

The Genetics of Racing Performance in Arabian Horses

Usman @FAST

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Abstract

Arabian horses are commonly believed to be one of the oldest and most influential horse breeds in the world. The high financial benefits obtained from races tend to search for genetic markers strongly correlated with the results achieved. To date, the modern approaches such as transcriptome, miRNAome, and metabolome analyses have been used to investigate the genetic background of racing performance as well as endurance capacity in Arabians. The analysis of polymorphisms at the genome level has also been applied to the detection of genetic variants associated with exercise phenotype in the Arabian breed. The presented review summarizes these findings, with a focus on the genetics underlying flat racing and endurance performance traits in different Arabian horse populations.

1 Introduction

Horses (*Equus caballus*) are herbivorous mammals belonging to the family *Equidae*. They are well-known for their utility in transportation, agriculture, and recreation. Here's a concise overview:

1.1 Scientific Classification

- Scientific Name: *Equus caballus*
- Class: Mammal
- Diet: Horses primarily consume tough grasses, hay, and grains. Their digestive systems are adapted to frequent, small meals.

1.2 Lifespan

Horses typically live 25–30 years in captivity, although some have reached ages as high as 61. Wild horses often have shorter lifespans, with a maximum of around 36 years. Lifespan depends on factors such as breed, nutrition, activity, and health conditions.

1.3 Hypothetical Lifespan Formula

While no single universal formula calculates a horse's lifespan, we could propose one based on factors influencing longevity. For example:

$$L = 30 - (0.2N) - (0.1H) + A$$

Where:

- L = Expected lifespan (years)
- N = Number of significant health issues
- H = Annual hours of high-stress activity
- A = Adjustments for breed longevity (+2 to -2 depending on breed characteristics)

This formula emphasizes general trends but would need empirical data for accuracy.

2 Arabian Horses

Arabian horses, one of the oldest and most iconic breeds, are recognized for their extraordinary stamina and athletic performance, particularly in endurance racing. This review examines the genetic, physiological, and molecular factors contributing to their unique racing abilities.



Figure 1: The Arabian mare—Pianissima (Gazal al Shaqab-Pianosa by Eukaliptus) from Janów Podlaski State Stud in Poland (double triple crowned) (photo credit Stuart Vesty; all rights reserved).



Figure 2: The classic grey Arabian mare at the barn (photo credit Stuart Vesty; all rights reserved).

3 Arabian Horse Characteristics

Arabian horses excel in endurance due to structural and functional adaptations. Their muscle composition, rich in oxidative fibers, facilitates efficient fat metabolism, making them ideal for long-distance racing. Regions like the Middle East, Europe, and North America show variations in breeding focuses, with Polish Arabians emphasizing both appearance and performance, while French Arabians prioritize racing abilities.

4 Genetics and Performance Differentiation

Arabian horses differ significantly from breeds like Thoroughbreds in muscle fiber type, with a higher proportion of type I fibers for aerobic metabolism. Genetic studies highlight markers like *SLC16A1* and associated miRNAs as crucial for energy utilization and endurance. These findings underscore the role of gene expression and muscle metabolism in determining performance traits.

4.1 Training and Molecular Adaptations

Training profoundly impacts gene expression. Long-term regimens increase the expression of genes involved in fat metabolism while downregulating glycolysis pathways. These changes enhance muscle efficiency and endurance, adapting the horses for sustained physical effort. Notable genes like *FOXO3*, *SLC16A1*, and *ACTN3* are linked to muscle remodeling and stamina.

4.2 Genomic Studies

Genome-wide association studies (GWAS) and transcriptomic analyses have identified loci and pathways, such as oxidative phosphorylation and lactate metabolism, related to racing and endurance. Key candidate genes include *COX4I1*, *ADCY1*, and *PDK4*, which are associated with energy production and muscular adaptation during high-intensity exercise.

5 Conclusion and Implications

Arabian horses' endurance traits stem from a combination of genetic predispositions and training-induced adaptations. Understanding these factors can refine breeding programs, improve performance prediction, and guide training strategies. Further research into genomic markers promises to optimize endurance racing not only for Arabians but for equine sports as a whole.

The above article is taken from here.[\[1\]](#)

References

- [1] K Ropka-Molik, M Stefaniuk-Szmukier, AD Musiał, and BD Velie. The genetics of racing performance in arabian horses. *International journal of genomics*, 2019(1):9013239, 2019.