COMPARATIVE STUDY OF MORPHO-PRODUCTIVE PERFORMANCE FOR QUANTITATIVE AND QUALITATIVE MEAT PRODUCTION IN R1 (75% BOER × 25% CARPATINA) KIDS, COMPARED WITH THE CARPATINA BREED

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Abstract

In Romania, research aimed at increasing goat meat production through crossbreeding remains limited, being conducted mainly at the Research and Development Institute for Sheep and Goat Breeding (R.D.I.S.G.B.) Palas Constanța. The present study highlights the advantages of crossbreeding Carpatina with Boer on key morpho-productive indices, with the strategic objective of establishing a Romanian meat-type goat breed well adapted to local conditions. To this end, the analysis focused on the R1 genotype (75% Boer × 25% Carpatina), obtained by crossing Carpatina does with Boer bucks.

The results indicate a clear superiority of the R1 genotype: body weight was 17.67% higher than in Carpatina kids, and the average daily gain during the fattening period reached 185.30 g compared with 130.80 g in Carpatina. From a nutritional efficiency standpoint, the specific energy and protein consumption required to obtain one kilogram of weight gain was lower in R1 than in Carpatina. Experimental slaughter trials confirmed these differences, revealing superior carcass quality in R1 kids relative to the Carpatina breed.

In conclusion, the findings certify the genetic and technological advantage of the R1 genotype (75% Boer × 25% Carpatina) for meat production, underpinning the establishment of a specialized Romanian breed and justifying further validation on larger cohorts and across diverse farm environments.

Key words: *meat goats; R1 (Boer × Carpatina); average daily gain; feed efficiency; carcass quality*

INTRODUCTION

The development of the goat sector towards meat production is driven by the steadily growing demand for "lean" protein sources and by consumer preference for products with a reduced lipid content especially saturated fatty acids. Recent studies indicate that attributes such as "low-fat meat" and "low cholesterol" increase willingness to purchase goat meat products [1]. Interest in goat meat has also intensified due to its favourable nutritional profile, high biological-value proteins and a beneficial ratio of polyunsaturated to saturated fatty acids, alongside a low cholesterol content documented in recent assessments of lipid composition and meat quality [2].

Achieving a high, cost-effective output of premium meat depends on the characteristics

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and aptitudes of the animals exploited. Thus, the level of meat production depends on its genetic potential and on the extent to which it is expressed under environmental influences [3]. In Romania, literature on improving the quality of meat production in goats through crossbreeding remains limited, an aspect explicitly highlighted in recent research undertaken at R.D.I.S.G.B. Palas Constanta [4]. This paper aims to highlight the advantages of crossing Carpatina does with Boer bucks for meat production by quantifying both quantitative and qualitative components, in the context of the high importance of meat quality and its rich content of essential amino acids, various enzymes, mineral salts and vitamins [5]. Internationally, classical studies have demonstrated the benefits of using the Boer breed to increase meat output [6,7,8]. Results from R.D.I.S.G.B. Palas Constanta indicate superior growth and carcass quality in Boer × Carpatină crossbreds (Vicovan et al., 2010). More recently, studies at R.D.I.S.G.B. Palas Constanta on F1 (50% Boer × 50% Carpatină) and R1 (75% Boer × 25% Carpatină) populations confirm significant increases in body weight and average daily gain, and improved efficiency of nutrient use relative to Carpatina breed [4].

Overall, the data support continuing research to establish an autochthonous, meat-specialised goat type adapted to Romania's pedoclimatic conditions—an orientation already outlined in the experimental programmes at R.D.I.S.G.B. Palas Constanta.

MATERIAL AND METHOD

The research was conducted by organizing two groups of male kids from the current year, as follows:

- Batch 1 : 20 kids from the R1 population (75% Boer × 25% Carpathian/Carpatina),
- Batch 2 : 20 kids of the Carpathian (Carpatina) breed.

Within these groups, measurements and weighings were carried out to calculate average daily gain during the fattening period (ADG), the specific consumption of feed and nutrients (per kg live-weight gain), as well as the data obtained from control slaughters.

Feeds offered were weighed daily, and feed refusals (orts) were collected every 3 – 4 days. The fattening period was conducted from 110 – 115 days of age of the kids over a 72-day fattening period, using a compound feed mixture with the following nutritive value: N.U = 0.79; DCP = 129.7 g. Upon completion of fattening period, control slaughter was performed on 4 kids per genotype. Prior to slaughter, the kids were fasted for 24 hours, after which dressing percentage and carcass quality indices were determined, following a 24-hour chilling period at +2 to +4 °C.

The carcass yield was calculated according to the following formula:

$$\text{Yield} = \frac{\text{Cooled carcass weight (kg)}}{\text{Live weight (kg/head)}}\ x\ 100$$

[9, 10]

Each carcass was split longitudinally along the midline into two equal sides. The right half of each carcass was then fully dissected, separating muscle from bone and partitioning subcutaneous (cover) and intermuscular fat. The thigh (round) was cross sectioned at mid-femur, perpendicular to the femur's long axis, and the contours of both the thigh cross-section and the femoral section were traced. The half-carcass was also cut between the 12 and 13 vertebrae (perpendicular to the vertebral axis), and the outline of the m. Longissimus dorsi was traced onto tracing paper. Carcasses and all dissected components (muscle, bone, fat) were weighed on an electronic scale accurate to ±5 g.

The thigh muscularity index was calculated using Purchas formula [11]:

$$T.M.I. = \frac{\sqrt{G/F}}{\text{LF}}$$ where:

G - the weight of the muscles (in grams) grouped around the femur (m. quadriceps femoris, m. sartorius, m. semitendinosus and m. biceps femoris).

F – femur weight (in grams)

LF – femur length (in centimeters)

All data were processed and interpreted statistically using Fisher test [12].

RESULTS & DISCUSSIONS

At the start of fattening, the body weights of the two groups were similar (17.60–18.70 kg), with non-significant differences between genotypes ($p > 0.05$) (Table 1). By the end of the 72-day period, mean body weight ranged between 27.25 and 31.50 kg; R1 kids achieved a final body weight higher by 15.60% than Carpatina ($p < 0.05$). Total live-weight gain over the period was 9.67–12.80 kg, being 32.37% higher in R1 ($p < 0.01$). Average daily gain (ADG) ranged from 134.31 g in Carpatina to 177.78 g in R1, a +32.36% advantage for R1 ($p < 0.01$). Feed and nutrient intake data are presented in Table 2. Daily energy (N.U) and digestible crude protein (DCP) per head ranged between 0.85–0.93 N.U and 140–152 g DCP, respectively, being higher in the R1 group by 9.41% (N.U) and 8.57% (DCP). Energy consumption per kg gain was 5.23–6.33 N.U, lower in R1 by 17.38% compared with Carpatina breed. To achieve 1 kg live-weight gain, R1 consumed 12.0% fewer N.U than Carpatina breed. Specific protein consumption per kg gain ranged from 855 to 1042 g, higher in Carpatina breed by 21.87%.

At the end of the fattening period, four kids from each group with body weight close to group average were selected for quantitative and qualitative carcass evaluation. average slaughter weight was 28.40 kg in Carpatina kids and 32.25 kg in R1 kids (Table 3). R1 crossbreds achieved the highest carcass yield (47.63%) compared to 42.96% in Carpatina breed, a +4.67 percentage points advantage ($p < 0.05$).

The weight share of commercial regions obtained from carcass cutting for the two genotypes is presented in Table 4. Across the two genotypes studied, the three carcass cuts (gigot, shoulder, and carcass remainder) accounted for 30.15–32.42% for the gigot, 21.42–22.48% for the shoulder, and 45.10–48.43% for the remainder of the carcass. Compared with the Carpatina breed, values in the R1 crossbreds were +2.27 percentage points for the hind leg ($p < 0.05$), +1.06 percentage points for the shoulder ($p > 0.05$, not significant), and −3.33 percentage points for the carcass remainder ($p < 0.05$).

The tissue composition of the carcasses obtained from the control slaughters showed that the best carcasses were observed in the R1 crossbred kids compared with the Carpatina breed (Table 5). By analyzing carcass tissue composition, the date shows that R1 Boer × Carpatina crossbreds had 77.90% meat (muscle + fat) and 22.10% bone per carcass, compared with Carpatina kids, whose carcasses contained 76.11% meat and 23.89% bone. The differences between the crossbred groups R1 and the Carpatina group in meat and bone content were statistically significant ($p < 0.05$).

The thigh cross-sectional area within the two genotypes studied is presented in table 6. The R1 Boer x Carpatina hybrids had the highest value of thigh cross-sectional area, which was 110.07 cm^2, being 26.82% higher compared to the Carpatina breed kids whose thigh cross-sectional area was 86.79 cm^2, the differences being distinctly significant ($p < 0.01$).

Table 7 presents the cross-sectional area of the *Longissimus Dorsi* muscle in the R1 goat group compared to the Carpatina group.

From the data presented in the table the group of R1 Boer x Carpatina, the Longissimus Dorsi muscle had an area of 14.05 cm^2, which was 60.57% larger compared to the group of kids from the

Carpatina breed, in which the section area was 8.75 cm2, the differences being very significant ($p < 0.001$). By calculating the thigh muscularity index, the values are presented in table 9.

Table 1. Growth performance of male kids by genotype

Genotype	Body weight at start (kg)	Body weight at end (kg)	Total gain (kg)	Average daily gain (g)
R1 Boer × Carpatina	18.70 ± 0.99	31.50 ± 1.05	12.80 ± 0.98	177.78 ± 10.32
Carpatina breed	17.60 ± 0.77	27.25 ± 1.03	9.67 ± 0.69	134.31 ± 8.29

Table 2. Feed intake of male kids by genotype

Genotype	Fattening period (days)	Feed mixture Total (kg/head)	Feed mixture per day (kg/head)	N.U Total (kg/head)	N.U per day (kg/head)	N.U per kg gain	DCP per day (g)	DCP per kg gain (g)
R1 Boer × Carpatină	72	85.68	1.19	66.96	0.93	5.23	152	855
Carpatina breed	72	78.48	1.09	61.20	0.85	6.33	140	1042

Table 3. Live weight and carcass yield in intensively fattened kids by genotype

Genotype	Slaughter live weight (kg)	Carcass weight (kg)	Carcass yield (%)
R1 Boer × Carpatină	32.25 ± 1.45	15.36 ± 0.69	47.63 ± 1.62
Carpatină breed	28.40 ± 1.23	12.20 ± 0.53	42.96 ± 1.34

Table 4. Proportion of commercial cuts from the carcass by genotype

Genotype	Half carcass weight (kg)	Weight share of commercial cuts					
		hind leg (gigot) weight (kg)		Shoulder weight (kg)		Remainder of carcass weight (kg)	
	$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$	%	$\bar{X} \pm S\bar{x}$	%	$\bar{X} \pm S\bar{x}$	%
R1 Boer x Carpatina	7.68 ± 0.34	2.49 ± 0.28	32.42	1.73 ± 0.21	22.48	3.46 ± 0.34	45.10
Carpatina breed	6.10 ± 0.27	1.84 ± 0.21	30.15	1.31 ± 0.04	21.42	2.95 ± 0.15	48.43

Tabel 5. Tissue composition (%) of carcasses by genotype under intensive fattening

Genotype	Tissue composition (%)				
	Muscle	Bones	Fat	*Meat	Total
	$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$	$\bar{X} \pm S\bar{x}$	
R1 Boer x Carpatina	63.98 ± 3.36	22.10 ± 1.16	13.92 ± 0.73	77.90 ± 4.09	100
Carpatina breed	61.02 ± 3.20	23.89 ± 1.25	15.09 ± 0.79	76.11 ± 4.00	100

**Meat represents muscular tissue together with subcutaneous and intramuscular fat*

Table 6. Thigh cross-sectional area by genotype

Genotype	Cross-sectional area (cm^2)	Differences between genotypes (±, %) & significance by Fisher's test
	$\bar{X} \pm S\bar{x}$	R1 vs Carpatina breed
R1 Boer x Carpatina	110.07 ± 4.33	+23.28 cm^2 +26.82% p < 0.01 Distinctly significant differences
Carpatina breed	86.79 ± 3.21	

Table 7. Longissimus Dorsi muscle surface area according to genotype

Genotype	Section area (cm^2)	Differences between genotypes (±, %) & significance by Fisher's test
	$\bar{X} \pm S\bar{x}$	R1 vs Carpatina breed
R1 Boer x Carpatina	14.05 ± 0.27	+5.3 cm^2 + 60.57% p < 0.001 Very significant differences
Carpatina breed	8.75 ± 0.42	

Table 8 shows the cross-sectional area of the femur in the two groups studied.

Table 8. Femur cross-sectional area by genotype

Genotype	Section area (cm^2)	Differences between genotypes (±, %) & significance by Fisher's test
	$\bar{X} \pm S\bar{x}$	R1 vs Carpatina breed
R1 Boer x Carpatina	2.94 ± 0.29	+0.05 cm^2 + 1.73% p > 0.05 Insignificant differences
Carpatina breed	2.89 ± 0.27	

Table 9. Thigh muscularity index (TMI) values according to genotype

Genotipul	T.M.I.	Differences between genotypes (±, %) & significance by Fisher's test
	$\bar{X} \pm S\bar{x}$	R1 vs Carpatina breed
R1 Boer x Carpatina	0.52 ± 0.15	+ 20.93% p < 0.01 Distinctly significant differences
Carpatina breed	0.43 ± 0.17	

The femur cross-sectional area presented similar values in the two groups, with values ranging between 2.89 cm^2 in the Carpatina group and 2.94 cm^2 in the R1 group, the differences being insignificant ($p>0.05$).

The thigh muscularity index had values ranging between 0.43 in Carpatina breed kids and 0.52 in R1 hybrids, the highest value being found in R1 hybrids with 20.93%, the differences being distinctly significant ($p < 0.01$).

CONCLUSIONS

1. The R1 genotype exhibited superior growth performance, recording at the end of the fattening period a higher body weight (+15.6%), a greater total gain (+32.37%), and a significantly higher average daily gain (+32.36%) compared to the Carpatina breed.
2. Feed efficiency was clearly superior in the R1 genotype: feed conversion per kg gain was 17.4% lower for energy nutrients, and DCP (digestible crude protein) consumption per kg gain was

21.9% lower compared to the Carpatina breed, indicating better energy and protein conversion.

3. At slaughter, the R1 genotype had a heavier carcass (15.36 vs. 12.20 kg) and a higher dressing percentage compared to the Carpatina breed by +4.67 percentage points, with differences being significant ($p<0.05$).

4. Commercial carcass cutting showed that the R1 genotype had a relatively higher contribution of the gigot (leg) by 2.27 percentage points (significant differences, $p < 0.05$) and of the shoulder by +1.06 percentage points (non-significant differences, $p > 0.05$), along with a reduction in the remainder of the carcass by 3.33 percentage points (significant differences, $p < 0.05$).

5. Carcass tissue composition was characterized by a higher proportion of muscle and a lower proportion of bone in the R1 genotype compared to the lot of Carpatina kids.

6. The thigh cross-sectional area and the Longissimus dorsi muscle area showed significant increases in the R1 genotype compared to the Carpatina breed, while no significant differences were recorded for the femur area between the two genotypes.

7. The thigh muscularity index was higher in R1 compared to the lot of Carpatina kids, with the data confirming a conformation more favorable for meat production.

8. From an applied perspective, crossing Carpatina does with Boer bucks to obtain the R1 genotype simultaneously improves growth performance, feed efficiency, dressing percentage, and carcass conformation, recommending this genotype for meat-oriented systems under local conditions.

The results highlight that directing genetic improvement toward a meat-specialized type (e.g., R1 Boer × Carpatina) yields concurrent gains in growth, feed efficiency, dressing percentage, and carcass conformation, which strategically justifies the creation of a Romanian meat goat breed. Moreover, leveraging the native genetic pool (the Carpatina breed) in the formation scheme ensures adaptability to local pedoclimatic conditions and efficient use of natural pastures, reducing dependence on imported biological material and contributing to farm economic efficiency. Overall, establishing and recognizing a specialized meat breed represents a necessary step toward the professionalization of meat goat production in Romania and toward increasing added value throughout the agri-food chain.

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