



The Effect Of Using Spirulina Supplementation On The Performance Of 400-Meter Runners Under 20 Years Old

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Abstract

The idea of the present research lies in enhancing athletic performance through the application of auxiliary sciences that support the training process, such as nutrition science, by utilizing supplements that reduce muscular fatigue. The purpose of this research was to identify the effect of Spirulina supplementation on the performance of 400-meter runners under 20 years old. The research hypothesized that there would be no statistically significant differences between the pre-test and post-test results. The researchers adopted the experimental method using an experimental group and a control group design. The research sample was intentionally selected from elite 400-meter runners under 20 years of age, comprising ten athletes from various governorates of Iraq. The participants were randomly assigned using the odd-even method into two groups, with five runners in each group. The Statistical Package for the Social Sciences (SPSS) was used for data processing. According to the results, the researchers concluded that Spirulina supplementation contributed to the improvement of all biochemical variables investigated in the study, which was reflected in the enhancement of 400-meter running performance. The researchers recommend paying attention to the nutritional aspect of athletes alongside the training program, as it is no less important than training itself, given that physical exertion leads to numerous physiological and biochemical changes within the athlete's body.

Keywords: Spirulina supplement, performance, 400-meter runners, under 20 years old, biochemical changes.

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Introduction

The concept of this research is based on improving athletic performance in the 400-meter running event through the utilization of supportive sciences associated with the training process, particularly nutrition science, by administering Spirulina supplementation. Spirulina has been reported to reduce muscular fatigue resulting from elevated lactic acid concentrations and increased levels of free radicals. These free radicals negatively affect body systems and organs and cause substantial damage to cellular components, particularly deoxyribonucleic acid (DNA) located within the cell nucleus. DNA is responsible for the synthesis of all cellular components and determines both the nature and quantity of proteins. These vital biological processes are adversely affected by excessive free radical concentrations, which may lead to cellular damage and destruction (Abdel Fattah, 2003, p. 182). The purpose of the study was to identify the effect of Spirulina supplementation on the performance of 400-meter runners under 20 years of age. The research hypothesized that there would be no statistically significant differences between the results of the pre-tests and post-tests. Among the studies that addressed variables similar to those investigated in the current research was the study conducted by (Aziz, 2014), which aimed to determine blood lactate concentration levels following competitive effort at time intervals of 3, 5, 7, and 10 minutes and to compare these values during three different tests of the 400-meter race. The study concluded that the most appropriate time for recording the highest blood lactate concentration following exertion in the 400-meter event was five minutes. It also revealed variation in the timing of peak lactate accumulation during three months of specific preparation for the 400-meter event. Furthermore, the highest lactate concentration occurred at seven minutes, followed by ten minutes after exertion. The study by (Ta'ma, 2015) aimed to investigate oxidative stress responses, antioxidant responses, and selected biochemical indicators following a high-intensity training session in men's artistic gymnastics. The study concluded that oxidative stress occurred among gymnasts during high-intensity training sessions. No significant changes were observed in certain enzymatic antioxidants such as glutathione, nor in non-enzymatic antioxidants such as ceruloplasmin. Additionally, both enzymatic and non-enzymatic antioxidant systems returned to their normal state during the recovery period, indicating that twenty-four hours were sufficient for restoring the oxidant-antioxidant balance to normal levels (Yasser, 2018) investigated the effect of antioxidants on performance levels among weightlifters and concluded that antioxidant supplementation contributed to improved performance in both the snatch and clean-and-jerk lifts based on pre-test and post-test comparisons. (Ahmed, 2019) designed a training program incorporating circuit training and examined the values of CPK and LDH enzymes, as well as lactic acid accumulation in pre-tests and post-tests. The study concluded that the program was successful in terms of utilizing circuit training and training intensity. Furthermore, an eight-week training period was sufficient to produce an initial effect on CPK and LDH enzyme activity and lactic acid concentration. A main training session duration of 40–55 minutes positively affected the research variables, while exercise durations ranging from 20–60 seconds influenced CPK, LDH, and lactic acid levels (Jassim, 2019). investigated the effects of anaerobic exercises, curcumin, and ginseng extract on selected oxidative stress indicators and performance endurance among handball players. The study demonstrated that anaerobic training combined with ginseng supplementation produced superior effects in the first experimental group compared with the second and third groups, which performed anaerobic training and received curcumin supplementation. This superiority was observed in the

development of certain oxidative stress variables and performance endurance. Athletic performance is accompanied by numerous factors that may hinder achievement. One of the most significant factors is the elevated concentration of lactic acid within muscles, which causes muscular fatigue and subsequently increases the production of free radicals inside cells. Therefore, the scientifically controlled use of antioxidants under precise medical supervision can substantially reduce oxidative stress and lower free radical levels while enhancing total antioxidant capacity. This, in turn, contributes to improving the health, physiological status, and physical fitness of runners and assists in enhancing their performance levels.

Materials and Methods

The researchers adopted the experimental method to address the research problem using a design involving experimental and control groups, with both groups subjected to pre-tests and post-tests, as this design was deemed appropriate for the nature of the research problem. The research sample was intentionally selected from elite 400-meter runners under 20 years of age in the youth category. The sample consisted of 10 runners from different governorates of Iraq, selected based on the results achieved in the Iraqi Clubs and Institutions Athletics Championship held in Sulaymaniyah Governorate from March 7–9, 2024. The participants were randomly assigned using the odd-even method into two groups (experimental and control), with five runners in each group.

The following test was used:

400 Meter Running Performance Test (International Association of Athletics Federations (IAAF)).

Pre-Testing Procedures: The pre-tests for both the experimental and control groups were conducted on October 12, 2024, at 6:30 p.m. (post-exercise measurements) at the Ministry of Youth and Sports Specialized School Stadium. Before the implementation of the supplementation program, a specialist physician in sports nutrition was consulted to verify the safety of the product for athletes and to determine the appropriate dosage.

Spirulina Supplementation Program: A nutritional supplementation program using Spirulina was implemented for a period of two months, based on the manufacturer's instructions and the recommendations of specialists in nutrition and dietary supplementation.

The supplementation protocol was as follows: First month: 5 g of Spirulina administered two hours before each training session.

Second month: 10 g of Spirulina administered two hours before each training session.

The post-intervention biochemical assessments consisted of two measurements: one before exertion and another after exertion. Coordination was made with the coaches to standardize the training programs for all participants in terms of intensity, volume, and recovery periods in an attempt to control training-related variables among all athletes.

Post-Testing Procedures: Upon completion of the main experimental phase involving Spirulina supplementation, post-tests were conducted on December 12, 2024, at 6:30 p.m. (post-exercise measurements) under the same conditions used during the pre-tests.

Statistical Analysis: The Statistical Package for the Social Sciences (SPSS) was used to process and analyze the collected data

Results

Table 1. Means, Standard Deviations, Mean Differences, Standard Deviations of Differences, Calculated t-values, Significance Levels, and Statistical Significance for the Control Group in the Pre- and Post-Tests (Post-Exercise Measurements)

s	variable	Unit	Pre-Tests		Post- Tests		Mean Differences	Standard Deviations of Differences	Calculated t-values	Significance Level	Significance
			Mean	Standard Deviations	Mean	Standard Deviations					
1	400-m Running Performance	sec	54.714	1.007	54.676	1.003	0.038	0.024	3.413	0.027	Significant

(Degree of Freedom = 4; Significance Level = 0.05)

Table 2. Means, Standard Deviations, Mean Differences, Standard Deviations of Differences, Calculated t-values, Significance Levels, and Statistical Significance for the Experimental Group in the Pre- and Post-Tests (Post-Exercise Measurements)

s	variable	Unit	Pre-Tests		Post- Tests		Mean Differences	Standard Deviations of Differences	Calculated t-values	Significance Level	Significance
			Mean	Standard Deviations	Mean	Standard Deviations					
1	400-m Running Performance	sec	54.744	0.983	52.876	0.965	1.868	0.147	28.342	0.000	Significant

(Degree of Freedom = 4; Significance Level = 0.05)

Table 3. Differences Between the Control and Experimental Groups in the Post-Test (Post Exercise Measurements)

s	variable	Unit	Control Group		Experimental Group		Calculated t-values	Significance Level	Significance
			Mean	Standard Deviations	Mean	Standard Deviations			
1	400-m Running Performance	sec	54.676	1.003	52.876	0.965	2.890	0.020	Significant

(Degree of Freedom = 8; Significance Level = 0.05)

Discussion

Table (1) shows that the mean performance time for the 400-meter run in the control group during the pre-test (post-exercise measurement) was (54.714) seconds, whereas in the post-test (post-exercise measurement) it became (54.676) seconds. This indicates the presence of significant differences between the pre-test and post-test in favor of the post-test. The researcher attributes this improvement in performance to the training program followed by the athletes.

Table (2) shows that the mean performance time for the 400-meter run in the experimental group during the pre-test (post-exercise measurement) was (54.744) seconds, whereas in the post-test (post-exercise measurement) it became (52.876) seconds. The figures clearly demonstrate a substantial improvement in 400-meter running performance. The researcher attributes this development to the regulated training program undertaken by the athletes, in addition to the Spirulina supplement, which contributed noticeably to performance enhancement. Spirulina supplementation increased the total antioxidant capacity in the runners' blood, which is considered a positive indicator reflecting improved efficiency and reserves of total antioxidant capacity among the runners. This increase was reflected in the free radical index, as total antioxidant capacity plays a direct role in reducing and combating free radicals, thereby preventing cellular damage within the athletes' bodies. From the researcher's perspective, improvement in athletic performance is associated with the integrity of functional systems and body cells, which are positively influenced by supplementation with antioxidant-containing products. Through reviewing numerous scientific sources, it became evident that short-distance runners of the Iraqi national team, being among the country's elite athletes, undergo high-load training programs that require intensive physical effort. Consequently, oxidative stress develops and free radical levels increase due to the high training intensities. This finding is consistent with the results of (Ta'ma, 2015), which indicated that oxidative stress occurs during high-intensity training sessions that constitute a fundamental component of athletic achievement. However, elevated free radical levels can lead to cellular damage, especially when athletes suffer from insufficient antioxidant reserves, negatively affecting recovery and physical performance. Under such circumstances, athletic development becomes slower or does not reach the expected level despite exposure to high training loads. Therefore, attention should be directed toward athletes' health status and ensuring that their nutritional intake contains adequate levels of antioxidants to compensate for deficiencies that may occur during training periods. Increasing antioxidant reserves is considered an essential component of nutritional and recovery strategies aimed at improving performance and minimizing the negative effects of oxidative stress. (Al-Kaabi, 2007, p. 172) stated that antioxidant deficiency within the body leads to multiple disturbances in vital functions and internal balance, thereby weakening athletic performance and negatively affecting achievement. This process is considered one of the principal causes of cellular damage, including damage to the cell membrane, which compromises its ability to regulate the movement of substances into and out of the cell and consequently impairs its normal functions. Damage to DNA within the cell nucleus directly affects all vital cellular processes. Furthermore, mitochondria, which are responsible for energy production, may also be damaged, resulting in cell death and directly

influencing athletic performance. Free radicals may spread to neighboring cells, causing a chain reaction of cellular damage. As a result, athletes, particularly runners, lose part of their internal energy reserves due to mitochondrial damage. Even if this loss is slight, it can adversely affect muscular strength and reduce the athlete's ability to sustain training for longer periods and achieve higher performance levels. The optimal approach for reducing muscular damage and limiting the harmful effects of free radicals is to enhance antioxidant defenses within cells. Antioxidants serve as an essential line of defense that protects body cells from the damaging effects of free radicals, thereby helping maintain athletic performance and improve achievement levels. Consequently, the researcher supplied the runners with Spirulina supplementation, which is rich in antioxidants. Scientific evidence indicates that Spirulina contains high concentrations of antioxidants and is characterized by a composition rich in biologically active compounds such as phycocyanin, chlorophyll, vitamins, and minerals. These compounds play a major role in combating free radicals and reducing oxidative stress at the cellular level. Such properties contribute to protecting cells from damage caused by intensive physical activity and improving post-exercise recovery, which in turn enhances overall athletic performance. Research also suggests that Spirulina supplementation may improve the body's resistance to cellular damage and enhance the functioning of vital physiological systems, making it a supportive option for improving athletic performance and reducing the adverse effects of oxidative stress. Some studies have reported that Spirulina supplementation contributes to improvements in muscular strength and endurance, making it beneficial for enhancing energy production and athletic performance (Joe Leech, 2024). Another study demonstrated that Spirulina supplementation improved oxygen uptake during exercise (Gurney & Spendiff, 2020). Recent studies indicate that muscular damage and the generation of free radicals constitute major factors negatively affecting athletes' performance, particularly among those participating in high-intensity activities such as sprint running. In this context, the use of antioxidant-containing nutritional supplements before training represents an effective strategy for reducing cellular damage within muscle tissue. These compounds help limit oxidative activity and enhance the body's natural antioxidant defenses. Antioxidant deficiency leads to oxidative stress because the cellular defense mechanisms, including antioxidant enzymes and nutrients, become insufficient to counteract oxidizing agents, resulting in substantial destruction of muscle cells and tissues. (Clarkson & Thompson, 2000) confirmed that the use of antioxidant substances is both safe and effective in improving athletic performance. Therefore, athletes exposed to strenuous physical activities should be encouraged to follow antioxidant-rich dietary regimens supplemented with appropriate nutritional products as part of preventive strategies aimed at reducing muscular damage and improving athletic achievement. The 400-meter sprint is considered one of the most demanding events in athletics because it requires substantial physical effort. During this event, athletes rely on the anaerobic energy system for approximately 80–85% of total energy production. Since performance duration exceeds 30 seconds, energy production depends primarily on the lactic acid system. Lactic acid accumulates within muscles due to insufficient oxygen availability during performance, leading to muscular fatigue and pain (Al-Shammaa, 2015, p. 77). The researcher attributes the improvement observed in the indicators—namely the increase in total antioxidant capacity reserves, the reduction in free radical levels, and the decrease in lactic acid concentration—to the enhancement of performance in the 400-meter run.

Table (3) shows that the mean 400-meter performance time in the control group during the post-test (post-exercise measurement) was (54.676) seconds, whereas the corresponding



value in the experimental group was (52.876) seconds. This indicates the presence of statistically significant differences between the two groups in favor of the experimental group. The researcher attributes this improvement to the training program in addition to Spirulina supplementation, which enhanced antioxidant levels and effectively reduced free radicals, thereby preventing oxidative stress that adversely affects body systems and organs. Spirulina supplementation also contributed to reducing muscular fatigue resulting from elevated lactic acid concentrations in both blood and muscle cells.

Conclusions

Based on the obtained results, the researchers concluded that Spirulina supplementation contributed to the improvement of all biochemical variables investigated in the study, and this improvement was reflected in enhanced 400-meter running performance. Furthermore, the researchers recommend emphasizing the nutritional aspect of athletes' preparation alongside the training program. Nutritional preparation is no less important than training itself and should receive greater attention because physical exertion produces numerous physiological and biochemical changes within the athlete's body.

References

- Abdel Fattah, A. A.-a. (2003). In P. o. training. Cairo: Dar Al Fikr Alarabi.
- Ahmed, F. S. (2019). Implementing circuit training and its effect on the activity of certain enzymes and the accumulation of lactic acid in freestyle wrestlers. Baghdad: Journal of Physical Education, 31(4), 144-148.
- Al-Kaabi, J. R. (2007). Physiological and chemical foundations of sports training. Qatar: Qatar National Printing Press.
- Al-Shammaa, H. F. (2015). Using exercises based on repetitive training methods according to the concentration of lactic acid in the blood and its effect on specific speed endurance and performance in a 400-meter run. Baghdad: Journal of Physical Education, 27(2), 76-91.
- Aziz, A. A. (2014). Determining the optimal time frame for monitoring blood lactate concentration after competitive exertion in a 400-meter junior race. Baghdad: Journal of Physical Education, 26(1), 180-192.
- Clarkson, P. M., & Thompson, H. S. (2000). Antioxidants: what role do they play in physical activity and health?
- Gurney, T., & Spendiff, O. (2020). Spirulina supplementation improves oxygen uptake in arm cycling exercise.
- (n.d.). International Association of Athletics Federations (IAAF).



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Jassim, A. S. (2019). Effect of anaerobic exercise, curcumin, and ginseng extract on some indicators of oxidative stress and performance endurance in handball players. Karbala: University of Karbala, College of Physical Education and Sports Sciences.

Joe Leech, M. (2024). 10 Health Benefits of Spirulina. Retrieved on the 30th of Decembe.

Ta'ma, G. M. (2015). The effect of high-intensity physical exertion on oxidative stress, certain antioxidants, biochemical indicators, and recovery time in male artistic gymnasts. Baghdad.

Yasser, O. K. (2018). The effect of antioxidants on some biochemical and physiological indicators and their relationship to the performance of the four members of the national senior team. Baghdad: Journal of Physical Education, 30(2), 395-407.