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Research Article

Some Factors Affecting on Persistency of Lactation Milk Yield in Brown Swiss Cattle[#]

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ABSTRACT

The present study was carried out to investigate the persistency of lactation milk yield and effects of some environmental factors on this characteristic in Brown Swiss cattle in Altınova State Farm. The same feeding and management program was applied to all the cattle. In the study, in terms of measurable environmental factors; the effects of lactation turn, year and season were determined. In the statistical analysis of data, least squares method for the determination of effects of environmental factors and contrast test for the comparisons of data were used in GLM procedure. In the Brown Swiss cattle, the results of persistency of lactation milk yield, which were estimated with $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ models, were 91.93%, 59.91% and 64.46%, respectively. The effects of lactation turn and year on persistency of lactation estimated with $P_{2:1}$ and $P_{3:1}$ models ($P<0.001$), and lactation turn and season estimated with $P_{3:2}$ model ($P<0.001$ and $P<0.05$) were found to be significant. Because of higher persistency level of young cows, by keeping young cows at their peak of lactation for longer intervals in the herd, the milk productivity of herd can be increased.

Key Words: Brown Swiss, persistency, environmental factors

ÖZET

ESMER SIĞIRLARIN SÜT VERİMİNDE DEVAMLILIK DÜZEYİ ÜZERİNE ETKİLİ BAZI FAKTÖRLER

Bu çalışma, Altınova Tarım İşletmesi'nde yetiştirilen Esmer sığırların süt veriminin devamlılığına ait düzeylerin ve bunlar üzerindeki bazı çevre faktörlerinin etkilerinin belirlenmesi amacıyla yapılmıştır. Araştırmadaki hayvanlara ortak bir bakım ve besleme programı uygulanmıştır. Çalışmada etkisi ölçülebilir çevre faktörleri olarak laktasyon sırası, yıl ve mevsimin etkileri üzerinde durulmuştur. Verilerin istatistik analizlerinde, çevresel faktörlerin etki paylarının belirlenmesinde minimum kareler metodu ve bunların karşılaştırılmasında contrast-testi, GLM prosedürü kullanılarak yapılmıştır. Çalışmadaki Esmer sığırların $P_{2:1}$, $P_{3:1}$ ve $P_{3:2}$ modellerine göre hesaplanan süt veriminin devamlılığı %91,93, %59,91 ve %64,46 olarak belirlenmiştir. $P_{2:1}$ ve $P_{3:1}$ modellerine göre hesaplanan süt veriminin devamlılığında laktasyon sırası ve yıl ($P<0,001$), $P_{3:2}$ modeline göre ise laktasyon sırası ve mevsim ($P<0,001$ ve

[#] This study was summarized from the PhD thesis of Figen Çakıllı.

P<0,05), faktörlerinin önemli olduğu bulunmuştur. Genç hayvanların daha fazla devamlılık düzeyine sahip olmaları nedeniyle; sürüde genç sığırların bulundurulmaları ve laktasyonda en üst düzey verime ulaştıkları dönemin devamlılığının sağlanmasıyla, sürünün süt veriminin daha da arttırılabileceği görülmektedir.

Anahtar Kelimeler: Esmer, persistensi, çevre faktörleri

Introduction

Management, nutriton, lactation turn or the age, year and season in which lactation started are the leading environmental factors affecting milk production in cattle. Beside these factors, the persistency level of the highest milk production period reached on lactation is a significant factor (Johansson, 1961).

The persistency level of lactation milk production can be defined as the ability of keeping a high daily milk flow during lactation, in the milk productivity of lactation's first period's persistency level or the rest of the lactation as a measure of lactation curve diagram, the highest period productivity of the continuation level during lactation, continuation level of the highest productivity and after reaching the highest productivity the rate of decreasing seen on milk production in time. When the lactation milk productivity is thought as a lactation curve, it is seen that the mainly factors determining the productivity are the highest level of productivity and the level of persistency of lactation. In determining the productivity of lactation, highest milk productivity and persistency level of lactation needs to be high, also. Especially when the productivity level increases, persistency level of lactation's importance increases as well (Kaya and Kaya, 1997).

Shape of lactation curve has an economical importance. A moderate milker during the entire lactation should be preferred to a high producer which cannot keep this level till the end of lactation. High persistency or more flat lactation curve has some benefits. Among the cattle, with the highest equal productivity, those with higher, persistency level, have the highest milk productivity. Rough fodder amount can be increased in ration for those with a more flat lactation curve. These cattle need less concentrated food. Economical advantage depends on the rate of price between rough and concentrated (Sölkner and Fuchs, 1987).

There is no certain method in calculations determining the lactation curve. Various models are used to calculate the persistency level of milk productivity by different researchers. Persistency of milk productivity is generally calculated by rations between different sections of lactation, mathematical functions and with the developed methods by using standard deviation of milk productivity during lactation (Kaya, 1996). Lactation's persistency of milk productivity is also evaluated by dividing 100 days of lactation milk production into three parts. The prediction, according to the calculated first 100 days production, is affected by heritage, degree of production during early lactation, age or lactation turn, gap between calving, cattle's condition during calving and the level of feeding during lactation (Biedermann and Granz, 1976; Johansson, 1961).

Beside genetics, cattle's productivity traits are determined by environmental factors whose affects can be calculated such as the age on the time for productivity, year and season and those whose affects cannot be calculated such as climate, disease and pasturage. High level of production can be achieved by increasing the genetic structure together with environmental factors. An effective breeder selection can be done by determining the environmental factors whose affects can be counted and by individual standardization of these factors.

The present study was conducted for determining the level of Brown Swiss cattle's persistency of milk production in Altınova State Farm and for calculating some environmental factors affecting these qualities.

Materials and Methods

The study was carried out on the data collected from Brown Swiss in Altinova State Farm in Kadınhanı, Konya. Brown Swiss cattle's production values, during the years 1991-1997, were used. Individual care and feeding were applied to cattle. Between the years 1990-1991, computerized control system and feeding system were installed to the company. As surviving quota, required concentrated and rough fodders were prepared according to this system. In addition, in computerized automatic cabins extra concentrated food was given according to the milk productions of milked cattle. The cattle in the company were equally timed milked twice a day as morning and evening.

In order to define the persistency level of lactation (*P*), below methods, developed by Johansson and Hansson (1940), were used.

$$P_{2:1} = \frac{\text{Milk yield between 101 and 200 days after parturition}}{\text{Milk yield in the first 100 days of the lactation}} * 100$$

$$P_{3:1} = \frac{\text{Milk yield between 201 and 300 days after parturition}}{\text{Milk yield in the first 100 days of the lactation}} * 100$$

$$P_{3:2} = \frac{\text{Milk yield between 201 and 300 days after parturition}}{\text{Milk yield between from 101 to 200 days after parturition}} * 100$$

In milk production, related calculations, the milk production of cattle, milk amounts of the first 100 days, between the days of 101-200 and between the days of 201-300, control dates and production at these periods, were calculated as in the Trapezoid (M_T) method. The formula below was used (Güneş, 1996) for this purpose.

$$M_T = \left[(A_1 - D) * k_1 \right] + \left[\sum_i^n \left[\left(\frac{k + k'}{2} \right) * (A' - A) \right] \right] + \left[(S - A_n) * k_n \right]$$

The symbols in this formula are:

M_T : Lactation milk yield of any cow,

D: Parturition date,

S: Drying date,

A and *A'*: Following milk control dates,

k and *k'*: Milk yield in following controls.

Lactation turn, year and season effects are emphasized among researched qualities as environmental factors whose effects can be calculated. The below model was used for the statistical analyses related to researched production qualities:

$$Y_{ijkl} = \mu + L_i + S_j + M_k + e_{ijkl}$$

The symbols in this model are:

Y_{ijkl}: Observed trait yield value of a random individual,

μ: Expected mean,

L_i: Effect of the lactation turn (*i*= 1-8),

S_j: Effect of the year (*j*= 1991-1997),

M_k: Effect of the season (*k*= Winter, spring, summer and autumn),

e_{ijkl}: Random error.

In the study, the rate of factors having classed variations and the rate of researched environmental factors on general variation are defined with least squares method and the importance control of comparisons between fixed averages is done with the contrast-test which notified by Searle (1971). Achieved data were understood by benefiting from the equation with many unknown systems of GLM procedure (Goodnight and Harvey, 1978; Searle et al., 1980).

Results

$P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ values related to persistency of milk productivity of Brown Swiss cattle in Altinova State Farm are given in the Table 1 according to lactation turn, the year and the season of lactation.

Table 1. Overall and corrected averages of lactations persistency (%) by $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ models, effect proportions of the observed factors, comparison among the groups, significance level (*F values*) and determining degree (R^2) of Brown Swiss cows.

Tablo 1. Esmer sığırların süt veriminin devamlılığına (%) ait, $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ modellerine göre genel ve düzeltilmiş ortalamalar, etki payları, gruplar arası karşılaştırmalar, önemlilik düzeyleri (*F-değeri*) ve belirleme dereceleri (R^2).

Factors	***n***	**$P_{2:1}$**	**$P_{3:1}$**	**$P_{3:2}$**
Overall means	1316	94.95±0.512	62.55±0.577	65.87±0.452
Expected means	1316	91.93±0.439	59.91±0.537	64.46±0.439
All factors - *F value* (R^2)		*30.51*** (0.273)*	*13.79*** (0.145)*	*6.10*** (0.070)*
Lactation turn - *F value* (R^2)		*5.64*** (0.022)*	*13.04*** (0.060)*	*11.42*** (0.057)*
1	439	5.625^{a}	9.696^{a}	7.062^{a}
2	325	1.000^{b}	0.928^{b}	0.233^{b}
3	223	-0.162^{b}	-1.102^{bc}	-0.567^{bc}
4	130	-0.829^{b}	-3.047^{c}	-2.877^{bc}
5	83	-0.212^{b}	-3.621^{c}	-4.154^{c}
6	57	-0.619^{b}	-0.976^{bc}	-0.832^{bc}
7	30	-3.233^{b}	-2.202^{bc}	0.342^{bc}
8	29	-1.570^{b}	0.324^{bc}	0.793^{bc}
Year - *F value* (R^2)		*74.87*** (0.251)*	*22.77*** (0.090)*	*1.30^{NS} (0.006)*
1991	157	-7.081^{c}	-5.499^{c}	-1.013^{ab}
1992	156	-8.002^{c}	-5.061^{c}	0.479^{ab}
1993	178	-9.093^{c}	-4.752^{c}	1.570^{a}
1994	183	-3.684^{b}	-1.535^{c}	0.896^{ab}
1995	236	-1.122^{b}	-2.896^{c}	-2.177^{b}
1996	244	10.983^{a}	7.309^{b}	0.580^{ab}
1997	162	17.999^{a}	12.434^{a}	-0.335^{ab}
Season - *F value* (R^2)		*0.21^{NS} (0.000)*	*1.73^{NS} (0.003)*	*2.67* (0.06)*
Winter	315	-0.528	-0.817^{ab}	0.044^{ab}
Spring	442	0.256	-1.536^{b}	-1.850^{b}
Summer	337	0.373	0.463^{ab}	0.046^{ab}
Autumn	222	-0.101	1.890^{a}	1.760^{a}

$^{a, b, c}$: Differences between sub-groups with different superscripts are statistically significant (P<0.05).

^{NS}: P >0.05, *: P<0.05, ***: P<0.001.

In some models, on which the persistency of milk production was calculated, achieved high values show low persistency, meantime the achieved high values in the models used in this study, $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ showed persistency of milk production at higher rate.

Expected means according to models, about persistency of milk production, $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ were found 91.93%, 59.91% and 64.46% respectively. The determination ratio of persistency of milk production, whose effects are inspected, was calculated relating the models above 27.3%, 14.5%, and 7.0% respectively.

The general inspected effect on persistency of milk production was significant at a level of $P<0.001$. Similarly, the effect of lactation turn was important, too, at a level of $P<0.001$. The effect of year in which lactation started was important in the models $P_{2:1}$ and $P_{3:1}$ at a level of $P<0.001$, but in the model $P_{3:2}$, it was not important. Season did not have statistical importance in the models $P_{2:1}$ and $P_{3:1}$, but had great importance in the model $P_{3:2}$ at the level of $P<0.05$. Persistency of milk production was at the highest point in all the three models of cattle at first lactation. Differences between the fixed average values, achieved by separating into groups according to lactation turn, lactation year and season models used for persistency of milk production, was significant statistically ($P<0.05$) except the season factor in the model $P_{2:1}$.

Discussion

Persistency level of milk production according to models $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ has importance to show the presumptive milk production of other lactations. In the $P_{3:1}$ model, persistency of milk production was defined at a lower level than others (59.91%). Naturally, the milk production at the beginning of lactation is always higher than the last period of the milk production. On this point, since the milk production during the mid-lactation was similar to the first 100 days' production (91.93%), the milk production in the last period was again, found lower than the mid-period (64.46%).

The turn of lactation by $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ models of persistence of milk production determination levels were found to be 2.2%, 6.0% and 5.7%. The persistency of milk production belonging to the first lactating young cows having the lowest milk production was calculated at the highest level on all the three models. According to the lactation order, in most of the equivalents of values having the high level milk production, it was observed that they had lower persistency of milk production. Therefore during the lactation period which has high milk production, in mid-lactation, it can be said that the milk productivity is quite lower than the first period. Turn of lactation, has affected the persistency of the milk productivity as an important factor in all the three models, at a level of $P<0.001$.

It was observed that, the year in which the lactation is started has important effects on the persistency of the milk production on the models $P_{2:1}$ and $P_{3:1}$, whereas it has unimportant effects on the model $P_{3:2}$. The determination levels of the persistency of the milk production which in the three models of year were found to be 25.1%, 9.0% and 0.6%. In contrast to the turn of lactation, usually in the year factor, the levels of the persistency of the milk production in the sub groups with low milk production was found to be low and in the sub groups which have high milk productivity is found to be high. In the $P_{2:1}$ model, in the years 1996 and 1997, at the second 100 days of the lactation, a higher productivity of milk (102.91% and 109.93%) was obtained compared to the production of the first 100 days. In the $P_{3:1}$ model, the highest level of the production was obtained in the year 1997, which was 12.434% higher than the expected average. In the $P_{3:1}$ in which the lactation year was unimportant, there was no systematic distribution on the years statistically.

The season in which the lactation was started had important effect ($P<0.05$) only on the model $P_{3:1}$. The season in which the lactation started made determinative effects on the persistency of milk productivity in the model $P_{2:1}$ 0.0%, on $P_{3:1}$ 0.3% and on $P_{3:2}$ 6%. In every three models, the differences between

the levels in which the lactation started on winter and summer was unimportant in contrast to production of milk, whereas in the models in which milk production in the last 100 days of lactation was evaluated the differences between spring and autumn was important ($P<0.05$).

It was evaluated that, among the environmental factors, the turn of lactation in the models $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$, on which the persistency of milk production is calculated, had effects on all the three models and when the turn of lactation increased, the persistency of milk productivity decreased. This finding; is similar to Holstein cattle by Kaya (1996), Kaygısız et al. (1995) and Koçak and Ekiz (2006), Brown Swiss and hybrids for Akbulut (1990), $P_{3:1}$ model in the persistency of milk production of Holstein for Tekerli (2000a and 2000b), Brown Swiss cattle for Schneeberger (1981) and Simmental cattle for Sölkner and Fuchs (1987). While departs from the study of Kaygısız et al. (2003) informing that the turn of lactation was unimportant on the level of persistency of lactation of Brown Swiss, it resembles with the models $P_{2:1}$ and $P_{3:1}$ in this study showing that season effects are unimportant too. The findings in this study show similarity with the study, carried out by Kaya (1996), showing that year and season has effects on the $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ models and show similarity with the study, by Tekerli (2000a and 2000b), suggesting that on the model $P_{2:1}$ season is important. In the same way, different from the finding by Şekerden (1991) showing that in the persistency of milk productivity, the effect of turn of lactation is unimportant for Jersey cattle but it resembles with the finding showing that year and season factors are important. Koçak and Ekiz (2006) found that the season factor on the persistency of milk productivity which was calculated with different methods is important differing from this study.

In this study, nearly the milk production obtained in the first 100 days of lactation was produced in the second 100 days of lactation. However, because the amount of produced milk in the second 100 days was less, the persistency of milk productivity in the $P_{3:1}$ and $P_{3:2}$ models were found at lower levels. The level of persistency of milk productivity in the first lactation was found in all models at the highest value. The persistency of milk productivity decreased in later lactations. In this case, when evaluated in the frame of the fact that milk production increases with the lactation order, one can state that the least milk yield is continued during the highest production period of the lactation and highest milk yield is continuent during the lowest producing period of lactation.

Values, according to models $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ related to the persistency of milk productivity, were found highest in $P_{2:1}$, lowest in $P_{3:2}$ and average in $P_{3:1}$. The persistency of milk productivity in this study is higher in $P_{2:1}$ model than that defined for the Brown Swiss cattle by Schneeberger (1981) and is lower in $P_{3:1}$ and $P_{3:2}$ models. Similar condition is observed in some other studies (Çetinkaya-Arkıl, 2006; Evrim and Altinel, 1988; Kaya, 1996; Madsen, 1975). In contrast, the levels belonging to persistency of milk productivity is found higher than the study of Tekerli (2000a) working on Holstein (in the project of Turkish ANAFI), study of Sölkner and Fuchs (1987) working on the persistency of milk productivity of the Simmental cattle, study of Madsen (1975) working on milk cattle in Denmark.

Conclusion

Examining the persistency of milk productivity on $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ models, it can be stated that young cattle have higher level of persistency of milk productivity. For this reason, removing cows from the herd after the 5^{th} or 6^{th} lactation especially at their highest productivity of lactation, keeping the persistency of this level as long as possible, would enhence the overall milk production of the hard. It is found that the turn of lactation, the effects of year and season, which are examined as environmental factors, cause important variations on the persistency of milk productivity. Especially the effect of year is usually found to have positive effect the future years. An effective management, nutrition, selection and culling on a farm will always

provide progress in yields and this will be considered as the significant effect of the year factor.

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