Going the distance

For optimum performance, conditioners need to train the individual horse according to its muscle type and racing distance

by Brian Nielsen, Ph.D.

A FEW years back, I was visiting with a trainer who raced a few Arabian horses. That trainer had failed to win a race for about five years in a row.

When asked about the training protocol, the trainer indicated that her horses were galloped about six or seven miles per day. Given that the typical race that was carded for Arabians at the track she was racing was about five furlongs, I did not see the logic in galloping the horses so far.

However, as she explained to me, her horses were very fit and could “go forever.” My thoughts were that when they quit carding five-furlong races and started writing forever-furlong races, this training strategy would make some sense.

Fortunately, the trainer listened to the advice that she really needed to shorten the distance her horses were galloped. Her horses then went on to win the first two races in which they were entered that year.

Truthfully, I am always skeptical of anecdotal evidence, so I cannot say it was a difference in training distance that contributed to the turnaround in racing fortune, as many other factors may have played a role. That said, by understanding a little about different types of muscle fibers and how they adapt to training, one can recognize how training methods can affect performance and realize how, by training incorrectly, it can be impossible to maximize performance.

Sprinters and routers

Two major types of muscle fibers exist—slow-twitch and fast-twitch.

Slow-twitch fibers would be considered an endurance-type fiber. They have more ability to sustain exercise over a long period of time and are fatigue-resistant but do not generate a lot of force or speed.

Slow-twitch fibers would be considered highly oxidative (capable of effectively utilizing oxygen) and have a high concentration of mitochondria, often referred to as the powerhouse of the cell because they convert oxygen and nutrients into energy.

By contrast, fast-twitch fibers are able to generate greater power and speed but have less ability to sustain them for long periods.

Fast-twitch fibers can be further divided into highly oxidative fibers with a relatively high ability to utilize oxygen (but not to the same extent as slow-twitch fibers) and highly glycolytic fibers with an increased capacity to generate energy by using glucose (glycogen) without the use of oxygen.

Depending upon the percentage of each of these fibers in the body, the physical appearance of an individual can vary greatly. In human athletes, elite marathon runners have a very high percentage of slow-twitch fibers as compared to fast-twitch fibers, and this composition aids them in completing the 26.2 miles of a marathon without fatiguing by using predominantly aerobic metabolism (meaning with oxygen).

Slow-twitch fibers are more slender, which allows them to more easily get oxygen to all parts of the muscle fiber and remove waste products— both processes that are necessary to sustain exercise over long periods of time.

In contrast, elite human sprinters have a greater proportion of fast-twitch fibers that allow them to run rapidly for very short distances. These muscle fibers are larger in diameter and generate a lot of power when contracting, but they are rather inefficient in generating energy and they fatigue much sooner than slow-twitch fibers, as they function primarily anaerobically (without oxygen).

When you compare the two types of athletes, the difference in physical appearance is dramatic. Elite marathon runners appear to be skinny and have slender muscles; elite sprinters have rather large muscles.

In horse terms, we could compare the marathon runner to the Arabian and the human sprinter to the American Quarter Horse with its large muscles. The Thoroughbred is intermediate and probably would be comparable to the human who runs the 800-meter race or the mile.

As in humans, the fastest sprinters (Quarter Horses) have the greatest amount of fast-twitch fiber types while, of the three breeds mentioned, the Arabian would have the most slow-twitch fibers, with the Thoroughbred again in between.

In the genes

Obviously, there are genetic differences that cause variation in the amount and type of muscling present. For example, it is quite easy to distinguish between many Arabian and Quarter Horse foals at birth simply based on muscling. However, training also can affect muscle-fiber types. Most horses (at least the athletic breeds) seem to have a greater amount of fast-twitch fibers present compared with the slow-twitch fibers. From an evolutionary standpoint, this makes sense. The modern-day horse developed to escape from predators. Horses did not need to run for long distances to do so. Instead, they often needed to run for only a quarter-mile or less—just long enough to escape their pursuers.

Horses have an ability to change the composition of muscle-fiber type, though the capacity probably is not as great as in humans. And, whereas humans can train to increase either their endurance or their speed, the horse is much more limited, predominantly just increasing the amount of oxidative fibers present (increased endurance) at the expense of the fast-twitch fibers (reduced speed). Simply put, from a muscle standpoint, most of the training that is done with horses acts simply to increase endurance and not speed. This can either work to your advantage or disadvantage, depending upon the length of your race.

Sacrificing speed for endurance

I first started galloping racehorses about 20 years ago at Canterbury Downs in Minnesota. Despite the track running a mixed meet of Thoroughbreds and Quarter Horses, I never watched the Quarter Horse races in the two years I was there. At the time, I thought the way Quarter Horses were trained, with only a minimal amount of galloping, was totally inappropriate. However, once I moved to Texas and started galloping Quarter Horses in addition to Thoroughbreds, my view on this changed.

I was riding for a very successful trainer who explained to me that if you gallop Quarter Horses too much, you actually can slow them down. Interestingly, when one examines the science behind muscle physiology, it becomes apparent that this is true.

Horses such as Thoroughbreds and Quarter Horses start with predominantly fast-twitch fibers (approximately 80% of all muscle fibers). Especially when training Thoroughbreds, one of the goals is to increase the endurance of the horse to allow them to compete at distances often beginning at around five furlongs. That distance is too far to run using primarily anaerobic metabolism to sustain speed. By comparison, the racing Quarter Horse runs substantially shorter distances (typically less than 440 yards or about two furlongs), which require less dependence on aerobic metabolism, with success depending more on speed.

The more distance a horse travels in training, the greater the development of its capacity for aerobic metabolism. A portion of this development entails the change of some fiber types from more glycolytic to more oxidative. This change gives the horse more endurance, but it also reduces the speed of the horse. Knowing this, it is easy to understand why exercising a horse six or seven miles per day will result in a horse that cannot win a race at five furlongs. It also makes sense that training a horse for sprint races most likely is going to involve a different training program than the one for a horse that is going to be running in route races.

Similarly, though it has been promoted as a good way to get horses fit, interval training turns out to be a poor choice for the average Thoroughbred. Changes that occur with interval training involve a transformation of muscle-fiber types to ones that give more endurance, but typically at the expense of speed.

The body adapts

As with many physiological systems, the change that takes place in the composition of muscle fibers, which enables the body to work more efficiently at the distance for which it is being trained, is simply the body's adaptation to whatever forces are being applied to it. If the challenges to the body are to go a longer distance, the body adapts.

Unfortunately, it is not possible to have greatly increased endurance while maintaining top speed, which is why you will never see elite marathon runners competing in sprint races at the Olympics. While those marathon runners are capable of running faster miles than most of us could ever imagine running, they are no match for elite athletes who are trained for short sprints. Likewise, sprinters would be no match for distance runners when competing in longer races.

Besides probable genetic differences in the composition of muscle-fiber type, the amount and type of training they do greatly alters the ability of those athletes to compete at various distances. A similar situation exists with horses. Even within the Thoroughbred breed, there are lines known for speed and lines known for stamina. That is the genetic component. The training component deals with how far and how fast they are exercised.

The more miles covered in a week, the greater the endurance the horse will have but the slower its top speed. Unfortunately, guidelines indicating exactly what the balance will be are not well-defined. Part of the reason for this is that other factors besides muscle dictate how far you need to track your horse, including such things as different personalities and issues related to soundness.

Regardless, to determine the ideal training protocol for a horse, one must keep in mind the distance the horse will race. While it may seem reasonable to get the horse really fit by putting in a lot more miles, the question you need to ask is, "Do I plan to race five furlongs or forever furlongs?" When you realize that muscle adapts to what you subject it to and that it cannot have maximum endurance and maximum speed at the same time, you realize that galloping a lot more than everyone else may not be the answer you are seeking.

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