**Effects on milk production in F1 crossbred of Alpine goat breed (♂) and Albanian goat breed (♀)**

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**Abstract**

About 950,000 goats, farmed mostly in hilly and mountainous areas of Albania, contribute about 8% of the country’s total milk production. In order to increase milk production, farmers are currently using crosses of the local goat breed with exotic breeds, mainly the Alpine breed from France. This study examines milk production data of first lactation from 45 goats of the local breed, 82 goats of the Alpine breed and 58 F1 crosses (♀Alpine breed x ♂local breed). The goats were kept on small-scale farms according to the traditional Albanian system. Milking was carried out in the morning and evening. Kids were weaned at 65 days of age after which milking started. Milk yield was recorded twice with a 15-day interval between the two readings. Total milk yield was calculated using the Fleischmann method. The F1 goats produced 37.8 kg more milk than local breed goats although the lactation length (P<0.05) of F1 goats was six days shorter compared to that of local breed goats (P<0.05). Analysis of variance showed a highly significant effect (P<0.01) of the genotype factor on milk production. The average Cappio-Borlino curves of local breed and F1 crosses were similar. Although the F1 cross goats had 50% of their genomes from a genetically improved breed they were still able to deal with the difficult conditions that characterize the traditional extensive farming systems in Albania. Breeding pure Alpine breed or its crosses with the local goat breed improved milk production in an extensive traditional system.

**Introduction**

Alpine breed goats were imported into Albania from France for the first time in 1989. The aim of this was to farm this pure breed in herds with more than 50 goats or on small scale farms with 2-3 goats and to crossbreed the local goat breed with the Alpine breed to produce F1 with better yields in milk and meat production.

According to different scientific investigations, the population of Albanian local goat breeds is characterized by a high variability of morphometric features and a genetic visible profile (Kume and Bajrami, 1996, 2005). A high level of polymorphism of α and β caseins could be observed (Mahe et al., 1996). Genetic niches and isolated populations are often found (Kume, 1998). Albanian local goat breeds are characterized by their ability to deal with severe environmental conditions. Low levels of milk production are the result of an extensive traditional system based mainly on natural feed resources (Dema, 1987; Kume, 2005; Bleta et al., 2002) as well as lack of genetic improvements. Taking into consideration the lower level of local goat yields and the longer period needed to achieve genetic progress (Najari, 2005), especially for milk production traits which have low heritability, crossbreeding of local goats with ameliorative breeds was recommended (Najari and Ben Ahmed, 1996; Najari, 2005; Gaddour et al., 2008). In Albania, the Alpine breed is one of the main breeds used for this purpose (Hajno, 2009). This study examined the effect on milk production and on the lactation curve variability of crosses of local x Alpine goat breeds kept according to the traditional farming system.

**Materials and methods**

This study examined milk production data from the first lactation of 185 goats of which 45 were local breed, 82 Alpine breed and 58 F1 crossbred. The goats were kept on small-scale farms according to the traditional system. The goats were not synchronized before data collection. Data collection was carried out in natural conditions. Farms were located in hilly and lowland areas of central-eastern Albania. This region has a Mediterranean climate with an average 2590 hours sunshine and 1064.7 mm rain per year. Average maximum temperatures vary between +21.6°C and +35.6°C, and average minimum temperatures vary between -2°C up to +10.7°C. On average, temperatures below 0°C are recorded for 20-25 days per year during the period of December to February. Spontaneous vegetation is present almost throughout the year. In general, goats were fed from spontaneous feed resources. A small quantity of grain (maize + barley 70:30) 150-200 g/day was used only in the last month of pregnancy and the first two months after kidding. During the period of December-January, goats were generally kept indoors, but on sunny winter days they were fed in communal village pastures. Average indicator values of Alpine breed goats imported into Albania are reported in Table 1. The local goat breed used in crosses with the Alpine breed belongs to a rustic population with an average of 120-140 kg milk per year. Goats have a medium body size, wither height 60-62 cm (female) and 70-72 cm (male), and average live weight 40-45 kg (female) and 55-65 kg (male).

The first crossbred generation was the result of local goats mated with Alpine breed bucks. Milk yield was recorded from when kids had been weaned (age 65 days). The interval between two successive milk readings was 15 days. The average and standard deviations of the first milk reading of the three genotypes (in kg) were 0.564±0.03, 0.632±0.05 and 1.61±0.09 for local, crossbred and Alpine goat breeds, respectively. Milking was carried out two times per day, in the morning and in the evening. Total milk yield was calculated by the Fleischmann method:

$$TMY = y_1t_1 + \sum_{i=2}^{k} \left(y_i + y_{i+1}\right)/2(t_{i+1} - t_i) + y_{k+1} \times 15$$

where
In respect to milk performances, analysis of variance has led to the coefficient of determination (R²) varying from 75 to 89% (Table 3). The analysis of variances shows a highly significant effect (P<0.01) of the genotype factor on the performance. The environmental factor birth type had a significant effect (P<0.05) on the daily mean and on total production, but was not significant on the duration of lactation. Analysis of variance shows no interdependence between the genetic factor and birth type factor (Table 3). Therefore, the observed variability in the level of milk performance is partially attributed to differences in genetic nature (Najari, 2005; Ribeiro, et al., 2008; Gaddour, et al., 2008, 2009). Meanwhile, it can be seen that most of this variability is a result of large differences in milk performances, of the Alpine breed, local breed, and F1 crosses, respectively. Student’s t-test was carried out to prove the significance of the effect on this variability of increased milk production.

**Table 1.** Characteristics and performances of the Alpine goat breed in the country of origin.

| Origin   | Male weight, kg | Female | Milk yield, kg | Lactation length, days |
|----------|----------------|--------|----------------|------------------------|
| France   | 80             | 60     | 950            | 256                    |

**Table 2.** The least square means of the performances of lactation in relation to genotypes.

| Genotype    | Heads no. | Milking days | Daily production, kg | Mean±SD         | Cv, %     | Total production, kg | Mean±SD         | Cv, %     |
|-------------|-----------|--------------|----------------------|----------------|----------|----------------------|----------------|----------|
| Local breed | 45        | 178±2.1      | 0.724±0.03           | 27.8           | 129.2±4.9 | 26.1                 |                |          |
| F1 crossbed | 58        | 171±2.0      | 0.967±0.03           | 23.4           | 167.1±5.2 | 24.2                 |                |          |
| Alpine breed| 82        | 218±4.1      | 1.313±0.04           | 27.6           | 284.3±9.7 | 29.7                 |                |          |

SD, standard deviation; Cv, coefficient of variation. *Values within columns with different superscripts are significantly different (P<0.05).

**Table 3.** Analysis of variance of goats milk performances.

| Source of variance | DF | Average daily milk production, kg | Total milk production, kg | Milking days |
|--------------------|----|-----------------------------------|---------------------------|--------------|
| Genotype           | 2  | 7.89**                            | 8.53**                    | 5.63**       |
| Birth type         | 1  | 4.91*                             | 4.38*                     | 0.87         |
| Interaction genotype x birth type | 2  | 3.15                              | 3.08                      | 2.33         |
| Residuals          | 175| 151.1                             | 14387                     | 8124         |

R², %

DF, degrees of freedom; *P<0.05; **P<0.01.
production of $F_1$ crosses. Differences between average milk productions are statistically significant ($P<0.05$).

**Cappio-Borlino first lactation curves**

Parameters were evaluated using average milk yield readings (Table 4). These parameters formed the basis on which the Cappio-Borlino lactation curves for three genotypes were estimated (Figure 1). Curve shape was usually different for each of the three genotypes. This is explained by the magnitude and sign of the parameters used. Nevertheless, estimated lactation curve shapes of the local goat breed and $F_1$ crosses are similar. This is because the local and $F_1$ crossed breeds have almost the same reaction to the same environmental conditions. Although 50% of the genomes of the $F_1$ crossed goats were from a genetically improved breed, they were perfectly capable of facing the difficult conditions that characterize the traditional extensive farming systems.

The estimated production after kidding is represented by the $a$ parameter. This is higher for the Alpine goats but the difference was not statistically significant ($P>0.05$). The $b$ parameter, responsible for the rising phase of the curve, differs between the three genotypes. The $c$ parameter, which represents the decline pattern in milk production, is higher in the Alpine breed. Values are similar for the local goat breed and $F_1$ crosses and differences are not statistically significant ($P>0.05$). This agrees with the findings of Fernandez et al. (2002) regarding milk yields of Murciano-Granadina goats. According to the lactation curve, Alpine breed goats deal well with the Albanian environmental conditions. Their milk production after reaching the maximum point declines immediately in an exponential shape. This can be expected because of the stress of the process of acclimatization to Albanian farm conditions. It is an expression of genotype x environment interaction negative effects. This agrees with reports of other authors (Cappio-Borlino et al., 1995; Portolano et al., 1996; Gaddour, 2005; Gaddour et al., 2006). Building of curves by using Wood’s model and their correction by using a non-linear modification, is recommended in this case (Cappio-Borlino et al., 1995). This gives better results and more accurately reflects the performances of milk production during lactation (Portolano et al., 1996; Todaro et al., 1997; Franci et al., 1999). Goodness of fit statistics of the three model curves had high values ($R^2$ = 0.89, 0.86, 0.82 for Alpine breed, crossbred and local breed, respectively). In general, the estimated shape of the three genotype goat lactation curves is similar to the shape of observed milk production curves. In the case of the Alpine goat breed and local goat breed, the fitted curves showed an underestimation of milk yield at the start of lactation. Sakul and Boylan (1992) reported that the possible cause for such an underestimation could be due to a delay in milk data collection after kidding when the curve began to decline. On Albanian farms, the first milk record was taken after kids were weaned, more than 60 days after kidding. For this reason, only data from milk records after the first 60 days were considered in this study. This might directly affect the estimation of $a$ and $b$ parameters. Concerning the Cappio-Borlino’s curve parameters, analysis of variance has led to the determination coefficient ($R^2$) varying

### Table 4. The least square means of Cappio-Borlino’s parameters $a$, $b$, $c$.

| Genotype         | $a$          | Cappio-Borlino’s parameters | $c$          |
|------------------|--------------|-----------------------------|--------------|
| Local goat breed | 0.311±0.07*  | 3.061±0.12*                 | -0.153±0.02* |
| $F_1$ crossbred  | 0.489±0.11*  | 2.781±0.10*                 | -0.125±0.01* |
| Alpine breed     | 1.042±0.26*  | 4.651±0.16*                 | -0.624±0.04* |

Values within columns with different superscripts are significantly different ($P<0.05$). Data are expressed as mean ± standard deviation.

### Table 5. Analysis of variance of Cappio-Borlino’s parameters $a$, $b$, $c$.

| Source of variance | DF | Parameter | $a$          | $b$          | $c$          |
|--------------------|----|-----------|--------------|--------------|--------------|
| Genotype           | 2  |           | 5.02*        | 5.74*        | 6.01**       |
| Birth rank         | 1  |           | 3.01         | 4.05*        | 2.62         |
| Interaction in genotype x birth type | 2  | Variance  | 4.03*        | 4.30*        | 2.51         |
| Residuals          | 175| Variance  | 0.0021       | 0.00002      | 0.00001      |
| $R^2$ %            |    |           | 92           | 87           | 79           |

DF, degrees of freedom; *$P<0.05$; **$P<0.01$; ***$P<0.001$). Data are expressed as mean ± standard deviation.

### Table 6. Estimated total milk yields in kg.

| Genotype            | Fleischmann method | Cappio-Borlino model |
|---------------------|--------------------|----------------------|
| Local goat breed    | 128.2±6.3          | 122.3±5.1            |
| $F_1$ crossbred     | 166.4±5.8          | 164.7±4.2            |
| Alpine breed        | 279.3±10.1         | 271.4±8.6            |

Data are expressed as mean ± standard deviation.

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Figure 1. Cappio Borlino’s curves of 1st lactation: correspondence to different genotypes.
from 79 to 92% (Table 5). Analysis of variance shows a highly significant effect of the genotype factor on the curve’s parameters. The difference among the genotypes is highly significant (P<0.01) for the c parameter. The genotype has a significant (P<0.05) effect on the a and b parameters. The effect of birth type is significant (P<0.05) on the b parameter but not significant on the a and c parameters. This agrees with findings of Rosa et al. (2006). Analysis of variance shows no interdependence of genotype and type of birth factors to the c parameter (P>0.05).

Total milk yields (TMY) calculated by the Fleischmann method and estimated TMY from the Cappio-Borlino models for each genotype are shown in Table 6. The Cappio-Borlino models underestimated TMY. However, there was no statistical difference between the Fleischmann method and estimated TMY from the Cappio-Borlino models for each genotype (P>0.05).

Conclusions

Goats crossbred from local breed with Alpine breed rams improved milk performance. F1 crossbred goats produced approximately 29% more milk than the local breed goats. Crossbred goats maintained their ability to respond to the conditions of the Albanian small-scale farm production system; their response to environmental conditions was similar to that of local breed goats. Genotype is the most important factor that explains the variances in Cappio-Borlino curve parameters. Breeding of Alpine goat breed and/or their crosses (F1) with the local goat breed on Albanian farms increased milk production and, therefore, the income of family farms.

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