

RECENT RESEARCH ON MULTIPLE HORNED SHEEP BREEDS - Ingrid Painter

Research was carried out in 2016 at Utah State University (USU) by Tracy Hadfield and Noelle Cockett in conjunction with CSIRO (Commonwealth Scientific and Industrial Research Organization), Australia, James Kijas and Marina Sanchez to study the locus responsible for the four horned condition and its relationship to Split Upper Eyelid Deformity (SUED).

Breeders of Navajo Churro and Jacob sheep provided photographs and blood for analysis for the study of genome sequencing to identify the chromosomal location which controls two horned, multi horned and polled sheep. Four Utah and one Oregon Navajo Churro (n-c) breeder and four Jacob breeders participated in this study.

The study showed that the polled and multiple horned condition come from separate locations in genome sequencing. Multi horns are on Chromosome 2 and polledness on 10. The multiple horns (polycerate) are developed from several other genes during embryonic stage making it complex. The polycerate condition has been reported in many countries - UK, Iceland, Norway, China, Pakistan, North & South Africa, North & South America. It is not known if this trait has a common origin or whether it evolved independently throughout the world since sheep were first domesticated.

It has been established that the gene for polled n-c ewes is the same as for other breeds of sheep that are polled in both sexes. (*Hayes et al 2012; Kijas et al 2014*). Most Navajo Churro ewes show evidence of scurs of various lengths. There are a few polled rams encountered. In the Jacob breed polled rams and ewes are not acceptable for registration in the US or the UK because it is believed that this shows evidence of cross breeding.

At one time Jacob breeders in the UK were advised to cull any lamb with any type of SUED. Within a few years very few multi horned Jacobs could be found. The association (Jacob Sheep Society) then pleaded with their members to retain 4 horned individuals for breeding. So the polycerate Jacob in UK was saved ... unlike many other multi horned breeds in other parts of the world.

The study at USU provided some insight into the SUED condition being linked to multiple horns but more research and a larger sampling is needed to verify this connection. Some preliminary studying was done at Oregon State University by Dr Stanley Snyder, DVM, pathology (Director of Diagnostic Lab,) to look into the connection between SUED, multiple horns and Occipital Condylar Dysplasia. This study was never completed.

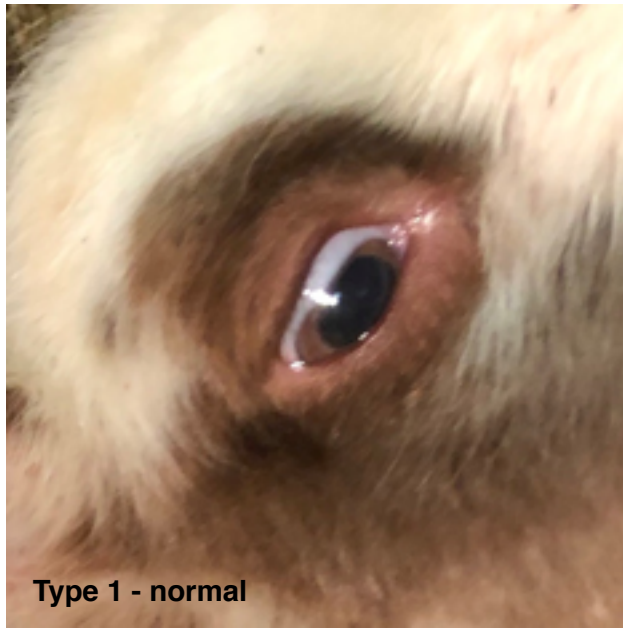
The origin of the multi horned trait is unclear along with its relationship to SUED. - is it a single gene producing or having multiple effects on another gene?

From experience within our breed we have found that by using two horned rams on multiple horned ewes or four horned rams on polled, scurred or 2 horned ewes the incidence of SUED is greatly reduced. The papers cited below are consistent with what breeders have observed. The evidence of SUED points to the fact that there is a connection and with careful breeding and record keeping it can be minimized without fear of eliminating the polycerate condition.

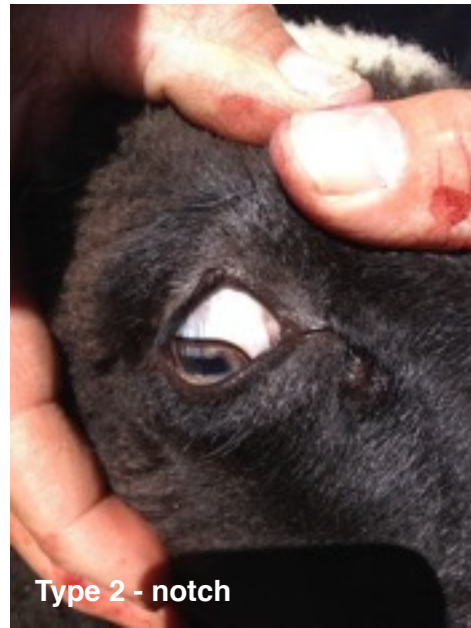
Examination by several n-c and Jacob breeders of multiple horned skulls of sheep with SUED in life showed distinct notches on the upper eye socket. In severe cases this split in the bone ran

from the eye to the base of the horn core. Some of the skulls from sheep showing no evidence of SUE in life had small notches on the eye socket rim. These skulls were from both breeds.

Unfortunately there was only a limited amount of data available to the researchers and therefore limited conclusions and sadly little research money to pursue what is a scientific curiosity.



Type 1 - normal



Type 2 - notch



Type 3 - split



Type 4, complete eyelid split

Photos by Tracy Hadfield and Ingrid Painter

Further reading:-

“Genome-wide association reveals the locus responsible for four-horned ruminants.”

Tracy Hadfield and Noelle Cockett in conjunction with CSIRO, Australia, by James Kijas and Marina Sanchez.

First published 14 January 2016 <https://doi.org/10.1111/age.12409>

“Polyceraty (multi-horns) in Damara sheep maps to ovine chromosome 2”

O. F. C Greyvenstein C. M. Reich E. van Marle-Koster D. G. Riley B. J. Hayes

First published: 14 January 2016 <https://doi.org/10.1111/age.12411>

The Catch Pen, Fall issue, October 2002, pages 10, 11, 12.

Synopsis of talk on “Occipital Condylar Dysplasia” given by Dr Stanley Snyder, DVM, pathology Oregon State University (Director of Diagnostic Lab).

SPLIT UPPER EYELID - AN OVERVIEW - by Elizabeth Henson,

The term “Split Eyelids” is generally used to describe a range of conditions found in the upper lid of sheep. This condition is almost exclusively confined to the breeds which also show multihorn characteristics, the Jacob, Manx, Hebridian and Navajo Churro. In the extreme case the eyelid may have a split of 1 1/2 - 2 cm in length with tufts of wool and hair growing inside the lid and into the eye itself. This is scored as a type 4 or 5. More commonly a small notch is seen which causes little or no detrimental affect to the animal in question and is scored as a type 32 split.

At a subclinical level a puckering of the lid or simple break in pigment may help in identifying carrier sheep. This is scored as a type 2 but may not even be detected without further examination. It is a weakness rather than a break in the tissue.

The inheritance of split eyelids has been a bone of contention for many years because it is not “simple”. However, most workers are in agreement that it is closely linked to the genes controlling multihorn factor.

LINKS TO HORNS

All evidence links the occurrence of severe split eyelids to four horned (or multihorned) sheep. It must be remembered that polled animals are often genetically four horned but they also carry an additional polling gene which masks the expression of any horns and this hides the multihorn character of the animal. Neither horns nor eyes are inherited in a simple, Mendelian fashion, with one condition being dominant to the other.

Both horns and eyes are found in continuum. In the case of horns from a split in the horn core, no visible in the live animal, to a split in the tip of the horn sheath, to grooved or split horn, to full multihorns. Similarly the eyelid may range from a notch to full split as already described.

Severe eye conditions do appear to be limited to multihorn animals and often those with a prominent forehead noted by a number of workers and noticeable also in the polled Navajo Churro of the USA.

It is important to remember that we are not dealing with a simple on/off, 2/4, split/not split system. We have the interaction of the genes controlling the number of horns and the genes controlling the split eyelids and we may have variable penetrance.

In the past workers have considered the sp-lit eyelid as being closely linked to the four horned characteristic and that therefore four horned animals were the carriers of the splitting gene. However there are other possible explanations.

Both 2 and 4 horned sheep might carry the eyelid splitting gene but being 2 horned could cause the eyelid splitting gene to be masked.

There might also be variable penetrance of the splitting gene such that an animal which has genetically bad eyelids might not develop them even though his or her lambs could inherit them. Penetrance of a gene is determined by the environment in the widest sense. Thus it might be affected by other genes carried by the animal, possibly unrelated to eye development. They could be influenced by minerals, diet, weather conditions, space in the womb and so on. It may be that none of these are involved but their effects might explain why some flocks are still experiencing problems having selected breeding stock with apparently good eyelids.

SELECTION

We have already selected within the continuum of horn types to fix on strongly 2 or 4 horned animals and have selected out the weak horns, fused and splitting horns.

We are now trying to impose on top of that, selection for good eyes. I believe that badly split eyelid animals should be culled from pedigree breeding programmes and that rams should be carefully selected to avoid those with even a weakness in the eyelid. **However, animal breeding is about balancing the faults and strengths of a flock.** Good teeth and jaws, strong legs and all the other characteristics that make up a good sheep should be given equal weight when making these important selections.