MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Microbiology and Biological Sciences (ISSN: 2408-7076) Vol. 10(5) pp. 046-054, October, 2022
Available online http://www.meritresearchjournals.org/mbs/index.htm

DOI: 10.5281/zenodo.7242509

Original Research Article

Hepatoprotective Potential of *Corchorus olitorius* Leaves against Potassium Bromate-induced Hepatotoxicity

K. J. Aguh[1], O. I. N. Onyekachi[2], M. U. Nwobodo[3], N. M. Chika-Igwenyi[3], C. A. Onyeaghala[4], F. U. Agu[5], S. F. Orji[3], C. Igwenyi[3], C. N. Ugwu[6], C. L. Uche[7], I. O. Abali[8], A. I. Airaodion[9*]

[1]Department of Radiology, Federal Medical Centre, Umuahia, Abia, Nigeria

[2]Department of Medical Microbiology, Ebonyi State University, Abakaliki, Nigeria

[3]Department of Internal Medicine, Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Ebonyi State, Nigeria

[4]Department of Internal Medicine, University of Port-Harcourt Teaching Hospital, Rivers state, Nigeria

[5]Department of Physiology, Gregory University, Uturu, Abia State, Nigeria

[6]Department of Internal Medicine, Ebonyi State University, Abakaliki, Nigeria

[7]Department of Haematology, Abia State University, Uturu, Nigeria

[8]Department of Surgery, Abia State University, Uturu, Nigeria

[9]Department of Biochemistry, Federal University of Technology, Owerri, Imo State, Nigeria*

***Corresponding Author E-mail: augustineairaodion@yahoo.com/ Tel.: +2347030204212**

Abstract

Corchorus olitorius **leaves have been reported to possess the ability to protect the liver from hepatotoxicity that has been experimentally induced. The purpose of this study therefore was to investigate its hepatoprotective potential against potassium bromate-induced hepatotoxicity. Fresh *C. olitorius* (jute) plants were taken from the Institute of Agricultural Research and Training, Moor Plantation, Nigeria. They were extracted using a Soxhlet technique with 95% ethanol as the solvent. Twenty-four male Wistar rats were used in the experiment. Before the experiment began, they were given seven (7) days to get acclimated to a laboratory setting. At random, they were split up into groups A, B, C, and D. Group A served as the control group and received oral distilled water. Animals in groups C and D received *C. olitorius* at doses of 100 and 200 mg/kg body weight, respectively, in addition to the 100 mg/kg body weight of potassium bromate given to groups B, C, and D. Every day for 28 days, *C. olitorius* extract and freshly prepared potassium bromate were given orally to rats. The animals were sacrificed and blood and liver tissue were collected for the determination of hepatic biomarkers. The findings demonstrated that, when compared to the control group, $KBrO_3$ caused a significant increase (*P<0.05*) in ALT, AST, LDH, ALP, total bilirubin (TB), conjugated bilirubin (CB), and unconjugated bilirubin (UB) levels, but decreased total protein, albumin and globulin in the serum of animals. In the liver cells, $KBrO_3$ reduced hepatic biomarkers. These perturbations were neutralized in the groups treated with 100 and 200 mg/kg of *C.olitorius* body weight respectively. According to the current study, potassium bromate caused liver injury by unhinging important hepatic indicators. Increased efforts should be made to stop the use of potassium bromate in food processing. Furthermore, by bringing the examined biomarkers back to levels that are substantially identical to those in the control group of animals, it may be inferred that *C. olitorius* leaves have a significant hepatoprotective effect against liver damage caused by potassium bromate. We recommend consumption of this vegetable.**

Keywords: *Corchorus olitorius* leaves, Hepatoprotective potential, Hepatotoxicity, Potassium bromate

INTRODUCTION

Potassium bromate ($KBrO_3$) is a well-known flour enhancer that also serves as a ripening agent (Airaodion et al., 2019a). For the past 90 years, it has been utilized as a food ingredient (Airaodion et al., 2019b). It mostly works in the late dough stage, giving the dough strength and elasticity during baking while also boosting bread rise. Additionally utilized in the production of cheese and beer, $KBrO_3$ is frequently added to fish paste products (Ahmad and Mahmood, 2014). It is also a component of cold wave hair treatments and used in the cosmetic and pharmaceutical industries (Airaodion et al., 2019b). Additionally, $KBrO_3$ can be produced as a byproduct when bromide-containing water is ozonized. Free radicals produced as a result of $KBrO_3$ biotransformation may oxidatively damage vital cellular macromolecules, resulting in significant nephrotoxicity and cancer in test animals (Chipman et al., 2018). International Agency for Research on Cancer (IARC) has limited the use of $KBrO_3$ in food processing due to its probable human carcinogen classification (category 2B). In fact, numerous earlier studies have shown that $KBrO_3$ can cause multiple organ toxicity in both humans and experimental animals, with the kidney being the harmful compound's principal target organ (Kujawska et al., 2013; Ahmad et al., 2014). Particularly the central nervous system (CNS) and kidney tissues are severely irritated and harmed by $KBrO_3$. Animal experiments have revealed that $KBrO_3$ has both carcinogenic and mutagenic effects (Altoom et al., 2017). An incidence of mild poisoning was observed in New Zealand, and it was reported that several occurrences of accidental poisoning in children due to consumption of bromate solution and sugar contaminated with bromate were to blame (Altoom et al., 2017). As a result, $KBrO_3$ was outlawed in a number of nations, including the UK in 1990, Nigeria in 1993, and Canada in 1994 (Airaodion et al., 2019a,b). The key vitamins present in bread are destroyed by $KBrO_3$, which adversely impacts the nutritional quality of bread, according to toxicological investigations (Altoom et al., 2017). Bromate-induced carcinogenesis may be caused by the oxidative stress that $KBrO_3$ causes in tissues (Ugwu et al., 2022a). Additionally, it has been linked to nephrotoxicity (Abali et al., 2022), hepatotoxicity (Onyekachi et al., 2022), testicular toxicity (Ezirim et al., 2022a), dyslipidemia (Ugwu et al., 2022b), reduced sperm quality (Ezirim et al., 2022b), decreased male reproductive hormones (Iwuoha et al., 2022) and other adverse effects.

A factor that may make traditional medicine less expensive than contemporary treatment is the fact that over 400,000 species of tropical flowering plants contain therapeutic characteristics (Airaodion et al., 2020a). The World Health Organization (WHO) now promotes the use of traditional medicines in the management of various diseases because they are widely accessible, affordable, and effective against specific disorders (Airaodion and Onabanjo, 2022). The pharmaceutical industry would utilize the bioactive components or plant extract as a new formulation for the creation of innovative medications to treat a variety of disorders (Airaodion et al., 2021a). Nearly every plant on the planet has some sort of health benefit, but there are still a lot of undiscovered plants that have health advantages (Airaodion and Onabanjo, 2022). Medicinal plants are described as those that are frequently utilized for curing or preventing a certain condition or disease that are typically thought to be detrimental to people (Ogbuagu and Airaodion, 2020a). These plants fall into one of two categories: "Wild plant species," which are those that grow naturally in self-sustaining populations in natural and semi-natural ecosystems and may exist without direct human intervention, or "Domesticated plant species," which are those that have developed through human activity such as selection or breeding, and rely on management to survive (Airaodion et al., 2020b). Recent studies on herbal plants have made significant advancements in the pharmacological analysis of diverse plants utilized in conventional medical systems. Therefore, it may be said that plants are the primary source of medications, both as crude drugs for the general populace and as isolated active principles to be administered in standardized dosage form (Airaodion et al., 2019c).

C. olitorius (jute) is an annual flowering plant that is a member of the 400 species and 40 genera of the Malvaceae family. The genus, which accounts for roughly 80% of the world's supply of bast fiber, has been categorized into a number of distinct families, including Tiliaceae (Islam, 2010). It is the most significant source of natural fiber. In many nations in Asia and Africa, *C. olitorius* is a common vegetable used both for cooking and medicine. Tropical and subtropical places around the world are home to the plant. In several African nations, including the Republic of Benin, Nigeria, Cameroon, Ivory Coast, Sudan, Kenya, Uganda, Zimbabwe, and Egypt, it is said to be a wild or domesticated vegetable. Nigeria's domestic and export markets have enormous potential (Olanrewaju and Nwangburuka, 2012). It goes by several names, depending on where it is found, such as "malukhiyah" in North Africa and the Middle East, "molohiya" or "molochas" in Turkey and Cyprus, "Ewedu" for Yoruba speakers in Nigeria, "Rama" for Hausa speakers in Nigeria, and "Ayoyo" for Northern Ghanaians. The Philippines refer to *C. olitorius* as "saluyot." The leaves, which are rich in minerals and vitamins, can be used fresh or dried and boiled into a thick, viscous soup or added to stew or soup (Airaodion et al., 2019d). The leaves of *C. olitorius* are rich in antioxidants that have a variety of biological features, including hypoglycemic (Smith-Hall et al., 2012), hypolipidemic, and anti-obesity effects, as well as diuretic, analgesic, antipyretic, and anti-microbial activities. This herbaceous vegetable has a wide range of agronomic traits that have not yet been fully utilized for the development and selection of better

varieties. One of the many traditional vegetables that make up the traditional mixed cropping systems on farmers' plots and in backyard gardens in West, Central, and North Africa is *C. olitorius*. The main benefit of *C. olitorius* leaves is as a source of several chemical compounds. Jute leaves contain 17 active nutrient compounds, including calcium for strong bones and teeth, iron for healthy red blood cells, beta-carotene that is good for vision, as well as protein, fat, carbohydrate, fiber, ash, sodium, potassium, phosphorus, riboflavin, ascorbic acid, thiamine, and niacin (Islam, 2010).

The liver is a vital organ that performs a variety of processes in the body, including the synthesis of glycogen, the generation of bile, the production of triglycerides and cholesterol, and the production of proteins and blood clotting factors (Jameson, 2018). The term "liver function tests" is misleading because many of these tests focus on identifying the cause of damage rather than the liver's health. The tests check the blood's levels of several proteins and enzymes such Alanine Transaminase (ALT), Alkaline Phosphatase (ALP), and Aspartate Transaminase (AST). Some of these tests gauge the liver's efficiency in generating protein and eliminating bilirubin, a waste product of the blood (Airaodion et al., 2020c). Other tests for liver health examine the enzymes that the liver cells produce in response to injury or disease. The severity of a disease, particularly liver scarring (cirrhosis), can be assessed using liver function tests, which can also be used to screen for liver infections like hepatitis, to monitor the progression of a disease like viral or alcoholic hepatitis, and to assess how well a treatment is working (Airaodion et al., 2019e). According to several investigations, *C. olitorius* leaves have the ability to protect the liver from hepatotoxicity that has been artificially caused (Ahmed et al., 2016; Lobna et al., 2020; Shehab and Ghadhban, 2021). Therefore, the purpose of this study was to investigate its hepatoprotective properties against potassium bromate-induced hepatotoxicity.

MATERIALS AND METHODS

Extraction of Plant Materials

Fresh *C. olitorius* (jute) plants were gathered from Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Nigeria. The leaves were carefully separated from the stem, and the harmed ones were thrown away. They were properly cleansed under running water to remove impurities. They were allowed to air dry for 14 days at room temperature in an open laboratory setting before being processed with an electric blender to make powder. Following the steps given by Airaodion et al. (2019f,g), the extraction was carried out utilizing a soxhlet device with ethanol as the solvent. The ethanol was evaporated at 35 ^{o}C in a rotary evaporator, producing 2.28 g, or a yield of 9.12%. The extract was kept in the fridge until it was required.

Experimental Design

Twenty-four (24) mature male Wistar rats (*Rattus norvegicus*) weighing between 140 and 160 g participated in the experiment. Before the experiment, they were given seven (7) days to get acclimated to a laboratory setting. The rats were housed in wire-mesh cages and had full access to rat food and water. The animals were kept in environments with consistent humidity levels, 12-hour light/dark cycles, and temperatures. This inquiry was carried out in accordance with the declaration of Helsinki and the guidelines established by the committee for the control and supervision of experiments on animals. In addition, animal experimentation was conducted in accordance with National Research Council policy (NRC, 2011). At random, they were split up into groups A, B, C, and D. Group A, which acted as the control group, was given oral distilled water. Animals in groups C and D also received *C. olitorius* at doses of 100 and 200 mg/kg body weight, respectively, in addition to the 100 mg/kg body weight of potassium bromate given to groups B, C, and D. Every day for 28 days, *C. olitorius* extract and freshly produced potassium bromate solution were given orally to rats. The animals were gently sedated with diethyl ether aftertwenty-four hours of the last treatment before being put to death. A hole was made in the heart to extract blood.

Preparation of Liver homogenate

The liver was removed from the animals after they had been dissected. Using a Teflon homogenizer, the liver tissue was homogenized in 50 mMol/L Tris-HCl solution (pH 7.4). In order to preserve the supernatants for use in biochemical analysis, the mixture was centrifuged at 5000 rpm for 15 minutes.

Determination of Hepatic biomarkers

Utilizing commercial Randox Enzyme kits, the activities of alkaline phosphatase (ALP), aspartate amino-transferase (AST), alanine aminotransferase (ALT), and lactate dehydrogenase (LDH) were assessed from liver and plasma homogenates in accordance with Reitman and Frankel's approach (Reitman and Frankel, 1957). Following the methods previously outlined by Airaodion et al. (2019h), additional biomarkers, including Total Protein (TP), Albumin (ALB), Globulin (GLO), Total Bilirubin (TB), Conjugated Bilirubin (CB), and Unconjugated Bilirubin (UB), were

Table 1. Effect of *C. olitorius*on Hepatic Biomarkers in the Plasma of Potassium Bromate-induced Rats

Hepatic Biomarkers	Control	$KBrO_3$ Only	$KBrO_3$ + 100 mg/kg *C. olitorius*	$KBrO_3$ + 200 mg/kg *C. olitorius*	p-value
AST (U/L)	54.27±3.34	86.25±4.37	80.18±6.16	71.66±4.23	0.03
ALT (U/L)	151.53±9.53	211.28±8.93	199.68±7.12	182.34±5.12	0.03
LDH (U/L)	7.43±0.82	13.79±2.83	11.02±1.11	8.54±1.32	0.04
ALP (U/L)	73.45±6.47	102.00±5.93	96.17±3.83	85.18±3.27	0.03
TP (g/dL)	7.89±1.03	4.89±1.23	5.03±0.17	6.63±0.21	0.02
ALB (g/dL)	5.05±0.92	2.91±0.18	3.16±0.09	4.21±0.11	0.04
GLO (g/dL)	2.84±0.08	1.98±0.03	1.87±0.02	2.42±0.06	0.03
TB (g/dL)	0.09±0.00	0.22±0.01	0.20±0.00	0.15±0.00	0.02
CB (g/dL)	0.04±0.00	0.09±0.00	0.08±0.00	0.06±0.00	0.02
UB (g/dL)	0.05±0.00	0.13±0.00	0.12±0.00	0.09±0.00	0.02

Values are presented as Mean±SD, where n = 6.
Legend: AST = Aspartate Aminotransferase, ALT = Alanine Aminotransferase, LDH = Lactate Dehydrogenase, ALP = Alkaline Phosphatase, TP = Total Protein, ALB = Albumin, GLO = Globulin, TB = Total Bilirubin, CB = Conjugated Bilirubin, UB = Unconjugated Bilirubin

Table 2. Effect of *C. olitorius*on Hepatic Biomarkers in the Liver of Potassium Bromate-induced Rats

Hepatic Biomarkers	Control	$KBrO_3$ Only	$KBrO_3$ + 100 mg/kg *C. olitorius*	$KBrO_3$ + 200 mg/kg *C. olitorius*	p-value
AST (U/L)	48.46±2.27	29.75 ±1.88	38.28 ±3.00	40.93±2.78	0.03
ALT (U/L)	128.19±4.29	97.45±5.55	105.51±8.11	119.26±5.25	0.03
LDH (U/L)	9.35±2.11	7.84±2.22	7.93±1.22	8.96±0.31	0.02
ALP (U/L)	78.85±3.29	81.27±3.55	82.01±5.02	79.12±3.88	3.06
TP (g/dL)	9.35±1.85	7.27±1.44	8.00±1.31	8.79±1.22	0.04
ALB (g/dL)	6.99±1.21	5.04±0.66	5.62±0.28	6.36±1.03	0.03
GLO (g/dL)	2.36±0.28	2.23±0.11	2.38±0.08	2.43±0.13	1.96
TB (g/dL)	0.34±0.01	0.29±0.03	0.30±0.01	0.32±0.00	1.86
CB (g/dL)	0.21±0.02	0.18±0.00	0.19±0.02	0.20±0.01	3.34
UB (g/dL)	0.13±0.00	0.11±0.00	0.11±0.01	0.12±0.00	5.18

Values are presented as Mean±SD, where n = 6.
Legend: AST = Aspartate Aminotransferase, ALT = Alanine Aminotransferase, LDH = Lactate Dehydrogenase, ALP = Alkaline Phosphatase, TP = Total Protein, ALB = Albumin, GLO = Globulin, TB = Total Bilirubin, CB = Conjugated Bilirubin, UB = Unconjugated Bilirubin

also measured from plasma and liver homogenate.

Statistical Analysis

The data were subjected to a variance analysis using Graph Pad Prism software (version 8.0). Results were displayed as Mean±Standard Deviation (SD). Both Tukey's post hoc analysis and one-way analysis of variance (ANOVA) were used to compare the means. Differences between means were considered statistically significant at $P \leq 0.05$.

RESULTS

The results showed that potassium bromate significantly increased ($P \leq 0.05$) the levels of ALT, AST, LDH, ALP, total bilirubin (TB), conjugated bilirubin (CB), and unconjugated bilirubin (UB) in the plasma of animals treated with only 100 mg/kg body weight of potassium bromate when compared to the control group, as shown in Table 1. However, the plasma levels of these indicators were significantly lowered in a dose-dependent manner, in rats given potassium bromate, as well as 100 and 200 mg/kg body weight dosages of *C. olitorius* extract. When compared to the control group of rats, the group of rats given only 100 mg/kg body weight of potassium bromate had significantly lower plasma levels of total protein (TP), albumin (ALB), and globulin (GLO) (Table 1). The plasma levels of TP, ALB, and GLO significantly increased following a second treatment with 100mg and 200mg/kg body weight of *C. olitorius* extract in a dose-dependent manner.

When compared to the rats in the control group, Table 2 demonstrates that the liver cell activities of AST, ALT, and LDH as well as the concentrations of TP and ALB were considerably reduced ($P \leq 0.05$) in the rats given a

potassium bromate dose of 100 mg/kg body weight. The additional administration of *C. olitorius* extract doses of 100 mg/kg and 200 mg/kg body weight mitigated this decline in a dose-dependent manner. There was no statistically significant difference in the amounts of the other biomarkers that were seen in the liver cells (Table 2).

DISCUSSION

Plant components are essential to conventional and medical procedures and have continued to be good sources of novel medications (Airaodion et al., 2019i). Alternative healthcare is still used throughout the world, despite the fact that mainstream medical therapy is generally becoming acceptable (Ogbuagu et al., 2019). Traditional herbal treatment is frequently utilized in conjunction with Western medicine in developing nations, with herbal medicine winning out when the cost of Western medicine is out of reach (Airaodion et al., 2019j). The utilization of plant-based ingredients in the production of more effective medications is currently receiving renewed and expanding interest (Airaodion et al., 2019k). Animals and people have benefited greatly from the benefits of plants.

The hazardous effects of potassium bromate ($KBrO_3$) are numerous. Animal experiments and human subjects both experience the hepatotoxic and ototoxic effects of $KBrO_3$. It is a carcinogen that causes thyroid follicular cell tumors, mesotheliomas, and hepatic cell tumors in rats. Active oxygen radicals are likely responsible for the effects that result in DNA damage. An essential consideration in the diagnosis of liver damage is the test of hepatic functioning (Airaodion et al., 2019l). Clinical and toxicological significance can be found in measuring the enzymatic activities of aspartate aminotransferase (AST), alanine amino transferase (ALT), lactate dehydrogenase (LDH), and alkaline phosphatase (ALP), as changes in these enzymes' activities can be a sign of liver damage from toxicants or from disease (Singh et al., 2001). According to the study's findings, $KBrO_3$ significantly raised the plasma levels of AST, ALT, LDH, and ALP compared to the control group (Table 1). All of the major hepato-degenerative disorders are linked to and may contribute to increased oxidative damage, according to a substantial body of research (Halliwel, 2007). The high permeability of the hepatocyte membranes or its breakdown in the liver cell may be responsible for the rise in ALT and AST enzyme levels. This result is consistent with Shehad and Ghadhban's findings (Shehab, 2021). Increased plasma AST and ALT activity are also utilized to forecast liver injury, signaling intracellular enzyme leakage and a lack of stability of the liver cell membrane (Airaodion et al., 2019m). Additionally, it might be brought about by the hepatocyte degeneration caused by exposure to $KBrO_3$.

It was hypothesized that there may be a leakage of these enzymes from the liver to the plasma based on the observed increase in plasma AST, ALT, and ALP activities (table 1) and concurrent decrease in their activities in the liver following exposure to $KBrO_3$ (table 2). In an independent study, Abdel-Tawwab et al. (2001) described the decrease in transaminases activity to liver necrosis caused by the toxicants and potential harm to the hepatocytes. The inhibition of the enzyme or interference with protein metabolism in the cells may be to blame for the decreased ALT and AST activity in the liver [43]. Reduced transaminases suggest preserving the stability of the plasma membrane and protecting the hepatocytes from harm caused by hepatotoxin (Airaodion et al., 2020c). The widely accepted theory holds that repair of the hepatic parenchyma and hepatocyte regeneration cause plasma transaminase levels to revert to normal (Airaodion et al., 2019n). These results were in line with those ofAiraodion et al., (2020c), Sule et al. (2017) and Dewanjee et al. (2013). They recommended using extracts as a preventive and restorative supplement to stop the leakage of liver enzymes. The inclusion of antioxidant components and polyphenols like vitamin C, gallic acid, and quercetin, which serve as free radical scavengers, are responsible for this hepatoprotective effect, and may be the cause of this effect (Hamadouche et al., 2012; Zhang et al., 2014).

The loss of membrane components caused by a potential reaction between potassium bromate and the membranes of liver cells, leading to a leakage of the enzyme into the plasma, may be responsible for the significant ($P \leq 0.05$) increase in ALP activity observed in the plasma of rats exposed to potassium bromate compared to those in the control group. Ahmed et al. (2016)'s report that any injury to the cell membrane may cause the leaking of ALP, a marker enzyme in the plasma membrane, into extracellular fluid, supported this observation. Increased biliary pressure is thought to be the cause of the elevated ALP level (Gursoy et al., 2013). Rising liver enzyme levels are a symptom of cellular leakage and a breakdown in the functional integrity of the liver (Abdel-Tawwab et al., 2001). ALP levels may rise significantly in conjunction with liver tumors and lesions as well as with conditions like hepatitis. An important enzyme in steroidogenesis is ALP, which is involved in the intra and intercellular transport required for metabolic processes to channel essential inputs for steroidogenesis (Sofikitis and Miyagawa, 2001). ALP plays a role in the mobilization of lipid and carbohydrate metabolites for use by the spermatozoa in the seminal fluid or by the cells of the accessory sex structures (Dajas et al., 2005). Increased levels of hepatic enzymes are a clear sign that the integrity of the liver has changed. However, the results showed that giving rats $KBrO_3$ and various dosages of *C. olitorius* extract at the same time reduced the effects, as these parameters were practically restored to their control levels. This suggests a potential

modulatory function for the extract's hepatoprotective properties (Mahbubul, 2013). The leaves of *C. olitorius* are a good source of beta-carotene, iron, calcium, and vitamin C. The plant exhibits significant Vitamin E (tocopherol) equivalent antioxidant activity. Free radicals are "sucked up" by the vitamins A, C, and E found in jute leaf before they can cause cellular sabotage (Mahbubul, 2013).

Vegetable *C. olitorius* leaves are rich in antioxidants, which have been linked to protection against conditions like heart disease, cancer, diabetes, and hypertension as well as other illnesses (Consolacion et al., 2016). The findings of this study are in good agreement with those of earlier investigations in which *C. olitorius* extracts from various solvents significantly decreased plasma liver enzymes in ethanol (Airaodion et al., 2019n), carbon tetrachloride (Ujah, 2014; Iweala and Okedoyin, 2014), sodium arsenite (Das et al., 2010), streptozotocin (Saliu et al., 2019), hydrogen peroxide (Haridy et al., 2020), and thioacetamide (Sule et al., 2017) induced hepatotoxicity in experimental rats.

When compared to the control group in this study, $KBrO_3$ significantly reduced the plasma concentrations of total protein, albumin, and globin. A decrease in plasma protein during hepatotoxicity just indicates the presence of para-proteins or a decrease in antibody formation, according to Ekam and Udosen's research (Ekam and Udosen, 2012). This decline is in line with what they discovered. As a result of liver dysfunction, malnutrition and malabsorption, diarrhea, nephrosis, alpha-1-antitripsin deficiency, acute hemolytic anemia, hypo-gammaglobulinemia/agammaglobulinemia, loss through the urine in severe kidney disease, pregnancy, and other conditions, the level of total protein, albumin, and globulin may decrease. Long-term hepatic cell death causes additional hepatic releases to exacerbate hepatic dysfunction and lowers plasma levels of total protein, albumin, and globulin (Airaodion and Ogbuagu, 2020b).

Cytochromes, catalase, peroxidase, tryptophan pyrrolase, and a modest amount of free heme are among the other hemeoproteins. The heme moiety of hemoglobin breaks down to produce bilirubin (Airaodion et al., 2019o). An increase in the amount of directly reacted bilirubin in the blood results in hyper-bilirubinaemia. This toxic condition can cause brain damage as a result of neurotoxicity, jaundice, and hearing loss (Airaodion and Ogbuagu, 2020b). Modest unconjugated hyperbilirubinaemia, on the other hand, serves as a mild antioxidant and may offer protection against the onset of tumors and cardiovascular diseases (Mahbubul, 2013). Human cardiac problems and strokes can sometimes result from low levels of directly reacting bilirubin (Ogbuagu et al., 2021). Plasma bilirubin levels are frequently increased under a variety of clinical conditions. The possibility of toxicity thought to be caused by free bilirubin is reduced because bilirubin is linked to plasma albumin throughout blood circulation. High affinity bilirubin binding to albumin is countered by rapid and selective liver uptake, conjugation with glucuronate, and secretion of bile (Ogbuagu et al., 2021). Bilirubin is consequently converted into bilirubin glucuronic acid in the liver and excreted with bile. The plasma levels of total, conjugated, and unconjugated (indirect) bilirubin increased significantly in the $KBrO_3$-treated rats compared to the control animals, which may signify tissue injuries. However, this impact was diminished in rats that also received *C. olitorius* leaf extract. The extensive range of therapeutic uses of *C. olitorius* leaves has long been acknowledged by traditional medicine, and recent scientific advancements have provided ample support for the majority of these claims. The present *in vivo* investigation has further demonstrated the plant's ability to protect the liver.

This study demonstrated that rat $KBrO_3$ poisoning led to hepatocellular damage based on a substantial rise ($P \leq 0.05$) in hepatic biomarkers in comparison to the control group. Rats given concurrent administration of *C. olitorius*leaf extract experienced a dose-dependent reduction in the $KBrO_3$-induced changes in their plasma hepatic biomarkers, suggesting that this plant may have hepatoprotective properties. Our results appear to confirm a previous study by Airaodion et al. [45] that *C. olitorius* protects the liver from acute ethanol-induced oxidative stress in Wistar rats.

The results in Table 2 reveals that the treatment of $KBrO_3$ reduced the levels of total protein, albumin, globulin, total bilirubin, conjugated bilirubin, and unconjugated bilirubin in the liver when compared to the control group. The results of this study may indicate that $KBrO_3$ decreased either the synthesis of these parameters or increased their efflux from the liver, thereby increasing their level in the blood, since the liver is where these biomarkers are primarily produced. These perturbations were reduced by the *C. olitorius* seed extract treatment. The hepatoprotectivity of the extract as well as its therapeutic activity may be due to the presence of antioxidant components like betacarotene, Vitamin C, Vitamin E, and Vitamin A. This is also in line with the findings of Das et al. (2010), who reported that *C. olitorius* leaf extract has a sizable protective effect against oxidative damage caused by sodium arsenite to the liver and kidneys. Adedosu et al. (2013) later reported that rats exposed to sodium arsenite had hepatoprotective, antioxidative, and anti-lipid peroxidative effects from the extract of *C. olitorius*.

CONCLUSION

According to the current study, potassium bromate caused liver injury by unhinging important hepatic indicators. Increased efforts should be made to stop the use of potassium bromate in food processing. Furthermore, by bringing the examined biomarkers back

to levels that are substantially identical to those in the control group of animals, it may be inferred that *C. olitorius* leaves have a significant hepatoprotective effect against liver damage caused by potassium bromate. We recommend consumption of this vegetable.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. It was solely sponsored by the authors.

Ethical Consideration

This study was approved by relevant ethical committee

Consent for Publication: Not applicable.

Conflict of Interests

The authors declare that they have no known conflicting financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCES

Abali IO, Chika-Igwenyi NM, Agu, FU, Onyeaghala CA, Orji SF, Ugwu CN, Igwenyi C, Uche CL, Onyekachi OIN, Nwobodo MU, Iwuoha CE, Airaodion AI. Nephro-protective efficacy of african locust bean seed against potassium bromate-induced renal damage. Asian Journal of Biochemistry, Genetics and Molecular Biology, 2022; 12(3):28-36.

Abdel-Tawwab, M., Shalaby, A.M.E., Ahmed, M.H., Khattab, Y.A., (2001).Effect of supplement dietary Lascorbic acid (vitamin C) on mercury intoxication and growth performance of Nile tilapia (*Orechromisniloiicus* L.). Ann. Agric. Sci. 39 (2), 961–973.

Adedosu OT, Akanni OE, Afolabi OK, Adedeji AL. Effects of *Corchorusolitorius*Extract on Certain Antioxidants and Biochemical Indices in Sodium Arsenite Exposed Rats. Ame. J. Phytomedicine and Clin. Therapeutics, 2013;3(3): 245-256.

Ahmad MK, Amani S, Mahmood R. Potassium bromate causes cell lysisand induces oxidative stress in human erythrocytes. Environ. Toxicol. 2014;29, 138–145.

Ahmad MK, Mahmood R. Protective effect of taurine against potassium bromate-induced hemoglobin oxidation, oxidative stress, and impairment of antioxidant defense system in blood. Environ. Toxicol.2014. http://dx.doi.org/ 10.1002/ tox.22045.

Ahmed WE, Ali AA, Osman I. Biochemical and Histopathological Changes in Potassium Bromate- fed Rats. Int. J. Sci. Res. 2016;5(11):123-126.

Airaodion AI, Adekale OA, Airaodion EO, Ogbuagu EO, Ogbuagu U, Osemwowa EU.Efficacy of Combined crude Extract of *Curcuma longa* and *Moringaoleifera* in the Prevention of Peptic Ulcer in Albino Rats. Asian J. Res. Med. Pharma. Sci. 2019j; 7(2):1-8.

Airaodion AI, Airaodion EO, Ogbuagu EO, Ogbuagu U, Osemwowa EU. Effect of Oral Intake of African Locust Bean on Fasting Blood Sugar and Lipid Profile of Albino Rats. Asian J. Res. Biochem. 2019f;4(4): 1-9.

Airaodion AI, Akinmolayan JD, Ogbuagu EO, Esonu CE, Ogbuagu U. Preventive and therapeutic activities of methanolic extract of *Talinum triangulare* leaves against ethanol-induced oxidative stress in Wistar rats. Int. J. Bio-Sci. Bio-Technol. 2019m; 11(7):85-96

Airaodion AI, Awosanya OO, Ogbuagu EO, Ogbuagu U, Njoku OC, Esonu C, Airaodion EO. Assessment of Bread in Ogbomoso Metropolis for the Presence of Potassium Bromate.Asian J. Res. Biochem. 2019b; 4(2): 1-6.

Airaodion AI, Ayita EB, Oluba SO, Emaleku SA, Osunmuyiwa OJ. Chemical composition and nutraceutical potential of velvet tamarind fruit pulp. Asian J. Biochem. Genetics and Molecular Biol. 2021a;3(5):22-31.

Airaodion AI, Ekenjoku JA, Ngwogu KO, Ngwogu AC. Consumption of coconut (*Cocos nucifera*L.) water improved fertility parameters in male Wistar rats. Asian J. Pregnancy and Childbirth. 2019i;2(3):1-7.

Airaodion AI, Ene AC, Ogbuagu EO, Okoroukwu VN, Ekenjoku JA, Ogbuagu U. Biochemical changes associated with consumption (by rats) of "garri" processed by traditional and instant mechanical methods. Asian J. Biochem. Genetics and Molecular Biol. 2019o;2(4):1-11.

Airaodion AI, Ewa O, Ogbuagu EO, Ogbuagu U, Agunbiade AP, Oloruntoba
AP. Evaluation of potassium bromate in bread in Ibadan metropolis: Fifteen years after ban in Nigeria. Asian Food Sci. J. 2019a;7(4):1–7.

Airaodion AI, Ngwogu AC, Ekenjoku JA, Ngwogu KO. Hepatoprotective potency of ethanolic extract of *Garcinia kola* (Heckel) seed against acute ethanol-induced oxidative stress in Wistar rats. Int. Res. J. Gastroenterol. Hepatol. 2020c;3(2): 1-10.

Airaodion AI, Ogbuagu EO, Ekenjoku JA, Ogbuagu U, Airaodion EO. Therapeutic effect of methanolic extract of *Telfairia occidentalis* leaves against acute ethanol-induced oxidative stress in Wistar rats. Int. J. Bio-Sci. Bio-Technol. 2019l;11(7):179-189.

Airaodion AI, Ogbuagu EO, Ekenjoku JA, Ogbuagu U, Okoroukwu VN. Antidiabetic effect of ethanolic extract of *Carica papaya* leaves in alloxan-induced diabetic rats. Ame. J. Biomed. Sci. Res. 2019k;5(3):227-234.

Airaodion AI, Ogbuagu EO, Ekenjoku JA, Okoroukwu VN, Ogbuagu U, Airaodion EO. Antifertility Effect of Ethanolic Leaf Extract of *Carica papaya* in Male Wistar Rats. Merit Res. J. Med. Med. Sci. 2019g;3(9):121-129.

Airaodion AI, Ogbuagu EO, Ewa O, Ogbuagu U, Awosanya OO, Adekale OA. Ameliorative Efficacy of Methanolic Extract of *Corchorus olitorius* Leaves against Acute Ethanol-Induced Oxidative Stress in Wistar Rats. Asian J. Biochem. Genetics and Molecular Biol. 2019n;7(6):1-9.

Airaodion AI, Ogbuagu EO, Ogbuagu U, Adeniji A, Agunbiade AP, Airaodion EO. Hepatoprotective effect of *Parkiabiglobosa* on acute Ethanol-induced oxidative stress in Wistar rats. Int. Res. J. Gastroenterol. Hepatol. 2019e; 2(1): 1-11.

Airaodion AI, Ogbuagu EO, Ogbuagu U, Awosanya OO, Airaodion EO. Effect of Methanolic extract of *C. olitorius* leaves on hypoglycemic and hypolipidaemic activities in albino rats. Asian Plant Res. J. 2019d;2(4):1-13.

Airaodion AI, Ogbuagu EO. Ameliorative effect of *Parkiabiglobosa* (African locust bean) against egg-yolk induced hypertension. Int. J. Bio-Sci. Bio-Technol. 2020a; 12(5):17-25.

Airaodion AI, Ogbuagu EO. Consumption of Tiger Nut (*Cyperusesculentus*L.) Improves Haematopoiesis in Wistar Rats. Int. J. Res. Reports in Hematol. 2020b;3(1): 13-19.

Airaodion AI, Ogbuagu EO. Effect of *Cyperusesculentus*L. (tiger nut) milk on hepatic and renal indices of Wistar rat. *Asian* J. Res. Nephrol. 2020c;3(2):10-16.

Airaodion AI, Ogbuagu U, Ekenjoku JA, Ogbuagu EO, Airaodion EO, Okoroukwu VN. Hepato-protective efficiency of ethanol leaf extract of *Moringaoleifera*against hydrocarbon exposure. Int. J. Adv. Herbal and Alter. Med. 2019h;03(01):32-41.

Airaodion AI, Ogbuagu, EO, EkenjokuJA,Ogbuagu U, Airaodion EO. Haematopoietic potential of ethanolic leaf extract of *Talinum triangulare* in Wistar Rats. Asian J. Res. Biochem. 2019c; 5(2):1-7.

Airaodion AI, Onabanjo KS. Effect of fortifying zobo (*Hibiscus sabdarifa*) drink with pineapple and watermelon on the mineral compositions and microbial quality.Merit Research Journal of Food Science and Technology. 2022;7(1):001-007.

Altoom NG, Ajarem J, Allam AA, Maodaa SN, Abdel-Maksoud MA. Deleterious effects of potassium bromate administration on renal and hepatic tissues of Swiss mice. Saudi J. Biol. Sci. 2017; 25(2018):278–284

Chipman JK, Davies JE, Parsons JL, Nair J, O'Neill G, Fawell JK. DNAoxidation by potassium bromate; a direct mechanism or linked to lipidperoxidation? Toxicology, 2008; 126, 93–102

Consolacion YR, Julius LA, Chien-Chang S. Chemical Constituents of *Corchorus olitorius* L. Int. J. Pharmacognosy and Phytochem. Res. 2016; 8(12): 2085-2089.

Dajas F, Arrendondo F, Echeverry C, Ferreira M, Morquio A, Rivera F. Flavonoids and the brain. Evidences and mechanisms for a protective capacity.Curr.Neuro. Pharma, 2005; 3(3): 1-2.

Das AK, Bag S, Sahu R, Dua TK, Sinha MK, Gangopadhyay M, Zaman K, Dewanjee S. Protective effect of *Corchorus olitorius* leaves on sodium arsenite-induced toxicity in experimental rats. *Food ChemToxicol.*2010;48(1):326–335.

Dewanjee S, Sahu R, Karmakar S, Gangopadhyay M. Toxic effects of lead exposure in Wistar rats: involvement of oxidative stress and the beneficial role of edible jute (*Corchorus olitorius*) leaves. Food and chemical toxicology, 2013; 55:78-91

Ekam VS, Udosen EO.Total protein, albumin and globulin levels following the administration of activity directed fractions of *Vernoniaamygdalina*during acetaminophen induced hepatotoxicity in Wistar albino rats. Glo. J. Pure and Applied Sci. 2012; 18(1&2): 25-29.

Ezirim EO, Onyeaghala CA, Orji SF, Ugwu CN, Igwenyi C, Uche CL, AbaliIO,Onyekachi OIN, Nwobodo MU, Iwuoha CE, Chika-Igwenyi NM, Airaodion AI. Attenuation of potassium bromate-induced infertility by African locust bean (*Parkiabiglobosa*) seed. Asian J. Med. Health, 2022b; 20(5):12-23.

Ezirim EO, Uche CL, Abali IO, Iwuoha CE, Chika-Igwenyi NM, Onyeaghala CA, Orji SF, Ugwu CN, Ugwu NI, Igwenyi C, Airaodion AI. Therapeutic potential of *Parkiabiglobosa* seed against potassium bromate-induced testicular toxicity. Int. J. Res. Reports in Gynaecol. 2022a;5(3):78-89.

Gursoy İ, Yilmaz İ, Dogan Z.The effects of apricot on serum proteins and liver enzymes in rats. J. Food and Nutr. Res. 2013; 52(2):101-106.

Halliwel B. "Dietary polyphenols: good, bad, or indifferent for your health?" *Cardiovasc. Res,* 2007; 73(2): 341-347.

Hamadouche NA, Slimani M, Aoues A. Beneficial effect administration of vitamin C in amelioration of lead hepatotoxicity. Notulae Scientia Biologicae, 2012; 4(3):07-13.

Haridy LAM, Ali SS, Alghamdi RK. Protective role of *Corchorus olitorius* L leaves extract against experimentally-induced hepatotoxicity. Int. J. Pharm. Phytopharm. Res. 2020;10(1):50–60.

Islam MM. Medicinal/Herbal use of *Jute*.*Jute* (*Corchorus capsularis L.* and *Corchorus olitorius L.*) leaf: Vegetable for nutrition and medicine for human health and beauty, 2010.

Iweala EEJ, Okedoyin AG. Effect of consumption of *Corchorus olitorius* L., in carbon tetrachloride-induced liver damage in male Wistar rats. Ame. J. Biochem. Molecular Biol. 2014;4(4):143–154.

Iwuoha CE, Ezirim EO, Onyeaghala CA, Orji SF, Ugwu CN, Igwenyi C, Uche CL, AbaliIO,Onyekachi OIN, Nwobodo MU, Agu FU, Chika-Igwenyi NM, Airaodion AI. Perturbation of sex hormones by potassium bromate and preventive effect of African locust bean (*Parkiabiglobosa*) seed. Asian J. Res. Biochem. 2022; 10(5):22-31.

Jameson Harrison's Principles of Internal Medicine, 20th ed.(Vol. 1 & Vol.2).McGraw-Hill Education, 2018.

Kerr JB, Mayberry RA, Irby DC. Morphometric studies on lipid inclusions in Sertoli cells during the spermatogenic cycle in the rat" Cell Tissue Res 2004; 236: 699-709,1996.

Kujawska M, Ignatowicz E, Ewertowska M, Adamska T, Markowski J, Jodynis-Liebert J. Attenuation of KBrO3-induced renal and hepatic toxicity bycloudy apple juice in rat. Phytother. Res. 2013;27, 1214–1219.

Lobna AMH, Soad SA, Reham KA. "Protective Role of *Corchorusolitorius*L Leaves Extract against Experimentally-induced Hepatotoxicity", Int. J. Pharm. Phytopharm. Res. 2020;10(1):50-60.

Mahbubul I. Biochemistry, Medicinal and Food values of Jute (*Corchoruscapsularis* L. and *C. olitorius* L.) leaf: A Review. Int. J. Enhanced Res. Sci. Technol. Engineering, 2013; 2(11): 35-44.

National Research Council. United States Committee for the update of the Guide for the Care and Use of Laboratory Animals. Guide for the Care and Use of Laboratory Animals. 8th Ed., Washington (DC): National Academies Press (US). 2011; PMID: 21595115.

Ogbuagu EO, Airaodion AI, Ogbuagu U, Airaodion EO. Effect of methanolic extract of *Vernoniaamygdalina*leaves on glycemic and lipidaemic indexes of Wistarrats. Asian J. Res. Medical and Pharm. Sci. 2019;7(3):1-14.

Ogbuagu EO, Airaodion AI. Tiger Nut (*Cyperus esculentus* L.) Boosts Fertility in Male Wistar Rats. Asian Res. J. Gynaecol. Obstetrics.2020;3(3): 8-18

Ogbuagu EO, Unekwe PC, Airaodion AI, Nweke IN, Ogbuagu U. Hepatotoxic effect of *Xylopiaaethiopica* fruit in Wistar rats. Int. Res. J. Gastroenterol. Hepatol. 2021; 4(1):1-16

Olanrewaju AD, Nwangburuka CC. Morphological diversity among *Corchorus olitorius* accessions based on single linkage cluster analysis and principal component analysis. Jordan J. Biol. Sci., 2012; 5: 191-196

Onyekachi OIN, Orji SF, Ugwu CN, Igwenyi C, Uche CL, Abali IO, Nwobodo MU, Iwuoha CE, Chika-Igwenyi NM, Onyeaghala CA, Agu FU, Airaodion AI. Hepatocellular injury ameliorated by a common african food, *Parkiabiglobosa*, Asian J. Res. Med. Pharm. Sci. 2022;11(4):26-34.

Reitman S, Frankel S. A colorimetric method for determination of serum glutamate oxaloacetate and glutamic pyruvate transaminase. Ame. J. Clin. Pathol. 1957;28:56-58.

Saliu JA, Ademiluyi AO, Boligon AA, Oboh G, Schetinger MRC, Rocha JBT. Dietary supplementation of jute leaf (*C. olitorius*) modulates hepatic delta aminolevulinic acid dehydratase (δ-ALAD) activity and oxidative status in high-fat fed/ low streptozotocin-induced diabetic rats. J. Food Biochem. .2019;43(8):e12949.

Shehab ZA, GhadhbanRF.Effect of Potassium Bromate on Some Hematological and Biochemical Parameters and Protective Role of Vitamin C on Laboratory Rats (*RattusRattus*).Annals of R.S.C.B., 2021; 25(2): 669 – 674.

Singh NS, Vats P, Suri S, Shyam R, Kumria MML, Ranganathan S, Sridharan K. 2001. Effect of an antidiabetic extract of Catharanthusroseus on enzymic activities in streptozotocin induced diabetic rats. J. Ethnopharmacol. 2001;76, 269–277.

Smith-Hall C, Larsen HO, Pouliot M. People, plants and health: a conceptual framework for assessing changes in medicinal plant consumption. J. Ethnobiol. Ethnomed. 2012; 8: 43.doi:10.1186 /1746-4269-8-43

Sofikitis N, Miyagawa I. Secretary dysfunction of the male accessory genital gland due to prostate infections and fertility: A selected review of the literature," Jpn. Fertil.Steril. 2001;36:690-699.

Sule OJ, Arhoghro EM, Erigbali P. protective and curative activity of ethanol leaf extract of *Corchorusolitorius* in thioacetamide exposed rats. World J. Pharm. Res. 2017; 6(12):25-36.

Ugwu CN, Abali IO, Iwuoha CE, Chika-Igwenyi NM, Onyeaghala CA, Orji SF, Igwenyi C, Uche CL, Onyekachi OIN, Nwobodo MU, Airaodion AI. Ameliorative effect of *Parkia biglobosa* (African locust bean) seed against potassium bromate-induced oxidative stress. Merit Res. J. Med. Med. Sci. 2022a;10(8): 213-219.

Ugwu CN, Iwuoha CE, Chika-Igwenyi NM, Onyeaghala CA, Orji SF, Igwenyi C, Uche CL, Onyekachi OIN, Nwobodo MU, Abali IO, Airaodion AI. Chemotherapeutic propensity of Africa locust bean (*Parkia biglobosa*) seed on lipid profile against potassium bromate-induced cardiotoxicity. J. Applied Life Sci. Int. 2022; 25(8):24-31.

Ujah O. Phytochemistry and hepatoprotective effect of ethanolic leaf extract of *C. olitorius* on carbon tetrachloride induced toxicity. Eur. J . Medicinal Plants.2014;4(8):882–892.

Zhang JQ, Shi L, Xu XN, Huang SC, Lu B, Ji LL, Wang ZT. Therapeutic detoxification of quercetin against carbon tetrachloride-induced acute liver injury in mice and its mechanism. J. Zhejiang Uni. Sci. B, 2014; 15(12):1039-1047.