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Original Research

Impact of Energy Drinks Consumption on Renal Functions in Female Mice

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ABSTRACT:

This study investigated the effects of energy drink consumption on kidney function in female mice. Fifteen mice were divided into three groups, with five animals in each group. The control group received a normal diet and water, while the second and third groups were administered 1.2 ml and 2.4 ml of an energy drink, respectively, in addition to their regular diet. Renal function was assessed by measuring selected biochemical parameters, and behavioral changes were monitored throughout the experimental period. The findings revealed significant increases in renal function biomarkers in both treated groups compared with the control group. In addition, mice exposed to energy drinks exhibited reduced daily activity and altered social behavior. These effects were more pronounced at the higher dose level.

KEYWORDS: Drink Energy, Renal Function, Female Mice, Behavior.

INTRODUCTION

Energy drinks are widely consumed beverages formulated to enhance alertness and physical performance. They commonly contain caffeine as the primary active ingredient, together with taurine, glucuronolactone, sugars, and plant-derived extracts such as ginseng and guarana. The concentration of these components may vary considerably among different products (Mattioli *et al*., 2017).

Frequent intake of energy drinks has raised concerns regarding their potential effects on human health. Due to their stimulant content, excessive consumption may influence several physiological systems, including the cardiovascular, hepatic, and renal systems. Increased caffeine intake has been associated with elevated blood pressure and accelerated heart rate in some individuals (Temple, 2009).

The kidneys may also be affected by prolonged or excessive consumption of energy drinks. Caffeine can increase urine output, which may contribute to fluid loss and dehydration. Furthermore, the phosphoric acid, citric acid, and high sugar content found in many beverages may place additional stress on renal function. Long-term exposure to these components has been linked to an increased risk of kidney stone formation and disturbances in normal kidney activity (Maughan & Griffin, 2003).

Several experimental studies have reported elevations in renal biomarkers, including urea, uric acid, and creatinine, following the administration of energy drinks, suggesting possible adverse effects on kidney function (Khayyat *et al*., 2014).

Since their introduction in Asian and European markets during the 1960s, energy drinks have expanded globally and become increasingly popular. Their consumption has grown rapidly over recent decades, making them one of the fastest-growing sectors within the beverage industry (Valle *et al*., 2018). In the United States alone, energy drink sales generate billions of dollars annually (Goldfarb *et al*., 2014; Higgins *et al*., 2010).

MATERIALS AND METHODS

1-Experimental Animals: A total of 15 local domestic female mice weighing 22 – 29 g were used in the present study, the animals were grouped and housed in cages at the laboratories of cycle and temperature was adjusted at 25±1˚C. the animals were fed on commercial standard pellet and offered drink water and libitum .

The animals were acclimatized to laboratory conditions for one week before commencement of the experiment.

2. Energy Drinks : Red Bull energy drink was used in this study, as it was purchased from local market and dosed directly to the experimental animals

3.Experimental Groups and Protocol : mice were randomly distributed into three groups (five mice/group) .

- Group I: (G1) normal control mice were given distilled water orally daily.

- Group II: (G2) mice were given 1.2 ml / mouse of energy drink orally daily .

- Group III: (G3) mice were given 2.4 ml /mouse of energy drink orally daily

All groups was tested for a full month (Abd El-Hady, M. *et al*., 2017).

4.Physiological Parameters: Renal functions: Creatinine , Uria and Uric acid was measured in this study social behavior also observed daily .

RESULTS AND DISCUSSION

Effect of energy drink on Kidney functions:

The findings presented in Table 1 and Figures 1–3 demonstrate a clear dose-related increase in plasma uric acid, creatinine, and urea levels in mice receiving energy drinks. These parameters are commonly used to assess kidney function, and their elevation may indicate impaired renal performance.

A significant increase in uric acid concentration was observed in the treated groups compared with the control group. The highest value was recorded in G3, suggesting that higher energy drink intake may interfere with normal uric acid metabolism and excretion. This effect may be associated with oxidative stress and the high caffeine and sugar content of energy drinks.

Creatinine levels also increased progressively with increasing doses of the energy drink. Because creatinine is an important indicator of glomerular filtration efficiency, elevated levels may reflect reduced renal filtration capacity and possible damage to renal tissues.

Likewise, urea concentrations were markedly higher in treated animals than in controls. Increased blood urea levels are frequently associated with impaired kidney function or dehydration, both of which may result from excessive consumption of caffeinated beverages.

Statistical analysis revealed significant differences among groups ($P < 0.05$), confirming that the observed alterations were related to energy drink administration. The results suggest that prolonged consumption of energy drinks may negatively influence renal function in a dose-dependent manner.

The present findings are consistent with previous studies that reported elevations in renal biomarkers following energy drink exposure. El-Tantawi et al. (2021) observed significant increases in creatinine and urea levels after repeated administration of energy drinks to experimental animals. Similar observations were reported by Al-Saleh et al. (2015), who documented evidence of renal dysfunction associated with chronic energy drink intake.

Overall, the present study indicates that excessive consumption of energy drinks may adversely affect kidney function and highlights the importance of limiting long-term intake, particularly among individuals who may already be at risk of renal disorders.

"Parameter"	*"Experimental groups"*		
"Enzyme"	"G1"	*"G2"*	*"G3"*
Uric acid (mg/dl)	1.6 ± 0.21^{b}	2.8 ± 0.06^{a}	3.1 ± 0.07^{a}
Creatinine (g/dl)	0.4 ± 0.07^{c}	1.2 ± 0.04^{b}	1.5 ± 0.07^{a}
Urea (mg/dl)	23.8 ± 2.70^{b}	46.6 ± 0.91^{a}	52.0 ± 0.79^{a}

Table (1) : Plasma uric acid, creatinine and urea of mice treated with Different energy drink Concentrations.

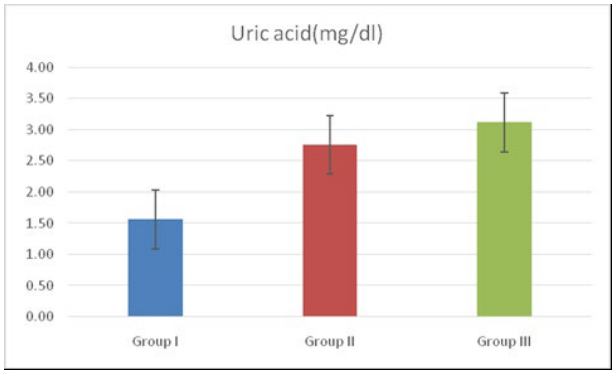

Figure (1): Changes in uric acid during treatment of female mice with different concentration of energy drink.

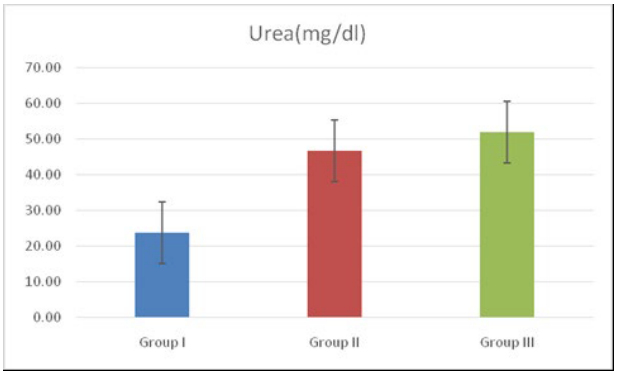

Figure (2): Changes in urea during treatment of Female mice with different concentration of energy drink.

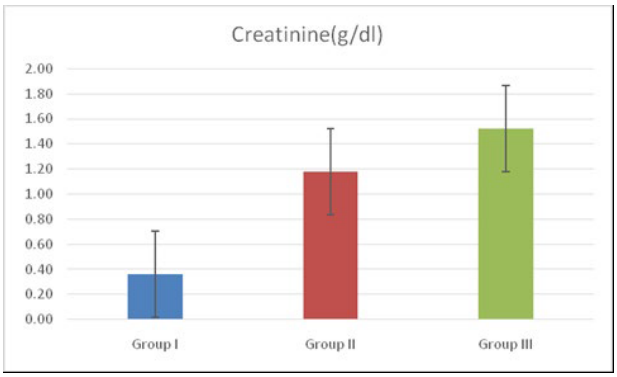

Figure (3): Changes in creatinine during treatment of male mice with different concentration of energy drink.

CONCLUSION

The present study demonstrated that prolonged exposure to Red Bull energy drink resulted in measurable alterations in renal function indicators in female mice.

Increases in urea, uric acid, and creatinine levels were observed, with greater changes occurring in animals receiving the higher dose. These findings suggest a dose-dependent effect of energy drink consumption on kidney function.

Considering the widespread use of energy drinks, further investigations are recommended to better understand their long-term biological effects and the mechanisms responsible for their potential impact on renal health.

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ETHICS

Ethical standard were followed during all experimental procedures involving laboratory animals

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تأثير استهلاك مشروبات الطاقة على وظائف الكلى لدى إناث الفئران

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الملخص

تُعد مشروبات الطاقة من أكثر المشروبات استهلاكًا على مستوى العالم، إلا أن المخاوف تزايدت بشأن آثارها المحتملة على الصحة، وخاصةً على وظائف الكلى. هدفت هذه الدراسة إلى تقييم تأثير مشروب الطاقة ريد بول على بعض مؤشرات وظائف الكلى لدى إناث الفئران. شملت الدراسة خمسة عشر فأرًا، تم توزيعها عشوائيًا إلى ثلاث مجموعات، تضم كل مجموعة خمسة فئران. تلقت المجموعة الضابطة الماء فقط، بينما تلقت المجموعتان التجريبيتان جرعات يومية مقدارها 1.2 مل و2.4 مل من مشروب الطاقة عن طريق الفم لمدة شهر واحد. وفي نهاية الفترة التجريبية، تم قياس مستويات اليوريا، والكرياتينين، وحمض اليوريك لتقييم وظائف الكلى. أظهرت النتائج ارتفاعًا معنويًا في جميع المؤشرات المقاسة لدى الفئران المعالجة مقارنةً بالمجموعة الضابطة، كما ازدادت شدة هذه التغيرات مع زيادة الجرعة، مما يدل على وجود تأثير يعتمد على الجرعة. بالإضافة إلى ذلك، لوحظت تغيرات سلوكية، منها انخفاض النشاط لدى الفئران المعرضة للمشروب. تشير هذه النتائج إلى أن الاستهلاك المطول لمشروبات الطاقة قد يؤثر سلبًا في وظائف الكلى، وتؤكد الحاجة إلى إجراء المزيد من الدراسات لاستقصاء آثارها البيولوجية طويلة المدى.

الكلمات المفتاحية: مشروبات الطاقة، وظائف الكلى، إناث الفئران، السلوك.

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