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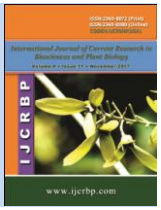

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Consumption of Energy Drinks among College Female Students and its Effect on Blood Chemistry

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Abstract

Energy drinking among college students is widespread and known to cause significant harms and hazards for the drinker. In this study we have determined the prevalence estimate of energy drinks among college female students in Jazan University such as Bison, Power Horse and Red Bull which may effect on blood chemistry, and determine correlation of consumption with study pattern, urination, health problems, heart pulses, nausea, abdominal pain, diabetes, menstrual period problems and headache. We made questionnaire that assessed consumption patterns of energy drinks among these students and withdraw blood samples for analysis. The consumers were divided into two groups regular and irregular consumers. This study showed that energy drinks are diuretic. There is a significant relation between energy drink consumption and health problems, and it also proved the strong effect of energy drinks stoppage for regular consumers. There is no effect of energy drink on blood chemistry and on Follicle stimulating Hormone.

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Keywords

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Introduction

Energy drinks (ED) are non-alcoholic beverages marketed to improve energy, stamina, athletic performance, and concentration. Categorized as "functional beverages" alongside sports drinks and nutraceuticals, the ED industry has grown dramatically in the past 20 years (Al-shaar et al., 2017). Energy drinks (e.g., Red Bull, Monster and Rockstar) are beverages marketed with claims of providing users with increased alertness and energy boosts (Miller et al., 2008). These beverages contain a variety of compounds including plant-based stimulants (e.g., guarana), simple sugars (e.g., glucose, fructose), amino acids (e.g., taurine) and herbs (e.g., ginseng) (O'Brien et al., 2008). However, most researchers agree that the extremely high caffeine content (the principal active ingredient) of these beverages drives the stimulant properties that users often report following consumption (Howard and Marczinski, 2010).

Food and Drug Administration does not regulate the caffeine content of energy drinks and worldwide energy drink market (Seifert et al., 2011). Heavy episodic (binge) drinking has been argued to the number one public health hazard and the primary source of preventable morbidity and mortality for the more than six million college students in the United States (Wechsler et al., 1995). Little search has examined the rates of use and motivations for consumption of energy drinks alone and mixed with alcohol in college students.

The ingredients in energy drinks have both a direct and an indirect effect on heart and blood vessels. Plaque build-up inside arteries leads to atherosclerosis, which reduces blood flow to heart and raises risk of heart attack and stroke. Consuming large amounts of sugar and caffeine can increase the chance of developing plaque formation in heart (University of Illinois Extension; March 2011).

The sugar content of energy drinks could contribute to high cholesterol levels if over indulge, increased intake of sugar is associated with lower levels of high-density lipoprotein, the so-called "good" cholesterol, which decreases risk of atherosclerosis excess cholesterol in blood and removing it to the liver. High intake of more than 20 percent in the form of simple sugars also increases triglyceride levels, another lipid associated with heart disease (Medical News Today; November 2007). High caffeine consumption is associated with chronic daily headaches (particularly) among young women (age <40 years) and among those with chronic episodic headaches, central nervous system, cardiovascular, gastrointestinal, and renal dysfunction have been associated with chronic caffeine ingestion (Malinauskas et al., 2007). Energy drinks have stimulating properties that can boost heart rate and blood pressure, dehydrate the body and may aggravate the effects of other stimulants, and prevent sleep unlike sports drinks (the use of which is supported for athletes), energy drinks should not be used while exercising because the combination of fluid loss, sweating, and the diuretic quality of the caffeine can leave the user severely dehydrated (Reissig et al., 2009, Waring et al., 2003). Energy drinking among college students is widespread and known to cause significant harms and hazards for the drinker and those around the drinker (Marczinski, et al., 2009, Wechsler, et al., 1994).

Therefore, the purpose of this study To determine prevalence estimate of energy drinks among college female students in Jazan University such as Bison, Power Horse and Red Ball which may affect blood chemistry, and determine correlation of consumption it with study pattern, urination, health problems, heart pulses, nausea, abdominal pain, diabetes, menstrual period problems and headache.

Materials and methods

We made questionnaire that assessed consumption patterns of energy drinks among students of Faculty of Medicine and Applied Medical Sciences. In the present study we asked these students open-ended questions regarding situations in which college students use energy drinks. Based on the focus group responses we developed a 17-item questionnaire. Questions 1 and 2 assessed demographic information (age, name and college year). Question 3 asked about residential information, next question used to identify energy drink users, the participant indicated "No" were instructed to skip the remaining questions in the survey and return the questionnaire to the research assistant. Participants who indicated “yes” were instructed to continue the survey.

Then asked about frequency of drinking, their favorite beverage, if they added additives to energy drink before drinking or not, the effect of energy drink on study pattern and how does it effect. Also, we evaluated the questions about health problems, regularity of menstrual cycle, diabetes, the effect of energy drink on heart pulses, nausea, abdominal pain, and any effect after stopping the usage of drink.

In the last of questionnaire we have taken the consent for withdrawing blood sample from consumer to estimate calcium, creatinine, alanine transaminase, and aspartate transaminase, Lipid profile and Luteinizing hormone (LH) and Follicle stimulating hormone (FSH) hormone. After that we divided the consumers into two groups. Group 1 which usually took energy drinks (on regular basis). Group 2 people took energy drinks sometimes (on irregular basis).

Results

The number of participants was 324 their age range from 18-28 years old with mean 19.95 and stander deviation 1.3 and blood samples were drawn from 20 participants of female students during the menstruation for blood analysis. The prevalence estimate of energy drinks consumption showed that 102 out of 324 (31.5) %were consumer energy drinks and the percentage of prevalence is more 72 (70.6%) in urban area than in rural 30 (29.4%) (Table 1). Frequency of energy drinks consumption among college students showed that majority of them 27 (26.5%) consumer it on weekly basis while minority 14 (13.4%) take it more than one time in a day (Fig. 1).

Pattern of favorite energy drinks of consumers showed that the most popular energy drink among students of study is Bison in combination with Code Red 27

(26.5%) then comes individual energy drinks (Table 2). Pattern of adding additives in energy drinks during consumption showed that the majority of consumer 93 (91.2%) prefer to take energy drinks without any additives where only little 9 (8.8%) drink it with additives (Table 3). However 4 (44.4%) mixed it with soft drink (Pepsi or Dio), 3 (33.3%) added analgesic tablets (panadol or histop) and 1 (11.1) added fruit (Table 4).

Table 1. Prevalence estimates of energy drink consumption.

Drinking		Frequency	Percent
Yes	Urban	72	70.6%
	Rural	30	29.4%
	Total	102	100.05
No	Urban	87	39.2%
	Rural	135	60.8%
	Total	222	100.0%

Table 2. Pattern of favorite energy drink of consumers.

Drinking	Frequency	Percent
Bison	23	22.5%
Bison, Codered	27	26.5%
Bison, Codered, Red bull	1	1.0%
Bison, Codered, Red bull, another	4	3.9%
Bison, Codered, another	21	20.6%
Bison, another	4	3.9%
Codered	14	13.7%
Codered, Red bull	1	1.0%
Codered, another	2	2.0%
Another	4	3.9%
Total	101	99.0%
Missing	1	1.0%
Total	102	100.0%

Table 3. Pattern of adding additives in energy drink during consumption.

Drinking		Frequency	Percent
Yes	Yes	9	8.8%
	No	93	91.2%
	Total	102	100.0%
No		222	100.0%

Table 4. Pattern of various types of additives during consumption.

Drinking	Additives	Frequency	Percent
Yes	Soft drink	4	44.4%
	Analgesic tablets	3	33.3%
	Fruit	1	11.1%
	Missing	1	11.1%
	Total	9	100%

The correlation of energy drinks consumption with study pattern showed that 54 (53%) participants thinks there is no relation between energy drinks and study pattern, while 48 (47%) of energy drink consumers think that energy drinks

consumption help in better study (Table 5), and the majority of them 22 (45.8%) consume it to increase their concentration and insufficient sleep (Table 6).

The relation of energy drinks consumption with urination showed that 25 (24.5%) of consumers found no relation between energy consumption and urination while 77 (75.5%) found effect on urination and this effect was increased urination (Table 7).

Relation of energy drinks consumption with nausea showed that 78 (76.5%) there is no effect but 12 (11.8%) showed the energy drinks consumption always or sometimes lead to nausea (Table 8). Pattern of health problem among energy drinks consumers showed that 26 (37.7%) of Group 1 had health problem while this percentage decrease to 6 (18.2%) in Group 2, $p<0.05$ significant (Fig. 2). Correlation of energy drinks consumption with heart pulses showed that Group 1 had more chance of increased in heart pulses 12 (17.4%) as compared to Group 2 which was less 3 (9.1%), $p>0.05$ non significant (Fig. 3).

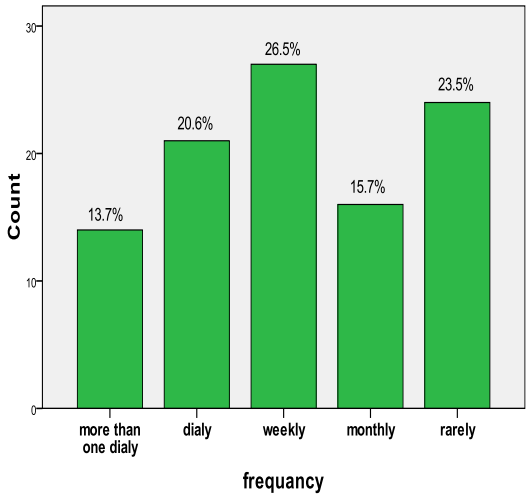

Fig. 1: Frequency of energy drink consumption among consumers.

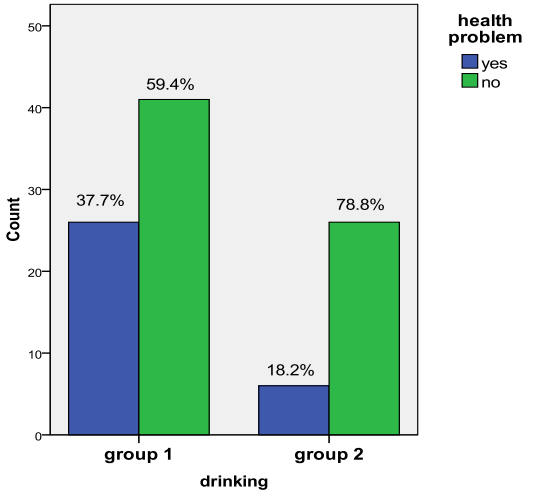

Fig. 2: Pattern of health problems among energy drink consumers.

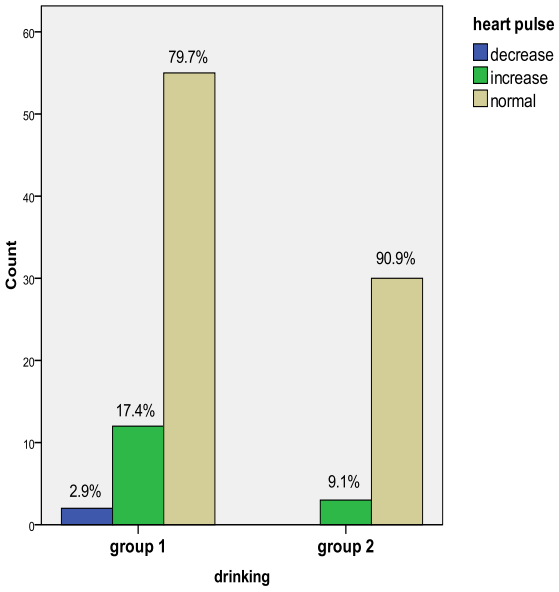

Fig. 3: Correlation of energy drinks consumption and heart pulses.

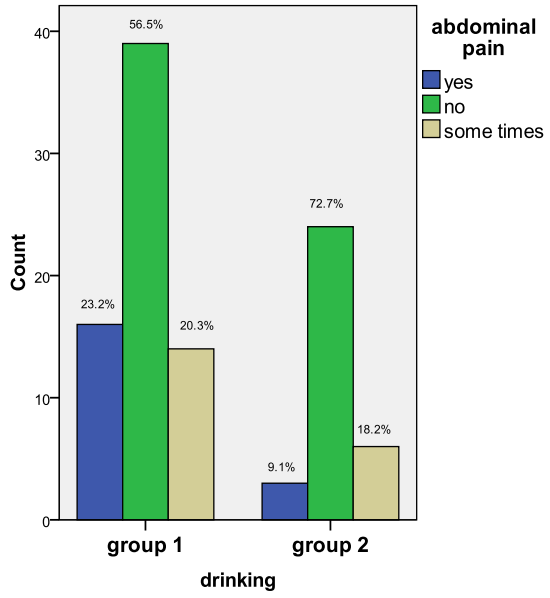

Fig. 4: Correlation of energy drinks consumption and abdominal pain.

Further, the correlation of energy drinks consumption and abdominal pain showed that 16 (23.2%) always suffering from abdominal pain in Group 1,while this percentage decrease in Group 2 to 3 (9.1%), also 14 (20.3%) sometimes suffering from abdominal pain in Group 1 and decrease to 6 (18.2%) in Group 2, $p>0.05$ non significant (Fig. 4). Correlation of energy drinks with diabetes showed that 6 (8.7%) in Group 1 were diabetes on the other hand none were found to be diabetes in Group 2, $p>0.05$ non significant (Fig. 5).

The pattern of menstrual period among energy drinks consumers showed that 28 (40.6%) of the Group1 had irregular period and this percentage decrease to 8 (24.2%) in Group 2 while 41 (59.4%) of the Group 1had regular period and this percentage increase to 25 (75.8%) in Group 2, $p>0.05$ non significant (Fig. 6). The effect of stop drinking on consumers showed that if Group 1 stop taking energy drinks they get effected 19 (27.5%), whereas the major 50 (72.5%) remain un effected on the other hand the stoppage of energy drinks consumption in Group 2 did not affect, $p<0.001$ highly significant (Fig. 7). Relation of stopping energy drinks consumption with headache showed that 14 (13.7%) subject have headache problem while the rest of the people, 87 (85.3%) exhibited no effect (Table 9).

Blood chemistry of energy drink consumers demonstrates all participants had normal values for all biochemical parameters (Table 10). Hormonal analysis for energy drink consumers showed that 1 sample (5%) had high value of FSH and 3 samples (15%) had low values of LH (Table 11).

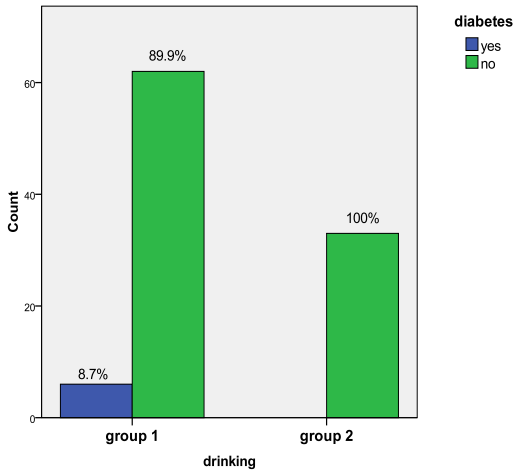

Fig. 5: Correlation of energy drinks with diabetes.

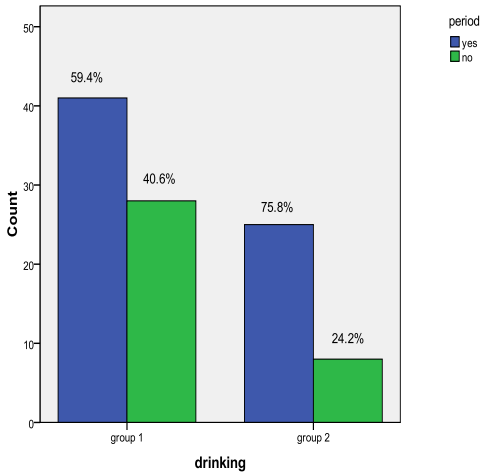

Fig. 6: Pattern of menstrual period among energy drink consumers.

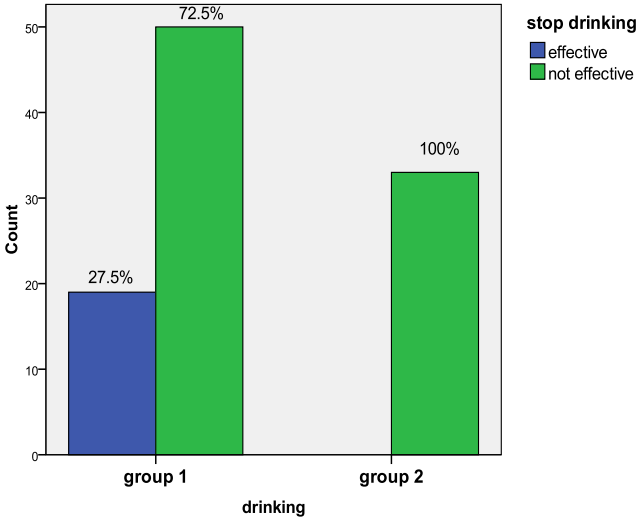

Fig. 7: The effect of stop drinking on consumers.

Table 5. Correlation of energy drinks consumption with study pattern.

Drinking		Frequency	Percent
Yes	Help study	48	47%
	No relation	54	53%
	Total	102	100.0%
No		222	100.0%

Table 6. Effect of energy drinks consumption on study pattern.

The effect	Frequency	percent
More concentration	15	37.5%
Insufficient sleep	6	12.5%
Relax	1	2.1%
Active	2	4.2%
More conc. & Insufficient sleep	22	45.8%
More conc. & Insufficient sleep & relax	2	4.2%
Total	48	100 %

Table 7. Effect of energy drink on urination.

Drinking		Frequency	Percent
Yes	Increase	77	75.5%
	No relation	25	24.5%
	Total	102	100.0%

Table 8. Relation of energy drink consumption with nausea.

Drinking		Frequency	Percent
Yes	Yes	12	11.8%
	No	78	76.5%
	Sometimes	12	11.8%
	Total	102	100.0%
No		222	100.0%

Table 9. Relation of stopping energy drink consumption with headache.

Drinking			Frequency	Percent
Yes		Yes	14	13.7%
		No	87	85.3%
		Total	101	99.0%
	Missing		1	1.0%
	Total		102	100.0%
No	Valid		222	100.0%

Table 10. Blood chemistry of energy drink consumers.

Participant Number	Calcium	Creatinine	Aspartate transaminase	Alanine transaminase	Cholesterol	Triglyceride	High density lipoprotein	Low density lipoprotein
1	2.32	51.00	13.00	11.00	4.03	0.62	1.11	2.60
2	2.32	39.00	19.00	12.00	4.00	0.41	0.93	2.90
3	2.32	40.00	21.00	17.00	4.63	0.52	1.09	3.30
4	2.40	43.00	19.00	9.00	5.18	1.00	1.30	3.40
5	2.46	65.00	13.00	11.00	4.44	0.51	1.20	3.00
6	2.39	51.00	20.00	7.00	4.19	0.65	1.52	2.30
7	2.51	57.00	21.00	13.00	5.29	0.39	1.91	3.20
8	2.28	34.00	20.00	18.00	5.84	0.43	1.75	3.90
9	2.22	41.00	21.00	16.00	4.85	0.81	1.15	3.30
10	2.42	61.00	17.00	11.00	3.95	0.77	0.94	2.60
11	2.35	41.00	26.00	12.00	3.65	0.54	1.37	2.00
12	2.29	41.00	19.00	9.00	2.74	0.24	0.92	1.70
13	2.43	57.00	14.00	9.00	3.96	0.67	1.13	2.50
14	2.35	45.00	19.00	10.00	3.42	0.51	1.19	2.00
15	2.28	67.00	22.00	8.00	3.72	0.83	0.91	2.40
16	2.67	53.00	16.00	12.00	4.20	0.98	0.90	2.80
17	2.43	57.00	16.00	10.00	3.25	0.76	0.86	2.00
18	2.45	46.00	16.00	11.00	3.57	0.68	1.01	2.20
19	2.33	N.D	35.00	26.00	3.17	1.11	1.10	1.50
20	2.41	76.00	23.00	12.00	4.12	0.43	1.06	2.80
Normal range	2.20-2.62 mmol/L	50-115 µmol/l	15-37 IU/L	10-50 IU/L	4.0-6.2 mmol/L	.40-1.3 mmol/L	0.9-2 mmol/L	2-3.4 MMO/L

N.D : not determined.

Table 11. Hormonal analysis for energy drink consumers.

Participant number	Follicle stimulating Hormone (FSH)	Luteinizing hormone (LH)
1	4.10	2.92*
2	4.35	5.18
3	6.10	4.30
4	4.00	2.85*
5	5.46	3.00
6	5.40	3.90
7	5.70	7.45
8	6.95	7.52
9	6.75	1.83*
10	5.25	9.10
11	4.93	10.60
12	7.41	4.90
13	5.24	5.20
14	3.84	5.24
15	6.70	6.15
16	4.59	5.89
17	17.80**	5.99
18	7.60	5.40
19	6.10	4.60
20	5.80	5.30
Normal range	3.0-12.5 IU/L	3 .0 -12.6 IU/L

*: low value; ** : high value.

Discussion

For some years now, the market has been flooded by beverages manufacturers call "energy drinks". According to them, these drinks were created to increase physical endurance and resistance, provide better concentration and faster reaction times, increase alertness, avoid sleepiness, provide a feeling of well-being, stimulate metabolism and help eliminate harmful substances from the body (Ballistreri and Corradi-Webster, 2008).

Energy drinks are marketed to young adults and marketing efforts may be particularly appealing among college students. For example, Cocaine energy drink, with a Cut Cocaine variety, has been marketed as a "legal alternative" to the class A drug (Cruse, 2007). On April 4, 2007, the Food and Drug Administration issued a warning to Drink Reboot, the firm that markets Cocaine, citing numerous marketing violations, including promoting this product as a street drug alternative (Cruse, 2007).

Red Bull energy drink is reportedly a "functional beverage" that was designed to increase physical and mental performance and "is appropriate to drink during sports, while driving and during leisure activities".

The purpose of the present study was to identify energy drink consumption patterns and side effects associated with consumption of energy drinks among college students. In this study 324 participants took part, having age range from 18-28, we found that energy drink consumption is a popular practice among college students, where 102 (31.5%) out of them consume energy drinks. Particularly if the student has had insufficient sleep, if they need more energy in general, while studying for exams or working on major course projects. This is in an agreement with report published by (American College Health, 2007).

In this study we found that the majority of students 22 (45.8%) who think energy drinks help them in studying consume it to increase their concentration and insufficient sleep. This is in agreement with Malinauskas et al. (2007) who found that 50% of energy drink users drank two or more energy drinks while studying for an exam or working on a major course project, and 36% to 37% drank two or more following insufficient sleep, when they needed energy throughout the day, or while driving an automobile for a long period of time.

We found that the percentage of prevalence is more 72 (70.6%) in urban areas is more than in rural area population. Only 30 (24.4%) were involved in energy drinking .This may be due to high standard of living of urban population. We found 8.8% of consumers added additives in energy drink including soft drink (44.4%) and analgesic tablets (33.3%). Another study showed that energy drink use predicts subsequent nonmedical use of prescription stimulants, further study of whether energy drink use serves as a gateway to other forms of drug dependence is warranted (SAMHSA, 2005).

The present study showed that there is a significant relation between energy drink consumption and health problems. This is in agreement with another study which demonstrated that there is a growing empirical support for a linkage between energy drink consumption, particularly in large quantities, and negative health consequences (Worrall et al., 2005; Lyadurai and Chung, 2007; Machado-Vieira et al., 2001).

Recent investigations have led to the regulation of these substances in Ireland, Sweden, Canada, and Norway, and their outright ban in Denmark and France. A number of other countries now require energy drinks to carry health warning labels (Food Safety Promotion Board, 2007; Kapner, 2004; Finnegan, 2003).

In this investigation it was noticed that the concentration of ALT range (8-26 IU/L) while the normal rang (10-50 IU/L)., AST range (13-35 IU/L) while normal range (15-37 IU/L) and creatinine (40-76 µ mol/L) while normal range (50 -100 µ mol/L) these finding are in agreement with those of Ebuehi et al. 2011 who found that the blood chemistry results showed that the concentrations of the aspartate and alanine amino transferases, plasma creatinine, were increased in the control as compared to the Red Bull and caffeine administered rabbits.

The present work exhibited that all lipid profile were in normal range, these finding in contrast of Ebuehi et al. (2011) who reported that total cholesterol, triglyceride, high density lipoprotein (HDL) and low density lipoprotein (LDL) concentrations were increased in Power Horse and Red Bull administered rabbits as compared to control rabbits.

Hormonal analysis showed that one only participant had high value in FSH this may had polycystic ovary

syndrome, and three participants had low LH about these we cannot say they had pituitary or hypothalamus disorder without more investigations. Finally we can say energy drinks may effect on LH hormone but this need further investigations to confirm.

This study shows the diuretic effect of energy drink which is in accordance with previous study caffeine have diuretic effect ("Alcohol and Energy Drinks Warning", September 21, 2011). Energy drink consumption increases the urination which is same as our study. Energy drink consumption increases the heart pulse in Group 1 of the study than Group 2. This shows the effect of energy drink on heart pulse which has already reported by earlier workers (Miller et al., 2008).

The correlation of energy drink with diabetes in this investigation showed no significant relation ($p>0.05$). But this observation raises a potential question as whether taking energy drink regularly induce diabetes in participants who were predispose to diabetes. Similarly some other parameters gave insignificant results. As effect of energy drink is on them is not potential enough and their "p" value is insignificant ($p>0.001$).

Conclusion

In the present study, it was concluded that prevalence of energy drink consumption among applied medical science and medicine female students in Jazan region is 31.5%, and the majority of students consume these drinks to increase their concentration, and insufficient sleep during study. Energy drinks are diuretic. There is a significant relation between energy drink consumption and health problems, and also proved the strong effect of energy drinks stoppage for regular consumers. No effect of energy drink on blood chemistry. Finally energy drink may effect on LH hormone but this need further investigations to confirm.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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