Haematological Changes Following Administration of Alcohol and Caffeine in Albino Wistar Rats

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Abstract

The haematological changes following the administration of varying concentrations of alcohol and caffeine for 7days were investigated in six groups of albino Wistar rats. Each group consisted of 8 rats (4 males; 4 females). The parameters assayed include percentage packed cell volume (%PCV), red blood cell (RBC) and white blood cell (WBC) counts and haemoglobin (Hb) concentration of rats. Rats that were administrated 1ml and 2ml of 43% alcohol recorded lower % PCV than controls. However, this lower value was only significant (P<0.05) in the female rats when compared with their corresponding controls. A similar picture was observed for RBC counts in these animals. All the rats that received the respective treatments recorded haemoglobin concentrations similar to their controls. Male and female rats administered alcohol and caffeine or caffeine alone recorded increases in WBC counts which were only significant (P<0.05) for the male rats. Male and female animals administered alcohol alone recorded WBC counts similar to the controls. The results indicate that alcohol ingestion may precipitate anaemia especially in the female rats.

Keywords: Alcohol, Caffeine, Haematological indices, Albino rats

Introduction

Alcoholic drinks have occupied a very important place in the history of man. Interestingly in Africa, alcohol consumption has been sustained and there is an ever increasing trend especially with the advent from Europe and the Western world of various brands of beer, rum, dry gin, brandy and other drinks which contain a high percentage of ethanol. As a central nervous system depressant followed by its sedative effect, alcohol has been found to cause liver damage which can also lead to malfunctioning of other body organs such as the brain and kidney when consumed in excess (Bogan, 2003). It also produces alterations in several signal transduction cascades and injures the nervous system by disturbing the growth of neural processes (Tewari *et al*, 1987). Caffeine on the other hand is a central nervous system stimulant that is widely distributed in nature, being found mainly in kolanuts, coffee beans and tea leaves. Caffeine, the main constituent of kolanut commonly called 1, 3, 7- trimethylxanthine is a purine alkaloid and its toxicity and that of its metabolites have been reviewed. (Eteng et al, 1997).

In Nigeria alcohol consumption is traditional for most communities and kolanuts are often served with alcohol in the form of illicit gin, brandy, whisky, beer etc. the most popular alcohol widely served with kolanut is illicit gin popularly known as “Ogogoro” in Nigeria. Today, “Ogogoro” has been refined into several trade names such as Seaman’s Aromatic Schnapps’, Lords Dry Gin etc. The consumption of kolanuts and alcoholic beverages is on the increase among Nigerians especially among the youth. This habit may however predispose our population to a numbers of haematological alterations that may affect health status. This study therefore seeks to evaluate the haematological changes associated with the ingestion of alcohol and caffeine in rats.

Materials and Methods

Caffeine and alcohol: Caffeine was purchased from the British Drug House, England. Alcohol (Lords dry gin, 43%) was purchased from the Nigerian Distillers Ltd., Sango Otta, Ogun state.

Animals grouping and experimental protocol: The animals were assigned on the basis of weight into 7groups (A-G) each group comprising of 4 male, 4 female rats. Group B to G were administered varying concentrations of alcohol, caffeine or both. Administration was done by oral intubation for 7 days. The seven groups of rats were treated as follows: Group A animals served as control, group B animals were administered with 1ml of 43% alcohol; group C animals received 2ml of 43% alcohol; group D received 1ml of 43% alcohol and 100mg/kg body weight of caffeine, group E received 2ml of 43% alcohol and 200mg/kg body weight of caffeine. Group F and G received 100mg/kg body weight of caffeine and 200mg/kg body weight of caffeine respectively. At the end of the seven days treatment period, the animals were sacrificed.

Collection and preparation of samples for analysis: Blood samples were collected via cardiac puncture and the samples put into heparinized tubes for haematological analysis.

Haematological estimations: The blood samples collected into heparinized samples tubes were immediately used for determination of haematological parameters. The percentage packed cell volume was determined according to the haematocrit method of Alexander and Griffiths

Table 1: Haematological indices of experimental animals

Group	Hb. Conc. (g/dl)		RBC ($X10^6/mm^3$)		WBC ($X10^3/mm^3$)		PCV (%)	
	Males	Females	Males	Females	Males	Females	Males	Females
A (Control)	9.67±0.34	8.40±0.29	5.83±0.43	5.81±0.35	22.63±2.48	22.88±1.83	28.75±1.32	29.00±0.58
B	9.74±0.18	8.27±0.10	5.41±0.34	4.93+1.26*,a	22.24±0.32	22.86±0.75	27.00±1.73	22.75±0.48a
C	9.55±0.07	8.28±0.28	5.55±0.77	4.16±0.02*,a	22.63±1.28	23.50±0.65	28.00±0.41	24.00±0.41*,a
D	9.46±0.88	8.28±0.28	5.55±0.77	5.79±0.24	26.25±0.78a	24.89±0.68	29.00±1.87	28.75±1.75
E	9.62±1.05	8.67±0.18	5.88±0.19	5.92±0.23	27.50±0.29a	24.63±0.63	30.00±0.41	29.50±0.29
F	9.58±0.90	8.58±0.39	5.90±0.25	5.81±0.19	27.75±0.48a	24.13±1.09	30.00±3.63	29.75±1.97
G	9.60+0.15	8.61+0.56	5.80±0.36	5.94±0.33	26.75±0.92a	25.25±1.11	30.75±0.95	31.50±2.40

*Results are presented as Mean ± S.D; * significantly different from corresponding pair (p<0.05); * significantly different from control (P<0.05)*

(1993a) while the blood haemoglobin concentration in all samples was estimated according to the cyanomethaemoglobin method of Alexander and Griffiths (1993b). Total red blood cell and white blood cell counts were estimated according to the visual method of Dacie and Lewis (2002).

Statistical analysis: Data were reported as means ± SD and were analyzed using one-way analysis of variance (ANOVA). Pair wise comparisons were done using the students't-test. Values of P<0.05 were regarded as being significant.

Results

Table 1 shows the effect of oral administration of alcohol and caffeine on haematological indices of experimental animals. Treatment with alcohol, caffeine or both resulted in alterations in haematological indices with male and female animals responding differently. Male and female animals recorded percentage packed cell volume (%PCV) values between 23-32 percent. Female rats treated with alcohol recorded significantly (P<0.05) lower percentage cell volume when compared with control. Administration of alcohol and caffeine or caffeine alone resulted in increased percentage packed cell volume though these increases were not significant (P>0.05) when compared with the controls. Male rats treated with alcohol alone also recorded decreased percentage packed cell volume, though not significant (P>0.05) when compared with control. Females rats treated with alcohol recorded significantly (P<0.05) lower red blood cell counts when compared with controls. However male and female animals treated with alcohol and caffeine or caffeine only recorded red blood cell counts similar to controls. Male rats treated with alcohol only recorded lower red blood cell counts than controls although this lower red blood cell count were not statistically significant (P>0.05). Male and female animals that received various treatments recorded haemoglobin (Hb) concentrations similar to their controls. Similarly, male and female rats treated with alcohol recorded white blood cell count similar to their controls. Conversely, animals treated with alcohol and caffeine recorded increased white blood cell counts, which were only significant (P<0.05) for male animals.

Discussion

Administration of alcohol and caffeine to rats resulted in alterations in haematological indices with male and female animals responding differently. Animals treated with only alcohol recorded decreased percentage packed cell and hence red blood cell counts compared to controls. The decreases in percentage packed cell volume and red blood cells counts may be as a result of effects of alcohol or its metabolites on the erythropoietic machinery involved in the synthesis of red blood cells. Reports by Keller and Snyder (1986) and Degowin et *al* (1987) indicate that xenobiotics may pertub on growth or differentiation inducers involved in erythropoiesis and hence suppress erythropoiesis. These observations suggest that ingestion of alcohol may induce anaemia. Anaemia is defined as a state of lower than normal concentration of haemoglobin, percentage packed cell volume or red blood cell counts. Percentage pack cell volume below 30 percent has been reported for anemic rats (Chen and Chang, 1981; Ifere, 1986). The fact that the haemoglobin concentrations of these animals were comparable to control animals may suggest that the anaemia is not hemolytic since red blood cell hemolysis will reflect as a rise in blood haemoglobin concentration (Bolarin, 1997). The significant decreases in red blood cell count and hence percentage packed cell volume in female rats may suggest that the female rats could not tolerate alcohol as do the males. Animals administered alcohol and caffeine or only caffeine recorded percentage packed cell volume and red blood cell counts which were not significantly different from control. This observation may imply that caffeine does not precipitate anaemia and co-administration of caffeine with alcohol may reduce the haematotoxic effects of alcohol probably by counteracting the effects of alcohol on the machinery involved in red blood cell synthesis. Expectedly, all the experimental animals recorded increase white blood cells counts. This is a normal physiological response following the recognition of foreign compounds by the body defence mechanism. The results of this study indicate that ingestion of alcohol causes a reduction in red count and hence percentage packed cell volume and therefore suggest that alcohol ingestion may precipitate anaemia especially in female rats.

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