ABSTRACT

LIPID COMPLEX SUPPLEMENTATION VERSUS BLOOD ANTIOXIDANT STATUS AND INCIDENCE OF MUSCLE SORENESS IN LONG-DISTANCE RUNNERS

Ultramarathon running is a type of off-road long-distance endurance run with an added component of eccentric muscle work. In addition to genetically determined physiological factors, adaptive changes that improve the utilization of aerobic energy stores and tolerance of exercise-induced changes play a key role in runner training. These in turn translate into improved performance and a shorter recovery period.

Significant strain to which runners are subjected causes, on the one hand, mechanical disorders of the microstructure and function of the elements involved in muscle fiber contraction, and on the other hand, a number of biochemical changes disrupting the prooxidation-antioxidation balance in cells. This results in the release of specific markers of muscle damage into the blood, increasing the inflammatory response and oxidative stress. These changes affect perceived fatigue and can trigger a cascade of systemic reactions contributing to delayed muscle soreness syndrome. Athletes who regularly train for long-distance running commonly use nutritional supplements to aid in the training and recovery process. The effectiveness of formulations enriched in unsaturated fatty acids (PUFAs) on increasing endurance exercise tolerance and on recovery and anti-inflammatory abilities has been proven. Lyprinol, due to its content of EPA and DHA having a similar structure to arachidonic acid, competes with it and may modulate the inflammatory response. Reducing prostaglandin and leukotriene synthesis inhibits further muscle cell destruction and reduces nociceptor irritation. The main objective of this study was to evaluate the effects of supplementation with the lipid complex PSCO-524 *(Perna canaliculus L.)* on red blood cell fatty acid content, blood prooxidant-antioxidant balance, levels of muscle damage markers and inflammatory mediators, as well as improved skeletal muscle recovery in long-distance runners. To this end, the following research questions were formulated:

1. Does lipid complex *(Perna canaliculus L.*) supplementation affect red blood cell fatty acid content in long-distance runners?
2. Does the supplementation used in the study affect the prooxidant-antioxidant balance, levels of muscle damage markers and inflammatory mediators in long-distance runners after running exercise with predominantly eccentric contractions?

3. Does supplementation with an applied lipid complex improve skeletal muscle recovery, i.e., reduce muscle pain and tension in long-distance runners after applied running exercise?

The study was conducted in 24 athletes training in long-distance running and competing in ultramarathon running during the preparatory period of the annual training cycle. The runners were informed of the purpose and protocol of the study, which had previously been approved by the local Bioethics Committee for Scientific Research at the Jerzy Kukuczka Academy of Physical Education in Katowice and agreed to participate in the research project and met the specified selection criteria. The experiment was conducted in three stages. In the first stage, anthropometric measurements with assessment of body weight and composition, resting heart rate and resting oxygen uptake (gasometric analysis), as well as determination of maximal oxygen uptake ($V0_2$ max) and obtaining maximal exercise heart rate by direct method were performed. In the second stage, all subjects performed an eccentric running test: 30 minutes of running exercise at 70% VO_2 max and a treadmill incline of minus 16 percent. Prior to exercise, the following blood parameters were determined: fatty acid index (HS-Omega-3 Index®), indicators of prooxidant-antioxidant balance (superoxide dismutase [SOD], CAT [CAT], glutathione peroxidase [GPx], reduced glutathione [GSH]), oxidative stress index (malondialdehyde [MDA]), markers of muscle cell membrane damage (creatine kinase [CK], lactate dehydrogenase [LDH], troponin [TnT], and myoglobin [Mb]) as well as inflammatory mediators (IL-6 and TNF-α), and muscle pain (pain threshold [PT]) and lower limb muscle tone (area under the curve [AUC]) were assessed. The tests were repeated immediately after the test, after one hour and 24 hours of rest. In stage 3, athletes were randomly divided into two groups: supplemented (SUPL; daily dose: 800 mg olive oil, 400 mg stabilized lipid extract containing fatty acids including 58 mg EPA and 44 mg DHA and 1.8 mg vitamin E) and control (PL; daily dose: 1200 mg of olive oil). After three weeks of taking the prescribed doses, the eccentric exercise test with determination of biochemical indices, muscle pain and muscle tone was repeated according to the protocol of the second stage of the study.

After analyzing the results obtained, the following conclusions were made:

1. Three-week intake of the lipid complex at 1200 mg per day did not reduce levels of saturated fatty acids and TRANS fats in the red blood cells of the study runners. Supplementation induced beneficial changes in the AA/EPA ratio. The observed greater reduction in the index in the supplemented group may be due to both the presence of eicosapentaenoic acid in the ingested complex and its inhibitory effect on arachidonic acid metabolism.
2. Supplementation with the lipid complex did not significantly affect the prooxidant-antioxidant balance, levels of muscle damage markers, and inflammatory mediators in the

study runners. Among the antioxidant enzymes studied, the most favorable changes were observed only in superoxide dismutase activity immediately after and in the first hour after exercise.

3. A beneficial effect of the supplement on levels of perceived pain and muscle tone was observed using the measurement tools used. For muscle pain, increasing pain threshold values at 24 hours are characteristic of the group taking the lipid complex compared to previous measurements. Additionally, the significant reduction in muscle tone in resting and immediate post-exercise measurements, as well as the relatively high AUC levels in the last measurement, indicating lower muscle tone, may indicate a beneficial effect of the supplement on the recovery process.
4. In order to investigate further the effect of the lipid complex on the course of muscle recovery and especially the occurrence of delayed muscle soreness, further studies extended by measurements at 48 and 72 hours are needed.