What has Pedigree Breeding done to the Domesticated Dog: Beauty or Beast?

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Introduction

The dog (*Canis familiaris*) is thought to have been the first animal species to be domesticated. Dogs ha have been shaped by artificial selection into more breed categories than any other living animal with more than 400 breeds now recognised (Careau *et al.*, 2010). Each breed is essentially a closed breeding population with its own mutations and genetic diseases. Humans have exerted selection for specific traits to shape each breed as they see fit, whether it's for phenotypic traits such as a short snout, or for a specific task such as herding. But have our selections caused more harm than good?

Inherited disorders due to breeding practices include metabolic defects, neurological and sensory disorders, immune system abnormalities, blood disorders and congenital physical deformities (Summers *et al*., 2010), and the number of newly recognised canine genetic diseases increases by 5-10 percent per year (Patterson, 2000). This paper aims to analyse the effects of pedigree breeding by overuse of popular sires and inbreeding in the domesticated dog, and to suggest solutions for the defect epidemic.

Discussion

The popular-sire effect is when breeders choose to use some sires more intensively than others. This practice leads to dissemination of genetic disorders and reduction in genetic diversity. When one sire is used more than others, there is risk of him being the carrier of a deleterious recessive allele, which will then be disseminated throughout the population (Leroy & Baumung, 2010). For example, a clinically healthy male dog that is a winner at shows or a champion in field trials may happen to be a carrier of a disease mutation that is not yet evident. He is widely sought after for breeding and is mated to a number of females. The mutation he carries can then be passed on without being noticed through a number of subsequent generations until descendants of this popular sire are interbred, allowing the disease to manifest.

A recent study on thoracolumbar spinal cord compression in Shiloh Shepherd dogs gives good evidence of the common sire effect (McDonnell *et al*., 2008). The authors found in five closely related dogs born from different dams but all by the same sire, all displayed thoracolumbar myelopathy (McDonnell *et al*., 2008). These results indicate that the sire is responsible for the disease in the offspring and the authors recommend further examination of more Shiloh Shepherds to confirm this unfortunate trend.

Inbreeding involves the mating of close relatives to fix certain characteristics within a population originating from a specific animal. If a breed is based on small founder numbers, it is impossible to avoid inbreeding, which has been shown to be the causative factor behind the relatively high prevalence of certain inherited disorders (McGreevy & Nicholas, 1999). Inbreeding also has potential to negatively affect biological fitness in dogs, which is associated with a higher risk of disease (Crispin, 2011). Leroy and Baumung (2010) show that inbreeding has been intentionally practised in most dog breeds. They also show by close examination of 10 dog breeds raised in France that the practice of inbreeding has hastened the purging of lethal alleles with the percentage of homozygous animals increasing and with it, the number of individual deaths per generation (Leroy & Baumung, 2010). The greater the level of inbreeding, the greater the chance of breeding dogs with inherited defects (McGreevy & Nicholas, 1999). Contrary to popular belief, genetic diseases are not due to inbreeding per se but instead to the presence of deleterious mutant alleles being carried in the breeding population (Patterson, 2000). If these mutations can be detected by laboratory testing, it

should be possible to continue selective breeding while eliminating the carriers of deleterious mutations from the breeding pool (Patterson, 2000).

Some established breeding programs have aimed to reduce the incidence of inherited defects by placing regulations on breeders. One such program to reduce the incidence of myxomatous mitral valve disease in Sweden for Cavalier King Charles spaniels (CKCSs) involved a minimum age for breeding and a heart auscultation without murmurs eight months before mating. Lundin and Kvart (2010) studied the effectiveness of this breeding program by examining six-year-old CKCSs and found that there was no improvement on the prevalence of the disease from dogs born in 2003 compared to those born in 2001. This could be due to the short timeframe, but the breeding program may yet have a slow effect on disease prevalence over a longer period. More research will need to be done in the future. However, such breeding programs have been shown to be ineffective for other inherited diseases such as hip dysplasia. Despite screening procedures and breeding programs based on phenotypic selection, the prevalence of hip dysplasia in large and giant breeds remains high (Ginja *et al*., 2010; Lewis *et al*., 2010).

Conclusion

More measures should be put in place so that breeders and breed associations must comply with the regulations already legislated. It is less expensive and less complicated to prevent the occurrence of inherited diseases than it is to eliminate the diseases later. The goal should be to enable breeders to reduce the disease burden across pedigree dog breeds through effective and efficient genetic selection. Some breed-management strategies could include avoidance of certain sires, limiting the number of litters per sire and even the relaxation of breed rules to permit controlled out-crossing. Breeders should also avoid mating close relatives to prevent the negative consequences of inbreeding. Quality of life should always be taken into account when breeding for a specific trait. The breeding community should also consider the scientifically assessed impact of any abnormalities. If the scientific community believes that a trait is a liability to the animal's health and quality of life, measures should be taken to eliminate it. However, with all of these suggestions, the need for compliance by breeders and breed associations is essential for genetic progress.

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