

GUIDE TO COLOR GENE TESTING

University of Kentucky Animal Genetic Testing and Research Lab

108 Gluck Equine Research Center, University of Kentucky, Lexington KY 40546-0099

Mandy Eakins • (PH.) 859-257-4757, ext. 81150 • Email: m.eakins@uky.edu

AGOUTI GENE - The **A** locus can be thought of as the gene that determines if a horse is bay or black, although other genes come into play. A horse that has at least one dominant "**A**" allele will be bay if it also possesses at least one "**E**" allele. A horse that is homozygous recessive for "**a**", that is "**aa**", will be black if it also possesses a "**E**" allele. **All black horses are "E/-, aa".**

WHY TEST- If a horse is homozygous for "**e**", it will have a sorrel or chestnut base coat regardless of what genes it carries at the A locus. Thus a chestnut horse may be able to produce blacks if it carries an "**a**" allele and is bred to another horse carrying the "**a**" allele that also has an "**E**". If a person has a black horse and wants to know if a breeding to a chestnut horse will produce a black, the black horse needs to be tested for the E locus and the chestnut horse needs to be tested for the A locus. A black horse that tests homozygous for "**a**" must also be homozygous for "**E**" to produce 100% blacks/bays/buckskins.

CHAMPAGNE - Like Cream Dilution, Champagne is a dominant dilution gene, meaning that if the horse has even one copy of the Champagne gene, it will express the Champagne coloration. Unlike the Cream Dilution gene, two copies of the Champagne gene has no more effect than one copy on the horse's color. Horses carrying the Champagne gene are born with blue eyes that later darken to hazel or brown. In addition the skin is pink and becomes mottled around the muzzle. A Champagne gene on a black horse produces a Classic Champagne, on a bay horse Amber Champagne, and on a chestnut Gold Champagne. If the horse also carries a Cream Dilution gene, the body color is further diluted and it is referred to as a Classic Cream, Amber Cream or Gold Cream Champagne. This mutation was discovered by Deborah Cook, a student of Dr. Ernest Bailey's, at the University of Kentucky.

WHY TEST: Since there is no way to visually distinguish between a homozygous and heterozygous Champagne horse, the test is valuable to determine which horses will be 100% Champagne producers (homozygotes). In addition it may be difficult to distinguish horses homozygous for Cream Dilution from those that carry the Champagne gene.

CREAM (Dilution) GENE - The cream gene, designated **Cr**, is a dominant dilution gene that causes a reduction in red pigment in the body hair and mane and tail hair. It acts on any base color- therefore a sorrel horse that inherits one copy of the Cr allele is palomino (ee, Cr/cr), a sorrel that inherits a Cr from each parent is Cr/Cr and is a cremello (ee, Cr/Cr). A bay horse that inherits a Cr allele from one parent is a buckskin (E/-, Cr/cr), while one that is homozygous for Cr is a perlino (ee, Cr/Cr). True black horses can mask the presence of the Cr gene, so it is possible for a black horse to produce palominos or buckskins. Cream is a different gene than **Dun**, which is also a dilution gene. In general, dun horses have a dorsal stripe.

WHY TEST- Owners of a black horse with a palomino or buckskin parent may want to determine if the horse carries an unexpressed Cr allele. Horses carrying the champagne gene may be confused with horses carrying the Cr gene-this test will verify if the horses indeed possess the Cr allele. It will also determine if a dun or gray horse may also possess a Cr allele.

(continued)

October 2009

EXTENSION LOCUS (also referred to as "red" gene test) - The **E** locus controls expression of black pigment. This is also a dominant gene, so that a bay or black horse has at least one copy of the **E** allele. The recessive form of this gene, "**e**" restricts the distribution of the black pigment, and a horse that is homozygous recessive or "**ee**" is a chestnut or sorrel. A horse that is homozygous for the dominant form or "**EE**" will have black pigment and because it must pass a "**E**" allele onto its foals, it can never produce a chestnut or sorrel.

WHY TEST: In breeds where black is valued, horses homozygous for **E** are important because they cannot produce sorrels or chestnuts. People breeding black or bay Paints/Pintos or Friesian horses especially are concerned with the **E** locus.

GRAY - Gray is a dominant gene meaning that only one copy is needed to be expressed. Therefore, a gray horse must have at least one gray parent. Regardless of the color of the horse when it is born, if it has the gray gene, the coat will begin turning gray when the foal coat is shed and the horse will get progressively lighter throughout life. Ultimately a gray horse is white or flea-bitten (white with small colored specks throughout the coat).

WHY TEST: It may be hard to determine in horses carrying dilute genes if they also have the gray gene. In addition, if a horse has two gray parents, it may be useful to know if the horse is homozygous for the gray gene, in which case all its offspring will inherit a gray gene.

SABINO1 - Sabino is a Paint color pattern that is variably expressed and can range from white stockings and a blaze to white leg and face markings and extensive white spreading up from the belly into the body area. The mutation we detect is indicative of the Sabino1 gene. Homozygous sabinos may have more extensive white than heterozygous horses. There is more than one sabino gene so that a horse that appears to have the sabino pattern may test negative for the Sabino1 gene. So far all horses that test positive for Sabino1 have the sabino pattern.

WHY TEST: Horses that carry the Sabino1 gene may produce white or near white horses when bred to another Sabino1 carrier. The test offers breeders information that will allow them to selectively breed for the full expression (maximum) sabinos (**Sabino1/Sabino1**). A **Sabino1/Sabino1** horse will always pass a Sabino1 gene to its foals.

SILVER DAPPLE - Silver dapple is a color also known as chocolate by many breeders. Horses are a reddish to brownish color with a flaxen/silver mane and tail. "Red chocolates" refer to horses that carry the Silver Dapple gene on a bay background. "Chocolates" refer to horses that carry the Silver Dapple gene on a black background. At least one copy of the **E** allele (see Extension locus above) is required for the Silver Dapple phenotype to be expressed. A chestnut horse (**ee**) can carry the Silver Dapple gene but it is not expressed. However when bred to a black or bay horse a silver dapple phenotype can be produced. The Silver Dapple gene (**Z**) is dominant, therefore a horse only needs one copy of the gene to be expressed.

WHY TEST: Horses that are homozygous **ZZ** are thought to have a purer light colored mane and tail than heterozygotes (**Zz**). A horse homozygous for **Z** and **E** (**ZZ EE**) will always produce silver dapple (chocolate) offspring. Some breeders believe that **ZZ** horses are at higher risk for an eye disorder known as ASD (anterior segment dysgenesis). Since chestnut horses do not express Silver Dapple, the test enables breeders to determine if a chestnut/sorrel horse is a carrier for **Z**.

(continued)

TOBIANO - Tobiano is a spotted pattern generally characterized by white areas on the body (that usually cross the topline) interspersed with large areas of colored hair, a dark face and four white legs. Tobiano is a **dominant** gene, meaning that a foal can inherit the gene from just one parent, and express the tobiano pattern. Horses that have inherited a Tobiano gene from BOTH parents are **homozygous**, and therefore will always pass on the Tobiano gene to their foals.

Dr. Samantha Brooks at the University of Kentucky discovered that a chromosomal inversion is responsible for the tobiano spotting pattern. This test is now the only tobiano test performed at the University of Kentucky. Unlike marker tests, the direct test for this inversion is reliable across all breeds of horses tested to date.

WHY TEST: Breeders value horses that are homozygous for Tobiano (TOB/TOB) because they will always produce a spotted foal. A Tobiano horse that is heterozygous (TOB/N) on the other hand, will only produce a colored foal about 50% of the time.