# Danish Swedish Farmdog Health Testing

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### *Breed History and General health and longevity*

The Danish Swedish Farmdog (DSF) has a long history from lower Sweden and Denmark where the breed was common on farms where it was a multi-purpose working dog. The Farmdog is a dog that was small, predominantly white and friendly and was common in these regions. It was not formally registered with a stud book until the 1980s when a large group of dogs was introduced into the registry. For a period of time the Swedish Kennel Club maintained an open stud book and the Danish Kennel Club still currently has an open stud book. The Swedish Kennel Club and the breed club also discourage inbreeding. This history is important to the health of the breed since it is an almost ideal breed history for genetic diversity. Many breeds suffer from small founding populations and/or intense inbreeding which has resulted in decreased genetic diversity. Not so with the DSF. My research group recently did an analysis of inbreeding across dog breeds and the DSF was one of the breeds with the highest genetic diversity. The average inbreeding across all dog breeds was 25% and the DSF was only 8% [1].

Everything has to be put into perspective and compared to other breeds the DSF is doing quite well. However, once genetic diversity is lost it is impossible to get back without crossing outside of the breed. It is very important to continue to support the most diverse breed possible which includes in the US 1. Breeding more dogs rather than one dog more times (encourage new owners to consider a litter and to keep their dogs intact). 2. Importing unrelated dogs as much as possible to keep our gene pool as diverse as possible. 3. Avoiding overcontribution of sires (trying to have equal contribution of sires and dams).

In addition to having genetic diversity the DSF are relatively healthy and live long lives. In Sweden the majority of dogs have health insurance and Agria Insurance data shows that the DSF is a very healthy breed. Agria reports breed based insurance data for mortality (death) and morbidity (non-routine veterinary care events). Compared to all breeds, DSF are 11% less likely to require non-routine veterinary care and have about the same risk as mixed breed dogs. Compared to all breeds in the same time window, DSF are 55% less likely to die and 30% less likely to die then mixed breed dogs.

### *Specific Health Issues- Phenotype tests*

Although the DSF is healthy there are some diseases that can occur based on morphology and coat color. Dogs of small body size are predisposed to a disease called Legg Calve Perthes (LCP) and this disease has been reported in the DSF and is a disease that the Swedish breed club suggests to watch for. This disease is a developmental orthopedic disorder that presents between 4 months and 1 year of age as rear leg lameness or reluctance to run and play (If it is bilateral). It occurs when the blood supply to the femoral head is disrupted and leads to necrosis (death and degeneration) of the head of the femur. While LCP may sound like hip dysplasia they are actually two very different diseases. In Sweden some

reports of clinical hip dysplasia led to the breed club requiring hip clearances at 1 year of age for breeding for a number of years. That requirement was recently lifted. In particular there was concern that removing dogs from the gene pool that were not clinical (grades as fair or mild hip dysplasia) might not be good for the breed diversity considering the very low number of clinical cases. Since severe hip dysplasia and LCP can both be diagnosed in young adults (1 year old) taking preliminary OFA hip films should work to screen for both of these diseases in the US.

Unilateral and bilateral deafness can occur in any breed with extreme white spotting. Since it is difficult for breeders to determine if a dog only hears in one ear, BAER (Brainstem auditory evoked response) is the recommended way to test each ear to determine if the dog can hear in both ears. BAER can be done as early as 5 weeks of age. Dogs that hear in one ear can have a difficult time localizing sound, so determining if a puppy is unilaterally deaf will aid in proper placement. White spotting deafness is causes by not having melanocytes (pigment producing cells) in the inner ear. In the Jack Russell terrier breed, greater white had a higher risk of deafness [2]. If a dog is unilaterally deaf it can be matched with a dog with hearing in both ears and more pigment on the face and head to reduce the chance of deafness in the puppies.

### *Specific Health Issues- DNA tests*

Multipanel DNA tests (Wisdom and optimal select) have provided data about the occurrence of disease mutations in breeds different from the breed in which the tests were developed. This allows breeders to take advantage of research already performed for other breeds. In the DSF, Primary Lens luxation (PLL), Hyperuricosuria (HUU), and MD1R were identified from results of multipanel tests [3]. These three diseases have been verified across many breeds of dogs and are recessively inherited. Primary lens luxation (PLL) can cause cataract, lens luxation and glaucoma resulting in blindness and eye removal. Hyperuricosuria causes increased excretion of urate in the urine which predisposes dogs to bladder stone formation. In male dogs this can become a serious condition. MD1R changes the permeability of the blood brain barrier making some medications toxic to dogs with two copies of the mutation.

**Table 1 Frequency of disease variants in the DSF in order of testing priority.**

| *Disease* | *Number* | *% N/M* | *% M/M* | *Inheritance* | *Comment* |
|---|---|---|---|---|---|
| **CDDY/IVDD** | **105** | **21.9** | **8.6** | **Dominant** | **Identified in two DSF with disc herniation** |
| **PLL** | **450** | **17.3** | **0.9** | **recessive** | **DSF with two copies affected with disease** |
| **AI** | **163** | **11.7** | **0** | **recessive** | **DSF have the disease** |
| **HUU** | 448 | 5.1 | 0 | recessive | Causes bladder stones in many breeds |
| NCL8 | 366 | 1.4 | 0 | recessive | Low frequency |
| MDR1 | 450 | 0.7 | 0 | recessive | Low frequency |
| Prcd-PRA | 366 | 0.3 | 0 | recessive | Low frequency |
| DM;SOD1A | 450 | 12.9 | 0.2 | recessive | Unsure if it causes disease in the DSF |
| PLN; NPHS1 | 366 | 25.4 | 1.4 | recessive | Poor evidence for disease causation |

N= normal version, M= mutant version

Recent results for DSF from Mars Wisdom added DM (degenerative myelopathy), Amelogenesis imperfecta (AI), NCL8 (Neuronal Ceroid Lipofuscinosis 8), and Protein Losing Nephropathy (PLN). For DM, it is important to identify clinically affected dogs before the test can be used. DM is a disease affecting the spinal cord, resulting in slowly progressive hind limb weakness and paralysis. A related

breed, the Fox Terrier, has a very high allele frequency of DM and no clinical cases, so the DSF may not be affected by this genetic variant either [4].

AI was previously identified in the Parson Russell terrier and is recessively inherited [5]. There are some reports of DSF with tooth enamel problems but to my knowledge they were not tested using this DNA test to confirm that this causes disease in the breed. NCL8 causes a severe degenerative neurological disease but has not been reported in the DSF possibly the mutation is so rare in the breed. Protein Losing Nephropathy (PLN); NPHS1 gene variant is not likely to be the actual causative variant since this disease has not been reported in the DSF. It has also not been reported in any breeds other than the original soft coated Wheaton Terrier.

CDDY (chondrodystrophy) have been identified by our laboratory in two clinically affected DSF. CDDY is a dominantly inherited risk factor for intervertebral disc herniation. The risk of disc herniation is 5 to 15 times greater in dogs with 1 copy of the CDDY mutation than in dogs without CDDY based on work done in other breed and mixes [6]. There are other causes of disc problems in dogs but this is the most common one seen in many breeds and the only one to have an identified genetic basis. Chondrodystrophy also causes a modest decrease in leg length (Multiple studies), increased head width [7] and rounding of the ear tips (anecdotal evidence). Since it causes phenotypic effects, breeders may inadvertently select FOR this mutation if they are not performing DNA testing to avoid it. Since CDDY is a risk variant for disc herniation there are many dogs with this mutation that never have clinical signs of disease.

At this time the most important diseases to test in the DSF are bolded, italicized and underlined in Table 1. Recessive diseases can be managed by **avoiding** breeding two carriers (dogs with 1 copy of the bad version of the gene) to each other (25% chance of producing an affected puppy). If a carrier is bred to an unaffected dog 50% of the puppies will be carriers and 50% will be normal on average. CDDY, which is a dominant risk variant, has to be managed differently. Breeding a dog with 1 copy of CDDY to a clear dog means that on average 50% of the puppies will have CDDY which increases the risk of disc herniation. However, it is important for breed diversity to breed a broad group of dogs. This is why we recommend a breed and replace strategy. Dogs with 1 copy of CDDY can be bred to clear dogs and the puppies tested to determine which ones can be used to keep up diversity in future generations without the added risk of disc herniation. Because this mutation also causes changes in the look of a dog, breeders could select for it, so it is important to test dogs to identify dogs at risk. Here is a link for more information about CDDY https://vgl.ucdavis.edu/news/managing-genetics-chondrodystrophy.

Some companies test for a linked marker to CDDY and this marker does not work in the DSF so I recommend testing for the mutation directly. All of the other DNA tests mentioned here are direct tests by companies at the time this article was written.

We live in a time when we are fortunate to have a lot of information about inherited disease variants. Genetic diversity is also incredibly important to the future health of the breed. These tests and suggestions are NOT meant to exclude dogs from breeding but to include as many dogs as possible into our small US gene pool so we can continue to build the incredible legacy of the DSF in the US and continue to have healthy dogs.

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