Colors in Highland Cattle

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Highland kilts come in many colors and so do Highland cattle! I had a chance to speak about the genetics of Highland coat colors at the annual meeting in Michigan. Pat White had sent me hair samples of many of her Highlands and so both the attendees and I were able to see some of the animals used in our DNA study first hand.

One thing I learned is that Highland calves may not be born with quite the same shade of color as they have as adults. Some members of the audience also suggested that some adults change as they age. So, with that in mind, assume that I'm talking about a group of 2-3 year old cattle and the coat color they'd have at that adult age.

Two genes are involved in producing the 6 solid shades seen in Highland cattle. *MC1R* or the E locus has three alleles in the dominance hierarchy of $E^D > E^+ > e$. SILV of the D locus has a deletion mutation (del) in Highland and Galloway cattle that reacts in a co-dominant fashion with wild type (+) allele. There are other mutations in this gene that may affect coat color in other breeds, such as Charolais.

The silver and white can be hard to distinguish. Examining the color of the nose leather, tongue and hooves may help decide which it is and therefore its genotype. The silver should have a gray nose and the white, a more pink nose (see the color photo page).

The shades of color in cattle can be affected by sun, some diets, some illnesses, sex, etc. Therefore although the table below is generally what to expect, there can be some variation occasionally.

Brindle

All brindle Highlands must have at least one E^+ allele and no E^D allele. Brindle cattle also need a second mutation in another gene. Although a mutation in the regulatory region of the *ASIP* gene (called A^{br}) was present in all 11 brindle cattle in this study, there were other cattle that had this mutation and were E^+/e, +/+ and were red, not brindle. This suggests that the second mutation for brindle needs further research.

It is not well proven but seems that if brindle cattle have one copy of the *SILV* del allele and are either E^+/ E^+ or E^+/e, then their brindle may not show well or even at all. The cattle with two copies of the *SILV* del allele would be white colored and not show any striping, even subtly.

At the convention, I learned that brindle is not present at birth. I have no explanation for this at present.

Color Photos page 8
The figure of Highland cattle photos shows: (A) black, (B) red, (C) dun, (D) yellow, (E) silver cow and white calf, (F) brindle. All of these cattle, from various owners, have the genotypes correlated to these colors, shown in the small table.

	BLACK SHADES	**RED SHADES**
	E^D/ - (any 2nd allele)	e/e or e/E^+ or E^+ / E^+
+ / +	Black	Red (dark red)
+/ del	Dun	Yellow (light red)
del / del	Silver	White

SPECIFIC GENOTYPES AND POTENTIAL CALF COLORS

Note that the potential calf colors are only all possible if the mates contributes certain alleles. This is meant to illustrate that some cows, for example, will have many different colored calves in their lifetime, with different bulls and others will not have such a wide variety. Likewise some bulls will produce a wide variety of colored calves with a group of cows of different colors and others will not.

Parental Genotype	**Coat Color**	**Potential Calf Colors**
E^D/ E^D, + / +	black	only black
E^D/ E^+, + / +	black	black, red, brindle
$E^D/$ e, + / +	black	only black
E^D/ E^D, + / del	dun	black, dun, silver
E^D/ E^+, + / del	dun	black, dun, silver, red, yellow, white, brindle?
$E^D/$ e, + / del	dun	black, dun, silver, red, yellow, white
E^D/ E^D, del / del	silver	dun, silver
E^D/ E^+, del/ del	silver	dun, silver, yellow, white, brindle?
$E^D/$ e, del/ del	silver	dun, silver, yellow, white
E^+/ E^+, + / +	red or brindle	black, red, brindle
$E^+/$ e, + / +	red or brindle	black, red, brindle
E^+/ E^+, + / del	yellow	black, dun, silver, red, yellow, white, brindle?
$E^+/$ e, + / del	yellow	black, dun, silver, red, yellow, white, brindle?
E^+/ E^+, del/ del	white	dun, silver, yellow, white
$E^+/$ e, del/ del	white	dun, silver, yellow, white
e / e, + / +	red	black, red, brindle
e / e, + / del	yellow	black, dun, silver, red, yellow, white
e / e, del/ del	white	dun, silver, yellow, white

Please see http://homepage.usask.ca/~schmutz/colors.html for further information about the genes involved in cattle coat color.