

We have been extremely selective in our breedings and purchases to include avoidance of blue eyed whites (BEW), their get and any other color which possess or produced blue eyes. I have gone as far as to contact a veterinarian who is also a geneticist when my children decided they wanted to raise fiber producing goats to enhance our offerings with our alpaca fiber. The opinion I had received from the geneticist was that the BEW was not an issue; however he did confirm that it did appear to breed through as a dominant trait. My opinion is that the reason it wasn't an issue for him was because he owns some. If it were an issue, it would be hypocritical. I had gotten thrown off one discussion board because of our position regarding the blue eyed white issue even though I had scientific evidence to support the decision. Since my posting to that board and the invitation to voice and explain our position, I have even found more reasons to continue avoid breeding these alpacas, and advocate their omission from the breeding pool. I am not a geneticist or veterinarian, I do have a Certificate in Animal Science and over 30 years of livestock experience. The information I have learned about the BEW issue is from the internet gleaned from many different published scientific studies from vet colleges, medical research facilities and the like.

There have been some awesome advances in this genetic area, and to us it justifies even more why we will not breed or buy animals with blue eyes or who come from blue-eyed parents.

Absolutely **none** of the advice I have found yet, including talking with noted veterinarians who specialize in Camelid Medicine, recommends breeding blue eyed whites (BEW) of **any** specie that have been afflicted. There is more and more genetic and health reasons for the animal not to be bred, justifying our decision and position I had been taught by several generations of livestock breeders in my family. This is again a reason why I am hoping breeders will respect the decision of those of us who choose not to choose breeding stock from BEW lines and disclose the information when asked. It may also be something established, "veteran" breeders might want to disclose regarding the BEW animals to new buyers who are not familiar with livestock or genetics. A common mistake is to call these BEW animals Albino. This is not correct, as Albino has pink eyes, not the white/blue-grey caused by lack of pigment.

In a nutshell, this is what causes all of this BEW stuff... the key is the Neural Crest:

The neural crest is a transient structure that extends along the rostral-caudal axis of developing vertebrate embryos. It is formed during the process of neurulation and contains a migratory population of cells that give rise to most of the peripheral nervous system, facial skeleton (more about its role for the facial skeleton later) and numerous other derivatives throughout the embryo. This is in all living things.

The pigment Melanin is produced in the body by cells known as Melanocytes, which are formed in the neural crest during vertebrate embryonic development. With the exception of the retinal melanocytes, (eye pigmentation cells), melanocytes migrate outwards from the neural crest to cover the various pigmented sections of the body. The pigment Melanin, is responsible for most mammalian coat coloration, and is widely found in many other living creatures including birds, insects, etc.

Within the melanocytes there are enzymes capable of bringing about the production of Melanin from the amino acid, Tyrosine, in a series of chemical reactions. In the first of these chemical reactions, the enzyme Tyrosinase slowly oxidizes Tyrosine to Dihydroxyphenylalanine better known as *D.O.RA*. It so happens that *D.O.RA* can be synthesized into both Melanin and Adrenaline. Therefore there is a common link between pigmentation within the body, nerve distribution and a hormone. It takes two chemical reactions to convert *D.O.RA* into Adrenaline, but many more to convert *D.O.RA* into Melanin. Each of the chemical reactions requires a specific enzyme, and each of the different enzymes is the product of specific genes.

Many times these chemicals are stopped at the throat or neck area and travel no further. This gives the animal a white neck, head and face, etc. If the pigment cells fail to reach the inner ear where there are hairs for hearing in the cochlea, the lack of pigment cells causes the death of

these hairs about three weeks after an animal is born. The lack of pigment which causes the death of the hairs results in deafness because the hairs are necessary to transmit sound. If the neural crest pigment cells do not reach the eye, the pigment of the eye remains bright blue. Normally vision in the eyes is not affected by the blue color. However, this does make it easy to see an animal that carries this condition.

So far, besides blue eyes and deafness, other health problems I have found with neural crest associations are gastrointestinal (intestinal nervous system) problems and cardiovascular implications... there are probably more, but I am still digging. A popular argument is that people have fair skin and blue eyes, so the BEW animal is being unfairly discriminated against. The fact about this issue is that blue eyes in humans are a different shade of blue caused by different chemical happenings in the body due to ethnic background. However, the same condition caused by the pigment not reaching the eyes and such caused by the neural crest is called Hirschprung disease, and in most if not all people afflicted with this, have the blue/blue-grey eyes.

Now, the fact that this Neural Crest affects the facial skeleton made me wonder if there is a connection in this with Choanal Atresia, Wry face, etc.... so I did some digging on that, also.

Not only is the Neural Crest responsible for the chemicals described above, but also for another portion of the transient structure called the prechordal mesoderm. Prechordal Mesoderm means this mesoderm is the middle of three primary germ layers of an embryo that is the source especially of bone, muscle, connective tissue and dermis (skin) and its location is situated anterior (in front of) the notochord. In following the train of thought in the animals clearly recognized by the blue eyes the neural crest is already not correctly doing its job, taking into account other areas dependent upon the neural crest not being able to properly develop all it is supposed to may help possibly explain many of the other anomalies we are seeing in the alpaca industry.

There is a multi-problem neural crest / prechordal mesoderm issue called CHARGE Syndrome. CHARGE is an acronym for a combination of associated defects - Coloboma (eye – a fissure or cleft of the eye is considered a genetic defect), Heart anomaly, Atresia (Choanal), Retardation (mental & growth), Genital anomaly, Ear anomaly (which includes deafness). This acronym for this syndrome was first proposed in 1981. Each of the main features of the syndrome happens in a degree from absent to severe, and no one feature is present in all individuals affected with the defects. Other anomalies including facial asymmetry (wry face), unilateral facial nerve paralysis, renal (kidney) abnormalities, orofacial (mouth /face) clefts, and esophageal Atresia (closure) frequently accompany the main features.

Now, to make a diagnosis of CHARGE itself, the presence to at least four of the seven features of the association is required, including a major anomaly; for example: Choanal Atresia, coloboma. CHARGE Syndrome itself is sporadic in occurrence. Note: I am not pointing to CHARGE itself in BEW's, mainly because of the necessity of the four of seven features needed, however, I do know of one confirmed case of Choanal Atresia of a blue eyed white cria.

More in depth, the prechordal mesoderm is necessary for the development of the mid face, and it exerts an inductive role on the subsequent development of the forepart of the brain. The mechanisms suggested are:

1. Deficiency in the migration of the neural crest cells neck to go into the pouches and arches of the pharynx that had been previously developed;
2. Deficiency of the mesoderm formation, and
3. Defective interaction between neural crest cells and mesoderm resulting in defects of the transformation of lymphocytes into larger cells capable of undergoing proper cell division. Lymphocytes are key to the immune system.

Since all of these defects certainly seem related in one way or another through the Neural Crest “gone bad”, it stands to common sense that because BEW’s are so easy to detect, there is no reason to breed these problems through. It certainly has so much more to do with the genetic soundness of the alpaca than merely “uniquely colored eyes” or deafness.

I also recently shared email back and forth with a breeder who had information passed to her about an alpaca she owns that supposedly has a Type II Collagen defect because of the thickening of the Pinna or outer ear. Type II Collagen defect has more to do with the connective tissue, joint cartilage (anyone else see a pattern?), etc, where Type III seems to have more to do with the type of cartilage like that of the Pinna. At any rate, the color of that alpaca is dark, and comes from dark imports. However, after doing this research regarding the BEW’s and the Neural Crest with its dictatorship over the precordial mesoderm, I wonder now if what has surfaced in that instance is just an example of what we will be seeing more of since most breeders have somehow gotten the idea that if a BEW dam is bred to a black male, it “erases” the blue eyes in the genetics. It may “hide” it, but it won’t erase it. Keep breeding BEW’s or any animal with blue eyes, and the genetics just get passed on. The only way to “erase” or eliminate something is to pull the animal from the breeding program when it surfaces, and also pull the parents who produced it.

We have always given the advice to ask about any defects in the bloodlines one plans to purchase or breed to. Since the Registry does not require disclosure of congenital defects, BEW, or even just eye color, it leaves one to only make a decision based on the memory of the breeder on whether or not there are blue eyes in the pedigree.

During my research on the internet, I found a Vet's article that gives several points for breeders to remember. I have integrated them with what I was told by my Great-Uncle when I was a kid, and I am finding they are serving me well:

1. Select for traits that are good for the animal,
2. Breed the best to the best (this does not necessarily mean ribbon winners to ribbon winners),
3. Sterilize and/ or pull inferior breeding animals from the pool altogether,
4. Encourage breeders of seedstock to have integrity,
5. Support genetic research,
6. Breed for type,
7. Educate yourself in genetics.

Best wishes and warm regards,

Dawn Turbyfill  
Herd/Breeding manager  
Cedar Grove Alpacas, LLC  
Yelm, WA 98597

© 2004 Cedar Grove Alpacas, LLC  
All Rights Reserved

This article cannot be copied in whole or in part without expressed written consent.