Indian J Physiol Pharmacol 2014; 58(1) : 17–21

Original Article

Effect of red bull energy drink on auditory reaction time and maximal voluntary contraction

Vartika Goel, S. Manjunatha* and Kirtana M. Pai

Department of Physiology,
Kasturba Medical College,
Manipal University, Manipal

Abstract

The use of "Energy Drinks" (ED) is increasing in India. Students specially use these drinks to rejuvenate after strenuous exercises or as a stimulant during exam times. The most common ingredient in EDs is caffeine and a popular ED available and commonly used is Red Bull, containing 80 mg of caffeine in 250ml bottle. The primary aim of this study was to investigate the effects of Red Bull energy drink on Auditory reaction time and Maximal voluntary contraction. A homogeneous group containing twenty medical students (10 males, 10 females) participated in a crossover study in which they were randomized to supplement with Red Bull (2 mg/kg body weight of caffeine) or isoenergetic isovolumetric noncaffeinated control drink (a combination of Appy Fizz, Cranberry juice and soda) separated by 7 days. Maximal voluntary contraction (MVC) was recorded as the highest of the 3 values of maximal isometric force generated from the dominant hand using hand grip dynamometer (Biopac systems). Auditory reaction time (ART) was the average of 10 values of the time interval between the click sound and response by pressing the push button using hand held switch (Biopac systems). The energy and control drinks after one hour of consumption significantly reduced the Auditory reaction time in males (ED 232±59 Vs 204±34 s and Control 223±57 Vs 210±51 s; $p<0.05$) as well as in females (ED 227±56 Vs 214±48 s and Control 224±45 Vs 215±36 s; $p<0.05$) but had no effect on MVC in either sex (males ED 381±37 Vs 371±36 and Control 375±61 Vs 363±36 Newton, females ED 227±23 Vs 227±32 and Control 234±46 Vs 228±37 Newton). When compared across the gender groups, there was no significant difference between males and females in the effects of any of the drinks on the ART but there was an overall significantly lower MVC in females compared to males. Both energy drink and the control drink significantly improve the reaction time but may not have any effect on muscular performance. Energy drink per se is no better than control drink, which may indicate that there is no role of caffeine in the beneficial effect seen after the drinks.

Introduction

Energy drinks are a fast growing trend among students aiming at fitness to rejuvenate and refresh before or after a tiring work out session or before an academic activity like exam as a stimulant. Energy drinks (EDs) containing stimulants and additives have appeared in most gyms and grocery stores and are being used increasingly by the student community to improve mental performance(1). The most common ingredient in EDs is caffeine, which is often combined with taurine, glucuronolactone, guarana and B vitamins to form what manufacturers have called an

***Corresponding author :**
S. Manjunatha M.D., Professor of Physiology, Department of Physiology, K.M.C. Manipal – 576 104, Karnataka; Phone : +91-820-2922659;
E-mail : drmanjunatha@gmail.com

(received on February 06, 2013)

"energy blend." A popular ED available and commonly used is Red Bull, containing 80 mg of caffeine in 250ml bottle. Previous studies with this ED show conflicting reports pertaining to the ergogenic and cognitive performance, with some studies showing a positive effect on mental performance and decreased reaction time of consumption of the ED (2, 3). However the effect on reaction time of ED has also been shown to be negligible when compared with placebo(4). Though few studies claim an improvement in magnitude of exercise performance and muscle endurance (5, 6), an earlier study observed that the consumption of ED did not influence exercise capacity (7). Therefore the primary aim of this study was to investigate the effects of Red Bull on muscle strength and mental alertness by testing the Maximal voluntary contraction and Auditory reaction time in medical students who volunteered as subjects.

Materials and Methods

Subjects

The study was conducted in a homogenous group of 20 medical students as volunteers, 10 females and 10 males. The demographic characters are as follows (Mean±SD): Age (in years) males 20.9±1.59, females 20.4±0.69, height (in cm) males 179.2±9.17, females 164±5.03, and weight (in kg) males 69.5±12.64, females 59.8±8.27 .Informed written consent was obtained after explaining the procedure and the protocol.

Methodology

10 study subjects were enrolled into the group taking ED and the rest 10 subjects received a control drink. A cross over study design was planned wherein the group enrolled into ED received control and vice versa separated by 7 days. The students were randomized either to energy drink or control drink and were blinded. The investigators who were collecting the data and analyzing the data were also blinded. The code was broken after completion of the study and at the time of analysis.

All the subjects were requested not to consume any caffeine containing food or drinks for a period of 24 hours before the day of the study. The subjects were called for the tests at the same time of the day between 4 and 6 PM. After a brief period of rest for 5 minutes, the subjects were given ED (Red Bull – caffeine at 2 mg/kg body weight) or isocalorigenic, isovolumetric, noncaffeinated Control Drink (CD) (Appy Fizz with Cranberry juice and soda) to be consumed over a period of 6 minutes. A baseline recording was carried out just before consuming ED or CD. After one hour after consumption of the drink, the students were again subjected to Auditory Reaction Time and Isometric hand grip dynamometer test for recording the force generated during Maximal Voluntary Contraction using BIOPAC Systems.

Auditory reaction time

All participants performed the Auditory Reaction Time (2 trials) using BIOPAC Systems. The subjects were seated in a relaxed state with headphones on, eyes closed. The subjects held the hand switch (BIOPAC SS10L) with his/her dominant hand (only right handers included) such that the thumb was ready to press the push button. The subjects were requested to press and release the push button switch as soon as he/she heard the click sound through the head phone. Ten stimulus clicks were given at pseudo random intervals at least one second apart but not more than 10 seconds apart. Auditory reaction time is the time interval between the click sound and the response by pressing the push button.

Isometric handgrip exercise

All participants were tested in the seated position with their elbow flexed at 90°. Maximal isometric force of the dominant hand (only right handers included) was measured three times 1 minute apart using a calibrated handgrip dynamometer (Biopac Systems Inc., Santa Barbara, CA). If the trials were not within 10% of each other, additional trials were performed until a plateau was reached. The highest of the 3 values (Newton) was defined as the subject's maximal voluntary contraction (MVC).

Statistical analysis

The data of all the subjects was pooled under the heading of Baseline, Energy Drink and Control Drink.

One Way ANOVA was performed to identify any significant difference between Baseline, ED and CD. A value of $p<0.05$ was considered significant. Post hoc analysis was done using Tukey's HSD test to identify which groups were significantly different when $p<0.05$. One way ANOVA was also performed to identify the gender effects, if any.

Results

All the volunteers completed the study. The results for the auditory reaction time parameter are shown in Table I.

There was a consistent decrease in the auditory reaction time after the consumption of the energy drink. The decrease was statistically significant compared to its own baseline. These changes are graphically represented in Fig. 1. There was a significant decrease in the auditory reaction time after the control drink also. When compared for any differences between the energy drink and the control drink, there was no statistically significant difference.

The effect of the drinks in lowering the reaction times seems to be more in males than in females as seen from the Table I though there was no statistically significant difference between males and females.

The consumption of either of the drinks did not have any effect on the force produced during maximal voluntary contraction as seen from the data in Table II. But there was a significant difference between males and females in terms of the maximal force

TABLE I: Effects of different drinks on Auditory Reaction Time (Milliseconds) (Mean±SD).

	Baseline 1	*After energy drink*	*Baseline 2*	*After control drink*	*F value*	*F critical*
Males	232±59	204±34*	223±57	210±51*	11.402	2.616
Females	227±56	214±48*	224±45	215±36*	3.726	2.616

*p<0.05 compared to its respective baseline.

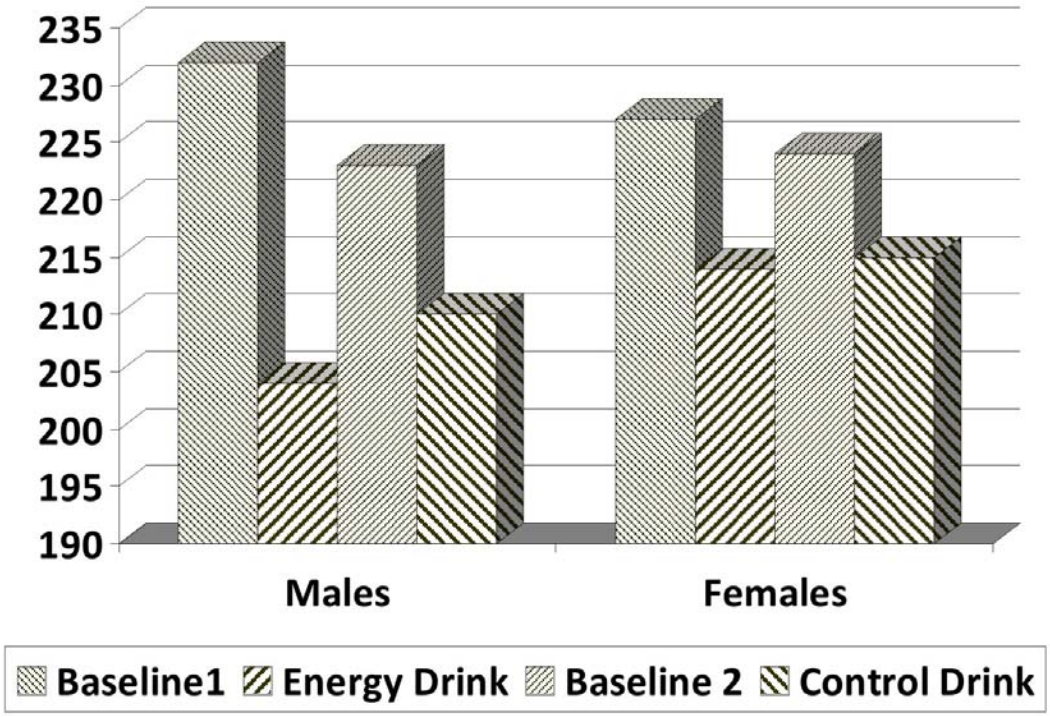

Fig. 1: Effects of different drinks on auditory reaction time (Milliseconds).

TABLE II : Effects of different drinks on Maximum Voluntary Contraction (Newton) (Mean±SD).

	Baseline 1	*After energy drink*	*Baseline 2*	*Affter control drink*
Males	381±37	371±36	375±61	363±36
Females	227±23	227±32	234±46	228±37

produced, males producing significantly higher force, which is a well-known phenomenon.

Discussion

In the present study, the ED was found to reduce the Auditory reaction time significantly irrespective of the gender of the subjects (Table I). This beneficial effect is generally attributed to the caffeine content because previous research has identified that caffeine is responsible for influencing cognitive measures including Simple reaction time in humans (8, 9). The finding that CD also resulted in significant reduction in Auditory reaction time after its consumption suggests that the excitatory effect is due to glucose, the only active ingredient in CD, which is non-caffeinated. It has been earlier reported that 25 g of glucose is sufficient to improve cognitive function (10). The high glucose level increases Acetyl CoA, a precursor of Acetylcholine that stimulates both central and peripheral nervous system which in turn can influence the initiation of response to a stimulus and reaction time (11, 12, 13).

There was no statistically significant difference between the effects of ED and CD on reaction time. Thus this study highlights the effect of glucose (common to and equal in both ED and CD) in influencing the reaction time negating the role of caffeine which was exclusive to ED.

The beneficial effect of caffeine on endurance muscle performance is well documented (14, 15). Caffeine at a dose of 5 mg/kg body weight has been shown to increase peak force, average force and time to exhaustion (16). However, previous studies have also demonstrated that caffeine at a dose of 5 mg/kg body weight did not affect maximal force generating capacity (17, 18). In our study, the consumption of ED (with caffeine at 2 mg/kg body weight dose) did not have any effect on Maximal Voluntary Contraction (Table II). Carbohydrates are known to improve endurance exercise performance and enhance recovery with improved subsequent exercise performance (19). The isocalorigenic control drink too did not produce any statistically significant effect on Maximal voluntary contraction in the present study. This implies that neither the caffeine content in ED nor the glucose present in both the drinks could influence Maximal voluntary contraction.

Conclusions

Both energy drink and the control drink significantly improve the reaction time but may not have any effect on muscular performance. Energy drink per se is no better than control drink, which may indicate that there is no role of caffeine in the beneficial effect seen after the drinks.

References

1. Malinauskas BM, Aeby VG, Overton RF, Carpenter-Aeby T, Barber- Heidal K. A survey of energy drink consumption patterns among college students. *Nutr J [serial online]* 2007; 6: 35.
2. Seidl R, Peyrl A, Hauser E. A taurine and caffeine-containing drink stimulates cognitive performance and well-being. *Amino Acids* 2000; 19: 635–642.
3. Meagan A. Howard and Cecile A. Marczinski. Acute Effects of a Glucose Energy Drink on Behavioral Control. *Experimental and Clinical Psychopharmacology* 2010; 18: 553–561.
4. Mathew H. Gendle, Darren M. Smucker, Jason A. Stafstrom, Melanie C. Helterbran, Kimberly S. Glazer. Attention and Reaction Time in University Students Following the Consumption of Red Bull®. *The Open Nutrition Journal* 2009; 3: 8–10.
5. Forbes SC, Candow DG, Little JP, Magnus C, Chilibeck PD. Effect of Red Bull energy drink on repeated Wingate cycle performance and bench-press muscle endurance. *Int J Sport Nutr Exerc Metab* 2007; 17: 433–444.
6. Astorino TA, Matera AJ, Basinger J, Evans M, Schurman T, Marquez R. Effect of redbull energy drink on repeated sprint performance in women athletes. *Amino Acids* 2012; 42: 1803–1808.
7. Candow, Darren G; Kleisinger, Amanda K; Grenier, Stephanie; Dorsch, Kim D. Effect of Sugar-Free Red Bull

Energy Drink on High-Intensity Run Time-to-Exhaustion in Young Adults. *J Strength Cond Res* 2009; 23: 1271–1275.

8. Hewlett P, Smith A. Effect of repeated doses of caffeine on performance and alertness: new data and secondary analysis. *Human Psychopharamacology* 2007; 22: 339–350.
9. Haskell C F, Kenedy DO. Cognitive and mood improvements of caffeine in habitual consumers and habitual non consumers of caffeine. *Psychopharmacology* 2005; 179: 813–825.
10. Owen L, Sunram-Lea SI. Glucose facilitation of cognition: Factors responsible for variability in behavioural response. *Appetite* 2008; 50: 564.
11. Owen DS, Benton D. The impact of raising blood glucose on reaction times. *Neuropsychobiology* 1994; 30: 106–113.
12. Wenk GL. An hypothesis on the role of glucose on the mechanism of action of cognitive enhancers. *Psychopharmacology* 1989; 99: 431–438.
13. Inglis F M, Day JC, Fibiger HC. Enhanced Acetylcholine release in hippocampus and cortex during the anticipation and consumption of a palatable meal. *Neuroscience* 1994; 62: 1049–1056.
14. Pasman WJ, van Baak MA, Jeukendrup AE, de Haan A. The effect of different dosages of caffeine on endurance performance time. *Int J Sports Med* 1995; 16: 225–230.
15. Berglund B, Hemmingsson P. Effects of caffeine ingestion on exercise performance at low and high altitudes in cross-country skiers. *Int J Sports Med* 1982; 3: 234–236.
16. Jaspal S Sandhu, Shweta Shenoy, I Dutt. Time Dose Relation of Caffeine Ingestion on Muscular Strength and Endurance Performance. *Journal of Postgraduate Medicine, Education and Research* 2012; 46: 19–23.
17. Sharma Archna, Sandhu S Jaspal. Effects of caffeine ingestion on strength and endurance performance of normal young adults. *Doping Journal* 2010; 7: 2.
18. Bond V, Gresham K, MacRae J, Tearney R J. Caffeine ingestion and isokinetic strength. *Br J Sports Med* 1986; 20: 135–137.
19. Millard-Stafford M, Childers WL, Conger SA, Kampfer AJ, Rahnert JA: Recovery nutrition: timing and composition after endurance exercise. *Curr Sports Med Rep* 2008; 7: 193–201.