ASSESSMENT OF TOXICITY OF ENERGY DRINK AND ALCOHOL CONTAINING BEER ON DIFFERENT ORGANS OF EXPERMINTAL RATS BY COMPARISON WITH CAFFEINE AND CARBONATED BEVERAGES

Ezzeldin Shalaby [(1)], Ahmed Naeem Eesa [(2)], Sarah A. Khater [(3)]

(1) Assistant professor of Forensic Medicine and Clinical Toxicology-Faculty of Medicine-Cairo University

(2) Assistant professor of Pathology-Faculty of Medicine-Cairo University

(3) Assistant professor of Forensic Medicine and Clinical Toxicology-Faculty of Medicine-Misr University for Science and Technology

Corresponding author: Ezzeldin Shalaby **Email:** ezz.shalaby@yahoo.com

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ABSTRACT

Background: caffeine, energy drink, cola, cola diet and beer beverages consumed widely all over the world, But its safety is controversial especially if taken regularly in higher amount and in vulnerable groups. **Objectives** we assess toxicity of Energy drink and Alcohol containing beer on different organs of experimental rats by comparison with Caffeine and Carbonated beverages on brain, liver, testis, kidneys and heart of experimental rats by using both laboratory and histopathological methods. **Methodology** in our study thirty mature male rats were assigned into 6 groups A-F of 5 rats per Group as follow, control group, high dose of caffeine, cola beverage, diet cola beverage, energy drink beer 4.5% intake groups for 4 weeks via oral route. Bilirubin, AST, ALT, Albumin, urea, creatinine, CK, CK-MB, LDH and testosterone level in blood was assessed at start and in day 28, After rats sacrificed brain, liver, testis, kidneys and heart tissues taken for histopathological examination. **Results:** Liver enzyme ALT, AST and LDH is higher than normal in beer and energy drink beverages groups by comparison with other groups; CK is high in energy drink beverages group by comparison with other groups. However, total testosterone is low in beer group by comparison with other groups; also, we found Histopathological changes in liver in energy drink beverages group. **Conclusion** energy drink beverages intake on high amount are hazardous on heart and liver of albino rats, Beer is hazardous on liver functions tests and lower Total testosterone level in Albino rats.

Key words: Energy drink, Beer, Coffee, Diet Cola, toxicity, Rats.

INTRODUCTION

The main source of added sugars in Western diets are Sugar-sweetened beverages **(Bleich and Wolfson, 2015).**

Carbonated soft drinks is containing highest sugar concentration by comparison with other soft drink, also it contain phosphoric acid in high concentration **(Reedy and Krebs-Smith, 2010), (Garnett et al., 2013)**.

Caffeine consume widely in different beverages including coffees, sodas, teas and energy **(Fulgoni et al., 2015).**

By reviewing United States (US) adults, about 90% of them drink caffeinated products **(Mitchell et al., 2014).**

Very high dosages of caffeine consumption in certain cases can lead to cardiovascular problems, seizures and even deaths **(Cappelletti et al., 2018).**

Energy drinks give energy boost through combination of stimulants mainly caffeine and energy boosters, most of it contain also large amounts of glucose or artificially sweetened in some versions **(Alsunni, 2011).**

In addition, energy drinks contain many components like taurine, ginkgo biloba, ginseng, guarana methylxanthines, maltodextrin, vitamin B and carnitin **(Alsunni, 2011).**

Alcohol and beer abuse have harmful effects on health especially liver diseases, cardiac and splenic enlargement, some studies prove than even if consumed in small and regular amount associated with health hazards **(Infante and van-Tets, 2008).**

Recently there is concern about the safety of energy drink especially many reports declared that it has harmful effect on health **(Alsunni, 2015)**.

Aim of the study: Energy drinks are widely consumed and often on regular bases, its safety is controversial especially in vulnerable groups, many reports prove its harm on health.

Beer also widely consumed in spite of it contain low percentage of Alcohol, its intake on regular base and frequently need to be evaluated especially for its chronic toxic effect.

The adverse on health effects associated with caffeine products, cola, diet cola, energy drinks and beer remains controversial.

Therefore, we aim in our study to assess toxicity of Energy drink and Alcohol containing beer on different organs of experimental rats by comparison with Caffeine and Carbonated beverages on brain, liver, testis, kidneys and heart of experimental rats by using both laboratory and histopathological methods.

Methodology:

After approval of ethical committee of Institutional Animal Care and Use Committee Cairo University Number CU/III/F/63/22.

Our study is animal pre-clinical study including Thirty mature male rats with average weight between 150- 200 gm obtained from animal house of faculty of medicine-Cairo University share in this study, living in 6 suspended cages each cage with 5 rats at rooms temperature maintained at 21 +- 2°C, with light adjustment. We fed rats with Spratt's Laboratory Rodent Diet and tap water.

Rats divided in 6 groups each group 5 male rats as follows:

- Group A: control group, Group B: received caffeine at high dose 180 mg /kg/day for 4 weeks via oral route. **Park et al. (2015),** Group C: received cola beverage by 50 ml/day for 4 weeks via oral route. **Tóthová, et al. (2013)**, Group D: received diet cola beverage by 50 ml/day for 4 weeks via oral route. **Eluwa et al. (2013),** Group E: received energy drink by 20mg/kg/day for 4 weeks via oral route **(Rehman et al., 2020)**, Group F: received beer 4.5% at dose of 0.5 g/kg/day for 4 weeks via oral route **(Cristine et al., 2006).**

All rats exposed to laboratory tests including liver function tests (Bilirubin, AST, ALT and Albumin), cardiac enzymes (CK, CK-MB and LDH) kidney function tests (urea, creatinine) and hormonal assay of testosterone in blood at start of the study and on day 28 of the study.

All rats sacrificed on day 28 of the study after taking the blood samples and brain, liver, testis, kidneys and heart tissues of rats submitted for histopathological examination.

The tissues from all groups fixed in 10% neutral buffered formalin then processed by routine histopathological preparation then embedded in paraffin blocks.

Sections 3 um prepared from the formalin-fixed, paraffin-embedded blocks and stained with hematoxylin and eosin, then examined under light microscope.

Statistical analysis:

We analyzed our data **using the statistical package for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA).**

Mean± standard deviation and ranges used for the quantitative data analysis. In addition, number and percentages used for qualitative variables.

We used the following tests:

- When we compared between more than two means we used A one-way analysis of variance (ANOVA) & in addition, we used Post Hoc test: Tukey's test when multiple comparisons between different variables.
- For accuracy of our result, we adjusted the confidence interval to be 95% and accepted error was set to 5% only.
- In addition, we used Probability (P-value) in our study.

RESULTS

OUR STUDY SHOW FOLLOWING RESULT:-

1-LABORATORARY RESULT:-

Table (1): Comparison between studied groups according to Total Bilirubin "mg/dl".

Groups	Total bilirubin (mg/dl)			
	Min.	**Max.**	**Mean**	**±SD**
Group (A) Control group	0.050	0.100	0.076	0.021
Group (B) Caffeine intake group	0.040	0.130	0.082	0.038
Group (C) Cola intake group	0.070	0.311	0.126	0.104
Group (D) Cola diet intake group	0.050	0.150	0.098	0.037
Group (E) Energy beverage intake group	0.050	0.220	0.126	0.074
Group (F) Beer 4.5% intake group	0.070	0.320	0.160	0.102
ANOVA test		**1.019**		
p-value		**0.428**		

Using: F-One Way Analysis of Variance; p-value >0.05 is insignificant

There is no statistically significant difference between groups according to total bilirubin (mg/dl); with p-value (p>0.05).

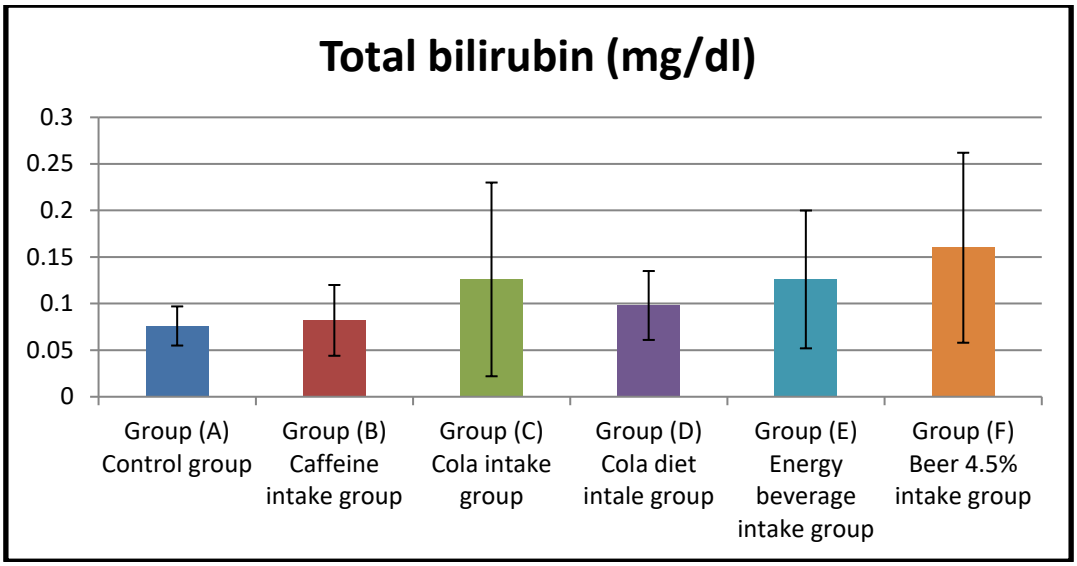

Figure (1): Comparison between studied groups according to Total Bilirubin "mg/dl".

Table (2): Comparison between studied groups according to ALT "u/l".

Groups	ALT (u/l)				Multiple Comparison
	Min.	Max.	Mean	±SD	
Group (A) Control group	38	45	40.80	2.77	D
Group (B) Caffeine intake group	24	61	44.20	13.35	CD
Group (C) Cola intake group	42	55	47.40	5.18	C
Group (D) Cola diet intake group	39	55	48.40	5.98	BC
Group (E) Energy beverage intake group	48	60	52.40	4.62	B
Group (F) Beer 4.5% intake group	72	82	76.60	4.16	A
ANOVA test			**17.240**		
p-value			**<0.001****		

Using: F-One Way Analysis of Variance; **p-value <0.001 is highly significant
Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a highly statistically significant difference between groups according to ALT "u/l"; with p-value (p<0.001).

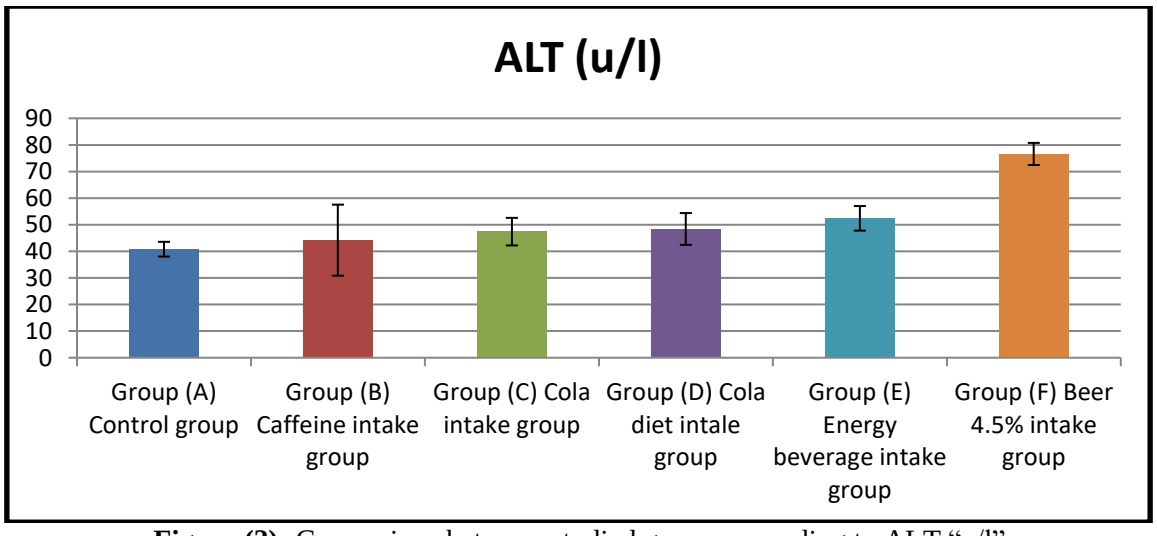

Figure (2): Comparison between studied groups according to ALT "u/l"

Table (3): Comparison between studied groups according to AST "u/l".

Groups	AST (u/l)				Multiple
	Min.	Max.	Mean	±SD	Comparison
Group (A) Control group	35	48	40.20	5.22	C
Group (B) Caffeine intake group	39	50	44.00	4.06	B
Group (C) Cola intake group	33	50	42.20	6.53	B
Group (D) Cola diet intake group	32	46	38.40	6.66	C
Group (E) Energy beverage intake group	36	52	43.40	7.13	B
Group (F) Beer 4.5% intake group	52	63	58.20	5.36	A
ANOVA test			**7.138**		
p-value			**<0.001****		

Using: F-One Way Analysis of Variance; **p-value <0.001 is highly significant
Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a highly statistically significant difference between groups according to AST "u/l"; with p-value (p<0.001).

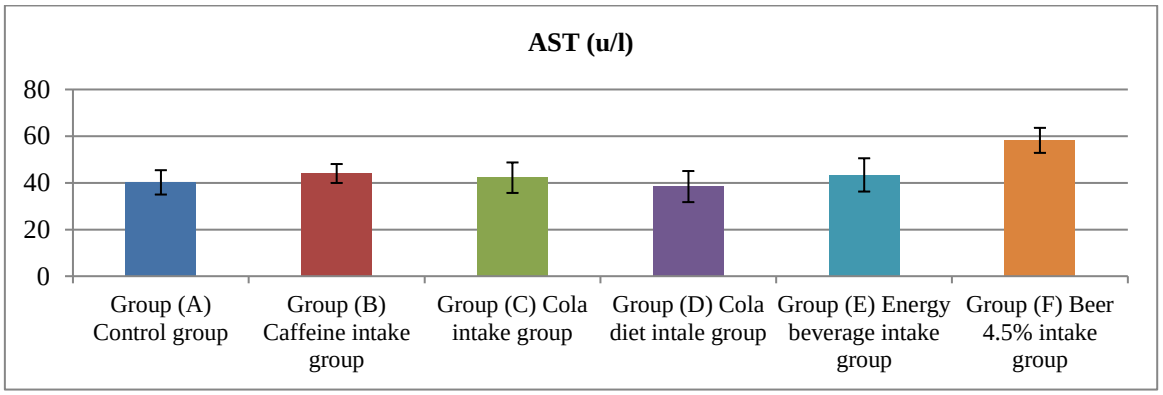

Figure (3): Comparison between studied groups according to AST "u/l".

Table (4): Comparison between studied groups according to serum albumin "g/dl".

Groups	Serum albumin (g/dl)				Multiple
	Min.	Max.	Mean	±SD	Comparison
Group (A) Control group	4.1	4.8	4.52	0.27	B
Group (B) Caffeine intake group	4.5	4.8	4.64	0.11	B
Group (C) Cola intake group	4.5	4.8	4.62	0.11	B
Group (D) Cola diet intake group	4.36	4.6	4.45	0.10	CB
Group (E) Energy beverage intake group	4.6	5	4.82	0.15	A
Group (F) Beer 4.5% intake group	4.1	4.6	4.30	0.23	CD
ANOVA test			**5.180**		
p-value			**0.002***		

Using: F-One Way Analysis of Variance; *p-value <0.05 is significant
Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a statistically significant difference between groups according to serum albumin "g/dl"; with p-value (p<0.05).

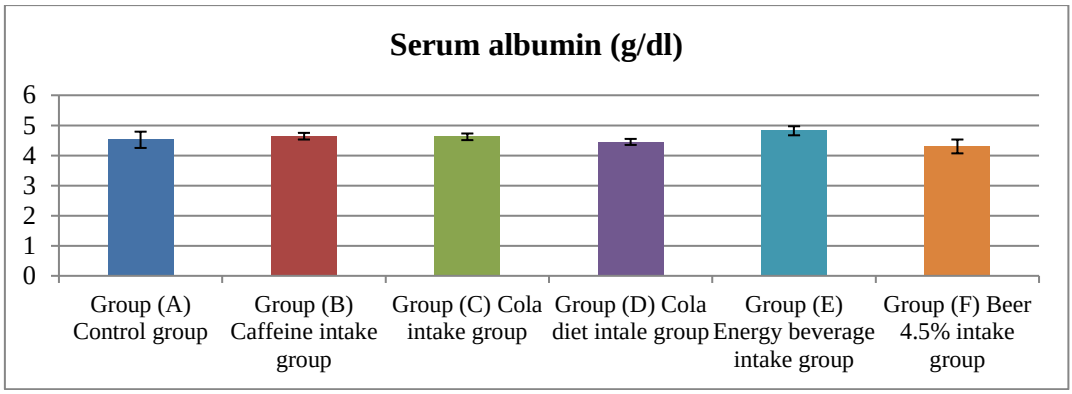

Figure (4): Comparison between studied groups according to serum albumin "g/dl"

Table (5): Comparison between studied groups according to serum creatinine (mg/dl).

Groups	Serum creatinine (mg/dl)				Multiple Comparison
	Min.	Max.	Mean	±SD	
Group (A) Control group	0.22	0.4	0.31	0.06	C
Group (B) Caffeine intake group	0.3	0.4	0.36	0.04	B
Group (C) Cola intake group	0.38	0.49	0.43	0.04	A
Group (D) Cola diet intake group	0.35	0.4	0.38	0.03	B
Group (E) Energy beverage intake group	0.4	0.5	0.45	0.05	A
Group (F) Beer 4.5% intake group	0.4	0.53	0.45	0.06	A
ANOVA test	**6.353**				
p-value	**<0.001****				

Using: F-One Way Analysis of Variance; **p-value <0.001 is highly significant
Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a highly statistically significant difference between groups according to serum creatinine "mg/dl"; with p-value (p<0.001).

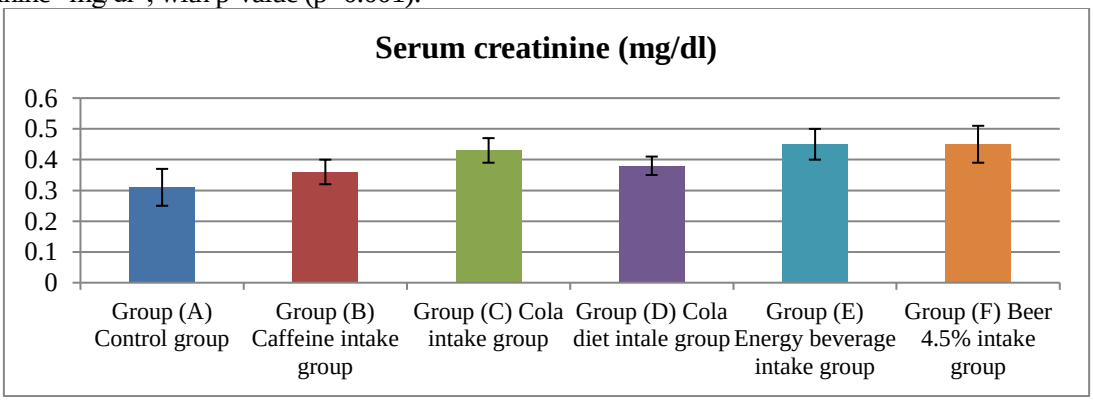

Figure (5): Comparison between studied groups according to serum creatinine (mg/dl).

Table (6): Comparison between studied groups according to blood urea (mg/dl).

Groups	Blood urea (mg/dl)			
	Min.	Max.	Mean	±SD
Group (A) Control group	29	40	34.40	4.04
Group (B) Caffeine intake group	35	42	38.20	2.86
Group (C) Cola intake group	32	42	37.40	3.85
Group (D) Cola diet intake group	29	42	36.80	4.97
Group (E) Energy beverage intake group	39	43	41.00	1.87
Group (F) Beer 4.5% intake group	35	45	41.20	4.27
ANOVA test	**2.372**			
p-value	**0.070**			

Using: F-One Way Analysis of Variance; p-value >0.05 is insignificant

There is no statistically significant difference between groups according to blood urea (mg/dl); with p-value (p>0.05).

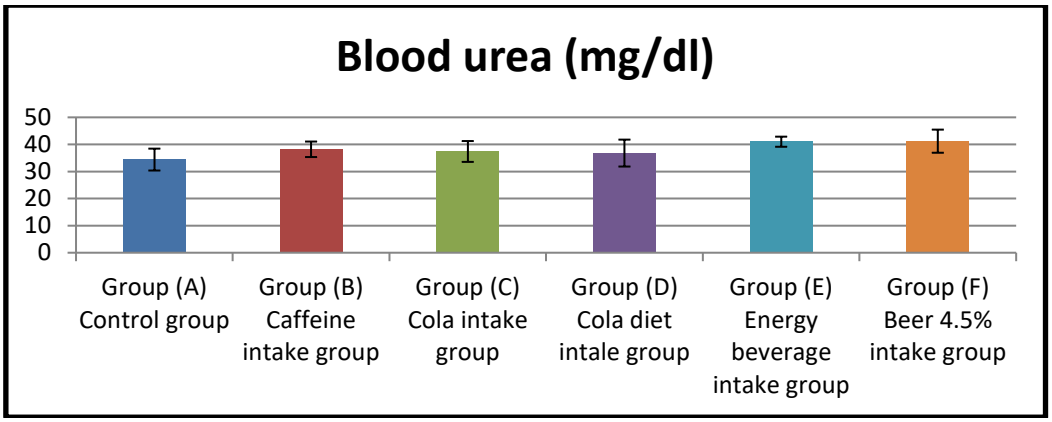

Figure (6): Comparison between studied groups according to blood urea (mg/dl).

Table (7): Comparison between studied groups according to serum CK (u/l).

Groups	Serum CK (u/l)				Multiple Comparison
	Min.	Max.	Mean	±SD	
Group (A) Control group	120	220	174.00	38.47	D
Group (B) Caffeine intake group	120	220	182.40	41.82	CD
Group (C) Cola intake group	130	180	152.00	19.24	E
Group (D) Cola diet intake group	160	210	188.00	19.24	C
Group (E) Energy beverage intake group	220	360	281.60	50.33	A
Group (F) Beer 4.5% intake group	180	260	230.00	33.17	B
ANOVA test	**8.668**				
p-value	**<0.001****				

Using: F-One Way Analysis of Variance; **p-value <0.001 is highly significant
Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a highly statistically significant difference between groups according to serum CK "u/l"; with p-value (p<0.001).

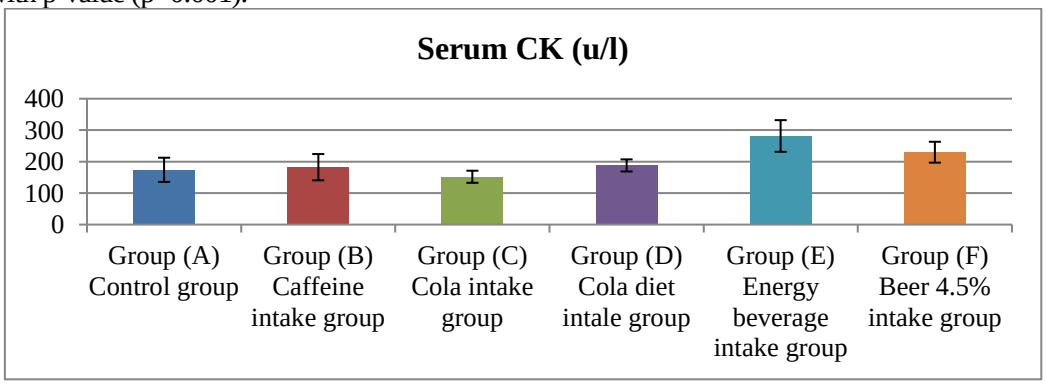

Figure (7): Comparison between studied groups according to serum CK (u/l).

Table (8): Comparison between studied groups according to CK MB I(u/l).

Groups	CK MB I(u/l)			
	Min.	Max.	Mean	±SD
Group (A) Control group	10	22	17.00	4.69
Group (B) Caffeine intake group	15	22	19.00	2.65
Group (C) Cola intake group	15	25	19.00	3.81
Group (D) Cola diet intake group	15	22	18.60	2.61
Group (E) Energy beverage intake group	17	25	20.40	3.21
Group (F) Beer 4.5% intake group	17	25	21.60	3.58
ANOVA test	**1.018**			
p-value	**0.429**			

Using: F-One Way Analysis of Variance; p-value >0.05 is insignificant

There is no statistically significant difference between groups according to CK MB (Iu/l); with p-value (p>0.05).

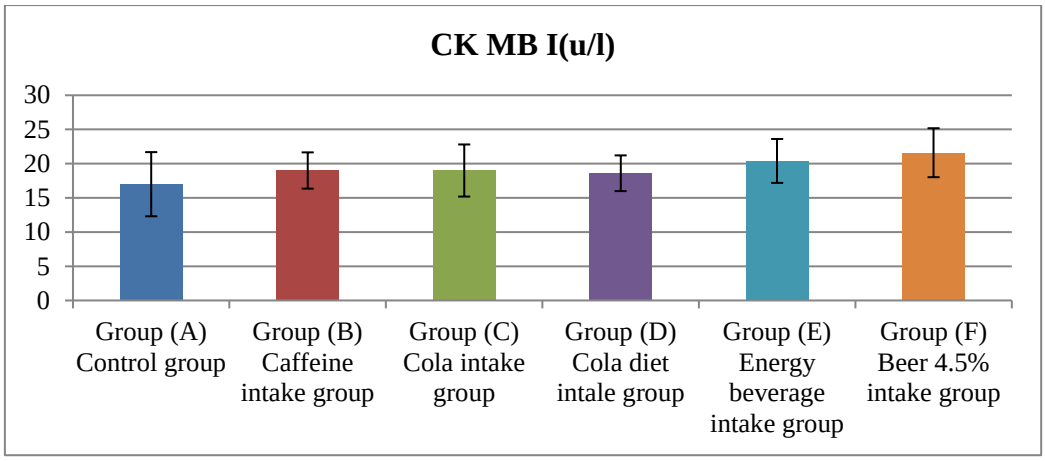

Figure (8): Comparison between studied groups according to CK MB I(u/l).

Table (9): Comparison between studied groups according to Serum LDH (Iu/l).

Groups	Serum LDH (Iu/l)				Multiple Comparison
	Min.	Max.	Mean	±SD	
Group (A) Control group	290	370	328.00	33.47	C
Group (B) Caffeine intake group	280	350	326.60	28.94	CD
Group (C) Cola intake group	280	380	332.00	37.01	BC
Group (D) Cola diet intake group	290	330	314.00	18.17	D
Group (E) Energy beverage intake group	290	390	352.00	38.99	B
Group (F) Beer 4.5% intake group	350	460	400.00	52.92	A
ANOVA test	**3.596**				
p-value	**0.014***				

Using: F-One Way Analysis of Variance; *p-value <0.05 is significant

Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a statistically significant difference between groups according to serum LDH "Iu/l"; with p-value (p<0.05).

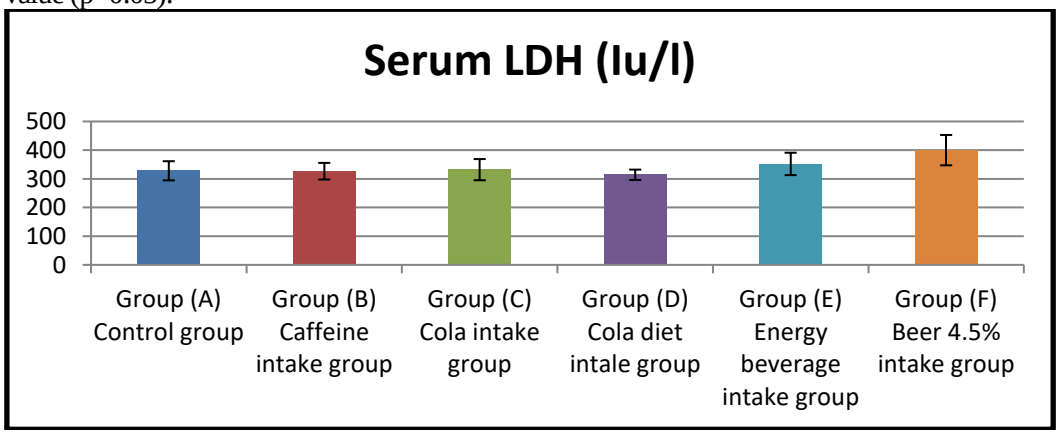

Figure. (9): Comparison between studied groups according to Serum LDH (Iu/l).

Table (10): Comparison between studied groups according to total testosterone (nmol/l).

Groups	Total testosterone (nmol/l)				Multiple Comparison
	Min.	Max.	Mean	±SD	
Group (A) Control group	2.5	3.5	2.94	0.44	B
Group (B) Caffeine intake group	1.8	3.2	2.60	0.62	C
Group (C) Cola intake group	1.6	2.8	2.08	0.46	D
Group (D) Cola diet intake group	1.5	2.2	1.82	0.29	E
Group (E) Energy beverage intake group	2.1	4.7	3.32	1.26	A
Group (F) Beer 4.5% intake group	0.5	1.7	1.08	0.50	F
ANOVA test	**7.292**				
p-value	**<0.001****				

Using: F-One Way Analysis of Variance; **p-value <0.001 is highly significant

Values in each row which have different letters are significantly different at (P<0.05) using Tukey's test

This table shows a highly statistically significant difference between groups according to total testosterone "nmol/l"; with p-value (p<0.001).

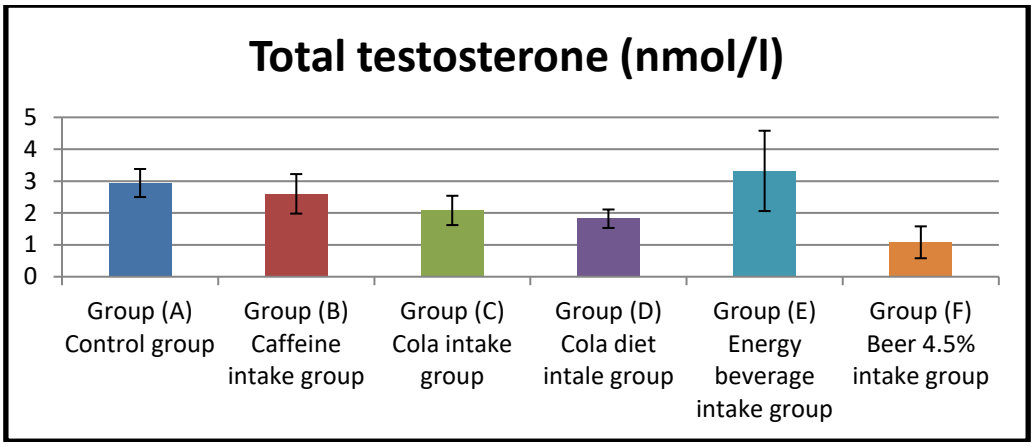

Figure (10): Comparison between studied groups according to total testosterone (nmol/l)

2-Histopathological result:-

As regards the histopathological results, no significant changes were detected among the groups under study apart from moderate portal inflammation and lobular necro-inflammatory changes (hepatitis) in group (E) (Energy beverage intake group) No remarkable changes could be identified in brain, cardiac muscle, kidney or testicular tissues among studied groups.

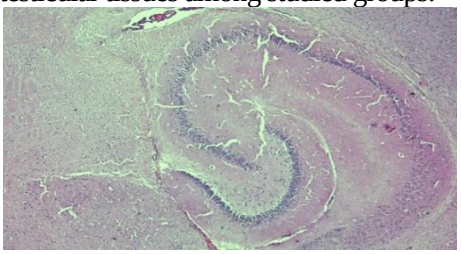

Figure (11): Group A: Normal brain tissue showing average cellularity and fibrillary background of cerebrum and cerebellum.

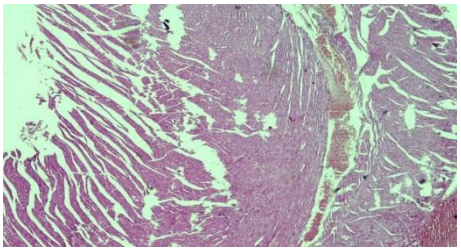

Figure (12): Group A: Within normal striated muscle bundles of the myocardium.

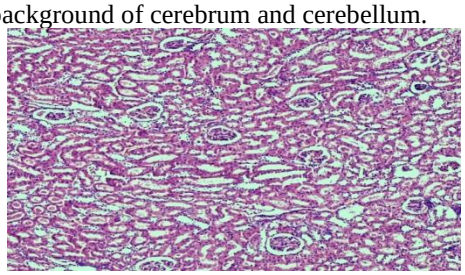

Figure (13): Group A: Normal kidney tissue showing preserved normal glomeruli and tubules.

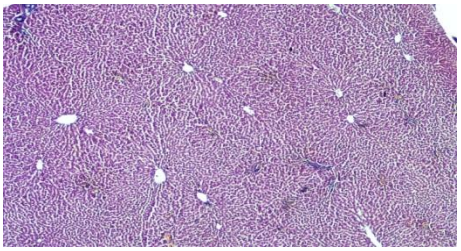

Figure (14): Group A: normal liver tissue with preserved lobular architecture and intact liver cell plates.

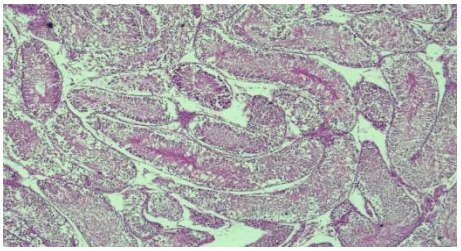

Figure (15): Group A: Normal testicular tissue with seminiferous tubules showing average spermatogenic cells.

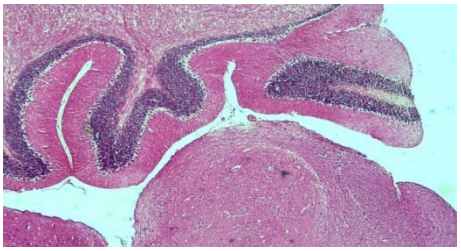

Figure (15): Group B: Normal brain tissue showing average cellularity and fibrillary background of cerebrum and cerebellum.

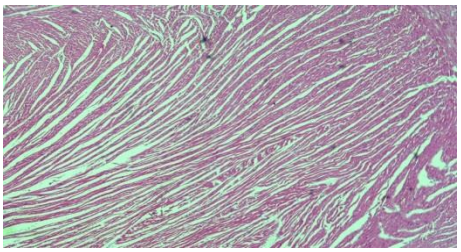

Figure (16): Group B: Within normal striated muscle bundles of the myocardium.

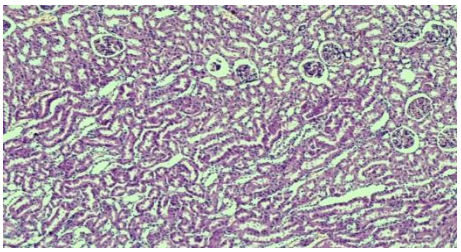

Figure (17): Group B: Normal kidney tissue showing preserved normal glomeruli and tubules.

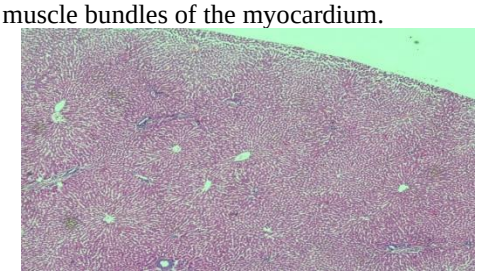

Figure (18): Group B: normal liver tissue with preserved lobular architecture and intact liver cell plates.

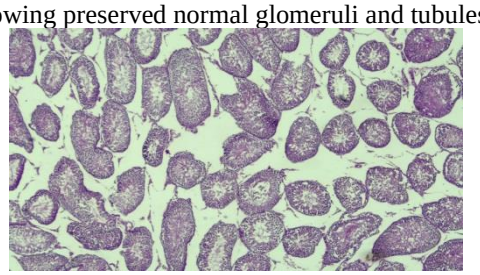

Figure (19): Group B: Normal testicular tissue with seminiferous tubules showing average spermatogenic cells.

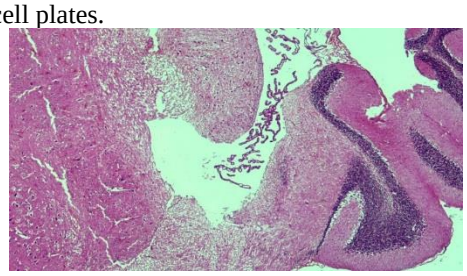

Figure (20): Group C: Normal brain tissue showing average cellularity and fibrillary background of cerebrum and cerebellum.

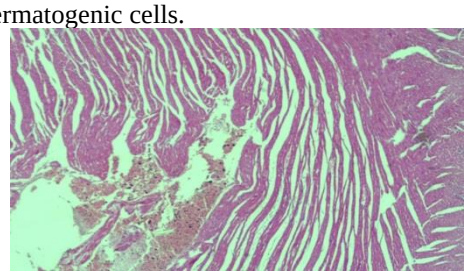

Figure (21): Group C: Within normal striated muscle bundles of the myocardium.

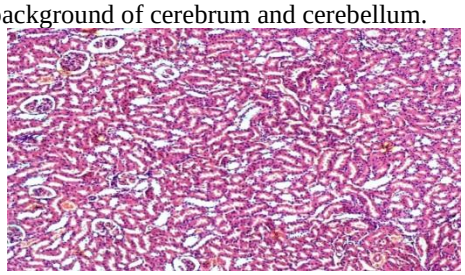

Figure (22): Group C: Normal kidney tissue showing preserved normal glomeruli and tubules.

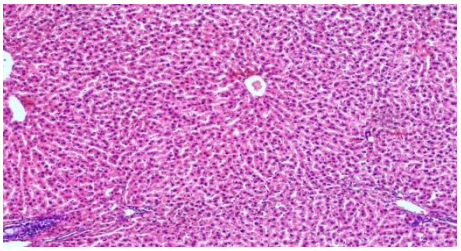

Figure (23): Group C: normal liver tissue with preserved lobular architecture and intact liver cell

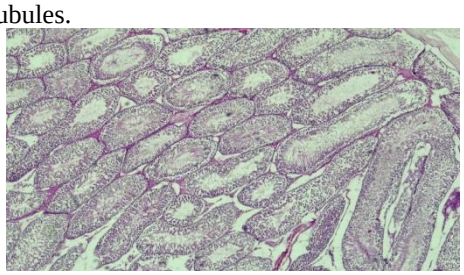

Figure (24): Group C: Normal testicular tissue with seminiferous tubules showing average spermatogenic cells.

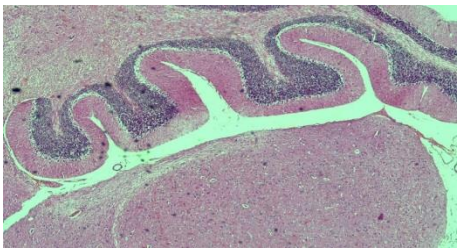

Figure (25): Group D: Normal brain tissue showing average cellularity and fibrillary background of cerebrum and cerebellum.

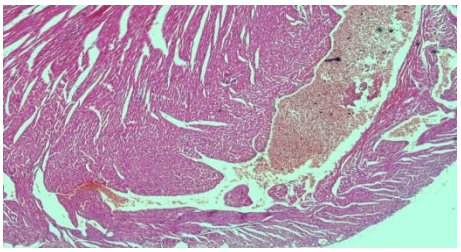

Figure (26): Group D: Within normal striated muscle bundles of the myocardium.

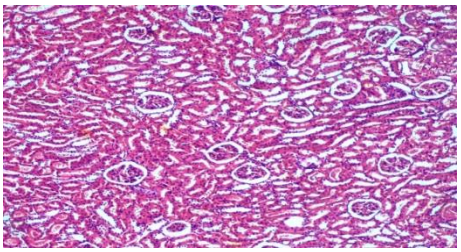

Figure (27): Group D: Normal kidney tissue showing preserved normal glomeruli and tubules.

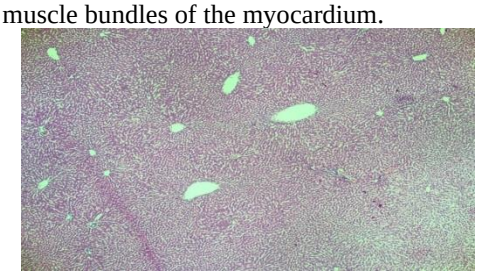

Figure (28): Group D: normal liver tissue with preserved lobular architecture and intact liver cell plates.

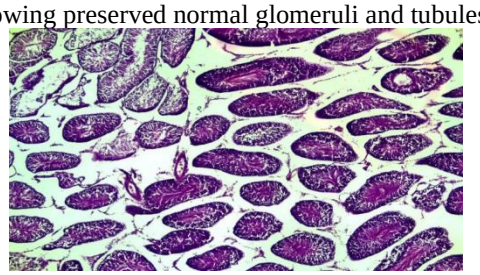

Figure (29): Group D: Normal testicular tissue with seminiferous tubules showing average spermatogenic cells.

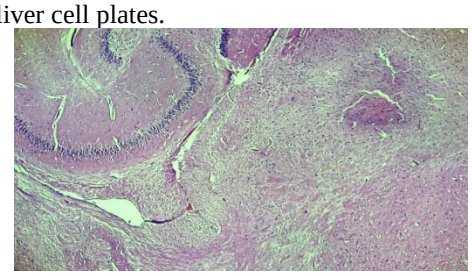

Figure (30): Group E: Normal brain tissue showing average cellularity and fibrillary background of cerebrum and cerebellum.

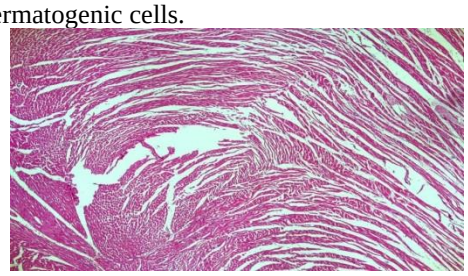

Figure (31): Group E: Within normal striated muscle bundles of the myocardium.

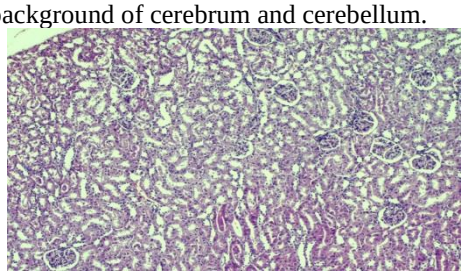

Figure (32): Group E: Normal kidney tissue showing preserved normal glomeruli and tubules.

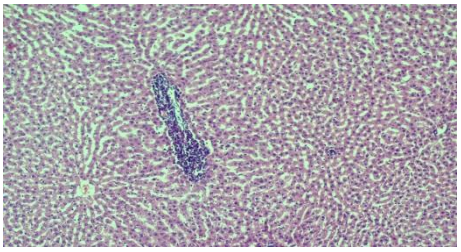

Figure (33): Group E: liver tissue with preserved lobular architecture and intact liver cell plates. The portal tracts show moderate lymphocytic infiltration.

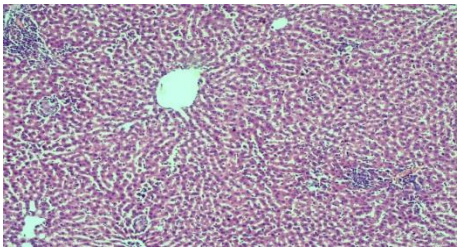

Figure (34): Group E: liver tissue with preserved lobular architecture and intact liver cell plates. The portal tracts show moderate lymphocytic infiltration. The lobules show foci of necroinflammatory changes.

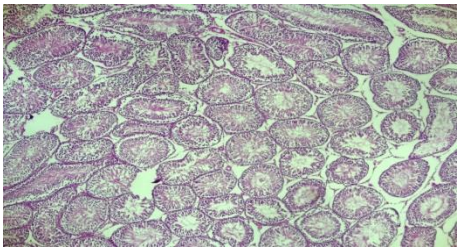

Figure (35): Group E: Normal testicular tissue with seminiferous tubules showing average spermatogenic cells.

DISCUSSION

Our study show the following result:-

1-Regarding liver function tests:-Our study show no statistically significant difference between groups according to total bilirubin (mg/dl); with p-value (p>0.05).

However, there is a highly statistically significant difference between groups regarding liver enzymes ALT as higher value in Group (F) Beer 4.5% intake group with mean value ±SD equal 76.6±4.16 followed by Group (E) Energy beverage intake group mean value ±SD equal 52.4±4.62 by comparison with other groups,

Regarding Liver enzyme AST there is highly statistically significant difference between groups as higher value in Group (F) Beer 4.5% intake group with **mean value ±SD equal 58.2±5.36** by comparison with other groups

Our study shows a statistically significant difference between groups according to serum albumin as Group (F) Beer 4.5% intake group show lower normal value by comparison with other groups with **mean value ±SD equal 4.3±0.23.**

-Interpretation: Beer 4.5% has hepatotoxic effect in experimental rats in the form of raising liver enzymes ALT, AST and decrease serum Albumin by comparison with other groups.

Energy beverages has mild hepatotoxic effect in experimental rats in the form of raising liver enzyme ALT by comparison with other groups.

Our study is in harmony with **Niemelä, et al (2017)** who proved that alcohol consumption even at light level associated with abnormal liver enzyme levels.

Our study is in harmony with **Jang, et al (2012)** who proved that Coffee consumption and alcohol drinking had a significant effect on Liver Function Test.

Our study is in harmony with **Mansy, et al. (2017)** who declare that intake of energy drink in significant doses for 12 weeks lead to significant increases in serum AST, ALT due to oxidative stress.

Our study is against the study of **Liangpunsakul, et al (2010)** who proved that liver enzyme lack to determine modest unhealthy drinking of Alcohol and he suggest for searching for new markers.

2-Regarding kidney function tests: Our study shows a highly statistically significant difference between groups according to serum creatinine "mg/dl"; but all within normal creatinine value but slightly higher in Group (F) Beer 4.5% intake group with mean value ±SD equal 0.45±0.06 followed by Group (E) Energy beverage intake group mean value ±SD equal 0.45±0.05 followed by Group (C|) Cola intake group with mean value ±SD equal 0.43±0.04 followed by Group (D|) Cola diet intake group mean value ±SD equal 0.38±0.03 by comparison with control group. There is no statistically significant difference between groups according to blood urea (mg/dl) which also indicate no dehydration.

-Interpretation: All groups within normal laboratory range value for urea and creatinine but there is highly statistically significant difference between groups but within normal value with higher result in Beer 4.5% intake group.

Our study is in harmony with **Epstein (1997) who prove** both acute and chronic alcohol consumption can compromise kidney function.

Our result is against the study of **Schaeffner et al (2005) who prove** that alcohol consumption not associated with the risk of renal dysfunction.

Our study is against the study of **Lee, et al (2021)** who declare that kidney function improved with alcohol consumption.

Our study is in harmony with **Alansari (2020) who prove that** Code Red administration had oxidative stress effect led to renal dysfunction and raising of creatinine.

Our study is in harmony with **Saldana et al (2007)** who revealed that cola consumption may increase the risk of chronic kidney disease in spite of in our study creatinine within normal range but higher than control group.

Our study is against the study of **Elbendary et al (2023)** who prove that energy drink has no effect on creatinine and decrease blood urea.

3-Regarding Cardiac Enzyme level: Our study prove a highly statistically significant difference between groups according to serum CK "u/l"; with higher value in Group (E) Energy beverage intake group with mean value ±SD equal 281.60±50.33 followed by Group (F) Beer 4.5% intake group with mean value ±SD equal 230.00±33.17 but no statistically significant difference between groups according to CK MB.

-Interpretation: Energy beverage has toxic higher CK level by comparison with other group, which may be cardiac or muscular as no significant raising in CK MB between groups. Beer 4.5% has toxic higher CK level by comparison with other group, which may be cardiac or muscular as no significant raising in CK MB between groups.

Our study is in harmony with Onuoha **Chimezie (2013)** who prove that Energy Drink raise Creatinine phosphokinase (CPK) and

Lactate Dehydrogenase (LDH) Level in Albino Rat as it has effect on cardiac muscle.

Our study is in harmony with **Schuchowsky, et al (2017)** who proved that energy drink has hepatic, renal and cardiac damage and raise CK level in rats.

Our study shows a statistically significant difference between groups according to serum LDH "Iu/l with higher value in Group (F) Beer 4.5% intake group mean value ±SD equal 400.00±52.92 followed by Energy beverage intake group (E) mean value ±SD equal 352.00±38.99.

Our study is in harmony with **Choe, et al (2022) who prove** that alcohol raise LDH level. (27)

However, LDH can raise for many reason especially alcohol affect liver and muscle so not specific for heart damage.

4-Regarding Total Testosterone level: Our study show a highly statistically significant difference between groups according to total testosterone "nmol/l" with low total testosterone level in Group (F) Beer 4.5% intake group **mean value ±SD equal 1.08±0.50.**

-Interpretation: Beer 4.5% has toxic effect on testosterone level, as testosterone level is low by comparison with other groups.

Our study is in harmony with **Apter and Eriksson (2003)** who declare that testosterone level decrease after alcohol drinking. Mostly due to dysregulation of testosterone synthesis through central effect of Alcohol on as the hypothalamic opiate system.

5-Regarding Histopathological results: As regards the histopathological results, our study show no significant changes were detected among the groups under study apart from moderate portal inflammation, lobular necroinflammatory changes (hepatitis) in-group (E) Energy beverage intake group at high dose.

-Interpretation: Energy drink at high dose has hepatotoxic effect on rats in in the form of Liver histopathological changes as moderate portal inflammation and lobular necroinflammatory changes (hepatitis).

Our study is in harmony with Nahla E Ibrahem et al (2022) who notice Loss of the typical liver architecture with energy drink intake but it reversible effect.

Our study is in harmony with **Mansy et al (2017)** who observe significant histopathological changes in hepatic and renal tissues of the energy drink treated rats.

In our study no remarkable changes could be identified in brain, cardiac muscle, kidney or testicular tissues among studied groups.

Our study is against **Abdelwahed et al** (2020) who prove Diet Coke had degenerative changes in both the cerebellum and the kidney especially when combined with Mono Sodium Glutamate but in our study no histopathological changes. Our study is against **Demirel, et al (2023)** who prove that Long-term combination of intake of energy drinks and alcohol use damage endothelium and heart muscles, but in our study not mostly because duration of our study was 21 days only also because alcohol concentration in our study was beer 4% by comparison of high alcohol concentration in Vodka. **Our study is against Al-badry (2018) who prove that** chronic cola and energy drink consumption lead to histopathological changes in rat's testes, kidneys and liver but in our study no histopathological changes but use different doses and longer duration.

Conclusion: Energy drink beverages intake on high amount are hazardous on heart and liver of albino rats. Beer 4.5% at high dose is hazardous on liver functions tests and lower Total testosterone level. **Recommendation:** we recommend 1-stop abuse of intake of energy drink beverages and Beer 2-We suggest more studies about safety of soft Beverages especially in Human. 3-Energy drink and Beer to be prohibited for vulnerable group including children and cardiac patients.

Conflict of interest: no conflict of interest in our study.

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تقييم سمية مشروبات الطاقة والبيرة المحتوية على الكحول على أعضاء فئران التجارب المختلفة بالمقارنة مع القهوة والمشروبات الغازية

أ.م. د/عزالدين مصطفى عبد الواحد شلبي (1)، أ.م. د/أحمد نعيم عيسى (2)، أ.م. د/سارة خاطر (3)

1-أستاذ مساعد الطب الشرعي والسموم الإكلينيكية-كلية الطب-جامعة القاهرة.

2- أستاذ مساعد الباثولوجي-كلية الطب-جامعة القاهرة.

3-أستاذ مساعد الطب الشرعي والسموم الإكلينيكية-كلية الطب-جامعة مصر للعلوم والتكنولوجيا.

الملخص العربي: -

المقدمة: أن مشروبات الطاقة، والبيرة خاصة المحتوية على الكحول، القهوة، المشروبات الغازية بنوعيها العادية والدايت تستهلك كثيرا على مدار العالم، ولكن خطورة سمية مشروبات الطاقة والبيرة المحتوية على الكحول خاصة في الجرعات الكبيرة منها وخاصة أنها تستهلك باستمرار مازالت محل خلاف بين العلماء في سميتها.

الهدف من البحث: - يهدف البحث إلى تقييم سمية مشروبات الطاقة والبيرة على أعضاء فئران التجارب المختلفة بالمقارنة مع القهوة والمشروبات الغازية العادية والدايت.

منهجية البحث وطرقه: -شارك 60 فأر تجارب بالبحث مقسمين إلى 6 مجموعات كل مجموعة 5 فئران ذكور وعلى النحو التالي، مجموعة (أ) مجموعة ضابطة، مجموعة (ب) تم إعطاءها القهوة بجرعة 180 مجم/كجم/اليوم، مجموعة (ج) تم اعطاءها الكولا بجرعة 50 مجم/اليوم، مجموعة (د) تم إعطاءها الكولا دايت بجرعة 50مجم/اليوم، مجموعة(هـ) تم إعطاءها مشروبات الطاقة بجرعة 20 مجم/كجم/اليوم، مجموعة (و) تم اعطاءها البيرة التي تحتوي على 4% كحول إيثيلى بجرعة 0.5 جم/كجم/اليوم.

وبعد إعطاء الجرعات المذكورة لمدة 4 أسابيع تم التضحية بفئران التجارب وأخذ عينات من الدم لعمل وظائف الكبد، الكلى، أنزيمات القلب ونسبة التستوستيرون.

وتم أخذ عينات المخ، الكبد، الكلى، القلب والخصية لفحص الأثر السمي على هذه الأعضاء لفئران التجارب.

نتائج البحث: أثبت البحث أن تعاطى جرعات كبيرة ومنتظمة من مشروب الطاقة له أثر سمى على قلب وكبد فئران التجارب، أما تعاطى جرعات كبيرة ومنتظمة من البيرة المحتوية على الكحول له الأثر على وظائف كبد فئران التجارب ونقص هرمون التستوستيرون.

التوصيات: نوصى بوقف إفراط الاستهلاك في مشروبات الطاقة والبيرة المحتوية على الكحول وعمل مزيد من الأبحاث عليها.