The Relationship between Nose Color and the Brown gene in e/e Red (Pink) Cardigans

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Abstract

This study was undertaken to determine if the variable nose color seen in dogs homozygous for e Red was related to the presence or absence of the b (brown) gene. Previous research reports indicated that in other breeds, nose color was black in dogs which were either missing the b gene or carried a single copy, while those dogs homozygous for the b gene had either brown or self colored noses. It was postulated in the 2005 CWCCA color study that this would be true in Cardigan, but this was not confirmed. Despite having variable nose color, this study failed to detect any e/e Red dogs (n=10) which carried the b gene. We speculate that the nose color could be most analogous to that seen in yellow Labrador Retrievers in which the color of the nose leather can change color with age. It was also discovered that the current test for dominant black (KB) detected this mutation in several Cardigans, but appears unrelated to nose color in e/e Red dogs.

Background

Recently, the Cardigan community has experienced an apparent increase in the number of dogs born with a "Clear red" or "Pink" coat. "Clear red" is a coat color which presents as a red coat totally lacking any black hairs. The genetic basis for this coat color has been clearly identified and is due to the lack of a receptor protein which produces the black hair color (Newton et al. 2000). When this protein is missing, the coat color normally defaults to "Clear Red" in Cardigans and the same mutation has been shown to produce yellow coats in Labrador Retrievers as well as the coat color seen in Irish setters (Schmutz et al., 2002). Designated as "e", the gene acts as a recessive with only the homozygous e/e dogs showing clear red coats. No health issues are known to be associated with e/e red and a DNA test is available for the gene. This coat color is accepted in the Cardigan standard under "red". However, a number of these dogs present with a nose color other than black.

Dr. Shelia Schmutz stated in her 2005 report on Cardigan Coat Color Genetics submitted to the CWCCA (currently available on the club website) that the nose color in e/e red dogs was not determined by the e gene, but by a different gene found at the B (Brown) locus. With this gene, the B variant (allele) was associated with a black nose, while the b allele was associated with a brown nose A study from the Schmutz lab found a one to one correlation with nose color and either the B allele (black nose) or b allele (brown nose) in many breeds, but Cardigans were **<u>*NOT*</u>** tested (Schmutz et al. 2002). Dr. Schmutz assumed that e/e red Cardigans with black noses would be either homozygous or heterozygous for "B", while e/e red dogs with brown noses would be homozygous for "b". In effect, an e/e red Cardigan with a brown nose would have a brown coat were it not for the dominant effect of the e "Clear Red" gene.

Results

Ten e/e red Cardigans with nose colors ranging from brown to black were tested in this study along with positive control dogs for brown, typical red and brindle. All e/e red dogs were found to lack the b allele indicating that brown does not play a role in determining nose color in these animals. Selected dogs (n=6) were tested for dominant black (KB). Two e/e Red dogs (one brown nose, one black nose) were found to carry one copy of dominant black as did the brindle control dog.

Sample #		nose color	E locus	B locus	K locus
1		black	ee	BB	
2		black	ee	BB	
3		black	ee	BB	
4		black as puppy (faded with age)	ee	BB	
5		black	ee	BB	one dominant black
6		black	ee	BB	no dominant black
7		brown	ee	BB	one dominant black
8		brown	ee	BB	
9		black	ee	BB	
10		black as puppy (faded with age)	ee	BB	
11	Brown coat	brown	EE	bb	no dominant black
12	Red coat	black	Ee	BB	no dominant black

13	Brindle coat	black	Ee (pedigree)	one dominant black

Dogs 1-10 displayed a clear red coat and were confirmed as being homozygous for the e allele. None of these animals carried brown. Dogs 11-13 served as positive and negative controls for the tests used.

Discussion

This study suggests that the brown gene does not play a major role in determining the nose color of clear red Cardigans. The low frequency of the b (brown) allele in the Cardigan gene pool prevented us from finding any dogs that were homozygous for both b and e alleles and so the nose color in such animals cannot be determined, but it would seem likely that the nose leather would be brown from birth as would the eye rims (Schmutz et al, 2002). Given these results, we would speculate that the nose color in clear red Cardigans is most analogous to that seen in Yellow Labrador Retrievers who are both e/e red and B/B (or B/b) there for lacking brown. In this situation e/e dogs that are not homozygous for the b allele have black noses and black eye rims. However, the nose color can change with age and is colloquially termed a "snow nose" even though it is independent of climate and season. In this case the nose will lighten (particularly in the center) while the eye rims remain black. The reasons for this change are unclear and the nose may revert to black cyclically or remain light permanently. Therefore clear red Cardigans may have either black or brown noses and the color may change with age.

Lastly, the K locus (Candille et al., 2007) was tested to determine if any K allele correlated with nose color in e/e red dogs. Although only a very small number of animals were assessed, there appeared to be no relationship with nose color. Surprisingly, the presence of dominant black (KB) was detected in several animals although the dominant black coat color does not occur in Cardigans. However, the K locus is also responsible for brindle coat patterning (kbr). While it is very preliminary, research suggests that the kbr allele shares some features in common with KB such that the current DNA test cannot distinguish between brindle and dominant black. If true, then e/e red dogs #5 and #7 would be expected to be genetically brindle, with brindle expression being masked by the e/e genotype.

References

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