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Acalypha wilkesiana (Copper leaf) Leaves Alters Acute Cyanide Induced Hepatoxicity in Wister Rats

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ABSTRACT: The aim of this investigation is to ascertain the possible ameliorating potential of Acalypha*wilkesiana* (subsp. macrophylla) methanolic leaf extract on cyanide induced hepatotoxicity and haemato toxicity in Wister rats. A total of 35Wister rats weighing between 100 and 150g were apportioned into 7 groups at random, each containing 5 rats. Group 1: negative control, received no treatment; group 2 and 3 received 200 and 400 mg/kg of *A. wilkesiana* crude extract respectively; group 4: received cyanide only (positive control); group 5: received cyanide and 660 mg/kg sodium thiosulphate (standard group); group 6 and7 received 200 and 400 mg/kg of crude extract of *A. wilkesiana* respectively. The result indicates that methanolic extract of A.*wilkesiana* irrespective of the concentration significantly reduced ALT, AST, and ALP activities in the rats induced with cyanide when compared with the positive control. However, Albumin and Total Protein concentrations were significantly increased in the treated Groups when compared with the positive control. In conclusion, Acalypha *wilkesiana* leaves were able to ameliorate cyanide induced hepatotoxicity comparable to standard cyanide antidotes in Wister rats.

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Cyanide, in the environment, has been found to be associated with many intoxication incidents in humans and animals caused from the breakdown of foods, environmental contamination, biochemical wars and occupational factors. It is also used in the production of drugs such as nitroprusside and laetrile (Kadiri *et al.*, 2020). In plants, cyanide originates mainly from cyanogenic glycosides, as found in *Manihot* sp., (Cassava), *Linum* sp., *Lotus* sp., *Phaseoluslunatu*s and *Sorghum* sp. and the content of this substance can be high as 100-800 mg/kg of the plant material. Irrespective of the method of exposure, cyanide can be taken in, into the blood stream and distributed to various organs throughout the body resulting in numerous organs exhibited diseases. Cyanide concentrates in the erythrocytes through binding to methemoglobin and several biochemical parameters have been altered after acute oral cyanide treatment to rats (Kadiri *et al.*, 2020). The toxicity of cyanide is a concern due to its effectiveness as a respiratory poison in all aerobic forms of life (Nielson *et al*., 2022). Along with acute cyanide intoxication, chronic toxicity has also been reported and most common difficulties arising from it are from chronic dietary, industrial and environmental sources. Cyanide causes oxidative stress and damage in a number of ways to biological systems (Okolie and Iroanya 2003) and ithas been proven that prolonged sub lethal cyanide exposure can cause biochemical and histopathological variations in different species (Nielson *et al*., 2022).Since ancient times, phototherapyhas been used as folk medicine to treat various diseases. Herbal medicine is any medicinal product that contains as active ingredient, aerial or underground parts of plants,

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or other materials or combinations thereof whether in the crude state or as plant preparations (Ikewuchi *et al.,* 2010). The South Pacific Islands is a home to one of such medicinal plant known as *Acalypha wilkesiana*, also called as Irish petticoat, it is a member of the Euphorbiaceae family and is a plant of great ornamental value due to its colored foliage. It is widely cultivated in the tropical and subtropical countries. In Southern Nigeria, the plant's leaves are said to be diuretic and are used traditionally to treat hypertension. These plants' therapeutic properties are due to a number of chemical compounds; Alkaloids, tannins, flavonoids, and phenolic compounds that have a clear physiological effect on the human body. (Kingsley *et al.,* 2013*). Acalypha wilkesiana* is frequently used in traditional medicine, exclusively or as a major constituent of several natural remedies for the management or treatment of several other diseases (Ikewuchi *et al.,* 2010). However this study is aimed at determining the possible ameliorating effect of methanol leaf extract of *A.wilkesiana* (Copperleaf) on hepatoxicity and haematotoxicity in Wister rats.

However this study is aimed at determining the possible ameliorating effect of methanol leaf extract of A. wilkesiana (Copperleaf) on hepatoxicity and haematotoxicity in Wistar rats.

MATERIALS AND METHODS

Collection of plant material and identification: *Acalypha wilkesiana* subsp. macrophylla leaves were harvested from Clearvis garden along Abraka-Obiaruku road, Abraka Delta State. The studied plant was identified and authenticated by Dr Akinnibosu of the Department of Botany, University of Benin, Benin-city Nigeria, where a voucher number UBH-A508 was given. The leaves were then milled using an automatic electrical Blender (model MS-223, China) to powder which were then used for the extraction and analysis.

Experimental design: In the experiment, a total of thirty-five (35) male Wister albino rats were used. They were shared into seven groups at random each containing 5 rats. All these animals were acclimatized for 7 days before experimental exposure of 21 days. The animals were kept in cages made of plastic (polypropylene), using paddy husk bedding at room temperature ($25 \pm 1\ ^0$C) in a 12 H light/dark cycle with 50 ± 5% humility. The rats were provided with grower‘s mash and water *ad-libitum*. The experimental animal models were as follows:

Group 1: rats received normal feed and water only (normal control)

Group 2: rats that received 200 mg/kg of methanol leaf extract of *A. wilkesiana*

Group 3: rats that received 400 mg/kg methanol leaf extract of *A. wilkesiana*

Group 4: cyanide induced rats only (positive control)

Group 5: cyanide induced rats that received 660 mg/kg sodium thiosulphate pentahydrate and 6.6 mg/kg sodium nitrite (standard control)

Group 6: cyanide induced rats that received 200 mg/kg methanol leaf extract of *A. wilkesiana*

Group 7: cyanide induced rats that received 400 mg/kg methanol leaf extract of *A. wilkesiana*

Cyanide (CN) induction was carried via oral administration 3mg KCN/kg body weight (b.wt) (Kadiri *et al*., 2020). The rats were fasted for 12hrs, followed by the administration of CN.

The median lethal dose (LD_{50}) of the leaf extract had been determined to be 2197.72 mg/kg, and the extract was relatively safe (Homburger, 1989).

Biochemical assays: Determination of biochemical parameters: Determination of aspartate transaminase, alanine transaminase and alkaline phosphatase were carried out using the Prietest Easylab Biochemical Analyzer, which measured theoretical densities of samples and used algorithm to calculate values of parameters investigated. (Stokol *et al*., 2021).

Haematological parameters: Hematological parameters were assayed using BC 5300 Mindray Hematology Auto-Analyzer. The samples were analyzed by the auto analyzer and the results were printed. Lactate dehydrogenase was assayed for, according to the method described by Valvona *et al*., (2016).

RESULTS AND DISCUSSION

Quantitative phytochemical analysis of A. wilkesiana leaves: The results of the quantitative phytochemical analysis of leaves of *A. wilkesiana* are presented in Table 1. Bioactive compounds of the initial crude extract were obtained. Highest concentrations was phenol (9.32 µg/ml) followed by flavonoid (8.57 µg/ml) and the lowest was steroid (1.38 µg/ml).

Table 1: Quantitative Analysis of Photochemicals

Phytochemicals	Concentrations
Tannin	4.27 ± 1.05
Steroid	1.38 ± 0.48
Reducing Sugar	13.07 ± 2.44
Alkaloid	5.38 ± 1.00
Saponin	6.54 ± 1.12
Flavonoid	8.57 ± 0.90
Phenol	9.32 ± 1.81

Values are means ± Standard Deviations of triplicate determinations

Effect of co-administration of A. wilkesiana methanol leaf extract and cyanide on body weight and relative

organ weight of Wistar rats: The results of the effect of co-administration of *A. wilkesiana* leaf extract and cyanide on bodyweight gain and relative organ weights are shown in Table 2. The body weight gain showed a significant decrease ($p>0.05$) in all rats intoxicated with when compared to the normal control except the Group7 rats that were treated with 400mg of the extract. No significant difference ($p>0.05$) was observed in the relative liver weight in all rats treated with cyanide and with the leaf extract when compared to the normal and positive control.

Table 2: Percentage body weight gain and Organ relative weight of female wistar rats co-administered with *A. wilkesiana* methanol leaf extract and cyanide

Groups	Body weight gain (%)	Relative Liver wt (%)
1	64.2 ± 7.99 [a]	0.70 ± 0.15 [a]
2	59.9 ± 6.36[a]	0.67 ± 0.05 [a]
3	57.9 ± 4.91[a]	0.72 ± 0.14 [a]
4	41.5 ± 4.79 [b]	0.56 ± 0.13 [a]
5	50.9 ± 4.86 [b]	0.56 ± 0.02 [a]
6	51.1 ± 4.58 [b]	0.60 ± 0.01 [a]
7	59.1 ± 7.93 [a]	0.62 ± 0.06 [a]

The results are expressed as Mean ± Standard Deviation (n=5). Values with different alphabets on the same column differ significantly (p<0.05)

Effect of co-administration of methanol leaf fraction of Acalypha wilkesiana and cyanide on hepatic antioxidant markers in female Wistar rats: The result of the *in-vivo* study of the effect of the co-administration of methanol leaf fraction of *Acalypha wilkesiana* (MLFAW) on hepatic antioxidant biomarkers in female Wistar rats are presented in table 4.9. There was a significant decrease ($p<0.05$) in catalase and superoxide dismutase activities in all groups intoxicated with cyanide and treated with MLFAW when compared to the positive control group (group 4). No significant difference was observed between the groups intoxicated with cyanide and treated with MLFAW when compared the normal control not treated. In addition no significant difference was observed between the groups intoxicated with cyanide and treated with MLFAW when compared with the standard control Glutathione peroxidase activities were significantly increase ($p<0.05$) 6, 7, 8 and 9 respectively when compared to the negative control group. MDA levels were significantly decreased in all *Acalypha wilkesiana* treated groups when compared to the negative control groups. Glutathione-S-transferase activities showed no significant differences in all *Acalypha wilkesiana* treated groups when compared to the negative control groups.

*Co-administration of methanol leaf extract from A. wilkesiana and cyanide on serum liver biomarker in Wister rats***:** The results of the *in-vivo* study ofco-administration of methanol leaf extract of *A. wilkesiana* and cyanide on serum liver biomarkers in female *Wistar* rats are shown in Table 4. The activities of AST, ALT ALP, and LDH were significantly decreased ($p<0.05$) in treated groups when compared to the negative control group. However, there were no significant differences in activities of liver enzymes in all treated groups relative to the standard group. Total protein and albumin levels recorded significant decrease ($p<0.05$) in Groups 5, 6 and 7 treated with different concentrations of the extract when compared to the negative control group. However, no significant difference was recorded Groups 5, 6 and 7 when compared with the positive control group

Table 3: Hepatic antioxidant indicators of co-administered methanol leaf fraction of *Acalypha wilkesiana* and cyanide in female Wistar rats

Groups	CAT (Units/g)	SOD (Units/g)	GST×10^{-3} (Units/g)	GSH×10^{-6} (µg/g tissue)	MDA×10^{-3} (Units/g)	GPx×10^{-3} (Units/g)
1	92.3 ± 2.80 [a]	11.4 ± 0.74 [a]	5.86 ± 0.10 [a]	10.5 ± 1.33 [a]	1.19 ± 0.18 [a]	2.18 ± 0.14 [a]
2	99 ± 3.65 [a]	9.06 ± 1.79 [b]	6.33 ± 0.10 [a]	19.8 ± 0.00 [a]	1.07 ± 0.07 [a]	2.21 ± 0.02 [a]
3	93 ± 2.90 [a]	9.48 ± 1.06 [b]	7.01 ± 0.21 [a]	18.9 ± 1.99 [a]	0.67 ± 0.07 [a]	2.26 ± 0.18 [a]
4	52.2 ± 4.37 [b]	5.33 ± 0.45 [b]	6.84 ± 0.80 [a]	3.92 ± 0.08 [b]	4.43 ± 0.30 [b]	1.14 ± 0.14 [b]
5	89.2 ± 3.42 [a]	9.36 ± 1.28 [a]	6.91 ± 0.59 [a]	8.36 ± 1.52 [a]	1.55 ± 0.41 [a]	2.26 ± 0.12 [a]
6	85.9 ± 1.23 [a]	9.67 ± 2.28[a]	7.93 ± 0.27 [a]	21.1 ± 3.50 [a]	1.37 ± 0.09 [a]	2.45 ± 0.12 [a]
7	90.9 ± 4.46 [a]	11.7 ± 0.99 [a]	7.63 ± 0.53 [a]	9.24 ± 0.00 [a]	2.16 ± 0.09 [a]	2.17 ± 0.26 [a]

Values are means ± standard Deviations of triplicate determinations. Values are presented as Mean ± SD. Values on the same column with different superscript differ significantly (P<0.05).

Table 4: Serum liver biomarkers of co-administered *A. wilkesiana* methanol leaf extract and cyanide in female Wistar rats

Groups	AST (U/L)	ALT (U/L)	ALP (U/L)	TP (mg/dl)	ALB (mg/dl)	LDH (U/L)
1	109±5.00 [a]	18.0±3.00 [a]	17.0±1.00 [a]	7.70±0.36 [a]	5.27±0.40 [a]	10.21±0.94 [a]
2	123±3.51 [a]	23.0±2.00 [a]	16.7±0.58 [a]	7.87±0.40 [a]	5.07±0.29 [a]	12.40±1.08 [a]
3	108±3.51 [a]	22.3±2.52 [a]	16.0±1.00 [a]	7.17±0.55 [a]	4.43±0.15 [a]	3.76±1.78 [b]
4	161±2.89 [b]	34.0±1.73 [b]	25.7±0.58 [b]	5.87±0.21 [b]	3.47±0.15 [b]	17.96±2.13 [c]
5	114±6.00 [a]	23.0±3.00 [a]	16.3±1.16 [a]	7.83±0.40 [a]	4.80±0.61 [a]	4.99±1.39 [b]
6	118±8.54 [a]	22.3±3.22 [a]	15.0±1.00 [a]	7.37±0.55 [a]	4.50±0.10 [a]	2.54±1.28 [b]
7	115±4.93 [a]	23.7±4.95 [a]	15.0±0.00 [a]	7.10±0.66 [a]	4.77±0.74 [a]	2.65±0.38 [b]

The results are expressed as Mean ± Standard Deviation (n=3). Values with different alphabets on the same column differ significantly (p<0.05).

Histological findings: The histological findings from the *invivo* study of the effect of co-administration of leaf extract of *A. wilkesiana* and cyanide in female Wister rats are presented below. Fig 1 shows micrograph of the liver section of the control group showing normal hepatocytes of histological features. Fig.2 and 3 shows the photomicrographs of the liver sections of rat administered with 200 mg/kg and 400 mg/kg methanol leaf extract of *A. wilkesiana* respectively. Sections appear to have normal hepatic features. Fig 4 shows micrograph of liver section of rat induced with 3 mg/kg KCN. Section shows ballooning degeneration of hepatocytes. Fig 5 shows photomicrograph of liver section cyanide induced of rat administered with 660 mg/kg sodium thiosulphate and 6.6 mg/kg sodium nitrite showing normal hepatic histologic features. Fig 6 and 7 show photomicrograph of liver section of cyanide induced rats administered with 200 mg/kg and 400 mg/kg methanol leaf extract of *A. wilkesiana* respectively. Section shows normal hepatocytes.

Occupational hazards pose a concerned threat to human existence, as they are known to induce cellular aberrations ranging from cellular damages of biomolecules (proteins, carbohydrates, lipids and nucleic) to inhibition of electron transport chain, thereby causing cytotoxic hypoxia as seen with cyanide toxicity (Kadiri and Asagba, 2019).Changes in body weight serve as a sensitive indication of the general health status of animals (Okochi *et al.*, 1999). However, weight gains were observed in all animals administered with *Acalypha wilkesiana* extract. It can be stated that the *Acalypha wilkesiana* extract did not interfere with the normal metabolism of animals as corroborate by the non-significant difference ($P \leq 0.05$) from animals in the vehicle control group. The significant increment in food and water intake is considered as being responsible for the increment in body weight gain. As mentioned earlier the loss of appetite is often synonymous with weight loss due to disturbances in the metabolism of carbohydrate, protein, or fat (Ezeonwumelu, 2011). Therefore, the normal food and water intake ($P \leq 0.05$) without loss of appetite are suggested as being responsible for the observed increment in body weight in this study. In addition, Aladejimokun *et al*., (2017) had reported high nutritional contents of *Acalypha wilkesiana* extract, which could be attributed the increase in body weight of the studied animal model. Similarly, no significant changes in tissue weights were observed, suggesting that administration of *Acalypha wilkesiana* extract at the subacute oral doses had no effect on the normal growth. The usefulness of weighing organs in toxicity studies includes their sensitivity to predict toxicity, enzyme induction, physiologic perturbations, and acute injury; it is frequently a target organ of toxicity; it correlates well with histopathological changes; there is little inter-animal variability; historical control range data are available (Avwioro *et al*., 2010). The relative organ weights have been found to be a relatively sensitive indicator for certain organs in toxicity studies, and as a result, toxicity is defined as significant alterations seen in those specific organs. (Asagba *et al*., 2019). According to the study's findings, vital organs like the liver and kidneys weren't negatively impacted and didn't exhibit any clinical toxicity symptoms either. The level of tissue damages could be effectively assessed biochemically by the estimation of the levels endogenous antioxidant defense system. One of the antioxidants in the body is the reduced glutathione, a reducing agent in biological cells that provide a primary antioxidant defense against reactive intermediates of metabolism, drugs or carcinogens (Meister and Anderson, 1983). Previous studies had shown that in ingestion of cassava cyanide depletes blood glutathione.

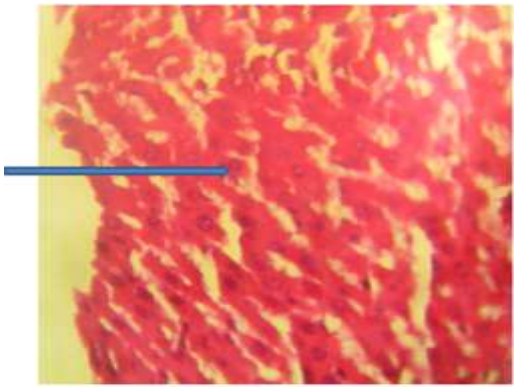

Fig.1: Histology of the liver section of the control group showing normal liver histological features. Section shows normal hepatocytes. H&E X400

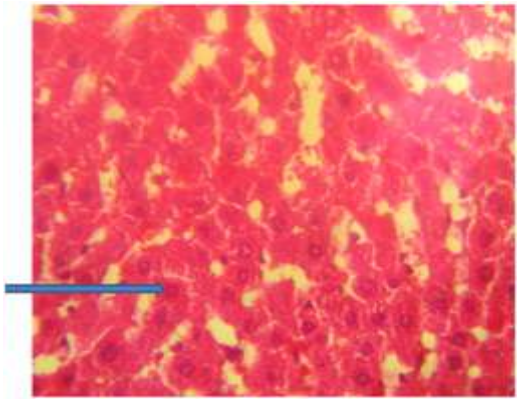

Fig2: Histology of the liver section of Wistar rat administered with 200 mg/kg methanol leaf extract of *A. wilkesiana* leaf extract showing normal liver histologic features. Section shows normal hepatocytes. H&E X400.

This depletion in glutathione status could be one of the mechanisms by which cyanide exerts its numerous toxicities (Okafor *et al*., 2002). From this study, *A. wilkesiana* demonstrated to have significantly elevate ($p<0.05$) the level of GSH (in liver and kidney) in groups treated with extract compared to CN-induced group. Thus, *A. wilkesiana* could have helped reduce the damaging effect of cyanide by increasing the body's glutathione level and GST activity, as cyanide has been shown to deplete whole blood glutathione (Okafor *et al*., 2002).

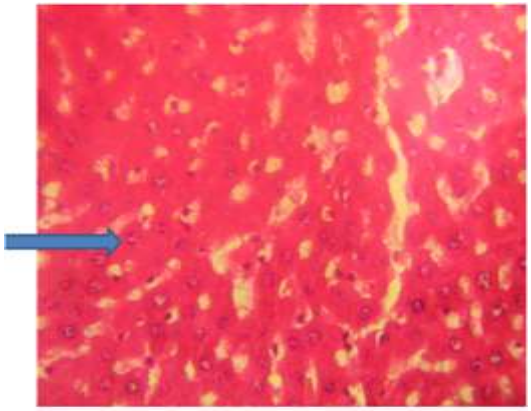

Fig3: Histology of the liver section of Wistar rat administered with 400 mg/kg methanol leaf extract of *A. wilkesiana* leaf extract showing normal liver histologic features. Section shows normal hepatocytes. H&E X400.

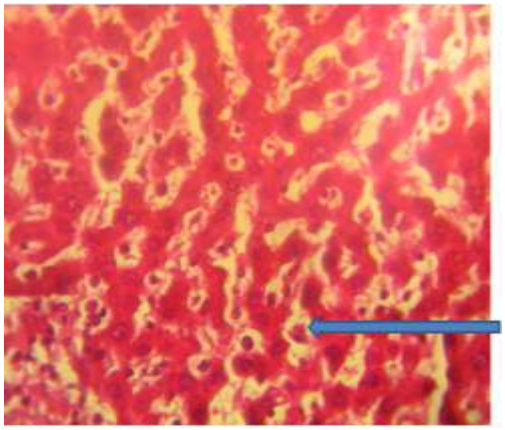

Fig4: Histology of the liver section of cyanide induced rat administered with 3 mg/kg of KCN. Section shows ballooning degeneration hepatocytes. H&E X400.

Lipid peroxidation is a free-radical-mediated chain of reactions that, once initiated, results in an oxidative deterioration of polyunsaturated lipids. The most common targets are components of biological membranes. When propagated in biological membranes, these reactions can be initiated or enhanced by a number of toxic products, including endoperoxides and aldehydes (Kadiri and Adegor, 2015). The loss of membrane integrity during oxidative stress results in an imbalance in the equilibrium of influx and efflux of molecules in and out of the cells, thereby leading to cellular abnormalities.

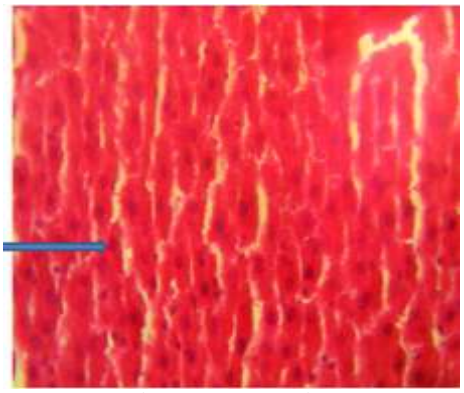

Fig.5: Histology of the liver section of cyanide induced rat administered with 660 mg/kg Sodium thiosulphate and 6.6 mg/kg Sodium nitrite showing normal hepatic histologic features. H&E X400.

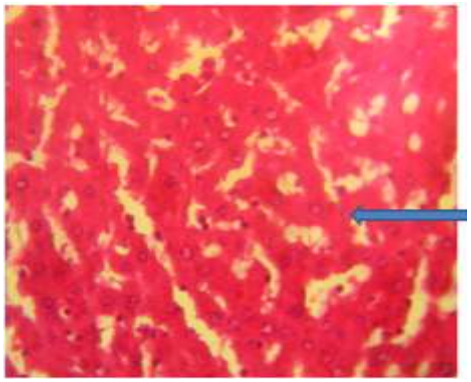

Fig6: Histology of the liver section of cyanide induced rats administered with 200 mg/kg methanol leaf extract of *A. wilkesiana*. Section shows normal hepatocytes. H&E X400.

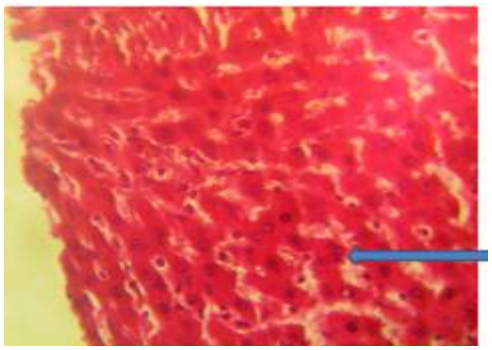

Fig.7: Histology of the liver section of cyanide induced rats administered with 400 mg/kg of *A. wilkesiana* methanol leaf extract. Section shows normal hepatocytes. H&E X400

It was observed from this study that malonyl aldehydes (MDA) levels were seen to be reduced compared to the elevated effect caused by cyanide as seen in the cyanide control groups. The ability of *A. wilkesiana* extract to restore the lipid bilayer of the cell

membrane as observed from this study could be as a result of the plant to mediate reduction in the oxidation of triacylgycerols and enhance clearance of products of lipid peroxidation from cells and circulation. *A. wilkesiana* are also rich in flavonoid which possesses antioxidant properties (Kingsely *et al*., 2013). Its rich source of flavonoid could also be a possible mechanism against oxidative damages caused by cyanide toxicity. The findings from the histological examinations of the organs (liver and kidney) are in harmony with the raised levels of lipid peroxidation and the corresponding decrease in the activities of antioxidant enzymes in cyanide exposed wistar rats.

Catalase (CAT) and Superoxide dismutase (SOD) are two enzymes in which the cells employ in response to immediate presence of radicals, hence they are termed primary antioxidants defense enzymes. Catalase provide protective effect against hydrogen peroxide, while the superoxide dismutase (SOD) mop up super anion radical, it is disintegrated into hydrogen peroxide and oxygen. Studies have also reported that, cyanide inhibit metalloenzymes including superoxide dismutase (SOD), catalase (CAT), peroxidases (Px), nitrogenase, nitratereductase and subsequently induce oxidative stress in functionally different tissues by enhanced generation of Reactive Oxygen Species (ROS) (Kadiri *et al*., 2020)this was confirmed by the significant decrease in the level of these enzymes in the cyanide treated groups in this study. Again treatment with different doses of the extract was able to reverse this increase due to the presence of the flavonoid present in the plant extract which possesses antioxidant properties (Kingsely *et al*., 2013).

In this study the administration of cyanide causes biochemical alteration in the liver enzymes and indices of ALT, AST and ALP. Transamination is among the principal pathways for the synthesis and deamination of amino acids, enabling carbohydrate and protein metabolism to be sustained during fluctuating energy demands (Okoro and Kadiri, 2019). Increased levels of the transaminases may be a result of metabolic activities in the Krebs cycle that maintain internal homeostasis. ALP is an endoplasmic reticulum and plasma membrane marker enzyme. (Kadiri *et al.*, 2020) of the tissues. It is frequently used to evaluate the plasma membrane's integrity. (Akanji *et al*., 1993) since it is found mainly in the microvilli in the bile canaliculli, located the plasma membrane. Phosphate monoesters are hydrolyzed by ALP, hencehyper production of the enzyme may pose a threat to the survival of cells that rely on certain phosphate esters for essential functions. (Butterworth *et al*., 1966) as it may lead to indiscriminate break down of phosphate ester metabolite of the liver. High levels of ALT, AST, and alkaline phosphatase are reported in liver diseases or hepatotoxicity (Asagba *et al*, 2019, Okoro and Kadiri, 2019). The hepatic leakage observed from the cyanide control, was seen from the results to be cleared from the blood circulation across all treated groups (*Acalypha wilkesiana* crude extract and fraction group). Accessory hepatic indicators of AST and ALP enzymes are mainly localized in the muscles and bone with some of its isoenzymes found also found in hepatic tissues. Thus, the activities are also predominantly found to be increased during hepatic damage and consequently ameliorative activities upon administration of a drug caused a reversal effect of the toxicant. A decrease in total protein, albumin, and globulin is a sign of the reduced synthetic function of the liver or might be due to impaired hepatocellular function. Low serum albumin content may suggest infection or continuous loss of albumin (Yakubu, 2003).

The organic molecule (protein) comprises albumin and globulin, with both combining to make up total protein evaluation indices. Pathological conditions caused decrease in levels of albumin as from twenty (20) days this is due to its half-life being that duration and as such acute hepatic damage show no changes in albumin. Based on the present findings serum LDH activities were increased significantly in group exposed to cyanide only compared to the untreated group. It was also observed groups treated with *Acalypha* leaf extract and fractions showed significant reduction in LDH level compared to CN-toxified group. Okolie and Iroanya (2003) found that cyanide feeding in rabbits resulted in an increase in LDH in tissues, which is consistent with the current study. This may be connected to the function of LDH in anaerobic glycolytic pathway which is augmented in cyanide intoxication. Cyanide, known as a strong metabolic toxicant, can inhibit the terminal step in respiratory chain, resulting in cellular hypoxia and a shift from aerobic to anaerobic metabolism. Toxicity, increases anaerobic glycolytic pathway and this may account for less ATP from oxidative phosphorylation, however the surplus pyruvate formed is converted into lactate. One possibly mechanism of combating the challenge of this metabolic aberrations is via the slowdown of the rate glycolysis, and this effect could have been exerted by the plant extract and fraction. The ability of plant activities to restore abnormalities in damage tissues and the cell membrane integrity is done to circumvent the leakage of molecules in and out of the cell. Thus possibly *A. wilkesiana* could have possibly enhanced synthesis of cell membrane and structure. This finding also support the plants medicinal attributes from folklore medicine.

Conclusion: The results from this finding indicate that methanol leaf extract of Acalypha *wilkesiana (*copperleaf) leaves was able to ameliorate cyanide induced hepatotoxicity comparable to standard cyanide antidotes in Wister rats.

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