

DOT to DOT

A Case Study of Leopard Appaloosa Alpacas in one Australian Herd

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THERE IS A REMARKABLE colour pattern occasionally seen in the coat of alpacas in which the body of the animal is evenly covered in spots. The spots are distributed throughout the saddle (main fleece) and extend to the ears, muzzle and feet. It is usually displayed as darker coloured spots (fawn or brown) over a white body. As borrowed from terminology used to describe coat colour in horses, this pattern of spotted colour is referred to as 'appaloosa'.

As distinct from 'blanket' appaloosa in which a part of a darker fleece (usually positioned on the rump in horses) displays an area of lighter colour infused by spots of the same colour as the rest of the coat, the term 'Leopard' is used to describe coloured spots evenly distributed over the entire body (Wilpedia, 2009). This pattern of colour occurs in a wide range of species, including the horse, dogs (ie dalmations), moths and frogs. The Wilpedia provides no specific reference to the existence of spotted coat in alpacas. Leopard markings are, however, a recognised colour standard in llamas. Not surprisingly, this spotted colour pattern has originally been derived from the pattern of black and yellow spots displayed on the coat of the leopard cat.

Wilpedia describes the existence of a leopard spotting gene (Lp) producing coat spotting patterns, which is believed to be autosomal dominant. It acknowledges that the gene for spotting may be a complex rather than single gene and that not every horse with the Lp gene exhibits hair coat spotting. There is no DNA test for the gene.

If the gene is dominant, it must be extremely rare in alpacas, as this colour pattern is seldom seen. It is not to be confused with the more common display in the coat of isolated, irregular shaped or unbalanced patches of colour. This pattern in alpacas is typically referred to as 'fancy' or 'multi'.

The prevalence of appaloosa alpacas in Australia is difficult to ascertain as the coat colour classification system used by the Australian Alpaca Association in connection with alpaca pedigree registration has no provision for registering alpacas with spots as distinct from alpacas with a patch or two of secondary colour. Industry journals from the United States (*Alpaca Magazine*) have provided photographic evidence of leopard appaloosa alpacas in its advertising material. Spotted alpacas are very likely to also be in herds in South America, from where the alpacas were originally sourced to build the

current Australian herd. It is probable that limited numbers of leopard appaloosas are in all major alpaca populations around the world.

Case study

At Ambersun Alpacas in South Australia, there are currently eight alpacas which display the coat colour of leopard appaloosa (out of a herd of approximately 1000 alpacas).

All of these spotted alpacas are historically related back to a single female alpaca, 'Royal Canadian (RCA) Safari'. RCA Safari displayed a mainly white fleece, with an uneven distribution of different sized dark fawn spots and patches over her body. By definition, she was not a leopard appaloosa, but more aptly described as a 'fancy'.

Two female cria were born to RCA Safari, neither of which were leopard appaloosas. RCA Chiquita was solid light brown and RCA Carmella is a fancy – primarily white with one fawn patch on her saddle.

There are several generations of progeny and a sufficient number of descendants in the family lineage of RCA Chiquita (see *diagram 1*) to assist with the identification of patterns of inheritance of the leopard appaloosa gene.

The leopard appaloosa markings began to appear in the next generation of offspring, ie the cria born to RCA Chiquita, with the birth of Ambersun (ASA) Cheetah. RCA Chiquita also gave birth to a second leopard appaloosa, ASA Sprinkles. Both were sired by the late Peruvian Auzengate, a solid white male. RCA Chiquita also gave birth to two other solid coloured female offspring, RCA Kiata (solid medium brown) and ASA Evita (solid light fawn).

The next generation of offspring from each of RCA Chiquita's four daughters provides some informative direction on the inheritance of the appaloosa (Lp) gene.

ASA Cheetah (leopard appaloosa) has produced both solid coloured cria (solid white, and solid medium fawn) and three

Colouration of the spotted fleece.





leopard appaloosa offspring, ASA All Spice (sire NWA Ltd El Sol), ASA Tapioca and ASA Jag (both sired by Jolimont Warrior). The last of these three, a male, has been certified for breeding and currently has progeny in utero. When born, the coat colour of his progeny should help to understand the inheritance of the Lp gene, especially when mated to females with no established connection with the gene or coat colour.

ASA Sprinkles (leopard appaloosa) has also produced both solid coloured and leopard appaloosa progeny. She has a son, ASA Camouflage (leopard appaloosa), sired by Jolimont Warrior, who has been exported as a breeding male to Popham Alpacas in the UK. ASA Sprinkles also produced an appaloosa daughter, ASA Confetti, sired by ASA Peruvian High Dancer.

Of the two solid coloured daughters born to RCA Chiquita, only one has produced leopard appaloosa offspring. RCA Kiata has produced five solid coloured offspring and two leopard appaloosas (ASA Kiandra and ASA Spotswood, both sired by Peruvian Auzengate).

The second solid coloured daughter (ASA Evita, sired by Peruvian Auzengate) has, to date, produced only solid coloured offspring (solid white and solid light fawn). Her four cria born thus far would suggest that either she has not inherited the Lp gene or alternatively, the colour pattern has not yet been displayed in the phenotype of her offspring.

Similar patterns of inheritance have been carried through the second daughter born to the original matriarch RCA Safari, with both solid coloured and leopard appaloosa offspring in the family tree of RCA Carmella.

Summary of findings

An analysis of the colour pattern in cria born to the descendants of RCA Safari provides some information on the inheritance of the leopard appaloosa gene.

1. The gene is rare. All leopard appaloosa coloured alpacas within the study herd (of approximately 1,000 alpacas) had one female matriarch common in their descendancey.
2. Alpacas do not need to display the spotted colour pattern in their coat to be carrying the Lp gene. Solid white, solid dark fawn and solid medium brown coloured alpacas have a proven history of carrying the gene for spotted colour; being expressed later through the coat colour of their offspring. It is, therefore, possible

for the colour pattern to 'skip' one or more generations.

3. There appears to be no link between the gene for appaloosa coat pattern and the gene responsible for fancy or multi coloured alpacas.
4. Given the rarity of the colour pattern it would be expected that the gene responsible for the spotted colour pattern would be autosomal recessive. This would mean, however, that both the dam and sire would need to carry the gene to produce appaloosa coloured offspring. The study of pedigrees of the leopard appaloosas in the Ambersun herd showed them to have been sired by five separate males. If the gene is so rare, it seems beyond coincidence that five different males would be carrying the same gene. The results, therefore, would tend to support the earlier assertion based on research with horses as (Wilpedia, 2009) that the gene has dominance, which would confirm that the gene needs only to be transmitted through one rather than both parents. It may be the case in this family tree that the colour pattern has been inherited entirely through the genetic contribution of the

dam. These findings reinforce the information in Wilpedia as reported in other species of animals (eg horses).

5. If the gene is dominant, it is more likely to be a complex gene than a simple gene. Alpacas displaying the spotted coat colour do not always produce offspring of a similar colour: Leopard appaloosas can produce both solid coloured offspring and spotted offspring.
6. All solid coloured offspring born to appaloosa dams have been coloured within the range of colours of the spotted fleece of the dam (solid white, solid fawn and solid brown)
7. Use of breeding males which display the spotted coat colour should increase the prevalence and distribution of this apparently rare Lp gene in the alpaca population, as males can have more widespread impact on a greater number of progeny than achievable through the females only. Future progeny born to the certified male ASA Jag (in Australia) and ASA Camouflage (in the UK) may shed more light on the inheritance of the leopard appaloosa colour coat trait.

These observations of inheritance of the leopard appaloosa gene (Lp) have been based on the phenotype of coat colour of the descendants from a single female alpaca (RCA Safari). It is likely that a similar pattern will emerge in other alpaca herds fortunate enough to include these unusually coloured alpacas. As more offspring are born with this genetic lineage, the inheritance of the leopard appaloosa gene will be better understood.

