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Inheritance of white, black and brown coat colour in alpaca by segregation analysis

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Introduction

The world wool production is 2 million tonnes, about 10% of the natural textile fibre production.

The world production of alpaca fibre is around 5 thousand tonnes, with Peru as the largest producer (90%), followed by Bolivia and Chile and it can be considered part of a niche market in rapid expansion.

Alpaca fibre is appreciated by the textile industry for both the high quality and the wide range of natural colours and are used for quality fabrics made from naturally coloured fibres (not dyed).

Therefore, the genetic background of coat colours in Alpaca, as in other fibre producing animals, is of great interest.

Figure 1. White and coloured alpacas

Figure 2. Experimental station in Quinsachata, Inia ILLPA Centre.

Table 1: Experimental crossing plan

Cross	Rams ♂	Dams ♀
White x White	2 Suri	30 Huacaya
	2 Huacaya	30 Suri
White x Pigmented	2 Suri	30 Huacaya
	2 Huacaya	10 Suri
Pigmented x Pigmented		
Black x Black	2 Suri	30 Huacaya
	2 Huacaya	17 Suri
Black x Brown	1 Suri	15 Huacaya
	1 Huacaya	15 Suri
Brown x Brown	2 Suri	30 Huacaya
	1 Huacaya	15 Suri
Total	**17**	**230**

Table 2. White x White cross

Rams	Dams (n)	Observed Offspring		Expected [a] Offspring		G_{adj} [b]	P (0.05)
		W	P	P	W		
443303	8	5	3	5.42	2.58	0.093	0.761
058104	10	9	1	8.14	1.86	0.539	0.463
1199-M	9	6	3	6.34	2.66	0.058	0.810
Pooled	27	20	7	19.90	7.20	0.001	0.966

Table 3. White x Pigmented cross

Rams	Dams (n)	Observed Offspring		Expected [a] Offspring		G_{adj} [b]	P (0.05)
		W	P	W	P		
SO-502	9	2	7	4.491	4.509	2.768	0.096
EEI-025	15	5	10	7.5	7.5	1.644	0.2
322203	9	6	3	4.491	4.059	0.977	0.323
370397	6	4	2	2.952	3.048	0.688	0.407
Pooled	39	17	22	19.43	19.57	0.6	0.438

Objectives

Establish the inheritance model of the most represented coat colours in the alpaca population: full white (W), black (Bl) and brown (Br).

Materials and Methods

Coat colour inheritance in alpaca was investigated through segregation analysis on the offspring of 17 paternal half sib families. Crosses were carried out in an experimental herd of 230 dams in the Peruvian plateau (INIA ILLPA Centre).

Segregation analysis was applied only to segregating families showing at least one proband (truncate selection).

The available offspring consisted of 145 crias (80 females and 65 males) from 145 dams.

The experimental plan and the crosses are summarised in Table 1.

Results

Dominance with complete penetrance of white over pigmented was observed in the three crosses of white parents (*Gtotal* = 0.72; P = 0.87), as well as in four white male x pigmented female crosses (*Gtotal* = 6.4; P = 0.17) (Table 2 and 3 respectively).

Dominance with complete penetrance of black over brown was observed in the four crosses of black parents (*Gtotal* = 0.512; P = 0.97) (Table 4) and in one of the two black male x brown female crosses (*Gadj* < 0.13; P = 0.72). This latter hypothesis was further supported by the results of three crosses between brown parents, where all the offspring (25 crias) were brown. Statistical tests seem to validate the monofactorial hypothesis of dominance with complete penetrance of full white over pigmented, and black over brown.

Table 4. Black x Black cross

Rams	Dams (n)	Observed Offspring		Expected [a] Offspring		G_{adj} [b]	P (0.05)
		Black	Brown	Black	Brown		
237204	6	3	3	3.567	2.433	0.201	0.654
244203	7	5	2	4.574	2.426	0.11	0.74
095101	6	4	2	3.649	2.351	0.081	0.776
035104	6	4	2	3.649	2.351	0.081	0.776
Pooled	25	16	9	15.44	9.56	0.053	0.818

Table 5. Black x Brown cross

Rams	Dams (n)	Observed Offspring		Expected [a] Offspring		G_{adj} [b]	P (0.05)
		Black	Brown	Black	Brown		
366203	5	2	3	2.419	2.581	0.13	0.720

Figure 3. Experimental station in Quinsachata, Inia ILLPA Centre.

Conclusions

Since full white no albino fleece is particularly appreciated by the textile industry, and pigmented fleeces are appreciated for niche markets focusing on natural fibres, understanding of the phenotypic and genetic relationships among coat colours is a basic step for establishing correct reproductive practices in alpaca breeding.