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Examination of Study Physiological Variables among Energy Drinkers in Iraq

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Abstract

The literature suggests that the effects of caffeine on cognitive function (such as alertness, vigilance, memory, and mood) vary depending on the type of Energy drink consumed. Alcohol and tobacco use are two examples of uncontrolled confounders that may contribute to discrepancies in study outcomes. Other potential causes include variations in research methods, participant characteristics, study timing, and other contextual factors. Caffeine has been shown to boost performance on both complex and basic tasks by increasing alertness and decreasing weariness, according to a few studies. Research suggests that anxiety may be exacerbated by caffeine in very large doses, but that this effect is negligible at typical coffee intake levels. Adults with pre-existing anxiety disorders may find that caffeine makes their symptoms worse. There is evidence that quitting caffeine can have harmful consequences, although the research is mixed. Caffeine has been shown to improve wakefulness, which is especially helpful for night workers and those suffering from sleep loss.

Keywords:

Caffeine, cognitive function, alertness, anxiety, sleep loss.

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Introduction

The function of this ergogenic resource is linked to several mechanisms and one of the main and most accepted in science is the antagonism to the adenosine receptor, since they have a greater binding affinity for caffeine metabolites (paraxanthine and theophylline), perhaps improving the caffeine in the tests does not depend only on the genotypic variation of its metabolizer, but on the genotypic variation in its mechanisms. It is also speculated that other factors may influence these results, such as training status, habitual caffeine consumption (Kolomeets et al., 2019). periodization of your training due to a different sports calendar for each sport. This fact may have been a limitation of the present study. However, we take care to carry out the visits as closely as possible following the 72-hour interval. Another limitation of the study was the lack of a *validated* questionnaire that could clearly and objectively answer the amount of habitual caffeine consumption. Even

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though the food surveys were applied, it was not possible to obtain clear answers that could assess this consumption (Astley et al., 2017).

Results from behavioural tests support the claim that taurine supplementation is beneficial for older mice, supporting (Neuwirth et al., 2013) conclusion's that taurine has neuroprotective effects. Two- and sixteen-month-old FVB/NJ mice were used in a passive avoidance test. Supplemental taurine in the drinking water (dosage not provided) had no effect on the controls, but it dramatically improved the performance and memory of the elderly animals (Nowak & Jasionowski, 2015).

Male C57BL/6 mice were treated with 0.12% taurine in their drinking water from birth to 24 weeks of age in a study by Suge et al., and the results were analysed before and after weaning (Shalom, 2024). Long-term exposed mice (1–24 weeks) performed significantly worse on visual acuity and discriminating tasks compared to control mice, while mice administered taurine only after weaning fared better than control mice. Neuwirth et al. (2013) conducted an acoustic fear conditioning test in which they compared the effects of acute taurine consumption (43 mg/kg subcutaneous injection) to chronic taurine supplementation (0.05% in drinking water up to six months of age).

For eight to nine weeks, (Takahashi et al., 2015) treated male Wistar mice with alcohol, a popular energy drink, or a combination of the two for six days per treatment to create a model of alcohol intoxication. Memory for familiar things was also affected in mice that had been administered either alcohol or a combination of energy drinks and alcohol. When compared to the control group, the discrimination index was reduced only in the energy drink group of rats. As a result of these findings, it appears that taurine does not provide any neuroprotection when combined with alcohol. In a conditioned site preference test, rats given both alcohol and energy drinks showed a substantial increase in their choice for alcohol, which raises serious concerns for human health (Krahe et al., 2017; Adeshina et al., 2024) used both male and female Swiss P40 mice in a comparable experiment. The combination of energy drink and alcohol greatly raised the mice's locomotor activity, boosted their anxiety, and decreased their rotator fall latency. It appears from both studies that the taurine and caffeine found in energy drinks may not mitigate the negative consequences of alcohol consumption, and may even have the opposite effect.

Materials and Methodology

Population and Sample

A cross-sectional analytical study is carried out with students from the College of Medicine, University of Baghdad, belonging to the first 4 semesters of the Medicine career, with a total sample of 50 students (40 students ED background and 10 students having no habit to ED), size based on the approximate population of these in each semester; in order to identify the prevalence and health effects of the consumption of this type of substance in our population.

A survey is applied to students, whether or not they consume these beverages, to figure and analyse their prevalence in relation to the variables of: semester, academic load, symptoms associated with their consumption and age, in addition variables such as consumption of other substances are included. such as coffee, alcoholic beverages and tobacco, to find out a history of consumption of stimulant substances and possible predisposition to the consumption of ED; and the most offered commercial products to find out which is the preferred brand.

Inclusion Criteria

Medical students from the BMC, 18 years of age and older, who are from 1st to 4th semester, studying all the stipulated subjects as established by the academic curriculum of the BMC university for each semester established for the study, who must agree to their participation and have the physical and mental capacity to adequately solve the survey (Acar & Yüksekdağ, 2023). The semesters of the medical degree were selected from the first to the fourth semester due to their availability on all days of the week, being viable for the study (Prabahar et al., 2024).

Exclusion Criteria

Any student who does not belong to the academic program of Medicine, under 18 years of age, who is not from the 1st to 4th semester, will be excluded because the following semesters are in clinical rotations and availability is limited. variable; who are not seeing all of the subjects of the current semester, students who have cardiovascular, metabolic and neurological pathological antecedents and/or who do not want to take the survey.

Techniques and Instruments

The techniques used to develop the research are the complete blood picture, data sheets and the survey. Surveys were applied to energy drinkers/patients of the from College of Medicine, University of Baghdad to know everything about their illness and other health problems in the future. The instruments were the data sheet, the observation sheet and the survey guide. liver and kidney function tests using the Fuji chemical test device. design of special primers for DNA extraction from blood samples and polymorphism of the receptor gene using Tetra Arms.

Information Collection

Taking into account that the methodology proposed for the study is of a qualitative cross-sectional analytical type, the information was collected through the application of the proposed survey, previously authorized by the students, the BMC university for its use, reviewing them with emphasis. in the possible effects of ingesting these (Marinković et al., 2019). Study variables shown in Table 1.

Table 1. Study variables

Category	Variable	Description	Feature	Measurement scale
Socio-graphic	Age	age in years	Quantitative-continuous	Reason
	Sex	Female	Qualitative	Nominal
		Male	Qualitative	Nominal
	Socioeconomic	1 to 6	Qualitative	Ordinal
Academic	Semester	First Second Third Fourth	Qualitative	Ordinal
Clinic	Health Effects	Tachycardia Nervousness Abdominal pain Nausea Headache Diaphoresis Hyperactivity Fatigue Irritability Emesis	Qualitative	Nominal

Processing and Analysis

Through analysis and interpretation, the data obtained in relation to the effectiveness and efficiency of external and internal communication strategies were processed. For the analysis, statistical models were applied that were designed for the purpose, both qualitatively and quantitatively, that is, through the data obtained and the established indicators, it allowed us to achieve what was proposed in the investigation. For the processing and analysis of the data, a review analysis was first carried out based on the results obtained thanks to these, it will be possible to verify the fulfilment of the hypothesis to establish conclusions and recommendations critical of the information, data verification, organization, to then be presented in written, tabular and figure form.

Experimental

Sampling and Processing of the Same

- Explain to the patient the procedure to be performed.
- Gather the material required for blood collection, such as gloves, tourniquet, test tubes, syringes, alcohol swabs.
- Place the patient in the proper position for the puncture, place the tourniquet 4 to 5 cm from the elbow crease, palpate the vein, and clean the puncture site with the alcohol swab.
- Perform the puncture and collect the sample in tubes without anticoagulants with a red cap for chemical tests.
- Once the samples have been obtained, we must centrifuge the tubes.

LABORATORY EXAMS CHEMICAL TESTS

Biochemical, Serological and Autoantibody Tests

- Blood glucose, basal insulin serum levels, TC, HDL, TG.
- IgG and/or gammaglobulin dosage in protein electrophoresis.
- AST, ALT, γ-GT, FA.

These routine exams for the investigation of liver diseases were performed by collecting 10 ml of peripheral blood with the subjects fasting for 10 to 12 hours. After centrifugation, the serum obtained was used to measure the biochemical parameters: glucose, TC, HDL cholesterol, TG, AST, ALT, GGT and FA, quantified by the Dry Chemistry method (Vitros® System, Johnson & Johnson). Serum aliquots were stored at -80°C for analysis of insulin, which was quantified by the immuno-chemiluminescence method, using commercial kits (Siemens diagnostics).

Insulin Resistance (IR)*:* For the diagnosis of IR, the homeostatic model was used:

HOMA = [fasting insulin (μIU/mL) x fasting blood glucose (mg/dl)/22.5μ(mg/dl=mmol/Lx18,182)]

To assess plasma insulin sensitivity, the QUICKI.

QUICKI = 1/μ log fasting insulin (μIU/mL) + log blood glucose (mg/dl) μ (mg/dl=mmol/Lx18,182)

The HOMA value varies on a scale of 1 to 15, with values higher values indicating greater IR and the QUICKI value ranging from 0.25 to 0.40, with higher values indicating greater insulin sensitivity.

The participation of young people in the sample was conditioned to the prior explanation, authorization and signature, by the athletes and their guardians, of the Free and Informed Consent Term in 2 copies (guardian and researcher) and the Assent Term (athlete). The present study was approved by the Research Ethics Committee of the Federal University of Alagoas, in accordance with the guidelines of the Declaration of (Puri et al., 2009).

Experimental Draw: A double-blind, placebo-controlled, randomized design was used in this experiment. The study consisted of three visits, separated by at least 72 hours. During the first visit, the following procedures were performed: 1) The subjects underwent an anthropometric assessment (body mass, height and skinfolds) for sample characterization, 2) A self-assessment of sexual maturation, 3) Blood collection for extraction and DNA analysis, 4) Familiarization with the battery of tests. The second and third visits differed only in the ingestion of supplementation consisting of 6 mg/kg of anhydrous caffeine or placebo (300 mg cellulose), with a 200 ml glass being offered for ingestion of the capsule, with a 60-minute rest for the beginning. of the battery of tests. After this period, a 5-minute warm-up trot was performed, followed by stretching and a sequence of tests that minimized fatigue, in the following order: 1) Handgrip strength, 2) Agility, 3) Arm bending, 4) Jumping vertical, 5) Abdominal strength-endurance and 6) Yo-yo intermittent recovery test level 1 (YoyoIR1). The rest interval between tests was 5 minutes. At the end of the study, the subjects were asked if they felt any side effects at any time during the test or afterward (Yang & Singh, 2024). All tests were performed at the same time of day for the same participant.

Results and Discussion

Within the background and general data of the surveys carried out, it was observed that the average age of the participants was 17.12±1.6 years; Regarding the semester to which they belonged, 31 students from the fourth semester, 26 from the third semester and 24 from the second, 19 from the first, of which 54 are women and 46 are men, were surveyed. 11 women and 9 men in control group with an average age of 19.26±0.96 years. In the assessment of the University-Housing travel time, it was found that the students take an average of 78.9 minutes on this journey. Regarding the hours of sleep, it was found that the students surveyed sleep an average of 5.11 hours per day, which does not meet the standard of hours shown to ensure that the body has a good rest and therefore an adequate performance in daily life.

75% of the students surveyed stated that they drink coffee frequently, 43% responded that they consume alcoholic beverages, 88% said they do not consume tobacco and 100% of people responded affirmatively to the consumption of energy drinks, on average it was found that 100% of students consume these products at least one can once a week (SD: 4.95) Table 2.

Table 2. History of consumption of stimulant substances

Variable	Absolute Frequency	Relative Frequency
Coffee Consumption	75	75%
Alcohol Consumption	43	43%
Tobacco consumption	12	12%
Consumption Energy Drinks	100	100%

In general, it was stated that on average the students drink 1.27 drinks per day (SD: 0.68), consume these substances at least 2.37 days a week (SD: 1.5), and the maximum number of drinks consumed per week is 24, reported by a student from the entire sample and the majority of respondents consume only one can per week.

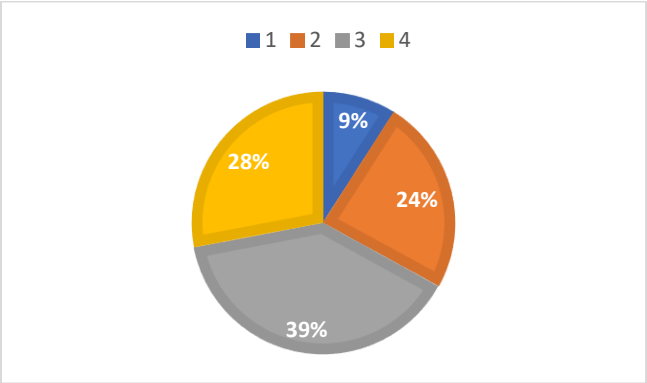

Figure 1. Consume of energy drinks characterized by semester

Of the 100 people who claimed to consume energy drinks, 89% reported associating the need to consume these products due to the academic load Figure 2 and in connection with this, a notable increase in ED consumption was evidenced in semesters 3 and 4 (67%) compared to the first and second semester, in which the percentage was 33%. Figure 1.

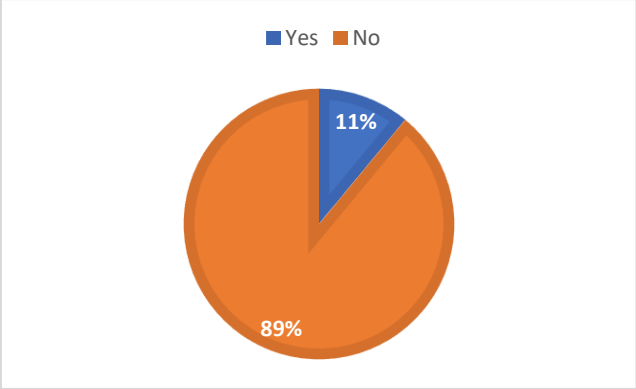

Figure 2. Association of the consumption of energy drinks with the academic load by students

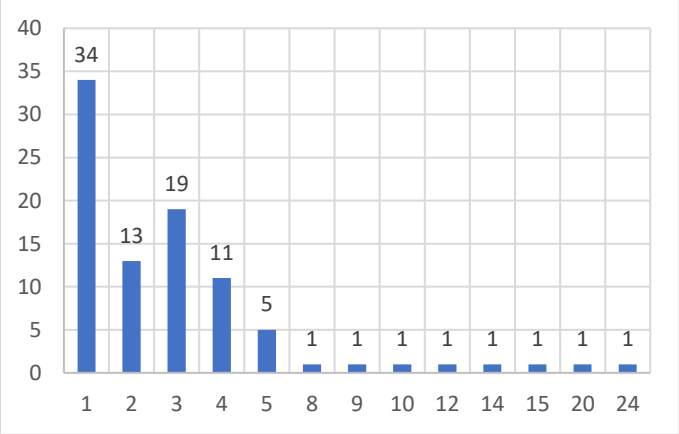

Figure 3. Number of cans consumed per person

Within the energy drinks on the market, it was observed that the most consumed drinks are Vive100 and Speed, with a percentage of 31%, followed by Redbull, Monster and Peak, and only 2% referred to the consumption of other brands of less commercial recognition. Number of cans consumed per person shown in Figure 3.

Regarding the symptoms presented, of the students who do consume energy drinks, it was found from highest to lowest presentation: Increased urine with a prevalence of 48.8% (CI: 38.6-59.1%), followed by headache with a prevalence of 48.8% (CI: 38.6-59.1%), hyperactivity with a prevalence of 38.8% (CI: 29.2-49.2%), irritability with a prevalence of 33.3% (CI: 24.1-43.5%), palpitations with a prevalence of 32.2% (CI: 23.9-42.3%), and the least common symptoms were fatigue, abdominal pain, sweating, nausea and vomiting Table 3.

Table 3. Prevalence of symptoms associated with ED consumption

Symptoms	Absolute Frequency	Prevalence (CI of 95%)
Increased urination	45	45% (38.6- 59.1%)
Headache	43	43% (38.6-59.1%)
Hyperactivity	36	36% (29.2-49.2%)
Irritability	29	29% (24.1-43.5%)
Palpitations	30	30% (23.9-42.3%)
Fatigue	23	23% (18.3-36.5%)
Sweating	17	17% (10.8-26.7%)
Abdominal pain	14	14% (10-25.4%)
Nausea	15	15% (9.13-24.1%)
Vomit	4	4% (2.06-11.8%)

When performing an analysis of the dose/response relationship taking into account a high exposure group (>3 cans/week) and a low exposure group (≤3 cans/week), it was observed that the symptom with the highest risk of presenting , at high exposure, is the increase in urine with a prevalence of 66.67% (χ^2: 4.14) given a value of 0.04, with which the null hypothesis is rejected, this means that there is an association between the presentation symptom and high consumption of energy drinks, in addition, a high risk was found with low exposure to present headache and a lower risk with high consumption (prevalence of 50% and 45.8%, respectively, χ^{2} =0.12, the same happens with hyperactivity, however the level of significance of both data is of low significance Table 4.

Table 4. Relationship of symptoms with the consumption of energy drinks

Symptoms	High exposure prevalence	Low exposure prevalence	χ^2	P-value	OR	CI
Increased urination	66.67%	0.42	4.14	0.04	2.71	1.01-7.49%
Headache	45.83%	0.5	0.12	0.72	0.84	0.33-2.15%
Hyperactivity	37.50%	0.39	0.026	0.87	0.92	0.35-2.41%
Irritability	41.67%	0.3	1.02	0.31	1.63	0.62-4.31%
Palpitations	29.17%	0.33	0.13	0.7	0.82	0.29-2.27%

Biochemical Analysis

General Information and Comorbidities: 50 cases were effectively analysed. A mean BMI of 42.4±7.2 Kg.m^2 was observed in this population. As for comorbidities, we observed 58.3% of cases of SAH, 25% of DM, 18.3% of DLP and 1.67% of CAD. The glycemic variables analysed were: blood glucose, HbA(1c), and insulin, with 88±29.7 mg/dL, 8.4±2.6% and 16.9±35.5 uIU/ml, respectively. Lipid variables revealed 196.5±25.5 mg/dL of total cholesterol, 34±7.5 mg/dL of its HDL fraction, 120.5±21 mg/dL of LDL and 130±70.9 mg/dL of triglycerides. The haematological investigation showed 8149±2433/mm^3 for leukocytes and 294000±73568.7/mm^3 for platelets, with 12.1±1.2 g/dL of haemoglobin and 39.6±3.8% of haematocrit. Renal function showed 28±7.5 mg/dL for urea and 0.7±0.1 mg/dL for creatinine. The electrolytes analysed were: sodium 138±1.6mEq/L, potassium 4.4±0.4 mEq/L, calcium 9.4±0.4 mg/dL, phosphorus 3.6±0.7 mg/dL and magnesium 1.7±0.3 mEq/L. It was found 66.5±26.1 ug/dL of serum iron, 40.5±9.78 microg/L of ferritin, 320±189.3 ng/L of vitamin B12 and 3.6±2.4 ng /ml of folic acid. Liver function tests

revealed 28±28.8 U/L of gamma-glutamyl transferase (GGT), 81±34.9 U/L of alkaline phosphatase, 19±10.3 U/L of aspartate aminotransferase (AST) and 21±12.4 U/L alanine aminotransferase (ALT), 7.5±0.6 g/dL total proteins and 4.3±0.4 g/dL albumin. Glycemic, Lipid, Haematological variables shown in Table 5-6.

Table 5. Glycemic variables

	Control (Group-1)	**Group-2**	**Group-3**	**Group-4**
blood glucose (mg/dL)	93±45.1	92.5±46	107±22	149±39.8
Hb A 1c (%)	6.9±1.7	7.8±1.6	7.3±1.6	9.2±2.9
insulin (uIU/ml)	10.5±10.2	15.7±43.9	22.35±29.5	30.5±28.1

Table 6. Lipid variables

	Control (Group-1)	**Group-2**	**Group-3**	**Group-4**
total cholesterol (mg/dL)	198±37.4	186±34.2	204±36.9	184±21.0
HDL (mg/dL)	43±2.6	43.5±7.3	46±8.3	35±14.6
LDL (mg/dL)	133±36.8	117±29.9	126.5±27.6	96±30.5
triglycerides (mg/dL)	129±21.6	127.5±73.8	136.5±59.8	129±180.7

Table 7. Haematological variables

	Control (Group-1)	**Group-2**	**Group-3**	**Group-4**
leukocytes (leuc./mm^3)	7,100±1,529.5	8,400±2390.1	8,050±2,359.8	10300±3464.6
platelets (platelets/mm^3)	310,000±60,453	284000±76,902	273,000±73,162	327000±106775.5
haemoglobin (g/dL)	13.8±1.3	13.05±1.3	13.35±1.5	13.3±0.2
haematocrit (%)	40.9±3.7	40.6±3.5	40.2±4.5	39±1.3

Discussion

The research was to determine the prevalence of ED consumption in medical students, which is 47%, a finding that corresponds to a high prevalence, comparable with other research worldwide: in Texas, United States, (Champlin et al., 2016) estimated a prevalence of consumption of these substances of 38%.

In another geographical context in the Middle East, at the University of Alexandria, a prevalence of ED consumption by university students of 34.8% (Ezzat, 2016) was determined, a figure similar to that found in this study. This similarity could be due to the design of the study, which has similar characteristics (Ling et al., 2012).

In Turkey, a study by (Attila & Çakir, 2011) estimates a prevalence of ED consumption in university students of 48.3%, this value being the most similar to that presented in this document (Flayyih, et al., 2023).

For the Colombian context, it is important to compare this work with a study carried out in Tunja, where a prevalence of 53.7% in a public higher education institution was determined in a sample of 134 students, which determined the main causes of consumption, finding that the reason for consuming these products was the need to improve academic performance (Ospina, 2015).

The mechanism of antagonism of adenosine receptors, at the renal level, increases natriuresis by inhibition in the tubular fraction of sodium reabsorption, without forgetting the alpha-adrenergic effect in the detrusor muscle and in the urinary tract, which facilitates or helps this physiological symptom of diuresis is present in an increased manner, generated by caffeine, widely described in studies and medical literature (Riesenhuber et al., 2006). Physiologically speaking, taurine acts through the inhibition of the central release of antidiuretic hormone, ADH, at high doses, and it is important to understand that although the mechanisms of action of both caffeine and taurine are different, they can exert a synergistic effect at the level of increased diuresis as they do when they are present combined in energy drinks.

Hepatic damage was characterized by serum enzymatic activity, product of the increase in secretory pathways or damage to the structure of hepatocytes. For the purposes of this study, the most clinically used markers were taken into account for a liver profile, which evaluates enzymes such as ALT, AST, ALP, γTG, LDH and CHE.

ALT activity was evaluated in serum obtained from rats at 60 days, in the different groups. The analysis of the data reveals the increase of the group's vodka, energy drink and vodka-energy drink with a percentage of 1201%, 992% and 879%, respectively. Being statistically different from the control.

Likewise, the activity of the AST enzyme was evaluated. The results reveal the increase of it, the group that consumed vodka increased by 327.6%, the group that consumed the energy drink showed an increase of 215.9%, while the group with the vodka-beverage combination energizing increased 89.7%. The comparison against the control group reveals that there are significant differences.

The evaluation of ALP revealed that the group treated with vodka presented a slight increase of 14.9%, while the group that drank the energy drink and the group that consumed the vodka-energy drink combination presented a decrease of 4.8%. % and 9.8% respectively. No differences compared to the control group.

The assessment of the enzyme γGT shows a slight increase of 13.3% in the group that consumed vodka, a decrease of 19.9% in the case of the ED group. For its part, the group that consumed vodka in combination with the energy drink presented an increase of 43.0% compared to the control. The decrease being significant in the ED group and increased in the vodka + ED group.

Another of the enzymes evaluated was CHE in which a decrease in its activity of 49.4% is shown in the animals that consumed vodka, however, on the contrary, the group that consumed the energy drink increased 16.4%, the group with the combination presented an elevation of 77.1%, with significant differences with respect to the control group.

Elevated serum aminotransferases have been recognized as the biochemical parameter that best reflects hepatocellular injury. The serum AST/ALT ratio is a useful indicator of alcoholic, viral, or toxic liver disease.

Given the AST/ALT Index, the results suggest a cytoplasmic dynamic in which there is an excretion of ALT greater than AST. Therefore, to confirm the results, the ALT/LDH index was evaluated, which, if there was lytic necrosis, would present values below the control. The evaluation of the ALT/LDH index showed that the group that consumed vodka + ED presented a statistically significant increase of 337.9%. Likewise, the group that consumed vodka presented an increase of 561.2% and the group treated with ED presented a similar behaviour of 544.2%.

In addition to enzymes, there are very well-defined changes that trigger liver damage, such as the accumulation of lipids within hepatocytes, mainly in the form of triglycerides.

The synthesis of triglycerides takes place in the endoplasmic reticulum of cells, mainly in the liver, where this process is more active and of greater metabolic relevance. An increase in serum triglycerides was observed in the three cases compared to the control; In the case of the group that only consumed vodka, an increase of 66.5% was observed, which presents significant differences as well as the group that consumed ED with a percentage of 29.7%; while in the group treated with the vodka + ED combination, a slight increase of 4.6% was observed with no significant difference.

Conclusion

Finally, caffeine has shown a strong impact on cognitive skills including attention, memory, and mood. However, the exact effects might vary depending on things like the energy drink type, the subjects, and the research methods employed. Caffeine works well for those who work night shifts or suffer from sleep deprivation. It also makes people more alert and focused, but too much of it may make anxiety worse, especially for those who already suffer from it. Although research on the topic has been inconsistent, it is possible that discontinuing caffeine might have negative consequences. The potential advantages and limitations of caffeine could be better understood if future research take into account potential confounding variables, such as the use of alcohol and smoke.

Author Contributions

All Authors contributed equally.

Conflict of Interest

The authors declared that no conflict of interest.

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