Summary in English

Skeletal muscles are an important organ involved in the regulation of numerous metabolic processes in the body through the use of basic energy substrates such as glucose and long-chain fatty acids (LCFA). The degree of glucose or LCFA utilization under physiological conditions by the muscle tissue depends on many factors, including the availability and intracellular transport of energy substrates, energy requirements, and the hormonal balance of the body. In conditions of increased availability of fatty acids (FAs) in the diet, exceeding the body's energy requirements and the oxidative capacity of the mitochondria, lipids are stored in adipose tissue as well as in other metabolically active tissues such as skeletal muscles. Excessive intramuscular lipid accumulation is mainly observed in the triacylglycerol (TAG), diacylglycerol (DAG) and ceramide (CER) lipid fractions. Numerous studies have shown that the increased concentration of bioactive DAG and CER fractions contributes to the impairment of insulin action, which results in the development of insulin resistance (IR) in muscle tissue.

Numerous literature data show that during the course of obesity, increased activation of selected components of the endocannabinoid system (ECS) is observed. This system is involved in the regulation of numerous physiological processes, including the metabolism and energy homeostasis of the organism. It has been shown that the ECS is also one of the target sites of the phytocannabinoid interactions, which are compounds of plant origin (Cannabis sativa). This group of compounds includes cannabidiol (CBD), which, due to its lack of psychoactive properties and good safety profile, is a potential therapeutic compound. Many studies have shown the positive effects of CBD, including anticonvulsant, antipsychotic, analgesic, and anti-inflammatory actions. It is also postulated that CBD may have beneficial effects in the treatment of obesity, despite the fact that most of its mechanisms of action are currently unknown. Therefore, the aim of the study was to determine the effect of CBD on lipid metabolism in skeletal muscle in a rat model of obesity induced by a high-fat diet.

All experiments were conducted on male Wistar rats, which were fed a standard diet or high-fat diet (HFD) for 7 weeks; each experimental group consisted of 10 individuals. From the beginning of the sixth week, the animals received once-daily intraperitoneal injections of CBD at a dose of 10 mg/kg of body mass or its solvent for the next 14 days of the experiment. In the material of skeletal muscle obtained for analysis, the concentration of selected lipid fractions and sphingolipids as well as the content of individual fatty acids in the examined fractions were determined using gas-liquid chromatography (GLC) and high-performance liquid chromatography (HPLC). Plasma glucose and insulin levels, intramuscular glycogen content,

and parameters of oxidative stress were determined using colorimetric and enzyme immunoassay (ELISA) methods. Additionally, the expression of selected proteins was assessed by the Western Blot technique. Data were analyzed by one-way ANOVA followed by an appropriate post-hoc test (p < 0.05 considered significant).

The results obtained in our research indicate that in the skeletal muscles of rats fed a high-fat diet there is an increased accumulation of examined lipid fractions (DAG, TAG) and CER, which is related to the deterioration of insulin signaling. Concomitantly, the n-6/n-3 PUFA ratio is elevated, resulting in an increased inflammatory response in skeletal muscle tissue. The effects of CBD seem highly promising, indicating a reduction in the above-mentioned lipids content, lowering the n-6/n-3 PUFA ratio by shifting the balance in favor of the anti-inflammatory n-3 PUFA, as well as improving insulin signal transduction in skeletal muscles under the conditions of high-fat diet-induced obesity.

Our data provide a new insight into the role of CBD as a regulator of lipid metabolism in skeletal muscle and indicate that CBD presents potential therapeutic properties with respect to the treatment of obesity and related disturbances.