

## **Antipuritive Effect of Aqueous Root Extracts of *Moringa oleifera* on Alcohol-induced Haematotoxicity in Wistar Rats**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors GE and EO conceived and designed the research work, authors SB and KA carried out the Experiment, authors JE and IA did the statistical analysis, author VE supervised the work, authors EO, GE and SU wrote the paper and finally author VE read and approved the final manuscript.*

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### **ABSTRACT**

**Aim:** The study is aimed at investigating the antinutritive effects of aqueous root extract of *Moringa oleifera* on haematological indices following sub-chronic consumption of alcohol in Wistar rats.

**Methods and Materials:** Thirty (30) experimental rats weighing 100-120 g were randomly divided into 6 groups of 5 rats each. Group 1, the normal control group was given just rat feed and water, group 2, negative control was administered alcohol only (1.5 ml/kg body weight), rats in group 3, 4 and 5 received combined administration of alcohol 1.5 ml/kg body weight and 200, 400 and 600 mg/kg body weight of aqueous root extract of *Moringa oleifera* respectively, group 6 rats were

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administered 250 mg/body weight of extract only. At the end of fourteen days (14) the experimental rats were then sacrificed, and blood was collected for haematological analysis.

**Results:** The result obtained shows a dose-dependent response in almost all the parameters, white blood cell (WBC) count increases significantly ( $P < 0.05$ ) with 600 mg/kg while dose 200 mg/kg and 400 mg/g shows no significant change. Red blood cells (RBC) decreases non-significantly ( $P < 0.05$ ) with increased amount of aqueous *Moringa* root extract. Likewise, there was also a dose-dependent decrease in the haematological count and more noticeable with 200 mg/kg dose. It was also observed that mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular volume (MCV) increases in all the treatment groups with significant observed in 400 mg/kg and 600 mg/kg. The increase in alcohol can bring about suppression of the blood cells production, enhance if there is reduction in the red blood cells, it, therefore, implies that there will be reduction in the oxygen-carrying capacity of the red blood cells, that would be carried to the tissues as well as the level of carbon dioxide returned to the lungs. Also, the PCV is involved in the transport of oxygen and absorption of the nutrient. Therefore, increase in PCV, shows a better transportation and thus results in an increase in both primary and secondary polycythemia.

**Conclusion:** This research work shows that the plant extract contains some bioactive component or phytochemical constituents that are capable of ameliorating the toxicity effect of alcohol on animal models.

**Keywords:** Packed cell volume; white blood cells; red blood cells; mean volume corpuscular; mean corpuscular haemoglobin concentration; *Moringa oleifera*.

## 1. INTRODUCTION

Medicinal plants are used in an attempt to maintain health, to be administered for a specific condition or both, whether in modern medicine or in traditional medicine [1]. They are widely used in both developing and developed societies as sources of drugs or herbal extracts for various chemotherapeutic purposes mainly because they are readily available and cheaper than modern medicines. On a scientific ground, these plants are used because of their active phytochemical constituents. The medicinal and pharmacological activities of medicinal plants are often attributed to the presence of secondary plants metabolites known as phytochemicals. Unlike the ubiquitous macromolecules of primary metabolites like monosaccharides, polysaccharides, amino acids, proteins, nucleic acids and lipids which are present in all plants, secondary metabolites with medicinal properties are found only in few plant species and they have more medicinal value. Secondary plants metabolites with reported medicinal properties include alkaloids, phenolics, saponins, glycosides and terpenoids [2]. They offer the anti-microbial, anti-oxidative, anti-inflammatory properties of plants. Natural constituents based on the plant can be derived from every plant part like roots, bark, seeds, flowers, leaves etc. [3].

Phytochemicals are chemical compounds produced by plants through primary or secondary metabolism [4]. They are non-nutritive plant

chemicals that have disease preventive or protective properties, they offer plants natural defense system providing protection against such things as an attack from insects, grazing animals and microbes. Examples include flavonoids, phenols, terpenes, alkaloids etc. They contribute to plant colour, aroma and flavour [5]. *M. oleifera*, which is also known as the "Miracle Tree" and "Mother's Best Friend," has been named the most nutrient-rich plant. Other than having a high concentration of vitamin A, vitamin C, potassium, and calcium, the plant contains all the essential amino acids [6] (Mahmood et al. 2010). Different parts of the *Moringa oleifera* tree have been established as being a good source of unique glucosinolates, flavonoids and phenolic acids [7], carotenoids [8], tocopherols, polyunsaturated fatty acids, highly bio-available minerals and folate [8].

Worldwide adults consume about average 5liters of pure alcohol from beer, wine and spirits per year. The average alcohol consumption is highest in Europe following America than Africa. It tends to increase with economic development. Alcohol consumption is the leading risk factor for disease burden in low mortality developed countries [9]. Alcohol causes 1.8 million deaths (3.2% of total) and a loss of 58.3 billion (4% total of disability-adjusted life years [10]. Excessive alcohol consumption is widely associated with liver damage [11]. Just along the streets of Nigeria today, one is sure to find at least one or two herbal concoction sellers either hawking or

situated somewhere in the vicinity. This herbal brew is known popularly as agbo has drawn quite a significant attention from the nation's health sector with lots of debates trailing it. In recent times, however, this trend has taken on another dimension in the country as consumption of the locally brewed gin mixed with some roots and herbs has reached an all-time high. While some people are quick to attribute this trend to the poverty level in the country which has financially incapacitated many citizens, others feel it is as a result of lack of adequate provision of medical care. However, for whatever reason and with the recent indiscriminate sell of agbo that is attracting more subscribers from other classes in the society and despite fears that the consumption of agbo would be detrimental to health, the number of people patronizing it keeps soaring. The notion at the back of an average of agbo consumer's mind is to keep healthy in the most natural way without any negative side effect from chemical reactions.

## 2. MATERIALS AND METHODS

### 2.1 Apparatus

Sample (*M. oleifera* roots), grinding machine, electronic weighing balance, beakers, funnel, plastic buckets, filter paper (what man filter paper No 1), measuring cylinder, sieve basket, chess cloth, thermo-regulated water bath, palletized rat feed, alcoholic beverage (tombo), water bottles, saw dust, poly-carbonated cages, hand gloves, syringes, needles, Auto Analyzer, Department of Biochemistry, College of Basic Medical Science, University of Calabar, Calabar. Used for Hematological parameters.

### 2.2 Sample Collection

A fresh sample of *Moringa oleifera* roots was harvested from the University of Calabar Staff Quarters. The roots were then chopped into smaller fragments, washed properly with tap water to remove debris and other physical contaminants and then air dried at room temperature for two weeks.

### 2.3 Preparation of Extract (Cold Maceration Method of Extraction)

The mature root of *Moringa oleifera* was obtained from the university of calabar, Botanical Garden and identified by Dr Francis Eko, of Botany Department university of calabar, calabar. Voucher specimen deposited in the Departments

herbarium number 2435 was kept for future reference. The root was rinsed with water to remove debris and sand and then sun-dried. The dried samples were pulverized to powder form using a grinding machine. The grinded sample was then weighed using an electronic weighing balance and put in a plastic bucket. 2700 ml of water was then added to the plastic bucket containing the sample. The soaked sample was allowed to stand for 24 hours, after which it was first filtered using a sieve basket and then chess cloth. The filtrate obtained was then filtered again using what man filter paper No 1. The filtrate obtained was collected in beakers and then placed into a thermoregulator water bath with the temperature set at 50°C and allowed to concentrate. The extract gotten was then collected into plastic vials and then stored in the refrigerator at 4°C to be used for the further experiment.

### 2.4 Toxicity study on *Moringa oleifera*

According to one acute toxicity study of various extracts of *Moringa oleifera* roots, the results of that study showed a safe range. The LD50 for the aqueous extract was 15.9/kg. The results were supported by the work done by [12].

### 2.5 Experimental Procedure

Thirty (30) *albino wistar* rats weighing 100- 120kg from the animal house of the Department of Biochemistry, University of Calabar was used. The animals were acclimatized for a week in the animal house, they were fed with standard rodent pellets and water was provided *ad libitum*. The animals were maintained there at standard conditions of temperature and relative humidity. The rats were then afterwards divided into 6 groups of 5 rats each.

### 2.6 Administration of Alcohol and Root Extract

Alcohol and root extract of *M. oleifera* were administered orally with the aid of a studded needle and syringe. During the first 3 days, rats in group 2, 3, 4 and 5 were induced with sub-chronic liver damage orally using a commonly available alcoholic beverage, Tombo (4.82%) at a dose of 1.5ml per body weight only after which on the 4<sup>th</sup> day to the last day (14<sup>th</sup>), they were given aqueous root extract of MO shortly after alcohol administration. At the end of the treatment period, the rats were reweighed and then were sacrificed.

**Table 1. Experimental design**

Group	Designation	Treatment	Dose
1	NC	Water	<i>Ad libitum</i>
2	NgC	Alcohol	1.5 ml of alcohol/bw
3	AMR1	Alcohol and rMO	1.5 ml of alcohol/bw + 1.5 ml of 200 mg of Rmo
4	AMR2	Alcohol and rMO	1.5 ml of alcohol/bw + 1.5 ml of 400 mg of Rmo
5	AMR3	Alcohol rMO	1.5 ml of alcohol/bw + 1.5 ml of 600 mg of Rmo
6	EC	Rmo	1.5 ml of 250 mg of Rmo

Keys; NC- Normal control; bw – body weight; NgC- Negative control; AMRn – groups administered with alcohol and extract (n = 1, 2, 3); rMO – root extract of *Moringa oleifera*; EC – Extract control

## 2.7 Collection and Preparation of Blood for Analysis

At the end of the 14<sup>th</sup> day treatment period, the animals were anaesthetized with chloroform. They were then dissected and their blood collected with sterile syringes by cardiac puncture into sterile labelled plain vials and was allowed to clot for about 2 hours, they were then centrifuged at 3000g for 15 minutes to allow for separation of serum from blood cells. The serum was then precipitated into a plain and well labeled vial for a liver function test.

## 2.8 Haematological Estimation

The blood samples collected into heparinized tubes were immediately used for determination of haematological parameters. Total red blood cells and white blood cells count were estimated according to the visual methods of Dacic and Lewis [13]. The percentage packed cell volume was determined according to the hematocrits methods of Alexander and Griffith [14], while the blood haemoglobin concentration in all the samples was estimated according to the cyanomethaemolobin method of Alexander and Griffiths [15].

## 2.9 Differentials White Blood Cells Count

These were estimated using the methods of Osim et al. [16]. A dry micropipette was used to suck in blood from the blood sample bottle a small drop of the blood was applied to one end of a slide and quickly placed on the bench holding it in position, the end of the second slide was placed in the drop and held there until the blood had spread across its, it was then drawn slowly over the whole length of the first slide being held at an angle of 45°c After the blood had spread, it was dried before staining with Leishman's stain. The film which was washed off in a gentle stream was dried with filter paper and examined under low and high power microscope and the different kinds of cells counted.

## 2.10 Ethical Approval

Ethical approval was also sought from the committee, faculty of basic medical science, university of calabar, calabar.

## 2.11 Statistical Analysis

Quantitative data were analyzed using one-way analysis of variance (ANOVA), followed with a post hoc (Duncan) test for significant values. P-value < 0.05 was considered statistically significant. Statistical package for the social sciences application software, SPSS version 20 was used for statistical analysis and the charts were plotted using Microsoft-Excel application software 08. Data are expressed as mean ± standard error of the mean (SEM).

## 3. RESULTS

The table below shows the statistical representation of the outcome of the results in (Table 2).

From the result of the White blood cell count of the experimental animals following alcohol toxicity as shown in the figure below did not show significant ( $p < 0.05$ ) change in count, though there was decreased in count relative to Normal control. According to the data obtained the WBC count of Control and Negative control was  $(8.47 \pm 1.00)$  and  $(8.04 \pm 0.72)$  respectively. Upon the administration of different doses of aqueous extract of *Moringa oleifera*, the groups treated with 200 mg/b.wt. and 400 mg/b.wt. Shows no significant ( $p < 0.05$ ) decrease  $(6.90 \pm 0.52)$  and  $(7.20 \pm 0.20)$  respectively relative to the negative control notwithstanding the decrease in the white blood cell count. But, the group treated with 600 mg/b.wt of *Moringa oleifera* extract shows significant ( $p < 0.05$ ) increase  $(11.62 \pm 0.47)$  in WBC count compared to the control groups as well as other treatment groups. Also, the group treated with the only extract shows a significant decrease  $(4.70 \pm 1.19)$  in WBC count relative to control and another treatment group.

**Table 2.**

	<b>WBC</b> <b>10<sup>3</sup> cells/μL</b>	<b>RBC</b> <b>10<sup>6</sup> cells/μL</b>	<b>HGB</b> <b>g/dL</b>	<b>HCT</b>	<b>MCV</b> <b>fl</b>	<b>MCH</b> <b>pg</b>	<b>MCHC</b> <b>g/dL</b>	<b>PLT</b> <b>10<sup>9</sup> cells/μL</b>
Control	<b>8.47±1.00</b>	8.02±0.79	13.57±1.37	53.95±5.85	<b>67.00±1.53</b>	16.93±0.03	25.23±0.70	641.33±66.46
Negative Control	<b>8.04±0.72</b>	8.64±0.93	14.05±1.55	52.30±5.44	<b>60.50±0.50*</b>	16.25±0.05	26.75±0.15	784.50±44.50
200 mg Treatment	6.90±0.52	8.36±0.28	13.57±0.67	50.91±2.29	<b>60.67±0.88*</b>	16.23±0.32	26.70±0.20	750.67±39.35
400 mg Treatment	7.20±0.20	6.63±0.44	11.50±0.60	44.43±3.34	<b>67.33±2.40<sup>a,b</sup></b>	<b>35.53±18.24</b>	26.00±0.78	792.33±28.83
600 mg Treatment	11.62±0.47 <sup>*,a,b,c</sup>	6.33±0.12	10.70±0.20	45.48±0.39	<b>72.00±2.00<sup>a,b</sup></b>	16.90±0.00	23.45±0.65	623.50±10.50
Extract treatment	4.70±1.19 <sup>*,a,c,d</sup>	4.93±1.62 <sup>*,a,b</sup>	13.97±2.99	31.85±10.7 <sup>*,b</sup>	<b>64.00±0.58<sup>d</sup></b>	<b>29.55±4.82</b>	46.55±7.94 <sup>*,a,b,c,d</sup>	619.50±139.4

*Concentrations of haematological parameters in the different experimental groups.*

*Values are expressed as mean ± SEM, n = 5.*

*\*significantly different from Control at p<0.05; a=significantly different from Negative Control at p<0.05; b=significantly different from 200 mg treatment group at p<0.05  
c=significantly different from 400 mg treatment group at p<0.05; d=significantly different from 600 mg treatment group at p<0.05*

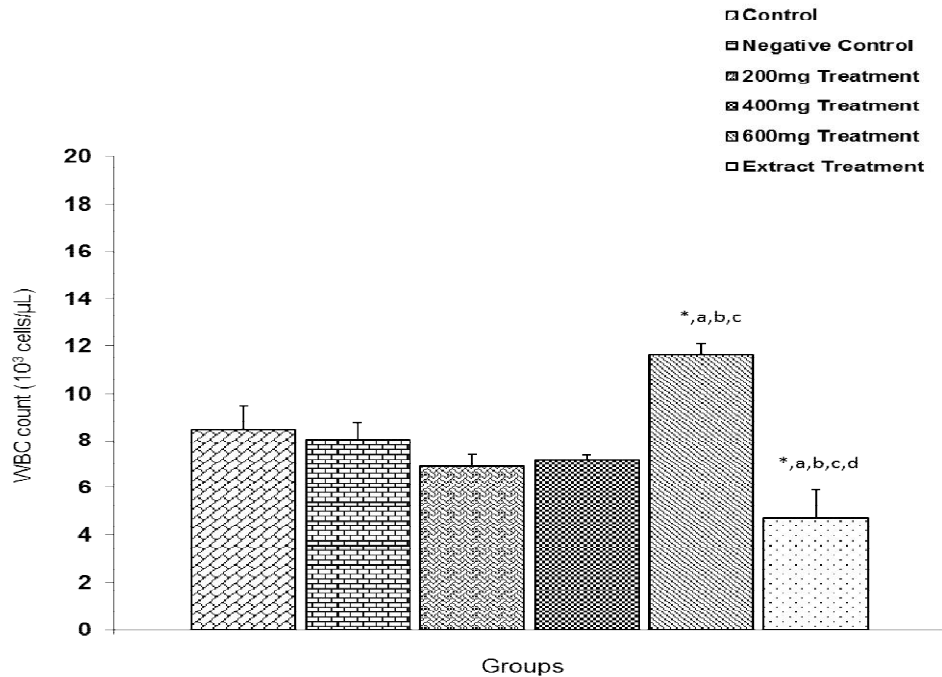


Figure : Comparison of white blood cell Count in the different experimental groups. Values are expressed as mean ± SEM, n =5. \*significantly different from Control at p<0.05 a=significantly different from Negative Control at p<0.05 b=significantly different

From the data obtained, the negative control group shows no significant ( $P < 0.5$ ) increase ( $8.64 \pm 0.93$ ) compared to red blood cells (RBC) of animals in normal control group. But upon treatment with the different doses of *Moringa oleifera* extract, there was a decrease in the red blood cell count of 200 mg, 400 mg and 600 mg showing a dose-dependent response, though the decrease was insignificant compared to the negative control. Also, a significant decrease in red blood cell count was observed in the group treated with extract only. This result is demonstrated in the figure below.

The data obtained as shown in the figure below indicated that the alcohol-treated group (negative control) has an insignificant ( $P > 0.05$ ) decrease in packed cell volume ( $52.30 \pm 5.44$ ) compared to the normal control ( $53.95 \pm 5.85$ ). Upon treatment with different doses of *Moringa oleifera* extract (200 mg, 400 mg and 600 mg). There was further decrease in hematocrit values with the 400 mg dose, though the decrease was insignificant ( $P > 0.05$ ) with a mean value of ( $44.43 \pm 3.34$ ) compared to the negative control with a mean value of ( $50.51 \pm 2.29$  and  $45.48 \pm 0.39$ ) of the doses of 200mg and 600mg respectively. But, a

significant ( $P < 0.05$ ) decrease was also observed in the group treated with extract only without alcohol toxicity. The data shows that the extract treated group has packed cell volume (PCV) value of ( $31.85 \pm 10.70$ ).

Following the induction of alcohol toxicity, the data obtained as shown in the figure below shows that there was a significant ( $P < 0.05$ ) decrease in mean corpuscular volume (MCV) value ( $60.50 \pm 0.50$ ) of the negative control and the normal control ( $67.00 \pm 1.53$ ). Upon treatment with 200mg dose of *Moringa oleifera* extract there was no significant ( $P < 0.05$ ) change compared to the negative control, but the decrease was also significant ( $P < 0.05$ ) compared to the normal control.

Meanwhile, the acute alcohol toxicity and the subsequent treatment with different doses of *Moringa oleifera* did not show any significant ( $P < 0.05$ ) effect on the blood MCH and MCHC as well as blood platelets relative to the controls. Nevertheless, the extract treated group shows significant ( $P < 0.05$ ) increase in MCHC relative to the controls and the other treatment groups the figure below shows the effect of different

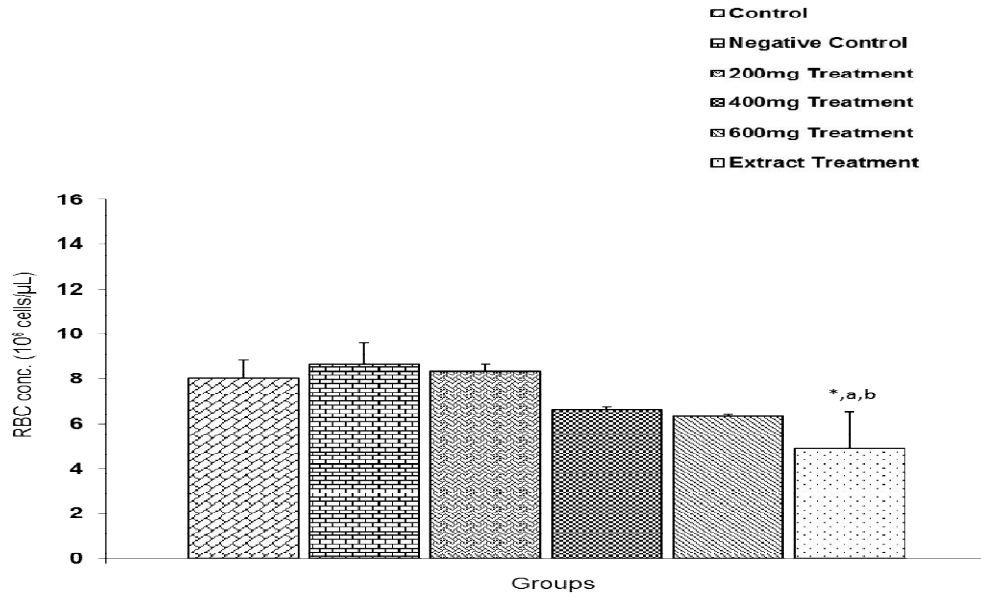


Figure Comparison of of RBC conc. in the different experimental groups.  
 Values are expressed as mean  $\pm$  SEM, n = 5.  
 \*significantly different from Control at  $p < 0.05$   
 a=significantly different from Negative Control at  $p < 0.05$   
 b=significantly different from 200mg

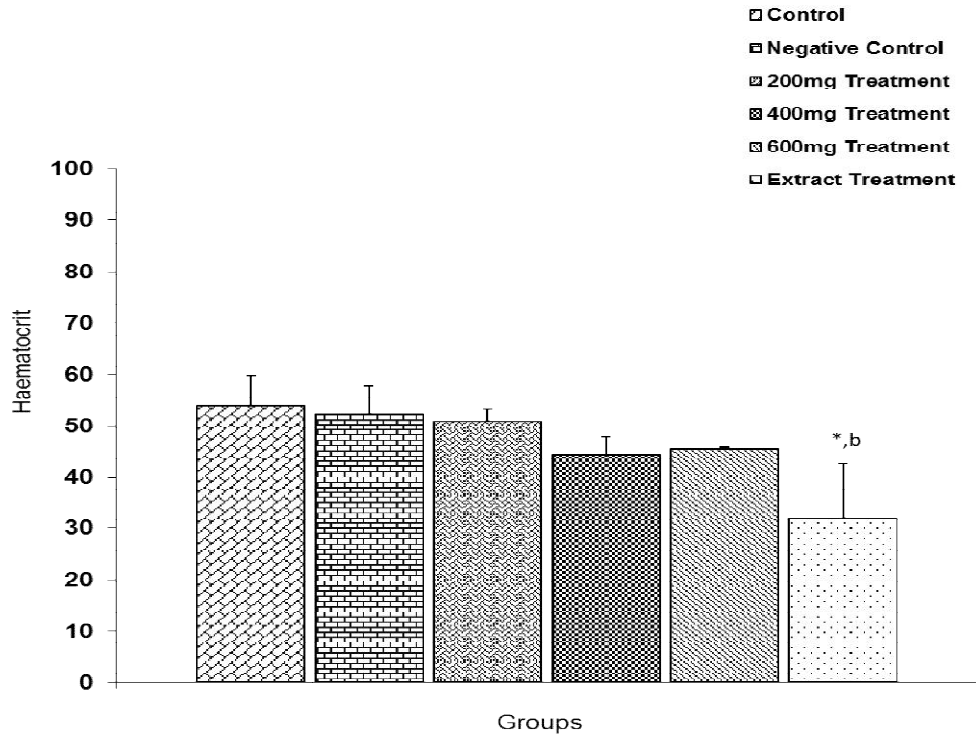


Figure : Comparison of haematocrit in the different experimental groups.  
 Values are expressed as mean  $\pm$  SEM, n =5.  
 \*significantly different from Control at  $p < 0.05$   
 b=significantly different from 200mg treatment group at  $p < 0.05$ .

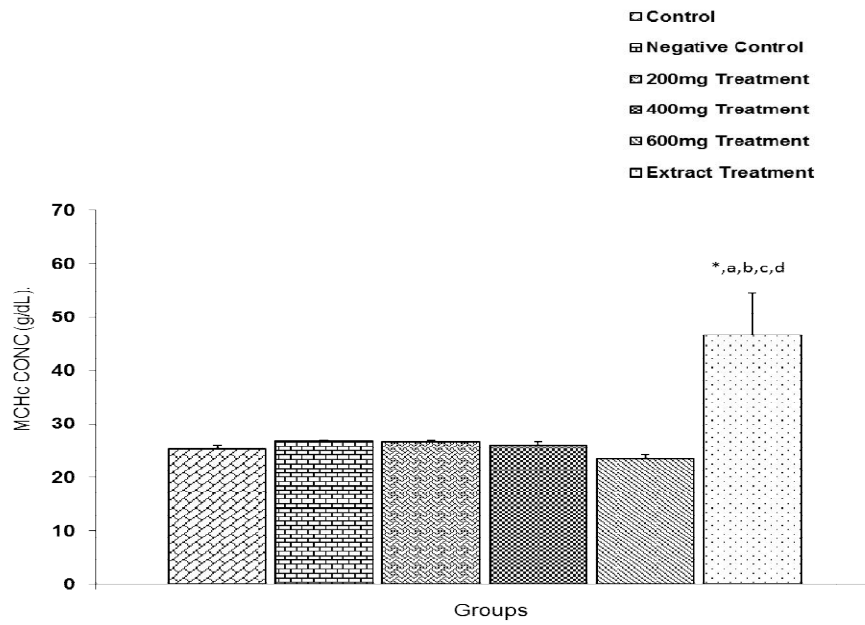


Figure Comparison of of MCHC in the different experimental groups.  
 Values are expressed as mean  $\pm$  SEM, n = 5.  
 \*significantly different from Control at  $p < 0.05$   
 a=significantly different from Negative Control at  $p < 0.05$   
 b=significantly different from 200mg treat

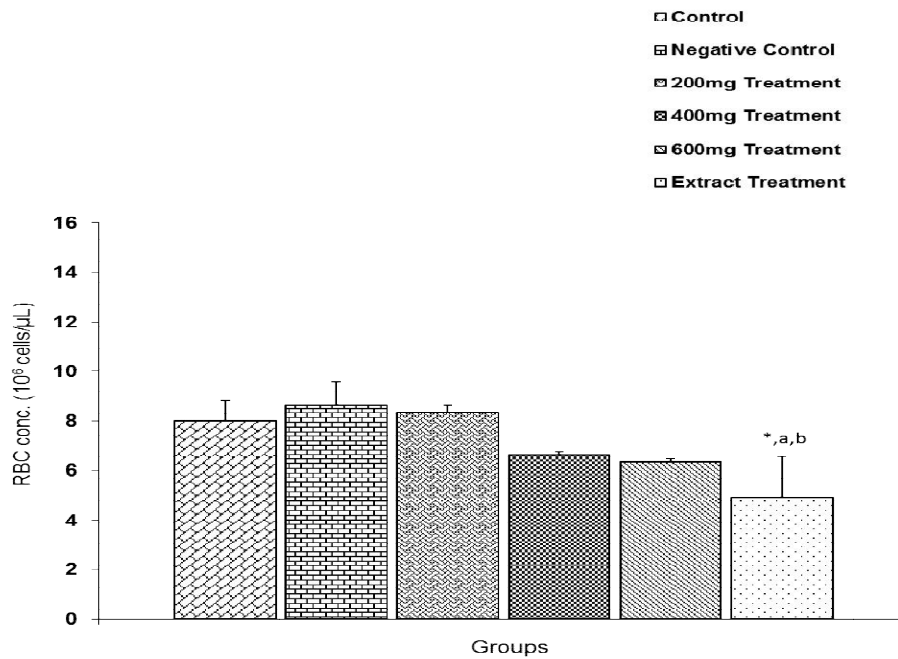


Figure Comparison of of RBC conc. in the different experimental groups.  
 Values are expressed as mean  $\pm$  SEM, n = 5.  
 \*significantly different from Control at  $p < 0.05$   
 a=significantly different from Negative Control at  $p < 0.05$   
 b=significantly different from 200mg



doses of *Moringa oleifera* extract following acute alcohol toxicity on haemoglobin count of rats. According to the data obtained, it was observed that haemoglobin volume increased insignificantly ( $P < 0.05$ ) following acute alcohol toxicity as shown in the negative group ( $14.05 \pm 1.55$ ) compared to the control group ( $13.57 \pm 1.37$ ). A further decrease was also observed following treatment of the induced animals with different doses (200 mg, 400 mg and 600 mg) of *Moringa oleifera* extract. While the decrease was more obvious in dose 400 mg and 600 mg ( $11.50 \pm 0.60$  and  $10.70 \pm 0.20$ ) respectively, the 200 mg dose and the non-induced group treated with the extract shows almost no change. Meanwhile, the overall effect of the treatment on haemoglobin count was insignificant ( $P < 0.05$ ) compared to the controls.

#### 4. DISCUSSION

The administration of aqueous root extract of *moringa oleifera* for 14 days produced a significant ( $P < 0.05$ ) decrease in RBC and WBC count comparing to that of the control group. The observed decrease in RBC count in *moringa oleifera* treated group may have been due to the suppressive effect of some of the active component of the plant extract on bone marrow. These bioactive components such as saponins, alkaloids, flavonoids, and phenolic [17], might also have suppressed the growth factors in the bone marrow. Another issue of the decreases in RBC may be due to hemolysis mediated via the phytochemical components of the plant extracts, or may be the extract could cause failure of erythropoietin production, which would lead to anemia. From the data obtained it was observed that white blood cells (WBC), packed cell volume (PCV) and mean corpuscular volume (MCV) insignificantly ( $P < 0.5$ ) decreases following acute alcohol toxicity, it is well-known that PCV is otherwise called hematocrits which represent the percentage of blood therefore, increases in PCV, shows a better transportation and thus results in increase in both primary and secondary polycythemia. There is also a direct relationship between erythrocytes, PCV and haemoglobin concentration [18]. This report is in accordance with the previous work reported by Elanchezian et al. [19]. Also, the red blood cell (RBC) and haemoglobin (Hb) count were slightly increased following alcohol toxicity. This observation contradicts the previous report by Isaac et al. [20] which reported that there was a reduction in red blood cells and lymphocytes count relative to their control following treatment of rats with 10

ml/kg of alcohol. Likewise, the same treatment causes no significant ( $P < 0.05$ ) change in total white blood cells (TWBC), Haemoglobin (Hb) and platelets relative to their controls this sharp changes in Hb concentration must have been a high dose of the extracts that could result in increase in hemolysis of the red blood cells. This also agrees with the outcome of this experiment as the alcohol toxicity did not show any significant ( $P < 0.5$ ) change in the blood indices. The same observation was noted as PCV, MCV and MCHC did not show any significant change. Upon treatment with different doses of *Moringa oleifera* root extract, it was observed that there was a dose-dependent response. Whereas, the 200 mg and 400 mg doses decreased insignificantly ( $P < 0.5$ ) relative to the negative control. The 600mg dose shows a significant ( $P < 0.5$ ) elevation in WBC count relative to both the negative control and the other treatment groups. This result indicates that with a dose of about 600mg aqueous root extract of *moringa oleifera*, the extract has the capacity to elevate WBC count which would equally impact the immunological integrity of the body by boosting the defense mechanism of the body. The elevation of WBC count is in tandem with the previous reports by Bamishaiye [21] who reported that aqueous extract of *Moringa oleifera* seed administered 100-400mg/kg weight significantly ( $P < 0.05$ ) increased neutrophil, eosinophil, basophil and monocytes counts at the second and third week of administration relative to the control group. Also, from the result shown in the figure showing effects of extract on WBC count, it was observed that the group treated with extract without toxicity induction shows a significant decrease in WBC count which shows that aqueous extract of moringa extract with highly extremely doses can significantly ( $P < 0.05$ ) reduce WBC hence, compromising the body immune's system. The decrease in the WBC count following the administration of *Moringa oleifera* extracts is not in line with the normal physiological response following perception of a foreign attack by the body defense mechanism, this decrease may have resulted from the suppression of their production in the bone marrow. Also, it was observed that RBC counts were non-significantly elevated in the negative control relative to the normal control. While among the treatment group, it was observed that there was a continuous non-significantly decreased RBC count as the extract doses increases from 200 mg, 400 mg and 600mg showing a dose-dependent response. While the group treated with extract alone shows a further

decrease in RBC count which was significant ( $P < 0.05$ ). The result indicates that higher doses of aqueous root extract of *Moringa* are toxic to RBC and such effect can lead to anemia.

Meanwhile, the effect of the aqueous root extract of *Moringa oleifera* shows a further decrease in hematocrits count relative to the negative control. Among the dose determined treated groups, the group treated with a 200 mg dose shows a higher decrease compared to other groups, but all changes were insignificant ( $P < 0.05$ ) except the extract treated group which shows significant ( $P < 0.05$ ) decrease compared to the normal control.

It was also observed that they were a little increase in MCHC levels compared to the normal control across groups, a significant ( $P < 0.05$ ) increase was only observed in the last group (The group treated with the only extract). The results above also show that alcohol group treated with 400 mg and 600 mg body weight of the aqueous root extract of *Moringa oleifera* shows a significant ( $P < 0.05$ ) increase in MCV which indicates that the extract is capable of reversing the anemic condition.

## 5. CONCLUSION

The root extract of *Moringa oleifera* plant is widely recognized as a medicinal plant and sometimes consumed concomitantly with alcohol. The effect of the aqueous root extract of *Moringa oleifera* shows a further decrease in hematocrits count relative to the negative control. This research work shows that the plant extract contains some bioactive component or phytochemical constituents that are capable of ameliorating the toxicity effect of alcohol on animal models.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

Ethical approval was also sought from the committee, faculty of basic medical science, University of Calabar, Calabar.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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