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Çiğdem TAKMA[1*]

Yakut GEVREKÇİ[1]

Turğay TAŞKIN[1]

Nedim KOŞUM[1]

Çağrı KANDEMİR[1]

Funda ERDOĞAN ATAÇ[1]

Hülya ATIL[1]

[1] Ege University, Agricultural Faculty, Animal Science Department, Bornova/Turkey

***** Corresponding author: (Sorumlu yazar):

cigdem.takma@ege.edu.tr

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Estimation of partial lactation milk yields in Saanen goats raised in semi-intensive conditions

Yarı entansif koşullarda yetiştirilen Saanen keçilerinde kısmi laktasyon süt verimlerinin tahmini

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ABSTRACT

Objective: The objective of this study was to estimate the lactation curves of Saanen goats by using individual milk yields in the early, mid and 0-6 months periods of lactation. For this purpose, Wood's lactation curve was used to estimate lactation yields.

Material and Methods: Milk yields of Saanen goats in different periods of lactation were estimated. For this purpose, the Wood's lactation curve model was adapted to a total of 480 milk yield measured at 14-day intervals of 40 Saanen goats. Milk yields of goats in the first three months of lactation in January-March, mid-lactation in April-June, and 0-6 months in January-June were estimated.

Results: According to the harmony of Wood's model, the determination of coefficient values of the estimations of milk yields in the first, mid-lactation and 0-6 months of lactation are 0.84, 0.87 and 0.84, respectively. The root mean square errors of Wood's model are 0.91 for the first period of lactation, 0.81 for the mid-lactation period and 0.30 for the from 0 to 6 months of lactation period.

Conclusions: According to the results obtained in this study, Wood's model was found sufficient to define the lactation curve in Saanen goats. However, it would be beneficial to conduct similar studies with larger herds and yield records.

ÖZ

Amaç: Çalışmada Saanen keçilerinin laktasyonun erken, orta ve 0-6 aylık dönemlerindeki bireysel süt verimleri kullanılarak laktasyon eğrileri tahmin edilmiştir. Bu amaçla, laktasyon verimlerini tahmin etmek için Wood modeli kullanılmıştır.

Materyal ve Yöntem: Saanen keçilerinin laktasyonun farklı dönemlerindeki süt verimleri tahminlenmiştir. Bu amaçla 40 baş Saanen keçisinin 14 günlük aralıklı ölçülen toplam 480 adet süt verim ölçümüne Wood laktasyon eğrisi modelinin uyumu yapılmıştır. Keçilerin Ocak-Mart aylarındaki laktasyonun ilk üç aylık dönemi, Nisan-Haziran aylarına ait orta dönemi ve 0-6 aylar arası süt verimleri tahminlenmiştir.

Araştırma Bulguları: Wood modelinin uyumuna göre laktasyonun ilk, orta ve 0-6 aylık dönemlerindeki süt verimlerinin tahminlerine ait belirleme katsayısı değerleri sırasıyla; 0.84, 0.87 ve 0.84 olarak bulunmuştur. Wood modeline ait hata kareler ortalamasının karekök değerleri ise laktasyonun ilk dönemi için 0.91; orta dönemi için 0.81 ve 0-6 aylık laktasyon dönemi için ise 0.30 olarak bulunmuştur.

Sonuç: Wood modelinin Saanen keçilerinde laktasyon eğrisini tanımlamada yeterli olduğu söylenebilir. Ancak buna benzer çalışmaların daha büyük sürü ve verim kayıtları ile yapılmasında yarar vardır.

INTRODUCTION

The sustainability of dairy goat production in Turkey is possible with effective raising and breeding programs for milk and reproductive efficiency. Many factors influence high milk yield in goats (Savaş et al., 2016). On the other hand, milk yield obtained from goats decreases behind the considered level due to the low genetic capacity of dairy goats. Genotype breeding should be given importance in order to obtain high milk and reproductive efficiency. In addition, the maintenance conditions should be improved. In appropriate regions, crossbred dairy goat breeding should also be encouraged (Şengonca et al., 2003).

Saanen goats first brought to Turkey for dairy goat breeding by Ege University in 1959, were used in crossbreeding studies for the purpose of grading hair goats, especially in dairy goat production in the region, and its widespread effect was achieved (Kandemir et al., 2018). Saanen is one of the goat breeds in Switzerland and very well known in the world. Their bodies are covered with plain white, short, and hard hairs, goats have an average live weight of 50 kg and male goats 75 kg. The lactation length of Saanen goats varies between 280 days, lactation milk yields of 750-800 kg and average milk yields between 2.67 and 2.85 kg (Şengonca et al., 2003; Kaymakçı and Engindeniz, 2010; Koşum et al., 2016; Taşkın et al., 2017). Due to its high adaptability, it is one of the most used breeds in the world as dairy goats.

Today, lactation curves are widely used to determine the milk yield characteristics of breeding goats and for a sustainable production. (Dağ et al., 2005, Keskin & Dağ, 2006, Rojo-Rubio et al., 2016). Changes in milk yield for goats, starting from birth to dry off are defined by the lactation curve. There are many models such as Wood, Cobby Le Du, Gompertz and Logistic to describe lactation curves in dairy animals (Wood, 1970, Cobby & Le Du, 1978, Grossman et al., 1986, Pande, 1986). In this study, lactation curves of Saanen goats were estimated by using individual milk yields in the early, mid and 0-6 months of lactation. For this purpose, Wood's model was used to estimate lactation yields.

MATERIALS and METHODS

Animal material

The animal material of the research consisted of 40 Saanen goats, whose births were synchronized within 20 days, which were reared in an open barn system that can be closed on one at Ege University, Faculty of Agriculture, Department of Animal Science, Farm Animal Experimantal Research, Training and Practice Unit. The data set consisted of individual daily milk yields of goats milked between January and June 2020. These milk data were obtained from a total of 480 milk records measured at 14-day intervals and milk yield records of goats were started to be taken 3 days after colostrum consumption. The distribution of goats based on parity numbers was 10 goats have second, 5 goats have third and 25 goats have 4 and greater parity number, respectively.

Management practise

The nutrition of the goats was done by evaluating them separately in three different periods. These are respectively; early, mid-lactation and late lactation (pregnancy) period. In the early lactation period, the amounts of roughage and concentrated feeds are mixed; 0.5 kg of dry alfalfa grass, 0.3 kg of coarse wheat straw, 1.5 kg of corn silage and 0.5 kg of goat milk feed. Amounts in the mixing of roughage and concentrate feed the mid-lactation period; 0.6 kg of dry alfalfa grass, 0.2 kg of coarse wheat straw, 2.5 kg of corn silage and 0.5 kg of goat milk feed.

The goats housed in semi-intensive conditions were grazed on artificial pasture for 3 hours in a day and the feeds given according to the periods are tabulated in Table 1. The daily milk yields of the goats were controlled, and the increasing requirements were determined according to the milk yield, and it was given individually in automatic feeders with Radio-frequency identification (RFID) system.

Study area

The province of Izmir, where the study was carried out, is a province in the Aegean Region, located at 38º north parallel and 27º east longitude, and its height varies between 0-20 m above sea level. In the region, the summer months are hot and dry, and the winter months are warm and rainy. The average humidity is around 66%. The prevailing winds are north and south. Due to pressure differences during the seasons, winds can blow from both directions, but generally south in summer.

Statistical method

In the study, individual milk yields of goats including the first three months of lactation (January-March), the mid period (April-June), and the 0-6 months period of lactation (from January to June) were used.

The Wood's model was used to fit the milk yields of Saanen goats. Because it is widely used in large and small ruminants and it has a good fit for the estimation of lactation milk yields (Ruvuna et al., 1995; Montaldo et al., 1997; Felix et al., 1999).

The model and model terms were given as below:

$$y_t = a.\, t^b \exp^{(-c.t)} + \varepsilon$$

The t is control day, y_t shows the daily average milk yield, a is initial milk yield, b is ascent to peak yield, c is descent after peak yield, e is base of natural logarithm and ε is error term (Wood, 1970; Landete-Castillejos and Gallego, 2000).

The high determination of coefficient values (R^2) and low root mean square error (RMSE) values are accepted as indicators of a good fit. The root mean square error is defined as in the following:

$$\mathrm{RMSE} = \sqrt{\frac{\sum(y_t - \hat{y_t})^2}{T}}$$

where, y_t : Observed values, $\hat{y_t}$: Estimated values and T: Number of observations.

RESULTS and DISCUSSION

The descriptive statistics for early and mid-lactation test day milk yields are given in Table 2. It was observed that the average milk yields ranged between 2.52 and 4.19 kg.

Table 2. The descriptive statistics for early and mid-lactation test day milk yields

Çizelge 2*. Erken ve orta laktasyon süt verimleri için tanımlayıcı istatistikler*

Early	n	Minimum	Maximum	Average Milk Yields	Std. Dev.	Coefficient of variation (%)
January	40	1,79	5,74	4,19	0,94	22,43
February	40	2,13	7,14	3,94	1,08	27,41
March	40	2,05	6,95	3,64	0,98	26,92
Mid-lactation						
April	40	1,79	5,74	3,33	0,93	27,92
May	40	1,30	5,83	3,01	0,83	27,57
Jun	40	0,83	4,65	2,52	0,68	26,98

According to the Wood lactation curve model, test day milk yield for early, mid and 0-6 months lactation parameter estimation values vary between 0.07 and 4.48.

Using the early, mid period and 6-month milk yields were estimated based on Wood's model. The coefficient of the determination estimation results for the early, mid, and 0-6 months of lactation values were found 0.25, 0.54, and 0.31, respectively. The RMSE values of Wood's model also were found as 0.62 for the early, 0.89 for the mid, and 0.84 for the 0–6-months of lactation (Table 3).

Table 3. The mean of goodness of fit criteria and parameter estimates of Wood model for early, mid and 0-6 months of lactation milk yields

Çizelge 3. *Wood modelinin erken, orta ve 0-6 aylık laktasyon süt verimleri için uyum iyiliği kriterleri ve parametre tahminleri*

Estimates	**Milk Yields**					
	Early		**Mid**		**0-6 Month**	
	Estimate	**Std. Error**	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**
a	3,97	0,16	2,70	0,79	4.,8	0,29
b	0,11	0,10	0,41	2.,9	0,13	0,04
c	0,07	0,04	0,13	0,28	0,07	0,03
R^2	0,25		0,54		0,31	
RMSE	0.62		0.89		0.84	

It is seen that R^2 values are estimated nearby to 1. In addition, RMSE estimates have low values (<1). Therefore, the Wood model has good fit for milk yields that subject to this research.

The observed and predicted early, mid and 0-6 months of lactation milk yields estimated by Wood model are illustrated in Figure 1- 3. As seen from the graphs, the estimated values are in good agreement with the observed values.

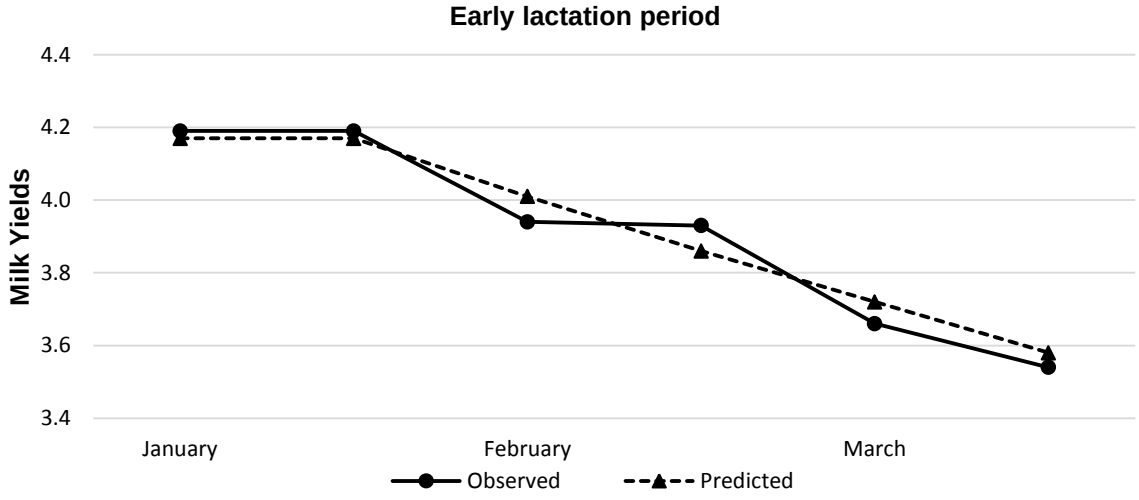

Figure 1. The observed and predicted early milk yields estimated by Wood model.

Şekil 1. *Wood modeli ile tahmin edilen ve gözlemlenen erken dönemdeki süt verimleri.*

In this study, changes in milk yield of goats on the early stages of lactation are observed. High milk yields of Saanen goats started with kidding and decreased compared to early lactation periods.

It can be explained by the negative situations experienced in herd management on the farm. The coefficients of determination for the results of estimating individual milk yields for the early and mid periods of lactation were found to be 0.25 and 0.54, respectively. These values were lower than reported by Ruvuna et al. (1995), Montaldo et al. (1997), Fernandez et al. (2002), Keskin & Dağ (2006), Takma et al. (2009) and Felix et al. (1999).

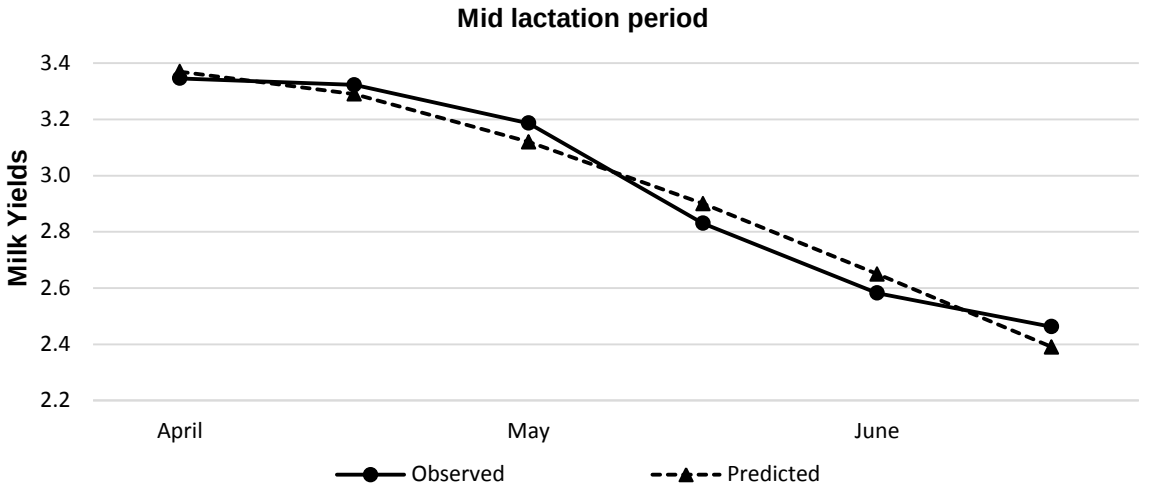

Figure 2. The observed and predicted mid-lactation period milk yields estimated by Wood model.

Şekil 2. *Wood modeli ile tahmin edilen ve gözlemlenen orta dönemdeki laktasyon süt verimleri.*

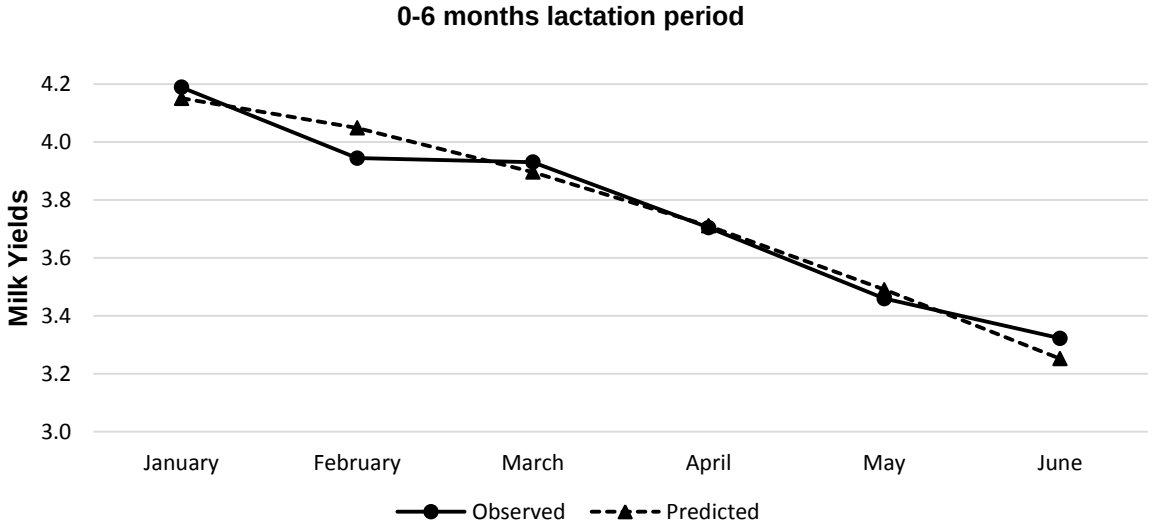

Figure 3. The observed and predicted 0-6 months of lactation period milk yields estimated by Wood model.

Şekil 3. *Wood modeli ile tahmin edilen ve gözlemlenen 0-6 aylık laktasyon süt verimleri.*

In addition, the positive values of b and c parameters, which determine the yield changes before and after the peak in Wood's model, indicate the normal (typical) lactation curve (Hernández et al., 2014). It is known that animals with non-standard, in other words, atypical lactation curves have lower milk yield than animals with typical lactation curves. For this reason, animals with atypical non-standard lactation curves can be removed from the herd by looking at the lactation curve. In this study, approximately 18% of lactations were found to be atypical.

In addition, the RMSE values were found to be 0.62 for the early and 0.89 for the mid periods of lactation. This value was estimated as 0.84 for the from 0 to 6 months' of milk yields. When the RMSE values are examined, it has been revealed that the smallest value is seen for early lactation milk yield records. The coefficient of determination values was nearly the same for early and 0-6 months of milk yields. According to these results, it can be said that Wood's model is sufficient to estimate the lactation curve from early lactation yields in Saanen goats.

As a result, the estimation of lactation milk yield is possible only by daily milking during the whole lactation. Determining milk yield in this way requires a serious labor and cost. Different lactation curve models are of great importance in determining lactation milk yield from test day milk yields and estimating total production before the end of lactation.

With the lactation curve models in goat breeding, the milk yield of the herd or individual lactation as well as the yield of the missing test day can be accurately estimated according to the milk yields in the previous period. Thus, the profitability of the farm can be increased, and sustainability can be ensured by sorting to be made in the direction of milk yield in the herd and by improving environmental conditions. It would be beneficial to examine the model fit by conducting similar studies with larger herds and milk yield records. The inability to provide a uniformity in terms of parity on goats and the low or unequal number of samples in the subgroups were effective on these results. Maintenance-feeding practises and especially seasonal feeding changes and irregular grazing are also considered to be effective on the results.

CONCLUSIONS

Consequently, in this study, it is thought that the lack of uniformity in terms of parity in goats and the small and unequal number of samples in the subgroups influence the estimations. When the environmental factors were examined, the management practices especially seasonal feed changes and grazing were effective on the results. For a reliable estimation, especially in semi-intensive farms, a special importance should be given to the uniformity of the herd and keeping the yield records and the management practices should be improved. This study is designed to make diligence. The findings are valid for the Saanen herd in our processing and can also be applied to the Saanen and the other genotype herds in the region.

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