

Thoroughbreds and Greyhounds: Biochemical Adaptations in Creatures of Nature and of Man

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1 Introduction

The purpose of this paper is to describe how adaptations, especially within the muscular system, may have bestowed advantages that may account for the athletic abilities of two species, canine and equine. Although both species may not represent the fastest of mammalian animals known nor the best for endurance, selection processes imposed during their domestication and development for specific tasks initially connected with hunting, farming, and warfare, and more recently for leisure activities, led to a wide spectrum of breeds with differing capabilities. A study of these provides an interesting comparison to elite human athletes whose training today tries to lift them above their natural limitations. It could be argued that information obtained from studies of these two athletic species could be more useful in an understanding of muscular development in man rather than the extensive studies carried out in the most commonly used model, the rat. In a recent review on skeletal muscle adaptability (Saltin and Gollnick 1983), studies in the rat were generally referred to when the required data was lacking from investigations in man.

Within the canine species the greyhound is commonly acknowledged as the fastest breed, attaining speeds of just under $1,000 \text{ m min}^{-1}$ over 400 m. The greyhound, evolved for hunting by keenness of sight and fleetness of foot, originated in Babylon and Egypt, and reference to its participation in coursing was recorded in Ancient Rome by Ovid. Development for speed with stamina has led to the modern greyhound, a description of which is best given in the following quote, "The modern greyhound the most elegant of the canine race, the highest achievement of man's skill in manipulating the plastic nature of the dog ... as he is stripped in all his beauty of outline and wonderful development, not only of muscle but of the hidden fire which gives dash, energy and daring, stands revealed a manufactured article, the acme of perfection in beauty of outline and fitness of purpose. He is a combination of art and Nature that challenges the world unequalled in speed, spirit, and perseverance, and in elegance and beauty of form as far removed from many of his clumsy ancestors as the English Thoroughbred from a coarse drayhorse" (Dalziel 1868). At the other end of the spectrum are the sled dogs, huskies, which can race over distances of up to 1,710 km in 12–14 days. Twelve dog teams have been recorded as pulling a sled and driver over 32.5 km cross-country in sub-zero temperatures in 77 min (Van Citters and Franklin 1969).

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In comparison, the development of equine species for true speed has been a much more recent occurrence. Breeds have been selected from both cold-blooded and hot-blooded types, the former giving rise to pony and draught horse breeds, whilst the latter to those endowed with speed such as the Thoroughbred, Arab, and Standardbred (Trotter). The Thoroughbred, which is portrayed as the epitome of speed, has only been developed within the last 300 years. The breed was first raced over distances of 3–4 miles, but changes in fashion have seen still faster animals being developed and racing distances now vary between 1,000–3,200 m; although jump races are held over longer distances. In the USA the further pursuit of speed has given rise to the Racing Quarterhorse, with speeds of up to $1,200 \text{ m min}^{-1}$ over 400 m.

The eliteness of these two species can be seen when their maximum oxygen consumption is studied. Although in both species the rate of oxygen consumption at rest is as for other mammalian species, proportional to their body weight raised to the power of 0.75, both deviate from the predicted scaling effect when $\text{VO}_{2\text{max}}$ is compared to body weight in that they have higher than expected values (Fig. 1). As the results shown in Fig. 1 were determined from non-elite breeds, an even higher $\text{VO}_{2\text{max}}$ could be expected in the elite.

This high aerobic capacity indicates a very high metabolic activity of working muscle, and is related to the sustained speed of these species. The ability to attain this high

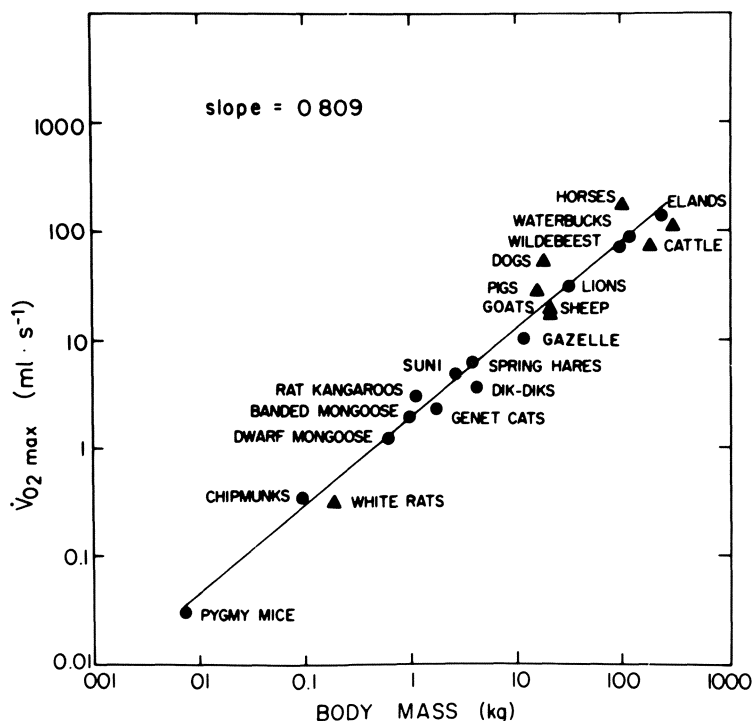


Fig. 1. Average values of $\text{VO}_{2\text{max}}$ for 14 species of wild animals (circles) and 7 species of laboratory/domestic animals (triangles) are plotted as a function of body mass on logarithmic co-ordinates. (From Taylor et al. 1980)