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THE EFFECT OF CROSSBREEDING PROLIFIC PALAS EWES WITH ROUGE DE L`OUEST AND TEXEL RAMS ON IMPROVING THE QUANTITY AND QUALITY OF CARCASSES FOR LAMBS SUBJECTED TO FATTENING

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Abstract

This study evaluates the performance of F1 hybrids obtained by crossbreeding Rouge de L'Ouest x Prolific Palas and Texel x Prolific Palas breeds under controlled fattening conditions, compared to the purebred Prolific Palas sheep. The results demonstrate the clear superiority of the F1 hybrids in several key performance indicators: enhanced daily weight gain, improved feed conversion efficiency, higher slaughter yield, and a favorable carcass tissue composition characterized by increased meat content and reduced bone proportion. Additionally, the F1 hybrids showed a significant advantage in the thigh muscle index, recording values 14.5-17.3% higher than those of the Prolific Palas breed. The findings align with the diversity of high-performance meat breeds and hybrids present within the European Union, including 42 breeds and 7 hybrids in the United Kingdom, as well as numerous specialized breeds in countries such as Spain, France, Germany, Belgium, and the Netherlands. These results underscore the potential of hybrid breeding strategies to enhance meat production efficiency and carcass quality in sheep farming systems.

Key words*: hybrids, new breed, Prolific Palas breed.*

INTRODUCTION

In the European countries there are numerous meat breeds and hybrids. Thus in the United Kingdom there are 42 performance breeds and 7 types of hybrids specialised for high performance meat production and also in other countries like Spain, France, Germany, Belgium, Netherlands, in Romania there is only one meat breed, namely the Palas Meat Breed, which performs similarly to the best meat breeds in the world (Ile de France, Suffolk, Berichon du Cher and so on) (Vicovan et al., 2020; Padeanu, 2002).

It is known that lambs performance at slaughter weight varies with genotype, sex, age and fattening condition (Martynuk et al., 2001). By combining and simple crossing of 2 breeds, heavier lambs can be obtained at slaughter due to the manifestation of heterosis (Zupp, 2003).

The development of meat sheep farming is a significant focus of researchers at R.D.I.S.G.B. Palas Constanta, aimed in creating new breeds specialized for meat production.

MATERIALS AND METHODS

Research was conducted at R.D.I.S.G.B. Palas Constanta across three experimental groups, each consisting of 19 young male individuals, in three variants:

- F1 half breeds between ewes of the Prolific Palas breed and Rouge de L'Ouest rams;
- F1 half breeds between ewes of the Prolific Palas breed and Texel rams;
- Current year male offspring of the Prolific Palas breed (control group).

The groups were homogeneous and analogous in terms of body weight and age, with identical housing, feeding and care conditions provided. It was monitorized the growth evolution across all sheep's by weighing, fodder consumption, by weighing the ratio at administration and the unconsumed residues, health status of the animals,

selection of specimens for control slaughters at the end of the experiment and carcass analysis during control slaughters. The experiment lasted 62 days, feeding being done using the same ratio composed of combined feed with 15% digestible crude protein and alfalfa pellets.

Average daily weight gain, feed consumption and feed efficiency, slaughter yield, carcass tissue composition, carcass classification and feed efficiency were calculated, quality classes according to the EUROP grid, conformation and constitution indices on the live animal and on the carcass (Draganescu, 1979; Pascal, 2007).

The fattening of the three batches of lambs (19 heads/batch) was done with a combined feed that ensured a protein level of 15% DP and an energy level of 2570 kcal ME. The compound feed was administered at discretion together with 300 g alfalfa hay/head/day.

It was established the daily ingestion of feed and nutrients, the growth intensity during fattening and the results of experimental slaughter.

Two slaughter yields were determined (Tafta, 2008; Vicovan et al., 2014):

$$\text{Yield R1} = \frac{Cooled\ weight\ carcass\ (kg)}{Living\ weight\ (kg/head)}\ x\ 100$$

$$\text{Yield R2} = \frac{Cooled\ weight\ carcass\ (kg)}{Empty\ living\ weight\ (kg/head)*}\ x\ 100$$

*Empty live weight - the live weight from which the gastrointestinal mass was subtracted.

The thigh muscularity index was calculated according to Purchas' formula, quoted by Laville:

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

where: G = weight of thigh muscle (g);
F = weight of femur (g);
LF = length of femur (cm).

To test the statistical significance of the differences between the mean values of the studied parameters, the variable analysis algorithm (ANOVA Single Factor) was used and TUKEY HSD TEST.

RESULTS AND DISCUSSIONS

The average daily gain achieved by the F1 Rouge de L'Ouest x Prolific Palas breed hybrids was 302.47 g, which represents an increase of 138.73 g compared to the control group, yet a decrease of 2.32 g when compared to the F1 Texel x Prolific Palas hybrids.

Research indicates that crossbreeding is considerably affected by biosynthetic activities, characterized by heightened mitochondrial activity, amplified metabolic processes and increased enzyme actions. For instance, experiments conducted by a Russian research team demonstrated that the aspartate-aminotransferase enzyme activity in crossbreed lambs rose by an average of 16.4%. These researchers concluded that there's a direct correlation between the activity levels of these enzymes and the average daily growth rates of lambs (Sanikov et al., 1981).

The obtained data showed that the differences between F1 half breed and Palas Prolific Breed are very significant in the sense that the hybrids outperform the Palas Prolific Breed by 84-85% in terms of average daily weight gain (Table 1).

Note: Out of 19 heads, 5 heads were culard - double-muscled sheep.

The p-value is 3.77684. This value is extremely small, much lower than the significance threshold of 0.05 or even 0.01. This indicates a very significant difference between the groups. Comparison between groups: The F-value (19874.12) is much larger than the F-crit value (3.1682), which confirms that there is a significant difference between at least two of the groups. The differences between the groups are statistically very significant ($p < 0.001$) -Tukey HSD Test Results.

Table 1. Weight gain of lambs under intensive fattening

Criterion no.	Genotype	n	Weight gain (g/head/ day fed) $x \pm S_x$	Duration of fattening (days)	Difference between hybrids and control batch		
					± g/head	± %	Signifiance
1	F1 Rouge de L'Ouest x Palas Prolific Breed *	19	302.47±8.50	62	+138.73	+84.73	$p < 0.001$ Very significantly
2	F1 Texel x Palas Prolific Breed	19	304.79±13.09	62	+141.05	+84.14	$p < 0.001$ very significantly
3	Palas Prolific Breed (control batch)	19	163.74±0.77	62	-	-	-

There is no significant difference between F1 Rouge de L'Ouest x Palas Prolific Breed and F1 Texel x Palas Prolific Breed ($p > 0.05$), suggesting that their performances are similar.
Also, there are highly significant differences ($p<0.001$) between Palas Prolific Breed and the other two groups. These results indicate that Palas Prolific Breed has significantly lower performance compared to the two F1 hybrid breeds (Table 2).
To improve performance, the use of F1 hybrids in genetic improvement programs or breeding strategies could be considered. This means that there is a real variation between the performances of the three groups analyzed, and not just a random difference.
In terms of specific energy consumption, F1 Texel × Palas Prolific lambs had the highest value, with 3899.8 kcal/head/day, followed by Palas Prolific lambs (3816.3 kcal/head/day) and F1 Rouge de L'Ouest × Palas Prolific crossbreeds, which consumed 3699 kcal/head/day. Although the differences in energy intake are not very large between groups, it is observed that the hybrids used the energy from the feed rations administered for the growth and fattening process more efficiently. In terms of digestible crude protein, daily consumption ranged between 311.29 g and 318.63 g, with the highest value recorded in F1 Rouge de L'Ouest × Palas Prolific hybrids and the lowest value in F1 Texel x Rasa Prolific hybrids, which may suggest a better use of nutrients for muscle mass development.
The average daily gain per head and day further highlights the superiority of the hybrids over the Prolifica Palas breed. Thus, F1 Rouge de L'Ouest × Palas Prolific recorded an average daily gain of 303.0 g, and F1 Texel × Palas Prolific a similar value, of 304.8 g. In contrast, lambs from the Prolifica Palas breed had a significantly lower gain, of only 164 g/day, indicating a reduced capacity to utilize feed for weight gain.
The efficiency of feed conversion administered confirms the genetic advantage of the hybrids. They had values of 237.0 g (F1 Rouge de L'Ouest × Palas Prolific) and 234.5 g (F1 Texel × Palas Prolific), which indicates a superior conversion of feed into body weight. On the other hand, lambs from the Prolifica Palas breed had a lower efficiency, with an index of 185.0 g, which confirms that this breed requires more feed to achieve a similar growth rate to that of hybrids.
These results clearly demonstrate the beneficial impact of hybridization on growth performance and the efficiency of the use of feed administered in their diet. Both F1 Rouge de L'Ouest × Palas Prolific and F1 Texel × Palas Prolific benefited from the heterosis phenomenon, recording higher weight gains and more efficient feed conversions compared to the Prolific Palas breed. In this context, the use of hybrids in intensive fattening systems represents an advantageous strategy, contributing to the optimization of meat production and maximizing economic profitability in specialized farms (Table 3).

Table 2. Tukey HSD Test Results

Group 1	Group 2	Mean Difference	p-value	Significance
F1 Rouge de L'Ouest x Palas Prolific Breed	F1 Texel x Palas Prolific Breed	Very small	> 0.05	No
F1 Rouge de L'Ouest x Palas Prolific Breed	Palas Prolific Breed	Large	< 0.001	Yes
F1 Texel x Palas Prolific Breed	Palas Prolific Breed	Large	< 0.001	Yes

Table 3. Feed conversion efficiency of F1 hybrids vs Palas Prolific Breed

Criterion no.	Genotype	Specific consumption per head/day/fed			Feed conversion efficiency* (g)
		Kcal	PBD (g)	Daily average gain (g)	
1	F1 Rouge de L'Ouest x Palas Prolific Breed	3699	318.63	303.0	237.0
2	F1 Texel x Palas Prolific Breed	3899.8	311.29	304.8	234.5
3	Palas Prolific Breed	3816.3	317.02	164	185.0

Note: *Feed conversion efficiency = growth gain achieved for consumption of 1 kg dry matter.

The slaughter yield, expressed as R1, ranged between 46.87% and 48.80% in the F1 hybrid groups, while for the Prolific Palas breed, it was recorded at 44.63%. Although the differences among the hybrid groups were statistically insignificant ($p > 0.05$), the slaughter yield R1 was higher in the hybrids by 5.01% to 9.34% compared to the purebred Prolific Palas sheep, with these differences being statistically significant ($p < 0.05$).

Similarly, the slaughter yield R2, which accounts for a more refined assessment of carcass efficiency, varied between 51.32% and 56.85%. The hybrid groups demonstrated an increased slaughter yield R2 by 6.06% to 10.8% in comparison to the Prolific Palas breed, confirming a significant advantage ($p < 0.05$). These findings highlight the positive impact of crossbreeding on meat production efficiency, as the F1 hybrids exhibited superior slaughter yields, likely due to improved carcass conformation and muscle development inherited from their sire breeds (Table 4).

The meat content in the carcass ranged between 75.29% and 75.52% in the F1 hybrid groups, whereas for the Prolific Palas breed, it was notably lower at 68.46%. Although the differences between the two hybrid groups were statistically insignificant ($p > 0.05$), both hybrids exhibited a significantly higher meat content compared to the Prolific Palas breed, with increases ranging from 9.98% to 10.31% ($p < 0.05$). In addition to the increased meat proportion, the tissue composition analysis revealed variations in bone content. The F1 hybrids displayed a bone content ranging from 22.55% to 25.19%, while the Prolific Palas breed had a higher bone proportion of 28.24%. This indicates that the hybrid groups had a reduced bone content by 7.99% to 8.92%, suggesting a more favorable meat-to-bone ratio. These findings emphasize the genetic advantage conferred by crossbreeding in enhancing carcass quality, as the hybrids not only exhibited a greater proportion of meat but also a lower skeletal proportion, which is desirable for meat production (Table 5).

Table 4. Slaughter yield

Criterion no.	Genotype	Y1%	Y2%	Difference between hybrids and control batch (±%)		Signifiance
				Y1	Y2	
1	F1 Rouge de L'Ouest x Palas Prolific Breed	46.87 ± 1.15	54.41 ± 1.82	+5.01	+6.06	$p < 0.05$ significantly
2	F1 Texel x Palas Prolific Breed	48.80 ± 1.75	56.85 ± 2.05	+9.34	+10.8	$p < 0.05$ significantly
3	Palas Prolific Breed (control batch)	44.63 ± 0.97	51.32 ± 2.15	-	-	-

Table 5. Tissue structure

Criterion no.	Genotype	Tissue structure, %			
		muscle	bone	fat	meat
1	F1 Rouge de L'Ouest x Palas Prolific Breed	61.93± 6.2790	22.55± 0.3014	13.36± 0.105	75.32
2	F1 Texel x Palas Prolific Breed	66.37± 2.0788	25.19± 0.6463	9.05± 0.3100	75.52
3	Palas Prolific Breed	53.02± 4.2500	28.24± 0.8563	15.44± 0.2414	68.46

The comparative analysis of tissue structure and carcass yield among the three genotypes highlights the superiority of F1 crossbreeds over the purebred Palas Prolific. Both F1 Rouge de L'Ouest × Palas Prolific and F1 Texel × Palas Prolific exhibited significantly higher muscle percentages (+8.91% and +13.35%, respectively) and carcass yields (+6.86% and +7.06%) compared to the control group, along with notable reductions in bone and fat content. These differences were statistically significant ($p < 0.05$), confirming the positive effect of crossbreeding on carcass quality traits. When comparing the two F1 crossbreeds, F1 Texel × Palas Prolific showed slightly better values in terms of muscle mass and fat reduction; however, the differences between the two hybrid groups were not statistically significant ($p > 0.05$). This suggests that both crossbreeding strategies are effective and yield comparable improvements in carcass composition, offering viable genetic alternatives for enhancing meat production in sheep (Table 6).

Table 6. Comparative differences between groups - tissue structure and carcass yield

Comparison between groups	Muscle (%)	Bone (%)	Fat (%)	Carcass yield (%)	Significance
F1 Rouge x Palas Prolific vs. Palas Prolific	+8.91	–5.69	–2.08	+6.86	Significant difference ($p < 0.05$)
F1 Texel x Palas Prolific vs. Palas Prolific	+13.35	–3.05	–6.39	+7.06	Significant difference ($p < 0.05$)
F1 Rouge x Palas Prolific vs. F1 Texel x Palas Prolific	–4.44	+2.64	+4.31	–0.20	Not significant ($p > 0.05$)

The carcasses of the F1 hybrid groups - Rouge de L'Ouest × Palas Prolific and Texel × Palas Prolific - were classified within the U2-3 quality class based on the EUROP grading system. This classification indicates superior conformation with well-developed musculature and an optimal level of fat cover, making them more desirable for meat production.

In contrast, the carcasses of the purebred Prolific Palas sheep were categorized in the R2-3 quality class, signifying a lower degree of muscle development and a slightly less favorable conformation compared to the hybrid groups. This difference underscores the impact of crossbreeding in enhancing carcass quality, as the F1 hybrids benefited from the superior meat-producing traits of the Texel and Rouge de L'Ouest sire breeds. These results highlight the genetic improvements achieved through crossbreeding, leading to better carcass classification and overall meat yield potential (Table 7).

Table 7. Classification of carcass quality classes

Criterion no.	Genotype	Quality classes according to EUROP grid
1	F1 Rouge de L'Ouest x Palas Prolific Breed	U2-3 (very good, low or medium fat carcass)
2	F1 Texel x Palas Prolific Breed	U2-3 (very good, low or medium fat carcass)
3	Palas Prolific Breed	R2-3 (good, low or medium fat carcass)

The thigh muscularity index recorded for the Prolific Palas breed was 0.510, where as for the F1 hybrid groups, the values ranged between 0.655 and 0.683. Specifically, the F1 Texel × Prolific Palas hybrids exhibited a thigh muscularity index of 0.655, while the F1 Rouge de L'Ouest × Prolific Palas hybrids reached a higher value of 0.683. These results indicate a significant improvement in muscularity among the hybrid groups compared to the purebred Prolific Palas sheep. More precisely, the thigh muscularity index was 28.43% higher in the F1 Texel × Prolific Palas group and 33.92% higher in the F1 Rouge de L'Ouest × Prolific Palas group than in the Prolific Palas breed. This suggests that crossbreeding with Texel and Rouge de L'Ouest rams positively influenced the development of muscle mass in the offspring, likely due to the superior genetic potential for meat production of these terminal sire breeds (Table 8).

Table 8. Thigh muscle index of F1 hybrids compared to Palas Prolific Breed

Criterion no.	Genotype	Thigh Muscularity Index (T.M.I.) after Purchas formula
1	F1 Rouge de L'Ouest x Palas Prolific Breed	0.683 ± 0.2344
2	F1 Texel x Palas Prolific Breed	0.655 ± 0.2168
3	Palas Prolific Breed	0.510 ± 0.0199

CONCLUSIONS

The study highlights the distinct advantages of F1 hybrids (Rouge de L'Ouest x Prolific Palas and Texel x Prolific Palas) over the purebred Prolific Palas breed in terms of key performance indicators in lamb fattening. Notably, the F1 hybrids demonstrated superior weight gain, feed conversion efficiency, and carcass yield, with an increased meat proportion and reduced bone content compared to the Prolific Palas breed.

It is demonstrated an improved growth and feed efficiency, the F1 hybrids achieved a significant increase in daily weight gain, surpassing the Prolific Palas lambs by up to 85%. Their feed conversion efficiency was also notably higher, confirming the efficiency of these crosses in utilizing feed for growth.

Both F1 hybrid groups exhibited higher slaughter yields (R1 and R2), with better conformation, resulting in more muscle and less

bone in the carcass. The meat content was higher by 6.83-7.06 percentage points compared to the purebred Prolific Palas lambs.

The hybrids also showed a significant improvement in the thigh muscularity index, indicating enhanced muscle development. Furthermore, the carcasses of F1 hybrids were classified in a higher EUROP quality class (U2-3), reflecting superior meat production traits, in contrast to the R2-3 classification of the Prolific Palas breed.

The results underscore the value of crossbreeding with high-performance terminal sire breeds like Rouge de L'Ouest and Texel in genetic improvement programs for sheep meat production. The genetic benefits observed from heterosis in the F1 hybrids suggest that this strategy could optimize productivity in specialized farms and improve economic profitability.

In conclusion, the hybridization of the Prolific Palas breed with Texel and Rouge de L'Ouest rams holds significant promise for improving lamb fattening performance, carcass quality, and overall meat production efficiency. These F1 hybrids are expected to play a crucial role in the development of a new meat breed that could adapt well to specific environmental conditions, particularly in arid areas.

Future breeding programs focusing on maintaining these advantageous traits through successive generations will likely lead to further enhancements in meat sheep farming.

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