

## Explanations of coat colour genetics

### XXLdog

#### BASE COLOUR

##### Eumelanin

###### B-Locus (brown, chocolate, liver(nose))

N (no modification) > bd, bc, bs (brown)

###### B-Locus (rare variants)

Breeds b4: Australian Shepherd, Miniature American Shepherd

Breeds be: Lancashire Heeler

Breeds bh: Husky

N (no modification) > b4, be, bh (brown)

Genotype	Inheritance	Effect
N/N	does not transmit brown	No modification
N/bx (onefold)	can transmit brown	
N/bx (multiple)	can transmit brown	No modification or brown Eumelanin
bx/bx	transmits brown	Brown Eumelanin

###### Cocoa (darkbrown, dark chocolate)

Breeds cocoa: French Bulldog

N (no modification) > cocoa (cocoa)

Genotype	Inheritance	Effect
N/N	does not transmit cocoa	No modification
N/cocoa	can transmit cocoa	
cocoa/cocoa	transmits cocoa	darkbrown Eumelanin

##### Pheomelanin

###### E-Locus e1 (yellow, lemon, red, cream, apricot)

N (no modification) > e1 (yellow/red)

###### E-Locus (rare variants)

Breeds e2: Australian Cattle Dog

Breeds e3: Alaskan/Siberian Husky

N (no modification) > e2, e3 (yellow/red)

Genotype	Inheritance	Effect
N/N	does not transmit yellow/red	No modification
N/ex	can transmit yellow/red	
ex/ex	transmits yellow/red	Loss of dark pigment → Coat Colour is determined by pheomelanin

###### I-Locus (pheomelanin intensity)

N (no modification) > i (creme/white)

Genotype	Inheritance	Effect
N/N	does not transmit light pheomelanin intensity	No modification
N/i	can transmit light pheomelanin intensity	
i/i	transmits light pheomelanin intensity	visible pheomelanin appears creme/white

## Dilution

### D-Locus d1 (Dilution, Colour dilution)

N (no modification) > d1 (dilute)

### D-Locus (rare variants)

Breeds d2: Chow Chow, Sloughi, Thai-Ridgeback

Breeds d3: Chihuahua, Italian Greyhound, Mudi, Pumi, etc.

N (no modification) > d2, d3 (dilute)

Genotype	Inheritance	Effect
N/N	does not transmit dilution	No modification
N/dx (einmal)	can transmit dilution	
N/dx (mehrfach)	can transmit dilution	No modification or pigment agglutinates → Base Colour is diluted
dx/dx	transmits dilution	pigment agglutinates → Base Colour is diluted

## WHITE AND WHITE SPOTTING

### White spotting and Ticking

#### S-Locus (piebald, white spotting)

N (no modification) <> S (White spotting)

Genotype	Inheritance	Effect
N/N	does not transmit white spotting	No modification
N/S	can transmit white spotting	assymetric white spotting of different sizes can occur
S/S	transmits white spotting	assymetric white spotting of different sizes → White spotting, Piebald

#### Panda white spotting

Breeds: German Shepherd

P (Panda white spotting) > N (no modification)

Genotype	Inheritance	Effect
N/N	does not transmit Panda White Spotting	No modification
N/P	can transmit Panda white spotting	spotting pattern includes white markings on the face, ventral abdomen, feet and tip of the tail → Panda white spotting
(P/P)		lethal

#### T-Locus (Ticking, Roan)

! The tests includes only the TR allele !

TR (Ticking, roan) > (T (Ticking)) > N (no modification)

Genotype	Inheritance	Effect
N/N	does not transmit ticking	No modification
N/TR	can transmit ticking	
TR/TR	transmits ticking	pigmented spots in the unpigmented areas of piebald dogs

## Albinism and partial albinism

### C-Locus (caL, OCA2, OCA4; albino)

Breeds caL: French Bulldog, Lhasa Apso, Pekingese, Pomeranian

Breeds OCA2: German Spitz

N (no modification) > caL, OCA2, OCA4 (partial albinism)

Genotype	Inheritance	Effect
N/N	does not transmit partial albinism	
N/caL	can transmit partial albinism	No modification
N/OCA2		
caL/caL	does transmit partial albinism	upartially blocked pigment synthesis → partial albinism
OCA2/OCA2		

### C-Locus (OCA4; albino)

Breeds OCA4: Bullmastiff

N (no modification) > OCA4 (partial albinism)

Genotype	Inheritance	Effect
N/N	does not transmit partial albinism	No modification
N/OCA4	can transmit partial albinism	
OCA4/OCA4	does transmit partial albinism	partially blocked pigment synthesis → partial albinism

## COAT PATTERN

### K-Locus

#### K-Locus (only KB-Allel)

KB (uniform pigmentation) > ky (coat pattern)

Genotype	Inheritance	Effect
KB/KB	transmits KB	"uniform pigment distribution → solid coat colour in pigmented areas"
KB/ky	transmits KB or ky	"uniform pigment distribution → solid coat colour in pigmented areas (in exclusion of kbr-allele)"
ky/ky	transmits ky	allows for a mixed distribution of the pig- ments eumelanin and pheomelanin → coat pattern according to A-Locus

#### K-Lokus (brindle)

KB (uniform pigmentation) > kbr (brindle) > ky (coat pattern)

Genotype	Inheritance	Effect
KB/KB	transmits KB	uniform pigment distribution → solid coat colour in pigmented areas
KB/ky	transmits KB or ky	
KB/kbr	transmits KB or kbr	
kbr/kbr	transmits kbr	brindle pattern above coat pattern
kbr/ky	transmits kbr or ky	
ky/ky	transmits ky	allows for a mixed distribution of the pig- ments eumelanin and pheomelanin → coat pattern according to A-Locus

### E-Locus

#### E-Locus (special colours)

E-Locus (EM, e1, e2), Expression depends on the A- and K-locus

N (no modification) > eA, eG, eH (domino, grizzle, sabel, hare pied)

Genotype	Inheritance	Effect
N/N	does not transmit the variant eX	No modification (only if e1/2/3 is N/N)
N/eX	can transmit the variant eX	
N/eX + N/eX	can transmit one of the variants eX	Domino/Sable phenotype (only phenoty- pically visible in combination with A- and K-Locus)
eX/eX	does transmit the variant eX	

#### E-Locus (melanistic mask EM)

EM (melanistic mask) > N (no modification)

Genotype	Inheritance	Effect
N/N	does not transmit EM	No modification
EM/N	can transmit EM	Melanistic mask (only phenotypically visible in combination with A- and K-Locus)
EM/EM	transmits EM	

**M-Locus (merle alleles: Mh, M, Ma+, Ma, Mc+, Mc, m)**

Mh (harlekin), M (merle), Ma+, Ma (atypic), Mc+, Mc (cryptic) ≥ m (non-merle)

Genotype	Inheritance	Effect
m/m	does not transmit Merle	No modification
Mx/m	can transmit Merle	depending on the exact allele, expression of different merle phenotypes
Mx/Mx	transmits Merle	Double Merle Health problems possible!

**H-Locus (Harlequin)**

Breeds: Great Dane

H (harlekin) &gt; N (no modification)

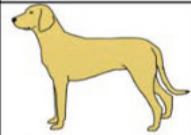

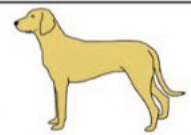
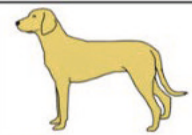
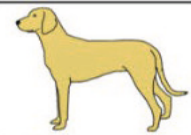
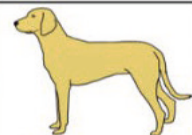












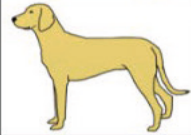





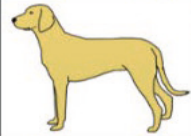











Genotype	Inheritance	Effect
N/N	does not transmit Harlequin	No modification
H/N	can transmit Harlequin	in combination with M-Locus → Harlequin coat pattern
(H/H)		lethal

**A-Locus ASIP Analyse**

DY (dominant yellow) &gt; SY (shaded yellow) &gt; AG (agouti)

&gt; BS (black saddle) ≥ BB1-3 (black back) &gt; a (recessive black)

Genotype	Inheritance	Effect (sofern am K-Lokus kein KB-Allel vorliegt)
DY/DY	transmits dominant yellow	Eumelanin almost displaced → dominant yellow phenotype
DY/SY	transmits dominant yellow or shaded yellow	
DY/AG	transmits dominant yellow or agouti	
DY/BS	transmits dominant yellow or black saddle	
DY/BB1-3	transmits dominant yellow or black back	
DY/a	transmits dominant yellow or recessive black	
SY/SY	transmits shaded yellow	dark Eumelanin in coat tips → shaded yellow
SY/AG	transmits shaded yellow or agouti	
SY/BS	transmits shaded yellow or black saddle	
SY/BB1-3	transmits shaded yellow or black back	
SY/a	transmits shaded yellow or recessive black	
AG/AG	transmits agouti	typical distribution of light and dark pigment → banded hairs of yellow and black
AG/BS	transmits agouti or black saddle	
AG/BB1-3	transmits agouti or black back	
AG/a	transmits agouti or recessive black	
BS/BS	transmits black saddle	Pheomelanin with Eumelanin saddle
BS/BB1-3	transmits black saddle or black back	Pheomelanin mit Eumelanin back
BS/a	transmits black saddle or recessive black	Pheomelanin mit Eumelanin back
BB1-3/BB1-3	transmits black back	Eumelanin mit Pheomelanin markings („black and tan“)
BB1-3/a	transmits black back or recessive black	
a/a	transmits recessive black	uniform coat colour → base colour!

Haplotypen-Allel	DY	SY	AG	BS	BB1-3	a
DY						
SY						
AG						
BS						
BB1-3						
a						

## COAT STRUCTURE, COAT LENGTH, HAIRLESSNESS

### Coat Structure

#### Furnishing (long hair/wire hair)

F (furnished) > f (unfurnished)

#### Improper coat

Breeds: Portuguese water dog

N (normal) > IC (improper coat)

Genotype	Inheritance	Effect
F/F = N/N	transmits Furnishing	furnished phenotype
F/f = N/IC	can transmit Furnishing	furnished phenotype
f/f = IC/IC	does not transmit Furnishing	No modification; lack of furnishing ("Improper coat")

#### Curly (Kraushaar)

C1: all Breeds

Breeds C2: Curly Coated Retriever, Chesapeake Bay Retriever, Lagotto Romagnolo, Spanish Water Dog, Bichon Frise, Irish Terrier

C1, C2 (curly) > NC (no modification)

Genotype	Inheritance	Effect
NC/NC	does not transmit the trait Curly Coat	No modification
NC/C1	can transmit the variant C1 or C2	in combination with coat length and Furnishing → fine curls
NC/C2		
C1/C1	transmits the variant C1	
C2/C2	transmits the variant C2	

### Haaren (Shedding)

N (non-shedding) <> SD (shedding)

Genotype	Inheritance	Effect
N/N	does not transmit Shedding	No modification
N/SD	can transmit Shedding	
SD/SD	transmits Shedding	in combination with coat length and Furnishing → increased shedding

### Double Coat

A (ancient, double coat) <> D (derived, single coat)

Genotype	Inheritance	Effect
A/A	does not transmit single coat	double coat
A/D	transmits single or double coat	double coat (single coat possible)
D/D	transmits single coat	single coat

### Coat length, Hairlessness

#### Coat Length I (long hair/short hair)

L (short hair) > I (long hair)

#### Coat Length II (long hair/short hair)

Breeds: Afghane, Akita Inu, Alaskan Malamute, Chow Chow, Eurasier, French Bulldog, Husky, Prager Rattler, Samojede, Shar Pei, Shiba Inu

Genotype	Inheritance	Effect
L/L	does not transmit long hair	short hair
L/I (einmal)	can transmit long hair	
L/I (mehrfach)	can transmit long hair	short or long hair
I/I	transmits long hair	long hair

#### Hairlessness (Powderpuff)

Breeds: Chinese Crested, Mexican hairless dog, Peruvian hairless dog

H (hairlessness) > N (no modification)

Genotype	Inheritance	Effect
N/N	does not transmit hairlessness	normally haired; Powderpuff
N/H	can transmit hairlessness	hairless (residual hair possible)
(H/H)		lethal

#### Hairlessness

Breeds: Deerhound

N (no modification) > H (Hairlessness)

Genotype	Inheritance	Effect
N/N	does not transmit hairlessness	normally haired
N/H	can transmit hairlessness	
H/H	transmits hairlessness	hairless (residual hair possible)