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Ergogenic Aids Used in Football and Effects on Performance

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Abstract

Aim: Football is a high-tempo sport with excessive physical requirements. With varying energy expenditure according to position, nutritional requirements, training types and rest durations vary. Currently, clubs, trainers and footballers understand the importance of nutrition along with correct training to increase performance. Ergogenic aid products, used in addition to sufficient and balanced nutrition, may assist in developing specific traits of sportspeople, increasing the speed of recovery after matches and reducing risk of injury. With this target, it is necessary to know which product should be taken at which time and which dose.

Methods: In this study, the effects of the most commonly used ergogenic aids of creatine, beta-alanine, caffeine and nitrate/nitric oxide on football performance were reviewed.

Results: Studies have stated that ergogenic aids increase performance parameters like sprinting, jump power and running speed and have positive effects on factors limiting exercise performance like tiredness and dehydration.

Conclusion: There is a need for more studies in order to present clear recommendations related to the dose and duration of use of ergogenic aids in football.

Keywords

Football, Ergogenic aid, Recovery, Performance.

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Futbolda Kullanılan Ergojenik Destekler ve Performans Üzerindeki Etkileri

Özet

Amaç: Futbol, fiziksel gereksinimlerin fazla olduğu, yüksek tempolu bir spor türüdür. Pozisyonlara göre değişen enerji harcaması ile, besinsel gereksinim, antrenman türü ve dinlenme süreleri de değişmektedir. Günümüzde kulüpler, antrenörler ve futbolcular performans arttırmak için doğru antrenmanla beraber beslenmenin de önemi kavramıştır. Yeterli ve dengeli beslenmeye ek olarak kullanılan ergojenik destek ürünleri sporcuların spesifik özelliklerini geliştirmeye, maç sonrası toparlanmayı hızlandırma ve sakatlanma riskini azaltmaya yardımcı olabilir. Bu amaçlarda hangi ürünün ne zaman ve hangi dozda kullanılması gerektiği bilinmelidir.

Materyal ve Metot: Bu çalışmada en sık kullanılan ergojenik desteklerden kreatin, beta-alanin, kafein ve nitrat/nitrik oksitin futbol performansına etkileri derlenmiştir.

Bulgular: Yapılan çalışmalarda ergojenik desteklerin depar, sıçrama gücü ve koşu hızı gibi performans parametrelerinde artış, yorgunluk ve dehidrasyon gibi egzersiz performansı sınırlayan etmenler üzerine olumu etkiler gösterdiği belirlenmiştir.

Sonuç: Futbolda ergojenik desteklerin dozu ve kullanım süresi ile ilgili net öneriler sunulabilmesi için daha fazla çalışma yapılması gerekmektedir.

Anahtar Kelimeler

Futbol, Ergojenik destek, Toparlanma, Performans.

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INTRODUCTION

One of the sports attracting most interest around the world of football is a team sport involving interval running. During a typical football match, players cover 10-13 km distance. However, most of this distance is covered by walking and low intensity running (Bangsbo, 2014). Additionally, during competitions, sportspeople expend maximum effort in sprinting, jumping, sudden acceleration and slowing movements. With all these features, football is a sport using both aerobic and anerobic energy systems (Oliveira et al., 2017). Playing high tempo matches in football causes footballers to feel excessive tiredness, increases risk of injury and as a result reduces performance (Giulianotti & Robertson, 2004; Oliveira et al., 2017). Factors that require focus in football include increasing performance during training and matches, rapid recovery, achieving suitable body composition and lowering the risk of injury. To solve these problems, ergogenic aid use is very popular among footballers in addition to correct nutrition strategies and fitness training (Tscholl et al., 2008). Ergogenic aids encompass all types of products supporting energy production, use and the recovery process (Porrini & Del Bo', 2016). Ergogenic aids are investigated in 3 categories of sports foods (drinks, bars, gels, etc.), medical supplements (iron, calcium, omega-3, vitamin D, etc.) and specific performance aids (creatine,

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caffeine, nitrate, etc.) (Erdman et al., 2016). The aim of this study is to review information related to specific performance aids used in football and current research about necessary doses and effects.

Creatine

Creatine is a type of amino acid compound found mostly in muscle cells and the brain, liver, pancreas and kidneys and produced in the body (Cooper et al., 2012). In the liver and pancreas arginine, glycine and methionine are produced from amino acids (Buford et al., 2007). In the body it is transformed to creatine phosphate and is stored in muscle cells. This form acts as an energy source during high-intensity exercise (Cooper et al., 2012). During intense exercise, the energy required to transform adenosine diphosphate (ADP) to adenosine triphosphate (ATP) is linked to the creatine phosphate amount in muscle cells. During these types of exercise, creatine phosphate stores are reduced and the ATP production speed reduces and the necessary energy amounts will not be provided. This situation causes a reduction in exercise performance (Buford et al., 2007). Creatine supplementation ensures slower reductions in the creatine phosphate stores in muscles during high-intensity exercise, sustaining energy production and exercise performance (Mielgo-Ayuso et al., 2019). The increase in muscle creatine stores with supplementation is linked to the person’s creatine level before supplementation. Individuals with lower creatine amounts have 20-40% store increase rates, while individuals with higher creatine levels have rates of 10-20% increase. According to research, the quickest way to increase muscle creatine levels is to consume nearly 0.3 g/kg creatine monohydrate for at least a three-day duration, called the loading period, and then consume 3-5 g/day in order to maintain these levels (Buford et al., 2007, Hall & Trojian, 2013; Maughan et al., 2018). Additionally, supplementation intake with nearly 50 g carbohydrate-protein mixture is considered to elevate muscle creatine more with insulin stimulation (Roberts et al., 2016; Oliveira et al., 2017, Maughan et al., 2018).

Much research has been performed about the effect of creatine on football performance. A placebo-controlled study by Ramirez-Campillo et al. divided amateur female footballers (n=30) playing in different positions without previous use of creatine supplements into randomized groups. The intervention group were given 4 equal doses of 20 g/day creatine monohydrate supplements for 1 week, with a single dose of 5 g/day for the following five weeks. At the end of the study, the creatine supplementation group were observed to have weight gain ($p<0.05$; 1.4%) and jump force increases ($p<0.05$) (Ramírez-Campillo et al., 2016). Another study of male Brazilian footballers (n=7) administered 20 g creatine for 1 week, with footballers in the control group (n=7) administered the same amount of placebo and applied 50-60 minutes of resistance and then jump exercises twice per week for 6 weeks. The group receiving creatine supplementation were found to have significantly lower degree of fall in jump exercise performance after resistance exercises compared to the placebo group ($p=0.05$). This situation was assessed as showing those receiving creatine supplements had better performance in the second exercise performed after intense training (Claudino et al., 2014). Greenwood et al. in another study administered 0.3 g/kg creatine monohydrate and then maintenance dose of 0.03 g/kg for 115 days to footballers (n=38) and the same amounts of placebo to footballers in the control group (n=38). They observed the players for injuries during one season. The creatine group were observed to have significantly less cramp ($p<0.021$), heat stroke or dehydration ($p=0.043$), muscle spasm ($p=0.020$) and injury numbers ($p<0.001$) (Greenwood et al., 2003). A study by Cox et al. (16) randomized female footballers (n=12) into groups and administered 20 g creatine per day for 6 days in the intervention group and the same amount of glycose polymer to the placebo group. Sportspeople underwent 5 x 11-minute running tests. Though the intervention group were observed to have significant degree of weight gain ($p<0.01$), sprint performance was observed to increase compared to the control group ($p<0.05$) (Cox et al., 2002). Table 1 reviews the studies related to the effect of creatine on football performance.

Table 1. Studies showing effect of creatine on football performance

Study	Sample	Method	Outcomes
Ramirez-Campillo et al. (2016)	30 amateur female footballers (19-27 age interval)	Given 20 g creatine or placebo for 1 week and investigated jump force and sprint speed.	The group given creatine supplements had significant degree of increase for jump force (p<0.05).
Claudino et al. (2014)	14 professional male footballers (mean age: 18.3 ± 0.9 years)	Given 20 g creatine or placebo daily for 1 week and first resistance and then jump exercises performed.	Group with creatine supplements was found to have significantly less reduction in jump forces after resistance exercises (p=0.05).
Greenwood et al. (2003)	72 male footballers (mean age: 19.7 ± 1.0 years)	Given 0.3 g/kg creatine for 5 days and 0.03 g/kg for 115 days or placebo and injury status investigated through the season.	Group with creatine supplements had significantly less cramp (p<0.021), heat stroke or dehydration (p=0.043), muscle spasm (p=0.020) and injury numbers (p<0.001) observed.
Cox et al. (2002)	12 professional female footballers (mean age: 22.1 ± 5.4 years)	Given 20 g creatine or placebo daily for 6 days and 5 x 11-minute run tests and sprint performance investigated.	Group with creatine supplements observed to have significant degree of weight gain (p<0.01) and increased sprint performance (p<0.05).

Caffeine

Caffeine, included on the observation list of the World Anti-Doping Agency (WADA), is a compound affecting the central nervous system (Brouns, 2003). Caffeine (1,3,7-trimethylxanthine) is easily absorbed by the gastrointestinal system and reaches tissues. Levels elevate in blood within 15-45 minutes after consumption linked to the amount of intake and reach a peak within 1 hour (Goldstein et al., 2010). It increases the levels of essential neurotransmitters like dopamine, serotonin and gamma aminobutyric acid (GABA) in the brain ensuring alertness and agility (Bagghi et al., 2013). It binds to adenosine receptors acting as an adenosine antagonist. This mechanism affects the central nervous system changing pain perception and delaying excessive tiredness (Maughan et al., 2018). The recommended dose for caffeine to display ergogenic effects is 3-6 mg/kg (Brouns, 2003; Goldstein et al., 2010; Bagghi et al., 2013; Maughan et al., 2018). Additionally, it is stated that consumption of caffeine in powder or tablet form is more effective (Goldstein et al., 2010).

A study in 2014 first gave female footballers (n=18) an energy drink containing 3 mg/kg caffeine and then the same amount of placebo 1 week later. At the end of the study, exercises after taking caffeine were found to have significantly higher jump height (p=0.05), maximum speed on 7 x 30 m running tests (p<0.05) and distance covered in 2 x 40-minute matches (p<0.05) (Lara et al., 2014). Another study randomized male sportspeople (n=19) into two groups and gave one group 5 mg/kg caffeine and the control group the same amount of maltodextrin. The caffeine group were found to have significant increases in blood lactate levels (p<0.001), heart rate (p=0.0009) and sprint speeds (p<0.05) compared to the control group (Glaister et al., 2008). Another study divided male team sports players (n=10) into two groups and gave the intervention group 6 mg/kg caffeine and the control group the same amount of placebo and performed interval sprint tests. At the end of the study, the sprint run numbers (p<0.05) and speeds (p<0.01) in the intervention group were significantly higher compared to the control group (Schneiker et al., 2006). A study by Evans et al. randomized male team sports players (n=18) into groups and gave one group chewing gum containing 200 mg caffeine and the other group placebo and measured repeat sprint performance. The group using caffeine gum were observed to have a significant degree of reduction in tiredness after sprints compared to the control group (p=0.049) (Evans et al., 2018). Another study randomized professional athletes (n=24) into 3 groups and gave one group 100 mg caffeine and 45 g carbohydrate, one group only carbohydrate and the final group placebo. Firstly, they performed 2.5 hours of 60% VO2 max exercises and then athletes performed 75% VO2max exercises (T2EX) until exhausted. In conclusion, the group receiving caffeine was observed to be faster during exercises compared to the other two groups (p<0.001). Additionally, the T2EX exercise exhaustion status of the caffeine group took significantly longer compared to the other groups (p<0.05) (Hogervorst et al., 2008). A study in 2018 randomized footballers (n=10) and administered 200 mg caffeine or placebo and performed maximum jump, 20-minute sprint and Yo-Yo tests. While there was no significant difference between the groups for the sprint test, the caffeine group covered 2.2% more distance on the Yo-Yo test and had 2.2% increase in jump height (Ranchordas et al., 2018). Another study randomized professional footballers (n=12) into groups and gave 5 mg/kg caffeine or the same amount of placebo. The caffeine group had significant degree of increase in jump power (p=0.009) and height (p<0.05) compared to the control group (Guerra Jr et al., 2018). Studies related to the effect of caffeine on sports performance are reviewed in Table 2.

Table 2. Studies showing effect of caffeine on sports performance

Study	Sample	Method	Outcomes
Lara et al. (2014)	18 female footballers (mean age: 21 ± 2 years)	Given energy drink containing 3 mg/kg caffeine for 1 week, then the same amount of placebo the next week and jump force, running speed and distance covered during football match measured.	Jump height (p=0.05), running speed (p<0.05) and distance covered (p<0.05) significantly increased in week when caffeine was given.
Glaister et al. (2008)	19 male sportspeople (mean age: 21 ± 3 years)	Intervention group given 5 mg/kg caffeine, control group given same amount of placebo and blood values, running speeds and durations measured.	Caffeine group had significant increases in blood lactate (p<0.001), heart rate (p=0.0009) and running speeds (p<0.05) compared to placebo group.
Schneiker et al. (2006)	10 male team sportspeople (mean age: 20 ± 3 years)	Intervention group given 6 mg/kg caffeine and control group given same amount of placebo and intermittent sprint tests performed.	Intervention group had significant increases in number of sprints (p<0.05) and speed (p<0.01) compared to the control group.
Evans et al. (2018)	18 male team sportspeople (mean age: 21.2 ± 1.1 years)	Intervention group given gum containing 200 mg caffeine, control group given gum without caffeine and repeated sprint performance measured.	Caffeine group had significant reduction in tiredness after sprinting (p=0.049) compared to the placebo group.
Hogervorst et al. (2008)	24 male professional sportspeople (mean age: 23 ± 5 years)	One group given 100 mg caffeine + 45 g carbohydrate, one group given only carbohydrate and one group given placebo, 60% and 75% VO_2max exercises performed.	Caffeine group was significantly faster (p<0.001) and had longer duration to tiredness (p<0.05) compared to the other two groups.
Ranchordas et al. (2018)	10 male footballers (mean age: 19 ± 1 years)	Sportspeople given gum containing 200 mg caffeine or normal gum and jump force, sprint speed and Yo-Yo tests performed.	Caffeine group had no significant difference for sprint speeds (p=0.056), jump height (p=0.008) and distance covered (p=0.016) significantly increased.
Guerra Jr. et al. (2018)	12 professional footballers (mean age: 23 ± 5 years)	Sportspeople divided into randomized groups and given 5 mg caffeine or placebo and jump performance tested.	Intervention group had significant increases in jump force (p=0.009) and height (p<0.05) measured at 1, 3 and 5 minutes.

Nitrate/Nitric Oxide

Nitrate is mainly found in green leafy vegetables and beet juice and is a compound which transforms to nitric oxide in the body (Jones, 2014). Though nitric oxide has many duties in the body, one of the most important is ensuring expansion of veins and increasing oxygen capacity in muscles with the vasodilator effect (Zafeiridis, 2014). It is an important neurotransmitter supporting the central nervous system (Turkoz & Ozerol, 1997). Increasing the bioavailability of nitric oxide is thought to improve muscle functions and exercise performance. The reason for this is explained by the role of nitric oxide in blood perfusion, contraction, glycose and calcium homeostasis, mitochondrial respiration and biogenesis (Jones, 2014). Nitrate supplementation has effective dose of 5-9 mmol (310-560 mg) and the effect on performance is stated to be seen 2-3 hours after supplementation (Wylie et al., 2013a; Maughan et al., 2018).

Wylie et al. randomly divided male team sports players (n=14) into two groups and gave one group beet juice containing 4.1 mmol nitrate (70 mL x 2) while the other group were given beet juice with reduced nitrate and then the Yo-Yo test was performed. The group with nitrate supplementation had 4.2% increase in distance covered compared to the control group (p<0.05) (Wylie et al., 2013b). Another study divided male team sports players (n=16) into two groups and gave the intervention group beet juice containing 12.8 mmol nitrate (140 mL) for 7 days while the other group were given beet juice with reduced nitrate. During the intermittent sprint test (IST) a significant degree of improvement was determined in the performance of the group given high nitrate (p<0.05). Additionally, they identified that the group given high nitrate had significantly quicker reaction durations compared to the control group (p<0.05) (Thompson et al., 2015). A similar study divided males team sports players (n=30) into random groups and gave the intervention group 70 mL beet juice containing 6.4 mmol nitrate for 5 days, while the control group were given beet juice with reduced nitrate for the same duration. At the end of the study, the intervention group were observed to have significant developments in 5 m, 10 m and 20 m sprint durations (p<0.05). The distance covered during the Yo-Yo tests was significantly increased in the intervention group (3.9%, p<0.05). Cognitive tests identified the reaction duration was significantly shorter in the intervention group compared to the control group (p<0.05); however, there was no significant change observed in the accuracy of answers (Thompson et al., 2016). A similar study by Nyakayiru et al (2017) divided male amateur footballers (n=32) into random groups and gave the intervention group 140 mL beet juice containing 800 mg nitrate for 6 days, while the control group were given placebo for the same duration. Yo-Yo test performance in the intervention group increased by 3.4% (p=0.027). Mean heart rate was lower by a significant degree in the intervention group (p=0.014) (Nyakayiru et al., 2017). Suzuki et al. (2019) gave male footballers (n=20) 1.2 g citrulline and 1.2 g arginine (Cit + Arg) or placebo for 6 days in random groups. Power output was observed to be significantly higher in the intervention group compared to the control group (p<0.05). Additionally, the supplementation group were identified to have positive changes in leg muscle pain after exercise and pedal pushing (p<0.05) (Suzuki et al., 2019). Table 3 reviews the studies related to the effect of nitrate on sports performance.

Table 3. Studies showing effect of nitrate on sports performance

Study	Sample	Method	Outcomes
Wylie et al. (2013)	14 male team sportspeople (mean age: 22 ± 2 years)	Randomized group with one given beet juice containing 4.1 mmol nitrate, the other given beet juice with reduced nitrate and Yo-Yo test applied.	Intervention group had 4.2% increase in distance covered compared to control group (p<0.05).
Thompson et al. (2015)	16 male team sportspeople (mean age: 24 ± 5 years)	Groups given beet juice containing 12.8 mmol nitrate or beet juice with reduced nitrate for 7 days, IST and cognitive tests performed.	Work during IST was significantly greater in the intervention group (p<0.05). Cognitive tests identified the intervention group had significantly quicker response times (p<0.05).
Thompson et al. (2016)	36 male team sportspeople (mean age: 24 ± 4 years)	Groups given beet juice containing 6.4 mmol nitrate or beet juice with reduced nitrate for 5 days and sportspeople first did maximal 20 m sprint series followed by Yo-Yo test.	Intervention group had reduced sprint durations (p<0.05), increased distance on Yo-Yo test (3.9%, p<0.05), significant reduction in response duration on cognitive tests (p<0.05) compared to control group.
Nyakayiru et al. (2017)	32 amateur male footballers (mean age: 23 ± 1 years)	Groups given beet juice containing 800 mg nitrate or placebo for 6 days, blood and saliva samples taken and Yo-Yo test performed and heart rate monitored.	Intervention group had significantly high nitrate concentrations in blood and saliva (p<0.001), 3.4% increase in Yo-Yo test performance (p=0.027) and low mean heart rate (p=0.014) compared to control group.
Suzuki et al. (2019)	20 male footballers (mean age: 19 ± 0.2 years)	Participants consumed 1.2 g citrulline and 1.2 g arginine (Cit+Arg) or placebo for 7 days and then 10-minute maximum power bicycle ergometry tests performed.	Intervention group had significantly high force output (p<0.05), significantly high plasma nitric oxide concentration after exercise (p<0.05) and positive changes in pain in leg muscles and pedal turning after exercise (p<0.05) compared to the control group.

* IST: Intermittent sprint test

Beta-Alanine

Beta-alanine is an amino acid produced in the liver and at the same time consumed in the diet in meat and meat products. The most important feature is that it limits the speed of carnosine synthesis (Trexler et al., 2015). Carnosine is a dipeptide compound comprised of beta-alanine and histidine amino acids. It is considered important for exercise due to being found in abundant amounts in skeletal muscles (Saunders et al., 2017). The main role of carnosine is to preserve the acid-base balance in the body through intramuscular hydrogen ion buffering capacity (Hoffman et al., 2012). Muscle pH reduces as a result of H+ ions occurring due to the transformation of lactic acid to lactate during muscle contraction and acidosis is observed. Accumulation of lactate in muscles along with acidosis causes tiredness (Hobson et al., 2012). Carnosine collects protons during acidosis acting as a H+ buffer and assists in reducing acidosis and tiredness (Hobson et al., 2012; Bellinger, 2014). The recommended dose for beta-alanine supplementation is 4-6 g per day for minimum 2-4 weeks (Trexler et al., 2015; Saunders et al., 2017; Maughan et al., 2018). This dose increases carnosine concentration by 40-80% if taken for 4-10 week durations (Blancquaert et al., 2015). However, use in divided doses (0.8-1.6 g every 3-4 hours) is recommended with the aim of preventing side effects like tingling (Saunders et al., 2017).

In a study Saunders et al. divided amateur footballers (n=17) into two random groups and used 800 mg beta-alanine 4 times per day at 3-4 hour intervals for 12 weeks or placebo. Sportspeople performed the Yo-Yo test two times before and after supplementation. The intervention group were observed to have significantly increased sprint performance after supplementation compared to before ($p<0.001$) (Saunders et al., 2012). Another study divided footballers (n=15) into random groups and used 2g beta-alanine two times per day for 8 weeks or placebo capsules. At the end of the study, the supplementation group had significantly shortened duration to finish shuttle tests (1.1 ± 0.94 s) compared to the placebo group (0.4 ± 2.2 s). No significant difference was observed in lactate values ($p>0.05$) (Kern et al., 2011). Hoffman et al. divided footballers (n=26) into random groups and they consumed 1.5 g beta-alanine or maltodextrin 3 times per day for 30 days. The study did not observe significant differences in energy or force levels and sprint performance ($p>0.05$). However, the intervention group had increased performance for the bench press movement during resistance exercises ($p<0.05$). Additionally, as a result of surveys the group receiving beta-alanine supplementation stated they felt less tiredness compared to the placebo group ($p<0.05$) (Hoffman et al., 2008). Rosas et al. divided amateur female footballers (n=25) into three random groups. These groups were determined as those doing plyometric exercises and receiving placebo, those doing plyometric exercises and receiving beta-alanine and those not exercising but receiving placebo. Participants consumed 0.8 g beta-alanine or placebo at 2-hour intervals 6 times per day for 6 weeks. The two groups doing plyometric exercises were observed to have significant improvements in jump performance compared to the control group ($p<0.05$). The jump performance of the group receiving beta-alanine was significantly improved compared to the placebo group ($p<0.05$). The two groups doing exercises were observed to have significant performance increases for running and running-based anaerobic sprint test (RAST) compared to initial values ($p<0.05$), but only the beta-alanine group had significant changes observed compared to the control group ($p<0.05$) (Rosas et al., 2017). Table 4 reviews the studies related to the effect of beta-alanine supplementation on football performance.

Table 4. Studies showing effect of beta-alanine supplementation on performance

Study	Sample	Method	Outcomes
Saunders et al. (2012)	17 amateur footballers (mean age: 22 ± 4 years)	Sportspeople divided into two groups, consuming 800 mg x 4 beta alanine or placebo for 12 weeks. Yo-Yo test performed before and after supplementation.	The group with beta alanine supplements had significant improvement observed in sprint performance compared to before treatment (p<0.001).
Kern et al. (2011)	15 footballers (mean age: 18.6 ± 1.5 years)	Randomized sportspeople consumed daily 2 g x 2 beta alanine or placebo for 8 weeks. Running tests performed before and after supplementation and blood lactate values measured.	No change observed in lactate levels, running performance in the intervention group significantly improved compared to placebo group (p<0.05).
Hoffman et al. (2008)	26 footballers (mean age: intervention group 19.7 ± 1.8 years, control group 19.8 ± 1.4 years)	Sportspeople consumed 1.5 g x 3 beta alanine per day or placebo for 30 days and did running training and resistance exercises.	Resistance exercise performance was significantly better in the supplement group compared to placebo (p<0.05). Tiredness felt was significantly less in the supplement group (p<0.05).
Rosas et al. (2017)	25 amateur female footballers	Participants divided into three groups and consumed 0.8 g x 6 beta alanine per day or placebo for 6 weeks. Two groups did plyometric exercises while one group consumed placebo.	Beta alanine group had increased performance for jump force compared to the placebo group (p<0.05) and for running and RAST tests compared to the control group (p<0.05).

*RAST: Running-Based Anaerobic Sprint Test

CONCLUSION

This review investigated the effect mechanisms and doses of ergogenic aid products stated to have effects in football. Some products act as physiological or psychological performance enhancers, while others are effective on the recovery duration and reducing tiredness.

Many ergogenic aids may be used with the aim of developing performance in football or increasing the speed of recovery. However, the presence of a sufficient and balanced nutritional plan should be checked, before using these aids. Nutritional ergogenic aid products should be considered with the aim of increasing periodic performance and in individuals with insufficient nutrition because it is known that nutrition or aid products are not effective alone in sportspeople. It is considered that optimum benefit will be provided when these aids are used with the correct training program, sufficient rest duration and balanced nutrition.

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