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EFFECT OF ACETAMINOPHEN AND CAFFEINATED ENERGY DRINK ON THE BODY WEIGHT AND HEMATOLOGICAL INDICES OF ALBINO WISTAR RATS DURING SUB-CHRONIC ALCOHOL CONSUMPTION

[*]Bassey N.O[1]., Ukpanukpong R.U[1]., Essien N.M., Abu C.I.[1]., Enyievi P.B[1]. and Ekam V. S[1].
Department of Biochemistry, University of Calabar, Calabar, Nigeria
**Author for Correspondence: nsedency@yahoo.com*

ABSTRACT
The effect of administering acetaminophen and energy drink on body weight and haematological indices during chronic alcohol consumption in Wister albino rats was investigated. The forty-two wistar albino rats used were divided into seven groups of six rats each. Group 1 served as the normal control and received 1ml of bottled water, group two received alcohol (2.5ml/kg body weight of Smirnoff vodka (40% v/v)), group three was given energy drink (5ml/kg body weight of power horse) while group four received paracetamol (28.55mg/kg body weight), group five received same dose of alcohol and energy drink, group six received same dose of alcohol and paracetamol, and group seven received same dose of alcohol, energy drink and paracetamol. The administration was carried out twice daily for 14 days. The results obtained show that, there was no significant difference ($p<0.05$) in the initial and final body weight of the rats in the normal control group. However, alcohol caused a significant decrease ($p<0.05$) in both percentage growth rate and percentage body weight compared to control and other treatment groups. The administration of alcohol + paracetamol + energy drink caused a significant increase ($p<0.05$) in the WBC count compared to the normal control group. PCV and Hb were above the reference range in all treatment groups.

***Keywords**: Acetaminophen; Bodyweight; Energy Drink; Heamoglobin (Hb); Pack Cell Volume; PCV); White blood Cell (WBC) Wistar Albino Rat*

INTRODUCTION
Alcoholic beverage is created when grains, fruits, or vegetables are fermented**.** It is a depressant and slows the function of the central nervous system. It actually blocks some of the messages trying to get to the brain. This alters a person's perceptions, emotions, movement, vision, and hearing (Jones–Webb, 1998). Alcoholic beverages are divided into three general classes: beers, wines, and spirits .They all contain different percentage of alcohol. When large amounts of alcohol are consumed in a short period of time, alcohol poisoning result, this is a process whereby the body becomes poisoned by large amounts of alcohol. Violent vomiting is usually the first symptom of alcohol poisoning. Extreme sleepiness, unconsciousness, difficulty in breathing, dangerously low blood sugar, seizures, and even death may result (Smith and Rogers, 2002).

Due to the toxic effect of alcohol, people tend to mix it with energy drink in order to reduce the level of intoxication. The Caffeine in energy drink is a central nervous system stimulant that temporarily increases attention, alertness and motor activity, while alcohol is a depressant, which tends to slow down brain and motor activity. Individually, the two substances serve completely opposite functions. However, in combination, they can magnify negative effects in the body such as increased heart rate, blood pressure, headache and urine elimination (Shapiro and Robert, 2008). Also, Short term side effects such as headache, nausea, and anxiety have been shown as symptoms of mild caffeine consumption (Ferreira *et al*, 2006).These energy drinks claim to stimulate the mind and body, provide a boost of energy but can

have adverse effects when mixed with alcohol. However, power horse for instance, is an energy drink which contains up to 80 mg or more of caffeine per can (O'Brien *et al.*, 2008).

High levels of caffeine can boost heart rate and blood pressure, causing palpitations. Mixing these drinks with alcohol further increases the risk of heart rhythm problems. It has also been reported that although energy drinks have stimulants in it, the alcohol still has similar effects. Energy drinks have a lot of stimulants in them like ginseng, since alcohol is a depressant, in mixing the two; a mixed message is being sent to the nervous system which can cause cardiac related problems. (Alford *et al.*, 2001). Alcohol makes people dehydrated, which is one of the reasons why people have hangovers, and the caffeine in the energy drinks is a diuretic which also causes loss of water, thereby worsening the effects of dehydration (Alford *et al*, 2001). Paracetamol is one of the drugs used as a hangover cure, by millions of people worldwide but mixing caffeine in the energy drink with paracetamol could be deadly (Emby and Fraser, 1977). Combining large quantities of the pain-killer and caffeine in the energy drink appeared to increase the risk of liver damage. Also it has been shown that Caffeine in the energy drink tripled the amount of a toxic by-product created when paracetamol is broken down (Jaya *et al.*, 1994).

It has also been shown that combining coffee with paracetamol could also prove deadly (Nelson, 2005). However, some people would be more susceptible, such as those taking anti-epilepsy medicines, or St John's wort, a herbal antidepressant as both of these boost levels of the enzyme involved. Alcoholic beverages are widely consumed in different forms and in a large quantity. Due to its toxic and depressant effect, people who drink now mix the alcoholic beverage with energy drinks. This Energy drinks on their own contain some amount of caffeine, from high to low mg of caffeine depending on the type of energy drink (Childs and de Wit, 2008). The reason for the mixture, being to reduce the depressant effect of alcohol. The mixing of energy drinks with alcohol has now led to people drinking more alcohol than they would have taken alcohol alone without the energy drink (Scholey and Kennedy, 2004).This large intake of alcohol leads to a hangover, and without considering the effect of this mixture, paracetamol is taken to reduce the headache and other problems associated with alcoholic hangover.

However, the reason why caffeine, alcohol and paracetamol may be so toxic together isn't fully understood, hence the reason for this research. But the combination appears to impair a drinker's judgment more than taking alcohol alone. Amongst some users, there is a higher incidence of risk-taking behaviors because the perceptions of their limitations are distorted (Scholey and Kennedy, 2004) As a stimulant, caffeine stimulates whole body, increasing blood pressure, heart rate and in some cases, it can cause heart palpitation. Caffeine also leads to headaches, jitteriness, agitation, stomach problems and abnormal breathing. This is the equivalence of an adrenaline rush.

MATERIALS AND METHODS

Collection and Preparation of Materials

Smirnoff vodka (40% v/v) and power horse obtained from sparkz shop in Calabar were used as alcohol and energy drink respectively. Emzor paracetamol was obtained from Obel pharmacy in Calabar.

Laboratory animals

Forty-two wistar albino rats weighing between 180 to 220g were obtained from the animal house of the Department of Biochemistry, University of Calabar. They were housed in plastic cages in the animal house, and fed with rat pellets and tap water *ad libitum*. The animals were acclimatized for two weeks and their weights noted before the commencement of experimental treatment. They were then divided into seven groups of six rats each.

Group 1 served as the normal control and received 1ml of bottled water, group two received alcohol (2.5ml/kg body weight of Smirnoff vodka (40% v/v)), group three was given energy drink (5ml/kg body weight of power horse) while group four received paracetamol (28.55mg/kg body weight), group five

received same dose of alcohol and energy drink, group six received same dose of alcohol and paracetamol, and group seven received same dose of alcohol, energy drink and paracetamol. The administration was carried out twice daily for 14 days.

At the end of the treatment period, the rats were weighed and fasted overnight. They were then anaesthetized with chloroform, dissected and their blood collected with sterile syringes by cardiac puncture into heparinized screw-cap bottles for haematological analysis.

Estimation of haematological parameters

Red blood cell (RBC) count: This was done using the method of Dacie and Lewis, 1991 as reported by Osim *et al.,* (2004) which involved a 1:200 dilution of blood with Haymen's fluid and then counting in a special counting chamber under the microscope. **Hemoglobin (Hb) concentration:** This was determined using Sahli's method as reported by Osim *et al* (2004). The hemoglobin present in a sample of blood was converted to acid hematin by addition of 0.1 NHCl and matched against a non fading brown colour standard. **The packed cell volume (PCV)**: This was determined by the method of Dacie and Lewis, 1991 as cited by Osim *et al.,* (2004). This was done by measuring the percentage volume of blood cells after centrifuging whole blood samples at 14,500g for 5 minutes so that the red cells become packed at the bottom of the capillary tube and plasma remains on top. **White blood Cell (WBC) count:** This was estimated from heparinized blood by the method of Dacie and Lewis, (1991). This involved microscopic visual identification and counting of white blood cells in Turk's fluid. **Growth rate:** This was calculated as the ratio of the weight gained during the treatment period to the number of days constituting the treatment period, and was presented as percentage growth rate. **Weight increase:** Initial and final weight of each rat was measured and the mean weight for each group was determined. Weight increase was calculated as the ratio of change in weight during the treatment period to the initial weight and was presented as percentage weight increase.

Statistical analysis

The data obtained were analysed statistically using analysis of variance (ANOVA) and the student's t-test to determine whether or not the null hypothesis should be rejected so as to accept the alternative hypothesis corresponding at 95% (0.05) probability level

RESULT

Effect of administration of acetaminophen, energy drink and alcohol on the body weight of wistar albino rats

The weight of rats after 14 days of administration of alcohol, energy drink and paracetamol were obtained and compared with the initial weight measured before treatment. The differences in weights were used to determine the percentage weight increase and the growth rate during this period. The results show significant differences ($P < 0.05$) in all the treatment groups compared to the normal control group. However, there were significant decreases ($P < 0.05$) in both percentage growth rate and percentage body weight in group treated with energy drink (-(142.9 ± 3.65 and -11.10 ± 3.86) compared to the group treated with alcohol (-226.2 ± 0.21 and-16.97 ± 0, 22). Also, the group treated with paracetamol (Acetaminophen) (47.6 ± 7.92 and 4.08 ± 7.91) was the only group that showed positive values and the values obtained reduced significantly ($P< .05$) compared to groups treated with alcohol and energy (-226.2 ± 0.21 and -16.97 ± 0, 22). The group administered with energy drink + alcohol (-142.9 ± 4.21 and -11.91 ± 8.43) showed significant decreases ($P> 0.05$) in both percentage body weight percentage growth rate compared to the group treated with paracetamol ((47.6 ± 7.92 and 4.08 ± 7.91).significant decreases ($P< 0.05$) were also, observed in groups treated with Energy drink + paracetamol (-142.9 ± 4.21 and -11.91 ± 8.43) compared to the group treated with only alcohol (-226.2 ± 0.21 and -16.97 ± 0.22). Nevertheless, there was a non significant difference ($P> 0.05$) in the percentage

growth rate and percentage body weight of rats treated with only energy drink (-142.9 ± 3.65 and -11.10 ± 3.86) compared to the group receiving energy drink + alcohol. (-142.9 ± 4.21 and -11.91 ± 8.43) Administration of alcohol + paracetamol (-119.0 ± 3.52 and 10. 04 ± 3,51) on Wister albino rat cause a significant decrease ($P < 0.05$) in both percentage body weight and percentage growth rate compared to the group treated with alcohol (-226.2 ± 0.21and -16.97 ± 0.22) and paracetamol (47.6 ± 7.92 and 4.08 ± 7.91) respectively.

However, the group administered with alcohol + energy drink + paracetamol (-(171.4 ± 4.94 and 10.91 ± 4.31) showed a significant decrease($P < 0.05$) in both percentage growth rate and percentage body weight of rats compared to the groups treated with alcohol(-226.2 ± 0.21 and -16.97 ± 0,22),energy drink (-142.9 ± 3.65 and 11.10 ± 3.86) as well as paracetamol (47.6 ± 7.92 and 4.08 ± 7.91).

Effect of administration of alcohol, energy drink, and paracetamol on some heamatological parameters

Effect of administration of energy drink, and paracetamol after chronic alcohol consumption was carried out. After 21 days of administration, full blood counts was carried out to assess changes in the level of red blood cells (RBC) ($x10^6$cells/μ^3) packed per volume (PCV) (%) heamoglobin (Hb) (g/dL) and white blood cells (WBC). (X103cells/µ3) the results are presented in Table 4.5. In RBC ($x10^6$cells/μ^3), there was no significant difference ($p > 0.05$) between the control group and the treatment groups. However, non significant decreases(p. 0.05) in RBC were observed in groups treated with alcohol(7.00 ± 0.15), alcohol + energy drink(7.06±0.15) and alcohol+ paracetamol (7.28 ± 0.05) compared to the normal control group(7.43 ± 0.09). While the groups that received energy drink (7.64 ± 0.022), paracetamol (7.63 ± 0.35) alcohol + energy drink + paracetamol (7.52 ± 0.07) respectively increased non significantly ($p > 0.05$) in RBC compared to the control group.

It was noticed that there were non - significant increases ($p > 0.05$) in RBC in groups treated with a alcohol+ energy drink (7.06 ± 0.15), alcohol + paracetamol (7.28 ± 0.05), and alcohol+ energy drink + paracetamol (7.52 ± 0.07) compared to the group treated with alcohol (7.00 ± 0.15). There was a significant reduction ($P< 0.05$) noticed in the RBC in the group treated with alcohol + energy drink (7.06 ± 0.15) compared to the group that received only energy drink (7.64 ± 0.22).while the group administered with alcohol + energy drink + paracetamol (7.52 ± 0.07) showed a non- significant reduction ($p > 0.05$) in the RBC compared to the group that received energy drink (7.64 ± 0.22). Also, The groups administered with alcohol + paracetamol (7.28 ± 0.05), and alcohol + energy drink + paracetamol (7.52 ± 0.07) were non – significantly ($p > 0.05$) reduced in RBC compared to the paracetamol group (7.63 ± 0.35). However, the values obtained for RBC in both control and test groups were below the reference range of 5.1- 5.5 ×10.

Effect of administration of alcohol, energy drink, and paracetamol on pack cell volume

The packed cell volume (PCV) (%) significantly decreased ($p < 0.05$) in groups administered with alcohol (50.75 ± 1.44) and paracetamol (50.75 ± 0.61) compared to the normal control group (55.17 ± 0.60). However, there were non significant ($p > 0.05$) increases in PCV in groups administered with energy drink (55.20 ± 1.71) and alcohol + paracetamol (55.75 ± 0.25) compared to the normal control group. Also, non significant decreases ($p > 0.05$) were observed in PCV in groups treated with paracetamol (50.75 ± 0.61), alcohol + energy drink (53. 80 ± 1.16) and alcohol + energy drink + paracetamol (53.00 ± 1.05) compared to the normal control group.(55.17 ± 0.60).

Also, there was a significant increase ($p < 0.05$) in the PCV in the group treated with alcohol + paracetamol (55.75 ± 0.25) compared to the group treated with alcohol. While in groups treated with alcohol + energy drink (53.80 ± 1. 16) as well as alcohol + energy drink + paracetamol (53.00 ± 1.05) the values of PCV increased non significantly ($p > 0.05$) compared to the alcohol group (50.75 ±1.44).

However, Non significant decreases ($p > 0.05$) in PCV were noticed in groups treated with alcohol and energy drink (53 .80 ±1.16) and alcohol + energy drink + paracetamol (53.00 ± 1.05) compared to the group treated with energy drink (55.20 ± 1.71).

Also, there was a significant increase ($p< 0.05$) in the PCV in the group treated with alcohol + paracetamol (55.75 ± 0.25) compared to the group that received only paracetamol (50.75 ± 0.61). Whereas, the group administered with alcohol + energy drink + paracetamol (53.00 ± 1.05) showed a non significant increase ($P > 0.05$) in PCV compared to the paracetamol group. However, the values obtained for PCV in both control and test groups were above the reference range of 40-45 % (William, David, and Heller 2004)

Effect of administration of alcohol, energy drink and paracetamol on heamoglobin level

Hemoglobin level showed a significant decrease ($p < 0.05$) in the group treated with alcohol (13.20 ±0.31) compared to the normal control group. However, the groups treated with energy drink (14.34 ± 0.35) , and alcohol+ paracetamol (14 .18 ±0.5) showed non significant increases ($p > 0.05$) in Hb level compared to the normal control group (14.10 ± 0.24).while there were non significant reductions ($p > 0.05$) in Hb level in groups treated with paracetamol (13.40 ± 0.17) , alcohol + energy drink(13.78 ± 0.25), and alcohol + energy drink + paracetamol (13.80 ± 0.26) respectively.

Also, there were no significant increases ($p>0.05$) in the Hb levels in groups administered with alcohol + energy drink (13.78 ± 0.25), and alcohol + energy drink + paracetamol (13.80 ± 0.26) compared to the group treated with alcohol (13.20 ± 0.31).while the group that received alcohol + paracetamol (14.18 ± 0.05) showed a significant increase ($p < 0.05$) in Hb level compared to the alcohol group (13.20 ± 0.31).

However, the groups administered with alcohol + energy drink (13.78 ± 0.25) and alcohol + energy drink + paracetamol (13.80 ± 0.26) showed non significant decreases ($p > 0.05$) in Hb level compared to the group treated with energy drink (14.34 ± 0.35) . Also, No significant increases ($p> 0.05$) in the Hb levels were observed in groups treated with alcohol + paracetamol (14.18 ± 0.05) and alcohol + energy drink + paracetamol (13.80 ± 0.26) compared to the group that received only paracetamol (13.40 ± 0.17). However, the values obtained for heamoglobin in both control and test groups were above the reference range of 2.1-2.7g/dL (Van Beekvelt *et al.*, 2001).

Effect of administration of alcohol, energy drink and paracetamol on white blood cell

White blood cell (WBC) ($x10^3$cells/μ^3) showed significant increases ($p< 0.05$) in groups treated with alcohol (9.90 ± 0.69), energy drink (11.76 ± 0.31), and paracetamol (9.93 ± 0.48) compared to the normal control group (7.35 ± 0.31). However, non significant increases ($p> 0.05$) in WBC were observed in groups treated with alcohol + energy drink (7.42 ± 0.56), and alcohol + energy drink + paracetamol (7.68 ± 0.15) compared to the normal control group. Also, noticed was a non significant decrease ($p> 0.05$) in the WBC in the group administered with alcohol + paracetamol (6.68 ± 0.82) compared to the normal control group.

There were also significant decreases ($p< 0.05$) in WBC in groups treated with alcohol + energy drink (7.42 ± 0.56), alcohol + paracetamol (6.68 ± 0.82) , as well as the group receiving alcohol + energy drink + paracetamol (7.68 ± 0.15) compared to the group treated with only alcohol (9.90 ± 0.69). Also there were significant reductions ($p< 0.05$) in WBC both the group that received alcohol + energy drink(7.42 ± 0.56) and the group treated with alcohol + energy drink +paracetamol (7.68 ± 0.15) compared to the group treated with only energy drink (11.76 ± 0.31).

It was observed that, there were significant decreases ($p< 0.05$) in the WBC in groups treated with alcohol + paracetamol (6.68 ± 0.82) and alcohol + energy drink + Paracetamol (7.68 ± 0.15) compared to the group treated with paracetamol (9.93 ± 0.48). However, the values obtained for White blood cell in both control and test groups were within the reference range of 11.5-14.5x10-3 cells/µ3

Table 1 Effect of administration of acetaminophen, energy drink and alcohol on the body weight

Treatment group	Growth rate (%)	Weight increase (%)
Normal control	62.53 ± 2.14	4.38 ± 1.88
Alcohol	-226.20 ± 0.21*	-16.97 ± 0.22*
Energy drink	-142.90 ± 3.65*,a	-11.10 ± 1.86*,a
Paracetamol	47.60 ± 2.92*,a,b	4.08 ± 1.91*, a,b
Alcohol + energy drink	-142.90 ± 4.21*,a,c	-11.91 ± 1.43*,a,c
Alcohol + paracetamol	-119.0 ± 3.52*,a,b,c,d	-10. 04 ± 1.51*, a,c
Alcohol+energydrink+ Paracetamol	-171.40 ± 4.94*,a,b,c,d,e	-10.91 ± 1.31*,a,c

Values are expressed as mean ± SEM, n = 6.
**significantly different from NC at p<0.05*
a = significantly different from alcohol at p<0.05
b = significantly different from energy drink at p<0.05
c = significantly different from paracetamol at p<0.05
d = significantly different from alcohol + energy drink at p<0.05
e = significantly different from alcohol + energy drink + paracetamol at p<0.05

Table 2: Effect of administration of acetaminophen, energy drink and alcohol on the hematological indices of wistar albino rats

Treatment Groups	RBC ($x10^6$cells/μ^3	PCV (%)	Hb (g/dL)	WBC ($x10^3$cells/μ^3)
Normal control	7.43 ± 0.09	55.17 ± 0.60	14.10 ± 0.24	7.35 ± 0.31
Alcohol	7.00 ± 0.15	50.75 ± 1.44*	13.20 ± 0.31*	9.90 ± 0.69*
Energy drink	7.64 ± 0.22[a]	55.20 ± 1.71[a]	14.34 ± 0.35[a]	11.76 ± 0.31*, [a]
Paracetamol	7.63 ± 0.35[a]	50.75 ± 0.61*, [b]	13.40 ± 0.17[b]	9.93 ± 0.48*, [b]
Alcohol+E. drink	7.06 ± 0.15[b, c]	53.80 ± 1.16	13.78 ± 0.25	0.42 ± 0.56[a, b, c]
Alcohol+ Paracetamol	7.28 ± 0.05	55.75 ± 0.25[a, c]	14.18 ± 0.05[a]	6.68 ± 0.82[a, b, c]
Alcohol +E.drink+Parac	7.52 ± 0.07	53.00 ± 1.05	13.80 ± 0.26	7.68 ± 0.15[a, b, c]

Values are expressed as mean ± SEM, n = 6.
**significantly different from NC at p<0.05*
a = significantly different from alcohol at p<0.05
b = significantly different from energy drink at p<0.05
c = significantly different from paracetamol at p<0.05
d = significantly different from alcohol + energy drink at p<0.05
e = significantly different from alcohol + energy drink + paracetamol at p<0.05

DISCUSSION

From the result, the initial and final weight of the albino Wister rats were the same in the control group, thereby causing both the percentage growth rate and the percentage weight values to be zero (0).

Therefore there were significant differences (P< 0.05) in all treatment groups compared to the normal control group. It was observed that the group treated with alcohol had the lowest value of both percentage growth rate and percentage body weight increase compared to all other treatment groups. This high reduction could have been due to malnutrition and absence of some vital nutrients. This is in line with an earlier report which says that, although alcoholic beverages contain calories, and under certain conditions these calories do not have as much value for the body as those derived from other nutrients (Pirola *et al.,* 1972**).** Lodgsdon, 1994 also reported that, Alcoholism is a major cause of malnutrition. This is because; alcohol interferes with central mechanisms that regulate food intake and causes food intake to decrease. Increasing amounts of alcohol ingested can therefore lead to the consumption of decreasing amounts of other foods, making the nutrient content of the diet inadequate, even if total energy intake is sufficient. Thus chronic alcohol abuse causes primary malnutrition by displacing other dietary nutrients.

However, apart from alcohol group, the group receiving Alcohol+ energy drink + paracetamol showed a significant reduction (P< 0.05) in both percentage growth rate and percentage body weight increase compared to all other treatment groups. This could have been due to the combine effect of energy drink, alcohol and paracetamol according to Jaya *et al., 1994.* The group administered with paracetamol was observed to have the highest value of both percentage growth rate and percentage body weight increase.

Effect of administration of energy drink, and paracetamol during chronic alcohol consumption was carried out. After 21 days of administration, full blood counts was carried out to assess changes in the level of red blood cells (RBC) ($x10^6$cells/μ^3) packed per volume (PCV) (%) heamoglobin (Hb) (g/dL) and white blood cells (WBC). (X103cells/µ3) the results in table 4.5 showed no significant difference between the control group and the treatment groups in RBC ($x10^6$cells/μ^3), however, non significant decreases (P > 0.05) in RBC were observed in groups treated with alcohol, alcohol + energy drink and alcohol+ paracetamol compared to the normal control group. While the groups that received energy drink, paracetamol, alcohol + energy drink + paracetamol respectively increased non significantly (P >0.05) in RBC compared to the control group. It was noticed that there were non - significant increases (P> 0.05) in RBC in groups treated with a alcohol+ energy drink, alcohol + paracetamol, and alcohol+ energy drink + paracetamol compared to the group treated with alcohol . There was a significant reduction noticed in the RBC in the group treated with alcohol + energy drink compared to the group that received only energy drink. As well as a non significant reduction in the RBC in group administered with alcohol + energy drink + paracetamol compared to the group that received energy drink. Also, The groups administered with alcohol + paracetamol, and alcohol + energy drink + paracetamol were non significantly reduced in RBC compared to the paracetamol group. The packed cell volume (PCV) (%) significantly decreased in groups administered with alcohol and paracetamol compared to the normal control group. However, there were non significant increases (p> 0.05) in PCV in groups administered with energy drink and alcohol + paracetamol compared to the normal control group. Also, non significant decreases were observed in PCV in groups treated with paracetamol, alcohol + energy drink and alcohol + energy drink + paracetamol compared to the normal control group. There was a significant increase in the PCV in the group treated with alcohol + paracetamol compared to the group treated with alcohol. While in groups treated with alcohol + energy drink as well as alcohol + energy drink + paracetamol the values of PCV increased non significantly compared to the alcohol group. However, non significant decreases in PCV were noticed in groups treated with alcohol and energy drink and alcohol + energy drink + paracetamol compared to the group treated with energy drink. Also, there was a significant increase in the PCV in the group treated with alcohol + paracetamol compared to the group that received only paracetamol .Whereas, the group administered with alcohol + energy drink + paracetamol showed a non significant increase in PCV compared to the paracetamol group. Heamoglobin level showed a significant decrease in the group treated with alcohol compared to the normal control group. However, the groups

treated with energy drink , and alcohol+ paracetamol showed non significant increases in Hb level compared to the normal control group while there were non significant reductions in Hb level in groups treated with paracetamol, alcohol + energy drink, and alcohol + energy drink + paracetamol respectively. Also, the result shows that, there were non significant increases in the Hb levels in groups administered with alcohol + energy drink, and alcohol + energy drink + paracetamol compared to the group treated with alcohol. While the group that received alcohol + paracetamol showed a significant increase in Hb level compared to the alcohol group. Hemoglobin deficiency can be caused either by decreased amount of hemoglobin molecules, as in anemia, or by decreased ability of each molecule to bind oxygen at the same partial pressure of oxygen. (Wiester *et al*., 2002) Elevated levels of hemoglobin are associated with increased numbers or sizes of red blood cells, called polycythemia. This elevation may be caused by congenital heart disease, (Padmanaban and Toora 2011) the groups administered with alcohol + energy drink and alcohol + energy drink + paracetamol showed non significant decreases in Hb level compared to the group treated with energy drink . Also, Non significant increases in the Hb levels were observed in groups treated with alcohol + paracetamol and alcohol + energy drink + paracetamol compared to the group that received only paracetamol. White blood cell (WBC) ($x10^3$cells/μ^3) showed significant increases ($p<0.05$) in groups treated with alcohol, energy drink, and paracetamol compared to the normal control group. However, non significant increases ($p> 0.05$) in WBC were observed in groups treated with alcohol + energy drink, alcohol + paracetamol and alcohol + energy drink + paracetamol compared to the normal control group. There were also significant decreases in WBC in groups treated with alcohol + energy drink, alcohol + paracetamol, as well as the group receiving alcohol + energy drink + paracetamol compared to the group treated with only alcohol. Also there were significant reductions in WBC both the group that received alcohol + energy drink and the group treated with alcohol + energy drink + paracetamol when compared to the group treated with only energy drink. The pronounced increase in the white cell count in the group receiving energy drink appeared to be caused by greater muscle stress and consequently more intense endothelial and muscle cell injury. This is in line with an earlier report that, the use of caffeine may augment the risk of muscle damage in athletes; he also said that the strong muscle contractions during exercise may cause micro-tears both in muscle and in the vascular endothelium, which also affect the migration of white cells (Horrigan *et al.*, 2006). It was observed that, there were significant decreases ($P< 0.05$) in the WBC in groups treated with alcohol + paracetamol and alcohol + energy drink + paracetamol compared to the group treated with paracetamol. The reduction in the number of white blood cells is known as Leukopenia which may affect the overall white cell count, therefore the reduction in the white blood cells in these group was assumed to be due to the multiple toxic effect produced by combining alcohol, paracetamol and energy drink. This confirms the ealier report by Roland *et al.,* (2007).He reported that the levels of the dangerous toxin in paracetamol tripled when caffeine and alcohol are added. Generally, the group administered with energy drink showed significant reductions ($P<0.05$) in both PCV(%) and Hb(g/dl) and a significant increase ($P<0.05$) in the WBC count.

Conclusion

In conclusion, consumption of alcohol causes a decrease in both growth rate and body weight. Also, the consumption of Alcohol and energy drink in combination with paracetamol decreases the WBC (white blood cell) whereas consumption of energy drink alone increases the WBC count within a 14 days.

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