

HISTORY GENETIC ANALYSIS OF POLWARTH SHEEP BREED

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Abstract

The research was carried out on a population of Polwarth sheep, intensely inbred belonging to the Research and Development Institute for Sheep and Goats Breeding, Palas - Constanta. Morpho-productive indices, reproduction indices, current number compared to the one acquired in 1995, inbreeding depression, intergenerational depression, inbreeding population, body weight differentiation and quantity of wool in the year of acquisition compared to 2020 were determined. From the presented data it results that the reproduction of the sheep was not affected instead in rams the body weight and the amount of wool decreased. Surprisingly, instead of shrinking and disappearing over time, the herd has increased and continues to grow, contrary to what is known to date from the effect of intense inbreeding on a breed of sheep.

Key words: effective size, inbreeding, inbreeding depression, relationship in itself.

INTRODUCTION

The Polwarth sheep breed is originated from Australia, around 1800 when the Lincoln breed crossed with the Merino breed. This combination was made in order to increase the weight of the Merino breed so that they could be raised more in grazing conditions.

The creation of the Polwarth breed was a success, the breed being able to live in regions with a more humid climate that favoured and maintained a vegetation on pastures for a longer time, being also imported to other parts of the world. It was imported into New Zealand in 1932 and has adapted very well to higher and colder temperature conditions in areas of hills and plains, making it an ideal choice for sheep farmers in this country.

The Polwarth sheep breed was imported from Australia and brought to Romania in November 1976. A number of 5125 heads were brought and distributed to 4 state agricultural enterprises (Oradea, Borcea, Liebling and Vetrișoiaia).

In 1995, the Palas Institute purchased 50 female sheep and 10 male sheep from the

Baitalu farm belonging to the Borcea I.A.S., Călărași County.

This population was reproductively isolated for a period of 25 years, during which time it has been monitored in terms of productive and reproductive performance.

The present study aimed to estimate the level of inbreeding of the breed and its effect on the morpho-productive parameters achieved.

The study looked at the evolution of the body weight of sheep and rams and young male and female sheep, wool production and reproductive rates.

Determining the level of inbreeding in any closed population is inevitable in determining its future growth. Inbreeding depression, expressed as a change in performance per inbreeding unit, is associated with decreased performance and depends on the rate of inbreeding. The process of inbreeding increases homozygosity for all present generations, leading to a decrease in their value for certain characters.

Research on the effect of inbreeding on productive and reproductive parameters in sheep has been done by Lax and Brown (1967),

Galal et al. (1981), Lamberson et al. (1982), Lamberson & Thomas (1984), Wiener et al. (1992), Ercanbrach & Knight (1991) and Van Wyk et al. (1993).

MATERIALS AND METHODS

The research was conducted on the current number of sheep (91 heads) consisting of 61 females and 30 males, reproductive isolate since 1995.

For this study, 4 random line pedigrees from 6 generations of sheep and rams (80 pedigrees) were used, according to the method presented by Draganescu & Sandu (1986).

Sheep and wool coats were weighed individually, establishing morpho-productive and reproductive indices compared to those in Australia.

Inbreeding depression, kinship, total inbreeding, inbreeding per generation, actual size (N_e), and other parameters were calculated. The generation interval was calculated in years, taking into account the date of birth of the ram, male offspring and female offspring and the date of birth of the ewe and male and female offspring's (Drăgănescu et al., 1986).

For the calculation of the effective size of the population (N_e) the formula mentioned by Draganescu (1986) was used.

$$N_e = \frac{4Nm \times Nf}{Nm + Nf}$$

where: Nm - the number of rams active in reproduction.

Nf - the number of ewes.

All data on morpho-productive indices were processed and interpreted statistically. The Fisher test was used to analyze the significance of the differences. (Snedecor, 1965)

RESULTS AND DISCUSSIONS

Table 1 shows the current Polwarth sheep herd. It is observed that out of a total of 91 heads, 30 heads are rams and young males and 61 heads are sheep and young female.

Table 1. Current herd of Polwarth sheep (2020)

No. crt.	Category	Number of heads	Observations
1.	Rams	13	-
2.	Young Males	17	Young reproductive males and youth from this year
3.	Sheep	34	-
4.	Young Females	18	Youth from this year
		9	Young reproductive sheep
5.	Total effective	91	

Table 2. Polwarth sheep dynamics (adults + youth) from 1995 to 2020

No. crt.	Specification	Herd (heads)		Dynamics of the herd	
		Total in 1995	Total in 2020	± heads in 2020	± % in 2020
1.	Polwarth breed	60	91	+ 31	+ 52,0

Table 2 shows the dynamics of the workforce in the period 1995-2020.

It turns out that the total number of heads increased by 52% compared to 1995 (the year of acquisition).

Table 3. Polwarth body weight and wool quantity in 1995

No. crt.	Category	Body weight (kg/head)	Quantity of wool (kg/head)
		$\bar{x} \pm s_x$	$\bar{x} \pm s_x$
1.	Rams	73.43 ± 2.2023	7.37 ± 0.3153
2.	Sheep	42.14 ± 0.7723	4.52 ± 0.1223

Table 3 shows the body weight and the amount of physical wool in Polwarth sheep in the year of purchase.

It turns out that the rams had an average body weight -73.43 kg/head and the average amount of wool -7.37 kg/head and the sheep weighed 42.14 kg/head and 4.52 kg/head the average amount of physical wool.

Table 4. Body weight and quantity of wool in the current flock of sheep (Polwarth 2020)

No. crt.	Category	Body weight (kg/head)		Quantity of wool (kg/head)	
		$\bar{x} \pm s_x$		$\bar{x} \pm s_x$	
1.	Rams	61.36 ± 4.1429		5.70 ± 0.4493	
2.	Sheep	48.84 ± 1.0171		3.82 ± 0.1344	

Table 4 shows the body weight and the amount of wool in the current herd.

It is observed that the rams weighed 61.36 kg/head and 5.70 kg wool and the sheep 48.84 kg/head and 3.82 kg/head physical wool.

Table 5. Body weight and amount of wool in Polwarth sheep in Australia

No. crt.	Category	Body weight (kg / head)	Quantity of wool (kg / head)
1.	Rams	80 - 90	8-12
2.	Sheep	50	4-6

Table 5 shows that in Australia Polwarth rams have a body weight in the range of 80-90 kg/head and have a quantity of wool in the range of 8-12 kg/head.

Sheep have an average body weight of 50 kg/head and 4-6 kg / head of physical wool.

Table 6. Body weight differentiation in Polwarth sheep, 1996 compared to 2020

No. crt.	Category	Body weight (kg / head)		± The difference between 2020 and 1996	
		1996	2020	kg	%
		1.	Rams	73.43	61.86
2.	Sheep	42.14	48.84	+ 6.7	+ 13.72

Table 6 shows that compared to 1996, in 2020 the rams were lighter by about 17% and the sheep were heavier by about 14%.

Table 7. Differentiation of the quantity of wool for Polwarth sheep, 1996 compared to 2020

No. crt.	Category	Quantity of wool (kg / head)		± The difference between 2020 and 1996	
		1996	2020	kg	%
		1.	Rams	7.37	5.70
2.	Sheep	4.52	3.82	- 0.70	- 18.32
3.	The significance of the differences				
4.	Rams	p < 0,001			
4.	Sheep	p < 0,001			

Table 7 shows that the amount of wool in rams decreased by about 29% and in sheep it decreased by about 18% in 2020 compared to 1996.

Table 8. Reproductive indices in Polwarth sheep

No. crt.	Category	Fecundity (%)**	Prolificacy (%)***	Weaned lambs (%)*
1.	Sheep	92.59	120.00	86.67
2.	Young reproductive sheep	88.89	112.50	88.89
3.	Total	91.67	118.20	87.18

*Average weaning age = 80 days; **Fertility in Australia is 93-95%; ***Sheep prolificacy in Australia = 110.0 - 120.0%

Table 9. Average weaning weight in Polwarth breed

No. crt.	Category	Average weaning weight (kg/head)		
		Males	Females	Total
1.	Sheep	22.16	21.64	21.90
2.	Young reproductive sheep	22.47	23.74	23.26
3.	Total	22.21	21.78	22.22

It is observed that the sheep had a fecundity of 91.67% and a prolificacy of 118.2%, values similar to those in Australia (Table 8).

At weaning at the age of 80 days, the male lambs had an average weight of 22.21 kg/head and the lambs weighed 21.78 kg/head, which indicates good growth increases (235-240 g/head and day) and a high milk production of sheep (Table 9).

Table 10. Inbreeding depression

No. crt.	Decreased performance by a 10% increase in Fx	Body weight (kg/head)		The quantity of wool (kg/head)	
		Rams	Sheep	Rams	Sheep
1.	+ 1.4	- 1.16	+ 0.67	- 0.167	- 0.070

From the Table 10 it results that for a 10% increase of Fx, in rams the body weight decreases by approx.1.16 kg/head, in sheep the body weight increased by 0.67 kg/head.

The amount of wool decreases in rams by 167 g/head and in sheep it decreases by 70 g/head.

Table 11. The evolution of the generation gap in the Polwarth breed

Specification	Father - son	Father - daughter	Mother - son	Mother - daughter	Total
Interval in years	3.30	5.12	3.12	4.58	4.85

Table 11 shows that the average interval was 4.85 years with variations between 3.30-5.12 years, the father-son interval, father-daughter and 3.12-5.58 years, mother-son interval, mother-daughter.

Table 12. Inbreeding of Polwarth breed

No. crt.	Specification	Medium values
1.	Relationship in itself R (%)	23.70
2.	Total inbreeding F (%)	67.50
3.	Non-current inbreeding (%)	64.40
4.	Current inbreeding (incest) (%)	3.13
5.	Average inbreeding per generation ΔF (%)	14.00
6.	Possible inbreeding (%)	13.44
7.	Inbreeding of strain (%)	50.96
8.	Medium number of generations	4.85
9.	Effective size of population (N_e)	3.59
10.	Effective number of males (N_m)	0.9
11.	Best number of males	12.0

Table 12 shows that the number of animals in 2020 had a total inbreeding of 67.50%, the increase in inbreeding per generation being 14%.

Incest (current inbreeding) reached 3.13%. The inbreeding by ΔF generations was 14%, and the line inbreeding was 50.96%.

CONCLUSIONS

From the presented data it results that the reproduction of the sheep was not affected instead in rams the body weight and the amount

of wool decreased by approx. 19% and 29.3% respectively and in sheep the body weight increased by approx. 14% and the amount of wool decreased by about 18%.

Surprisingly, instead of shrinking and disappearing over time, the herd has increased by 52% and continues to grow, contrary to what is known to date from the effect of intense inbreeding on a breed of sheep.

REFERENCES

- Dermengi., B., Râmneanțu, N., & Vintilă. I. (1981). *Raising and acclimatizing Polwarth sheep*. Bucharest, RO: Ceres Publishing House, 227 p.
- Drăgănescu, C., & Sandu, G. (1986). *Basic quantitative procedures in the improvement of domestic animals*. Bucharest, RO: Faculty of Animal Science, "N. Balcescu" Agronomic Institute.
- Ercanbrach, S., & Knight, A.D. (1991). Effects of inbreeding on reproduction and wool production of Rambouillet, Targhee and Columbia ewes. *J. Anim. Sci.*, 69, 4734-4744.
- Galal, E.S.E. et al. (1981). Lamb survival affected by inbreeding and cross-breeding. *J. Agr. Sci (Camb)*, 96 (1), 1-5.
- Lamberson, W.R., Thomas, D.L., & Rowe, K.E. (1982). The effect of inbreeding in a flock of Hampshire sheep. *J. Anim. Sci.*, 55(4), 780-786.
- Lamberson, W.R., Thomas, D.L., & Rowe, K.E. (1984). Effects of inbreeding in sheep: a review. *Anim. Breed. Abstr.*, 52, 287-297.
- Lax, J., & Brown; G.H. (1967). The effects of inbreeding material handicap and range in age on 10 fleece and body characteristics in Merino rams and ewes. *Austr. J. Agric. Research*, 18, 689-706.
- Snedecor, G.W. (1965). *Statistical Methods applied to Experiments in Agriculture and Biology*. Ames Iowa, U.S.A.: The Iowa state University Press.
- Van Wyk, J.B, Erasmus, G.J., & Konstantinov, K.V. (1993). Inbreeding in the Elsenburg Dormer Sheep stud. *Sud. Agric. Anim. Sci.*, 23 (3/4), 77-80.
- Wierner, G, Lee, G.J., & Woolliams, J.A. (1992). Effects of rapid inbreeding and of crossing inbred lines on the body weight growth of sheep. *Anim. Prod.*, 55, 89-99.