Arabian Coat Color Patterns

Copyright 2011 Brenda Wahler

In the Arabian breed, there are three unusual coat colors or patterns that occur in some purebred horses. The first is sabino, the only white spotting pattern seen in purebred Arabians, characterized by bold white face and leg markings, and, in some cases, body spotting. The second pattern is rabicano, a roan-like intermixture of white and dark hairs. Both sabino and rabicano horses are often registered by their base coat color, with white patterns noted as markings, but some extensively marked individuals have been registered as "roan," even though true roan is a separate coat color. The third unusual coat color is dominant white, a mutation characterized by a predominantly white hair coat and pink skin, present at birth. All Arabians in the United States currently known to be dominant white trace to a single stallion, foaled in 1996, verified to be the offspring of his registered Arabian parents, both of whom were solid-colored.

It is difficult to know how many Arabians have these unusual colors as they are often not searchable in registration records. For many years, Arabians with dominant white, body spots, or simply "too much white" were discouraged from registration, and white body markings were penalized in halter classes. The exclusion of boldly-marked "cropout" horses was also common in other registries, leading to the formation of a number of color breed associations. However, when parentage verification became possible, horses born with "too much" white could be confirmed as the offspring of their stated parents, and breed registries generally relaxed their rules or policies that previously excluded such animals.

Sabino

Sabino in Arabian horses is one of the best-known Arabian coat color patterns, but difficult to define because there is considerable variation in markings. It is characterized by bold facial markings and high white leg markings, usually with irregular edges, and often extending above the knees and hocks. It may include white spotting extending up the legs onto the belly with an vertical or upward orientation. These markings may have roaning, freckled, or lacy edges. However, minimal expression of sabino genetics may be indicated by as little as a small body spot, a jagged leg marking, or a white facial marking extending onto the lower lip.

A purebred Arabian with vivid sabino markings.
Photo courtesy of Khrosskhreek Arabians.

Most sabino horses are registered by their solid base coat color with their sabino traits recorded as white markings. However, some sabino Arabians may have been registered as roans, even though true roan is a different coat color.

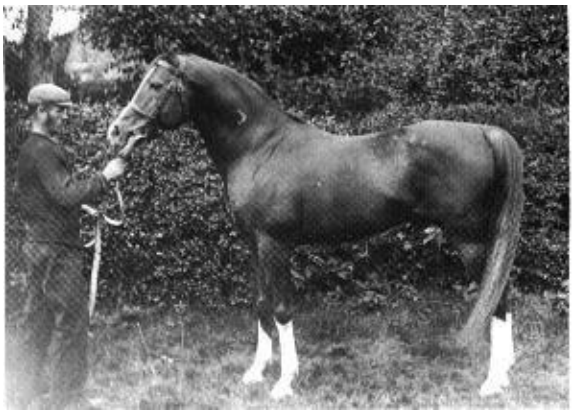
Lady Wentworth of the Crabbet Arabian Stud described white markings in her horses, and today these could be

White markings extending onto the nostril and lower lip of this otherwise black purebred Arabian may represent a minimal expression of sabino.
Photo by Brenda Wahler.

ARABIAN HORSE ASSOCIATION℠
10805 East Bethany Drive | Phone 303-696-4500
Aurora, Colorado 80014 | Fax 303-696-4599
www.ArabianHorses.org | info@ArabianHorses.org

classified as sabino. She also noted that parti-colored horses existed amongst the Arabians owned by Abbas Pasha. The Crabbet stallion Mesaoud, imported from Egypt, had extensive white markings described in the Crabbet Arabian herdbook. His white facial markings, body spots, and white leg markings with irregular edges that extended onto his knees and hocks fit the modern definition of sabino.

A modern purebred Arabian with sabino markings. *Photo by Johnny Johnston, courtesy of Khrosskhreek Arabians.*



Mesaoud was well-known for his extensive white markings.

Sabino markings in Arabians have sometimes been described as "parti-colored." Sabino spotting, and combinations of spotting patterns in other breeds, have been described with many other terms as well, including "calico," "speckled," "flecked," and even "overo." In England the word "blagdon" describes some vividly-patterned horses and ponies. Making matters more complicated is the practice in South America of using the word "sabino" to describe a flea-bitten gray, but "overo" to describe what is called a sabino in the USA.

The traits called "sabino" in Arabians include multiple patterns and are produced by a currently unknown genetic mechanism, and possibly more than one. Studies indicate that these forms of sabino have a complex inheritance pattern that is not highly predictable; for example, strongly marked horses are born to minimally-marked parents, and there may also be a genetic mechanism that masks sabino. There is only one form of sabino that currently can be verified via DNA testing, a dominant gene called Sabino–1 (SB–1). It has not been found to date in purebred Arabians, nor in the Clydesdale, a breed noted for having dramatic sabino-type markings.

Horses with one copy of the SB–1 allele usually have extensive white markings, and when homozygous, SB–1 can result in a predominantly or totally white horse with pink skin and dark eyes. SB–1 is commonly seen in Tennessee Walking Horses, and known to exist in American Miniature Horses, American Paint Horses, Aztecas, Missouri Foxtrotters, Shetland Ponies, Spanish Mustangs and the Pony of the Americas. SB–1 horses over 90% white are usually called "sabino-white," though they are sometimes called "maximum sabino." Within the Arabian horse community, however, the term "maximum sabino" is generally used to describe animals that are over 50% white.

A “splash white overo” Paint. The splash white pattern closely resembles sabino.
Photo credit: Grullotobi, Wikimedia Commons

Sabino patterns are similar to and often confused with “splash white,” particularly in Europe, where a splash white pattern is well- known in certain breeds, such as the Icelandic horse. There is also a pattern in the American Paint Horse called “splash white overo.” Splash white is characterized by extensive white on the head, often with blue eyes, along with white that is horizontally distributed across the lower body, as if the horse was dipped in white paint. Splash white overo may be linked to deafness, while sabino has no such issues. However, as there are a few Arabians with blue or partially blue eyes, there is a hypothesis that some form of splash white may exist in Arabians. However, splash white has not yet been DNA-mapped and further study is needed.

There are no known adverse health conditions linked to any form of sabino. However, confusion in terminology may cause concern. Sabino is sometimes classified as an “overo” spotting pattern. There are three genetically distinct “overo” patterns: frame, splash white, and sabino. Lethal white syndrome, a fatal condition found in some other breeds but not in Arabians, is sometimes called “overo lethal white.” However, only the “frame” overo pattern is associated with lethal white syndrome (acronym LWS or OLWS). Frame overo does not occur in purebred Arabians, and Arabians were actually used as known non-carrier controls in the studies that developed the LWS test.

That said, it is possible for a part-Arabian to carry a frame allele via its non-Arabian parent. There is a genetic test that was developed in 1998, and it can detect lethal white carriers. This test is of benefit to part-Arabian breeders who breed pinto color patterns. Because the frame pattern may be masked by other white spotting or be so minimally expressed that it is not visually apparent, testing is advised if a part-Arabian with possible frame overo ancestry is to be bred to a horse of any other breed that may carry frame genetics.

Rabicano

Rabicano is a pattern that includes roan-like white “ticking,” intermixed white and dark hairs that appear along the barrel and flank, sometimes extending vertically along the rib cage. It also is characterized by white hairs at the base of the tail, a trait colloquially called a “coon tail” or a “skunk tail.”

An extensively expressed rabicano Arabian.
Photo credit: Coreada, Wikimedia Commons

Though sometimes called “roan,” Rabicano differs from classic or “true” roan in several significant ways. A roan horse generally has intermixed light and dark hairs over its

ARABIAN HORSE ASSOCIATION℠
10805 East Bethany Drive | Phone 303-696-4500
Aurora, Colorado 80014 | Fax 303-696-4599
www.ArabianHorses.org | info@ArabianHorses.org

entire body, while the mane, tail, head and legs remain the dark underlying base color. Rabicanos, even extensively expressed ones, seldom have white hairs on their necks or hindquarters, ticking is concentrated in the midsection, and they almost always have white hairs at the base of their tails.

The most strongly expressed rabicano horses are usually chestnuts, but rabicano has variable expressivity, sometimes as minimal as white or light hairs in the mane and tail. Rabicano is the pattern of Arabians usually registered as "roan," though some sabinos also have been described by their owners as "roan." However, according to Dr. D. Phillip Sponenberg, the classic roan pattern does not occur in Arabians. There are no genetic studies on rabicano to date, though the pattern is mentioned briefly in genetics textbooks, and it may be inherited as a dominant trait in some horse family lines.

A bay roan Quarter Horse with typical "classic roan" traits: relatively uniform distribution of dark and white hairs over the body, dark head and legs. No white in mane and tail. Dark "corn marks" replace roan color where there have been minor skin scrapes.
Photo by Brenda Wahler

Detail of moderate rabicano traits on a purebred Arabian registered as a chestnut. Intermixed white hairs predominantly around barrel and flank, white "skunk tail" hairs at base of the tail.
Photo by Brenda Wahler

Dominant White

Dominant white (W) is a new and rare mutation in Arabians. It is characterized by a predominantly white hair coat present at birth, mostly unpigmented (pink) skin, and dark eyes. Across all breeds, there are 12 different known alleles of W identified as of 2010. Each allele has been traced to individual animals foaled within the past 100 years. All versions of dominant white currently recognized by modern DNA studies were initially produced by a random mutation in each foundation horse. But once in the gene pool, alleles of W are passed on to the descendants of the foundation horse as a dominant trait.

The founding sire of this line in Arabians is the horse R Khasper, foaled in 1996. He is predominantly white with dark eyes and minimal pigmentation. Both his sire and dam were solid colored horses and it is believed that his color was a spontaneous mutation. As of 2008, 12 of 25 offspring have been dominant white, a ratio to be expected of a dominant gene. He was initially believed to be sabino-white, but a 2007 study identified dominant white in the R Khasper family and labeled the particular allele *W3*. W3 is what geneticists call a "nonsense mutation," c.706A>T, located in exon 4 on the *KIT* locus, and it is the only known dominant white allele in the Arabian breed. That said, these may not be the only dominant white Arabians. Historically, although older registry records incorrectly recorded some gray Arabians as "white," it is also possible that dominant white mutations have occurred in the past and were correctly registered as "white." Similarly, there could be dominant white Arabians alive today that have not yet been verified by genetic testing.

A dominant white purebred Arabian, showing common features of white hair, pink skin, dark eyes, slight pigmentation along the topline and minor body spotting.
Photo Source: Haase B, Brooks SA, Schlumbaum A, Azor PJ, Bailey E, et al. (2007) Allelic heterogeneity at the equine KIT locus in dominant white (W) horses. PLoS Genet 3(11): e195. doi:10.1371/journal.pgen.0030195.

While it was once thought that a "true" white horse had no skin or hair pigmentation and blue eyes, genetic studies have disproved this. Dominant white horses usually have dark, fully pigmented eyes; blue eyes appear to be associated with a different genetic mechanism. Dominant white horses may also have some pigmentation along the topline and random spotting elsewhere on the body. Some dominant white horses are born with significant patches of colored hair and skin that may fade to white as they mature. These horses differ from grays in that most grays are born a solid dark color and their skin remains dark, except under white markings, as their hair coat gradually becomes white. Parti-colored dominant white horses can be distinguished from sabinos because sabino markings generally do not change over time.

It cannot be emphasized too strongly that Dominant White is NOT related to Lethal White Syndrome (LWS or OLWS). Lethal White is linked to the frame overo gene, as previously noted.
In the past, many white horses were excluded from breeding on because of beliefs that they were of impure bloodlines, fears that white horses were inherently weaker, and more recently, concerns about lethal white. However, modern horses known to be dominant white can have their parentage verified and appear to have no particular health problems.

Some studies hypothesized that dominant white is an embryonic lethal when homozygous (WW), meaning that foal embryos with two copies of the W allele are either aborted early on or are reabsorbed in the womb. However, most embryonic lethality studies were performed on mice, and those with horses have been criticized for methodological flaws, including limited numbers and a failure to segregate for other mutations. Thus, lethality of Dominant White, including the Arabian W3 allele has neither been proven nor disproven at present. As only one allele of W is required to produce a white horse, any risk of lethality can be completely avoided by not breeding two dominant white animals to one another. All currently known dominant white Arabians are heterozygous for W3 and are all the offspring or grandget of a single horse, so it is unlikely that a crossing of two white Arabians will occur for quite some time.

Acknowledgements:

Thanks to the Genetic Disorders Subcommittee of the Arabian Horse Association Equine Stress, Research and Education Committee, which supported and approved this Article for submission to the AHA web site, where it is used with permission of the author. Special thanks to Michael Bowling, Beth Minnich, Caitlin Doolittle, and Dr. Samantha Brooks, PhD, Cornell University for information, editing, review, critiques and other assistance.

Sources:

Bowling, Ann T. and Anatoly Ruvinsky. (2000) *The Genetics of the Horse.* CABI; First edition. ISBN 978-0851994291

Brooks, Samantha. (2006) *Studies of Genetic Variation at the KIT Locus and White Spotting Patterns in the Horse.* Doctoral Dissertation, Department of Veterinary Science, University of Kentucky.

Castle, Nancy. (2009) *Equine KIT Gene Mutations: Dominant White & Sabino-1*. Dun Central Station
Eakins, Mandy. (October 2009) *Guide to Color Gene Testing.* University of Kentucky Animal Genetic Testing and Research Lab, Gluck Equine Research Center, University of Kentucky

Eken, Helena. (2009) *Genetic Characterization and Inheritance of Belly Spot and Splashed White Coat Color in Horses.* Examensarbete 307, Swedish University of Agricultural Sciences.

Forbis, Judith. (1976) *The Classic Arabian Horse.* W.W. Norton and Co.

Hasse, Bianca, Samantha A. Brooks, Angela Schlumbaum, Pedro J. Azor, Ernest Bailey, Ferial Alaeddine, Meike Mevissen, Dominik Burger, Pierre-Andre´ Poncet, Stefan Rieder, Tosso Leeb (November 2007) "Allelic Heterogeneity at the Equine KIT Locus in Dominant White (W) Horses" *PLoS Genetics,* 3(11): e195. http://www.plosgenetics.org/article/info:doi/10.1371/journal.pgen.0030195#journal-pgen-0030195-sg001

Hasse, Bianca, Samantha A. Brooks, Teruaki Tozaki, Dominik Burger, Pierre-André Poncet, Stefan Rieder, Telhisa Hasegawa, Cecilia Penedo, Tosso Leeb (October 2009) "Seven novel KIT mutations in horses with white coat colour phenotypes" *Anim Genet.;* 40(5):623-9. Epub 2009 May 6. PMID: 19456317

Holl, H., S. Brooks and E. Bailey (2010) "De novo mutation of KIT discovered as a result of a non-hereditary white coat colour pattern." *Animal Genetics,* 41 (Suppl. 2), 196–198 doi:10.1111/j.1365-2052.2010.02135.x

ARABIAN HORSE ASSOCIATION℠
10805 East Bethany Drive | Phone 303-696-4500
Aurora, Colorado 80014 | Fax 303-696-4599
www.ArabianHorses.org | info@ArabianHorses.org

Overton, Rebecca. (March 2004) “By a Hair.” *Paint Horse Journal*, pp. 144-150.

Sponenberg, Dan Phillip. (2003) *Equine Color Genetics.* Wiley-Blackwell.

Vrotsos, Paul D. ; Elizabeth M. Santschi; and James R. Mickelson (2001) “The Impact of the Mutation Causing Overo Lethal White Syndrome on White Patterning in Horses.” *Proceedings of the Annual Convention of the AAEP*, vol. 47, pp. 385-391.

Wentworth, Judith Anne Dorothea Blunt-Lytton, Baroness. (1958) *The World's Best Horse.* London: Allen and Unwin.

_____. (2007) American Paint Horse Association's Guide to Coat Color Genetics. American Paint Horse Association. PDF booklet downloaded from http://www.apha.com

_____. (undated) *Coat Color Genetics.* American Quarter Horse Association. PDF booklet downloaded from http://www.aqha.com

_____. (2009) “Equine Coat Color Tests.” Veterinary Genetics Laboratory, University of California, Davis. Downloaded from http://www.vgl.ucdavis.edu/services/coatcolorhorse.php

ARABIAN HORSE ASSOCIATION℠
10805 East Bethany Drive | Phone 303-696-4500
Aurora, Colorado 80014 | Fax 303-696-4599
www.ArabianHorses.org | info@ArabianHorses.org