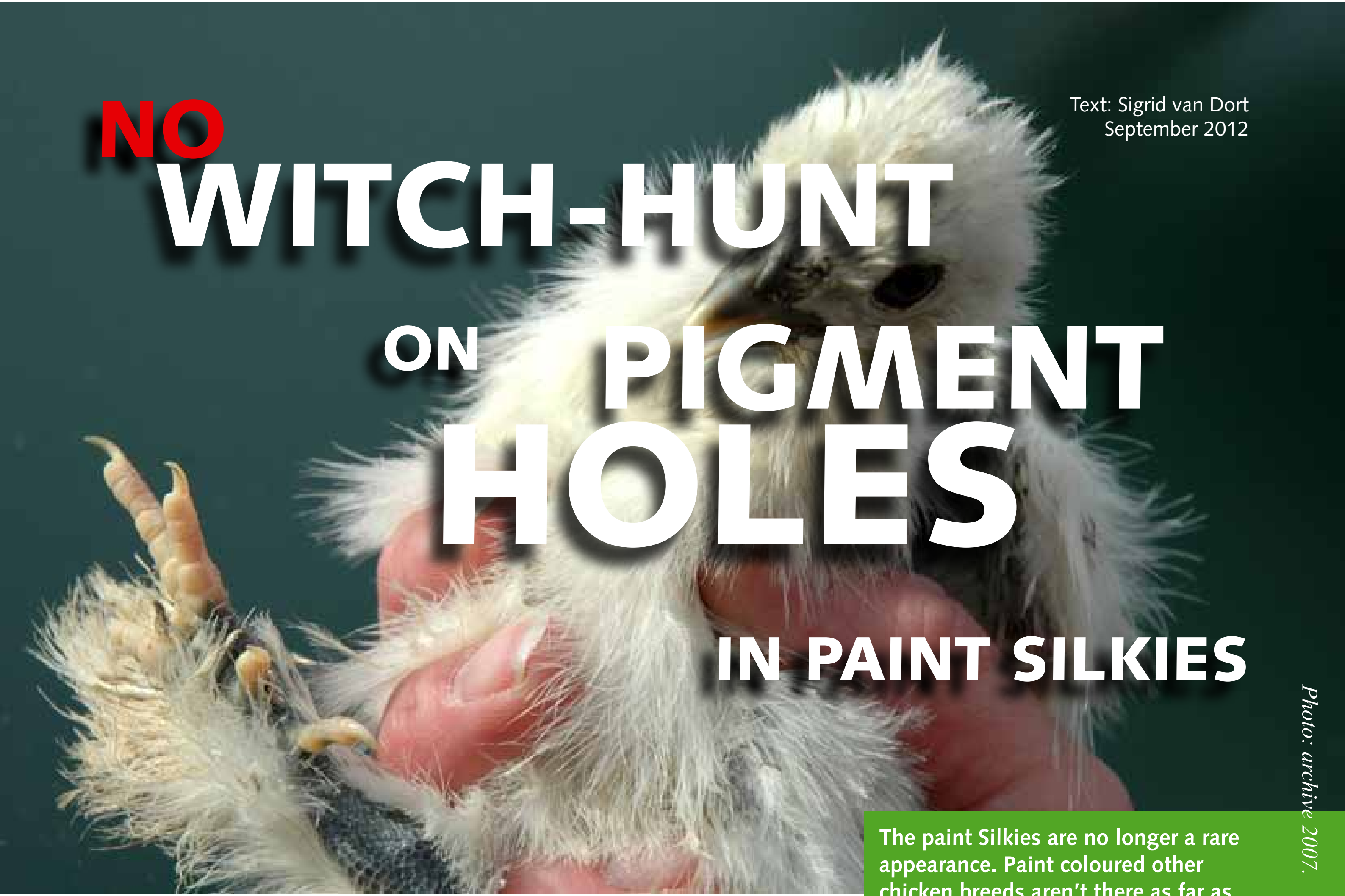

NO WITCH-HUNT ON PIGMENT HOLES IN PAINT SILKIES

Text: Sigrid van Dort
September 2012

Photo: archive 2007.

The paint Silkies are no longer a rare appearance. Paint coloured other chicken breeds aren't there as far as I know. Paint is a weird colour and I see strong similarities with the appaloosa horse coat colour. I bred appaloosas for 8 years, therefore this comparison. The appaloosa colour was explained to me as a coloured horse with a white sheet over it in which holes are cut. The sheet is smooth and the hair on the spots is a bit longer compared to the white hair. Just like in paint Silkies in horses also skin colour is part of the pattern with pigment spots or the absence of pigment. Bay and chestnut horses have dark skin, when they carry the LP (appaloosa) gene they have a spotted skin. Also the sclera around the iris is free of pigment in horses by which they have a 'human' eye. The hoofs are also part of the spotted pattern, they are striped because of the spots on the coronet of the hoof by which the horn grows out with stripes.

Comparing apples and pears: chickens and horses

The coat and feather patterns appaloosa and paint have some analogue

Paint Silkies	Appaloosa horse
Feathers White with black (or a dilution) spots.	***Hair*** White with black (or a dilution) and/or red (red pigment) spots
Skin Melanized with pigment holes (pink)	***Skin*** Melanized as spot (pigment clots the rest pink as paint feathers)
Horn White, black, brown	***Horn*** White, black, brown
Eyes Iris with pigment holes	***Eyes*** Sclera without pigment (human eye)

Why this comparison? I want to substantiate why pigment holes are part of the feather colour of paint Silkies, and therefore inherent to the pattern paint, or in the horse the appaloosa coat colour. I will substantiate it more, this notwithstanding that the precise character and the exact inheritance of the paint Silkie colour is not fully understood, nor researched (whatever is told). The inheritance resembles the way the appaloosa colour (LP, leopard pattern) is inherited which is an incomplete dominant gene, which can be influenced by other genes. The inheritance of LP is simple and can be compared to blue. Blue is the impure state, the pure state is splash and then there is not-blue. This is similar to the appaloosa pattern LP. A loud spotted horse can be compared to blue of the chicken (LP/lp+). A pure appaloosa is called a 'few spot', which can be compared to splash, this horse is LP/LP (Bl/Bl for splash), it has almost no spots,

only pigment behind the elbows, in the groin and perhaps one spot somewhere on the thigh, upper fore leg or the lower belly. The not-appaloosa is a one coloured horse which is even coloured and without spots.
Both the impure appaloosa as the pure few spot show also altered pigment distribution of the skin, eyes and hoofs.
The spots on the skin and the coat of the appaloosa are not synchronous there can be black spots on the coat where the skin is pink and the other way around. This is seen on the paint Silkies as well, white feathers grow from both black and pink skin and blacks as well.

*MC1R gene

...also known as melanocyte stimulating hormone receptor (MSHR). This explanation comes partly from Wikipedia. The MC1R gene is one of the key proteins which is in mammals and also in chickens and its part of the regulation of coat, skin and feather colour. The protein is located in the plasma membrane from the melanocytes which are the pigment producing (melanin) cells.

MC1R determines which type of melanin is produces. Pheomelanine (red) or eumelanine (black). When MC1R is switched 'off' red is produces, when its switched 'on' black is produced.

There are alleles which can weaken the action of MC1R resulting in a light colour: dominant white, agouti in coat colours by which black becomes yellow or red and enhance resulting in a black colour.

Mutations from the MC1R gene are known too. These cause the gene to be constant switched 'on', also when its not stimulated or inhibited by another gene.

Alleles which cause MC1R to be switched 'on' all the time are dominant and result in black pigment. Alleles which make MC1R dysfunctional are recessive and result in a light feather or coat colour.
MC1R can be found in a lot of species, except in us also in laboratory mice, dogs, cats, cattle, chickens and domesticated rabbits.

The same but different?

There has been done no research on the paint feather pattern of Silkies. Feathers given to prof. Andersson of the university of Uppsala didn't contain enough DNA, blood is necessary. Uppsala was part of many research for coat and feather colours and is therefore the right place to see if there are analogous mechanisms between chickens and mammals (e.g. horses) in pigment distribution of a gene which has influence on MC1R.

Paint of the Silkie is doing something with the distribution of black and no-pigment which you see in the pink spots and the white feathers. Red can't be fully suppressed by paint, quite similar to the action of impure dominant white (I/i+). This is another subject on which I will write later one time, in this article I want to show that paint causes pigment holes in skin and eyes of Silkies. I have found a few more examples in which the same mechanism is at play.

Fm (black skin) looks like spots when id+ is not pure on a rooster, or when the expression is suppressed by a feather colour gene (in this case I^D/I^D khaki). From: Genetics of the Chicken Extremes.

Silkies have black skin, this is caused by the gene Fm, fibromelanosis, which deposits black pigment in the skin but also in other tissues like muscles, skeleton and the organs. If there is an antagonist at play which inhibits the action of Fm or if this action is interrupted, this is clearly visible in the Silkie.

Silkies can only have black skin if there is another gene present: id+ (short for inhibitor of dermal melanin). The name is a bit confusing since the wildtype recessive id+ does not inhibit dermal melanin (dark pigment in shanks). It is id+ which causes in e+ wildtype as in Red Jungle Fowl the dark shanks and also in E extended black and ER birchen birds.

A Silkie can only have black skin is there are both Fm and id+ (NOT-inhibitor of dermal melanin) are present because these genes cooperate. Fm/Fm can be pure, but it won't be expressed without id+. The Silkie will have white skin with here and there a dark spot, also when id+ is impure because its recessive, it won't work as id+/Id. Next to this its sex linked, therefore a hen needs only one id+ (id+/-) to express dark skin when Fm is present. A Silkie rooster needs to be pure id+/id+ to have dark skin and dark legs.
id+ is wildtype because Red Jungle Fowl (RJF) has dark shanks, therefore the +. RJF is the norm/standard in chicken genetics.

The recipe for skin/leg colour of the Silkie is:
W+/W+ (white skin), Fm/Fm, id+/id+ or id+/- for the hen. White skin is the autosomal version.

Cuckoo Silkie hen without melanization due to the gene B (barred/cuckoo). She has only one doses of B (B/-) because B is sex linked.

Cuckoo (B) or barred

Cuckoo is a feather pattern gene and determines the overall colour. It causes a continuous on and off switching of all melanocytes (pigment producing cells) of the feathers like a kind of flash light. Cuckoo inhibits next to red and black pigment in the feathers, also effectively id+. It does not function anymore. Whether cuckoo inhibits the action of Fm (black skin), is not known because when id+ doesn't function, Fm doesn't either.
All black pigment in the skin and eyes is inhibited by cuckoo in Silkies by which the combs are red instead of very dark mulberry and the black eyes become eyes as other chickens without extra melanization. The light eye colours can be determined by the amount of blood vessels and carotene which are deposited in the eye. Therefore eyes are orange, or yellowish. There has been no selection for eye colour of Silkies without black pigment in it. Therefore the light Silkie eye colours vary a lot. Cuckoo Silkies show black spots in the eyes because there is some pigment deposited in the iris but not distributed in an even way.
These pigment spots in the iris of cuckoo Silkies are easily mixed up with a deformed pupil (coloboma), which it is not, its a pigment spot.
This is caused by the pursuit of Silkie breeders, against the action of B, of melanization (blue hue) on the legs,

skin, comb and darker eyes. This pigment is distributed in an uneven way with spots as result on both the shanks and in the iris.

European poultry authorities accepted, after a lot of discussions, that the B gene of cuckoo/barred, causes the disappearance of black pigmentation in skin and eyes of the Silkie, which is a breed characteristic. It took yéars to teach standard committees how the B gene works. Asking for a black skinned and eyed cuckoo or barred Silkie is impossible, regardless what some breeders state, some say they breed them with black skin. Nobody ever saw one. These breeders have probably very special Silkies which have something which can switch off something in B, so the skin does contain black pigment.
This idea on itself isn't very weird, an adequate switch, which can switch on the pigment in skin and eyes of cuckoo Silkies, doesn't exist (yet).
A very 'light' inhibitor of the skin pigment-dissolver in cuckoo is lavender. Lavender cuckoo Silkie hens and impure Silkie rooster have a blueish hue on the skin. Móre compared to cuckoo Silkies without lavender.

Impure cuckoo, red comb, white skin and pigment spots on the dermis. Photo: Angela Schouten.

A characteristic of cuckoo is also visible in the paint Silkies. Paint Silkies show light spots in the eyes or completely light eyes and also the skin of paint Silkies shows spots without black pigment just like on cuckoo Silkies. If the Silkie wasn't paint coloured, it would be black skinned. It is paint which causes the

Miniature pigment hole in paint Silkie eye, photo archive 2007.

spots without pigment and nothing else. What is the difference? The paint Silkie breeders don't 'create' the pigment holes, its the gene which is responsible for it, in more or lesser degree (see the photo on the other page), the little light spot in they eye on 6.30 h.

It is sometimes possible to breed a paint Silkie without a light spot in the iris by breeding only with birds without a light eye (mostly on one side). But, there will be always a percentage of offspring which still has one light and one dark or light spots in one or both eyes, even if the parents don't have it. The same, in lesser degree is possible for a few pink toes or spot on the skin when its a showgirl Silkie although the naked skin will become dark red due to UV radiation and the pigment hole will be less obvious. It seems to be more difficult to breed out the pink spots on the feet than pigment holes in the eyes. But what are you doing then as a breeder? Breeding nicely patterned Silkies of good type or only spot-hunting?
The pigment holes in skin and eyes seem not to have any relation, they appear independently from each other.

Top: legs of a black mille fleur Ancona. Due to mottled both black pigment in the dermis as in the epidermis is interrupted. The spots are green (dermis) and black (epidermis). Photo archive 2008.

Even blacks from paint breeding can have these pigment holes, see the photo of the feet of a black paint near the appaloosa photos.
Whether its due to the breeder who selects for no-pigment holes in eyes and visible toes, or that no holes is coincidence is not known, there has been no serious testing on this subject. It looks a bit like what Carefoot once wrote (1985) years ago about the black mille fleur Ancona leg spotting. In former days the spots in the dermis (2nd skin layer) should be on the same place as the dark spots on the epidermis (1st outer skin layer). This was a matter of coincidence and never 100% therefore this demand was dropped on the shows. You can want so much, it should be possible.

Mottled (mo)

The same as what we see in paint and cuckoo concerning suppression of dermal pigment and pigment in the iris, is seen when the gene mo is present from mottling, the white feather tips (like the above mentioned Ancona). Below photos of light Silkie eyes, the right one is from a black mottled Silkie and the left is the light eye of a paint Silkie. By imposing requirements on melanization of paint and mottled Silkies, as done first on the cuckoo/barred Silkies, is against the laws of nature.
The break-through of mottled Silkies in bronze (recessive sex linked chocolate) and blacks, which exist since 2009 from a cross black Silkie x choc/bronze

Below: black mottled Silkie bantam from Israel from a former cross to mottled Cochin bantam. Because of mottled the eye has no black pigment, this is coincidence, sometimes the eyes are black as required. Compare with the eye of the paint Silkie rooster on the left. Photo archive 2007,

Left: bronze/choc mottled Silkie bantam creation, due to mottled no optimal melanization of both skin and eyes. This cockerel is impure for id+ (id+/id). This lad is crossed to a black Silkie bantam hen. Photo from june 2010 of the creation of the bronze mottled Silkie bantams from Serama.

Below: F1 2008 bronze Serama (impure for mottled and silkied) x black Silkie bantam hen. Chick in impure for mottled, notice a bit white on the head.

Serama is just a matter of time. The Serama rooster which was used for this cross had one dose mottled and one dose silkied, that's how mottled came into the Silkie bantams in Holland. See pic above of a choc/bronze mottled Silkie cockerel from this project. There is a difference between bronze (choc is the genetical name) and chocolate which is impure dun colour as in the White crested Polands originally coming from the US (I^D/i+). The bronze Silkies bantams from Serama are pure breeding choc/choc for the roosters and choc/- for the hens because this colour is sex linked. Pairing choc x choc gives always choc because its recessive.
The dark brown dun coloured (hobby name chocolate) WC Polands should be impure to show the dark brown colour, these are made from dun colour I^D which is an allele of dominant white. A pure I^D/I^D dun coloured is called khaki which is a cream colour see pic on the next page. Pure breeding dun colour dilutes the dark shanks of these WC Polands, because dun colour inhibits dermal pigment when pure. Again a feather colour which influences the skin/leg colour. This is the fourth feather colour gene which causes pigment loss in the skin!

There have been made more crosses between Silkies and mottled other breeds, see the photo on the right from Angela Schouten from France.

That mottled changes the colour of the legs even on ER birchen e-allele based birds as WC Polands can be seen on the next page: chocolate (hobby name,

Photo from Angela Schouten from France. A F2 Silkie cross, both Fm and id+ are pure, but mottled causes no-pigment on the legs, only the toes and one complete leg without black pigment.

impure dun colour) mottled birds. Birchen is a pretty 'black' allele in which is also id+ by default, therefore several colours of Polish have dark shanks. As soon as mottled is added, the dermal melanin (black pigment in the dermis) is inhibited. See the large photo bottom page of 'chocolate' White crested Poland bantams in even colour and mottled. The mottled birds have not the required standard legs (dark). This chocolate mottled isn't an accepted colour in Holland as far as I know, so the discussion of the 'wrong leg colour' never took place. How about the khaki WC Polands? Photo on the right shows very light legs on this hen. I don't know, is it accepted by the standard committee that khaki and mottled birds don't have dark legs because I^D and mo make id+ disappear? These questions are for the future and will be asked in more countries but Holland.

It is clear that paint causes next to a white chicken with dark spots also pigment holes in skin and eyes where no black pigment is deposited. Proven evidence of the gene is lacking, I think its an allele of dominant white because the two independently emerged populations of paint Silkies in the USA and Holland have White Leghorn in their pedigree after which the paint colour pattern appeared. In the US there was also blue in the paints, which is also in Holland but from later date. The paint Silkies in both the US and Holland show pigment holes in skin and eyes. It can be assumed with reasonable certainty that its the same mutation.

Discussion

What I try to point out with this article is that certain feather colours have influence on the skin colour (leg colour) and eye colour, and this is part of the feather colour gene (s). There can be disturbances in the pigment expression and distribution in cuckoo,

Top: a pure dun coloured khaki White Crested Poland bantam hen. Pure dun colour (I^D/I^D) causes the disappearance of id+ in the legs, which should be dark. There is only a bit dark hue on the epidermis left.

Even and mottled dark brown dun coloured White Crested bantams, notice the leg colours. Mottled not only causes disappearance of dermal pigment but also the epidermal pigment is inhibited. Mottled is more effective compared to pure dun colour (khaki). Photo: Ringnalda, 2008 mottled, pure breeding dun colour (khaki), in both dermis and epidermis and the iris. This happens also in the paint feather colour.

There can be made no conclusions, nor in the mode of inheritance (is paint intermediary and how about the missing 'dark' last quarter?) although there has been done an experiment which I asked for in the US of paint x partridge to see if there is a dose of dominant white in them, which would result in pyle. Nope no pyle seen. There has been no good documented research done with large quantities of birds as the first geneticists did 100 years ago to determine the exact inheritance of paint. There is nothing wrong with this old fashioned way of testing since many conclusions from the first half of the last century still hold true today. You even don't need DNA because inheritance is inheritance, its a mechanism, a system. Do you want to know exactly what this mysterious paint colour is which seems to influence the MC1R gene, you need a laboratory. This is called molecular genetics if you want to know which protein is responsible for suppression of MC1R and how this typical pigment distribution and inhibition is caused.

Until its clear what the paint feather colour of the Silkies is, and what the pleiotropic effect are of this gene**, holding back concerning the requirements of these natural occurring pigment holes in skin and iris, is necessary. Because a witch-hunt on the pigment holes, causes the death of good typed Silkies, which shouldn't look like splash, so the colour is rather difficult.
If there is something which I really hate, its culling healthy birds from good type, in all other aspects okay, only a few pigment holes in the toes and gemstone-eyes, so ones which don't meet not substantiated requirements just because the knowledge is missing.
Until this knowledge is available, and we already know some feather colours affect skin pigmentation and eye colour, don't hunt for pigment holes.
Better safe than sorry, when it appears nothing can be done about the holes. Learn from the 'cuckoo Silkie' lesson, and also other breeds which should have a dark leg colour which is just impossible because some genes don't allow this.
Standard or not, it is impossible to go against nature. Till we know more.

**The paint-gene doesn't have to be one (1) gene, it can be that this colour needs the help of other genes or proteins; enhancers or inhibitors, which is no exception in chicken colour land.

US paint showgirl (Silkie with Na, naked neck gene) with absent melanization, comes from white showgirl x paint Silkie). Above as a chick, below as mature hen. Photos: Brenda Gambil, American Silkie Bantam Club.

Pigment holes on the rest of the skin in paint Silkie, they are not only on the toes. The naked neck of the showgirl shows this, its hidden under the feathers otherwise.
Photo: Brenda Gambil, American Silkie Bantam Club.