

ABSTRACT

Introduction

The beneficial impact of physical effort on health after regular physical activity results from to adaptations taking place in several systems in the human body, such as the cardiovascular and musculoskeletal systems. The specific type of adaptation depends, inter alia on the type of effort taken, e.g. strength training will intensify other adaptations to endurance training. Moreover, intense exercise can lead to an acute increase in inflammatory processes and oxidative stress, which in turn leads to the activation of compensatory mechanisms. At the turn of the 20th and 21st centuries, it was shown that reactive oxygen and nitrogen species generated during exercise serve as signaling molecules in the body and increase the production of endogenous antioxidants. Although an acute response to intense exercise is required for long-term adaptation to occur, this condition may be accompanied by decreased muscle function (e.g., a decline in muscle strength), muscle soreness, and exercise-induced muscle damage. This uncomfortable and bothersome feeling can make training impossible or difficult for both athletes and active people to continue. Dietary supplements containing tart cherry are becoming more and more popular among athletes and researchers. Scientific research suggests that giving athletes tart cherry can: reduce exercise-induced muscle damage, reduce pain, improve recovery, and improve sleep quality. At the same time, it is emphasized that the constant use of nutritional interventions accelerating recovery may adversely affect the adaptation processes in skeletal muscles, therefore chronic antioxidant supplementation is not currently recommended for athletes. There is no convincing scientific evidence in the literature that would suggest that supplementation with other (than vitamin C and E) antioxidants may have an equally unfavorable effect on adaptation to exercise. To the best of the author's knowledge, none of the previously published scientific works using tart cherry supplementation have focused on the impact of this fruit on adaptations induced by strength training.

Aim

The study aimed to assess the effect of supplementation with Montmorency tart cherry powder on exercise adaptations induced by strength training in trained men during the eight-week intervention period.

Material and methods

28 healthy, trained men aged 18 to 40 who met all the qualifying criteria were enrolled in the study. Once the volunteers were included in the study, they were invited to a meeting at which they were informed about the purpose of the study and were acquainted with information about its course and the method of data collection. Evaluation of the effect of tart cherry powder supplementation in men's strength training was conducted in an eight-week, randomized, double-blind trial. The research procedure consisted of: nutritional, supplementation, and training intervention, which respectively consisted of consuming a certain amount of energy and macronutrients; supplementation of tart cherry powder or placebo capsules, and compliance with a planned training program focused on muscle hypertrophy for a period of 8 weeks. After recruitment, the men were invited to the Exercise Physiology Laboratory at the Research and Development Center of Olimp Laboratories for exercise tests after which, based on the criterion of maximum bench press strength, they were subjected to stratified randomization and divided into two groups: receiving capsules with 600 mg of tart cherry powder or receiving capsules containing placebo. During the second visit to Exercise Physiology Laboratory, each of the study participants underwent a planned strength training and laboratory tests followed by an eight-week supplementation, training, and nutritional intervention. The exercise tests included among others: evaluation of Counter Movement Jump (CMJ), evaluation of the maximum bench press strength, and evaluation of the isokinetic muscle peak torque of the lower limbs. On the second day, the men were subjected to body composition analysis and intensive strength training, which was to induce the secretion of the tested myokines. During this meeting, blood samples were taken four times - before the training, immediately after it, 45 minutes after and 90 minutes after the end of the training. The same protocol was repeated after 8 weeks of intervention. The statistical analysis of the collected research results was performed with the SPSS® software from IBM® version 26.

Results

The assessment of the body composition of the studied group of men showed no statistically significant differences between the group receiving tart cherry powder and the group receiving placebo. The study of the thickness of the muscle compartments between the groups showed a significant increase in the thickness of the knee flexors in both groups and significant decreases in the thickness of the knee extensors and the elbow flexors only in the placebo group. The measurement of decorin concentration showed a significant decrease in its concentration at rest in both groups and a further significant decrease in concentration after training and 45 minutes after training only in the control group. The CHI3L1 concentration assessment showed a significant decrease in concentration immediately after training only in the group receiving tart cherry powder. The concentration of IL-6 increased significantly in both groups at each of the measured time points. The evaluation of the measured exercise capacity showed that the height of the CMJ after eight weeks of supplementation significantly increased only in the experimental group. The measurement of the maximum bench press strength shows the significance of the statistical tendency for the increase in strength in the experimental group compared to no change in the control group. The data obtained from the isokinetic dynamometer for the angular velocity of 180 °/second indicate a significant increase in a number of variables in the experimental group, including peak torque, peak torque/body weight ratio, average power, and mean peak torque value compared to the control group. The intra-group analysis for the angular velocity of 60 °/second showed a smaller number of statistically significant changes between the groups, although greater increases in the variables were noted in the group receiving tart cherry powder. There were no statistically significant changes in the frequency of symptoms of upper respiratory tract infections and upper respiratory tract infections between the studied groups.

Conclusions

1. Supplementation of Montmorency tart cherry powder had no effect on the measured parameters of body composition: body weight, fat free mass, percentage of adipose tissue during the eight-week intervention period. These results may indicate that tart cherry supplementation did not affect the energy

expenditure of the study participants and confirm the fact that a neutral energy balance is a key factor influencing body weight maintenance.

2. In both study groups, there was an increase in the thickness of the knee flexors, but only in the control group, there was a decrease in the thickness of the knee extensors and elbow flexors, which may indicate the potential anti-catabolic effect of polyphenols found in cherry fruit. The increase in the thickness of the knee flexors can be explained by the rare involvement of this muscle group in previous training plans.
3. Tart cherry powder supplementation significantly increased the height of the counter movement jump and indicated a tendency to increase bench press muscle strength during the eight-week intervention. In addition, in men taking cherries, a significant increase in a number of parameters measured on an isokinetic dynamometer was noted, e.g. peak torque, power, or total work performed. These results indicate the potential ergogenic effect of the dose of cherry polyphenols used.
4. Chronic supplementation with tart cherry powder did not reduce the incidence of upper respiratory tract infections and their symptoms in the study participants in the winter months. This result may suggest that the low ambient air temperature and the stress resulting from the change of training were definitely more important factors that contributed to the occurrence of infection. It is considered justified to conduct research that will focus on the effect of administering tart cherries on the severity of infections in conditions that predispose to them.
5. In both studied groups, there was a decrease in the resting decorin concentration after eight weeks of supplementation, which could have been caused by the adaptations that took place in skeletal muscles. Only in the control group, the concentration of decorin in the plasma decreased significantly immediately after, and 45 minutes after the training, which may indicate that tart cherry supplementation allows increasing the concentration of the studied myokine for a longer time after exercise, and thus support their regeneration more efficiently.

6. Tart cherry powder supplementation significantly decreased CHI3L1 concentration immediately after training and showed a tendency to decrease CHI3L1 concentration 45 minutes after training during the eight-week intervention period, which may indicate an increase in the anti-inflammatory potential of skeletal muscle cells, because pro-inflammatory cytokines are responsible for its activation.
7. In both studied groups there was a significant increase in the concentration of IL-6 at each of the four measured time points, however, the changes in the concentration of IL-6 were so small that they did not reflect the post-training values recorded in other studies, which may suggest that the performed training was too short to induce IL-6 secretion several times higher than the resting concentration. This suggests that in the case of this myokine, supplementation with powdered cherry fruit did not affect the concentration of IL-6 in relation to the control group.
8. A positive correlation was demonstrated in both studied groups between the resting decorin concentration after eight weeks of intervention and the percentage of lean body mass, and a negative correlation between the resting decorin concentration after eight weeks of intervention and the percentage of adipose tissue. Moreover, a positive correlation was noted between the post-training concentration of decorin and the peak moment of force, average power and the work performed by the lower limbs. These results suggest that an increased concentration of decorin may be involved in gains in muscle mass and strength. It is considered justified to conduct research that will focus on the influence of cherries on changes in the expression of decorin in skeletal muscle tissue.
9. A negative correlation was demonstrated in both studied groups between the resting CHI3L1 concentration after eight weeks of intervention and the percentage of lean body mass, and a positive correlation between the resting CHI3L1 of decorin after eight weeks of intervention and the percentage of adipose tissue. These results may suggest that serum CHI3L1 concentration is not a good

marker of adaptation to strength training in physically active people, possibly because it can be secreted by many other cells in the body.

10. Long-term supplementation of the assessed dose of tart cherry powder did not inhibit the tested adaptations and exercise capacity of men training strength. According to the author's knowledge, this is the first study using cherries, which is in opposition to studies using high doses of vitamins C and E, suggesting a negative impact on training adaptations. It is considered justified to conduct further research taking into account a higher dose of polyphenols in the supplementation protocol and using tests at the molecular level helpful in determining the mechanism of action of antioxidants from cherries.

Key words: tart cherry, antioxidants, myokines, strength training, exercise adaptations