The Effect of Whey Protein Supplementation on Various Performance Parameters in Tennis Players

Tenisçilerde Whey Protein Tüketiminin Bazı Performans Parametrelerine Etkisi

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Abstract

This study aimed to examine the impact of whey protein supplementation on various performance parameters in tennis players. Twelve trained male tennis players, aged between 18 and 25, participated in the research. On the first day, participants underwent a familiarization session, followed by a randomized, double-blind, crossover, and counterbalanced experimental design involving three separate test days. On each test day, the athletes were assigned to one of three groups and consumed the assigned supplement 30 minutes prior to performance testing. The supplements administered were whey protein (30 g mixed with 300 ml water), placebo (calorie-free sweetener with 300 ml water), and a control (300 ml water only). Differences between conditions were analyzed using repeated-measures ANOVA. No statistically significant differences were observed across conditions in vertical jump, anaerobic power, agility, handgrip strength, or visual analogue scale (VAS) scores ($p>0.05$). However, significant differences were found in ball speed and ratings of perceived exertion (RPE) ($p<0.05$). In terms of visual reaction time performance, statistically significant differences were observed in elapsed reaction time, average reaction time, fastest reaction time, and slowest reaction time ($p<0.05$), while no significant difference was detected for last reaction time ($p>0.05$). Furthermore, no significant differences were reported between groups in gastrointestinal symptoms following supplementation ($p>0.05$). Overall, whey protein supplementation was found to enhance ball speed and reaction time performance while reducing RPE values in tennis players. The absence of gastrointestinal symptoms supports whey protein as a beneficial nutritional supplement for performance enhancement in athletes. Additionally, the findings suggest that some of the performance improvements observed may be attributed to a placebo effect.

Keywords: Whey protein, Ball speed, Reaction time, RPE, Tennis.

Özet

Bu çalışmada tenisçilerde whey protein tüketiminin bazı performans parametrelerine etkisini incelemek amaçlanmıştır. Çalışmaya 18-25 yaş aralığında olan, antrenmanlı 12 erkek tenisçi katılmıştır. Çalışmada, tenisçilere ilk gün çalışmanın uyum seansı uygulanmış ve daha sonra sporcular randomize, çift kör, çapraz-döngülü ve karşıt dengeli deneysel dizaynı ile toplam 3 test gününe katılmışlardır. Tenisçiler test günlerinde 3 gruba ayrılmış ve testler başlamadan 30 dakika önce kendilerine verilen besin takviyelerini tüketmişlerdir. Farklı test günlerinde performans testlerinden önce sporculara whey protein (30 g+300 ml su), plasebo (kalorisiz tatlandırıcı+300 ml su) ve kontrol (300 ml su) takviyeleri verilmiştir. Değişkenler arası farklılık tekrarlı-ölçümler ANOVA ile analiz edilmiştir. Tenisçilere ait performans parametreleri karşılaştırıldığında, dikey sıçrama, anaerobik güç, çeviklik, el kavrama kuvveti ve görsel analog skala (GAS) değerleri arasında istatistiksel olarak anlamlı bir farklılık yoktur ($p>0,05$). Buna karşılık, top hızı ve algılanan zorluk derecesi (AZD) değerleri arasında istatistiksel olarak anlamlılık vardır ($p<0,05$). Görsel reaksiyon zamanı performansları karşılaştırıldığında ise, toplam reaksiyon zamanı, ortalama reaksiyon zamanı, en hızlı reaksiyon zamanı ve en yavaş reaksiyon zamanı parametreleri arasında istatistiksel olarak anlamlı farklılık bulunmuştur ($p<0,05$). Son reaksiyon zamanı performansında ise istatistiksel olarak anlamlı farklılık tespit edilmemiştir ($p>0,05$). Çalışmada, besin desteği kullanımı sonrasında gastrointestinal semptom durumlarında gruplar arasında istatistiksel olarak anlamlı farklılık bulunmamıştır ($p>0,05$). Çalışmada, whey protein tüketiminin tenisçilerde top hızı ve reaksiyon zamanı parametrelerinde performans artışı sağladığı ve AZD değerlerini de düşürdüğü tespit edilmiştir. Ayrıca, whey protein kullanımının gastrointestinal problemde oluşturmaması, sporcu diyetlerinde kullanımının performans artışı için iyi bir besin desteği olduğunu göstermektedir. Diğer yandan araştırmamızda, tenisçilerde plasebo etkisinden kaynaklı bir performans artışı olduğu da görülmektedir.

Anahtar Kelimeler: Whey protein, Top hızı, Reaksiyon zamanı, AZD, Tenis.

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INTRODUCTION

Tennis is characterized as an intermittent sport involving high-intensity activities interspersed with short rest intervals between points (Fernandez-Fernandez et al., 2006). During training sessions and matches, tennis players perform explosive movements including repeated accelerations and decelerations. One fundamental characteristic distinguishing tennis from other sports is the absence of a fixed duration for match play. While the average tennis match typically lasts around 1.5 hours, match durations can extend to 4–5 hours in elite-level tournaments such as the Grand Slam events (e.g., Roland Garros) (Kovacs, 2007). In these prolonged matches, tennis players must maintain high levels of aerobic and anaerobic fitness to sustain performance effectively (Smekal et al., 2001). Otherwise, fatigue emerging in the later stages of a match may have detrimental effects on players' performance (Davey et al., 2002). To mitigate this issue, athletes often utilize various ergogenic aids such as caffeine, carbohydrates, protein, and sodium bicarbonate either prior to or during competition, in an effort to delay fatigue and sustain performance levels (López-Samanes et al., 2015).

Ergogenic aids aim to optimize energy efficiency or accelerate adenosine triphosphate (ATP) production by acting on physiological mechanisms (Silver, 2001). A review of the literature reveals that caffeine consumption at doses of 3–6 mg/kg has been shown to positively influence groundstroke performance in tennis players (Ferrauti et al., 1998; Klein et al., 2012). Another commonly used ergogenic aid in tennis is carbohydrate supplementation, which has been reported to help maintain blood glucose levels toward the end of matches and to produce significant differences in perceived exertion (Hornery et al., 2007; Gomes et al., 2013). In addition, proteins are an integral component of many athletes' nutritional regimens and are favored for their role in enhancing physical performance, accelerating post-exercise recovery, and supporting muscle hypertrophy after resistance training (Aslan et al., 2024). Whey protein, in particular, accelerates muscle protein synthesis due to its rapid digestibility and high concentration of essential amino acids (Tang et al., 2007).

Whey protein is a protein complex that contains a rich profile of essential amino acids and is absorbed into the bloodstream more rapidly than other protein sources. As a highly popular dietary supplement, whey protein has also been associated with various health benefits beyond athletic performance (Krissansen, 2007). It is well established that protein supplementation is widely used among athletes, primarily due to its role in supporting performance and physical development. Among its primary performance-related benefits are the promotion of muscle hypertrophy and strength, preservation of muscle tissue, acceleration of recovery, prevention of muscle damage and loss through stimulation of muscle protein synthesis, contribution to energy production, enhancement of muscular endurance, elevation of anabolic hormone levels while suppressing catabolic hormones, reduction of oxidative stress, and support of optimal body composition (Marshall, 2004; Pal et al., 2010). Whey protein, recognized as one of the highest-quality protein supplements in sports nutrition, is most commonly utilized by athletes as a training aid (Levers & Vargo, 2015). A study reported that whey protein supplementation during resistance training significantly increased lean body mass and muscle strength among healthy young adults (Li & Liu, 2019). Numerous studies in this field have investigated the effects of whey protein on resistance training performance. Given that tennis combines strength-based and endurance-related demands, insights from resistance training studies can offer a solid basis for understanding the role of protein in racquet sports. However, while research involving caffeine and carbohydrate supplementation in racquet sports is relatively common, there is a limited number of studies addressing the impact of protein intake on the performance of tennis players and the specific nutritional demands within this context. A study recommended that tennis players engaged in high-intensity training consume 1.6 g/kg of protein per day (Ranchordas et al., 2013). However, there is a lack of sufficient research in the literature regarding the specific effects of protein intake on performance parameters such as jumping ability, speed, and endurance in tennis players.

The aim of this study was to determine the effects of whey protein supplementation on vertical jump, anaerobic power, agility, visual reaction time, handgrip strength, rating of perceived exertion (RPE), visual analogue scale (VAS) scores, and ball speed in tennis players. Although existing research has addressed the relationship between tennis performance and nutritional supplementation, studies focusing specifically on the defined participant group and the selected performance parameters remain limited. Given the implemented nutritional protocol and the chosen performance metrics, this study is anticipated to contribute meaningfully to the existing body of literature. Accordingly, the hypothesis of this research is that short-term whey protein supplementation would improve athletic performance in tennis players.

METHOD

A quantitative research design was employed in this study. A randomized, double-blind, counterbalanced crossover experimental design was implemented. This study was approved by the Sinop University Human Research Ethics Committee under the decision dated May 2, 2024, with protocol number 2024/80, confirming its compliance with ethical standards.

Design of the Study

All participants were thoroughly informed about the study protocol, and the procedures were explained in detail. Additionally, two days prior to data collection, a familiarization session was conducted in which participants were asked to perform the tests at a low intensity without exerting themselves. On the first day of the study, this familiarization session was administered, after which the participants took part in three separate testing days under a randomized, double-blind, crossover, and counterbalanced experimental design. All tests and measurements were carried out in the Faculty of Sport Sciences laboratories at Sinop University and on the Sinop University tennis court. At the outset of the study, participants' height and body weight were measured, and their body mass index (BMI) was calculated. To ensure adequate recovery, participants attended the testing sessions at 48-hour intervals. The study was conducted using a double-blind protocol. Accordingly, neither the athletes nor the researchers were aware of the nutritional supplement administered. On each test day, the tennis players were divided into three groups and consumed the assigned nutritional supplement 30 minutes prior to testing. On different test days, prior to performance assessments including vertical jump, anaerobic power, agility, reaction time, handgrip strength, and ball speed participants were administered one of the following: whey protein (30 g mixed with 300 ml of water), a placebo (a calorie-free sweetener mixed with 300 ml of water), or a control supplementation consisting of water only (300 ml). The tests were administered in a fixed order each day, with 3–5 minutes of passive rest allocated between trials. Participants completed a standardized, sport-specific warm-up protocol before each measurement and test. Participants were instructed to refrain from consuming any food for at least three hours prior to the performance tests. In the study, participants' perceived exertion during the performance tests was assessed using the Borg scale, while delayed onset muscle soreness (DOMS) was evaluated using the visual analogue scale (VAS). In addition, the Gastrointestinal Symptom Rating Scale (GSRS) was administered to evaluate symptoms commonly associated with gastrointestinal disorders. All tests and measurements were conducted at the same time of day to account for circadian rhythm variations. Participants were instructed to rest adequately and avoid engaging in strenuous physical activity prior to testing. All testing procedures were carried out under consistent environmental conditions (temperature: 16.66 ± 0.57°C, humidity: 66.66 ± 4.04%, atmospheric pressure: 1029.33 ± 1.15 mbar; mean ± SD).

Supplementation Protocol

Participants arrived at the laboratory 30 minutes prior to the commencement of testing. The research protocol was then explained to the athletes in detail again, after which they were instructed to consume their assigned supplements. In addition, participants were asked prior to the study whether they had any known food allergies. The participants were randomly assigned to the three conditions using the Research Randomizer software (www.randomizer.org). In the study, the experimental group received whey protein powder, while the placebo group was given an identical volume and form of a calorie-free sweetener to match the supplementation procedure. In the study, the control group received no nutritional supplement besides water. Participants in the experimental and placebo groups were administered 30 grams of whey protein powder (Weider, USA) or the placebo, each mixed with 300 ml of water, 30 minutes prior to testing in a laboratory setting (Davies et al., 2018). The control group received only 300 ml of water. Supplementation was conducted using a double-blind protocol. Supplementation was administered in accordance with the recommended daily usage and dosage guidelines established in the literature. Participants were advised to avoid strenuous exercise, abstain from alcohol and stimulants, and pay close attention to their nutrition and rest during the 24 hours preceding each testing session. Aside from these restrictions, no changes were made to the participants' regular diets, daily routines, or training programs in order to ensure that any positive or negative changes in performance parameters could be reliably attributed to the supplementation. Additionally, during the testing sessions, participants were permitted to consume only water based on their usual habits and in self-determined amounts apart from the assigned supplements. The whey protein powder doses were prepared at room temperature by a researcher using a digital laboratory balance (FLY 300) with a precision of 0.001 g.

Participants

The study included twelve trained male tennis players aged between 18 and 25 years. A priori power analysis indicated that a sample size of 12 participants was necessary and sufficient (Effect size: 0.50, Confidence interval: $1–\beta = 0.95$, Error probability: $\alpha = 0.05$, Actual power: 0.95). The study was conducted in Sinop, and the participating athletes were selected from students enrolled in the Faculty of Sport Sciences at Sinop University. To ensure the reliability of the findings and eliminate potential confounding effects of different training regimens, all participants were required to be engaged in the same training program. Participants engaged in a minimum of three weekly tennis training sessions (6 h per week). Furthermore, all participants confirmed that they had not used any ergogenic aids with the potential to influence body hydration status or exercise performance during the three months preceding the commencement of the study. All participants underwent the same tests, measurements, and analyses under three different nutritional protocols administered on non-consecutive days. Inclusion criteria required that participants be in good health, free from any chronic or acute illnesses, and without any movement limitations due to injury. Participants were removed from the study if any health problems were reported or observed. Informed consent was obtained from all participants prior to the commencement of the study.

Statistical Analysis

Prior to selecting the statistical tests to be applied to the data, the Shapiro-Wilk normality test was conducted to assess whether the error terms were normally distributed. Differences between variables were analyzed using repeated-measures ANOVA. Post-hoc comparisons between groups were evaluated using the Bonferroni correction. Between-group comparisons were analyzed with a paired sample t-test. Effect sizes were calculated using the eta-squared (η^2) coefficient, ranging from 0.00 to 1.00, and interpreted as follows: 0.01 = small, 0.06 = medium, 0.14 = large, and 0.20 = very large (Alpar, 2022). The results of the study are presented as mean ± standard deviation (M ± SD), and statistical significance was set at $p<0.05$. All statistical analyses were conducted using SPSS version 22.0 software.

Data Collection Procedure

A data entry form was developed for the purpose of data collection in this study. All parameters related to the athletes were recorded using this form. At the end of each testing day, participants completed the Gastrointestinal Symptom Rating Scale (GSRS). Following data collection, all recorded information was subjected to statistical analysis. Detailed information regarding the materials used for data collection is provided under the headings below.

Anthropometric Measurements

The height of the tennis players was measured in centimeters using a Seca S213 stadiometer (Hamburg, Germany), while their body weight was measured in kilograms using the InBody 120 bioelectrical impedance body composition analyzer (Seoul, South Korea). Body mass index (BMI) was calculated by dividing body weight by the square of height in meters (kg/m^2), following the measurement of height and body weight (Mor et al., 2021).

505 Agility Test

Athletes' agility was assessed on a tennis court using a photocell timing system (accuracy ±0.01 s) (Seven, SE-165 Photocell Chronometer, Istanbul, Türkiye). The 505 Agility Test was performed on a 15-meter straight track and evaluated based solely on the time required to cover the final 5 meters in a shuttle format. The initial 10-meter approach run was excluded from the measurement. Timing commenced when the athlete reached the 15-meter mark from the 10-

meter line and stopped upon their return to the same 10-meter line after executing a 180° turn. The test was administered twice with a 3-minute passive rest interval, and the best score was recorded for analysis (Draper & Lancaster, 1985; Gelder & Bartz, 2011).

Reaction Time Test

In this study, the reaction time of the tennis players was measured using a reaction training device (Light Trainer Reaction Development and Exercise System, Istanbul, Türkiye). The system comprises six wireless modules equipped with LED lights and proximity sensors capable of detecting objects within a 10 cm range. These modules transmit data wirelessly and in real time via Bluetooth to a dedicated application on a smartphone or tablet. In addition to general athletic performance testing, the device can be used for sport-specific assessments. It features adjustable difficulty levels and offers different colored light options on the modules. The device is suitable for use on various surfaces in both indoor and outdoor environments and enables the monitoring of reaction time data with millisecond precision via its integrated application. Athletes began the reaction time test from a distance of 1 meter from the modules, following the researcher's "ready" command. The test duration started with the illumination of the first module and ended when the athlete deactivated the final light. Athletes were instructed to deactivate a total of 30 illuminated modules during the test. If a participant made contact with and knocked over a module or caused damage to the testing area, the trial was deemed invalid and was repeated. Two trials were performed with a 3-minute passive rest interval, and the best completion time was recorded as the official reaction time (Mor et al., 2022).

Vertical Jump and Anaerobic Power Test

The vertical jump performance of the tennis players was measured using a digital vertical jump device (Takei 5406 Jump-MD Vertical Jump Meter, Tokyo, Japan). The vertical jump test is a common method used to evaluate and measure lower extremity strength Each participant was given two attempts with a 1-minute passive rest interval, and the best result displayed on the digital screen was recorded in centimeters with ±1 cm accuracy (Mor et al., 2022). Anaerobic power was calculated using the Lewis formula, based on each participant's body weight and vertical jump height: Anaerobic Power (W) = √4.9 × [Body Weight (kg)] × √Vertical Jump Height (m) (Fox et al., 2012).

Ball Speed Measurement

In the study, the ball speed of the tennis players was measured using a radar gun (Bushnell Velocity Speed Gun, Overland Park, Kansas, USA), capable of detecting speeds in the range of 16–177 km/h with an accuracy of ±2 km/h. All serves were performed on an indoor tennis court during the ball speed measurements to control for environmental factors such as wind. The radar device used to measure ball speed was positioned at the center service return area, aligned with the net line. Serves were required to comply with official tennis rules, specifically being directed toward the cross-court service box and the designated backhand return area. If a serve hit the net or landed outside the service box (i.e., was out), the recorded ball speed value was still documented. All serves were directed to the left service box (from the right side) for right-handed players, and to the right service box (from the left side) for left-handed players. All tennis players were instructed to use the flat serve technique, and a certified tennis coach evaluated each serve. Each athlete was given five attempts to serve at maximal speed, and the highest recorded ball speed (in km/h) was used for analysis (Avar & Akça, 2013; Mor et al., 2022).

Handgrip Strength

Handgrip strength was measured using a handgrip dynamometer (Takei 5401, Tokyo, Japan). Measurements were taken while the participant was standing, with the testing arm extended without bending at the elbow or touching the body, positioned at a 45° angle relative to the torso. The test was performed twice using the athlete's racket-holding (dominant) hand, and the highest value recorded was used for analysis (İbiş et al., 2004).

Borg Scale (Rating of Perceived Exertion – RPE)

The Rating of Perceived Exertion (RPE) is a method used to assess athletes' perceived exertion during physical activity. In the scale developed by Borg, the highest value is expressed as 10, and the lowest as 0 at rest. An increasing score between 0 and 10 corresponds to an increasing level of exertion experienced during the test (Borg, 1998). After each measurement, athletes were asked to rate the level of exertion they felt in their bodies using a numerical value, which was then recorded.

Visual Analogue Scale (VAS)

The Visual Analogue Scale (VAS), developed by Albersnagel (1988), is a measurement tool that allows for the assessment of perceived pain or fatigue on a 10 cm horizontal line divided into equal intervals. The scale ranges from "no pain" to "worst imaginable pain" (Albersnagel, 1988). In this study, the VAS was used to numerically evaluate athletes' levels of physical fatigue.

Gastrointestinal Symptom Rating Scale (GSRS)

The Gastrointestinal Symptom Rating Scale (GSRS) was developed by Revicki et al. (1997) to assess the severity of symptoms commonly associated with gastrointestinal disorders. The Gastrointestinal Symptom Rating Scale (GSRS) consists of 15 items and is structured as a

7-point Likert-type scale, with response options ranging from "no discomfort" to "very severe discomfort." Based on factor analysis, the 15 items of the GSRS are grouped into five subcategories: abdominal pain, reflux, diarrhoea, indigestion, and constipation. Items 1, 4, and 5 of the scale assess abdominal pain; items 2 and 3 assess reflux; items 11, 12, and 14 assess diarrhoea; items 6, 7, 8, and 9 assess indigestion; and items 10, 13, and 15 assess constipation. Evaluation is carried out accordingly. The total score obtained from the responses ranges from 15 to 105. Higher scores on the scale indicate more severe gastrointestinal symptoms (Revicki et al., 1997).

FINDINGS

The descriptive characteristics of the participating athletes are presented in Table 1. Comparisons of performance parameters across groups are shown in Tables 2 and 3, while the comparison of gastrointestinal symptom rating scale scores among the three groups is illustrated in Figure 1.

Table 1. Descriptive Characteristics of the Tennis Players

Variables	X	SD
Age (yr)	21.38	1.12
Training Age (yr)	10.46	2.33
Height (cm)	172.62	7.82
Body Weight (kg)	72.37	14.55
Body Mass Index (BMI) (kg/m²)	24.14	3.63

X = Mean; SD = Standard Deviation

Table 2. Comparison of Performance Parameters Across Groups in Tennis Players

Variables	**Control**	**Placebo**	**Whey**	**f**	**p**	**η2**
	X±SD	**X±SD**	**X±SD**			
Vertical Jump (cm)	54.92±6.89	56.15±6.14	55.62±6.21	0.636	0.538	0.05
Anaerobic Power (W)	1183.32±239.30	1198.94±249.76	1196.45±270.07	0.720	0.497	0.06
COD (s)	2.46±0.08	2.41±0.11	2.42±0.10	1.382	0.270	0.10
Handgrip Strength (kg)	45.59±6.30	44.45±8.03	45.61±8.59	0.973	0.369	0.07
Ball Speed (km/h)	41.77±10.50⸸	46.08±11.87	51.46±11.45ǂ	3.644	**0.041***	0.23
RPE	3.38±1.19#⸸	2.15±0.38ǂ	2.08±0.64ǂ	12.600	**0.000***	0.51
VAS	1.77±1.64	2.54±0.78	1.92±0.86	1.741	0.209	0.13

*****(p<0.05); X = Mean; SD = Standard Deviation; RPE = Rating of Perceived Exertion; VAS = Visual Analogue Scale; COD = Change of Direction

ǂ Indicates a statistically significant difference from the control group. # Indicates a statistically significant difference from the placebo group. ⸸ Indicates a statistically significant difference from the whey group.

In Table 2, no statistically significant differences were observed among the three groups in terms of vertical jump, anaerobic power, agility, handgrip strength, or VAS scores (p>0.05). In contrast, statistically significant differences were found in ball speed and RPE values (p<0.05).

According to the results, ball speed performance was significantly higher in the whey group compared to the control group, while RPE values were significantly lower in both the whey and placebo groups compared to the control group (p<0.05). Furthermore, effect size analysis indicated meaningful variations in performance parameters among the three groups.

Table 3. Comparison of Visual Reaction Time Parameters Across Groups in Tennis Players

Variables (sec)	Control	Placebo	Whey	f	p	η2
	X±SD	X±SD	X±SD			
Elapsed Reaction Time (s)	36.44±3.22#⸸	32.61±2.60ǂ	33.31±2.86ǂ	16.649	**0.000***	0.58
Average Reaction Time (s)	1.22±0.11#⸸	1.08±0.09ǂ	1.11±0.09ǂ	17.885	**0.000***	0.60
Fastest Reaction Time (s)	0.77±0.11⸸	0.71±0.07	0.66±0.12ǂ	3.882	**0.035***	0.24
Slowest Reaction Time (s)	2.34±0.62#⸸	1.79±0.41ǂ	1.90±0.58ǂ	5.407	**0.012***	0.31
Last Reaction Time (s)	1.18±0.35	1.14±0.31	1.11±0.32	0.252	0.779	0.02

*****(p<0.05); X = Mean; SD = Standard Deviation

ǂ Indicates a statistically significant difference from the control group. # Indicates a statistically significant difference from the placebo group. ⸸ Indicates a statistically significant difference from the whey group.

In Table 3, comparisons of visual reaction time performance across the three groups revealed statistically significant differences in elapsed reaction time, average reaction time, fastest reaction time, and slowest reaction time parameters (p<0.05). No statistically significant difference was observed in last reaction time performance (p>0.05). According to the results, elapsed reaction time, average reaction time, and slowest reaction time were significantly improved in both the whey and placebo groups compared to the control group (p<0.05). For fastest reaction time, a statistically significant difference was found between the control and whey groups in favor of the whey group (p<0.05). Furthermore, effect size analysis indicated meaningful variations in performance parameters among the three groups.

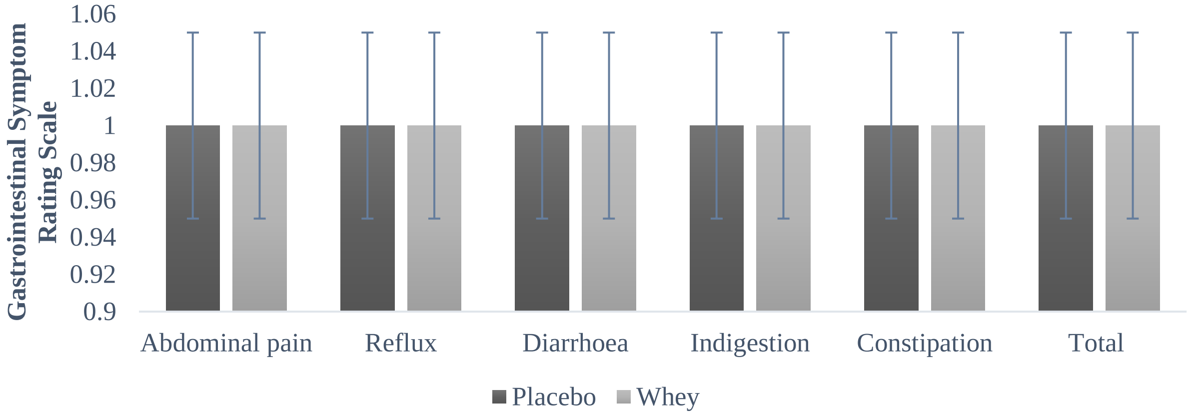

Figure 1. Comparison of Gastrointestinal Symptom Rating Scale Scores Among Tennis Players

Figure 1 presents the comparison of gastrointestinal symptoms following supplement intake among the tennis players. According to the results, no statistically significant differences were found between the groups ($p>0.05$).

DISCUSSION

The aim of this study is to determine the effects of whey protein supplementation on vertical jump, anaerobic power, agility, visual reaction time, handgrip strength, rating of perceived exertion (RPE), visual analogue scale (VAS) scores, and ball speed in tennis players. The use of selected performance parameters in conjunction with the Gastrointestinal Symptom Rating Scale distinguishes this study from others in the existing literature. The key findings indicate that short-term whey protein consumption in tennis players was associated with reduced perceived exertion without causing gastrointestinal issues and improved ball speed and reaction time. Additionally, the results suggest that a placebo effect may also have contributed to the observed performance enhancements among the athletes. No statistically significant differences were observed in vertical jump, anaerobic power, agility, handgrip strength, or VAS scores. Although these parameters did not show significant changes, they are partially aligned with our experimental hypothesis, suggesting that whey protein supplementation may still yield positive outcomes in enhancing performance among tennis players.

In the current study, while whey protein intake did not lead to improvements in performance components such as vertical jump, anaerobic power, agility, or handgrip strength, it did result in a notable increase in ball speed performance. In the visual reaction time parameters, where different results were observed, both the whey protein and placebo groups demonstrated improved performance compared to the control group. This finding supports the notion that the placebo effect may also contribute positively to performance enhancement. One of the study's most notable findings is the improvement in perceived exertion in favor of the whey protein group. This finding indicates that short-term supplementation whether it involves whey protein or a placebo may contribute to a reduced perception of training load among tennis players. Such a perception of decreased exertion, potentially driven by psychological factors, may be interpreted as a beneficial effect on athletic performance. On the other hand, whey protein consumption in our study did not lead to any changes in VAS scores and did not cause any gastrointestinal issues. When used appropriately, whey protein is generally considered a safe and effective dietary supplement for athletes. Nonetheless, it is important to acknowledge the potential adverse effects, such as gastrointestinal symptoms, kidney and liver strain, allergic responses, and disruptions in metabolic balance. Athletes are advised to follow dosage guidelines provided by qualified professionals and established protocols, select high-quality supplements, and consider their health conditions and nutritional requirements. Non-compliance with these recommendations may lead to gastrointestinal symptoms, including bloating, diarrhoea, nausea, and abdominal pain, all of which have the potential to impair athletic performance (Pan et al., 2025). There is a limited number of studies addressing protein requirements in racquet sports (Ranchordas et al., 2013). Previous research has shown that tennis players exhibit highly variable nutritional and recovery habits before, during, and after matches (Fleming et al., 2018). Although the literature provides evidence supporting the positive effects of whey protein consumption on exercise performance (Marshall, 2004; Miller et al., 2014; Davies et al., 2018; Lam et al., 2019), it also emphasizes the need for further research on both nutritional strategies (Fleming et al., 2018) and the use of whey protein specifically (Davies et al., 2018). Arazi et al. (2011) reported that whey protein supplementation increased explosive muscle strength and overall muscular strength in trained male athletes. Conversely, Weisgarber et al. (2012) found that whey protein supplementation consumed immediately before and after exercise had no significant effect on muscle mass or strength. Another study concluded that daily whey protein supplementation during resistance training was more effective than soy protein or carbohydrate supplementation in promoting gains in lean body mass (Volek et al., 2013). In an animal study, Chen et al. (2014) investigated the effects of whey protein on exercise performance and biochemical profiles in mice, reporting that whey protein supplementation improved exercise performance, body composition, and biochemical markers, and could serve as an effective ergogenic aid for aerobic exercise training. In addition to these results, a meta-analysis study found that pre-exercise protein supplementation has beneficial effects on both upper and lower body muscle strength and hypertrophy (Morton et al., 2018). These findings in the literature provide evidence supporting the favorable effects observed in ball speed performance for the whey protein group in our study. The observed increase in ball velocity is attributed to the activation of the mTORC1 signaling pathway a central regulator of muscle protein synthesis by leucine, a branched-chain amino acid (BCAA) present in whey protein. This activation enhances muscle protein synthesis, thereby promoting gains in lean muscle mass, improvements in muscle strength, and favorable metabolic adaptations (Kumar et al., 2009; Atherton & Smith, 2012; Pan et al., 2025). Furthermore, the rapid digestion and efficient absorption of whey protein further facilitate its capacity to support muscle protein synthesis (Pan et al., 2025). However, in our study, no statistically significant differences were observed in parameters such as vertical jump, anaerobic power, and handgrip strength. Nieman et al. (2020) reported that whey protein supplementation reduced biomarkers of muscle damage following intensive eccentric exercise. In our study, however, athlete feedback indicated no significant differences in VAS scores. Taylor et al. (2016) demonstrated that whey protein supplementation administered both pre- and post-exercise improved one-repetition maximum bench press and agility performance. In the current study, no significant differences were observed among groups in terms of agility test outcomes. On the other hand, our study revealed that visual reaction time performance was better in both the whey protein and placebo groups compared to the control group. The presence of this improvement across both supplement groups suggests that the observed effect may be attributed to a placebo response. Given that reaction time assessments demand a high degree of focus and cognitive engagement, it is plausible that the ingestion of supplements regardless of their active content may have positively influenced athletes' mental preparedness, enhancing motivation and readiness through a perceived stimulatory effect (Hurst et al., 2019). According to findings reported by Huang et al. (2017), whey protein supplementation may play a role in physiological protection and performance enhancement, making it an essential nutritional aid for muscle development. Other studies have indicated positive effects of whey protein supplementation on accelerated post-exercise recovery (Cooke et al., 2010; West et al., 2017). West et al. (2017) noted that whey protein supplementation promotes whole-body anabolism following intense resistance exercise and improves acute recovery after performance. Our study observed a reduction in perceived exertion following whey protein consumption. Whey protein facilitates anabolic signaling primarily by stimulating insulin secretion and activating the mTORC1 pathway. Additionally, it exerts anti-catabolic effects by attenuating muscle protein degradation, primarily through the suppression of the ubiquitin–proteasome system. Furthermore, whey protein has been shown to reduce circulating levels of cortisol, a catabolic hormone associated with muscle tissue breakdown during high-intensity exercise (Pan et al., 2025). We speculate that this decrease in perceived physical fatigue may result from the physiological and anabolic improvements facilitated by whey protein supplementation, particularly through elevating anabolic hormone levels and suppressing catabolic hormones.

CONCLUSION

The findings of this study indicate that whey protein consumption improved tennis players' performance parameters such as ball speed and reaction time, while also reducing their rating of perceived exertion (RPE). These results support the hypothesis that short-term whey protein supplementation positively impacts athletic performance. Moreover, the absence of gastrointestinal disturbances associated with whey protein intake suggests that whey protein is an effective nutritional supplement within athletes dietary regimens and nutritional strategies aimed at performance enhancement. Considering all these outcomes, short-term whey protein supplementation may be considered beneficial for tennis players aiming to enhance performance. On the other hand, our study also demonstrates performance improvements attributable to the placebo effect among the tennis players. Coaches and practitioners may consider incorporating short-term whey protein supplementation into training programs to enhance performance, while also acknowledging individual responses and potential placebo effects.

The primary limitation of our study is the inability to monitor athletes during the post-supplementation and post-performance recovery periods and the lack of evaluation of specific recovery biomarkers. In addition, the small sample size, the inclusion of only male athletes, and the short-term nature of the intervention should be acknowledged. Future research should examine the effects of long-term whey protein supplementation, incorporating both physiological and biochemical markers of recovery alongside performance parameters, to more clearly elucidate its impact on athletes.

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Ethical Statement

This study was conducted in accordance with the principles outlined in the Declaration of Helsinki and was approved by the Sinop University Human Research Ethics Committee (Approval Number: E-57428665-050.04-260602; Date of Approval: May 2, 2024/80).

Author Contributions

Study Design: BÇ, AM; Supervision: BÇ, AM; Data Collection: BÇ, AM; Data Analysis: AM; Literature Review: BÇ, AM; Writing: BÇ, AM; Critical Review: AM.

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