

The human intestinal microbiota is established to be one of the most complex sites of the human body, with the estimated number of microorganisms exceeding  $10^{14}$  cells. The biodiversity and overall composition of the gut microbiota plays a crucial role in maintaining homeostasis within the human body. Intestinal bacteria can modulate inflammatory level as well as oxidative stress status in, affect anabolic and catabolic processes, and regulate the nutrients bioavailability. Some bacteria species and their products can modulate glucose uptake and thus maximize muscle glycogen storage; enhance mitochondrial functions and thus regulate aerobic metabolism in skeletal muscle. It is believed that the gut microbiota may be an indirect factor influencing skeletal muscle adaptation to training, affect regeneration processes and exercise capacity. However, the available scientific evidences are often ambiguous and inconsistent. Some of them confirm our hypothesis, but others have not showed an influence of probiotic supplementation on the improvement of parameters of sport performance. Most of studies have underlined that there is a continuing need of further researches in more rigorous athletic population, to explain if probiotic intake may enhance sport performance.

We are planning to assess whether a 4-week supplementation with the multi-strain probiotic mixture in combination with an optimized diet can improve exercise capacity among athletes. The study group will state marathon runners as a group particularly vulnerable to disturbances in intestinal homeostasis as a result of long-term training. Athletes will undergo the identical study procedures and assessments both before and immediately after the intervention. In order to assess sports performance, exercise test with the use of bicycle ergometers or treadmill will be carried out. The cardio-pulmonary exercise test (CPET) will determine the maximum oxygen uptake, minute lung ventilation as well as heart rate. Inflammatory state will be evaluated by analyzing collected blood samples in which we will assess the levels of pro-inflammatory (IL-6 and TNF- $\alpha$ ) cytokines in the serum. The direct impact of probiotic supplementation on the microbiome composition will be assessed by analyzing collected stool samples that will be quantitatively and qualitatively assessed using the next-generation sequencing method. The analysis will also include the presence of parameters of intestinal permeability such as calprotectin, zonulin and IFABP, as well as products of bacterial metabolism such as short-chain fatty acids (SCFA).

The collected data will have an important contribution to understanding the influence of gut bacteria on the exercise capacity of athletes. Our purpose is to determine whether the composition of the intestinal microbiome will have an impact on the inflammatory state and thus on regeneration processes as well as parameters of sports performance. The obtained in the project results will also provide an answer to the question if probiotic supplementation can affect skeletal muscle adaptation to training, and thus contribute to the improvement of sports performance.