Coloured Sheep

a primer on sheep colour genetics

Irina Böhme
Saskia Dittgen

About the authors

Irina Böhme was born on September 19th, 1973 in Rinteln. As a molecular biologist she worked with state-of-the-art DNA-sequencing methods. In what sometimes feels like a parallel universe, she breeds sheep. Since spending time in Ireland as an Au-pair she has been fascinated with sheep. The old nordic breeds being most dear to her heart. That fascination led to travels - long and short - to some of the breed's 'home turf': In order to learn about sheep, shepherds, their country and their history.

Sheep colour genetics combines her interests in sheep and science and her passion for making scientific knowledge accessible to non-scientists.

Saskia Dittgen was born on November 12th, 1968 in Heidelberg. She made her dream come true in 2009 when she bought a smalholding in Krahne/Brandenburg. She takes care of 2 Border Collies, several cats and chickens and about 40 sheep. Saskia breeds pedigree Shetland sheep since 2018. She is fascinated with colour genetics and she and Irina have been working through pedigrees of many generations of Skudde which led to the idea for a colour genetics primer.

Saskia works as a freelance editor and translator for Dutch and German.

For Flora, Rosa and Violet
three white Skudde. Without them none of this would have happened.

Contents

The cards

Resolution to page 39

Foreword

With great excitement I awaited this book. It was long overdue. We were forever entangled in endless discussions about the question: what colour is this sheep? And why?

Sound knowledge was needed: we needed scientific foundations! Sure, colour genetics follows biological rules, but what are they? Irina Böhme and Saskia Dittgen have put it on paper — finally!

The passion of both authors for the colour diversity of nordic sheep breeds combined with in-depth knowledge in the field of genetics and Irina's very individual style of writing give this book a lightness that will hopefully inspire many readers, like me.

Back in school genetics seemed awfully complicated and applying it to breeding sheep seemed impos-sible. Now it not only makes sense but turned into a fun game!

Sigrid Heilmann

I think this is an excellent book and I am sure that all breeders of coloured sheep would learn a lot from reading it. It is really well done and much more detailed and covers a wider range of topics than it appears to at first glance. I am very impressed with this work.

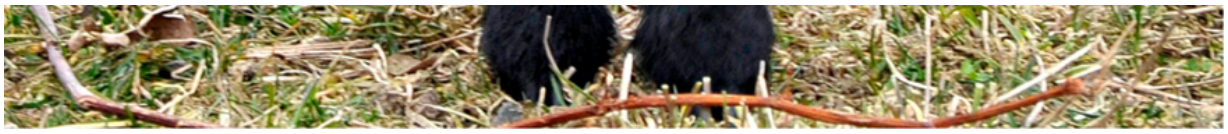
Roger Lundie

Is this book for you?

This book is for anyone who is interested in sheep colour genetics, who wondered about a black lamb out of two white parents, or a brown spotted one out of a white ram and a black ewe.

This book is for breeders who take delight in coloured sheep and who want to know where all this colour comes from, but it is also for those who want to avoid certain colours in their flock and want to learn how to do that.

This book is written for people without any background knowledge in heredity or genetics. It is a primer to help understand the basic principles of sheep colour genetics. To help open up a fascinating aspect of breeding sheep.



Introduction: coloured sheep

Nature is surprising, fascinating, and resourceful in creating diversity. That is also true when humans step in with planned breeding. Sometimes even more so when humans step in.

You probably have an image of an archtypical sheep in your head. But no single real sheep will match that 100%. There is lots of diversity. But we recognise those diverse animals as being sheep. In most cases.

Now think about colour: did you ever have a discussion about a shirt being turquoise, teal or light blue? Apparently everybody sees colours slightly differently. Most of us will have heard the cliché that women differentiate more colours than men. A discussion about ‘teal versus blue’ is probably not as common among men.

Colours and their distribution in the coat of a sheep (or other animal) and the genetics behind them cannot be assigned at will by a human observer. Genetics follows rules. We can deliberate over whether we call a particular colour ‘grey’ or ‘blue’ or ‘red’ or ‘brown’ or whatever we think describes it best. But the pigments that make up the colour and their distribution in the coat of a sheep won’t be changed by the name we call it.

This books aims to help to SEE. And to explain the biological rules that colour genetics follows. It might also be helpful for finding a common language when discussing a sheep’s

colour. What one person might call a ‘mottled red’ could be ‘brown’ for the next person.

'They all look the same!’ and ‘this is supposed to be the same colour?’

We’ll look at differences that have a genetic cause (that we can then use for our breeding aims) and we'll look at similarities that can sometimes hide behind individuality. Not all differences in appearance have a (simple) genetic cause.

Some things we can see easily. Others are more of a puzzle. Sometimes we can only figure out what is inherited if we know a couple of related animals and follow this trait through the generations. This book will help with that, too.

It is not only about SEEING what is there but also about describing it in a concise way: we’ll introduce some lingo for colour genetics. We won’t need lots of complicated terms; mostly it is the common, everyday terms that cause misunderstandings in discussions about sheep colour. Using standards terms for colour genetics will help.

The most confusing is COLOUR itself! In this book we use colour to mean the overall impression we have of the colour of the whole sheep. ‘It looks smudgy mottled blue’ would be its colour.

This overall colour is made up of several components. One of them being the pigment. ‘The main dye used for painting colour on a sheep’ if you so wish. We call this the base colour.

Keeping sheep has a long tradition. They were (together with goats) the first livestock that humans domesticated.

There are lots and lots of regional terms in use. We won’t be talking about gimmers and hoggs.

We’ll use **ram** for the (intact) male sheep and **ewe** for the female. We’ll use **ewe lamb** and **ram lamb** for the young animals.

Breeding for colour?

For hundreds – no: thousands – of years sheep have primarily been used as a source of fibre. Colour is important if wool is being used. White wool can be dyed in lots of different shades. Coloured wool won't need to be dyed. There are many examples of folk costumes that have bodices, vests and coats made of naturally black wool.

Some breeds were mainly used for making pelts. A silvery grey pelt was often preferred.

Fashion and the market often influenced the breeder's decisions and they still do today.

Those selling wool in large quantities to woolen mills need consistency. Large batches of very similar wool. In colour and quality.

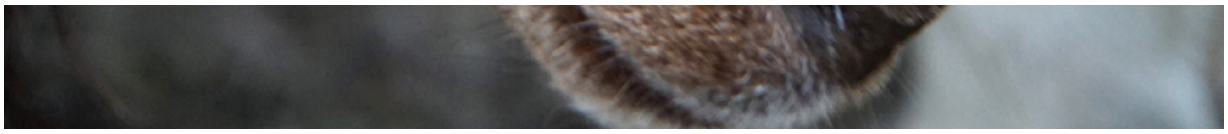
A small scale farmer might take delight in a colorful diverse flock. Fibre artists are fascinated by all the hues that can be found in naturally coloured wool.

Colour is powerful. It is rather hard NOT to look at colour. It jumps at us and influences our impression more than anything else. (Except maybe horns. They are hard to overlook, too.)

But there is much more to a good sheep. Colour can be an added bonus. Knowing how colour genetics works can help

us with our breeding decisions. Whether we aim for pure white or spotted or ‘creamy cappuccino coloured’.

And it’s great fun, too!



A simple model

Heredity – genetics – is pretty complicated. But predictable to a high degree with the knowledge of just a few basic rules.

One of the first who figured out that there are ‘rules’ to how traits are passed on to the next generation and the nature of these rules was the monk Gregor Mendel.

Mendel did breeding experiments with peas and came up with an idea to describe those rules that he observed. He published them in 1865, long before chromosomes and DNA were discovered.

Science has made a lot of progress since then and we know a lot more detail now. But Mendel's model is so good that it is still valid. Because it is a model based on clear observation. No more. No less. It is a system that helps us to visualise complex things in a simple way.

Lots of people remember Mendelian Rules from school. For some people they are very logical while others could never get their heads around them.

In this book we use a simple analogy to illustrate these rules:

Colour genetics as a game of cards

Colour genetics as a game of cards

A bit of luck, some skill and lots of fun: colour genetics is like a game of cards.

We need a bit of background knowledge. Or else this game would be like a slot-machine where we hope for ‘three lemons’ again and again.

The basic blueprint of a living being is coded in its ge-nome, its **DNA**. DNA is organised in long stretches - **chromosomes**. Each chromosome has sections – **genes** – that are small, functional units. Being just a blueprint these genes need to be ‘read’ and translated. Just like a blueprint is read and turned into a house or a car or whatever the plan specifies. A chromosome could be likened to a recipe book with a gene being a specific recipe.

Sticking to colour genetics: the blueprint gives instruc-tions to make certain proteins that carry out a range of 'jobs' in the body. “Go to this cell in this part of the body and incorporate this pigment”. That is an image we can use to visualise what is going on.

A sheep has 54 chromosomes with lots of genes on them. They contain everything that is needed to make a sheep. We can picture this as a stack of 54 cards. Organised in pairs. 27 pairs – 27 different cards (different sets of instructions) in duplicate. One of each pair from mum, one from dad. Each chromosome – each card in a pair – has instructions for the same trait as the other card in the pair but the details can vary. Each sheep has this full set of