Original Article

Effect Of A Two-Week Turmeric-Curcumin Herbal Supplementation On Muscle Damage Indices After Resistance Training In Athletes

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Abstract

Curcumin plays an important role in controlling the physiological mechanisms of inflammation and protein degradation. The aim of this study is to investigate the effect of curcumin in turmeric on muscle damage in athletes.

The present research is a quasi-experimental study applied for 45 volunteers from different active sports which were selected as a statistical sample with relative random sampling and received the desired supplement or placebo for two weeks, and were randomly divided into three groups:

Maltodextrin placebo control group, (Pla 0.1gr/Kg/day), experimental group 1: intake of curcumin turmeric (Cur 1000mg/day) one hour before the test, experimental group 2: intake of curcumin turmeric (Cur 1000mg/day) immediately after the test. Before warm-up and protocol, immediately after protocol and 24 hours after resistance training protocol which included lower body leg press and upper body chest press with 80% of 1RM, 5 cc venous blood was collected from upper arm vein using syringe, and creatine kinase (CK) and lactate dehydrogenase (LDH) indices were measured by photometric method. Eventually, the obtained results were analyzed with SPSS24 software.

The mean value of CK and LDH in the second phase after taking curcumin compared to the first phase and the control group, showed a significant decrease (p 0.05).

Thus, it can be concluded that curcumin contained in turmeric reduces the indicators of muscle damage (CK and LDH) in athletes.

Keywords: curcumin, muscle damage, resistance training, creatine kinase, lactate dehydrogenase.

Introduction

Muscle damage, which is one of the most common sports damages, is a common complication that occurs regardless of the level of physical performance and occurs several times throughout life; depending on the severity and causes, two types are distinguished: acute and delayed muscle damage. The occurrence of a muscle contusion is associated with syndromes and negative symptoms, the extent and severity of which depend on factors such as physical fitness, intensity and type of activity. Some of these symptoms are: decreased joint range of motion, decreased muscle strength, swelling and inflammation, muscle stiffness, microscopic damage, secretion of creatine kinase and lactate dihydrogenase in plasma (Rodrigues et al., 2010).

Muscle damage leads to disruption of the membrane and leakage of extracellular fluid, as well as an increase in the concentration of plasma enzymes such as creatine kinase (CK) and lactate dehydrogenase (LDH) (Tanabe et al., 2018).

Degradation of the Z-lines and damage to the sarcolemma result in the release of the enzymes creatine kinase and lactate dehydrogenase into the interstitial water and eventually into the plasma (Tanabe et al., 2019).

Physical activity, especially high-intensity eccentric muscle contractions, leads to exercise-induced muscle damage (EIMD) (Tanabe et al., 2018). EIMD leads to the onset of an inflammatory response associated with a decrease in the ability to generate muscle force, decreased range of motion (ROM), local swelling, delayed onset muscle soreness (DOMS), and an increase in muscle proteins in the blood, including creatine kinase (CK), lactate dehydrogenase (LDH), and myoglobin (Mb) (Fatouros and Jamurtas, 2016).

These changes affect a person's performance and affect athletes in performing exercises and participating in competitions, reducing their athletic performance and preventing them from showing their athletic abilities. Therefore, finding a way to prevent or treat the symptoms of muscle damage has always been of interest to researchers. One of the most common treatments for muscle inflammation is the use of herbal medicines. On the other hand, the body's antioxidants can be regulated by exercise, which stimulates the acute operating system and the inflammatory response (He et al., 2016). Therefore, inflammatory processes are always related to the operating system and should be analyzed and controlled, as both are directly involved in inflammation and exercise-induced muscle damage.

While many different compounds have been investigated for the treatment of EIMD and DOMS, curcumin is of particular interest as it has been reported to act via a similar mechanism to NSAID, albeit with a less pronounced suppression of inflammation. For example, curcumin acts by modifying the COX-2 pathway, resulting in decreased production of inflammatory cytokines (i.e., IL -1β, IL -6, IL -8, and/or TNF-α) and prostaglandins (Brian et al., 2016).

This modulation may be important as prostaglandins play a role in increasing the severity of subjective pain following EIMD and IL -8/TNF-α have been shown to be stable blood biomarkers of inflammation. Curcumin's known ability to reduce COX -2 signaling in vitro makes it an ideal candidate for the treatment of EIMD and DOMS; however, only a handful of studies have examined this effect (Brian et al, 2015).

Numerous studies have examined the effect of turmeric-containing curcumin on muscle inflammation and muscle damage in athletes. (Fernández Lázaro et al. 2020) concluded in their study that curcumin intake reduced psychological perceptions of muscle pain severity, reduced muscle damage by decreasing creatine kinase (CK), and ultimately improved muscle function. (Steven et al. 2019) investigated the effect of curcumin supplementation on exercise-induced oxidative stress, inflammation, muscle damage, and muscle pain in their study and concluded that curcumin reduces inflammation and muscle pain. (Tabrizi et al 2018) reoprted that curcumin supplements have an effect on biomarkers of inflammation. (Brian et al 2016) concluded in their study that curcumin significantly reduces muscle inflammation. (Kazim et al 2016) concluded that curcumin prevents muscle damage and improves muscle function by regulating NF-κB and Nrf2 signaling pathways.

Curcumin supplementation may prove beneficial in mitigating EIMD, as curcumin has been shown to help reduce performance degradation due to its membrane-protective, antioxidant, and anti-inflammatory effects following intense and strenuous exercise (Harty et al., 2019).

The anti-inflammatory properties attributed to curcumin are due to its ability to inhibit nuclear factor kappa, which may be a protective and muscle regenerating substance and plays an important role in controlling the physiological mechanisms of inflammation and protein breakdown (Hewlings et al., 2017).

Scientific evidence shows that most chronic diseases are caused by a lack of regulation of inflammation, and on the other hand, sports activities cause muscle inflammation in athletes. Therefore, the search for effective and safe anti-inflammatory substances is a real challenge for modern medicine. To date, steroids are probably the best known anti-inflammatory agents, but they are associated with many side effects, and herbal substances such as turmeric with anti-inflammatory properties are the best alternative to steroids in reducing inflammation. With this in mind, this study aims to answer the question of what effect curcumin contained in turmeric has on muscle damage and inflammation in athletes.

Method

The present study is an applied study whose method is based on a quasi-experimental study due to the nature of the study. The statistical population included all student athletes from Trabzon university in various sports who have competed in recent years. A total number of 45 volunteers from different active sports were selected as the statistical sample using relative random sampling. Indicators for inclusion in the study were: no strength training or resistance training for at least one months prior to the project, no muscle damage in the lower limbs and upper limbs, no use of steroidal and non-steroidal anti-inflammatory drugs, no use of supplemental antioxidants, and absence of neurological disease in the lower and upper limbs.

The statistical population was randomly divided into three groups:

Maltodextrin placebo control (Pla 0.1 gr /Kg /day (N:15), Experimental group 1: intake of turmeric curcumin (Cur 1000 mg /day) one hour before the test (N:15), Experimental group 2: intake of turmeric curcumin (Cur 1000 mg /day) immediately after the test (N:15).

The subjects consumed turmeric was equal to 1 capsule of curcumin (Cur 1000 mg /day).

The abbreviated name of the turmeric curcumin used is Zade Vital Curcumin Forte 1000 mg 40 Herbal Capsule.

Subjects drank turmeric capsules or placebo with 200 ml of water. Subjects were required to follow a diet for 24 hours before and after the study and were asked not to engage in any specific exercise program for 48 hours before and after the test. Initially, the subjects were fully informed about the conduct of the study, the nature of the exercise program, and the times of blood collection, and their consent was obtained to voluntarily participate in the study.

The subjects were all college students and had the same diet. One week before and after the testing protocol, subjects were advised to avoid any strenuous muscular activity and the use of supplements and medications, especially painkillers and caffeine. They were also advised to maintain a regular daily diet and avoid excessive consumption of foods containing polyphenols and antioxidants, and to sleep comfortably and without pressure for eight hours the night before the test session.

The training protocol consisted of a two-week training session. The testing session was seven days prior to the first test to reduce the effects of the contusion effect of the recording session. Muscle damage in the lower and upper body muscles was caused by leg presses and chest presses with weights equivalent to with 80% of 1RM.

Fasting blood samples were collected only between 9 and 11 am. After a 10-minute aerobic warm-up and 5-minute stretching exercises, subjects performed a light set of 12 repetitions at an intensity to with 40% of 1RM. They then performed leg presses and chest presses in four sets of 12 repetitions each at 80% of 1RM with a 3-minute rest between sets, and finally performed a protocol of intense resistance exercises. Before the warm-up and protocol, immediately after the protocol, and 24 hours after the resistance training protocol, 5 cc of venous blood was drawn from the brachial vein by a simple method with a syringe by an experienced physician and his assistant, and the indices of creatine kinase (CK) and lactate dehydrogenase (LDH) were measured. To avoid changes in blood composition, serum was centrifuged at 4,000 rpm at the study site. Data were analyzed using SPSS 24 software, and the ANOVA-test with repeated measures was used to analyze differences. An alpha level of 5%

was used as the significance level. The study was conducted in accordance with the latest version of the Declaration of Helsinki. Ethical approval was obtained from the local ethical committee.

Results

Table 1- Descriptive Statistics of CK

	Mean	Std. Deviation	N
CK1	301.6667	16.97337	15
CK2	294.6000	14.42617	15
CK3	261.0000	41.41256	15

According to the results of the above table, the mean value of creatine kinase (CK) in the studied samples of the control group is 301.66, which decreased to 294.60 after taking curcumin in the first phase, and in the second phase, after taking curcumin, the mean value of creatine kinase (CK) decreased to 261.

Table 2- Mauchly's Test of Sphericity of CK

Measure:ck							
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
time	.860	2.532	2	.231	.695	.747	.500

The Mauchly test is performed to test the sphericity hypothesis. Since the significance level of Mauchly test error for the variable creatine kinase (CK) is 0.23 which is greater than 0.05, the sphericity assumption is valid.

Table 3-Tests of Between-Subjects Effects of CK

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	3674530.689	1	3674530.689	6687.063	.000	.998
Error	7692.978	14	549.498			

According to the results of the above table and considering that the significance level of the repeated analysis of variance is less than 0.05, it can be said that there is a difference between the mean value of creatine kinase (CK) in the study groups. The mean value of creatine kinase (CK) in the second phase after curcumin intake compared to the first phase and also compared to the control group shows a significant decrease. Therefore, it can be said that curcumin contained in turmeric reduces creatine kinase (CK) in athletes.

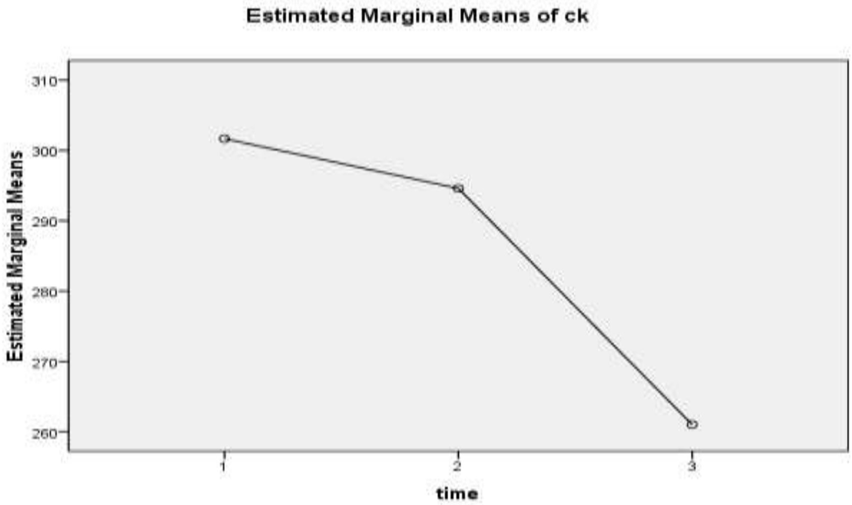


Table 4- Descriptive Statistics of LDH

	Mean	Std. Deviation	N
LDH 1	270.2667	15.69562	15
LDH 2	266.0000	13.80476	15
LDH 3	245.1333	12.25250	15

According to the results of the above table, the mean value of lactate dehydrogenase (LDH) in the studied samples is 270.26, which decreased to 266 after taking curcumin in the first phase, and in the second phase after taking curcumin, the mean value of lactate dehydrogenase (LDH) decreased to 245.13.

Table 5- Mauchly's Test of Sphericity of LDH

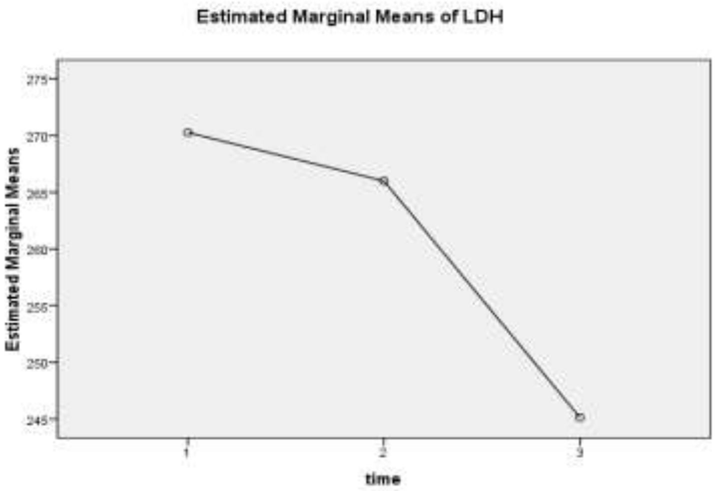
Measure:LDH							
					Epsilon		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
time	.746	3.808	2	.149	.797	.884	.500

The Mauchly test is performed to test the sphericity hypothesis. Considering that the significance level of Mauchly test error for the variable lactate dehydrogenase (LDH) is 0.14 and greater than 0.05, the sphericity hypothesis is valid.

Table 6-Tests of Between-Subjects Effects of LDH

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	3052929.800	1	3052929.800	12067.370	.000	.999
Error	3541.867	14	252.990			

According to the results of the above table and considering that the significant error level of the repeated analysis of variance is less than 0.05, it can be said that there is a difference between the mean value of lactate dehydrogenase (LDH) in the study groups. The mean value of lactate dehydrogenase (LDH) in the second phase after intake curcumin compared to the first phase and also compared to the control group shows a significant decrease. Therefore, it can be said that curcumin contained in turmeric reduces lactate dehydrogenase (LDH) in athletes.



Discussion

Due to the importance of muscle damage in athletes and the need to investigate the effect of curcumin on it, the present study was conducted with the aim of investigating the effect of curcumin in turmeric on muscle damage in athletes. The results of the study show that the mean value of creatine kinase (CK) in the second phase after intake curcumin shows a significant decrease as compared to the first phase and also as compared to the control group. So it can be said that curcumin present in turmeric reduces creatine kinase (CK) in athletes.
The research findings are in line with the research findings of Fernández Lázaro et al (2020), Steven et al (2019), Tabrizi et al (2018), Brian et al (2016), Kazim et al (2016). In these studies, the effect of curcumin on reducing muscle damage was confirmed. Drobnic et al (2014) concluded in their study that the use of a new curcumin delivery system reduced the pain caused by muscle damage.

Serum creatine kinase levels increase due to muscle tissue damage caused by resistance training. This increase can be due to both mechanical and metabolic causes. In fact, extroverted muscle contractions begin with varying degrees of muscle damage due to mechanical processes that damage the sarcomere and Z-lines, resulting in increased creatine kinase levels, especially in type 3 fibers, which are long and narrow and have a weak Z-line.

The muscle damage caused by mechanical loading during eccentric exercise and the subsequent inflammatory responses lead to deterioration in muscle performance. Therefore, changes in maximal voluntary contraction (MVC) force, range of motion (ROM), and isokinetic dynamometry reflect the magnitude and time course of EIMD, and thus these parameters can be used as markers of athletic performance (Tanabe et al., 2018, Tanabe et al., 2015 and Delecroix et al., 2017).

The results also show that the mean value of lactate dehydrogenase (LDH) significantly decreased in the second phase after curcumin intake compared to the first phase and also compared to the control group. So, it can be said that curcumin present in turmeric decreases lactate dehydrogenase (LDH) in athletes.

One of these reasons could be the antioxidant properties of curcumin. The antioxidant properties of curcumin are likely to cause less muscle damage. Antioxidants (including curcumin) are potent free radical scavengers and can inhibit the synthesis of free radicals, inactivating and scavenging them by increasing their antioxidant capacity. Consequently, reducing oxidative stress results in less damage to muscle membranes and prevents the leakage of lactate dehydrogenase.

Muscle soreness can be triggered by EIMD or unaccustomed activity (Proske et al., 2001) and leads to discomfort at the site of injury and loss of muscle function and strength; therefore, it limits physical function for several days after exercise (Järvinen et al., 2013). The potential effect of curcumin supplementation in reducing muscle pain may be due to its ability to suppress the induction of COX -2 isoform expression (Tanabe et al., 2019), thereby preventing the production of mediating substances such as prostaglandin E2 (PGE2), histamine, bradykinin, and serotonin, which are derived from COX -2 and activate nerve endings (Hatcher et al., 2008). The effect of curcumin reducing these mediators, particularly PGE2, would attenuate the phenomenon of prolonged hyperalgesia that occurs in type C sensory fibers (Kirkpatrick et al., 2016).

Conclusion

The results of the present study show that curcumin intake reduces some indicators of muscle damage such as creatine kinase (CK) and lactate dehydrogenase (LDH). It can be concluded that consumption of turmeric reduces not only muscle damage but also the pain associated with that damage. While there is disagreement on the dosage of this supplement for this purpose, the positive effects of intake this supplement may be beneficial to coaches, athletes, and exercise program developers.

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