Effect of Cyanide on the Liver Histological and Biochemical Status

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Abstract

The biochemical and histological response of the rats following dosed on the potassium cyanide was examined in this study, about 36 rats were randomly divided into sex groups ; G0 which considers the control group, G1 oral dosed with potassium cyanide concentration 500ppm (500U/L), G2 dosed with concentration 1000ppm (1g/L), waiting for a long time 21 days before anatomy the animal. G3, G4, and G5 dosed with 2000ppm, 2500ppm, and 3000ppm, respectively to study the effect of high dose concentration on the liver histology, liver enzyme and lipid profile and determined LD_{50} (lethal dose), and LC_{50} (lethal concentration). After anatomy, the animal experiment to study the liver histological and determine the effect of potassium cyanide concentration on the liver enzymes such as HDL, triglyceride, and cholesterol, compared the result with the control group and previous studies . The study indicated the presence of a significant increase ($P \leq 0.05$) in ALP in the G1 , a non-significant increase ($P \geq 0.05$) in the G2 , the G3 and G4 groups suffered from a significant increase ($P \leq 0.05$) while the G5 group suffered from a non-significant decrease ($P \geq 0.05$) in comparison with G0. The present study also showed that there was a significant increase ($P \leq 0.05$) in GPT in the G1 , G2 , G3 , G4 in comparison with G0. The study also indicated the presence of a significant increase ($P \leq 0.05$) in GOT In the G1 , G2 and G3 compared to the G0.

Keywords : *cyanide , liver enzymes , histological and biochemical status, lipid*

Introduction

Cyanide is a chemical material that is popularly regarded as a highly toxic agent. Cyanide can be formed by some plants, bacteria, fungi, and algae [(1)]. CN occurs in several forms, including gaseous cyanide hydrogen (HCN), water-soluble potassium (K), and sodium (Na) salts, poorly water-soluble mercury (Hg), copper (Cu), gold (Au), and silver (Ag) CN salts [(2)]. Cyanide enters the air, water, and soil [(3)]. In the lungs, gastrointestinal tract, and skin, cyanide is absorbed [(4)]. Symptoms may occur within seconds of inhalation of HCN, within minutes of ingestion of cyanide salts, and may delay up to 12 hours following ingestion of cyanogenic glycosides, nitriles, or thiocyanates. Absorption time following ingestion depends on the pH of the gut and the solubility of the compound containing cyanide. Cyanide ready for use [(5)] .

Cyanide is one of nature's most potent toxins which can affect all species including cattle. Provided their feeding style, ruminants can be easily affected by this toxin [(6)]. Understanding of toxicity mechanisms is both practical and theoretical, providing a rational basis for evaluating descriptive toxicity data and estimating the likelihood that toxicity will occur, creating fewer dangerous drugs and synthetic chemicals, and creating more highly harmful pesticides for their target species [(7)]. Cyanide is a chemical asphyxiate that prevents the

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aerobic use of oxygen by binding to cellular cytochrome oxidase. The bulk of unbound cyanide (80 percent) is detoxified by thiocyanate metabolism, a substance that is much less harmful and is excreted in urine [8].

The liver is the largest gland in the body, and its concerned with the production and secretion of bile and many metabolic functions crucial to normal Homeostasis [9]. The liver is of great interest to the toxicologist, it is invariably examined and removed at postmortem examination and then sampled for histological sectioning [10]. The liver is one of the largest digestive organs and is located in a very strategic position. All absorbed nutrients and liquids from the intestines enter the liver through the hepatic portal vein [11]. It comprises two main lobes of almost equal size—right and left—separated by a falciform ligament and a round ligament (ligamentum teres) [12]. Many circulating plasma proteins are produced and secreted by the liver. The liver plays an important role in the uptake, storage, and distribution of both nutrients and vitamins from the bloodstream. The liver has a dual blood supply: a venous supply via the hepatic portal vein and an arterial supply via the hepatic artery [13]. Histologically the liver is composed of lobules, each lobule comprises a central vein (a tributary of the hepatic veins) with the portal tracts situated at the periphery [9]. About 80% of liver tissue in the adult is parenchyma consisting of hepatocytes arranged as a labyrinth of cellular plates. The remaining 20% is the stroma, a delicate supportive framework of connective tissue that forms the outer Glisson capsule [12] .

Elevated levels of one or more liver enzymes are commonly found in asymptomatic patients. Such findings may be important, because minimal elevation may be the only manifestation of the significant hepatobiliary disease [14] .

Liver function tests (LFTs)—these should include tests for liver secretory capacity (bilirubin, alkaline phosphatase, and gamma-glutamyl transferase (GGT)); synthetic capacity (albumin) and inflammation (aspartate aminotransferase (AST)) and alanine aminotransferase (ALT) [9].

Material and Method

Thirty-six White rats used in the experiment divided into sex groups. This animal set in a plastic cage and kept in a temperature room between 21-24 C^o.

This animal let for long 14 days to become acclimatized to naturalize, the animals were orally dosed with potassium cyanide at different doses (table 1) to determine the effect solution on the liver histological and the liver enzyme. Measurement included : ALP (Alkaline Phosphatase), GPT (glutamic-pyruvic transaminase), GOT (glutamate oxaloacetate transaminase) , Cholesterol, Triglyceride and
HDL (High density Lipoproteins) .

Table 1. : Showing the dose for groups)

ON	Group	Number	Concentration	Death
1	G1	6	Zero	Zero
2	G2	6	500ppm	Zero
3	G3	6	1000ppm	Zero
4	G4	6	2000ppm	3
5	G5	6	2500ppm	5
6	G6	6	3000ppm	6

Statistical Analysis

Data were subjected to analysis. The value was reported as Mean+ SE, while ANOVA and LSD were used to test for difference science (SPSS) version 16 (P≤ 0.05) was accepted as significant.

Results

The statistical analysis of the study indicated the presence of a significant increase (P≤ 0.05) in ALP in the G1 as well as a non-significant increase (P≥ 0.05) In the G2 group for a length period of 21 days' comparison with the G0 group. The G3 and G4 groups suffered from a significant increase (P≤ 0.05) while the G5 group suffered from a non-significant decrease (P≥ 0.05) in comparison with G0.

The Statistical analysis also showed that there was a significant increase (P ≤ 0.05) in GPT in the G1 and G2 for a length period of 21 days' in comparison with G0. The statistical analysis indicates a significant increase (P≤ 0.05) In the G3, G4 and G5 comparison with G0.

The statistical analysis indicated the presence of a significant increase (P ≤ 0.05) in GOT In the G1 and G2 for a length period of 21 days' compared to the G0. It was also found that there is a significant increase (P≤ 0.05) In the G3 and G5 groups and indicated a non-significant increase (P≥ 0.05) In the G4 group comparison with G0 (as shown in table 2) .

Table 2. : showing the effect of potassium cyanide on the groups compared with the control group (Mean + SE).

Group	ALP	GPT	GOT	Dose
G1	497.50±33.76	58.06±2.71	134.67±1.64	500 PPM
G2	131.42±18.33**	75.13±2.05	137.63±5.81	1000 PPM
G3	275.00±2.24	100.52±0.23	346.50±101.12	2000 PPM
G4	372.90±42.88	59.37±6.86	112.20±2043**	2500 PPM
G5	38.13±1.73*	50.45±3.68	141.46±22.84	3000 PPM
G0	125.49±18.03	38.83±1.35	35.17±1.35	ZERO
Lsd	68.34	9.73	79.96	

* non-significant decrease compared to G0 .

** non-significant increase compared to G0 .

The Statistical analysis showed there was a non-significant decrease (P≥ 0.05) in cholesterol In the G1 group, while the G2 suffered from a non-significant increase (P≥ 0.05) for a length period of 21 days' in comparison with the G0. The statistical analysis showed a significant increase (P≤ 0.05) in triglyceride in the G4 and G5 groups. the G3 suffered from anon significate increase (P≥ 0.05) in comparison with G0. The statistical results of the study showed a non-significant decrease (P≥ 0.05) In the G1 and G2, for a length period of 21 days compared to the G0. It also indicated a non-significant decrease (P≥ 0.05) In the G3, G4, and G5 groups, in comparison with G0.

The statistical analysis of the current study showed there was a non-significant increase (P≥ 0.05)in HDL in the G1 and a non-significant decrease (P ≥ 0.05). In the G2 for a length period of 21 days compared with G0 group. The results indicated a non-significant increase (P≥ 0.05) In the G3 and G5 groups, as well as a non-significant increase (P≥ 0.05) In the G4 group comparison with G0, (as shown in table 3) .

The results of the microscopic examination showed the hepatic tissue of the G1 congestion blood in the central vein, discrete apoptotic hepatocyte cells, and

reduction in the glycoprotein granules. Comparison with the control group. (figure 1-A).

The results of the microscopic examination also showed the hepatic tissue of the G2 dosed in solution KCN showing look – like normal structure but with the widening of hepatic sinusoid and reduction in the size of the hepatocyte cells, Comparison with the control group. (figure 1-B).

Table 3. : Showing the effect of potassium cyanide on the groups compared with the control group (Mean + SE).

Group	Cholesterol	Triglyceride	HDL	Dose
G1	45.00±1.34	70.50±7.38**	34.67±0.30*	500 PPM
G2	67.84±5.56	47.00±4.81*	53.56±5.24**	1000 PPM
G3	73.04±18.69	90.50±4.25**	43.17±1.42	2000 PPM
G4	101.58±14.12	196.60±31.67	95.99±18.60**	2500 PPM
G5	89.44±8.19	94.19±8.56**	61.57±5.64	3000 PPM
G0	142.67±13.51	67.00±3.58	41.03±2.44	ZERO
Lsd	26.30	38.95	18.01	

* Non-significant decrease compared to G0.

** Non-significant increase compared to G0 .

The results of the microscopic examination showed the hepatic tissue of the G3 treated by KCN showing congestion blood in the central vein Section congestion blood in the central vein, certain degeneration, discrete apoptotic hepatocyte cells with depletion of glycoprotein granules comparison with the control group. (figure 2-A).

The results of the microscopic examination also showed the hepatic tissue of the G4 congestion blood in the central vein, rare apoptotic hepatic cells and dilated congested sinusoid, comparison with the control group. (figure 2-B).

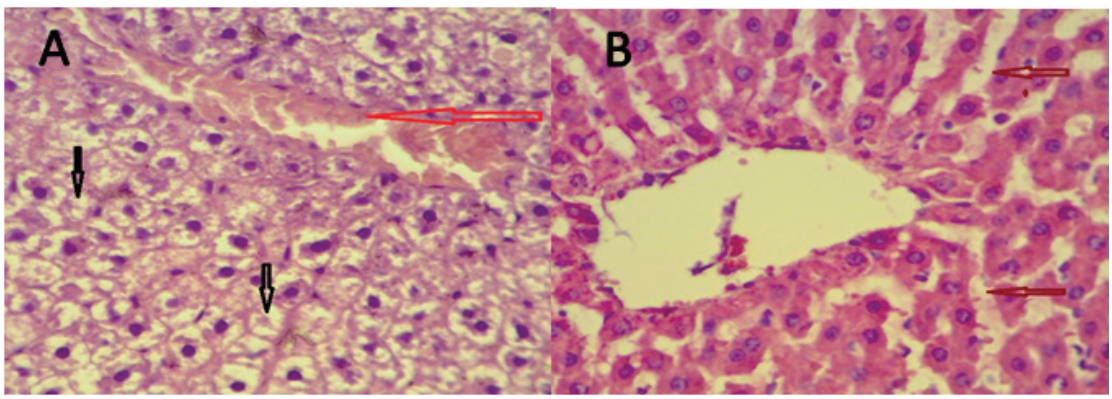

Figure (1) : A :rat liver treated with potassium cyanide solution at a concentration of 500 PPM, showing congestion (red arrow) and desecrate apoptosis hepatocytes and reduction (black arrow) in the glycoprotein granules (H & E)(X40). B : rat liver treated with potassium cyanide solution at a concentration of 1000 PPM, showing the widening (red arrow) of hepatic sinusoid and reduction in the size of the hepatocyte cells . (H&E)(X40).

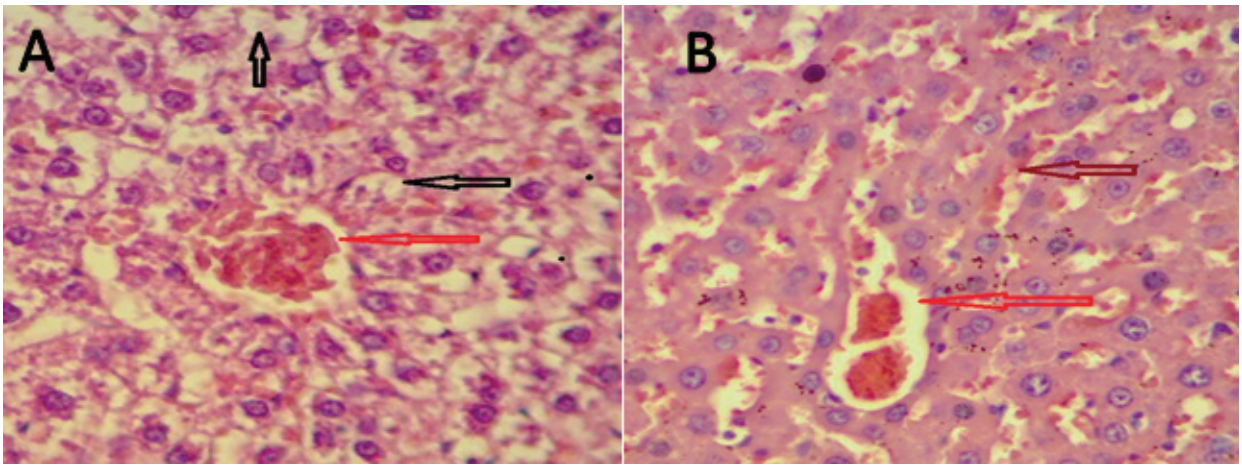

Figure (2) : A rat liver treated with potassium cyanide solution at a concentration of 2000 PPM, showing congestion (red arrow) and desecrate apoptosis hepatocytes and reduction (black arrow) in the glycoprotein granules. . (H & E)(X40). B : rat liver treated with potassium cyanide solution at a concentration of 3000PPM, showing congestion (red arrow) and widening of hepatic sinusoid (brown arrow). (H & E)(X40).

Discussion

Assessment of potassium cyanide toxicity concerning to rats, which is key to developing a toxicity assessment. Mortality of rats due to exposure to potassium cyanide (KCN) depended primarily on its susceptibility to the toxicant's concentration and duration, a strong idea of comparative le revealed the acute, chronic, sub-chronic toxicity test by earlier workers.

The liver histology shifts in coagulation, apoptotic hepatocyte cells, reduction of glycoprotein granules, depletion of glycoprotein granules, some degeneration and widening of hepatic sinusoid may be abbreviated for different dosages. This result agrees with more articles like [15] summarizes the impact of cyanide found in the article with the highest vacuum and hepatic degeneration

Showing in the Biostatistician for liver enzyme study in general found a significant increase for the liver enzyme parameters (GOT, GPT, ALP) except tow dose in alkaline phosphates. Most articles agree with the results, shown in article [16] a significant increase in the liver enzyme (ALT, AST, ALP) since an increase in these enzyme activity signifies hepatocellular injury and thus acts as biomarkers for liver damage. showing a non-significant change in the current study ($p > 0.05$) in all the dosage indicating that the cyanide treated does not affect cholesterol. When compared to the result study and data article [17], its discrepancy shows a significant increase in cholesterol in the worker's cassava compared to control in the article. Showing non-significant changes in the current study ($p > 0.05$) in all the dosages suggesting that triglyceride does not influence the cyanide handled. Relative to the outcome study and the data article [17], its disagreement shows a significant increase in triglyceride in the worker's cassava compared to control in the essay. showing the current non-significant change in the study except for G4 and G5 indicated a significant increase in high dosage, the difference between the current of the study shows no change in HDL for small dosages [17] . The impact of the article on the exposure of hydrogen cyanide to worker cassava is of interest since important data affect HCN on HDL. In the worker's cassava, show a substantial increase.

Ethical Clearance: Taken from University of Karbala ethical committee

Source of Funding : Self

Conflict of Interest : Nil

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