

GOLD GLORY: GENETICS OF THE VIZSLA COAT COLOUR — PART I

I am grateful to Professor Sue Ann Bowling and Dr. Bruce Cattanach** for their useful comments on the draft of this article. It goes without saying that responsibility for any remaining error or inconsistency is entirely that of the author. I have deliberately chosen to limit the number of footnotes in the text. Instead of referencing the many statements concerning coat colour genetics throughout the article, a bibliography of the works relied upon in its preparation is appended to the second part of this article – F.-R. Bernier*

INTRODUCTION

Anyone interested in learning about the genotype of the Vizsla's coat colour faces a dearth of information in breed specific literature. Authors of breed books and articles have shown little interest in discussing the genetic aspects of Vizsla coat colour and the suggestions offered in general works on genetics are contradictory.

One of the problems of determining the correct colour genotype of the Vizsla is the practical difficulty of testing possible hypotheses. Lacking both the resources and the inclination to initiate a test-breeding program involving crosses with various other breeds, the only practical way to obtain the required data is to seek information on accidental matings involving a Vizsla. A request for information on such crosses was made on various Internet breed lists and I am grateful for the response, particularly from members of the Vizsla Talk list.¹ The information received was invaluable. An effort has been made to use only reports involving dogs that were reasonably certain to be purebred and crosses about which the reporter had personal knowledge. Although the reliability of information obtained in this fashion is not unimpeachable, this is a case in which imperfect data is better than none. I also take comfort in the fact that these reports present a remarkably coherent and consistent picture.

To properly understand the data presented and conclusions reached in this article, it is useful to have a grasp of some of the basics of colour genetics in dogs and the first part of the article will provide a review of those aspects that are relevant to the Vizsla breed.

PIGMENT: MEANING OF BLACK AND YELLOW

The seemingly infinite variety of colour in dog coats is based on two kinds of pigment: eumelanin (black or dark pigment) and phaeomelanin (yellow pigment). In genetics, any dog that has a coat in which phaeomelanin predominates is referred to as "yellow", whether the actual colour of the dog be red, yellow, tan or fawn. Similarly, the description of black will be used to describe coats in which eumelanin predominates, whether the coat is actually black or the brown produced by the action of the recessive b allele on dark eumelanin pigment.

Pigment is present in the hairs of the coat as pigment granules, and factors such as granule size and granule shape will determine the colour of the hairs and that of the coat. For example, both black and brown require

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the presence of eumelanin (dark pigment). In black coats, the eumelanin granules are oval and intensely brown, so that the hair appears black to us. By contrast, phaeomelanin granules will be smaller, round and yellowish. In a liver dog, the recessive b gene acts on the black pigment granules and lightens their colour, so that the coat is changed from black to chocolate or liver to our eye. But the b allele does not act on phaeomelanin and this is why areas such as the tan points on a "red" Doberman are the same colour as on a black Doberman.

As will be more fully explained shortly, there are two kinds of yellow dogs. First, there is the yellow dog produced by the A^y - genotype. The A^y allele will restrict dark pigment to a greater or lesser degree and, where the restriction is at its greatest, may result in a "clear yellow" coat. Where the allele does not restrict dark pigment completely, the result will be a sable dog (i.e. a yellow dog with black shading). The second type of yellow dog is the ee dog. In that dog, all dark pigment is eliminated from the coat, irrespective of the genotype of the dog at the A locus. This dog could be homozygous for the solid black allele A^s and would still have no black whatsoever in its coat, as the effect of ee is to preclude the formation of eumelanin in the coat or to change it to phaeomelanin. The non-extension allele does not affect the pigment of the nose or eye rims.²

Thirdly, a phenotype resembling that of some yellow dogs may also be produced by the action of the b allele. The colour of most bb dogs is a medium to dark liver or brown; but the action of other genes may modify the expression of the colour so as to produce a phenotype very similar to that of some yellow breeds.

Theoretically then, we have three arrangements that could give rise to a coat colour similar to that of the Vizsla. These genotypes are: A^y -, ee, and bb. The first two would result in a yellow dog in which phaeomelanin is responsible for the coat colour. In the dog with the bb genotype, the base colour of the dog is caused by eumelanin. Both phaeomelanin and the bb form of eumelanin can result in a wide range of colour as a result of the action of various modifier genes. For example, the red of the Doberman or Australian Shepherd is genetically the same as the chocolate of the Labrador or the dead grass of the Chesapeake Bay Retriever. Similarly, phaeomelanin can be expressed as the deep mahogany of the Irish Setter all the way to the cream of some Poodles.

COAT COLOUR GENETICS

This section will focus on the allelic series that are of direct relevance to a determination of the Vizsla coat colour. The series in question are the A (Agouti) series, the B (Brown) series, and the E (Extension) series. As regards other series, such as the D (Dilution) or C (Albino) series, the genotype of Vizslas is fairly certain and these genes are of secondary importance in terms of basic coat colour. The Spotting (S) series, responsible for the distribution of pigment over the dog, and hence the appearance of white, will not be discussed here.³ In short, the focus is on those series and alleles that have the potential to produce a coat colour similar to that of the Vizsla.

Table 1

| <i>Symbol</i> | <i>Designation</i> | <i>Phenotype</i> |
|---------------|-------------------------|--|
| A^s | Dominant black | Distributes black pigment along the complete hair shaft |
| A^y | Dominant yellow (sable) | Yellow pigment predominates (partial to complete) |
| A | Agouti | Hair shaft shows alternance of dark and yellow pigment |
| a^{sa} | Saddle | Yellow dog with dark pigmented saddle |
| a^t | Black and tan | Black dog with "yellow" tan points |
| B | Black | Normal expression of dark pigment |
| b | Brown, liver, tan | Reduces intensity of dark pigment so it appears brown |
| E | Normal extension | Allows dark pigment to be expressed in hair |
| e | Non-extension (yellow) | Precludes expression of dark pigment in hair so only yellow pigment is expressed |

THE AGOUTI SERIES

The full Agouti series may include other alleles in addition to those identified in Table 1. In fact, there is no definitive consensus on the part of geneticists as regards this series. Although Little, Willis and Robinson place dominant black in the series, this has been questioned more recently. Little did not include the saddle gene a^{sa} in the series, but Willis and Robinson do so as a recessive to the agouti gene. Finally, there is a possibility that the black and tan gene (a^t) is not the last of that series but is followed by a recessive black (a) identified so far in German Shepherds and in Shetland Sheepdogs.

The dominant A^s gene is responsible for a solid black coat as it distributes eumelanin completely along the hair shaft. There is a possibility it is incompletely dominant so that A^sA^v or A^sa^t may result in black coats that have a reddish undertone. Dominant yellow A^v is responsible for a yellow or red coat. The A^v dog may be a clear yellow but may present some black-tipped hairs. When these hairs are abundant, sable is produced. For that reason, the dominant yellow gene is also referred to as the sable gene.

The third gene of interest in this series is the black and tan a^t gene. With the possible exception of the recessive black gene a in a few breeds, the black and tan gene is the lowest in this allelic series. When present in an homozygous state, this gene produces the well-known black and tan phenotype seen in breeds such as the Doberman, the Rottweiler or the Gordon Setter. All dogs of these breeds will be $a^t a^t$ at the A locus.

THE BROWN SERIES

Of the three series dealt with here, the Brown series is the simplest to describe. The genes of this series essentially act on eumelanin or dark pigment. The dominant B allows the eumelanin in the coat to appear black, while the recessive b lightens the colour of the eumelanin pigment granules in the coat, so that it appears brown. The B allele is completely dominant to b and also influences the colour of nose leather, eye rims and pads. It should be kept in mind that genes of the Agouti and Extension series determine whether black pigment is present in the coat. A dog may be B- without having a black coat. In such a case, however, the nose leather and eye rims will be black. For example, some yellow Labrador Retrievers have a black nose indicating they are B- even though they do not have any black in their coat.

THE EXTENSION SERIES

In the case of the Vizsla, we are interested in two of the alleles of the Extension series. The dominant E gene is responsible for the normal extension or production of dark pigment (eumelanin) in the coat. The recessive e gene suppresses or precludes the production of dark pigment in the coat, resulting in a yellow phenotype. It should be noted that only pigment in the coat is affected and that pigment of the nose leather, lips and eye rims is not affected. In an ee dog, dark pigment that would otherwise be produced by the action of genes at the A locus, will be suppressed. But pigmentation of the nose leather is unaffected by the genes of the E locus, so that even if the dog is ee, the nose leather will be black if the dog is B- or liver if the dog is bb.

INTERACTION OF AGOUTI AND EXTENSION SERIES

As noted by Robinson, "between them, the Agouti and Extension series control the appearance of the black and yellow pigment in the coat of the overwhelming majority of breeds" (Robinson, p.114). Generally speaking, the E series is epistatic to the A series, meaning that the genes of the Extension series control the phenotypic expression of the genes of the Agouti series. This becomes clearer when certain combinations are considered.

A dog that is A- can have dark pigment distributed over the whole dog, but only if the dog also has the extension allele E as part of his genotype. If an A- dog is homozygous for the recessive non-extension allele (i.e. the

dog is ee), the production of dark pigment will be inhibited and only yellow pigment will be present in the coat. Both dogs are A^s- but one will have a black coat, because he is also E-, while the second will be yellow, because he is ee.

GENETICS OF THE VIZSLA COAT COLOUR

In his *Genetics for Dog Breeders*, Robinson described the Vizsla as follows: "Yellow dog of varying shades, from rich sandy yellow to russet gold. Interestingly, the nose leather and lips are brown. Genotype A^v- bb". However, in *Genetics of the Dog*, Malcolm Willis suggests that the Vizsla is similar to the Chesapeake Bay Retriever. Given the genotype of that breed, as described by Little, Willis and Robinson, this would mean the Vizsla is A^s- bb. In other words, the Vizsla colour is essentially recessive brown (bb) with other genes modifying the brown to both lighten it and give it the reddish hue with which we are familiar. In a report to the 1999 International Conference of Vizsla Breeders in Bugac, Hungary, Professor Lazslo Zöldas endorsed this hypothesis. Finally, a third possibility is that the Vizsla is an ee breed. In his presentation to the International Conference of Vizsla Breeders, Professor Zöldas, while he apparently did not favour that explanation, mentions in passing that the Vizsla colour and its uniformity suggest a resemblance to ee dogs.

In Part II of this article, I review the results of various reported crosses involving Vizslas and evaluate the extent to which the results confirm or contradict the three stated hypotheses regarding the Vizsla coat colour genotype.

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¹ The current Vizsla Talk list has some 1,300 members and is operated by Jenny Peacocke. Information on this list can be found at <http://www.smartgroups.com/>

² It would also appear that the whiskers of A^y yellow dogs are generally black, while those of ee yellow dogs will be straw-coloured or appear colourless. Personal communication from Prof. Bowling.

³ See Bernier, François-R., "Understanding White" (2001). This article has been published in a number of breed newsletters and is also available at <http://www.bajnok.com/resources.htm>