ESTIMATION OF THE HETEROSIS EFFECT FOR THE PRODUCTION OF MEAT IN GOATS

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Abstract

In the current research, aspects that may influence meat production were analyzed, and in order to obtain results close to reality, the research team considered the elimination of some factors of influence that could distort the way of expressing the characters under evaluation. Therefore, estimating the heterosis effect for meat production was based on a well-developed plan in which experimental treatments were similar.

For the accuracy of the data, the fattened goat comes from the same calving season and, during the lactation, period, the young goat was kept together with the goat mothers in common breeding chairs and the weaning was done at the age of 80 days. When constituting batches for fattening, weight was also taken into account, being accepted only individuals with similar body development, the admitted differences being of ±2 kg.

The analysis of the heterosis effect pattern for the characters referring to the cut portions in the casing, respectively for the neck and back, the head of the chest, the crotch and for the jig, the heterosis effect determined has higher values at the Anglonubiana half breed and the statistical significance for the proportion of the jig is significant for the statistical threshold of more than 5%. On the basis of these data, it may be recommended that when the production of goat meat is prioritized, it can be used the industrial crossbreeding for the Anglonubiana male goats.

Key words: meat, goat, heterosis

INTRODUCTION

Industrial crosses are today practiced in a common way to improve all livestock-specific production, but, in goats, most are used to increase quantitative and qualitative milk production and less for meat.

Concerning the production of meat obtained from sheep and goats, we can say that the current concerns are at different levels, being more intense and more numerous in sheep. However, sporadically, in Romania, but also in other countries of the world, there are also activities aimed at analyzing certain aspects of meat production, and the comparison of the results creates problems because conditions, breeds, technologies and factors of influence are different and induce totally different effects, and research results become hard to comparable.

However, given that in Romania the increase in goats registered the highest rate among the EU state members, the research approach of the objectives on which meat production depends is justified because, inevitably, the exploitation of goats for milk can not be abandoned, or neglected. Another reason to justify this research is that the European Union will allocate six million euros, amount devoted exclusively to the promotion of sheep and goat meat consumption in the current community space (source: MADR, 2017, cited by Pascal et al. 2017a).

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MATERIAL AND METHOD

Biological material belonged to different goat populations, namely the Carpathian breed and first-generation half breed groups (F_1) resulting from the crossbreeding of local breed females with Anglonubiana and French Alpine male breeders.

In order to compare the results, as well as the breeding effect due to crossbreeding on the meat production capacity in the two generations of half breeds, experimental batches were organized in order to evaluate the capacity of meat production following a guided process of fattening.

In order to have a real situation on the level of accumulation of body masses and meat-specific skills, during fattening, control weights were planned at the beginning and at the end of each phase of the fattening technology applied.

Estimate of the heterosis effect was based on the analysis and interpretation of the data obtained on fattening and the level of body mass accumulation. To this end, the youth was grouped into batches and underwent a similar process of breeding and fattening. The fattening system used was of the semi-intensive type and was based on three technological phases, namely the accommodation, breeding and fattening and finally, finishing. The feed source was identical, being the discretionary administration of a unique blend.

In the choice of the fattening technology has taken into account the real situation in the units that were included in the experimental plan but also the fact that in the entire basin represented by the Central Plateau of Moldova and in the case of the capitalization of the young goat for meat, the same technology is applied as in young sheep.

Fertilization took place over a total of 160 days extended between May and October. The individuals which were fattened were divided into three groups:

- **LM** (made of pure Carpatina breed);
- **L1** (made of individuals resulting from crossing Carpatina females with Anglonubiana male goats);
- **L2**) (made from individuals resulted from the crossing of Carpatina females with male goats belonging to the French Alpine breed).

Each batch consisted of 8 individuals represented in equal proportions by the two sexes, and for the elimination of experimental errors individuals were randomly assigned. At the end of the fattening, weights were carried out to determine the live weight, and in order to assess the quality of the carcasses, control sacrifices were carried out. Subsequently, the obtained carcasses were analyzed according to the technical procedures underlying the appreciation of the meat production.

The evaluation of meat production was based on determinations and analyses of the physical and tissue structure supplemented by determinations of the main slaughter indicators.

The statistical processing of the data was based on the use of **S.A.V.C.** computer program (Statistic Analysis of Variance and Covariant 2003) to determine arithmetic mean ($\overline{X}$), arithmetic average error ($\pm s_{\overline{x}}$), standard deviation (s), genetic parameters (heritability and correlations).

Also, the software SPSS 16.00 for WINDOWS was used for the frequency, and the multiple regression coefficients was determined by the STEPWISE method, the Pearson correlation, the Chi-Square Tests, the Anova Test, the Significance Test **p** and the confidence interval (C.I.).

Estimating the genetic parameters as well as determining the proportion, share and role of the directly involved factors, namely the breeding season, the product's gender on the quality characters was based on the use of REML (REstricted Maximum Likelihood - of the limited maximum fidelity) that guarantees the estimation in the normal space of the parameters, and the effect of the half breeding was highlighted by the heterosis coefficient determined by the relation:

$$H = \frac{\overline{X}_{F1} - \overline{X}_P}{\overline{X}_P};$$ in which:

$\overline{X}_{F1}$ = the average of character for half breeds;

$\overline{X}_P$ = the average of character in parental breeds.

RESULTS AND DISSCUSIONS

Considering that the main objective of the research was to evaluate the breeding effect of parental breeds on the specific skills of meat production, a great attention was given to the characters that exert influence on the obtaining of this production, namely quantitative ones.

Quantitative characters are those attributes that can be determined and measured at any stage in the life of animals, such as daily average gain, body mass, carcass weight, share of commercial parts in the carcass etc., and some of these may be determined by many times over the same productive cycle, others only once.

The statistical processing of data on quantitative characters highlights the superiority of the two groups of half breed individuals for many of them. Thus, the character represented by the average daily increase in the young categories in full growth and development is the phenotypic value of the character. This phenotypic value is given and influenced mainly by the way, the quality and the combination of the genes they have in their own genotype, but also by their interaction with the environment in which the animal grows, develops and produces.

However, a feasible environment, efficient feeding, proper maintenance, will not cause spectacular increases in phenotypic value to a certain extent, up to the level at which the value of the genes and genotypes underlying its development [5]. Forcing certain limits to that end is inefficient because it is not biologically possible and attracts additional costs [4].

Once the maximum level has been reached, the further increase of the value and the quantitative expression for that character will only be possible if the genetic structure of the individual in question is subject to other modifications, using one of the ways of improving, but at a higher quantitative level. However, environmental conditions are capable and can often stop the use of the genetic potential of an individual and a population for that character in discussion.

The value and expression of a quantitative character is determined by the effect of several types of genes that when combined into different forms and genotypes that they can form, give different effects.

In the researches performed it was found that even in the case of the daily average increase, but also in the case of the growth intensity analysis, there is an obvious manifestation of the phenomenon of positive heterosis. The fact that these characters show a positive manifestation of the heterosis effect shows that the genes placed on different locus interact inadvertently (dominance, supra-dominance and epistaxis) and naturally determines the manifestation of a high level of the heterosis effect.

This also highlights the fact that the populations used at the crossings practiced, namely Carpatina, Anglonubiana and French Alpine, have a very different genetic structure, thus giving the possibility that the newly formed genotypes in the half breed descent have a rather high degree of heterozygosity. This makes the manifestation of non additive interactions intensify and, ultimately, through the hybrid force the level of expression of some of the characters considered to record higher exteriorization thresholds.

Lamkey et al. (1999), Casey et al. (2010), Popescu Vifor (1978) shows that the improvement of the characters directly involved in expressing the quality and quantity of productions is neither a simple nor complex activity, the results being mainly dependent on the choice of parental forms and how the breeder puts it into practice in order to get the maximal effect of heterosis.

After the fattening process and after the statistical processing of the obtained data, it is highlighted that in both groups of half breeds for the total accumulated increase in fattening but also for the average daily increase the differences, although higher in the fattening of the F1 half breeds resulting from the crossing of the local goats with Anglonubiana male goats, have the same degree of significance for the statistical thresholds considered (Table 1).

Table 1 The heterosis effect for weight gain indicators

Batch	Character	M.U	Average between parents	Average at half breeds F1	Difference (heterosis)		Difference significance
					real	$\frac{\overline{X}_{F_1} - \overline{X}_P}{\overline{X}_P}$ x 100	
Anglonub. x Carpatina	Total average increase	kg	13.476	17.676	4.200	31.16	**
French Alpine x Carpatina	Total average increase	kg	13.476	17.269	3.793	28.14	**
Anglonub. x Carpatina	Average daily increase	g	84.15	110.45	26.30	31.14	**
French Alpine x Carpatina	Average daily increase	g	84.15	107.90	23.75	28.20	**

Note:* significant (P ≤ 5%); ** distinctly significant (P ≤ 1%)

Because the Anglonubiana x Carpatina half breeds showed a heterosis effect higher with 9.69% for the total weight gained during fattening and with 9.44% higher for the character of the daily average increase, their production and fattening allows obtaining higher quantities of meat. On the basis of this finding, it can be concluded that it is more appropriate to produce them when the basic activity of a holding is the production of fattened goat's young meat.

Regarding the tissue structure of the carcass, it was found that they showed heterosis effect for the characters analyzed at both batches of half breeds. This is very important because the tissue structure is an important quality indicator and its inclusion in the characters undergoing positive changes can not be missing from any animal breeding program for meat.

Regarding the quantitative characters represented by the carcass weight, the quantity of meat in the carcass and the weight of the fat-free carcass, among the analyzed batches, the half breed batch resulting from the crossing of the local Carpatina goats with the Anglonubiana male goats showed a higher heterosis effect. These data show a very good breeding capacity for that breed for many of the characters specific to meat production.

Regarding the significance of the calculated heterosis coefficient, it was found that the differences between the half breed batches and the parental breed batches were significantly different for the statistical threshold of 1% both the sacrifice yield and the carcass weight (Table 2).

Table 2 The heterosis effect for the main slaughter indicators

Batch	Character	M.U	Average between parents	Average at F1 half breeds	Difference (heterosis)		Difference significance
					real	$\frac{\overline{X}_{F_1} - \overline{X}_P}{\overline{X}_P}$ x 100	
Anglonub. x Carpatina	Yield at slaughter	%	44.35	45.81	1.46	3.29	**
Fr. Alpine x Carpatina	Yield at slaughter	%	44.35	46.70	2.35	5.29	**
Anglonub. x Carpatina	Carcass weight	kg	10.79	13.24	2.450	22.70	**
Fr. Alpine x Carpatina	Carcass weight	kg	10.79	12.67	1.880	17.42	**

Note:* significant (P > 5%); ** distinctly significant (P > 1%)

Comparing the values obtained for the real absolute difference for the slaughter yield, it is found that the use at the crossing of the French Alpine breed male goats improves this character more clearly since the real difference of heterosis was 0.89 and the value of the statistical average of that character was 1.9% higher at the F_1 French Alpine x Carpatina.

Table 3 presents a centralization of the data obtained in evaluating the heterosis effect for the tissue structure and the main cut parts from the carcass.

Regarding the structure of the carcass components, it is noteworthy that both half breed batches were found to have a rather high heterosis coefficient. However, the fact that the structure of the carcass components presents different values, the most favorable crossing and beneficial effects on the way of expressing the characters specific to meat production was also with the Anglonubiana male goats.

At these half breeds, the average of the character represented by the meat quantity from the carcass is 9.531 kg resulting in a real difference from the parental average of 1.863 kg and the average value is higher by 4.56% compared to the level of expression found in the F_1 group formed of French Alpine x Carpatiana half breeds.

In the case of the analysis of the manifestation of the heterosis effect for the characters referring to the sliced portions of the casing, respectively for the neck and the back, the chest head and the meatloaf and jig, the determined heterosis effect has higher values in the Anglonubiana half breeds and the statistical significance for the proportion of the jig is significant for the statistical threshold of more than 5%. On the basis of these data, it can be recommended that when the production of goat meat becomes a priority, use may be made of industrial crosses of the Anglonubiana male goats.

Table 3 The heterosis effect on the tissue structure and the main slaughtered parts from the carcass

Batch	Character	M.U	Character average at parents	Character average in F_1	Difference (heterosis)		Difference significance
					real	$\frac{\overline{X}_{F_1} - \overline{X}_P}{\overline{X}_P}$ x 100	
Anglonub. x Carpatina	Meat in carcass	kg	7.668	9.531	1.863	24.29	**
Fr. Alpine x Carpatina	Meat in carcass	kg	7.668	9.096	1.428	18.62	**
Anglonub. x Carpatina	Bones from carcass	kg	2.852	3.524	0.672	23.53	**
Fr. Alpine x Carpatina	Bones from carcass	kg	2.852	3.180	0.328	11.50	*
Anglonub. x Carpatina	Neck and back	kg	3.152	4.240	1.088	34.51	**
Fr. Alpine x Carpatina	Neck and back	kg	3.152	3.954	0.802	25.44	**
Anglonub. x Carpatin	Chest head and meatloaf	kg	2.279	3.109	0.830	36.41	**
Fr. Alpine x Carpatina	Chest head and meatloaf	kg	2.279	2.983	0.704	30.89	**
Anglonub. x Carpatina	Gigot	kg	2.965	3.359	0.394	13.28	*
Fr. Alpine x Carpatina	Gigot	kg	2.965	3.181	0.216	7.28	*

Note:* significant (P > 5%); ** distinctly significant (P > 1%)

For some carcass dimensions (Table 4), the highest heterosis coefficient was manifested for the large and small perimeter of the jig, as well as for the width and depth

of the carcasses, thus revealing the more pronounced amelioration effect of the Anglonubiana breed on these characters. The use of this breed in the production of half breeds intended for fattening has the ability to impart positive effects to offspring that favorably affects the production of carcasses with a distinct commercial appearance, with globular jigs and rich in muscle mass, a superior bone / meat ratio, thus proving the place and role which it holds among listed breeds as a very good enhancer of the conformation and quality of the carcasses.

Table 4 The positive effect of heterosis manifested for some carcass dimensions

Half breed groups	Specification	M.U	Average between parents	Average at F1 half breeds	Difference (heterosis)		Difference significance
					real	$\frac{\overline{X}_{F1} - \overline{X}_P}{\overline{X}_P}$ x 100	
Anglonub. x Carpatina	Small length of the carcass	cm	64.609	64.910	0.310	0.465	*
Fr. Alpine x Carpatina	Large perimeter of the jig	cm	29.720	30.352	0.632	2.128	*
Anglonub. x Carpatina	Small perimeter of the jig	cm	21.394	23.185	1.791	8.370	**
Fr. Alpine x Carpatina	Width of the carcass at the jig	cm	22.637	23.752	1.115	4.924	**
Anglonub. x Carpatina	Width of the carcass at the chest	cm	21.232	22.378	1.146	5.396	*
Fr. Alpine x Carpatina	Depth of the carcass at hips	cm	20.675	21.666	0.968	4.770	*

Note:* significant (P > 5%); ** distinctly significant (P > 1%)

Between groups which manifested a heterosis effect, the registered differences were significant (p>5%) and distinctly significant (p>1%).

CONCLUSIONS

1. By statistical processing of the data obtained from the organized fattening it is observed that both groups of half breeds show a heterosis effect for the main weight gain indicators for fattening, and the real differences between batches are positive and distinctly significant for p≤1%.

2. The F_1 half breeds (Anglonubiana x Carpatina) showed a superior heterosis effect with 9.69% higher for the total gain accumulated during fattening and by 9.44% higher for the character represented by the daily average gain.

3. In the case of the obtained data from the fattening of the F_1 half breeds (French Alpine x Carpatina), the heterosis is also positive and the real difference from the mean of the character in parental breeds is higher with 23.81% for the total gain accumulated throughout the fattening process and with 22.01 for the character represented by the average daily increase.

4. On the basis of these data, it can be concluded that the production and fattening of the half breed individuals allows for higher quantities of meat, and the crossbreeding between different breeds is more appropriate when the basic activity is the production of fattened goat's young meat.

5. The average values of the heterosis coefficient calculated on the basis of the differences between the half breed batches and the parent breeds were distinctly significant for the statistical threshold of 1% both the scarification yield and for the carcass weight.

6. The use of the French Alpine breed improves the slaughter yield with 1.9% compared to the average of the same character obtained from the F_1 half breeds by using Anglonubiana male goats.

7. The Anglonubiana x Crapatina half breeds present a mean value for the character represented of the meat quantity in the carcass of 9.531 kg resulting in a real difference from the parental average of 1.863.

8. In the same batch, the average value for the proportion of meat in the carcass is higher with 4.56% than the level of expression determined in the F_1 group made up of the French Alpine x Carpatina half breeds.

9. The analysis of the heterosis effect pattern for the characters referring to the slaughtered parts from the casing, respectively for the neck and back, the chest head and the meatloaf and for the jig, the heterosis effect determined has higher values in the Anglonubiana half breeds and the statistical significance for the proportion of the jig is significant for the statistical threshold of more than 5%.

10. On the basis of these data, it may be recommended that when the production of goat meat is prioritized, use may be made of industrial crossbreeding for Anglonubiana male goats.

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