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Short-term effects of energy drink on the body's health among young adults in Erbil city

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Abstract

Background and objective: Nowadays, energy drink consumption has significantly increased in recent times. Students, athletes, and teenagers are among the most common consumers for a variety of reasons. For a public health point of view, little seems to be understood of the health benefits and other implications of these drinks by their consumer. This study aimed to evaluate the acute biochemical effects of energy drink in Erbil city.

Methods: Twenty four healthy male and female volunteer subjects of 21-23 years age consumed 250 ml of wild Tiger® beverage per day for one successive day after cross design. The biochemical tests were evaluated before and after consumption in the laboratory analysis using standard methods.

Results: There was a statistically significant increase in serum albumin, total protein, and GOT levels after consumption of energy drink (wild Tiger beverage) (P = 0.033, 0.034, and 0.017, respectively). However, energy drink consumption has no significant effect on serum electrolytes, urea, uric acid, creatinine, glucose, lipid profile, GPT, ALP, amylase, direct and total bilirubin, and minerals.

Conclusion: Energy drink consumption is associated with significant alterations in some biochemical parameters, and it will become a significant public health problem if their use among young people is not addressed through a cap on caffeine levels and restrictions on their sale for below eighteenth and marketing.

Keywords: Energy drink; Public health; Hypertension; Caffeine; Adolescents.

Introduction

Energy drinks are beverages that contain in addition to calories usually sugar, caffeine in combination with other energy-enhancing ingredients: such as taurine, herbal extracts most often guarana, minerals, and vitamin B-complex. The consumption of energy drink has increased worldwide since 1997 in response to consumer demand for a dietary supplement that would result in increased energy.[1-3] There is no estimated data for energy drink consumption among adolescents and athletes in our region. However and in common with many other countries, the Kurdistan region, has seen a frequent increase in the consumption of energy drinks in the last few years.[4,5] Consumption of energy drinks is common among college and high school students and athletes. These drinks are attractive especially for teenage population and are easily available at local shops due to this generation to ongoing their lifestyle and receptiveness to advertisements for these drink products.[6,7] Energy drinks are thought and designed to promote and enhance health. Additionally, some of them contain significant levels of antioxidants, particularly polyphenols.[8] The amount of caffeine added from guarana exceeds the total dose listed in the contents of the energy drink. Consequently, the total amount of caffeine can be higher than that of the beverage label.[9,10] Caffeine has an important role in increasing alertness, improving memory, and enhancing a person's mood. However, it has many side effects on human health, including increasing the heart rate and levels of

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dopamine and epinephrine, also may lead to hypertension, dehydration, increasing urination, and causing gastrointestinal upset.[11-13] On the other hand, the caffeine intoxication can occur when more than 300mg is consumed, the equivalent of three cans of energy drink consumed together.[14] Evidence that energy drink consumption by children and adolescents can significantly improve physical and mental performance is limited. Energy drinks do not appear to enhance driving abilities when an individual is tired or to decrease mental fatigue during long periods of concentration.[15]Literature has mainly reported adverse effects on health, including seizures, diabetes, cardiac abnormalities, mood, and behavioral disorders.[16] There is an increasing incidence of caffeine toxicity from the consumption of energy drink.[17] It has been revealed that long-term exposure to the different components of energy drinks may result in significant changes in the cardiovascular system. The results of the latest study conducted by Mayo Clinic Scientists in 2016 are not quite so sinister. They reported that these short-term changes could predispose an individual to a higher risk of cardiovascular diseases.[18] Usman and Jawaid,[19] reported a case of hypertension in a young boy due to high dose energy drink consumption. These drinks are not as safe as people think that they are, people needed to be warned about the dangers, particularly young people.[20,21] Ferreira et al.,[22] conducted a study that there were no differences in physiological and biochemical parameters of volunteers after energy drink consumption. While Modi et al.,[23] demonstrated a study administered energy drinks revealed that despite a modest trend, consumption of caffeine from sources other than coffee like an energy drink or of decaffeinated coffee was not associated with reduced liver abnormalities. Our research already noted the obvious limitations of the study: a small sample and using only one energy drink. In addition, concerns have been raised over their safety and with a currently absence regulatory environment; more research is needed into the effects of energy drinks on the body's health. On the basis of this knowledge, this is the first study that has been designed to evaluate the acute effects of energy drinks on the biochemical parameters among young people in Erbil city.

Methods

Experimental design

A relevant statement on permission and ethical practices were approved by the Research Ethics Committee in the College of Health Sciences at the Department of Clinical Biochemistry. This cross-sectional study was carried out during the period October 2016 to April 2017 at the Department of Clinical Biochemistry, College of Health Sciences, Hawler Medical University, Erbil, Iraq. Study subjects were placed into one group with two readings, where Reading one (R1) is before, or pre-tiger, and Reading two (R2) is after or post-tiger. Subjects were healthy male and female, young adults who were recruited into the study and their ages range from 21-23 years. The study protocol was carefully explained to them. Their body mass index was calculated, and they were in the middle of the healthy range (25 Kg/m^2), Subjects were not on a drug or alcohol, and none of them had biochemical evidence of any types of disease especially cardiac diseases. Twenty four subjects entered a run. All subjects consumed one can (250 ml volume) of one particular brand of energy drink (wild Tiger beverage) a day. All the analysis was done within two hours of sample collection. The Tiger beverage was purchased from public markets, and it is a popular brand that is commercially available.

Blood samples:

Five milliliters of venous blood samples of the 24 subjects were collected. Serum samples were obtained after clotting of the blood samples by using standard method

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EDTA. The samples were used to estimate the initial values of biochemical tests of the subjects before placing them on energy drink consumption. Other blood samples were equally collected after 45 minutes of energy drink intake, and the blood samples spun in a laboratory centrifuge at 2000 rpm for 5 minutes. The serum used immediately to estimate the values of the different parameters of the subjects.

Biochemical analysis:

Blood sodium, potassium, chloride, and ionized calcium were measured simultaneously by OPTI LION Electrolyte auto analyzer in the same single-use cartridge. The plasma urea was determined by urease method, the serum uric acid was determined by uricase method, and the creatinine estimation was done by kinetic jaff reaction method. The plasma alanine transaminase (ALT), and aspartate transaminase (AST) were determined by the IFCC method. The total cholesterol was evaluated by GOD PAP method, and direct and total bilirubin were determined by sulfanilic acid (J. mod) method. The triglyceride concentration was determined by TRINDER method, and alkaline phosphatase (ALP) was determined by diethanolamine method. The plasma albumin was determined by the colorimetric bromocresol green method, and serum glucose was estimated by the oxidase method. The total protein was estimated by the biuret method, while LDL cholesterol was evaluated by direct method and HDL-cholesterol was determined enzymatically after precipitation of other lipoprotein[s.] The serum amylase was determined by ethylidene para nitrophenol glucose-7 method. These tests were estimated with fully automated chemical analyzer by using cobas diagnostic kits (Roche/COBAS 311 INTEGRA, biochemical analyzer) and. Blood iron, ferritin, and UIBC (unsaturated iron binding capacity) were determined by bathophenanthroline method using the automated chemical analyzer.

Statistical analysis

The statistical evaluations of the results including the mean and standard deviation were calculated using the statistical package for the social sciences (version 19.0). The different variables were compared to each other; the paired t-test (before and after consumption of energy drink) was used. A *P* value of ≤0.05 was regarded as significant.[24]

Results

Out of the 24 subjects in the study, 13 (54.1%) were females, and 11 (45.8%) were males with a mean age of 24.15±4.62 years, and the mean values and standard deviations of variables such as age and body mass index (BMI) of the group in the pre and post tests are shown in Table 1.

Table 1: Characteristics of the (Mean ± SD) of different variables of the studied group.

Variables	Before (R 1) n=24	After (R 2) n=24	Range
Age (Mean±SD)	24.15±4.62	24.15±4.62	20-35
BMI (Mean±SD)	23.1±4.11	23.1±4.11	17-31.4

https://doi.org/10.15218/zjms.2018.044

The results obtained indicated that the (mean ±SD) of plasma albumin and total proteins were 4.96± 0.29 and 7.70± 0.45 g/ dl, in After (R2). These values were higher significantly than that obtained in Before (R1). (4.87± 0.28 and7.45± 0.46 g/dl) (*P* = 0.033 and 0.034, respectively). The mean ± SD of plasma GOT (glutamate oxaloacetate transferase) enzyme of liver function test was 27.11± 8.21IU/L, in (R2) which was significantly higher than that obtained in (R1) 23.25± 5.69IU/L (*P* = 0.017). The GPT (glutamate pyruvate transferase) enzyme of liver function test was 17.08± 8.08 IU/L was higher than that of obtained in (R1) 16.2± 7.77 IU/L but not significantly (*P* = 0.058). Results revealed an increase in plasma levels of electrolytes such as sodium, potassium, and chloride after consumption of energy drinks but these changes were not significant. Furthermore, plasma levels of urea, uric acid, and creatinine were not affected significantly, also plasma glucose level not changed significantly. Besides, the effects of energy drinks on the lipid profile were not affected significantly. Although an increase in the levels in TG (triglyceride), TC (total cholesterol), LDL-C (low-density lipoprotein-cholesterol) was observed with a decreased level of HDL-C (high-density lipoprotein-cholesterol) was also observed but none of them significant. On the other hand, ALP (alkaline phosphatase), amylase, direct bilirubin, and total bilirubin were not significantly increased. Finally, plasma levels of iron, ferritin, and UIBC (unsaturated iron binding capacity) levels were also not changed significantly. Table 2 provides the mean ± SD of different Biochemical parameters in the studied group.

Table 2: The (Mean ± SD) of Biochemical parameters in the studied group.

Biochemical parameters	Before (R 1) (Mean ± SD)	Range	After (R 2) (Mean ± SD)	Range	*P* value
Electrolytes					
Na^+:mmol/L	137.1±4.98	120-143	138.5±2.8	135-143	0.216
K^+:mmol/L	4.36±0.4	3.7-5.4	4.37±0.4	3.6-5.3	0.899
Cl^-:mmol/L	103.1±3.37	92-108	103.85±1.89	101-108	0.336
Ca^{+2}:mg/dl	10.22±0.66	9.1-11	10.11±0.60	9.14-10.7	0.347
Renal function tests		24-52			
Urea :mg/dl	36.07±8.83	2.19-6.68	36.61±8.23	25-49	0.599
Uric acid :mg/dl	4.11±1.29	0.45-1.22	4.08±1.27	2.14-6.24	0.754
Creatinine :mg/dl	0.89±0.21		0.85±0.31	0.1-1.26	0.499
Sugar					
Glucose:mg/dl	92.47±19.31	49-126	92.94±13.89	76-130	0.902
Lipid profile					
TG:mg/dl	98.19±57.7	34-242	103.56±56.3	33-223	0.159
TC:mg/dl	162.8±48.2	108-294	163.6±48.7	105-297	0.637
HDL-C:mg/dl	53.63±12.89	33-83	53.60±12.51	35-80	0.960
LDL-C:mg/dl	65.83±25.9	42-144	69.07±40.13	36-206	0.426
Proteins					
Albumin:g/dl	4.87±0.28	4.46-5.5	4.96±0.29	4.35-5.31	0.033
Total protein:g/dl	7.45±0.46	6.83-8.68	7.70±0.45	6.65-7.96	0.034
Liver function tests					
GOT: IU/L	23.25±5.69	16-43	27.11±8.21	14-33.8	0.017
GPT: IU/L	16.2±7.77	10-43	17.08±8.08	7-42	0.058
ALP: IU/L	145.9±38.1	82-214	149.2±35.89	100-210	0.319
Amylase: IU/L	83.25±31.37	57-155	84.87±27.11	57-145	0.534
D. Bilirubin:mg/dl	0.33±0.12	0.15-0.59	0.347±0.11	0.14-0.54	0.193
T. Bilirubin: mg/dl	0.97±0.45	0.36-2.36	0.985±0.44	0.4-2.19	0.637
Minerals					
Iron: ug/dl	112.0±35.89	61-186	113.0±31.24	65-176	0.668
Ferritin: ng/dl	60.83±41.89	15-128	59.66±42.88	16-128	0.457
UIBC:ug/dl	308.1±71.2	181-379	293.16±72.33	175-392	0.105

https://doi.org/10.15218/zjms.2018.044

Discussion

The current study reports the short-term effects of energy drink consumption among adolescents and youth in Erbil city. The present study has shown that energy drink has variable effects on plasma electrolytes, renal functions, liver enzymes, sugars, lipid profile, proteins, and minerals. In this study, it was found that serum albumin, total protein, and GOT levels were raised significantly in subjects after consumption of energy drink, but do not have any significant effect on the other biochemical parameters. These findings suggest adverse effects of the drinks on the liver. The results reported in our research is similar to that conducted by Ebuehi and colleagues,[25] who reported that consumption of energy drink was associated with lower ALT, AST, creatinine, uric acid, and albumin, but higher total protein, TG, HDL-C, and LDL-C. The reason for this disparity is not obvious, but it may be mainly due to high caffeine content in energy drinks. According to Ugwuja,[18] who conduct a study on rats revealed that energy drink consumption had been associated with significantly higher urea, uric acid, creatinine and liver enzymes and total bilirubin, which is consistent with the present findings. Furthermore, none significantly elevated plasma urea with decreased uric acid and creatinine suggest renal involvement, when the kidneys are affected both urea and creatinine are accumulated in the blood which they are products of protein metabolism. On the other hand, plasma potassium was raised insignificantly after consumption of energy drink in the present study has important health implication. Potassium is very important to the heart which may lead to cardiac defects. It has been revealed previously that long-term exposure to different ingredients of energy drinks may result in significant alterations in the cardiovascular system, also elevated plasma sodium was another finding of the present study.[26] Excessive caffeine consumption has been found to have health problems such as hypertension which mainly due to the increase in the level of plasma sodium that was another finding of this study but insignificantly.[27] A pilot study conducted on healthy 18-45 years old and normotensive, they found that single day energy drink consumption increased mean 24 hours and daytime blood pressure compared to caffeine control, this shows that excessive energy drink supplementation can lead to hypertension, one possible mechanism for this increased blood pressure could be related by its potential negative impact on endothelial function. Also, consumption of energy drinks has been associated with serious adverse effects such as diabetes mellitus, seizures, mood or cardiac abnormalities and behavioral disorders, especially in children, adolescents, and young peoples.[10] The cardiac abnormalities may also be attributed to lipid metabolism disorder as evidenced by elevated plasma TG, TC, LDL-C, and low level of HDL-C observed after consumption of energy drink in this research. It can be predicted that the sugars contained in energy drinks could affect the cardiovascular system on the basis that sugars belong to food calories after ingestion it is generally accompanied by increases in heart rate and other related disorders.[28] Another observation of the present study was slightly increased plasma iron and low ferritin and UIBC in post energy drink consumption group these alterations may be due to that some synthetic vitamins and minerals which are found in energy drink composition may break down quicker than their natural forms, this can cause harmful effects and toxicity in the long period. The health risks associated with energy drink consumption relates to their caffeine content, which is considered the main ingredient in energy drinks. The short and long-term effects of the combined consumption of ingredients of energy drinks are not well known. The main mechanism of action of caffeine, it has a similar chemical structure to that of

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adenosine allowing it to attach to the adenosine receptors. Therefore, it acts as an adenosine receptor inhibitor in the brain, causing sleep-promoting, nervous sleeping up, and increased secretion of epinephrine which can lead to a variety of metabolic changes. Also, it reduces food intake and promotes lipolysis.[29] Further studies are required to evaluate the potential for adverse health effects from energy drink consumption, especially from long-term, habitual consumption.

Conclusion

It may be concluded that energy drink consumption is associated with significant alterations in some biochemical parameters such as serum albumin, total protein, and GOT liver enzyme. Energy drinks will become a significant public health problem if their use among young people is not addressed through a cap on caffeine levels and restrictions on their sale and marketing. Because of the paucity of data on the safety and efficacy of energy drink, they should be consumed with caution.

Competing interests

The author declares no competing interests.

References

1. Global Energy Drinks Report 2012. (Accessed April 15, 2015, at: http://www.zenithinternational.com/reports_data/146/Global+Energy+Drinks+Report+2012).
2. Almadari KA, Kordi M, Choobineh S, Abbasi A. Acute Effects of two Energy Drinks on anaerobic power and blood lactate levels in male athletes. Physical Education and Sport 2007; 5(2):153–62.
3. Yunusa I, Ahmad IM. Energy drinks composition and health benefits. Bayero Journal of Pure and Applied Sciences 2011; 4(2):186–91.
4. Muhammad KR, Sultan SA, Mohammed SK. Influence of non-alcoholic malt beverages on urinary excretions of calcium and uric acid. Zanco J Med Sci 2015; 19(3):1104–8.
5. Breda JJ, Whiting SH, Encarnacao R, Norberg S, Jones R, Reinap M, et al. Energy drink consumption in Europe: Review of the risks, adverse health effects, and policy options to respond. Front Public Health 2014; 2(34):1–5.
6. Crisan M, Muntaneanu C, Rosiuru C, Lang C. Red Bull Induces Biochemical Changes in Wistar rat liver. Annals RSCB 2013; XVIII(2):118–22.
7. Alrasheedi AA. Prevalence and reasons for consumption of energy drinks among adolescents and young adults in Jeddah, Saudi Arabia. GJHS 2017; 9(2):23–32.
8. Yunusa I, Ahnad IM. Energy-Drinks: consumption and Health Benefits. Bajopas 2011; 4(2):186–91.
9. Nowak D, Jasionowski A. Analysis of the consumption of caffeinated Energy Drinks among polish Adolescents. Int J Environ Res Public Health 2015; 12:7910–21.
10. Seifert SM, Schaechter JL, Hershorion ER, Lipshultz SE. Health effects of energy Drinks on children, Adolescents, and Young Adults. Pediatrics 2011; S127(3):511–28.
11. Martz ME, Patrick ME, Schulenberg JE. Alcohol mixed with Energy drink use among U.S. 12th-grade students: prevalence, correlates, and associations with unsafe driving. J Adolescents Health 2015; 56:557–63.
12. Ward AE, Lipshultz SE, Fisher SD. Energy drink-induced near-fatal ventricular arrhythmia prevented by an intracardiac defibrillator decades after operative 'repair' of tetralogy fallot. Am J Cardiol 2014; 114:1124–5.
13. Shirey W. The hazards of drinking energy drinks and exercising. (Accessed April 15, 2015, at: http://www.livestrong.com/article/527382-the-hazards-of-drinking-energy-drinks-and-exercising).
14. Avic S, Sarikaya R, Buyukcam F. Death of a young man after overuse of energy drink. AJEM 2013; 6:32.
15. Kennedy DO, Scholey AB. A glucose-caffeine 'energy drink' ameliorates subjective and performance deficits during prolonged cognitive demand. Appetite 2004; 42(3):331–3.
16. Gallimberti L, Buja A, Chindamo S, Vinelli A, Lazzarin G, Terraneo A, et al. Energy drink consumption in children and early adolescents. Eur J Pediatr 2013; 172:1335–40.
17. Gunja N, Brown J. Energy drinks: Health risks and toxicity. The Medical Journal of Australia 2012; 196(1):46–9.
18. Ugwuja EI. Biochemical effects of energy drinks alone or in combination with alcohol in normal albino rats. Advanced Pharmaceutical Bulletin 2014; 4(1):69–74.
19. Usman A, Jawaid A. Hypertension in a young boy: an energy drink effect. BMC Research Notes 2012; 5:591.
20. Temple JL. Caffeinated use in children: what we know, what we have left to learn, and why we should worry. Neurosci Biobehav Rev 2009; 33:793–806.
21. Snipes DJ, Jeffers AJ, Green BA, Benotsch EG. Alcohol mixed with energy drinks are robustly associated with patterns of problematic alcohol consumption among young adult college students. Addict Behav 2015; 41:136–41.
22. Ferrieira SE, de Mello MT, Rossi MV, Souzaformigoni ML. Does an energy drink modify

the effects of alcohol in a maximal effect test? Alcohol Clin Exo Res 2004; 28(9):1408–12.
23. Modi AA, Feld JJ, Park Y, Kleiner DE, Everhart JE, Liang J, et al. increased caffeine consumption is associated with reduced hepatic fibrosis. Hepatology 2010; 51(1):201–9.
24. Daniel WW. Biostatistics: A foundation for analysis in the health science. 3rded.USA: John Wiley and Sons; 1983.
25. Ebuehi OA, Ajayl OE, Onyeulor AL, Awelimobor D. Effects of oral administration of energy drinks on blood chemistry, tissue histology and brain acetylcholine in rabbits. Nig Q J Hosp Med 2011; 21(1):29–34.
26. Higgins JP, Tuttle TD, Higgins CL. Energy beverages: contents and safety. Mayo ClinProc 2010; 85(11):1033–41.
27. Chinwe AO, Kennedy NJ, Hope O, Constance O, Helen U. The effect of coffee consumption on liver enzymes and bilirubin in healthy subjects. J Current Res Sci 2013; 1(2):104–8.
28. Berger AJ, Alford K. Cardiac arrest in a young man following excess consumption of caffeinated 'energy drinks.' Med J Australia 2009; 190(1):41–3.
29. Grasser EK, Miles-chan JL, Charriere N, Loonam CR, Dulloo AG, Montani JP. Energy Drinks and their impact on the cardiovascular system: potential mechanisms. Adv Nutr 2016; 7:950–60.