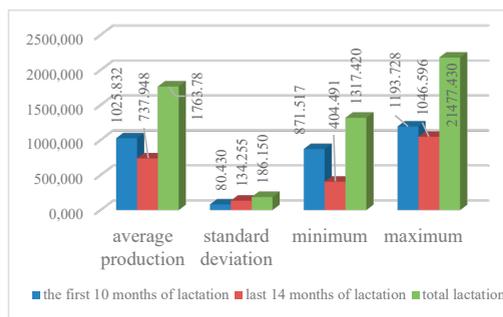


Figure 1. The ratio between the production during the normal lactation period and the additional lactation in goat batch 1

The analysis of the individual evolution of milk production during the 104 weeks (2 years) shows that the average production of the batch is stabilized for the first 7 months, after which a decrease of up to 200 g is observed from one month to another, until February-March in the second year of lactation. After week 83 of milking (approximately 600 days of lactation) there is a major decline in milk production.

The total production of each goat was calculated by multiplying the quantity on the control day by the number of days in that month.

Figure 1 shows the contribution brought by the additional milking period, respectively an average of 737.948 +/- 134.255 kg of additional milk/head/lactation (41.83%).

Table 3 shows the evolution of milk production in goats from batch 2, which in May and June recorded daily quantities of over 4 kg of milk/head/day. The initially selected batch was of 102 goats, of which the 94 we refer to in this study ended the prolonged lactation.

Table 3. Daily evolution of milk production in Saanen goats with a production of more than 4 kg milk/head/day, in first lactating year (Batch 2: n = 94)

Month	Reference time	Average production	STDEV	Min.	Max.
Jan	CD*	4.794	0.762	4.017	9.600
Febr	CD	4.825	0.786	3.973	9.722
Mar	CD	4.857	0.795	3.943	8.906
Apr	CD	4.847	0.768	4.023	8.772
May	CD	4.818	0.727	3.930	8.292
June	CD	4.814	0.694	4.028	8.303
July	CD	4.756	0.673	4.016	8.199
Aug	CD	4.564	0.706	3.422	7.959
Sept	CD	4.367	0.723	3.129	7.705
Oct	CD	4.221	0.706	2.880	7.309

CD* - control day

Batch 2 of primipara goats, Saanen breed, during the period of 300 days of lactation recorded average average daily values milk production between 4.221 +/- 0.706 (October) and 4.857 +/- 0.795 kg/head/day (Mars). The maximum value of daily production measured on the control day was 9.772 kg/head/day and the minimum recorded was 2.880 kg/head/day.

Table 4. Daily evolution of milk production in Saanen goats with a production of more than 4 kg milk/head/day, maintained in prolonged lactation (Batch 2: n = 94)

Month	Reference time	Average production	STDEV	Min.	Max.
Nov	CD*	4.063	0.676	2.850	7.087
Dec	CD	3.892	0.712	2.476	6.783
Jan	CD	3.661	0.692	2.140	6.141
Febr	CD	3.496	0.672	2.028	5.430
Mar	CD	3.277	0.658	2.024	4.924
Apr	CD	3.067	0.705	1.240	5.049
May	CD	2.757	0.783	0	4.526
June	CD	2.522	0.805	0	4.308
July	CD	2.234	0.830	0	3.885
Aug	CD	1.934	0.889	0	3.788
Sept	CD	1.585	0.876	0	3.482
Oct	CD	1.192	0.817	0	2.879
Nov	CD	0.692	0.690	0	2.434
Dec	CD	0.297	0.447	0	1.857

CD* - control day

Table 4 shows the values of average daily and monthly milk production during the period of prolonged lactation.

As in the case of the first batch, a decrease in milk production is observed, remaining at values of over 2 kg/head/day for over 9 months, ranging from 4.063 +/-0.676 to 2.234 +/-0.830 kg/head/day. The maximum quantity of milk obtained during this period was 7.087 kg/head/day. In the last 5 months of lactation, the downward curve of milk production is obvious, the rate of decrease of production being progressive and higher than in the case of batch 1.

The end of lactation for the batch of goats with yield over 4 kg/day occurred earlier, the first three weaned goats being registered at 17-19 months of lactation. At 20 and 22 months of lactation (580-640 days) they weaned 10 more goats and at 670-710 days of lactation 47 goats. In the interval of 710-742 days, they weaned 31 goats.

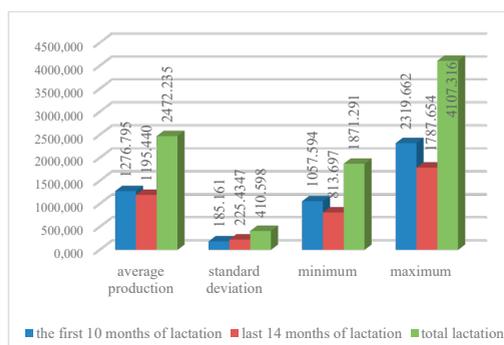


Figure 2. The ratio between production during the normal lactation period and additional lactation in goats batch 2

All the goats from batch 1 and 2 starting with July of the second year of lactation were reintroduced in the reproductive circuit, proceeding to detect the daily estrous. The goats that showed estrous, were mounted naturally starting with August. Goats that did not show estrous in the second year and had milk production were monitored until the final weaning, during which time the ration was adjusted in relation to the milk production of 1-2 kg milk/head/day, respectively he decreased at 1.4-1.6 kg granular concentrates/head/day. By graphically representing the total milk production divided into periods, respectively the

natural physiological lactation interval and the prolonged lactation interval by modulating the rations and the photoperiod, the productive contribution of the applied technology is observed.

Thus, from the average total production/goat of 2472.235 +/- 410.598 kg of milk obtained, 1276.795 +/- 185.161 kg represents the milk corresponding to the normal physiological lactation (51.65% of the total production/goat/lactation season) and 1195.440 +/- 225.437 kg (48.35%) is the extra milk obtained by keeping the goats on prolonged lactation (Figure 2).

During the quantitative monitoring of the milk, have been constantly checked the qualitative analysis bulletins provided by the laboratory of the dairy factory, respectively the protein and lipid level of the collection milk (common test for the 2 study batches) of all the goats kept in prolonged lactation.

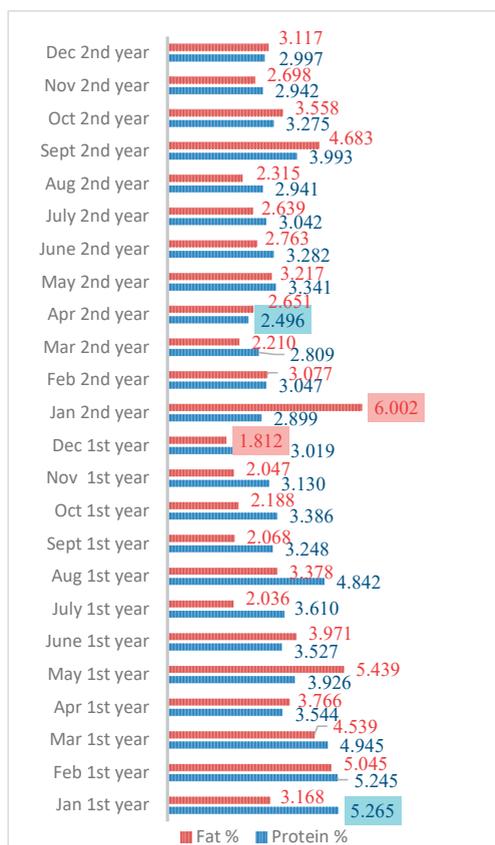


Figure 3: The percentage evolution of protein in milk collected during prolonged lactation

The percentage of protein during the whole lactation registered an average value of 3.531% +/- 0.785 with a minimum of 2.496 and a maximum of 5.265. The fat percentage ranged from 1.812% to 6.002%, with an average of 3.266% +/- 1.161 over the entire monitored period (Figure 3).

As can be seen from Figure 3, the critical periods were in January and July - December of the first year of control when due to the hyperprotein ration not properly correlated with the energy needs of goats, a slight metabolic acidosis appeared with clinical digestive manifestations. In January of the second year, 80% of the study population showed digestive dysfunctions associated with nerve forms. Milk analysis and blood tests revealed the condition of metabolic alkalosis in the whole group. Both acidosis and metabolic alkalosis have been treated with conservative methods based on mineral supplements and phytotherapy.

CONCLUSIONS

The embrace of a specific technology for primipara Saanen goats to maintain lactation for as long as possible without breeding has resulted in obtaining a lactation of up to 23 months of which 17-18 months with an average production of over 2 kg/head/day. The quantitative intake during the additional lactation period was 41.83-48.35% extra milk.

The application of constant rations is one of the factors that have maintained lactation for over 600 days, but metabolic risks require detailed studies to make a correlation between the protein level administered and the energy required to ensure milk production.

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