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Therapeutics potential of *Ocimum basilicum* following mercury chloride-induced hepatotoxicity in rats (*Rattus norvegicus*)

Sunday A. Adelakun[1,*], Olusegun D. Omotoso[2] and Grace T. Akingbade[1]

[1]Department of Human Anatomy. School of Health and Health Technology. Federal University of Technology. Akure. Ondo State. Nigeria. E-mail: saadelakun@futa.edu.ng.
[2]Department of Anatomy, Faculty of Basic Medical Sciences, Kogi State University Anyigba, Kogi State, Nigeria.

Abstract. Globally mercury (Hg) has been reported as one of heavy metal of known toxicity, noted for inducing public health disasters. Present study examines the therapeutics potentials of *Ocimum basilicum* on mercury chloride ($HgCl_2$) induced hepatotoxicity in Wistar rats. Thirty adult Wistar rats randomly divided into six groups (A-F) of five rats each. Group A served as control was given 2 mL/day of distilled water, Group B, C, D, E and F received 500 mg/kg body weight (bwt) of *O. basilicum* extract, 20 mg/kg/bwt of $HgCl_2$, 40 mg/kg bwt of $HgCl_2$, 20 mg/kg bwt of $HgCl_2$ and 500 mg/kg bwt *O. basilicum* leave extract, 40 mg/kg bwt and 500 mg/kg bwt *O. basilicum* administered daily by gastric gavage, for 21 consecutive days. The gross anatomical parameters of the liver and liver histology were assessed. Liver oxidative stress was evaluated by liver superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), reduced glutathione (GSH) and malondialdehyde (MDA) assays. The activities of the biomarker enzymes of the liver (alanine transaminase, aspartate transaminase and alkaline phosphatase were assayed). Histological profiles of the liver revealed derangement of the liver cytoarchitecture following consumption of mercury chloride and a marked improvement was observed after *O. basilicum* administration. Similarly, *O. basilicum* improved the reduction of antioxidant parameters (SOD, CAT, GPx and GSH) and the increased MDA caused by mercury chloride consumption. *O. basilicum* thus proffer protection against free radical mediated oxidative stress in mercury chloride-induced hepatotoxicity in rats.

Keywords: Histology; *Ocimum basilicum*; Mercury chloride; Oxidative stress; Rat; Liver.

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ORCID
0000-0002-8328-3119
Sunday A. Adelakun
0000-0001-7962-3363
Olusegun D. Omotoso
0000-0002-7899-5138
Grace T. Akingbade

Introduction

There is a growing problem of worldwide contamination of the environment with mercury, the fate and behavior of mercury in the environment depends on its chemical form (Rice et al., 2014). Inorganic mercury compounds enter water bodies by different ways and undergo a process of methylation (Gilmour and Henry, 1991). Mercury poisoning result from inhalation, ingestion, or absorption through the skin and may be highly toxic and corrosive once absorbed into blood stream (Khan et al., 2004). High exposures to inorganic mercury may result in damage to the gastrointestinal tract, the nervous system, and the kidneys (USEPA, 2018). Many populations worldwide have been exposed to doses of mercury through the consumption of fishes and sea foods (Valey et al., 1980; WHO, 2003). The most famous case of contamination with organic mercury is the Minamata case in the 1950/1960s in Japan (Popescu, 1978; Tan et al., 2009). People who consumed food mainly fish, contaminated with methyl mercury presented several health problems, especially children exposed to the metal in utero (Ekino et al., 2007). Liver is a target organ for the accumulation of cadmium and mercury (Yannai and Sachs, 1993). Mercury is a prevalence environmental and industrial pollutant, which induces severe alterations in the tissues of both animals and men (Lund et al., 1983; Stacey and Kappus, 1982). It is highly toxic metal, results in a variety of adverse health effects including neurological, renal, respiratory, immune, dermatologic, reproductive and developmental sequels (Risher and Amler, 2005). Mercury recycles through the entero-hepatic system in adults and is excreted primarily in the faeces (Dalia, 2010).

Ocimum basilicum L. is a medicinal plant which has received a great deal of attention over the past few decades around the world, It belongs to the Lamiaceae Family of floral plants usually producing white-purple flowers (Daneshian et al., 2009). It is commonly known as sweet basil (Omidbaig, 2005). Basil is one of the species used for the commercial seasoning and it is commonly known that the presence of essential oils and their composition determine the specific aroma of plants and the flavour of the condiments (Marotti et al., 1996).

Many species of aromatic plants belonging to the Lamiaceae Family grow wild in the Mediterranean Basin (Akgül, 1989; Sanda et al., 1998; Martins et al., 1999). Hot tea of basil plant leaves is good for treating nausea, dysentery and flatulence. Externally it can be used for different skin infections such as treatment of acne, snake bites and insect stings. In addition to these, basil has been used as a remedy for an enormous number of ailments, including cancer, convulsion, deafness, diarrhea, epilepsy, insanity, sore throat, toothaches, and whooping cough (Khatri et al., 1995).

O. basilicum is being utilized as a source of essential oils mainly in industries, perfumery, dental, oral products and traditional ritual (Pino et al., 1996; Saira et al., 2014). Recent scientific research has investigated the health benefits associated with Ocimum basilicum essential oils. Studies reveal the anti-viral, anti-microbial, antioxidant, and anti-cancer properties of the oils; further research is underway (Chiang et al., 2005; Bozin et al., 2006).

Liver is the largest gland in our body, the vital metabolic organ which metabolizes various xenobiotics daily. In the process the organ is affected by various chemicals and toxins. Exposure to different organic and inorganic elements and compounds including several environmental toxins, pollutants and drugs can cause induction of generation of highly reactive substances such as reactive oxygen species (ROS) who in turn can bring about oxidative stress mediated cellular damages. Identification of a successful

hepatoprotective agent without any cytotoxic side effect will be very useful for treating hepatic diseases and protect this vital organ (Gnanaprakash et al., 2010).

The present study demonstrates the therapeutics potentials of *O. basilicum* on mercury chloride induced hepatotoxicity in Wistar rats.

Materials and methods

Ocimum basilicum

The plant material was collected from research Farm Federal University of Technology, Akure, Nigeria, and *O. basilicum* leaves were identified by Dr. K. D Ileke in the Department of Biological Science, of Federal University of Technology, Akure, Nigeria.

Preparation of extract

Plant materials were air dried at room temperature and ground by using electronic blender model FS-343, Indian) to powdered form. 67 g of *O. basilicum* leaves powder was soaked in 1,000 mL of 95% ethanol for five days at room temperature. The mixture was mixed daily for regular infusion after five days the extract was filter by using Whatman filter paper No.1. The filtrate was dried using rotary evaporator at 60 °C. The dried extract was stored in sterile glass bottles at -20 °C until use (Kandil et al., 1994).

Animals and Diet

30 adult Wistar rats obtained from a breeding stock maintained in the animal house of Department of Anatomy, School of Health and Health Technology, Federal University Of Technology, Akure, Ondo State, Nigeria.

The rats were fed with standard rat chow at a recommended dose of 100 g/kg as advised by the International Centre of Diarrheal Disease Research, Bangladesh (ICDDR, B) daily, drinking water was supplied *ad libitum* and they were randomly divided into six groups (A-F) of five rats each in a separate room at a constant temperature (22.0 °C ± 1.0 °C) under a 12h light/dark cycle. Rats in Group A served as control was given 2 mL/kg/day of distilled water, Group B received *O. basillicum* leave extract at 500 mg/kg bwt. Group C received $HgCl_2$ at 20 mg/kg bwt. Group D received $HgCl_2$ at 40 mg/kg. Group E received $HgCl_2$ at 20 mg/kg bwt and *O. basillicum* leave extract at 500 mg/kg bwt. Group F received $HgCl_2$ at 40 mg/kg bwt, and *O. basillicum* leave extract at 500 mg/kg bwt, administered daily by gastric gavage, for 21 consecutive days.

All experimental investigations were done in compliance with humane animal as stated in the "Guide to the Care and Use of Laboratory Animals Resources" (NRC, 1985) and in accordance with the guideline and approval of Nigeria Medical Ethical Association for Accreditation of Laboratory Animal Care.

Animal sacrificed and sample extraction

12 h after the administration of the last mercury chloride and *O. basillicum*, the rats were at the time of sacrifice first weighed and then cervical dislocation was carried out following ethical humane animal euthanasia which was adopted with expertise cervical dislocation. The abdominal cavity of each rat was opened up through a midline thoracic incision to expose the liver. The liver was excised and weighed with an electronic analytical and precision balance. The liver of each animal was fixed in 10% formosaline for histological examination.

Estimation of haematological parameters

Blood was collected by means of Cardiac puncture and blood cell count was done using an auto-analyzer. Red blood cell count (RBC), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), platelet count, white blood cell count (WBC), packed cell volume was analyzed

and differential white blood cell count was done.

Determination of serum glucose, total protein, albumin levels and ALT, AST and ALP assay

The degree of liver damage was evaluated by ALT, AST and ALP in serum using a commercially available kit. Detailed procedures for the above measurements were performed according to the kit manufacturer's instructions.

Determination of oxidative stress parameters

SOD activity in liver was determined according to the method described by Marklund and Marklund (1974) and GSH-Px activity was determined by GSH-Px assay kit. Detailed procedures for the above measurements were performed according to the kits' protocol. CAT was assayed by the method described by Ferro et al. (2010). The non-enzymic GSH was analyzed by the method of Moron et al. (1979).

Determination of Liver MDA contents

Lipid peroxidation was evaluated on the base of MDA level and MDA in liver was determined using the method described by Jain et al. (1989).

Protein quantification

Protein was measured by the method of Bradford (1976), using bovine serum albumin as the standard.

Histological preparation of tissues

This was done as described by Omotoso et al. (2016). The liver was fixed in 10% formosaline to prevent autolysis. The liver was passed through ascending grades of alcohol (70%, 80%, 90% and absolute 100%) to gradually remove its water contents. The sample was placed in xylene to remove the alcohol. This improves the refractive index of the tissue. The tissue was immersing in molten paraffin wax so that the holes left by the alcohol would be filled up. This gives the tissue support. The tissue is placed into an embedding mold which is filled with more paraffin wax and allowed to solidify. This is done in order to make the tissue compact for sectioning. The block is trimmed to remove the excess wax. The block of tissue was placed in a microtome and trimmed to expose the surface. The microtome was set to 3-5 micron and the tissue was sectioned. The sections were picked with forceps and placed in a water bath to float out and spread well. It was picked with a slide

Statistical analysis

Data were expressed as Mean±SEM. Statistical differences between the groups were evaluated by one-way ANOVA, followed by Dunnets comparison test to compare between treated and control groups. Differences yielding $p < 0.05$ were considered statistically significant. All statistical analysis of data was performed using GraphPad Prism 5.0 for Windows (GraphPad Software, San Diego, California, USA).

Result

Physical observation

During the period of administration, the animals were given intimate observation throughout the period of experiment. During acclimatization, all animals appeared presumably normal with laid hairs and pinkish eyes with good feeding habit. The animals were observed to be using their forelimbs to scratch their mouth on mercury chloride administration, the animals got weakened which was observed as a result of reduction of their physical activities. There was decrease in body weight in the animals administered with mercury chloride only, especially after day 14 and 21 of treatment whereas there was increase in body weight in the control group.

Body weight

The differences in body of animals subjected to different treatments were shows in Table 1. During the course of present investigations. It was observed that the body weight in control and *O. basilicum* treated group increased progressively, contrary, in $HgCl_2$ treated rats, results revealed significant decreased in body weight gain as compared to the control.

Table 1. Shows mean body weights in control and treated rats.

Period	Treatment groups					
	Group A	Group B	Group C	Group D	Group E	Group F
Day 1	160.0±4.472	195.0±2.000*	200.0±2.010*	200.0±8.000*	200.0±12.65*	224.0±28.21*
Day 7	180.0±6.325	217.5±4.787	231.0±3.674*	223.0±6.782*	199.0±7.810*	234.0±19.90*
Day 14	186.0±4.000	222.5±3.782*	228.0±9.138*	204.0±9.695*	206.0±6.000*	223.3±28.48*
Day 21	194.0±6.782	227.5±4.787	219.0±9.950	184.0±10.68	197.5±4.330	221.7±29.20*

Values are expressed as mean ± SD for n=5; *p < 0.05, significantly dissimilar from control One-Way ANOVA. OB: *Ocimum basillicum*, bwt: body weight. A: (Control) Distilled water, B: (500 mg/kg bwt of OB), C: (20 mg/kg bwt of $HgCl_2$), D: (40 mg/kg bwt of $HgCl_2$), E: (20 mg/kg bwt and 500 mg/kg bwt OB), F: (40 mg/kg bwt and 500 mg/kg bwt OB).

Absolute and relative liver weights

The difference in absolute and relative liver weights of animals subjected to different treatments were shows in Table 2. During the course of present investigations, there was observed significant increase in absolute and relative liver weights of $HgCl_2$ and *O. basilicum* treated group as compared to the control.

Table 2. Showing difference in absolute and relative liver weights in control and treated rats.

Parameters	Treatment groups					
	Group A	Group B	Group C	Group D	Group E	Group E
Absolute Liver weight (g)	4.32±0.10	4.53±0.26*	4.51±0.15*	4.69±0.12*	4.79±0.17*	4.90±0.10*
Relative Liver weight (g/100 g bwt)	2.21±2.23	2.32±0.13	2.26±0.08	2.35±1.5	2.40±1.34	2.19±0.35

Values are expressed as mean ± SD for n=5; *p < 0.05, significantly dissimilar from control One-Way ANOVA. OB: *Ocimum basillicum*, bwt: body weight. A: (Control) Distilled water, B: (500 mg/kg bwt of OB), C: (20 mg/kg bwt of $HgCl_2$), D: (40 mg/kg bwt of $HgCl_2$), E: (20 mg/kg bwt and 500 mg/kg bwt OB), F: (40 mg/kg bwt and 500 mg/kg bwt OB)

Effects of treatments on serum biochemical Parameters

As showed in Table 3, the serum levels of AST, ALT and ALP were significantly increased in the mercury chloride group compared to the control group, but the serum AST, ALT and ALP activities in mercury chloride and *Ocimum basilicum* group were significantly lower than that of the mercury chloride group. However, combined administration of *O. basilicum*

with mercury chloride results in gradual recovery in AST, ALT and ALP activities as compared to the control group. The content of serum glucose of the mercury chloride treated group tented to be higher compared to the control. Albumin and protein levels in mercury chloride treated animals were decreased, but the co-administration of *O. basilicum* with mercury chloride has produced a recovery in the above mentioned biochemical variables.

Table 3. Shows difference in biochemical parameters in control and treated rats**.**

Groups	Parameters					
	Glucose (mg/dL)	Total protein (g/dL)	Albumin (g/dL)	AST(U/L)	ALT(U/L)	ALP (U/l)
Group A	77.59±7.92	8.70±0.53	5.90±0.38	99.10±1.03	25.82±0.73	240.0±6.10
Group B	73.14±1.60	9.04±0.42	5.52±0.30	122.70±1.5*	36.80±0.74*	230.4±1.75*
Group C	95.49±3.09*	7.47±0.30*	4.52±0.32*	151.20±1.27*	61.89±0.72*	240.3±1.67
Group D	98.58±2.33*	8.45±0.40	4.77±0.31*	153.30±1.07*	62.97±0.69*	244.6±1.24
Group E	82.16±4.05	8.26±0.15	5.67±0.35	140.00±100*	59.94±0.71*	230.6±1.60*
Group F	87.22±8.50*	8.45±0.26	5.44±0.43	142.70±0.83*	60.50±0.72*	232.8±2.27*

Values are expressed as mean ± SD for n=5; *p < 0.05, significantly dissimilar from control One-Way ANOVA. OB: *Ocimum basillicum*, bwt: body weight. A: (Control) Distilled water, B: (500 mg/kg bwt of OB*)*, C: (20 mg/kg bwt of $HgCl_2$), D: (40 mg/kg bwt of $HgCl_2$), E: (20 mg/kg bwt and 500 mg/kg bwt OB), F: (40 mg/kg bwt and 500 mg/kg bwt OB).

Antioxidant levels (CAT, SOD, GSH, GP_X) and MDA levels

Showed in Table 4, the MDA levels in group C and D increased compared with the control group A but decreased in group B, E and F compared to mercury chloride group (C and D). The anti-oxidant levels (CAT, SOD, GSH and GPx) decreased significantly in mercury chloride group (C and D) (*P < 0.05) compared to the control group but the CAT, SOD, GSH and GPx level group B, E and F decreases (*P < 0.05) compared to the control group.

Table 4. Shows antioxidant and lipid peroxidation levels in liver of control and treated rats.

Groups	Parameters				
	MDA (nmol/mg protein)	CAT (µ/mg protein)	SOD (µ/mg protein))	GST (nmol/mg protein)	GPx (nmol/mg protein)
Group A	8.76±0.21	21.70±1.21	14.86±0.77	9.48±0.47	6.36±0.40
Group B	7.72±0.24*	19.54±0.40	14.18±0.68	8.54±0.40*	4.14±0.23*
Group C	11.04±0.50*	13.58±0.66	6.30±0.80*	5.62±0.36*	2.32±0.41*
Group D	12.20±0.60*	14.82±0.73	7.50±0.46*	6.28±0.67*	2.66±0.42*
Group E	6.70±0.45*	16.94±0.36	11.74±0.57*	7.80±0.46*	3.78±0.38*
Group F	8.60±0.45	19.02±0.58	14.30±0.56	8.40±0.51*	3.64±0.66*

Values are expressed as mean ± SD for n=5; *p < 0.05, significantly dissimilar from control One-Way ANOVA. OB: *Ocimum basillicum*, bwt: body weight. A: (Control) Distilled water, B: (500 mg/kg bwt of OB), C: (20 mg/kg bwt of $HgCl_2$), D: (40 mg/kg bwt of $HgCl_2$), E: (20 mg/kg bwt and 500 mg/kg bwt OB), F: (40 mg/kg bwt and 500 mg/kg bwt OB).

Hematological parameters

As showed in Table 5 the mean value of hematological parameters of group C and D decrease when compared to group A indicating the toxic effect of mercury chloride. Mean value of Group B, E and F compared with Group C and D indicating the effect of *O. basilicum* and co-administration of mercury chloride and *O. basilicum*.

Table 5. Shows Hematological Indices in control and treated rats.

Groups	Parameters				
	PCV (I/L)	Hb (g/L)	Neutrophl	Lymphocyt	Eosinophil
Group A	0.76±0.04	18.07±0.72	35.5±1.40	83.28±1.07	3.01±0.84
Group B	0.76±0.02	15.41±0.87*	32.24±1.09*	84.66±1.00	3.91±0.50
Group C	0.78±0.02	17.90±0.88*	36.40±0.65	80.89±1.00*	3.65±0.54
Group D	0.77±0.01	16.33±0.89*	36.31±1.42	79.32±1.02*	4.22±0.87
Group E	0.74±0.02	16.33±0.93*	35.74±1.31	78.82±1.71*	3.70±0.57
Group F	0.75±0.02	16.33±0.93*	33.77±1.02*	85.44±0.87*	3.35±0.80

Values are expressed as mean ± SD for n=5; *p < 0.05, significantly dissimilar from control One-Way ANOVA. OB: *Ocimum basillicum*, bwt: body weight, PCV: Packed cell volume, Hb: Hemoglobin concentration. A: (Control) Distilled water, B: (500 mg/kg bwt of OB), C: (20 mg/kg bwt of $HgCl_2$), D: (40 mg/kg bwt of $HgCl_2$), E: (20 mg/kg bwt and 500 mg/kg bwt OB), F: (40 mg/kg bwt and 500 mg/kg bwt OB).

Liver histology

Cross section of the livers of animals after the study showed that Group A had a normal histoarchitecture of the liver with central vein, hepatocytes, sinusoid and kupffer cells. Group B showed intact hepatocyte cells, central vein and sinusoid however, Groups C and D showed mononuclear cell infiltration, congestion of central vein and diffused necrosis of hepatocytes. Group E showed restoration in the hepatocyte, mild congestion of the cytoplasm, absence of centrilobular necrosis with nearly visible central vein. The result from Group F showed restoration in the hepatocyte, mild congestion of the cytoplasm, absence of centrilobular necrosis with nearly visible central vein (Figure 1).

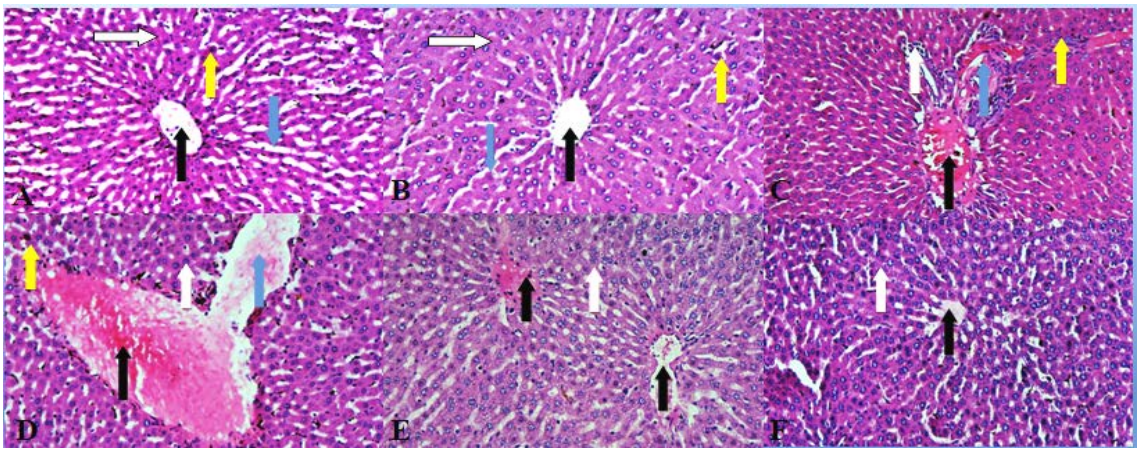

Figure.1. Photomicrograph of section of Liver Group A control and group B showing intact hypatocyte cells (white arrow), CV: central vein (black arrow), S: sinusoid (blue arrow) and kupffer cells (K yellow arrow). Group (C-D) with cellular necrosis (CN white arrow), central vein (CV black arrow), enlarged sinusoids (S blue arrow), mononuclear cellular infiltration (MN yellow arrow). Group (E-F) showing restoration in the heptocyte (white arrow), mild congestion of the cytoplasm, absence of centrilobular necrosis with nearly visible central vein (black arrow). H&E x400.

Discussion

The accumulation of noticeable amount of mercury in liver tissue resulted in induction of oxidative stress response in the liver. Mercury is a common environmental and occupational toxic heavy metal, which is known to have direct and indirect effects on biological systems and cells (Hesse, 2007; Jaishankar et al., 2011). One of the ways that mercury exerts its toxic effects is through oxidative stress that may be an important contributor to the negative pathogenesis observed after mercury chloride exposure (Valera et al., 2008; ATDRS, 2011). Oxidative stress can be defined as a situation of an imbalance toward the pro-oxidant side of the pro-oxidant/antioxidant balance (Mitra et al., 2012).

O. basilicum is a medicinal plant which has received a great deal of attention over the past few decades around the world. It belongs to the Lamiaceae Family of floral plants usually producing white-purple flowers (Keita et al., 2000; Daneshian et al., 2009).

The present study revealed that mercury chloride intoxication causes significant increased in lipid peroxidation and glucose levels, significant decreased in the serum albumin and total protein. The activities of aspartate aminotransferase (ALT), alanine aminotransferase (AST) and ALP in the serum of rats are tested as indicator for hepatic function (El-Maraghy et al., 2001; Kumar et al., 2005). In our study, the activities of ALT, AST and ALP in the serum of mercuric chloride exposed rats were significantly increased indicating mercury related injury to the liver. This is in accordance as reported by Brzóska et al. (2003), Pari and Murugavel (2005) also the increased in these enzymes may be due to cellular necrosis of hepatocytes, which increases in the permeability of cell resulting in release of transaminases and ALP in the blood stream (Vandenberghe, 1995; Rana et al., 1996). This confirms our earlier reports on histological alterations in liver induced by mercury intoxication which is in accordance as reported by (Sharma et al., 2000; 2002) but the serum AST, ALT and ALP activities in the mercuric chloride and *O. basilicum* group were significantly lower than in the mercury chloride group. However, combined administration of *O. basilicum* with mercury chloride results in gradual recovery in AST, ALT and ALP activities as compared to the control group. The content of serum glucose of the mercury chloride treated group tented to be higher compared to the control. Albumin and protein levels in mercuric chloride treated animals were decreased, but the co-administration of *O. basilicum* with mercury chloride has produced a recovery in the above mentioned biochemical variables.

The reduction in PCV and Hb in this study revealed microcytic hypochromic anemia. This observation was consistent with an earlier observation of others on genotoxic potential of mercuric chloride and different anti-oxidants alone or in combined form in the liver and other tissues (Wang et al., 2007; Burger et al., 2011; Cordeiro Júnior et al., 2012). Co-administration of mercuric chloride with *O. basilicum* in the present study resulted in ameliorative effects on haemato-biochemical parameters. However, the overall mean value of the group treated with *O. basilicum* tend to move towards normal, indicating the recuperative effect of this anti-oxidant against mercury toxicity as reported by (Ibegbu et al., 2014).

In addition, the antioxidant enzymes and lipid peroxidation levels can be used to predict the degree of mercuric chloride induced liver damage. Antioxidants enzymes such as SOD, CAT, GSH and GPx dependently act in the metabolic pathways that involve free radicals. Therefore, SOD, CAT, GSH and GPx levels decreased in liver due to toxic effects of mercury chloride on liver functions but the administration of *O.*

basilicum can counter the impact of mercury chloride on liver cells thereby blocking the decreased antioxidants levels. Since it was proved that the significance of GSH in the detoxification of chemically reactive metabolite in drug induced toxicity after decreased in GSH (James et al., 1982; Saalu et al., 2012) then we can conclude that increased oxidation and decreased synthesis of GSH causes decreased in GSH levels. Therefore, increased in antioxidant enzyme activities levels (SOD, CAT, GSH and GPx) after *O. basilicum* extracts administration might contribute to the ameliorating effects of oxidative stress. MDA is a known biomarker of lipid peroxidation and oxidative stress, the increased in MDA level shows the toxic effects of mercury chloride on liver (Trush et al., 1982) but the counter actions of *O. basilicum* in reducing MDA level suggest the potential characteristics of *O. basilicum* in the restoration of damaged liver tissues following exposure to mercury chloride. Therefore, the antioxidant potential improved the liver functions by promoting antioxidant enzyme activities of *O. basilicum*. Also during the period of administration, the animals were given intimate observation throughout the period of experiment and during acclimatization, all animals appeared presumably normal with laid hairs and pinkish eyes with good feeding habit. The animals were observed to be using their forelimbs to scratch their mouth on mercury chloride administration, the animals got weakened which was observed as a result of reduction of their physical activities. There was decreased in body weight in the animals administered with mercury chloride only, especially after day 14 and 21 of treatment whereas there was increased in body weight in the Control group these is in accordance as reported by Ibegbu et al. (2014).

Furthermore, histological evaluation following mercury chloride consumption suggests inflammation of the hepatocyte, hepatocytic vacuolation and congested sinusoids. However, *O. basilicum* extracts treated group shows fewer areas of congestion, wider sinusoidal spaces and presence of binucleated cells indicating proliferation and regeneration which are in conformity with previous study Ibegbu et al. (2014) and Youcef et al. (2013) reported effects of ascorbic acid on mercury-induced changes on the liver in adult Wistar rats and amelioration of mercury chloride toxicity on rat liver with argan oil and sodium selenite supplements.

There was an observable improvement in the microscopic appearance of the liver after *O. basilicum* administration showing restoration in the hepatocyte, mild congestion of the cytoplasm, absence of centrilobular necrosis with nearly visible central vein. Since *O. basilicum* has antioxidant components that can alter the damage done following exposure to mercury chloride, we can therefore conclude from our findings that *O. basilicum* tentatively decreased the effects of mercury chloride on the liver of rats.

Conclusion

It may be concluded that combined administration of *O. basilicum* has a preventive and protective effect on mercury chloride induced oxidative stress. It protects from $HgCl_2$ induced hepatic dysfunction and executes its modulatory role in mercury chloride induced free radical production.

Conflicts of interest

Authors declare that they have no conflict of interests.

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