Genetic Achievements of Claw Health by Breeding

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Take Home Messages

- There are large variations in claw measurements as well as in the incidence of claw diseases. Part of this variation is due to additive genetic effects, which makes it possible to select for better claw health.
- A large volume of claw health reports from Swedish claw trimmers gives a base for breeding for claw traits.
- There is an indisputable difference in claw disease incidence between Swedish Red and Swedish Holstein cattle.
- There is a poor correlation between conformation traits and claw disease traits. This implies that claw health is a genetic variation not captured in the traditional breeding program.
- A high claw health breeding value is associated with longevity.
- There are long term possibilities to improve resistance against the most common claw diseases if claw disease traits are used in breeding programs.
- A claw health breeding index is based on the four most important claw diseases.
- Breeding values are available for more than 600 bulls used in Sweden.

Introduction

More than hundred years ago, in the Swedish Veterinary Journal it was stated that *"Claw disease, with inflammation of the claw corium, is the most common cause of lameness, and purulent complications are common often leading to impaired performance and slaughter"*. Although a completely different

husbandry system exists today, the importance of health and performance stays the same. Lameness, where claw disease is the most important cause, is an increasing problem in high-yielding dairies world-wide and different strategies are used to promote health. It is well known that good management, feeding and housing promote good claw health, and healthy animals are a prerequisite for high production. But, high milk yield is also a risk factor for production diseases such as claw disease and poor fertility (Hultgren et al., 2004).

Production diseases can be prevented or kept in control by different short- and/or long-term strategies. Evolution is based on natural selection and a long-term and very old strategy is to improve traits by breeding. But in husbandry in general and in dairy production in particular, breeding has been used primarily to enhance milk production. Breeding for conformation traits has also been very popular with the expectation to increase longevity. All breeding is based on a natural variation of the trait of choice. Even if both sexes are responsible for genetic development the use of artificial insemination makes the contribution from males much more important. Bull breeding values are based on data from progeny and the quality of the data determines to a great deal the success. For milk performance, the breeding has been a success as we produce excellent data from each individual cow, which can be gathered daily and measured exactly. Conformation traits are more subjective data and are collected by trained, synchronised evaluators. But health and fertility traits are even more difficult to collect and harder to diagnose correctly as many different evaluators are involved, and the calculated heritability is therefore much lower. The number of registrations also needs to be higher to estimate reliable breeding values. Moreover, because health and fertility are usually negatively correlated to production, it is difficult to get improvements in both performance and health as performance is often prioritized.

Dairy cow conformation traits, including leg and feet posture, are believed to produce healthier cows with longer survival. It has been an aim to breed for a steeper toe angle. However, despite breeding efforts progress in reducing lameness internationally is not evident.

Figure 1. Common claw trimming with record keeping

■ Can Lameness Be Reduced By Breeding?

Holstein cows have, at least under Swedish conditions, a higher risk for lameness and sole ulcer as well as a higher risk for culling for feet and leg in comparison to other breeds. Thus, can claw health be improved in the long-term by genetic achievements under high performing conditions? More than twenty years ago attempts were made to collect claw data from Swedish AI-bulls at their claw trimming to find correlations between claw measurements and claw diseases. The purpose was to breed and use bulls selected for optimal feet and legs traits to get healthier progeny. This indirect method was however not found to be successful. The next step was to gather direct claw information from progeny of certain young bulls and search for hereditary traits. All available daughters from 105 Swedish Red (SR) and Swedish Holstein (SH) bulls were identified and one person collected claw data (measurements and lesions) after trimming within 2 to 4 months after their first calving. Altogether 299 SR and 324 SH cows were studied at trimming. The study generated relatively good heritability values for some measurements and diseases (claw pigmentation 0.7-0.8, sole hemorrhages 0.1-0.2 and heel horn erosion 0-0.1) but the number of daughters from each bull should have been higher to get more reliable results (Ral et al., 1995). Another approach has been to collect lameness and claw disease records from Swedish veterinary practitioners to find possible traits for breeding. However, those data resulted in very poor genetic correlations, probably

because the diagnosis was uncertain and the disease incidence was low. A reason for low incidence of claw diseases and lameness, recorded by practicing veterinarians in Sweden is that claw trimmers are treating most claw lesions such as sole ulcers, white line disease, digital dermatitis etc. Most claw trimmer treatments are also made at maintenance preventive claw trimming, which means that many subclinical diseases are detected and lameness is reduced. With this in mind, a system to collect claw data at regular claw trimming was developed. The study, KOFOT 2000, where 5000 cows in 100 Swedish herds were trimmed and lesions recorded during 2 years (Manske, 2002), contributed to the development of the new recording system. In this study record keeping was explored and suitable scores were developed in close contact with practicing claw trimmers and researchers.

■ Record Keeping by Swedish Foot Trimmers

Swedish foot trimmers are private entrepreneurs and are trained to record claw lesions at maintenance foot trimming but certainly sometimes at acute visits (Figure 1). Today Swedish foot trimmers record about 250,000 trimmings annually (Table 1). The record keeping is voluntary and the number of active foot trimmers and participating herds is constantly increasing. A paper form is used and beneath the first page the copy is kept clean that is sent in for scanning. The scanned data are then stored in the national cow data base together with data on production, fertility, udder health etc. for further use (Figure 2). Farmers, extension personnel, veterinarians, foot trimmers and other animal health staff can enter the data base via internet and explore claw statistics at a cow, herd, and national level. The administration of the system is managed by the Swedish Dairy Association (www.svenskmjolk.se) and financed by the breeding association recently named Viking Genetics (www.vikinggenetics.com). The foot trimmer charges the farmer for the trimming and is free to charge extra for the record keeping. There has been one campaign with very good results but the best marketing for record keeping is to show that the records are used and generating positive breeding results. Nordic Cattle Genetic Evaluation is also promoting the system and a common Nordic system has been agreed upon. In Denmark an electronic recording system is under development (http://www.landbrugsinfo.dk/Kvaeg/Sundhed-og-dyrevelfaerd/Klove-og-lemmer/Sider/Startside.aspx).

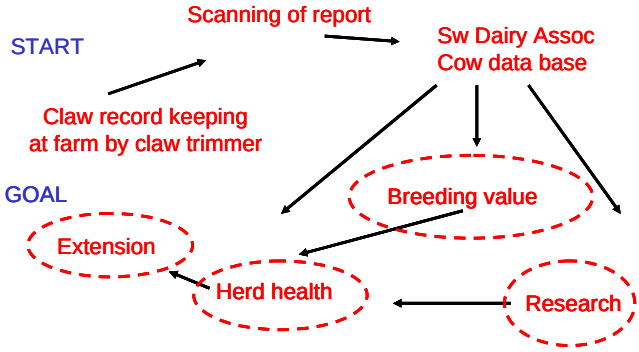

Fig. 2 Swedish claw disease recording system

Table 1. Prevalence (%) of claw disease for Swedish Red (SR) and Swedish Holstein (SH) during 2008 and 2009.

	2008			2009		
	SR	SH	Total	SR	SH	Total
No. of trimmings	94 200	107 037	219 501	107 354	120 382	250 231
Healthy	65	59	62	65	59	62
Sole hemorrhage	17	23	20	16	23	20
Heel erosion	20	20	20	20	21	20
Dermatitis	8	10	8	8	12	10
Ulceration sole, WL	3	6	5	4	7	6

■ Difference Between Breeds

Claw trimming data from 2003 to 2007 from 180,000 trimmings from Swedish Red (SR) and Swedish Holsteins (SH) were used to calculate genetic parameters and repeatability between lactations. Univariate analyses were used to estimate the heritability and bivariate analysis was used to estimate correlations between lactations. The heritability varied between 0.035 and 0.085 for the four claw diseases in SR and SH breeds. Genetic correlations were very high between the same trait in lactation 1 and 2 and also between dermatitis and heel horn erosion as well as between sole haemorrhages and sole ulcer. There were clear breed differences and the prevalence for heel

horn erosion, sole haemorrhages and sole ulcer differed clearly between SR and SH and the differences between breeds for sole haemorrhages and sole ulcers increased with higher lactation number (Table 2). This difference indicates a higher recovery rate in SR or more pronounced weaknesses with age in SH. There was also a very good correlation between claw health and prolonged survival value, which is promising for the use of claw disease records for future long term improvement of claw health. Estimated breeding values are now available for approx. 600 breeding bulls. More new bulls get proofs for each index run. The bulls get official claw health proofs 2-3 months after receiving proofs for milk production. More data from the progeny of young bulls is needed to generate breeding values from these animals.

Table 2. Prevalence (%) of the most common claw diseases in Swedish Red (SR) and Swedish Holstein (SH) breed by lactation number

Heel horn erosion	SR	SH
1st lactation	17.4	16.3
2nd lactation	20.0	21.2
3rd lactation	22.3	23.9
4th and higher lactation	24.1	26.4
Sole haemorrhages		
1st lactation	20.9	24.7
2nd lactation	16.9	22.7
3rd lactation	18.5	26.2
4th and higher lactation	21.3	32.8
Ulceration of sole and WL		
1st lactation	3.3	4.4
2nd lactation	2.5	4.7
3rd lactation	3.3	7.2
4th and higher lactation	4.8	9.4

■ Genetic Correlations Using Claw Disease Data

In a recent study (Buch et al., 2009) these Swedish claw trimmer data were used to calculate breeding values and correlations between claw disease, performance, fertility and mastitis. The study set consisted of 64,000 records from Swedish Red first calving heifers. A good correlation was found within hygiene-related claw diseases (dermatitis and heel horn erosion) and within laminitis-related claw diseases (sole hemorrhage and sole ulcer), although the heritability values (Table 3) were lower than in a previous study (Ral et al.,

1995). There was no indication that their genes (hygiene and laminitis related diseases) were connected to each other which is rather logical. A higher Milk Index (protein yield) was unfortunately associated with more claw diseases. Mastitis was associated with laminitis-related claw diseases and fertility was associated with both laminitis-related and hygiene-related claw diseases (Table 4).

Table 3- Breeding values in first calving heifers of Swedish Red breed

Trait	Heritability	Genetic association
Dermatitis	0.035	0.87
Heel horn erosion	0.031	
Sole hemorrhage	0.05	0.73
Ulceration of sole & WL	0.033	

Table 4. Associations between breeding values for claw diseases and mastitis, fertility and Milk Index

	Mastitis	Fertility	Milk Index
Claw disease	0.18	0.21	- 0.11

■ Association between Conformation and Claw Diseases?

Breeding for feet and leg conformation traits has been used for a long time with the intention of improving claw health. Claw disease data from 200,000 trimmed cows together with claw and leg type traits from 120,000 of these cows were selected from first calvers of SR and SH breeds, trimmed and recorded during 7 years. The heritability was generally low for conformation traits and genetic correlations with some exception (Uggla et al. 2008). There were no associations between claw diseases and conformation traits for SH and were low for SR, which makes indirect selection to reduce claw diseases by using conformation traits less promising.

General Reflections

Today's claw health breeding values in Sweden are based on at least 40 daughters. The breeding value is an index where each claw disease contribution is based on its importance for lameness and economy under Swedish conditions; dermatitis 0.1, heel horn erosion 0.2, sole haemorrhages 0.2, and sole ulcer 0.5. This index can certainly be modified if the disease panorama changes and more weight is needed for another claw disease. At present, the farmer demands records from each trimming and this supports the system since the foot trimmers want to satisfy their customers. Moreover, the quality of trimming and keeping records are now subject to improvement by continuing education of claw trimmers and control of their records according to the golden standard.

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