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# The milk production traits of Balkan goat breed estimated by using mixed linear model

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## Introduction

The Balkan goats breed is the most numerous breed in goat population of Montenegro with many strains (genotypes) in regards of coat colour (red, black, white and multicoloured). The production of milk, together with production of kid's meat, is the main production purpose of goat production in Montenegro. However, in total output from goat production milk has a major part, approximately 60%, then meat follows. Since goats are reared in different natural conditions, with differences in management and nutrition, production traits vary in quite big range.

The aim of this paper is to investigate how fixed effects: flock, lactation and strain influence on the milk yield and lactation duration of Balkan goats by using mixed linear model.

## Material and methods

Milk traits of Balkan goats breed in Montenegro were investigated on 529 completed lactations. Doers were distributed in four flocks, each originates from different region. Variation of milk yield in the lactation and duration of lactation was analysing by using the following model:

$$Yijkl = \mu + Fi + Lj + Sk + (FL)ij + eijkl,$$ where:

*Yijkl* = milk yield or duration of lactation (DL) of *ijkl*$^{th}$ doer; $\mu$ = *overall mean; Fi - fixed effect of* $i^{th}$ *flock, (i=1,..4); Lj = fixed effect of* $j^{th}$ *lactation (j=1,..4);* *Sk*= fixed effect of $k^{th}$ strain (k=1, ..3);FL*ij* = interaction of flock with lactation; e*ijkl* = *random error.*

In analyzing milk yield on test day (MYTD), the next mixed model was applied:

$$Yijklm = \mu + Fi + Lj + Vk + R(ijk) + Cl + (FC)il + eijklm,$$ *where:*

Yijklm; μ; Fi; Lj; Vk and e*ijkl* are the same as in the previous equation; R*ijk*= random effect of test day for the doer $m^{th}$ in $i^{th}$ flock, $j^{th}$ lactation and $k^{th}$ strain, C*l* = fixed effect of the test day; FC*il* = interaction of flock with test day. In statistical analyses SAS program was applied.

## Results and discussion

Based on 529 completed lactations, which were lasted 204 days in average, average milk yield was 140,54 litres. Variation of duration of lactation and total milk yield was significantly (P<0,01) affected by fixed effects such as flock and subsequent lactation, interaction (flock x lactation) P<0,05, but not by genotype (strain of goats), table 1 and 2.

Table 1. Statistic parameters for milk traits

| Item | N | $\bar{X}$ | St. Deviation | Min. | Max |
|---|---|---|---|---|---|
| Duration of lactation | 529 | 204,40 | 18,68 | 114 | 253 |
| Lactation milk yield | 529 | 140,54 | 30,59 | 30,00 | 260,20 |
| Daily milk yield | 3221 | 0,683 | 0,163 | 0,05 | 1,90 |

Average daily milk yield was 0,638 litres, and it was determined on 3221 individual measuring during regular milk recording procedure. This trait was significantly (P<0,01) affected by fixed effect of flock and lactation, as well as the random regression effect of animal, test day and interaction of flock x test day.

The significant differences between different flocks and lactations, as well as wide variability into observed groups has showed in this study too.

Table 2. F - values for effects which were included in applied models

| Effect | Degree of freedom | Duration of lactation **F – value** | Total milk yield **F - value** | Daily milk yield **F - value** |
|---|---|---|---|---|
| Flock (F*i*) | 3 | 171,44** | 155,17** | 501,81** |
| Lactation (L*j*) | 3 | 15,81** | 32,57** | 134,92** |
| Strain (S*k*) | 2 | $0,14^{ns}$ | $1,60^{ns}$ | $0,11^{ns}$ |
| Interaction (F x L) | 9 | 2,01* | 2,22* | |
| Animal (R*ijk*) **random effect** | 474 | | | 3,97** |
| Test day (C*l*) | 13 | | | 644,63** |
| Interaction (F x C) | 16 | | | 19,4** |
| Repeatability | | $R^2$ = 0,568 | $R^2$ = 0,596 | $R^2$ = 0,831 |

## Conclusion

Variability of milk production traits are affected by all observed fixed effects and their interactions, except effect of strain of goats. The random effect of animals had significant effect to the variability of daily milk yield.