

Determination of factors affecting pregnancy rate in Turkish Saanen goats

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Summary: Reproductive performance in goats is one of the important trait which has a major effect on commercial farm income. The objective of this study was to evaluate the factors effecting reproductive performance of Turkish Saanen goats with using Logistic Regression. The records of Turkish Saanen goats, aged 2 - 4 (2.05 ± 1.19), were used in this study. Data were analyzed with using stepwise multivariate logistic regression analyses. The response variable was pregnancy and the model included milk yield, insemination type and insemination day. As a result, milk yield at the insemination day ($P<0.001$) was one of the major factor with insemination type ($P<0.05$) and the increase in insemination day ($P<0.05$) was tend to be significant factor for the likelihood of pregnancy and were determined as the main factors. Milk yield at the insemination day 99.9% effects pregnancy and artificially inseminated goats were 2.4 times less likely to become pregnant than the naturally inseminated goats. The increase of insemination day also caused 30.0% increase in likelihood of pregnancy. As a conclusion, milk yield on the insemination day is the most significant factor affecting the pregnancy likelihood in Saanen goats. On the other hand, artificial insemination is not very effective to get higher pregnancy rates in Saanen goats.

Key words: Insemination, logistic regression, milk yield, pregnancy.

Türk Saanen keçilerinde gebelik oranını etkileyen faktörlerin belirlenmesi

Özet: Hayvanlarda üreme performansını etkileyeceği düşünülen birçok faktör farklı araştırmalarda incelenmiştir. Bu çalışmada, Saanen ırkı keçilerde gebeliği etkileyen faktörlerin Lojistik Regresyon yöntemi ile belirlenmesi amaçlanmıştır. Çalışmanın verileri, yaşları 2 ile 4 (2.05 ± 1.19) arası değişen 39 baş Saanen keçisine ait kayıtlardan oluşmaktadır. Tohumlama günündeki süt veriminin, tohumlama tipinin ve tohumlama gününün gebeliği etkilediği belirlenmiştir. Tohumlama günündeki süt veriminin gebeliği %99.9 olasılıkla etkilediği ($P<0.001$), suni tohumlanan keçilerde doğal tohumlananlara göre gebe kalma oranının 2.4 kat ($P<0.05$) azaldığı belirlenmiştir. Tohumlama yapılan gün sayısının artması da gebe kalmayı %30 oranında ($P<0.05$) arttırmaktadır. Sonuç olarak, tohumlama günündeki süt veriminin, Saanen keçilerde gebeliğin şekillenmesini etkileyen en önemli faktörlerden biri olduğu saptanmıştır. Ayrıca, Saanen keçilerde suni tohumlama uygulamasından etkin düzeyde gebelik elde edilemediği görülmektedir.

Anahtar sözcükler: Gebelik, lojistik regresyon, süt verimi, tohumlama.

Introduction

All over the world, goat is a livestock often preferred by people in low-and middle- income (16). As well as other farm animals, reproductive performance has a significant effect on management profitability in goats (5, 11). Reproductive performance can be defined as the number of live offspring after a period of fertility in animals. In goat breeding, success of kidding and sustaining reproductive performance is considerably important (1, 6). Reproductive performance is a feature depending on multiple factors. (3, 7, 13). There are different studies have investigated the factors affecting pregnancy. In some cases, both genetic and environmental factors were effecting while in others only environmental factors were determined as major factors in reproductive performance

(7). Saanen goats can be bred all year round and can adapt to different climatic conditions easily (2). In goat breeding both natural and artificial insemination methods can be used. Saanen breed is a highly fertile got breed with the number of kids per fertile goat is 1.2 to 2.4 (8). In addition, the raising of both pure breeds and crosses were used to increase yields for inefficient local breeds in Turkey and also there is a high demand for this breed. For Saanen, average milk yield is 750 l (liter) per lactation and average lactation period is 280 days (17, 19).

The objective of this study was to investigate the likelihood of pregnancy rate related to major factors associated with reproductive performance in Turkish Saanen goats with using logistic regression analysis.

Material and Method

Environment: The study was conducted at goat breeding section of Uludag University Animal Health, Production and Application Centre. This area is located in Marmara region at the northwest part of Turkey (40° 14' N and 28° 52' E). All goats were housed in a semi-open barn with at least 1.5 m² inside barn floor area per goat.

Animals and records: Data were consisted of 39 Saanen goats, aged between 2 to 4 (2.05 ± 1.19) years old. All goats were randomly allocated into natural (n=22) or artificial insemination (n=17) group. In order to determine lactation milk yield, individual milk yield was recorded bi-weekly during the study and the milk yield of first 60, 90, 120, 150, 180, 210, 240-days were calculated with using these records. For each goat, birth and dry off date were recorded and lactation period was calculated according to these records. Then average daily milk yield levels were calculated for each goat.

In this study, goats were inseminated either artificially or naturally during the first week of insemination period of September 2009 in order to eliminate the effects of different environmental conditions (such as ambient temperature). For this reason, only goats inseminated 16 to 23 September 2009 were used. During the insemination period young bucks were used to determine the does which were in estrous twice in a day. Estrus detection was performed both in the morning (09:00 to 10:00 h) and in the afternoon (15:00 to 16:00 h). Does that were showing estrus randomly assigned to one of the insemination type (Natural or artificial insemination). The bucks were used for natural and artificial insemination of does in each group. The buck's semen that was used for artificial insemination was progeny tested and proven with high milk yield capacity originated from Canada and the straws were obtained from EGEVET (Izmir, Turkey). Goat were fed twice a day (at 09:00 and 15:00 h) with alfalfa hay and concentrate feed (18% protein and 2800 kcal/kg metabolizable energy). Additional feeding was applied to all goats which was started 30 days before and ended 15 days after the insemination period. During the additional feeding period all goats were fed with an additional 0.5 kg concentrate feed. All goats had free access to water and a trace-mineralized salt block during the day.

Statistical analysis: Data were analyzed with using PROC LOGISTIC (multiple logistic regression) procedure of Statistical Analysis System (SAS version 9.3; SAS Institute, Inc., Cary, NC, USA). The three methods of multiple logistic regression were used to determine the best fit model; stepwise and forward selection and backward elimination methods. Logistic regression method is based on odds ratios (14, 18). The factors of; 60, 90, 120, and 150-day milk yield, days in milk (DIM), lactation milk yield, insemination day milk yield, average

milk yield, age of goat, order or insemination day and insemination type (artificial vs natural) were used to evaluate likelihood of pregnancy rate. Only first half of the periodical milk yields (60 to 150 day milk yield) were used because the production capacity before breeding season is one of the major factors on reproductive performance (13). Among all these factors, only the ones with a significance level of P<0.30 for pregnancy were included in the statistical model as independent variables. In model estimation, status of pregnancy is defined as the dependent variable given a value of 1 to goats which were pregnant, and the value 0 was defined as not pregnant. For interpreting results of logistic regression analysis P<0.05 significance level was used. In addition to the method, odds ratios and their 95% confidence intervals were calculated.

Results

Average lactation period and milk yield of Turkish Saanen goats were found 211.7 ± 2.3 days and 505.7 ± 26.0 l, respectively. The average daily milk yield during the lactation was found 2.4 ± 0.1 l and 25.2% of total lactation milk production was produced during the first 60 days of milking period. Table 1 shows lactation characteristics of Turkish Saanen goats (Mean ± SEM).

Table 1: Statistical values of milk yield and lactation length of Turkish Saanen goats at different lactation periods.

Tablo 1: Türk Saanen keçilerinde laktasyonun çeşitli dönemlerinde süt verimi ve laktasyon süresi ile ilgili istatistik değerleri.

Parameter	Mean ± SEM
60. day milk yield, (l)	127.52 ± 7.88
90. day milk yield, (l)	189.2 ± 11.0
120. day milk yield, (l)	256.1 ± 14.6
150. day milk yield, (l)	332.6 ± 18.8
Lactation milk yield, (l)	505.7 ± 26.0
Lactation period, (day)	211.7 ± 2.3
Average daily milk, (l)	2.4 ± 0.1
Milk yield on insemination day, (l)	3.5 ± 1.0
Age, (years)	2.1 ± 1.2
Insemination day milk yield, (l)	3.5 ± 0.2

Results of logistic regression analysis, Wald statistics, odds ratios, 95% confidence intervals of estimated odds ratios and p values were presented in Table 2.

According to the stepwise multiple logistic regression analysis, three factors remained in the model with a determination coefficient of 71.4%. The milk yield at the insemination day (P<0.001) was one of the major factors with insemination type (P<0.05) and the increase in insemination day (P<0.05) was tend to be significant factor for the likelihood of pregnancy and were determined as the main factors.

Table 2: Statistical values of logistic regression analysis
 Tablo 2: Lojistik regresyon analizine ait istatistik değerler

Independent Variables	Coefficient	SEM	Wald	P (Wald)	Odds ratio	95% Confidence intervals	p
Constant	5.7373	4.4696	1.647	0.199			
X ₁	-0.0012	0.0007	3.013	0.082	0.999	0.997-1.000	<0.001
X ₂	-3.7273	1.3092	8.105	0.004	0.024	0.002-0.313	0.05
X ₃	0.2623	0.2050	1.636	0.200	1.300	0.870-1.943	0.11
R ²	0.714						
χ ²	2.388 (p=0.967)						

X₁: Milk yield on insemination day, X₂: Insemination type (artificial or natural), X₃: Insemination day (September 16 to 23)
 X₁: Tohumlama gününde süt verimi, X₂: Tohumlama tipi (sunî veya doğal), X₃: Tohumlama günü (16-23 Eylül)

Milk yield on insemination day (X₁), insemination type (X₂) and insemination day (X₃) were determined as the major factors and model was determined as:

$$Y = 5.7373 - 0.00123 * X_1 - 3.7273 * X_2 + 0.2623 * X_3$$

According to this study, odds ratios showed that an increase in milk yield on insemination day caused a decrease of pregnancy rate (P<0.001) and increase of insemination day caused an increase of pregnancy rate (Table 2; 99.9% less likely). At the same time, insemination type was found the other major factor on pregnancy rate (P<0.05). The effect of insemination type is indicated that artificially inseminated goats were 2.4 times less likely to become pregnant than the ones that were naturally inseminated. The goats which were inseminated at a later date during the breeding season were more likely to become pregnant (P<0.05) and pregnancy status is more likely to increase by 30.0% when they were bred at a later date.

Another evaluation criteria was Wald statistics; if Wald statistics value is greater than 2 or when its probability value is less than 0.25 (P_{wald} < 0.25) then it shows the importance of the variable entering the model (9). Wald statistics and probability values in this study confirm these variables to be included in the model. Also conformity of model is evaluated by Hosmer- Lemeshow goodness of fit test. As a result of this test, χ² value is calculated as 2.388 and P = 0.967 (α > 0.05) has been found to be compatible with that model.

Correct classification rate of the model is 87.2%. Pregnant goats are 76.5% and un-pregnant goats are 95.5% of rate correctly classified with generated model. The R² value of the study was 0.714. This rate indicates a model is obtained from approximately 71.4% percent of relationship between dependent and independent variables.

Figure 1 (a, b and c) was the graphical representations of observed variables in the model. In Figure, it was observed that pregnancy rate is lower in goats those were inseminated at the beginning of breeding season. Towards to the end of the breeding season, pregnancy rate increased. The result of insemination type on

pregnancy rate showed a clear decrease on pregnancy rate when artificial insemination used for breeding in Turkish Saanen goats.

Discussion and Conclusion

Reproductive performance is affected by various factors (13) and the major factors are related to either goat (genetic structure) or environmental conditions (nutrition, weather conditions, age, season, buck and breeding type, etc.). Artificial insemination is one of the methods to increase genetic improvement in goats but the results of this study showed that artificial insemination has a detrimental effect on pregnancy status. These results are in consistent with the findings of Chandler et al. (4) for dairy goats. There are also some other factors affecting reproductive performance in goats like ovulation rate, fertilization rate, and the length of breeding season (7). The negative effects of breeding type should be monitored carefully because breeding type might cause significant reduction in reproductive performance which consequently reduces the number of goat kids and also causes economic losses in dairy goat enterprises (9).

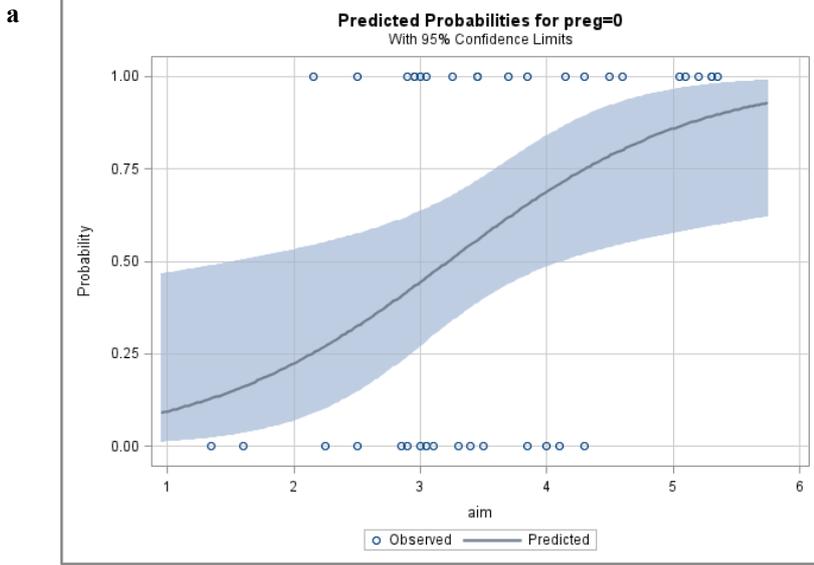
In addition to insemination type, it was concluded that factors effecting pregnancy status of Turkish Saanen goats are insemination day and milk yield on the day of insemination. During the breeding season, goats with high milk yield (milk yield > 3 l; Figure 1a) need more attention because of their less effective reproductive performance. The cut off point for milk yield at the day of insemination is 3 l (liter) because the goats with milk yield greater than 3 l (liter) were less likely to become pregnant. These results are similar with the findings of Mellado et al. (13). Increase in the insemination day cause a significant increase in pregnancy status (P<0.05) in Turkish Saanen goats. A similar result has been show by several other researchers (10, 12). One of the reasons of this significant result might a buck effect. Goats, which were exposed to bucks for several days, showed more frequencies of estrus and had higher pregnancy rates (12).

Figure 1: Pregnancy likelihood and the level of factors in Saanen goats.

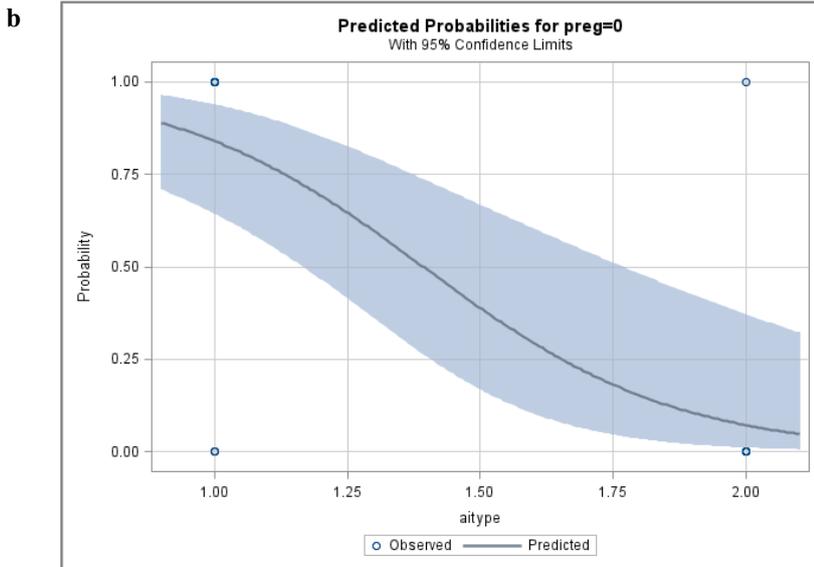
a:Milk yield on insemination day, **b:**Insemination type (Natural:1, Artificial:2), **c:**Insemination day (September 16 to 23).

Şekil 1: Saanen keçilerinde gebelik olasılığı ve faktörlerin düzeyi.

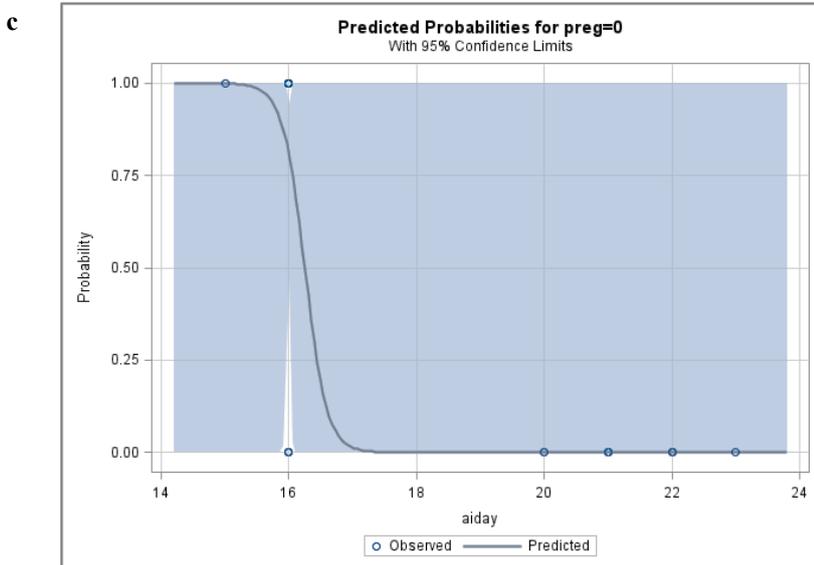
a:Tohumlama gününde süt verimi, **b:**Tohumlama tipi (Doğal:1, Suni:2), **c:**Tohumlama günü (16-23 Eylül).



*aim: milk yield on insemination day (l)
*aim: tohumlama gününde süt verimi (l)



aitype: insemination type, natural insemination =1 vs artificial insemination = 2
aitype: tohumlama tipi, doğal tohumlama=1
suni tohumlama=2



aiday: Insemination day
aiday: Tohumlama günü

In fact, the amount of progeny that was born in a year has a direct impact on the success or failure in Saanen goat farming. For this reason, it is very important to determine the major effects on reproductive performance of Turkish Saanen goats. Logistic regression analysis, which was used as an alternative to the linear regression model in this study, became a widely used method in recent years. The results obtained by this method were being applied to different livestock species and the model determined with this analysis is easy to interpret (15). As a result, high milk yield on the day of insemination of Turkish Saanen goats was found to be one of the most important factors which was determining the pregnancy. In addition to milk yield on the day of insemination, artificial insemination was the second major factor to determine pregnancy. Also, artificial insemination is not a proper method to achieve successful dairy goat farming in Turkey.

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Geliş tarihi: 03.02.2014 / Kabul tarihi: 17.04.2014

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