EVALUATION OF HEAMATOLOGICAL CHANGES IN RABBITS EXPOSED TO SODIUM CYANIDE

ABSTRACT

INTRODUCTION: cyanide (HCN, NaCN) is a compound that dissociates to the cyanide anion (CN) and a cation (H^+, Na^+) [1]. Cyanides, like sodium and potassium cyanide, are crystalline hygroscopic salts widely used in ore extracting processes

AIM: The aim of this study was to evaluate the haematological changes in rabbits due to sodium cyanide exposure.

Study design: An experimental study.

Place and Duration of Study: This study was carried out at Animal House, Applied and Environmental Biology Department, Rivers State University, Port Harcourt, Rivers State, Nigeria, between April 2020 and November 2020.

Methodology: Atotal of forty-eight (48) rabbits as indicated by Mead's formula constituted the sample size. The study was divided into three groups including the control group. With the exception of the control rabbits, others were treated daily with 0.05 mg/kg sodium cyanide for 30 days, 60 days and 90 days respectively. Cardiac blood samples were extracted from the rabbits using standard procedure. Haematological parameters investigated include packed cell volume (PCV), white blood cell count (WBC), lymphocyte (L), neutrophil (N), monocyte (M), eosinophil (E) and platelet count (P). Data were expressed as mean ± SD. Statistical differences between groups were computed using Graph pad prism 7.0 version. Results were analyzed using analysis of variance (ANOVA) and significance between groups was taken at $p< 0.05$.

Results:Haematological results showed significant ($p<0.05$) decrease in levels of packed cell volume, neutrophil and monocyte in 30 days, 60 days and 90 days respectively as compared to control.

Conclusion; Exposure to 0.05 mg/kg sodium cyanide may have harmful effect on haematological parameters due to damages done to red blood cells.

Keywords: Haematological parameters, sodium cyanide,PortHarcourt.

INTRODUCTION

Generally, the term cyanide refers to the anion CN or to its acidic form, hydrocyanic acid (HCN). Cyanogen (C_2N_2) is a product of the oxidation of cyanide ions; however, the term cyanogens also refers to any substance that forms cyanide upon metabolism and produces the biological effects of free cyanide. Precisely, simple cyanide (HCN, NaCN) is a compound that dissociates to the cyanide anion (CN) and a cation (H^+, Na^+) [1].Cyanides, like sodium and potassium cyanide, are crystalline hygroscopic salts widely used in ore extracting processes, synthesis of organic and inorganic chemicals and production of chelating agents[2].

Principal features of toxicity profile for cyanide are, high acute toxicity by all routes of administration, with a very steep and rate-dependent dose-effect curve and chronic toxicity , probably mediated through the main metabolite and detoxification product, thiocyanate [3].The toxic effects of cyanide in humans and animals are generally alike and are assumed to result from inactivation of cytochrome oxidase inhibition of cellular respiration and histotoxic anoxia [4].

Cyanides are well absorbed through the gastrointestinal tract or skin and rapidly absorbed through the respiratory tract. Once absorbed, cyanide rapidly and ubiquitously distributed round the body, although the highest levels are specifically found in the liver, kidney, lungs, blood and brain[5].

The most widespread problems arising from cyanide are from chronic/sub chronic exposures. Chronic cyanide toxicity is involved in the pathogenesis of some health problems. Besides acute poisoning, cyanide chronic intoxication may also produce some pathologic effects on different tissues that precede alterations in biochemical parameters [6.]

Moreover, chronic cyanide intoxication induces alterations in some tissue haematological, biochemical, histological and oxidative stress parameters in experimental animal model [7,8] reported decrease levels of erythrocyte count, haemoglobin concentration, packed cell volume and mean corpuscular haemoglobin and normal leukocyte count, leukocyte differential count and platelet count in rabbits exposed to cyanide.

This study was designed to evaluate haematological parameters in rabbits exposed to 0.05mg/kg sodium cyanide.

MATERIALS AND METHODS

Study Area

The breeding and intoxication of the study was conducted at Rivers State University, Port Harcourt. The biochemical investigations were carried out at National Nigerian Petroleum Corporation (NNPC), Medical laboratory, Akpajo, Port Harcourt

Study Population

A total of forty eight (48) rabbits constitute the sample size.The animals used were divided into three groups with matched control. Four rabbits were assigned to each group and the study lasted for 90 days as follows: group one (0 – 30) days, Group two (0 – 60) days, Group three (0 – 90) days. Each rabbit in a group (treated group) was given 10ml of 0.05mg/kg sodium cyanide orallydaily for 90 days. The matched control and treated rabbits were given water *ad-libitum* and feed daily.

Ethical Approval

The Ethical clearance and experimental protocol were approved by the Ethic Committee of Rivers State Ministry of Health. The Animal Welfare Act of 1985 of the United State of America for research and Institutional Animal Care and Use Committee (IACUC) protocol were strictly adhered to.

Selection Criteria

Only apparently healthy male and female rabbits of same age and weight were used for the study. The age range was between six to eight months. The weight brackets were 1.2 to 1.5 kg. lysed blood samples were rejected.

Procurement of materials

Sodium cyanide, 98% purity, produced by Changsha Hekang Chemical Co. Ltd was purchased at Decosmiller Ventures, Ogbete, Enugu State, Nigeria.

Experimental animals

Forty eight (48) rabbits were used for the experiment. The animals were purchased at Sandre Farm,Oyigbo, Rivers State, Nigeria.

Study design

The animals used were divided into three groups with matched control. Four rabbits were assigned to each group and study lasted for 90 days as follows: Group one (0 – 30) days, Group two (0 – 60) days, Group three (0 – 90) days. Each rabbit in a group was given 10ml of 0.05mg/kg sodium cyanide orally daily. The matched control and treated rabbits were givenwater

ad-libitum and feed daily. The blood samples were taken for analysis at day 30, 60 and 90 respectively. All animals used for the study were handled in compliance with the guide to the care and use of animals for research and teaching.

Collection of Sample

The blood samples were collected into ethylene diamine tetra acetic acid (EDTA) bottles.

2.1 Laboratory Analysis

The samples were analyzed for estimation of haemoglobin concentration (HB), packed cell volume (PCV), white blood cell count (WBC), neurophils (N), lymphocytes (L), monocyte (M), eosinophil (E) and platelets count using Genrui KT 6300.

Statistical analysis

Data are expressed as mean ± SD. Statistical differences between groups were computed using Graph pad prism 7.0 version. Results were analyzed using analysis of variance (ANOVA) and significance between groups was taken at $p < 0.05$

RESULTS

Haematological changes for rabbits given oral doses of 0.05mg/kg sodium cyanide for day 30, 60 and 90 are presented in Table 1, 2 and 3

Table 1: Mean ±SD of Haematological Parameters of Rabbits Treated with 0.05 mg/kg Sodium Cyanide for 30 days

S/N	Experimental Groups	Parameters							
		PCV (%)	HB (g/dL)	WBC (x 10^9 /L)	NEUT (%)	LYMP (%)	EOSIN. (%)	MONO (%)	PLT (x10^9 /L)
1	Control	32.47±	10.82±	7.70±	32.14±	63.09±	1.47±	3.17±	198.70±

		1.24	0.42	0.48	0.09	0.05	0.24	0.10	0.63
2	Test	31.83± 1.42	10.61± 0.48	7.77± 0.49	31.14± 0.19	63.32± 0.10	1.45± 0.19	4.21± 0.13	198.00± 0.75
3	T-value	0.6797	0.6803	0.2103	4.751	4.058	0.9765	12.7	0.8641
4	P value	0.5220	0.5217	0.8404	0.0032	0.6067	0.4145	<0.00 01	0.1787

Keys: PCV = packed cell volume, HB = haemoglobin, WBC = white blood cell, NEUT. = neutrophils, LYMP = lymphocytes, EOSIN. = eosinophil, MONO = monocytes, PLT = platelets.

Table 2: Mean ±SD of Haematological Parameters of Rabbits Treated with 0.05 mg/kg Sodium Cyanide for 60 days

S/N	Experimental Groups	Parameters							
		PCV (%)	HB (g/dL)	WBC (x 10^9 /L)	NEUT (%)	LYMP (%)	EOSIN. (%)	MONO (%)	PLT (x10^9 /L)
1	Control	32.50± 1.10	10.83± 0.36	7.71± 0.10	32.15± 0.08	63.14± 0.09	1.31± 0.20	3.20± 0.13	198.70± 0.57
2	Test	29.04± 0.29	9.68±0. 10	7.78± 0.62	29.62± 0.11	63.64± 0.09	1.36± 0.10	4.88± 0.13	199.00± 0.77
3	T-value	6.109	6.108	0.1684	36.78	8.082	1.353	18.93	0.5244
4	P value	0.0009	0.0009	0.8718	<0.000 1	0.6301	0.6446	<0.00 01	0.6188

Keys: PCV = packed cell volume, HB = haemoglobin, WBC = white blood cell, NEUT. = neutrophils, LYMP = lymphocytes, EOSIN. = eosinophil, MONO = monocytes, PLT = platelets.

Table 3: Mean ±SD of Haematological Parameters of Rabbits Treated with 0.05 mg/kg Sodium Cyanide for 90 days

S/N	Experimental Groups	Parameters							
		PCV (%)	HB (g/dL)	WBC (x 10^9 /L)	NEUT (%)	LYMP (%)	EOSIN. (%)	MONO (%)	PLT (x10^9 /L)
1	Control	32.78± 1.02	10.92± 0.34	7.70± 0.65	32.25± 0.12	63.09± 0.05	1.44± 0.11	3.14± 0.12	198.70± 0.52
2	Test	25.30± 0.21	8.43±0. 07	7.86± 0.57	27.67± 0.15	63.78± 0.10	1.49± 0.03	5.14± 0.10	199.10± 0.63
3	T-value	14.43	14.52	0.3524	46.91	31.14	2.531	28.91	1.008
4	P value	<0.000 1	<0.000 1	0.7366	<0.000 1	0.4201	0.0646	<0.00 01	0.3524

Keys: PCV = packed cell volume, HB = haemoglobin, WBC = white blood cell, NEUT. = neutrophils, LYMP = lymphocytes, EOSIN. = eosinophil, MONO = monocytes, PLT = platelets.

DISCUSSION

The result of this study showed that haematological parameters of rabbits fed with topfeed mixed with sodium cyanide solution for 30, 60 and 90 days respectively caused a significant reduction in haemoglobin concentration at $p<0.05$ when compared with the match control level. Sodium cyanide can affect the haematopoietic system through retraining synthesis of haemoglobin by hindering key enzymes involved in haeme synthesis pathway such as aminolevulic acid dehydratase (ALAD).Cyanide is found to be highly poisonous to living organism, primarily due to the formation of complexes with metal ions that present as enzyme cofactors[9].The notable effect of cyanide occurs with Fe^{3+} ion in cytochrome, thereby obstructing cellular respiration and hence oxidative phosphorylation [10].

Haematological parameters (Tables 1 and 2) showed that there was an increase ($p<0.05$) in monocyte count with a decrease ($p<0.05$) in packed cell volume, haemoglobin concentration and neutrophil count. This result agree with the work of [11] that observed increase levels of lymphocyte, monocyte and a derease levels of neutrophile, oeosinophile and platelets inrabbits fed with *Manihot utilissima.* The observed reduced packed cell volume could be attributed to histotoxic hypoxia effect of cyanide on cell which is capable of heamolysis.

The haematological parameters (Table 3) showed that chronic exposure could cause anaemia as showed in decreased heamoglobin and packed cell volume. This result is in line with the work of [12]that observed sodium cyanide induced toxicity whichcaused anaemic conditions in

rabbits. The Toxicity effects observed might be attributed to the effect of cyanide on the red blood cells.

Haematological indices are of diagnostic significance in routine clinical evaluation of health. The reduction in the heamatocrit values observed in this study was an indication of an anaemic condition and this condition could be attributed to haemolysis which was beyond the capacity of the bone marrow to compensate for the loss. Also, the toxic effect of sodium cyanide on the haematopoietic cells in the bone marrow could be associated with the metabolites of sodium cyanide that were released in high concentration which hindered the normal mechanism that regulate blood cell formation.

The total white blood cell of rabbits in control group differed significantly ($p<0.05$) from the rabbits at 60 and 90 days groups, this observation could be associated with the toxic effect of sodium cyanide on the immune system. This effect could cause an immunosuppressive effect, which is suggestive of an impairment of the ability of the leukocyte to respond to antigenic mutagenic stimuli due to rapid proliferation.

CONCLUSION

It can be concluded that long term exposure to 0.05mg/kg sodium cyanide may have harmful effect on haematological parameters.

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