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Acute effects of Red Bull energy drink on counter movement jump and repeated sprint performances in healthy young men

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Abstract

Objectives: The aim of the current study was to investigate the acute effects of Red Bull energy drink consumption on repeated sprint (RS) and counter movement jump (CMJ) performances.

Methods: Nine healthy male students of faculty of sports science (mean age: 22.66±1.58 years, mean height: 173.52±5.48 cm, mean weight: 69.05±6.54 kg) volunteered to participate in this study. One of the treatment drinks (Red Bull or placebo) was applied with one week break in a randomized, placebo-controlled, crossover design. The Red Bull treatment drink (RB) consisted of 250 ml of commercially available product in Turkey. The placebo drink (PLA) was a mixture of 220 ml of caffeine and taurine free soda ginger ale (Beyoğlu Soda Drink Company), and 30 ml of free sugar lemonade (Uludağ Drink Company). Firstly, participants performed three maximal voluntary vertical jumps, and then they performed accelerations and decelerations over 20 meter for 2 min. The RS test involved seven repeated straight-line 30-m sprints, separated by 30 sec of active recovery.

Results: No significant differences were observed between experimental trials in terms of CMJ height (cm), total sprint time (sec), mean sprint time (sec), best sprint time (sec), and decrement of sprint performance (%) ($p > 0.05$).

Conclusion: A thin of Red Bull, produced in Turkey, was not enough to enhance RS and CMJ performances. Young Turkish athletes may consider the consumption of Red Bull to improve their performances; however, because of the amount of caffeine and taurine are much lower than ones in abroad, Red Bull might not be an effective ergogenic support.

Keywords: Ergogenic, Exercise, Performance, Taurine, Caffeine, Beverages

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Introduction

Sports drink and energy drink are different products, but these two terms are often used incorrectly instead of each other. Sports nutrition products (drinks) are defined as formulated food or food blends to help athletes meet their specific nutritional needs or to demonstrate their best performance (Turkish Nutrition Codex Declaration on Sports Nutrition, 2003). On the

other hand, energy drinks are often flavored non-alcoholic drinks (Turkish Nutrition Codex Declaration on Energy Drinks, 2017). According to the literature and also to the Turkish Nutrition Codex Declaration on Energy Drinks (2017), the energy drinks are often a combination of caffeine (main active ingredient), taurine, carbohydrates, sugar, inositol, glucuronolactone, B vitamins, and ginseng (Amendola, Iannilli, Restuccia, Santini, & Vinci, 2004; McCusker, Goldberger, & Cone, 2006).

Consumption of caffeine-containing liquid energy supplements (i.e., energy drinks) has increased dramatically over the past several years (Campbell, Richmond, & Dawes, 2016). It has been observed that the students, athletes, and 21-35-aged active individuals use the energy drinks extensively (Dikici, Aydın, Kutlucan, & Ercan, 2012). Many studies reported that ergogenic aids such as energy drinks are popular among student-athletes (Gallucci, Martin, & Morgan, 2016; Hardy, Kliemann, Evansen, & Brand, 2017). It has been suggested that collegiate student-athletes consume these beverages to improve athletic performance (Geiss, Jester, Falke, Hamm, & Waag, 1994; Ivy et al., 2009).

Energy drinks are on the market for more than 15 years in the world, but because of the high caffeine and taurine content, they were banned in Turkey previously. Marketing the energy drinks were released after legal changes were made in 2005. According to the Turkish Nutrition Codex Declaration on Energy Drinks (2017) the maximum content of caffeine, taurine, inositol, and glucuronolactone are limited with 150 mg/L, 800 mg/L, 100 mg/L, and 20 mg/L, respectively.

As an energy drink, the Red Bull is one of the most consumed brand in the world (Gunja & Brown, 2012). Therefore, there are many studies investigating the effects of Red Bull energy drink on athletic performance (Alford, Cox, & Wescott, 2001; Astorino et al., 2012; Forbes, Candow, Little, Magnus, & Chilibeck, 2007; Geiss et al., 1994; Ivy et al., 2009; Umaña-Alvarado & Moncada-Jiménez, 2005). However, the studies' findings are contradictory; whether athletic performance actually improves in result of consuming energy drinks is not clear (Alford et al., 2001; Forbes et al., 2007; Ivy et al., 2009; Umaña-Alvarado & Moncada-Jiménez, 2005). Hence, the aim of the current study was to investigate whether the Red Bull energy drink would affect the repeated sprint (RS) performance and enhance the counter movement jump (CMJ)'s height.

Methods

Participants: Nine healthy male students of faculty of sports science, volunteered to participate in this study. Their mean (± SD) age, height and weight were 22.66 (± 1.58) years,

173.52 (± 5.48) cm and 69.05 (± 6.54) kg, respectively. Participants were instructed not to ingest any caffeine or caffeinated products for 48 h and refrain from intense exercise in the 24 h before each trial. The study protocol conforms to the ethical guidelines of the Declaration of Helsinki, therefore at the beginning of the study all participants were informed about possible risks and benefits of the study and written consent forms were obtained. Additionally, all participants filled out a health questionnaire to ensure they met all inclusion criteria of the study.

***Treatments*:** One of the treatment drinks (Red Bull or placebo) was applied with one week break in a randomized, placebo-controlled, double-blind crossover design. To blind the study, a colleague was responsible for randomizing and coding the trials and mixing the drinks. None of the participants drank any stimulant liquids before the tests.

The treatment drinks were prepared according to Astorino et al. (Astorino et al., 2012) with minor modification. The placebo drink (PLA) was a mixture of 220 ml of caffeine and taurine free soda ginger ale (Beyoğlu Soda Drink Company), and 30 ml of free sugar lemonade (Uludağ Drink Company). The Red Bull treatment drink (RB) consisted of 250 ml of commercially available product in Turkey (Red Bull GmbH). The treatment drinks were given in a cardboard cup and covered with a lid to prevent the appearance of the beverages. One box of Red Bull produced in Turkey (250 ml) contains 37.5 mg of caffeine and 200 mg taurine.

The experiment started when the volunteers ingested the treatment drinks (Red Bull energy drink or placebo) 1-hr. before the test (Astorino et al., 2012). A 1-hr period was chosen because research has determined that caffeine is quickly absorbed, with plasma levels reaching a maximum level within 1 hour of ingestion (Graham, 2001), and maximal cardiovascular effects (Mosqueda-Garcia, Tseng, Biaggioni, Robertson, & Robertson, 1990) occur at that time. During the 1-hr period, the participants stayed in the indoor athletics hall, spending time on telephone, surfing in social networks, and etc. One hr. after the consumption of the treatment drink (Red Bull or placebo), the CMJ and RS tests were performed.

Counter Movement Jump (CMJ) Test: Following a standardized warm-up of 5-7 min. of jogging and 5-7 min. of dynamic stretching in indoor athletics hall, the participants rested for 5-min. After a familiarization session (learning the proper technique of CMJ), each participant performed three maximal voluntary vertical jumps. The CMJ was performed from an upright standing position, with the hands fixed on the hips and with a counter movement; preparatory phase ended at a position corresponded to the starting position with the participants' knees flexed to 90^0. Jumping heights were recorded in cm using force platform (Smartspeed, Fusion Sport Pty Queensland, Australia). More than 2 min. was given for rest between trials.

Repeated Sprint (RS) Test: Following the CMJ test, the participants performed accelerations and decelerations over 20 meter for 2 min. The RS test involved seven repeated straight-line 30-m sprints, separated by 30 sec of active recovery (i.e. jogging back to the starting line within 25 sec to allow 5 sec of passive recovery before the start of the next sprint repetition) (Aybek, Ağaoğlu, Ağaoğlu, & Eker; Lara et al., 2014). Three seconds prior to the commencement of each sprint, participants were asked to assume the ready position and await the start signal. During recovery, audio feedback (i. e., time countdown) was given to the participants to maintain the required running speed. The participants were instructed to sprint maximally for every repetition. Running scores were recorded in seconds using electronic timing gates placed on the start and finish lines (Smartspeed, Fusion Sport Pty Queensland, Australia) (Şahin Kafkas, Çınarlı & Kafkas, 2018). Strong verbal encouragement was provided to each participant during all sprints. Four scores were used for analyses: the best sprint time (BST (m/s)), the total sprint time (TST (m/s)), the mean sprint time (MST(m/s)), and the percent sprint decrement (as a fatigue index) (SD%) calculated with ((MST / BST)*100) – 100 (Rampinini et al., 2007).

***Statistical analyses*:** The analyses were executed using the SPSS for windows (version 18.0). Descriptive statistics were computed and all values were presented as mean ± standard deviation (SD). The normality of distribution of the data was assessed with Shapiro – Wilk test. Finally, the Wilcoxon signed ranks test was used to compare the CMJ and RS performances between Red Bull intake and placebo trials. The statistical significance was set at $p < 0.05$.

Results

The acute effects of Red Bull and placebo drinks on CMJ and RS performances are presented in Table 1. No significant differences were observed between experimental trials in terms of CMJ height (cm), total sprint time (sec), mean sprint time (sec), best sprint time (sec), and decrement of sprint performance (%).

Table 1: Acute effects of Red Bull intake on counter movement jump and repeated sprint performances.

	Red Bull Energy Drink	Placebo	p value
CMJ (cm)	41.33 ± 6.04	41.52 ± 6.51	.953
Total ST (sec)	32.54 ± 2.16	32.43 ± 1.84	.314
Mean ST (sec)	4.64 ± 0.30	4.63 ± 0.26	.314
Best ST (sec)	4.37 ± 0.19	4.32 ± 0.22	.440
Decrement of SP (%)	6.19 ± 3.40	7.16 ± 3.44	.441

CMJ: Counter movement jump; ST: Sprint time; SP: Sprint performance

The acute effects of Red Bull on each sprint performance are presented in Figure 1. No significant differences were determined between experimental trials for each sprint performances ($p>0.05$).

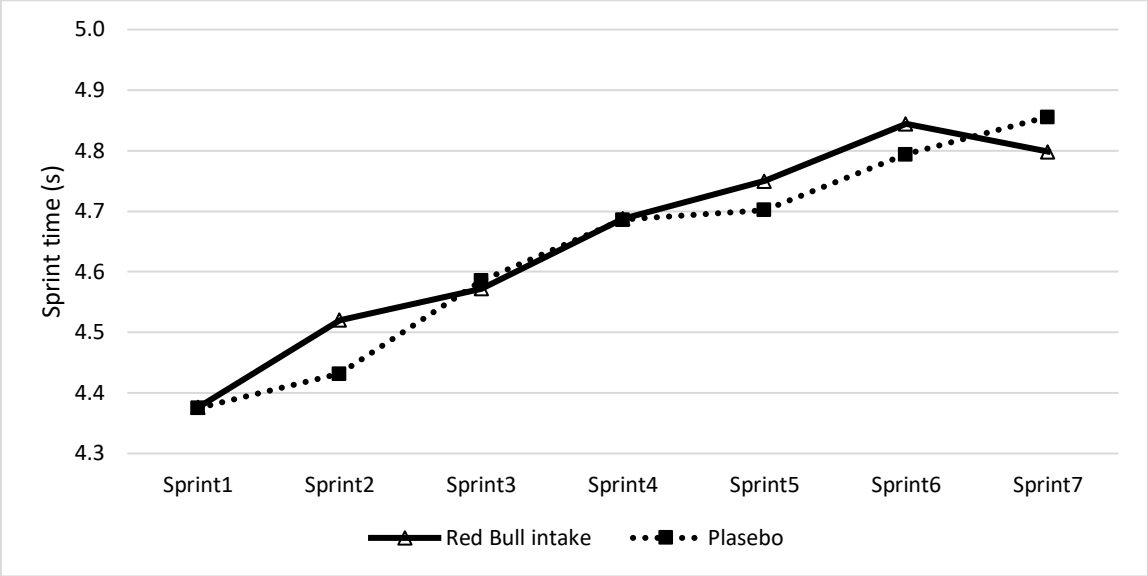

Figure 1. Effects of Red Bull intake on each repeated sprint performances. Not: Standard deviation bars were removed to enhance clarity of figure.

Discussion

The aim of this study was to investigate the acute effect of consumption of Red Bull energy drink sales produced in Turkey on repeated sprint running and jumping performance in healthy young males. The results showed that a thin of Red Bull did not improve the RS and CMJ performances in physically active men. These findings demonstrated that the Red Bull that containing 37.5 mg of caffeine and 200 mg taurine has no impact on sprint running and jumping performances.

The main active ingredient in Red Bull energy drink is caffeine. Since the mechanisms of caffeine's ergogenic effects are not wholly known, reasonable theories contain the antagonism of adenosine receptors leading to an increment in central-nervous-system activation, plasma epinephrine concentration, improved calcium release and reuptake from the sarcoplasmic reticulum affecting skeletal-muscle excitation–contraction coupling, and the alteration of plasma potassium concentration (Forbes et al., 2007). It has been shown that caffeine decreases plasma potassium level compared with placebo during exercise. The increased intracellular potassium concentration coupled with lower extracellular potassium

might help maintain membrane contractility during exercise (Lindinger, Graham, & Spriet, 1993).

The effects of energy drinks were investigated in endurance athletes and it has been reported that consuming a commercially available energy drink before exercise could improve endurance performance (Geiss et al., 1994; Ivy et al., 2009). Another study has showed that Red Bull energy drink significantly improved aerobic endurance (maintaining 65–75% max. heart rate) and anaerobic performance (maintaining max. speed) on cycle ergometers (Alford et al., 2001). Furthermore, (Forbes et al., 2007) indicated that Red Bull energy drink significantly increased upper body muscle endurance. In contrast to these findings a study conducted on male runners showed that there was no significant difference between energy drink and placebo conditions in terms of the mean working time (Umaña-Alvarado & Moncada-Jiménez, 2005). Additionally, it has been reported that Red Bull energy drink did not affect anaerobic peak or average power during repeated Wingate cycling tests in young healthy adults (Forbes et al., 2007).

Lara et al. (2014) conducted a study on female soccer players (mean age: 21 ± 2 years, mean height: 161 ± 6 cm, and mean weight: 58 ± 8 kg) and reported conflicting results to the current study; it has been showed that energy drink decreased the average best sprint time (increased running speed) and increased the CMJ height (Lara et al., 2014). Differently from mentioned study, but in accordance with the present study findings, (Astorino et al., 2012) has showed that a thin of Red Bull energy drink did not provide an ergogenic benefit for women athletes engaging in sprint-based exercise. Moreover, (Fernández-Campos, Dengo, & Moncada-Jiménez, 2015) has emphasized that the acute consumption of an energy drink did not improve physical performance of professional Costa Rican female volleyball players. Additionally, (Candow, Kleisinger, Grenier, & Dorsch, 2009) has indicated that sugar-free Red Bull energy drink did not affect high-intensity run time-to-exhaustion in young adults.

The major limitation of the present study is that the Red Bull produced in Turkey include relatively low dose of caffeine (37.5 mg), and taurine (200 mg) in 250 ml, whereas, a thin of Red Bull (250 ml) contains 80 mg of caffeine and 1000 mg taurine in another countries. Another limitation is that the content of Red Bull is changed in Turkey, and it is different from the ones produced abroad (i.e., Red Bull produced in Turkey does not include Glucuronolactone; a naturally found product in the body which is believed to increase releasement of hormones, some chemicals, and the biosynthesis of vitamin C (Yunusa and Ahmad, 2011). These could be the main reasons of why the Red Bull did not affect the sprint and jump performances in the current study. Studies revealed that higher volumes of Red Bull

(i.e., 500 ml), total amount of 160 mg of caffeine, 2000 mg of taurine, and 1200 mg of glucuronolactone enhanced endurance performance (Ivy et al., 2009), as well as bench press - muscle endurance performance (Forbes et al., 2007). The contents and quantities used in researches made with Red Bull and energy drinks are summarized in Table 2. The contents of a thin of Red Bull energy drink used in the present study are lower than world standards in terms of caffeine, taurine, and glucuronolactone.

Studies have shown that up to 4–6 mg/kg of caffeine supplementation affects performance (Carr, Dawson, Schneiker, Goodman, & Lay, 2008; Glaister et al., 2008; Stuart, Hopkins, Cook, & Cairns, 2005). On the other hand, a study conducted by Alford et al. (2001) has shown that, although the amounts of caffeine was much lower (< 1.6 mg/kg) the Red Bull augmented the performance. Therefore, as well as caffeine, the effects of other substances such as taurine and glucuronolactone in Red Bull should not be ignored.

Conclusion

The present study demonstrated that a thin of Red Bull produced in Turkey was not enough to enhance RS and CMJ performances in young males. Young Turkish athletes may consider the consumption of Red Bull to improve their sprint performances; however, because of the limitations mentioned in the text the Red Bull might not be an effective ergogenic support.

Table 2: The contents and quantities used in researches conducted with Red Bull or other energy drinks.

	Drink source	Caffeine	Taurine	Glucuronolactone	Carbohydrate	Athletic performance	Findings
The current study	Red Bull 250 ml	37.5 mg	200 mg		28,25 g	CMJ RS running	↔ ↔
Lara et al. 2014	Fure Pro Energetics	3 mg/kg (mean amount = 174 mg)	18.7 mg/kg (mean amount = 1080 mg)	---	---	CMJ Average peak running speed Total running distance The number of sprints bouts	↑ ↑ ↑ ↑
Geiss et al. 1994	Red Bull 500 ml	160 mg	2000 mg	1200 mg	glucose 10,5 g saccharose 43 g	The heart rate level Endurance time	↓ ↑
Ivy et al. 2009	Red Bull 500 ml	160 mg	2000 mg	1200 mg	54 g	Cycling performance RPE	↑ ↔
Alford et al. 2001	Red Bull 250 ml	80 mg	1000 mg	600 mg	sucrose 21.50 g glucose 5.25 g	Aerobic endurance Anaerobic performance	↑ ↑
Forbes et al. 2007	Red Bull ml ? unspecified	2.0 mg/kg	---	---	---	Total bench-press repetitions over 3 sets Wingate peak or average power	↑ ↔
Umaña-Alvarado & Moncada-Jiménez, 2005	Red Bull 6 ml/kg	1.90 mg/kg	24 mg/ kg	---	---	Mean racing times RPE	↔ ↓
Candow et al. 2009	Red Bull (mean amount = 458 ml)	2 mg/kg	25 mg/kg	15 mg/kg	Sugar Free	Run time-to-exhaustion RPE	↔ ↔
Astorino et al. 2012	Red Bull 255ml	80 mg	1000 mg	---	27 g	Mean sprint time HR and RPE	↔ ↔
Campos et al. 2015	Energy drink 6 ml/kg	1.67 mg/kg	20.8 mg/kg	---	0,68 g/kg	CMJ SJ Peak power (w) Mean power (w)	↔ ↔ ↔ ↔

CMJ: counter movement jump; SJ: squat jump; RS: repeated sprint; HR: heart rate; RPE: rate of perceived exertion; ?: unspecified; ↔: no change; ↑: significant increment; ↓: significant decrement.

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