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Research Article

Some Effects of Moringa Oleifera Leaf Extract on Cobalt Chloride Induced Kidney Damage in Adult Wistar Rats

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Abstract

Cobalt chloride is a potential, toxic metal that has been reported to adversely affected the body leading to weight loss, tissues and cells damage in the kidney that has been (as this study is concerned), and other body functions. Moringa oleifera is commonly known as drum stick tree (due to slender, long, triangular seed pods), horse radish tree (the roots taste similar to that of horse radish), benoil tree, which has the tenacity to increase immune system and repair of body worn out tissues. This study investigated the effect moringa leaf extract on cobalt induced kidney damage in adult wistar rat.

Forty (40) male albino (wistar) rats with a body weight of 90-130g were separated into five groups, A, B, C, D and E with each group containing eight animals. Group A rats were the control while group B was treated orally with cobalt chloride 45mg/kg body weights for 51days, group C and D were co-treated orally with 45mg/kg body weight and 250mg/kg and 500mg/kg respectively for 51days. The rats were sacrificed by cervical dislocation on 52th day of administration. Blood samples were collected for biochemical analysis of urea and creatinine levels in the blood. The kidney was then removed and weighed using the same balance before they were fixed in 10% formol calcium for histological analysis using H&E technique.

The result showed that the body weight decrease significantly ($p<0.05$) in group B compared with group A, C, D and E. The kidney weights increase significantly($p<0.05$) in the treated groups compared with the control. Biochemical analysis indicated that Urea level and Creatinine levels were significantly increased ($p<0.05$) in Group B cobalt treated rats compared to significantly reduced creatinine and urea levels in group C and D cobalt-extract treated rats. The ALT, AST and ALP activities were slightly increased in Group B while the activities of these enzymes were significantly reduced in group C and D. Histological analysis in Group A, D, E; treatments did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining as the renal cortex shows normal glomeruli with normal mesangial cells and capsular spaces, the renal tubules appeared normal, the interstitial spaces appeared normal and clear with no signs of congestion or infiltration while Group B & C treated rats show some conspicuous observable altered morphological changes in renal cortex with collapsed glomeruli with pyknotic mesangial cells.

In conclusion, the results obtained in this study following co-administration of cobalt chloride and moringa leaf extract on the histomporphology of the kidney has shown the ameliorative effects on moringa leaf extract on cobalt chloride induced kidney damaged in wistar rats investigated.

Keywords: moringa oleifera; antioxidant; antiatherosclerotic; hypolipidaemic

Introduction

Moringa oleifera is commonly known as drum stick tree (due to slender, long, triangular seed pods), horse radish tree (the roots taste similar to that of horse radish), benoil tree (as the benzoil is extracted from the tree). *Moringa* is a fast growing drought resistant tree which is an important species of moringaceae, in momogeneric family. Report has indicated that *moringa oleifera* was medically used by ancient Egyptians and greeks, after that it was globally cultivated for spreading its medicinal benefit around the word (Oliveira *et al.*, 1999) It has been shown that all the *moringa* parts are edible and have long been utilized by human beings

(Fuglie, 1999). *Moringa oleifera* leaves are well-known to possess numerous good biological activities, such as antioxidant, antiatherosclerotic, hypolipidaemic, and preventer of cardiac disorders (Chumark *et al*., 2008), immune activator (Faizi *et al*., 1994), and tumor suppressor (Murakami *et al*., 1998). Moreover, studies have indicated that *moringa* leaves have been utilized for treatments of various ailments such as hypertension, malaria, asthma, diabetes, and stomach disorders and to expel retained placenta, while a decoction of the root is also used to treat malaria. Furthermore, the root and leave extracts have been reported ton show activity against Trypanosoma brucei (Mekonnen and Gessesse, 1998), the parasite responsible for trypanosomiasis. Research investigators found that cultured HepG2 cell line revealed high sensitivity to the hepatotoxicant *Moringa* galactosamine when compared with in vivo experiments upon liver cancer-induced models (Mekonnen *et al.,* 2005).

Moringa has been known to be a perennial softwood tree with timber of low quality, but which for centuries has been advocated for traditional medicinal and industrial uses. It is an important crop cultivated in Ethiopia, India, the Philippines and the Sudan, and has been grown in tropical Asia. Latin America, West, East and South Africa, the Caribbean, Florida and the Pacific Islands. All parts of the *Moringa* tree are edible and have long been consumed by humans (Fahey, 2005).

Previous studies have shown that *moringa* possesses many valuable properties which make it of great scientific interest that includes high protein content of the leaves, twigs and stems, the high protein and oil contents of the seeds, the large number of unique polypeptides in seeds that can bind to many moieties, and the presence of growth factors in the leaves. Equally important is the fact that few parts of the tree contain any toxins that might decrease its potential as a source of food for animals or humans (Foidl *et al.,* 2001).

The kidneys are a pair of bean-shaped organs present in all vertebrates. They remove waste products from the body, maintain balanced electrolyte levels, and regulate blood pressure.The kidneys are some of the most important organs. The Ancient Egyptians left only the brain and kidneys in position before embalming a body, inferring that the held a higher value. The main role of the kidneys is maintaining homeostasis. This means they manage fluid levels, electrolyte balance, and other factors that keep the internal environment of the body consistent and comfortable (Fausto *et al*., 2015)

Moringa trees have been reported to combat malnutrition, especially among infants and nursing mothers. Three non-governmental organizations in particular—Trees for Life, Church World Service and Educational Concerns for Hunger Organization—have advocated *Moringa* as "natural nutrition for the tropics." Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. *Moringa* is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce (.Ramasubramania, 2016).

A large number of reports on the nutritional qualities of Moringa now exist in both the scientific and the popular literature. Any readers who are familiar with Moringa will recognize the oft-reproduced characterization made many years ago by the Trees for Life organization, that "ounce-for-ounce, Moringa leaves contain more Vitamin A than carrots, more calcium than milk, more iron than spinach, more Vitamin C than oranges, and more potassium than bananas," and that the protein quality of *Moringa* leaves rivals that of milk and eggs. These readers will also recognize the oral histories recorded by Lowell Fuglie in Senegal and throughout West Africa, who reports (and has extensively documented on video) countless instances of lifesaving nutritional rescue that are attributed to Moringa. In fact, the nutritional properties of Moringa are now so well known that there seems to be little doubt of the substantial health benefit to be realized by consumption of Moringa leaf powder in situations where starvation is imminent. Nonetheless, the outcomes of well controlled and well documented clinical studies are still clearly of great value (Rashid *et al*., 2008).

In many cultures throughout the tropics, differentiation between food and medicinal uses of plants (e.g. bark, fruit, leaves, nuts, seeds, tubers, roots, flowers), is very difficult since plant uses span both categories and this is deeply ingrained in the traditions and the fabric of the community. Thus, Table 1 in this review captures both nutritional and medicinal references as they relate to Moringa, whilst avoiding most of the better known agro-forestry and water purification applications of this plant (Owen, 2010).

It was reported that India is the largest producer of Moringa with an annual production of 1.1 to 1.3 million tonnes of tender fruits from an area of 380 km2. Among the states, Andhra Pradesh leads in both area and production (156.65 km2) followed by Karnataka (102.8 km2) and Tamil Nadu (74.08 km2). In other states, it occupies an area of 46.13 km2. Tamil Nadu is the pioneering state insomuch as it has varied genotypes from diversified geographical areas, as well as introductions from Sri Lanka (Rajangam, 2001).

(Walter Bushnell Ltd. Mumbai, India), Kupid Ford, Eilert *et al.,* 1981.

Moringa oleifera also has numerous medicinal uses, which have long been recognized in the Ayurvedic and Unani systems of medicine. The medicinal attributes and pharmacological activities ascribed to various parts of Moringa are detailed below (Jahn, 1996).

The widespread combination of diuretic along with lipid and blood pressure lowering constituents make this plant highly useful in cardiovascular disorders. Moringa leaf juice is known to have a stabilizing effect on blood pressure [The Wealth of India, 1962; Nitrile, mustard oil glycosides and thiocarbamate glycosides have been isolated from Moringa leaves, which were found to be responsible for the blood pressure lowering effect. Most of these compounds, bearing thiocarbamate, carbamate or nitrile groups, are fully acetylated glycosides, which are very rare in nature (Fuglie, 2001).

Bioassay guided fractionation of the active ethanol extract of Moringa leaves led to the isolation of four pure compounds, niazinin A, niazinin B, niazimicin and niazininA B which showed a blood pressure lowering effect in rats mediated possibly through a calcium antagonist effect. Activity-directed fractionation of the ethanol extract of pods of M.oleifera has led to the isolation of thiocarbamate and isothiocyanate glycosides which are known to be the hypotensive principles. Methyl phydroxybenzoate and β-sitosterol investigated in the pods of *M. oleifera* have also shown promising hypotensive activity, Moringa roots, leaves, flowers, gum and the aqueous infusion of seeds have been found to possess diuretic activity and such diuretic components are likely to play a complementary role in the overall blood pressure lowering effect of this plant. The crude extract of Moringa leaves has a significant cholesterol lowering action in the serum of high fat diet fed rats which might be attributed to the presence of a bioactive phytoconstituent, i.e. β-sitosterol. Moringa fruit has been found to lower the serum cholesterol, phospholipids, triglycerides, low density lipoprotein [LDL], very low density lipoprotein[VLDL] cholesterol to phospholipid ratio, atherogenic index lipid and reduced the lipid profile of liver, heart and aorta in hypercholesteremic rabbits and increased the excretion of fecal cholesterol (Manzoor *et al*., 2007).

Moringa roots have antibacterial activity and are reported to be rich in antimicrobial agents. These are reported to contain an active antibiotic principle, pterygospermin, which has powerful antibacterial and fungicidal effects. A similar compound is found to be responsible for the antibacterial and fungicidal effects of its flowers. The root extract also possesses antimicrobial activity attributed to the presence of 4- α-L-rhamnosyloxybenzyl isothiocyanate. The aglycone of deoxy-niazimicine

[N-benzyl, S- ethyl thioformate] isolated from the chloroform fraction of an ethanol extract of the root bark was found to be responsible for the antibacterial and antifungal activities. The bark extract has been shown to possess antifungal activity, while the juice from the stem bark showed antibacterial effect against Staphylococcus aureus. The fresh leaf juice was found to inhibit the growth of microorganisms [Pseudomonas aeruginosa and Staphylococcus aureus], pathogenic to man.

Moringa leaves to be a potential source for antitumor activity. O- Ethyl-4-[α-L-rhamnosyloxy]benzyl carbamate together with 4[α-L-rhamnosyloxy]-benzyl isothiocyanate, niazimicin and 3-O-[6′-O-oleoyl-α-D-glucopyranosyl]-β-sitosterol have been tested for their potential antitumor promoting activity using an in vitro assay which showed significant inhibitory effects on Epstein–Barr virus-early antigen. Niazimicin has been proposed to be a potent chemo preventive agent in chemical carcinogenesis. The seed extracts have also been found to be effective on hepatic carcinogen metabolizing enzymes, antioxidant parameters and skin papillomagenesis in mice. A seed ointment had a similar effect to neomycin against Staphylococcus aureus pyodermia in mice.It has been found that niaziminin ,a thiocarbamate from the leaves of Moringa oleifera, exhibits inhibition of tumor-promoter- induced Epstein–Barr virus activation. On the other hand, among the isothiocyanates, naturally occurring 4-[[4′-O-acetyl- α-i-rhamnosyloxy]benzyl], significantly inhibited tumor-promoter induced Epstein–Barr virus activation, suggesting that the isothiocyano group is a critical structural factor for activity (Makonnen *et al*., 1997) .

Moringa oleifera has also been reported to exhibit other diverse activities. Aqueous leaf extracts regulate thyroid hormone and can be used to treat hyperthyroidism and exhibit an antioxidant effect. A methanol extract of M.oleifera leaves conferred significant radiation protection to the bone marrow chromosomes in mice. Moringa leaves are effective for the regulation of thyroid hormone status. A recent report showed that M. oleifera leaf may be applicable as a prophylactic or therapeutic anti-HSV[Herpes simplex virus type 1] medicine and may be effective against the acyclovir-resistant variant. The flowers and leaves also are considered to be of high medicinal value with anthelmintic activity.An infusion of leaf juice was shown to reduce glucose levels in rabbits. *Moringa oleifera* is coming to the forefront as a result of scientific evidence that Moringa is an important source of naturally occurring phytochemicals and this provides a basis for future viable developments. Different parts of *M. oleifera* are also incorporated in various marketed health formulations. Moringa seeds have specific protein fractions for skin and hair care. Two new active components for the cosmetic industry have been extracted from oil cake. Purisoft consists of peptides of the Moringa seed. It protects the human skin from environmental influences and combats premature skin aging. With dual activity, antipollution and conditioning/strengthening of hair, the *M. oleifera* seed extract is a globally acceptable innovative solution for hair care (Miller, 1988).

Materials And Methods

Experimental Animal

Male albino (wistar) rats with a body weight of 90-130g were purchased. The rats were housed in plastic cage in a well conducive room and they were fed well with adequate water supply, they were taken care of according to the modern rearing method and left to acclimatize for 3weeks prior to the initiation of the experiment.

Plant Material Preparation

The fresh moringa oleifera lam (moringaceae) leave were harvested and later authenticated by the project supervisor Dr. Ajibade, Faculty of basic medical science, Anatomy department of Ladoke Akintola University of technology, Oyo state, Nigeria.

The leave was dried at room temperature and grounded to pounder form was then sent to food processing unit a laboratory at food science department in Ladoke Akintola University of Technology for further processing to obtain the leave extract.

Experimental Animal

Forty (40) Male albino(wistar) rats with average body weight of 90-130g were obtained.

The rats were housed in experimental plastic cage under a conducive condition. They were fed with rat feed and have access to water.

Plant Material

The fresh *Moringa Oleifera*(moringaceae) leaves were harvested in January 2020, with the permission of the land's owner, Mr/Mrs Odedele who owns the land in Oyo state, Nigeria the *Moringa Oleifera* was identified at the department of environmental biology and botany of LAUTECH Ogbomoso.

The leave was dried at room temperature and grounded to powder form and was sent to food processing unit, a laboratory at food science department in Ladoke Akintola University of Technology for further processing to obtain the leave extract.

Experimental protocols

Fourty (40) adults male wistar rats weighing (110-200g) were divided into five groups based on the weight range.

The acclimated animals were divided into five (5) groups of eight (8) animals each

- Group A (Control group) was given normal feed and distilled water
- Group B orally received cobalt chloride only (0.7mg)
- Group C orally received cobalt chloride + low dose of *Moringa* extract (0.4mg)
- Group D orally received cobalt chloride + high dose of *Moringa* extract (0.9mg)
- Group E orally received *Moringa Oleifera* extract only

Method of Administration

The administration of cobalt chloride and moringa extract was done orally using the oral cannula Cobalt chloride and *Moringa Oleifera* extract was given simltaneously daily for 51days. The animals were sacrificed on the 52nd day of administration by cervical dislocation which rendered the animal unconscious temporarily. The kidneys were harvested, weighed and fixed in formal saline for histological procedures evaluation using Hand E staining technique.

Statistical Analysis

All data were expressed as mean of mean ± SEM. The statistical analysis of the result obtained in this study was evaluated and tested for significance using t-test in less than 0.05($p<0.05$), then result is significant, if p-value of the t test is greater than 0.05($p>0.05$), then that means that the result is not significant.

Results and Findings

Groups	Initial Weight (g)	Final Weight (g)	% Weight Gain or Loss
A	148.8 ± 9.34	150.8 ± 5.35	2
B	156.3 ± 2.63	163.5 ± 5.39	7.2
C	168.8 ± 5.49	180.4 ± 7.24**	11.6

D	181.3 ± 5.81*	177.7 ± 4.23**	-3.6
E	178.8 ± 6.11*	185.1 ± 3.92***	6.5

Significance: P < 0.05, value greater than 0.05 were considered insignificant while values less than 0.05 were considered significant (*). Values were expressed as Mean ± SEM

Table 1: the initial and final body weights of Wistar rats.

Table 1 above shows the result of body weights loss or gain across the various groups. The body weights of the wistar rats were significantly increased in group C and E, while the body weights were reduced significantly in group D. Group A and B revealed insignificant increased in the body weights after treatment.

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Groups	Right kidney weight (mean ± s.e.m)	Relative right kindey weight (%)	Left kidney weight (mean ± s.e.m)	Relative left kidney weight (%)
A	0.42 ± 0.03	0.28	0.44 ± 0.03	0.29
B	0.55 ± 0.03*	0.34	0.48 ± 0.02	0.30
C	0.56 ± 0.03**	0.31	0.58 ± 0.02	0.32
D	0.54 ± 0.03*	0.30	0.55 ± 0.02*	0.31
E	0.59 ± 0.02***	0.31	0.53 ± 0.03*	0.29

Significance: P < 0.05, value greater than 0.05 were considered insignificant while values less than 0.05 were considered significant (*). Values were expressed as Mean ± SEM

Table 2: Table showing the Mean ± S.E.M of kidney weights of Wistar Rats

Table 2 showed that the kidney weights in group B, C, D and E treated rats were significantly increased compared with the control.in the right kidneys, while the weights of the kidneys were increased significantly in group C and D compared with the controls.

Kidney Function

Groups	Urea	Creatinine
A	16.59 ± 0.34	0.57 ± 0.08
B	20.27 ± 0.64***	1.43 ± 0.11***
C	15.30 ± 0.47*	1.02 ± 0.12*
D	14.20 ± 0.90*	0.85 ± 0.16
E	12.35 ± 0.57***	0.82 ± 0.09

Significance: P < 0.05, values greater than 0.05 were considered insignificant while values less than 0.05 were considered significant (*). Values were expressed as Mean ± SEM

Table 3: the Mean ± S.E.M of Urea and Creatinine level in Wistar rats after administration of *Moringa oleifera* leaf extract and Cobalt chloride.

The Urea and Creatinine levels increased significantly in Group B cobalt –treated compared to Group A (control group) while urea and creatinine levels were significantly reduced in a dose dependent manner in group C, D and E compared with group A control and group B cobalt –treated group.

Groups	Alt	Ast	Alp
A	48.62 ± 4.25	86.92 ± 11.93	13.54 ± 0.88
B	81.84 ± 4.25***	171.7 ± 9.82***	15.83 ± 0.23*
C	50.07 ± 5.67	145.0 ± 7.37**	14.44 ± 0.55
D	63.98 ± 1.45**	136.3 ± 11.28*	15.73 ± 0.19*
E	36.77 ± 2.83*	109.0 ± 3.54	12.76 ± 0.40

Significance: P < 0.05, values greater than 0.05 were considered insignificant while values less than 0.05 were considered significant (*). Values were expressed as mean ± Standard error of mean.

Table 4: Liver Function

The ALT, AST and ALP activities were slightly increased in Group B while the activities of these enzymes were significantly reduced in group C and D.

Histological Analysis

Plate A: Group A: Control Group

Panoramic view of kidney, control group A showing the micromorphological section demonstrated by Haematoxyl in and Eosin staining at low magnification (X100). Magnified view of kidney micromorphological section demonstrated by Haematoxyl in and Eosin staining at high magnification (X400). This group did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules (Blue arrow) appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration.

Plate B: Group B: Exposed to Cobalt Chloride Only

Photomicrograph of group B, exposed to 45mg/kr of Cobalt chloride showing some severe observable altered morphological. Renal cortex (Black arrow) shows collapsed glomeruli (Black arrow) with some signs of pyknotic mesangial cells (Yellow arrow) and observable wide capsular spaces, the renal tubules (Blue arrow) appear dilated, the interstitial spaces appear congested and infiltrated with some observable presence of red inflammatory cells, some signs of fibrosis/hemorrhage.

plate c: group c: exposed to 45mg/kg of cobalt chloride and treated with low dose of *moringa oleifera* leaf extract (250g)

Photomicrograph of group C, treated with 45mg/kg of Cobalt chloride and low dose of *Moringa oleifera* of 250g extract showing some severe

observable altered morphological. Renal cortex (Black arrow) shows collapsed glomeruli (Black arrow) with some signs of pyknotic mesangial cells (Yellow arrow) and observable wide capsular spaces, the renal tubules (Blue arrow) appear dilated, the interstitial spaces appear congested and infiltrated with some observable presence of red inflammatory cells, some signs of fibrosis/hemorrhage.

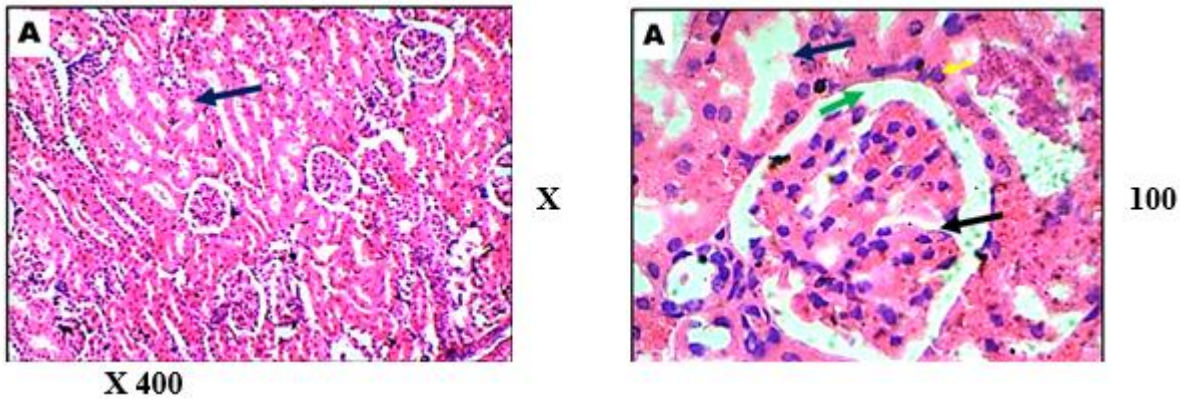
Plate D: Group D: Exposed to Cobalt Chloride and Treated with High Dose of *Moringa Oleifera* Leaf Extract (500mg/Kg)

Photomicrograph of group D, exposed to cobalt chloride and treated with 500mg/kg high dose of *Moringa Oleifera* leaf extract. This group did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration. There was improved histo architecture of the renal tissue and cells in this section.

Plate E: Group E: Treated with Moringa Only (500mg/Kg)

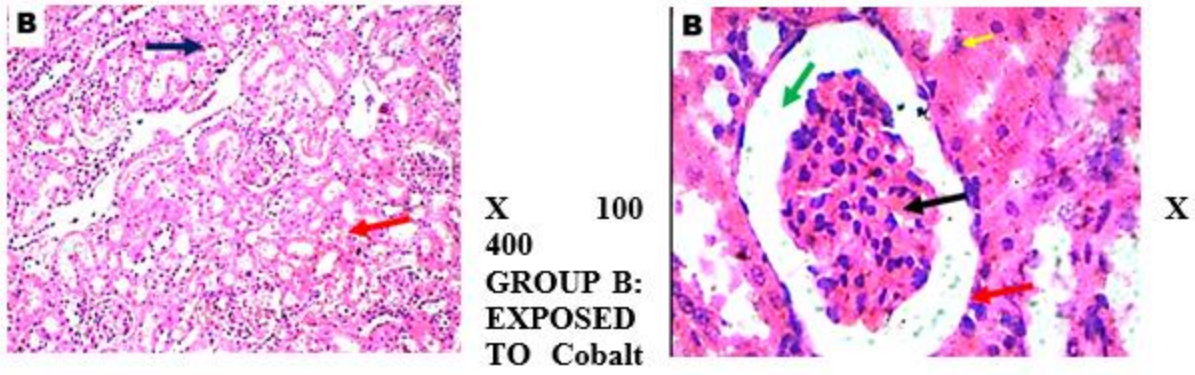
Photomicrograph of group E, Treated with 500mg/kg of *Moringa Oleifera* leaf extract only. This group did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration. The renal tissue in this section appeared normal.

Photomicrograph Plates of Histological Analysis



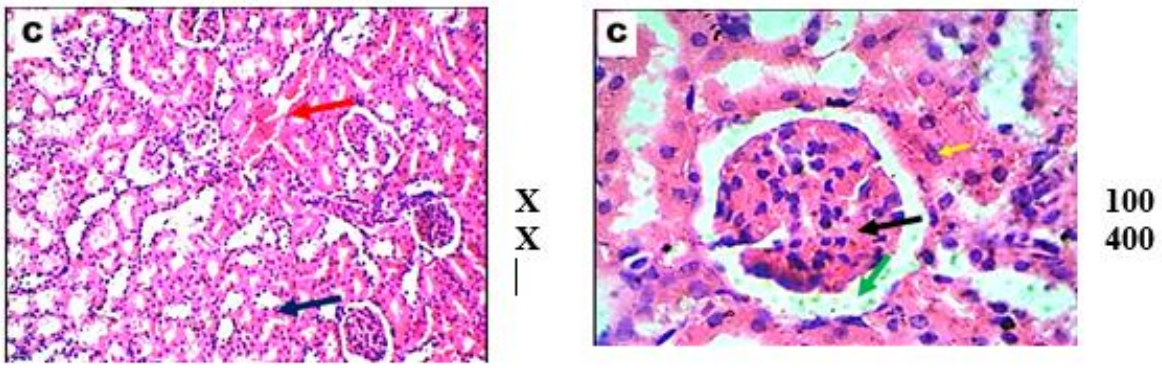
Group A: Control Group

Panoramic view of kidney, control group A; showing the micromorphological section demonstrated by Haematoxylin and Eosin staining at low magnification (X100). Magnified view of kidney micromorphological section demonstrated by Haematoxylin and Eosin staining at high magnification (X400). This group did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules (Blue arrow) appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration.



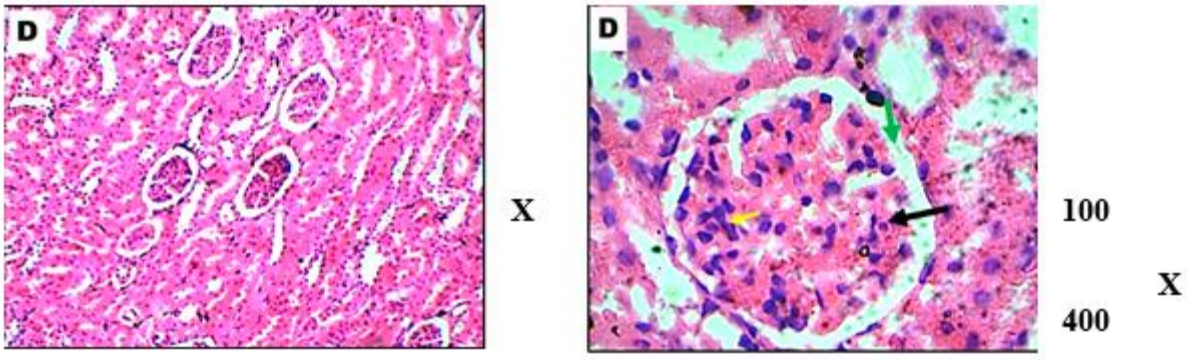
Group B: Exposed to Cobalt Chloride Only

Photomicrograph of group B, exposed to 45mg/kg during the 52days of Cobalt chloride administration showing some severe observable altered morphological. Renal cortex (Black arrow) shows collapsed glomeruli (Black arrow) with some signs of pyknotic mesangial cells (Yellow arrow) and observable wide capsular spaces, the renal tubules (Blue arrow) appear dilated, the interstitial spaces appear congested and infiltrated with some observable presence of red inflammatory cells, some signs of fibrosis/hemorrhage.



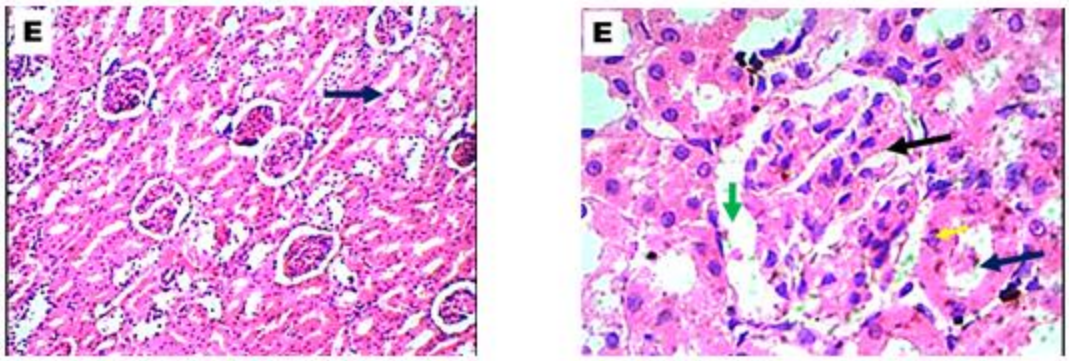
Group C: Exposed To 45mg/Kg of Cobalt Chloride and Treated with Low Dose of *Moringa Oleifera* Leaf Extract (250g)

Photomicrograph of group C, treated with 45mg/kg of Cobalt chloride and low dose of *Moringa oleifera* of 250g extract for 52days showing some severe observable altered morphological. Renal cortex (Black arrow) shows collapsed glomeruli (Black arrow) with some signs of pyknotic mesangial cells (Yellow arrow) and observable wide capsular spaces, the renal tubules (Blue arrow) appear dilated, the interstitial spaces appear congested and infiltrated with some observable presence of red inflammatory cells, some signs of fibrosis/hemorrhage.



Group D: Exposed to Cobalt Chloride and Treated with High Dose of *Moringa Oleifera* Leaf Extract (500mg/Kg)

Photomicrograph of group D, exposed to cobalt chloride and treated with 500mg/kg high dose of *Moringa Oleifera* leaf extract for 52days. This group did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration.



Group E: Treated with Moringa Only (500mg/Kg)

Photomicrograph of group E, Treated with 500mg/kg of *Moringa Oleifera* leaf extract only. This group did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration.

Discussion

This study investigated the histomorphological effect of cobalt chloride on the kidney of adult wistar rats. The study considered the effect of

Moringa Oleifera extract on cobalt chloride induced hypoxia on adult wistar rat brain and the effect of cobalt chloride on the body weight, mean and relative organ weight in the adult wistar rat. Cobalt is natural element found throughout the environment. Cobalt chloride is an essential trace element being an integral part of vitamin B12. Cobalt has also been used as treatment for anemia because it stimulates RBC production. In this research cobalt chloride has been used to induced hypoxia on adult rats brain, by oral administration for 52days.

Moringa oleifera is a popular staple in different parts of the world. M. oleifera is consumed not only for its nutritional values but also its medical benefits. Moringa oleifera leaves are rich in beta-carotene, vitamin C, vitamin E, and polyphenols and are a good source of natural antioxidants (Anwar, 2007). Currently, Moringa oleifera is reported to enhance a broad range of biological functions including anti-inflammatory, anti-cancer, hepatoprotective, and neuroprotective functions (posmontier, 2011). In addition, many studies have revealed its therapeutic value including anti-diabetes, anti-rheumatoid arthritis, anti-atherosclerosis, anti-infertility, pain relief, anti-depression, and diuretic and thyroid regulation (Chumark, 2008). Due to these reported functions, the bioactivity of Moringa oleifera has gained tremendous attention over the last decade, thereby leading to the increasing exploration and understanding of its pharmacological functions and underlying mechanisms.

The administration of cobalt chloride to experimental rats has been shown to cause insignificant increase ($P > 0.05$) in group B (cobalt-treated group) which was exposed to 45mg/kg of cobalt chloride when compared to group A (control group). The body weight of animals in group C which was exposed to 45mg/kg of cobalt chloride and 250mg/kg of moringa extract (low dose) increased significantly ($P<0.05$) when compared to the body weights of animals in group A (control group). The body weight of animals in group D which was exposed to 45mg/kg of cobalt chloride and 500mg/kg of moringa extract (high dose) decreased significantly ($P<0.05$) when compared to the body weights of animals in group A (control group). The body weight of animals in group E which was exposed to 500mg/kg of moringa extract only (high dose) increased significantly ($P<0.05$) when compared to the body weights of animals in group A (control group) These implies that Moringa oleifera extract increases feed intake which resulted in significant increase in the weight of animals in group E compared to animals in group D. The brain makes up only 2-4% of the body weight so cobalt chloride does not really have any effect on the body weight (Hoyt et al., 1997). The exposure of group D to cobalt chloride reduced the body weight of the animals in this group because the toxicity of cobalt chloride causes reduction in the body weights of the wistar rats.According to Madzharova (*et al*., 2010) significant decrease was also observed in cobalt-chloride treated group. This is also in accordance with the study done by (Ghebreselassie *et al*.,2011). He reported that mice treated with 900 mg/kg of the extract where increased in weight when compared with the controls (Ghbreselassie *et al*.2011).

Comparing the relative kidney weight of group B (cobalt-treated group) which was exposed to 45mg/kg of cobalt chloride, an insignificant decrease ($P > 0.05$) was observed when compared to relative kidney weight of group A (control group). For the relative kidney weight of group C which was exposed to 45mg/kg of cobalt chloride and 250mg/kg of moringa extract (low dose), an insignificant decrease ($P > 0.05$) was observed when compared to relative kidney weight of group A (control group). For the relative kidney weight of group D which was exposed to 45mg/kg of cobalt chloride and 500mg/kg of moringa extract (high dose), an insignificant decrease($P > 0.05$) was observed when compared to relative kidney weight of group A (control group). For the relative kidney weight of group E which was exposed to 500mg/kg of moringa extract only (high dose), an insignificant decrease($P > 0.05$) was observed when compared to relative kidney weight of group A (control group).

This result shows decrease of the kidney weight in the group B treated with cobalt only and this is similar to the findings of (Aaishwarya *et al*., 2012) that cobalt chloride affected the kidney thereby damaging and decreasing the weight and by this causing increase in the level of Urea and Creatinine.

The histological observation showed in Group A did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules (Blue arrow) appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration. The histological section of group B (treated with 45mg/kg of cobalt chloride only) showed some severe observable altered morphological. Renal cortex (Black arrow) shows collapsed glomeruli (Black arrow) with some signs of pyknotic mesangial cells (Yellow arrow) and observable wide capsular spaces, the renal tubules (Blue arrow) appear dilated, the interstitial spaces appear congested and infiltrated with some observable presence of red inflammatory cells, some signs of fibrosis/hemorrhage. The histological section of group C (treated with 45mg/kg of cobalt chloride and low dose of moringa extract 250mg/kg) showed some severe observable altered morphological. Renal cortex (Black arrow) shows collapsed glomeruli (Black arrow) with some signs of pyknotic mesangial cells (Yellow arrow) and observable wide capsular spaces, the renal tubules (Blue arrow) appear dilated, the interstitial spaces appear congested and infiltrated with some observable presence of red inflammatory cells, some signs of fibrosis/hemorrhage. Histological section of group D (treated with 45mg/kg of cobalt chloride and high dose of Moringa extract 500mg/kg) did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration. The histological section of group E (treated with 500mg/kg high dose) also did not show any significant observable morphological alteration as seen in both magnifications and demonstrated by H&E staining; the renal cortex (Black arrow) shows normal glomeruli (Black arrow) with normal mesangial cells (Yellow arrow) and capsular spaces, the renal tubules appear normal, the interstitial spaces appear normal and clear with no signs of congestion or infiltration.

Conclusion

In conclusion, the results obtained in this study following co-administration of cobalt chloride and *moringa* leaf extract on the histomporphology of the kidney has shown the ameliorative effects on *moringa* leaf extract on cobalt chloride induced kidney damaged in wistar rats investigated.

Recommendation

In industries where there is high exposure to cobalt chloride and its products such as the mining, metal fabrication and weaponry industries. It is advised to take a regular dose of moringa extract to alleviate the effects of cobalt chloride.

More research is required to provide detailed Information on this research work.

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