

## EVALUATION OF HETEROSIS EFFECT ON MILK PRODUCTION AT HALF-BREED FEMALES RESULTED BY CROSS-BREEDING OF CARPATINA BREED WITH OTHER BREEDS

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### Abstract

*The effectuated research aimed to analyse the improvement possibility of milk production at goats on the basis of the application of a cross-breeding programme between Carpatina breed domestic females with male reproducers belonging to some more productive breeds and which proved that have a higher capacity for improving the milk production at half-breed populations. Biological material was represented by goat populations which belong to different breeds, respectively autochthonous Carpatina breed (LM) as well as other half-breed groups of first generation resulted by cross-breeding domestic breed females with male reproducers belonging to Anglo-Nubian breed (L<sub>1</sub>) and French Alpine (L<sub>2</sub>). To compare the results and ameliorative effect due to cross-breeding, especially on milk production capacity, were utilise3d data obtained after application of performances productive control. The applied working methods for estimation of milk production were based on technical norms which regulate effectuation of official control for milk production at farm animals accepted in experimental technique and recommended by International Committee for Animal Recording. Based on applied productive control was observed that between L<sub>1</sub> and LM exist a real difference for total milk production of 17.74 kg milk, difference which have a high degree of statistical significance for P>1%. In case of cross-breeding of batch L<sub>2</sub> in comparison with autochthonous goats the real difference between level of mean milk production is 23.30 kg milk being distinct significant for P>1%.*

**Key words:** Carpatina goat, milk goat, improvement, heterosis

### INTRODUCTION

Role and importance of goat rearing represent a basic activity for many farmers. At world level is estimated that nowadays will be around 703.39 millions of goats, from which almost 95% of them are in developing countries from Asia and Africa (Zaman et al., 2002).

Based on an ample study, Pulina et al. (2018), show that at world level breeders of small ruminants for milk production represent almost 21% and produce around 3.5% from world milk production, from which 2.7% are processed in industrial units. The highest rate of goat breeders is founded in temperate and subtropical areas from Asia, Europe and Africa. In Europe goats are reared for milk and are concentrated around Mediterranean Sea and in

regions from Black Sea, where dairy products are typical ingredients for humans and are part of daily diet.

Regarding productions obtained from goats at world level but also in European countries could be observed an increasing trend for cheeses obtained from milk processing (Pascal et al., 2017). To face the demands imposed by market all the countries in which goats are reared must find technical solutions for sustain the increasing of milk production based mainly on application of some breeding programmes and less on increasing of flocks.

In this context, the effectuated research aimed to enlighten the productive capacity as effect of heterosis manifested in expression of lactogen capacity at two populations of half-breed females.

## MATERIALS AND METHODS

Biological material was represented by goat populations which belonged to different breeds, respectively autochthonous breed Carpatina (LM) as well as some groups of first generation resulted by cross-breeding of autochthonous breed females with male reproducers belonging to Anglo-Nubian (L<sub>1</sub>) and French Alpine (L<sub>2</sub>) breeds.

Option face to those breeds was sustained by the fact that in many scientific works is shown that those ones have a high degree of genetic combination and proved that have a pronounced influence in breeding of characters specific for milk production (Serradilla, 2001). At the moment of first lactation debut to eliminate the influence of some external factors on productive performances were established homogenous batches belonging to all studied populations, each of those being formed by 25 females.

Also, maintenance, nourishment conditions as well as the evaluation period for the aimed characters were realised in the same time interval.

To compare the results and the breeding effect due to cross-breeding, mainly on milk production capacity, were utilised data obtained after application of productive performances control. The working methods applied for estimation of milk production were based on technical norms which regulate effectuation of official control for milk production at farm animals accepted in experimental technique and by International Committee for Animal Recording.

$$\text{Milk yield [kg]} = L_1 \cdot \text{int}_1 + \sum_{i=2}^{2n} \left( \frac{L_i + L_{i-1}}{2} \cdot \text{int}_i \right) + L_n \cdot 14$$

where:

L<sub>1</sub> = milk yield in 1<sup>st</sup> monthly test;

L<sub>i</sub> = milk yield in i<sup>th</sup> monthly test (i = 1, ..., n);

L<sub>n</sub> = milk yield of the last test;

int<sub>1</sub> = number of days from kidding to 1<sup>st</sup> monthly test;

int<sub>i</sub> = number of days between monthly tests (i-1) and

i (i = 1, ..., n);

n = total number of monthly test for a specific animal.

Data were statistically evaluated with the algorithm REML (REstricted Maximum Likelihood), which provides the achievements of the statistical parametric estimators within the normal range.

Estimation of heterosis effect was realised using bi-variant mixed models inside breed and between populations included in research and was based on analysis and interpretation of obtained data at official control applied for evaluation of lactogen potential.

The effect due to application of a cross-breeding between populations with a different genetic structure to obtain half-breed populations was enlightened by heterosis coefficient, calculated in according with the formula:

$$H_{F1} \% = \frac{\bar{X}_{F1} - \bar{X}_P}{\bar{X}_P} \times 100;$$

in which:  $\bar{X}_{F1} \%$  = character mean at half-breed females;  $\bar{X}_P$  = character means at parents.

## RESULTS AND DISCUSSIONS

Effect due to manifestation of heterosis could represent a maintain way of the characters targeted for change at an upper level and on a greater period of time when are manifested as an unexpected deviation face to mean of those two parental populations (Dikerson 1975; Wakchaure et al., 2015).

In many areas of the world, to shorten the interval in which are obtained new goat generations, more performing, are utilised cross-breeding between local goats with other goat breeds, the most utilised ones being: Sannen, French Alpine, Anglo-Nubian, Toggenbourg and others. Interest face to those breeds, which were formed and evaluated in other areas, is due to the fact that have a high adaptability degree to the new pedo-climatic conditions and have remarkable qualities regarding amelioration of milk production (Pascal et al., 2017). In the context of goal the utilisation of those breeds for cross-breeding with the local ones is for capitalization of effect due to heterosis which is manifested at a high level in the first generations or for being included in formatting schemes of new breeds, with productive valences superior to the local breeds.

So in animals' rearing by cross-breeding could be achieved a safe way for increasing of performances for some characters because maximized pheno-typical effects resulted by application of pairing between individuals, populations, lines, which are gene-type

different. In these conditions the main consequence of unrelated pairings is represented by increasing of frequency of heterozygous level in descendant generation, at the same time with decreasing of homozygous level and as a consequence exactly reverses to related pairing system.

In the same way if homozygous produced by inbreeding causes pheno-typical effects for inbreeding depression, heterozygous determine apparition of a reverse pheno-typical effect named heterosis effect (Negruțiu et al., 1975; McAlister, 2002). The cause of heterosis is due to exercised actions of some non-additive genes (dominant, supra-dominant and epistasis) and isn't observed heterosis for features governed by action of additive gene.

Evaluation of heterosis effect for milk production, as effect of realised cross-breeding, represented the main target of research. Were subjected to appreciations half-breed females from first generation ( $F_1$ ) because it is well known the fact that this phenomenon appear and has a more intensively manifestation at first half-breed generation. This aspect is due to the fact that after cross-breeding in gene-type of new populations are established some genetic interactions which have the role to allow an increased influence on the externalization way of certain productive and reproductive characters (Pascal, 1997). Value and expression of a quantitative character is determined by the effect of several gene types which when are combined in different forms and gene-types could give different effects (Pipernea, 1979; Popescu Vifor, 1978).

To estimate the effect due to heterosis were utilised data collected after application of productive control and by statistical processing was observed a manifestation tendency for positive heterosis type for milk quantity at both half-breed populations. This affirmation is sustained by the fact that both batches of half-breed females provided milk productions higher with 10.44% for the ones resulted by cross-breeding with Anglo-Nubian breed bucks and with 11.56% at batch obtained with French Alpine (figure 1).

In case of analysis effectuated to determine the breeding effect for milk production obtained from first half-breed females' generation resulted by cross-breeding of Anglo-Nubian breed bucks with autochthonous females could be observed a real difference for total milk production, per controlled lactation, of 17.74 kg milk, difference which have a higher degree of statistical significance for  $P > 1\%$ . In case of cross-breeding of French Alpine breed bucks with autochthonous females the real difference between level of milk mean production is 23,30 kg milk being distinct significant for  $P > 1\%$  (Table 1).

All those differences were recorded in conditions in which all microclimate, technological, maintenance and nourishment parameters were identical. Also, to eliminate the influence of season on performances obtained by females from first generation ( $F_1$ ) research was carried out simultaneously in the same time interval.

Into a similar study in which local goats Carpatina was cross-breed with Saanen breed bucks at half-breed females  $F_1$  mean milk production was superior with almost 30% face to total mean quantity obtained from a batch formed from females belonging to the local breed (Taftă, 1996).

Regarding the effect due to heterosis could be observed that this one have a higher manifestation on productive performances at females from  $F_1$  resulted by cross-breeding of Carpatina breed females with bucks belonging to French Alpine breed. In according with this observation could be affirmed that French Alpine breed have a better degree for genetic combination with Carpatina domestic breed.

The effect of manifested heterosis in this case could be explained by the fact that in expression of lactogen capacity at this two half-breed females' generations took place an increasing of the number of involved loci, consequence of genetic differences between those breeds regarding the frequency of relevant alleles at the level of those loci.

Table 1. Heterosis effect for milk quantity

Gene-type	n	Character	MU	Milk mean production at Carpatina	Milk mean production at F <sub>1</sub> half-breeds	Difference due to heterosis		Signific. difference
						absolute kg	$\frac{\bar{X}_{F_1} - \bar{X}_P}{\bar{X}_P} \times 100$	
Anglo-Nubian x Carpatina	25	Milk quantity	kg	153.14	169.88	17.74	11.66	**
French Alpine x Carpatina	25	Milk quantity	kg	178.25	201.55	23.30	13.07	**

Note: \* significant (P<5%); \*\* distinct significant (P>1%).

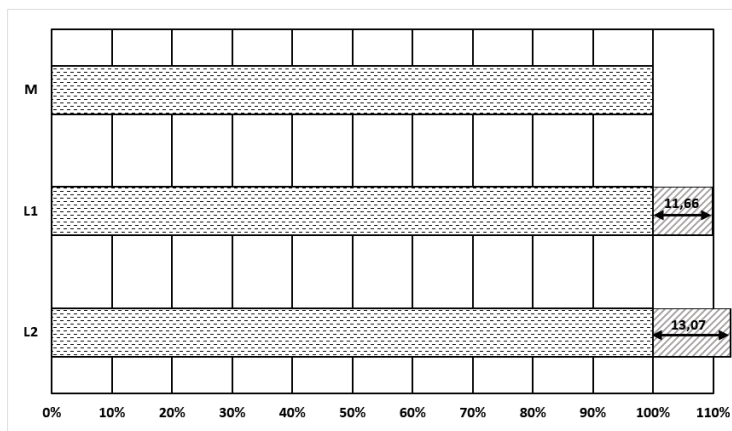
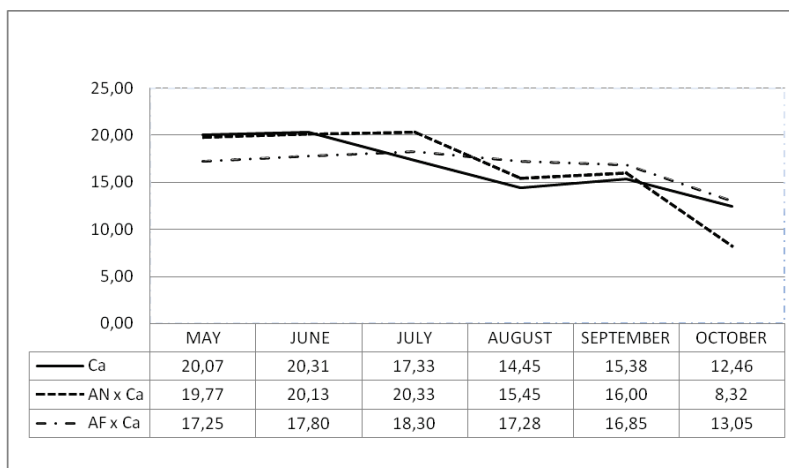


Figure 1. Graphical design of effect due to heterosis on milk production



Note: Ca = Carpatina; AN x Ca = F1 Anglo Nubian with Carpatina; AF x Ca = F1 French Alpine with Carpatina

Figure 2. Rate of monthly production from total quantity obtained in controlled lactation (%)

The existence of a higher level for heterosis manifestation of first generation females resulted by cross-breeding of Carpatina breed goats with French Alpine bucks is due to the fact that between them exist a greater genetic difference, aspect which induce also a higher genetic frequency and implicit a more intense expression of effect due to heterosis.

Also on the base of those data we could affirm that application of cross-breeding represent a more rapid and efficient solution to obtain some new type populations at which to be observed an improvement of characters which require a longer time for improving from pure breed selection and by application of some

breeding programmes based on selection (Popa et al., 2012).

The goals aimed in the applied research are into the international tendency by which it is desired to improve the genetic quality of local breeds based on application of breeding programmes or by application of amelioration cross-breeding at which to participate genitors of breeds which proved that have the improvement capacity for specific characters of basic productions of goats, especially the milk one. Connected with this, in 2001, Serradilla show that performing breeds are introduced in other areas for replacing the local ones which are less productive or to be utilised in amelioration cross-breeding for improving their production performances. Comparing the obtained productions from exotic breeds, local and transversal is always difficult due to strong management differences of all information regarding environment and rearing technologies conditions and breeding methods. Also, application of cross-breeding to obtain the effect due to heterosis is more pronounced when the aim is represented by improving of features with a low heritability, such as milk production, resistance and fertility.

On the based of effectuated observations we noticed that heterosis effect is manifested also by a better homogeneity, maturity and uniformity for the majority of characters and provide a higher growing intensity at kids being in the first neonatal periods. Higher precocity, an increased ecological plasticity and superior quality are also, important characteristics for hybrid vigour.

In figure 2 is presented the level of monthly production based on determination of rate from obtained milk production from each batch in the lactation subjected to control. From analysis could be observed that at those two batches formed by half-breed females, in each month the obtained milk quantity is superior in comparison with the obtained data for the batch formed only by females from Carpatina local breed.

In case of those two batches formed by half-breed females of first generation ( $F_1$ ) it could be observed that amplitude of lactation curve have a reduced decreasing, confirming that those ones have a superior milk production face to the local breed.

## CONCLUSIONS

By the fact that at both half-breed batches is observed a manifestation of heterosis positive type for obtained milk quantity at first lactation we could affirm that the aim of research was fulfilled and the participant breeds were correctly chosen.

However, because we are speaking about different gene-type also the effect due to heterosis manifested for milk production was different. To justify this affirmation from the obtained data could be observed that at batch represented by half-breed females  $F_1$  resulted from cross-breeding of Capatina local females with bucks belonging to French Alpine breed the value of determined heterosis was higher with 1.41 and had a high degree of statistical significance.

Batch formed by half-breed females provided milk production higher 10.44% in case of the ones resulted by utilisation of Anglo-Nubian breed bucks and with 11.56% at batch obtained with French Alpine.

The fact that at half-breed females population obtained by utilisation at cross-breeding of French Alpine breed bucks was realised a production higher with 200 l into a normal lactation recommend the utilisation of those one for improving of this character at domestic goats.

Analysis of monthly mean productions by determination of rate from total milk quantity show that at those two batches formed by half-breed females from first generation ( $F_1$ ) lactation curve had levels situated over the values determined at the batch formed only by local females, confirming the fact that those ones have a superior milk production face to the local breed.

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