

## **Examining the response to exercise using a systems biology approach in race horses**

Horses trained to compete in races are subject to considerable loads on the musculoskeletal system. The significant intensity of physical exercise may cause tissue damage, thus weakening the locomotor system's structures. Then the accumulation of microtrauma may contribute to the formation of fatigue fractures. Orthopaedic injuries are the most common cause of career termination and permanent elimination from competitive use of racehorses. In some cases, they can lead to the euthanasia of an animal. In 2020, five horses sustained fatal injuries during four days of racing in Saratoga, USA. To avoid further preventable injuries or deaths, diagnostic techniques are needed to assess more accurately the health of competing horses. There are many cases when the preparation for and possibilities of safe participation in horse racing were erroneously assessed. For the above reasons, it is extremely important to monitor adaptation to increasing exercise-loads in this group of animals. Only regular examinations make it possible to assess the health and exercise capacity of an animal. Usually, the evaluation of a horse's preparation for competing in race is based on the trainer's opinion, clinical and haematological examination, and monitoring of heart rate value. However, the evaluation of these parameters does not allow detecting distortions at an early stage of their formation.

The adaptational reactions involve many systems in the athletes' organism and are still not fully understood. The project will not only focus on the processes taking place in the specific tissue but also on the changes which reflect the status of the whole organism. Such a large-scale study using the newest and the most advanced technology, will allow for subsequent targeted analyses that can be used to identify proteins related to specific biological processes and signaling pathways that modulate adaptation to increasing loads and indicate the risk of injury in the horse athletes. In addition, a better understanding of the cellular effects of exercise, coupled with advances in the characterization of the horse genome, could lead to improved personalized/targeted exercise interventions (personalized medicine). This has helped illuminate genomic regulation in response to external stimuli such as physical exercise. Moreover, an improved understanding of how and when remodeling of the genome structure modifies the response to exercise may facilitate the diagnosis of certain overtraining syndromes in human athletes. Horse model is used in human exercise physiology studies because they are more controlled, as less activities may disturb the training program and cause additional stress. Therefore, this innovative project will not only provide insight into the basic changes taking place in the body under the influence of exercise, but will also help to prevent overtraining syndrome in horses. It will also broaden the knowledge of the general impact of exercise on the health and performance of human athletes with the use of the innovative and advanced technologies, so far very rarely used.