

# Chinese Shar-Pei Coat Color DNA Study

*An update and information page for the owners of Chinese Shar-Pei who have contributed DNA brushes to the study*

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*This webpage was first mounted in 2005 and last updated on April 14, 2013 by Sheila Schmutz*

## The Study



We are grateful to [Jerry Doka](#) for coordinating the samples, photos, consent forms, etc. for this study conducted on behalf of the DNA Committee of the Chinese Shar-Pei Club of America (CSPCA). This study was funded by the contributors of the samples.

The package of 23 DNA brushes arrived in Saskatoon at our lab on March 2, 2005. On March 20, the DNA was extracted from the brushes. This collection represents a wide variety of coat colors. Noses of various colors also occur. Some dogs have facial masks and other do not. The masks are black or gray or brown.

Call names that were provided have been used, not the registered names of the dogs. Generic information has been posted on this site. Specific information was emailed to the owner of a specific dog. We have begun DNA testing but it will likely take a couple of months before we complete the testing and analyze the results.

**Terminology** Differs for several terms used in regards to color occurring amongst Shar-Pei owners and many other dog people and geneticists. This is often true in specific breeds to some extent but it is a bit more important in Shar-Pei. When Shar-Pei people say "no pigment" they usually mean that the dog has a pink nose (please see the section on nose pigmentation below). When they say the dog is "dilute", they are again referring to the nose pigmentation primarily, not the coat color. Any nose other than black is considered dilute. This can lead to misunderstandings and misinterpretation about DNA tests for coat color and web pages and articles about coat color if these were not written specifically for a Shar-Pei audience.

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## Red

There are two genetic mechanisms by which dogs can be reddish in coat color. The first one is inherited as a recessive, "e/e" at the E locus, which is the *MC1R* gene. This is the yellow of Labrador Retrievers and also the red of Irish Setters so the shade can vary tremendously. "e/e" dogs are "clear red" without a single black hair or even whisker. Mulan, the pup at the top is an example of such a dog.

The other form of red is "fawn red", called "sable" in a few breeds of dogs such as Shetland Sheep Dogs. This fawn red is caused by the dominant allele "a<sup>y</sup>" at the agouti or A locus. This form of red also occurs in Shar-Pei and is typically called fawn. Some dogs have black whiskers or some black hairs intermingled in their coat, but not all with this genotype have black hairs.



Houston on the left is an example of a "e/e" clear red dog and Connor on the right is an example of a "a<sup>y</sup>/-" fawn red dog who is "E/E". Note that the depth of red pigment in their hair is not necessarily different between "e/e" "clear red" dogs and "a<sup>y</sup>/-" dogs. The depth of pigmentation or dilution thereof is caused by another gene or genes, such as C or D.

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## Mask

Facial masks in Shar-Pei are a bit different than in many other breeds. As in Chows, a black tongue is a typical feature. Likewise, dark skin pigmentation around the muzzle is typical in many pups. This skin could have any of the eumelanin pigments however: black, brown or gray. Geneticists do not know which gene causes either the black tongue or the eumelanin pigmented skin on the muzzle yet.

"Melanistic Mask" which is caused by the E<sup>M</sup> allele means there are eumelanin pigmented hairs on the muzzle. E<sup>M</sup> is the top dominant allele at the E locus. In other words, E<sup>M</sup> > E > e in its effect on phenotype in the Shar-Pei.

Sometimes these black/brown/gray hairs extend well up the face and onto the ears in some breeds, but in Shar-Pei the Mask seems to include only the muzzle area. Therefore it can be difficult from photos to see the difference between a dark muzzle that is dark skin showing through the hairs and one that is eumelanin hairs on the muzzle. Shady, below left, has a Melanistic Mask of gray hairs on his muzzle. On the other hand, Banger, below right, has black skin under cream hairs on his muzzle.





Dancer, above left, has a Melanistic Mask of black hairs on his muzzle. On the other hand, Manner, above right, has a Melanistic Mask of brown hairs on his muzzle. Kobe, the black dog below has a black mask too, but no one could see this on his black body!

## Black



Dogs may be black by two different genetic mechanisms. Dogs that have two "a" alleles at the agouti locus inherit black as a recessive trait. They are unable to make red pigment since their agouti gene is not functional. This allele was not found in the black or blue Shar-Pei.

Black that is inherited as a dominant is caused by having at least one copy of the  $K^B$  allele plus at least one copy of the E or  $E^M$  allele. This is the black that occurs in Chinese Shar-Pei, such as Kobe.

## K Genotypes

The gene causing black in most dog breeds, including Shar-Pei, is beta-defensin103. The locus is known as K. Although there are three alleles at the K locus,  $K^B$ ,  $k^{br}$ , and  $k^y$ , only  $K^B$  and  $k^y$  occur in Shar-Pei. A DNA test to distinguish dogs that are homozygous black from those carrying a  $k^y$  became available in fall, 2007.

All Shar-Pei that are black, blue or brown (chocolate) produce eumelanin pigment and therefore have at least one  $K^B$  allele. If such a dog has had fawn pups or parents then it is  $K^B/k^y$ .

All Shar-Pei that are fawn with a melanistic mask of black (or blue or brown) facial hairs are  $k^y/k^y$ .

Some Shar-Pei are  $e/e$  at MC1R and in the case of these dogs, one can not predict their K genotype. Such  $e/e$  dogs could be  $K^B/K^B$  or  $K^B/k^y$  and still not be black since the  $e/e$  genotype Prevents black pigmentation of hairs in dogs (but not nose leather or pads). Some of the  $e/e$  dogs in this study have been called cream or apricot by the owners.

How can a dog that is cream bred to a dog that is fawn have black pups? This can occur from a dog that is cream, such as the one shown at the right is  $e/e$ ,  $K^B/k^y$ . His  $K^B$  allele doesn't cause him to be black because of the  $e/e$ . His fawn mate could contribute the E allele to the black pup/s. Thus the black pup/s would have a  $K^B$  from him and an E from their dam and that would cause them to be black.



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## Agouti Genotypes





The most common allele at the A locus, which is the agouti gene, in Shar-Pei is the  $a^y$  allele. This allele is the dominant allele in this series. In the presence of E or  $E^M$  allele and  $k^y/k^y$ , dogs with this allele will be fawn red. Jackson, on the left, is homozygous  $a^y/a^y$  but even one copy of this allele would have caused him to be this color.

Some Shar-Pei have the wolf-type banded hair pattern, such as Sage at the right. She has at least one  $a^w$  allele and no  $a^y$  allele. Sage has a  $E^M$  allele causing her to have a melanistic mask, and has the characteristic black tongue. In breeds such as the German Shepherd Dog and Chinese Shar-Pei, this coat color is called sable however in Collies and Shelties sable denotes an intermingling of black and red hairs but very few to no banded hairs.

Sage is also displaying her black tongue which is characteristic of this breed and the Chow Chow.

Apparently some Shar-Pei have tan points. Such dogs would have the genotype  $a^t/a^t$ . This allele is recessive to both  $a^y$  and  $a^w$ .

The fourth allele at the bottom of the dominance hierarchy is "a". This allele causes "recessive black" when homozygous but does not appear to occur in Chinese Shar-Pei.

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## Brown, B Locus Genotypes



Tyrosinase Related Protein 1 (*TYRP1*) is the gene responsible for brown coat colors in dogs (and mice and cattle and cats). Three different mutations in this gene all can produce brown. Godiva, on the left, is an example of a chocolate Shar-Pei that has one  $b^s$  allele and one  $b^c$ . The  $b^d$  allele was not found amongst the 20 Shar-Pei tested.

Like Manner above, Honey Brown at the right, has a brown mask on a fawn body. Dogs with  $b/b$  genotypes also have a brown nose.



Bocephus is an interesting color that looks brown from a distance but is quite different in color than chocolate. He has a *TYRP1* genotype of  $B/b^s$ . It is typical that all dogs with black nose leather and pads have at least one B allele.

Chinese Shar-Pei breeders have called dogs that look brown with black noses, like Bocephus, brown and dogs that have a brown coat and brown nose, chocolate. However from a genetic standpoint, only the chocolate dogs would be classified as "brown" in coat color because they have a  $b/b$  genotype and therefore never have a black nose.

Bocephus is  $a^y/a^y$  and  $E/E$ . He is best described as a heavily sabled fawn, when sabbling is used to mean black hairs interspersed among the fawn ones.

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## Blue, D Locus Genotypes



"Blue" is used as the name for diluted black in Chinese Shar-Pei and many other dog breeds. Cici at the left looks a slate grey and Misty on the right looks a bluish grey, but this is likely in large part due to the lighting and color tones of the photos.

The locus causing blue or "dilute" black is classically known as the D locus. Both Cici and Misty are d/d in genotype at this locus. "Dilute" is used to mean any dog that does not have black nose pigment in Chinese Shar-Pei. Therefore both Cici and Misty fit this category also since each has a grey nose instead of a black nose.



The female pup, Canuck, is a pale or dilute brown. Her sire is a chocolate and her dam was a blue. Therefore she is also d/d, in addition to the b/b genotype that makes her brown. Note that her nose is pale brown, not pink like the hands or T shirt.

Millie is an adult that is pale chocolate. She is b<sup>s</sup>/b<sup>s</sup> and d/d. Millie also has a pale brown, not pink nose. This color is called "lilac" by some Shar-Pei breeders. It is not given an official name on the Chinese Shar-Pei Club's AKC color list. On that list chocolate dilute is b/b with at least one D allele.

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## Nose Pigmentation



Porter, left, has black nose pigment and mask. Misty, second from left, is a blue female with a blue nose. Manner, third from left, has brown nose pigment and mask. Easy, right, has a pink nose which lacks pigmentation. Therefore the 3 dogs on the left "have pigment", it's just different colors of pigment. At this time we do not know the gene that causes Easy to have a pink nose, pads and skin. Easy has "no pigment" in its nose.....but does in its coat.

Some Shar-Pei owners seem surprised that when they mate a dog that is an apricot dilute (or cream), with a pink nose to a dog like Manner or Misty or Canuk with some nose color that isn't black, but isn't pink either, they get pups with nose pigmentation. This should not surprise them. It's just a nomenclature issue. "No pigment" only applies to pink noses. They could even get some pups with black noses from such matings!

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## Cream



I am using "cream" below where most Shar-Pei people would use apricot dilute. If they use dilute to describe the nose pigmentation, as in their custom, then to me it's not clear what coat color is meant in an apricot dilute, so I'm using cream.

All of the cream Shar-Pei studied thus far are "e/e" genotype at MC1R, including the pups in the litter shown at the left, born to a cream sire and fawn dam. Conversely, not all "e/e" dogs are cream. Some like Houston and Drizzle are apricot. Thus far we do not know which gene causes the difference between apricot and cream. However it appears that THIS cream gene would only effect e/e dogs. In Afghans, at least, there is a gene that causes a cream body and leaves the mask black.

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## Flowered

We have new data about the mutation in the gene MITF that causes the "flowered" or white spotted phenotype in Shar-Pei. This appears to be inherited as an autosomal recessive trait with no hint of white markings on the heterozygous dogs. We have found this mutation in all the flowered dogs we've tested, from several different kennels so feel it is the mutation causing the flowered phenotype. Testing to detect carriers of this trait is available at HealthGene.



## Unsolved Colors

The genes causing 2 colors in Chinese Shar-Pei still are puzzling. The two colors are Brown of the type shown by Bocephus above and Cream (or Apricot Dilute) as shown above.

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## Links

[Dog Coat Color Genetics Main Page](#)

**Chinese Shar-Pei Club Coat Colors-** <http://www.cspca.com/education/colors.asp>

**Shar-Pei Coat Color Genetics by Marina Smirnova**

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The CSPCA would like to thank Dr. Sheila Schmutz for her work on this project and for allowing us to post this article to our website. The article can be found at the following link:

<http://homepage.usask.ca/~schmutz/Shar-Pei.html>