RED BULL INDUCES BIOCHEMICAL CHANGES IN WISTAR RAT LIVER

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Summary

Despite the increasing popularity of energy drinks’ consumption, there are concerns regarding the safety and effectiveness of this type of drink. The aim of the present study was to evaluate the changes in blood and liver biochemical parameters in male Wistar rats, after 15 days of ad libitum Red Bull energy drink administration. Increased serum transaminases and LDH activities, and a high glycaemia were observed. An alarmingly high liver glycogen deposition was also recorded. These results showed that Red Bull consumption may lead to hepatic injuries and to unexpected metabolic modifications. Further studies are required to elucidate whether energy drinks are a safe choice for athletic and cognitive performance enhancement.

Key words: Red Bull, energy drink, liver

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Introduction

The raising interest in improvement of sport performance led to an increasing demand for ergogenic supplements. Energy drinks, promoted as cognitive and athletic performance enhancers, are some of the most popular supplements worldwide. Red Bull is the best sold energy drink in the world, with 4.5 billion cans sold per year, and the number is ever increasing (http://www.reportbuyer.com).

According to a recent EFSA (European Food Safety Authority) report, 12% of European adults (18-65 years) and 12% of teenagers (10-18 years) are high chronic energy drinks consumers, with 7 liters of energy drinks consumed in one month (approximately a can of 250 ml/day).

Despite the popularity of these drinks, their effects on consumers’ health are quite controversial and not sufficient research on energy drinks’ safety has been conducted yet.

There are several studies recording a modest improvement of energy drinks consumption on physical endurance (Alford et al., 2000), but also studies that showed no significant enhancement of endurance related to the consecutive energy drinks consumption (Carvajal-Sancho and Moncada-Jiménez, 2005; Eckerson et al., 2013, etc).

Some of the compounds found in energy drinks are used in therapy for treating certain disorders, like taurine and niacin for dyslipidemas. Other compounds, like glucuronolactone, are not well studied.

An alarming number of side effects and even deaths were reported, as a consequence of energy drinks consumption. Atrrhythmia, cardiac arrest and hepatitis are some of the quoted side effects (Ballard et al., 2010; Clauson et al., 2008; Vivekanandarajah et al., 2011).

The present study sought to observe changes of some biochemical parameters in liver and serum in Wistar rats, following Red Bull ingestion ad libitum for 15 days. This study was designed as the pilot phase of a more complex project concerning the effects of Red Bull consumption on biochemical parameters in liver, brain, skeletal and cardiac muscle.
Material and methods

All chemicals used in this study were of analytical grade, purchased from Sigma-Aldrich Chemie GmbH, Germany, Nordic Invest S.R.L., Romania and S.C. BioZyme S.R.L, Romania.

Red Bull energy drink was purchased from the local market.

16 male Wistar albino rats, weighing 186.60±3.15 g were used. Animals were housed in the zoobase of Molecular Biology & Biotechnology Department, School of Biology and Geology, Babeş-Bolyai University, Cluj-Napoca. They were kept in hygienic conditions and received a standard diet.

Animals were organized in two groups: the control group (n=6), received tap water and the Red Bull group (n=10), received Red Bull energy drink ad libitum.

After 15 days, the animals were killed and blood and liver samples were harvested for biochemical assays: glycaemia, glucose and glycogen hepatic content, total serum and liver proteins, ALT (alanine aminotransferase), AST (aspartate aminotransferase), LDH (lactate dehydrogenase) enzymatic activities in serum.

Blood and liver glucose was determined using the Somogy-Nelson method (Somogy, 1945; Nelson, 1944). Glycogen content was measured using Lo’s method (Lo et al., 1970). Total protein concentration was assayed with Bradford reagent (Bradford, 1976).

ALT and AST activities were assessed according to the photocolorimetric method described by Reitman and Frankel (1957), and for LDH activity, the method of Bergmeyer and Bernt (1974) was used.

Results were analyzed using two tailed t test and considered statistically significant at p ≤ 0.05.

Results and discussion

As expected, Red Bull administration led to a significant increase in glycaemia (Fig. 1). A 250 ml can of Red Bull has 27 g carbohydrates, and other compounds that may affect carbohydrates metabolism, such as niacin.

According to Zhou et al. (2010) and Li et al. (2009), niacin supplementation in high carbohydrate diets may be one of the causes of diabetes “epidemic”. Moreover, niacin can induce insulin resistance (Chang et al., 2006; Greenbaum et al., 1996).

A can of Red Bull assures 100% of niacin RDA (Recommended Daily Allowance). Even if this quantity is not usually seen as a risk, it should be considered that high carbohydrate content of Red Bull may amplify niacin’s side effects. A normal diet assures niacin RDA and there is no need for external supplementation in healthy subjects.

![Fig. 1. Glycaemia in rats treated with Red Bull energy drink ad libitum (n=10) compared with C group (n=6). The results are expressed as mean value ± standard error; significant difference by t test (*** p ≤ 0.005).](image-url)
Liver glucose

**Fig. 2.** Liver glucose in rats treated with Red Bull (** p ≤ 0.01).

The glycogen content in liver was tripled by Red Bull *ad libitum* administration (Fig. 3).

Abnormal glycogen deposition in liver due to Red Bull administration has been noted for the first time in the present study.

Hepatic glycogen deposition is seen in 80% of chronic diabetic patients. It is believed that this condition is closely related to liver enzymes abnormalities (Levinthal and Tavill, 1999).

In a study conducted by Clore *et al.* (1992) in humans, after 3 days of fasting, hepatic glycogen content of type 2 diabetic patients was 2-fold higher than that of controls.

**Fig. 3.** Liver glycogen in rats treated with Red Bull (**** p ≤ 0.005).

Ebuehi *et al.* (2011) reported an increase in serum protein after administration of 5 ml Red Bull daily, for 36 days, in rabbits.

In the present study, serum and liver protein concentrations were not affected by Red Bull administration (Figs. 4 and 5).

**Fig. 4.** Serum protein in rats treated with Red Bull

**Fig. 5.** Liver protein in rats treated with Red Bull

As seen below, ingestion of Red Bull *ad libitum* in rats led to a significant rise of serum AST, ALT and LDH activities (Figs 6, 7, and 8).

**Fig. 6.** Serum AST activity in rats treated with with Red Bull energy drink (* p ≤ 0.05).
ALT activity in serum

Fig. 7. Serum ALT activity in rats treated with with Red Bull energy drink (* p ≤ 0.05).

LDH activity in serum

Fig. 8. Serum LDH activity in rats treated with with Red Bull energy drink (* p ≤ 0.05).

Our results are supported by other studies, which reported hepatic injuries related with energy drink consumption. Khayat et al. (2012) studied the effects of three types of energy drinks including Red Bull, on Wistar rat liver. Animals received 1.5 ml energy drink daily, for 4 weeks. Results showed mild hepatotoxicity, with increased transaminase activities in serum, and hepatic tissue alterations. Akande and Bankojo (2011) conducted a study in which Power Horse energy drink administration in rats led to high AST, ALT and ALP (alkaline phosphatase) activities in serum.

Conclusions

Ad libitum Red Bull administration in Wistar rats is proven to increase blood glucose and to affect liver carbohydrate metabolism.

Excess glycogen deposition in liver due to Red Bull administration has been noted for the first time in the present study. Constant Red Bull consumption may lead to hepatic injuries.

References


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