

IN THE GENES



PEPTOBOONSMAL, THE RED ROAN STALLION THAT WON THE 1995 NATIONAL CUTTING HORSE ASSOCIATION FUTURITY, MADE THE ROAN COLOR POPULAR AMONG CUTTERS.

When Peptoboonsmal, a red roan stallion, won the 1995 National Cutting Horse Association (NCHA) Futurity, the color roan suddenly took off like a rocket in the cutting horse world. As with Custom Red Berry, a red roan whose multiple titles made her the highest-earning mare in the National Reining Horse Association (NRHA), Peptoboonsmal's silvery roan hue made him a standout in a sea of horses that were usually chestnut, sorrel, brown, or bay.

Although a longtime choice of working cowboys, roans also became popular in cutting and reining. Buyers often sought the horses for their color in addition to how well they might perform. But, conflicting genetic reports in the 1970s created an undercurrent of rumblings within the equine community about whether breeding roans with roans to get roan offspring could be lethal.

Now, a study completed by a renowned equine geneticist shortly before her death provides scientific evidence that roan horses that have two roan parents do exist.

The study was conducted by Dr. Ann T. Bowling, executive associate director of the Veterinary Genetics Lab at the University of California, Davis, before Bowling's sudden death in December 2000. Bowling's husband, Michael, put the final touches on the study's manuscript, and now, geneticists at UC-Davis are preparing it for

publication. Bowling's conclusion is in contrast to earlier studies that suggested that roan-to-roan breedings were lethal because the resulting embryos were absorbed. This was thought to be true because homozygous roans, horses that carried two alleles for the roan characteristic, were rare.

Although absorption of embryos is a possibility after any breeding, Bowling's conclusions are compelling because she was able to prove by molecular analysis that homozygous roans do exist, said Dr. Cecilia Penedo, associate director of the UC-Davis Veterinary Genetics Lab. Penedo is readying the manuscript of Bowling's study.

Although two earlier reports confirmed the existence of homozygous roan stallions in two equine breeds, Bowling's study concentrated on Quarter Horses.

"A couple of reports that have come



BLUE ROANS, SHOWN HERE AT FUNNY B RANCH, LOHN, TEXAS, HAVE A MORE OR LESS UNIFORM MIXTURE OF WHITE WITH BLACK HAIRS OVER A LARGE PART OF THEIR BODIES. THEY ARE USUALLY DARKER ON THEIR HEADS AND LOWER LEGS.

A soon-to-be-published study sheds new light on breeding for the popular roan color

BY REBECCA OVERTON



HOLLYWOOD DUN IT, A DUN STALLION WHICH WAS THE 1986 NATIONAL REINING HORSE ASSOCIATION OPEN RESERVE FUTURITY CHAMPION, BROKE THE COLOR BARRIER FOR DUNS, PALOMINOS, AND BUCKSKINS IN REINING.

out provide evidence of homozygous stallions that are alive and breeding," Penedo explained. "Ann did a fairly large study of roans in the American Quarter Horse Association (AQHA) stud book. The conclusion was that there was no evidence that roan was lethal."

Genetic commotion

Some horse people thought crossing roans with roans could be lethal after the publication of a scientific study by H.F. Hintz and L.D. Van Vleck in 1977.

"The paper by Hintz and Van Vleck caused all this commotion, but there were earlier mentions of a roan cross being lethal, too," Penedo explained. "But it was never fully established by any molecular analysis that homozygous roan horses would not be produced from matings of two roan parents."

"What Ann showed in her study was

exactly that — there were homozygous roan horses."

Homozygous roans have two alleles, RnRnRnRn, for the roan characteristic, unlike heterozygous roans which carry one allele for roan. An allele is one of two or more forms of a gene that occupies the same position on matching chromosomes. Chromosomes carry the genes that determine an animal's hereditary traits. Normally, an individual has two alleles for a trait, one from each parent.

If breeding roans to roans was lethal, homozygous roan horses would not exist. Other studies discovered them in two other equine breeds, the Ardennais, found in France, and the Hokkaido, which live in Japan. But, using the AQHA stud book, Bowling found homozygous roan stallions that were Quarter Horses and that also had get that were homozygous.

"Ann Bowling, in her research using



CUSTOM RED BERRY IS A SUCCESSFUL ROAN IN REINING. THE RED ROAN MARE'S VICTORIES INCLUDE WINNING THE 2002 ALL-AMERICAN QUARTER HORSE CONGRESS OPEN FUTURITY WITH TIM MCQUAY.

molecular markers, was also able to demonstrate that roan-to-roan matings in Quarter Horses she studied produced homozygous horses that lived long, productive lives," Penedo said. "This further documents the existence of homozygous roan horses."

"There is no good support for not crossing a roan with a roan, at least as far as a classic roan is concerned," she said.

Enter Hollywood Dun It

Tim McQuay is no stranger to the fads and fashions of equine coat color. When McQuay, an NRHA Hall of Famer, rode Hollywood Dun It, to the 1986 NRHA Open Reserve Futurity Championship and multiple titles later, dun suddenly became popular.

"Afterward, people called me and said, 'I want a horse just like that one,'" McQuay said. "I've been very fortunate to have him. He's also sired very pretty babies."

"You don't know how many people call, looking for a palomino, or a buckskin or a dun. They just want something a little different."

McQuay and Easton LLC, Tioga, Texas, own Hollywood Dun It, the leading sire of reining horses since 1988. By the legendary red dun stallion Hollywood Jack 86, Hollywood Dun It is out of Blossom Berry by Dun Berry.

Hollywood Jac 86 is still the No. 1 paternal grandsire of top reining horses, despite

his death in 1991.

In the 1970s, many successful reining horses, such as Be Aech Enterprise, were chestnuts or bays. Hollywood Jac, a dun that sired Hollywood Jac 86, and his offspring added another dimension to the show arena.

Hollywood Dun It's color, which was atypical for a reining horse at that time, didn't raise any eyebrows, said McQuay.

"They all loved him because he stood out in both ways, in ability and color," he said.

"I was a loner for awhile until Shining Spark (a successful palomino reining horse) came along. I was pretty much the dominant palomino and buckskin breeder until then."

Still, McQuay is color-blind when it comes to performance.

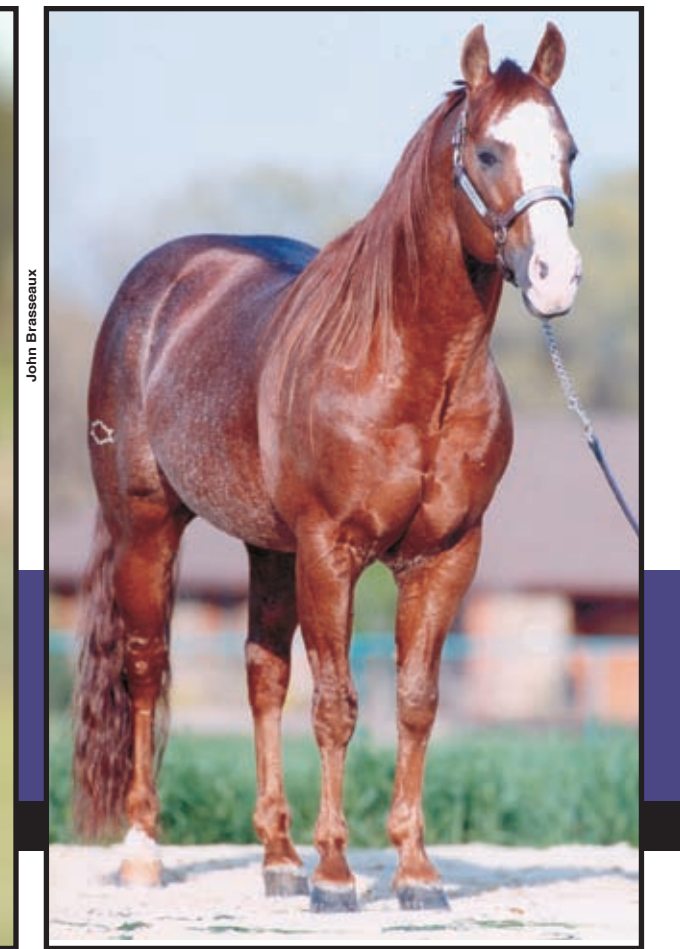
"To me, it makes no difference what color horses are," he said. "If they're good, they're good. I don't care if they're purple."

"But if a horse wins quite a bit, then everyone is after that breed or color because they think it will be

IN THE GENES



ROYAL BLUE BOON, THE ALL-TIME LEADING DAM OF CUTTING HORSE PERFORMERS, IS A BLUE ROAN. HER MANY OFFSPRING INCLUDE PERFORMERS SUCH AS PEPTOBOONSMAL.



SMART CHIC OLENA IS A GOOD EXAMPLE OF A RABICANO, A ROANING PATTERN THAT IS EXPRESSED MORE HEAVILY ON A HORSE'S FLANKS AND BARREL THAN ON ITS FOREHAND.

good."

Playing the odds

As an equine veterinarian for 38 years, Dr. Marlin Baker knows the attraction of color in horses. The owner of Alpha Equine Hospital, Baker stood Peptoboonsmal at his Weatherford, Texas, facility for nine years.

In addition to his veterinary hospital, Baker also owns Alpha Equine Breeding Center in nearby Granbury. He has bred thousands of horses of all colors and seen the horse sale market.

"If some of the roans that sold were plain old brown, they'd bring in a lot less money," Baker said. "People like

the color."

Peptoboonsmal's dam, Royal Blue Boon, a blue roan mare, is the all-time leading dam of cutting horses, with \$2,478,375 earned by 16 of her offspring by the end of 2003. Peptoboonsmal and Royal Blue Boon are owned by Larry Hall Cutting Horses, Weatherford, Texas.

Baker, who was Royal Blue Boon's veterinarian for many years, has a painting of the mare behind a desk in his office.

"She was a very, very fertile mare," he said. "I would tell Larry when she was in season and he would haul her himself to a stallion. She hardly ever missed."

Baker has never been apprehensive about crossing roans to roans, even though he believes the embryos are absorbed occasionally.

"If you breed a roan to a roan, you should get a roan at least half of the time," he said. "If the embryo is absorbed, you can breed the mare again during her next heat cycle. You're playing

BECAUSE EXTREMELY ROAN HORSES HAVE A LARGE AMOUNT OF WHITE, THEY ARE OFTEN CONFUSED WITH WHITE HORSES OR GRAY HORSES, SUCH AS SMART LITTLE PISTOL, THE GRAY STALLION SHOWN HERE. HOWEVER, THE ROAN GENE COVERS SPECIFIC PARTS OF THE BODY WITH WHITE HAIR, WHILE THE GRAY GENE CAUSES A SPRINKLING OF WHITE OVER THE ENTIRE COAT.



John Brasseaux

Funny B Ranch

John Brasseaux

John Brasseaux

John Brasseaux

John Brasseaux

BLUE ROAN CROSSINGS SUCCESSFUL, TEXAS BREEDER ATTESTS

Randy Brookings doesn't need a study to convince him that the breeding of roans to roans might not be lethal. He and his wife, Susan, have been successfully crossing blue roans with blue roans for years.

Randy estimates their cross of blue roans has produced blue roan offspring approximately 75 percent of the time.

"You used to hear you couldn't breed a blue roan to a blue roan, but I've disproved that theory a few hundreds of times," Randy said.

The couple specifically breed Blue Valentine horses, descendants of the great blue roan roping horse, Blue Valentine. The Brookings own and stand Leo Hancock Hayes, the last breeding son of Blue Valentine, at their Funny B Ranch near Lohn, Texas. They have been breeding blue roans since 1996.

The attributes that have made Blue Valentine offspring so popular with ropers and working cowboys have not been lost on cutters and reiners.

"We've had a lot of cutters and reiners call us and breed to Leo Hancock Hayes, trying to get more bone and stamina in their cutting and reining horses," Randy said.

Blue Valentine was an outstanding roping horse sired by Red Man, a red roan stallion that was one of the best sons of Joe Hancock, one of the great all-time sires of roping horses. Some of Red Man's get include Booger Red, which amassed \$51,324 in National Cutting Horse Association (NCHA) earnings; Lady Hur, another NCHA money earner that had AQHA Open performance Registers of Merits; and Cibecue Roan, the 1995 AQHA high-point steer roping stallion.

Blue Valentine's dam was Beauty's Dream, a 1938 black mare by Valentine By Lone Star, a stallion well-known by prominent ropers in Texas. Blue Valentine foaled in 1956 after Les Armour, of the Armour Packing dynasty, sent Beauty's Dream to his friend, Kenny Gunter, who had purchased Red Man around 1941 and stood him at his ranch in Benson, Ariz. In return for the breedings, Gunter got to keep some of

Beauty's Dream's foals.

Gunter sold Blue Valentine as a yearling to Dell Haverty, the World Champion calf roper and competitor who was inducted into the Cowboy Hall of Fame in 1996. Haverty sold half interest in Blue Boon to Buster and Laurie Hayes, who lived in Thermopolis, Wyo. Haverty's wife, Connie, was Buster Hayes' daughter.

The Hayes and Haverty took turns roping off "Blue" in the Southwest, where Haverty lived in Arizona, and at Cheyenne Frontier Days and other events in Wyoming.

When Haverty began scaling back on his rodeo schedule in the late 1960's, he sold his interest in Blue to Hyde Merritt, a roper who was married to Buster Hayes' other daughter, Dede. With Merritt, Blue continued to make a name for himself as an outstanding rope horse, and his large, powerful conformation and blue roan color, which was unusual, attracted attention wherever he went.

His good mind and mild disposition also made him popular as a breeding stallion.

"Blue Valentine horses have a lot of stamina and are really good-minded," said Brookings. "They're big-boned and tough. You can push one pretty hard and they don't get upset. They can take a lot of use."

"They make real good using horses for roping and rodeo, but they're good all-around horses, too."

Brookings purchased numerous Blue Valentine-bred, blue roan mares in 1995 before the Blue Valentine craze took over.

"Blue roans are popular because it's a real unusual color," he said.

"We have a lot of mares that are 50 percent Blue Valentine or higher than 50 percent because they're out of sons of Blue Valentine out of daughters of Blue Valentine. We also have five or six stallions that are Blue Valentine-bred."

Brookings purchased Leo Hancock Hayes, a Blue Valentine stallion out of Doll 01 by Rip Rip, in 2001 from Vincent Hayes, Thermopolis, Wyo.

"He'll be 25 this year, but he's still in real

good shape," he said.

"We try to raise the highest percentage of Blue Valentine colts and fillies that we possibly can. A lot of them go to breeding programs. This year we had 35 colts. We sold every one before we weaned them."

"We're already taking deposits on next year's colts that haven't been born yet. There's a pretty good demand for them right now."

Brookings estimates that out of 150 colts his horses have produced, 110 of them have been blue or red roan.

He doesn't believe many of his mares' roan embryos have been absorbed, something that can happen in non-roan breedings, as well.

"If you have 100 mares that are in foal during breeding season, in the following year about 10 percent of those mares probably won't produce a colt for some reason," he said. "I think that's normal in every breeding program. I think that's Mother Nature doing what Mother Nature does."

"I have found no evidence whatsoever that breeding blues to blues causes any problems."

Because the roan gene is dominant, Brookings has bred roans out of bays, sorrels, duns and buckskins.

"Some of the bluest blue roans you've ever seen have come out of buckskins and duns," he said. "But, when you look, there are roans in the pedigrees of those buckskin and dun mares."

Several of Brookings' mares are heavily bred blue roan on the top side and bottom side, too. Some may have 15 blue roans in their pedigrees.

"You can almost breed them to anything and get a roan," he said.

However, Brookings has never been able to get roan offspring when he has crossed a roan stallion with a gray horse.

"I get a whole lot of people who want to pay a stud fee and breed a blue roan to a gray mare," he said. "I have never gotten a roan colt out of a gray mare. The get will look like blue roans until they are 3 to 5 years old. Then they'll turn gray."

Cowboys appreciate the flint-hard hooves that some roans have. Brookings can attest that some roans have durable feet.

"The roans with really dark hooves, whether they are black or red, have real tough feet," he said. "We never put shoes on a lot of them unless they're in real rocky country."

the odds."

Advances in equine medicine, such as embryo transfer and ultrasound, have made it easier for veterinarians to predict and avoid problem pregnancies.

"Now, we can look at the embryo and the mare we're going to put the embryo in," Baker said. "We can say this embryo has a 40, 50 or 90 percent chance of holding in this mare."

"It's a 'guess-estimate,' but if you have a real good mare to put it into, if the embryo looks real healthy under the microscope, and if you don't have a real old mare the egg came from, its chances of surviving are good."

"We'll know more definitely about roan crosses being lethal when the DNA marker for roan is actually discovered."

Confusing color

Equine geneticists readily acknowledge the roan pattern is one of the most eye-catching — and confusing. One of the reasons identifying roan can be so challenging is because the term is used in two different ways to describe coat color, explained Dr. Phillip Sponenberg, professor of pathology and genetics at the Virginia-Maryland Regional College of Veterinary Medicine.

"Roan is a general term used for the intermixture of white hairs and colored hairs in all animals," Sponenberg writes in his book, *Equine Color Genetics*. "In that general sense, all of the patterns on horses that arise from such an intermixture could be called roan. . . ."

"It is important to note, though, that roan also refers to a very specific pattern of white hairs in horses. As a result, the use of roan in its general sense can be very misleading."

White hair mixed with colored hair can give a horse's coat a silvery effect. The roan pattern is identified by the background color of a horse's coat.

Thus, roans come in a rainbow of hues, such as strawberry, palomino and purple, the latter resulting when roan is combined with mahogany bay, brown and seal brown.

One thing's for sure: roan is not a common equine color. Out of 160,980 horses AQHA registered in 2003, only 10,418 were roan. Out of those, 2,816 were blue roan, 5,508 were red roan, and 2,094 were bay roan.

AQHA registers horses as red, blue or bay roans because chestnut (red), black (blue) and bay are the basic equine coat colors. It added bay roan to its list of accepted registration colors in 2003 to distinguish between roans that have base coats that are bay and those that have base coats of chestnut or sorrel. Some people

still call a bay roan a red roan.

In the classic, or true roan pattern, a horse's head, mane, lower legs and tail are always darker. Red roan is defined as having a more or less uniform mixture of white hair with red hair on a large portion of a horse's body, but it is usually darker on its head and lower legs. It can have a red or flaxen mane and/or tail.

Blue roans have a more or less uniform mixture of white with black hairs over a large part of the body, but it is usually darker on the head and lower legs. A few red hairs may be mixed in.

AQHA defines bay roan as a mixture of white with red hairs on a large part of the body. Bay roans usually have black lower legs, and a black mane and tail. They are darker on their head, usually red, but can have a few black hairs in the mixture.

Roaning patterns, such as rabicano, add another ingredient to the mix. Typically this pattern, which is also known as ticking, is uneven and is expressed more heavily on a horse's flanks and barrel than on its forehead. Rabicano is usually limited to a few white hairs on the base of a horse's tail and on its flank. It is also known as skunk tail or coon tail.

In another roaning pattern called frosty, the mixture of white is more uneven than in the classic roan. Frosty horses tend to have roan areas mainly over bony prominences, such as the hip, over the shoulder and down the spine. The mane and tail tend to be roan, and the head can have roan areas, as well.

Still another pattern, sabino, can include extensive roaning, which causes some people to confuse a sabino horse with a roan.

"Extremely roan sabinos can be confused with a classic roan horse," Sponenberg said, "but white on the legs and faces, as well as roan areas on the head, will give these horses away as sabinos."

"Roan areas on sabinos are also less even and uniform than they are on classic roans, and the areas are likely to be patched or flecked."

Genetic equations

So, what makes a horse a roan genetically, or, as the experts say, phenotypically? A roan horse must have one roan allele, which is written as RnRn. Because the roan allele (RnRn) is dominant, roan horses produce roan offspring 50 percent of the time.

Roan is believed to be linked to other genes that determine coat color, which makes establishing the inheritance of the gene more complicated because the genes are usually passed along as a group.

The roan gene is closely associated with the E gene, which determines a red or black base coat. Therefore, roans have a high percentage of offspring that are the same color as the roan parent.

For example, when red roans, which have a sorrel base coat, are bred to sorrels, the offspring are 50 percent sorrels and 50 percent red roans. A blue roan, whose roan gene is linked to its dominant E (black) gene, is likely to produce a high percentage of black and bay roans.

If a horse's roan gene is linked to the recessive e (sorrel) gene of a heterozygous (Ee) individual, the horse should produce

lost somewhere, most likely before they were developed.

But because several roan stallions that are homozygous have now been documented, roan may not be lethal in its homozygous form, Sponenberg said recently.

"Now, breeders can relax," he said. Because extremely roan horses have a large amount of white hair, they are often confused with white or gray horses. But, while the roan gene covers specific parts of the body with a light coating of white hair, the white gene (W) completely covers the body with an even, white coat.

The gray gene (G) causes a light sprinkling of white hair over the entire coat, which becomes lighter as the horse grows older. Eventually, the animal turns completely gray or white.

A foal may appear roan at birth, or the color may become apparent after the baby sheds its foal coat. But roans do not become progressively lighter with age, as do gray horses. Instead, some roans become darker as they grow older.

When a roan's hair regrows over a wound, the hair often doesn't come back in as white, so scars and brands are readily apparent, making many roan owners protective of their horses' coats.

Roans change color according to the season. They are lightest in spring, when they shed their winter coats. They are more medium-colored in summer. In winter, they sometimes become so dark they don't look like a roan.

These seasonal changes led to the Icelandic term for roan — litforott — which means "always changing color."

Time for a test?

Currently, there is no direct genetic test for roan, but researchers have identified a chromosome region in which they believe roan exists.

"Roan is linked to certain markers," Penedo said. "If we follow these markers, we can make very good predictions about homozygosity or heterozygosity for roan."

Because there are markers near roan, there is evidence that a chromosome carrying the roan gene has some of these markers associated with it.

"This creates an opportunity for us to identify the roan-carrying chromosome, and through pedigree analysis we can

follow the chromosome from parent to offspring," Penedo explained.

Breeders who want to produce roans would benefit from knowing genetically if their stallions are homozygous roans because such animals would sire roan get 100 percent of the time.

"If you bred a homozygous roan horse to a horse that is just plain chestnut base or black, you would get red roans or black roans (which are called blue roans) 100 percent of the time," said Penedo. "That is the expectation."

If there is enough interest, UC-Davis might develop a marker-assisted test that would help identify homozygous roan horses. Its veterinary genetics laboratory already offers coat color tests for the red factor and agouti (bay/black), as well as a cream dilution test and one for lethal white overo. The lab also does DNA typing and parentage verification.

In the complex world of equine coat color genetics, animals that can be verified to produce the same color consistently are valuable breeding tools in the horse industry, indeed. ■

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Want to learn more?

If you'd like to know more about roan and genetics, the following books and Web sites can help:

- *Equine Color Genetics* by Dr. D. Phillip Sponenberg. A revised second edition was published by Blackwell Press in 2003. Its ISBN number is 081380759X. To order, call (800) 862-6657.

- *Horse Genetics* by Dr. Ann T. Bowling. Published by Oxford University Press in 1996. Its ISBN number is 0851991017. To order, call (800) 445-9714.

- *American Paint Horse Association's Guide to Coat Color Genetics*. To order, call (817) 834-2742, extension 271.

- The Web site of the Veterinary Genetics Lab at the University of California, Davis, at www.vgl.ucdavis.edu. provides a wealth of information on equine genetics.



RANDY AND SUSAN BROOKINGS HAVE BEEN BREEDING BLUE VALENTINE HORSES SINCE 1996.



BLUE VALENTINE, A 1956 BLUE ROAN STALLION, WAS AN OUTSTANDING ROPING HORSE WHOSE OFFSPRING ARE VERY MUCH IN DEMAND TODAY.



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BABES BLUE VALENTINE IS 56.25 PERCENT BLUE VALENTINE, THE HIGHEST PERCENTAGE OF BLUE VALENTINE IN THE WORLD.



BAY ROANS HAVE A MIXTURE OF WHITE WITH RED HAIRS ON A LARGE PART OF THEIR BODIES, SUCH AS DRY FORTUNE, SHOWN HERE.