JSIANE: Vol. 4, Issue 4, 2024, Page 85-91 ISSN (Online) 2583-2093

Journal of Science Innovations and Nature of Earth

Journal homepage : www.jsiane.com

A Critical Review on Hepatotoxicity in Albino Rats after Assessment of Sodium Arsenite

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DOI: https://doi.org/10.59436/jsiane.306.2583-2093

Abstract

In toxicological research, hepatotoxicity is a major worry, especially when looking at environmental contaminants like sodium arsenite. The health of people and animals is seriously endangered by sodium arsenite, a very poisonous substance that results from both natural and industrial processes and is found in air, water and the soil. The hepatotoxic effects of sodium arsenite in Albino Rats, a commonly utilized model organism for liver toxicity research are extensively examined in this paper. With a focus on the consequences for the environment and public health, the paper summarizes previous research findings to clarify the impact of sodium arsenite on hepatic tissue in terms of biochemical, histological and antioxidant indices. A detailed review of research indicates that sodium arsenite causes notable changes in indicators of liver function. Furthermore, exposure to sodium arsenite has been demonstrated to alter the liver histological architecture, resulting in inflammatory cell infiltration, sinusoidal dilatation and hepatocyte destruction. The significance of dosage, exposure time and delivery method in assessing the degree of hepatotoxic effects is also emphasized in this review. The administration methods oral, intraperitoneal or inhaled has a major impact on sodium arsenite distribution and bioavailability, which in turn affects how hazardous it is. In conclusion, a great deal of research in albino rat models has shown that sodium arsenite is a serious hazard to liver health. We can more effectively handle the problems caused by this environmental toxin and protect the health of people and animals by improving our knowledge of sodium arsenite-induced hepatotoxicity.

Keywords: Cell Infiltration, Sinusoidal Dilatation, Hepatocyte Destruction, Albino Rats, Hepatotoxicity, Sodium Arsenite

Received 01.10.2024 **Revised 27.11.2024** **Accepted 30.12.2024**

Introduction

Heavy metal-induced environmental poisoning put millions of lives at risk and is a serious global public health concern. It is well recognized that exposure to heavy metals from many sources can cause oxidative stress, which may jeopardize an organism health (Sackett, 2016 and Akeem *et al*., 2021). Widespread pollution with metalloids and heavy metals, such as lead, arsenic, mercury and cadmium can affect global events. Since it is a naturally occurring element that does not deteriorate, arsenic is a chemical compound that exhibits characteristics of a metal. Humans can be poisoned by arsenic, which is frequently linked to major health problems. Natural processes and some human actions cause the earth crust to produce arsenic compounds (Brookes, 1998 and Charles, 2014). Numerous epidemiological studies have shown that long-term residence in locations where well water contains inorganic arsenic (as arsenate and arsenite) increases the risk of vascular disorders (Lilienfeld, 1988; Engel *et al*., 1994; Chiou *et al*., 1997 and Charles, 2014). For environmental health and occupational, being exposed to arsenic compounds through food and tainted groundwater from industrial processes and agrochemical wastes remains a major concern (Akinrinde *et al*., 2023). An extremely hazardous element called arsenic is present in the inorganic compound sodium arsenite. Sodium arsenite, which has the formula $NaAsO_2$, is an inoganic salt. Sodium arsenite (As III) is 60 times more toxic than sodium arsenate (As V). It has been determined that the trivalent form of inorganic arsenic (arsenite, As III) is more dangerous than the pentavalent form (arsenate, As V) thus using sodium arsenite has a major negative influence on the environment (Allen and Rana, 2007; Kumar and Sinha, 2018 and Gholamine *et al*., 2019). It is used in industry to make soap and dyes, as well as as a pesticide, insecticide, herbicide, rodenticide and wood preservative. In addition to its teratogenic and carcinogenic effects, sodium arsenite also has a significant impact on changing certain biochemical markers and histological alterations in physiological beings. In addition, migraines, convulsions, nausea, vomiting, diarrhoea, thickened skin, rash, burns, itching, irritation and loss of pigmentation are among the symptoms caused by drug interaction. Symptoms like weakness, poor coordination, or "pins and needles" may appear when the neurological system is seriously compromised, ultimately resulting in paralysis and death (Jing *et al*., 2012 and Anakor and Ekeke, 2023). One of the primary organs is liver that can be affected by exposure to $NaAsO_2$, which can happen through tainted food, drink or air. Albino rat hepatotoxicity caused by $NaAsO_2$ is a complicated, multidimensional process that has important

health ramifications for people. Hepatotoxicity caused by $NaAsO_2$ is a complicated process with several mechanisms involved. Oxidative stress, mitochondrial dysfunction, inflammation, apoptosis and microscopic analysis of liver tissue can all be important factors. Hepatocyte necrosis, inflammation and fibrosis are among the pathological alterations that can be seen. This review article examines the toxicological consequences of sodium arsenite exposure on a number of biochemical measures, including lipid profiles, liver function tests, kidney function tests, antioxidant indices and histological study of liver tissue.

Preliminary Work Done On the Line

Mentha piperita has been shown by Sharma *et al*. (2007) to protect Swiss albino mice liver against damage caused by arsenic. For 30 days, one group of rats was given intraperitoneal sodium arsenite (4 mg/kg body weight) in 0.9% NaCl, whereas rats in another group received oral Mentha Leaf Extract (1 g/kg body weight daily). Significant increases in ACP, ALP, SGOT and SGPT were observed in the group that received arsenic treatment. The liver biochemical characteristics are significantly altered both before and after Mentha receives arsenic treatment. According to the findings, Mentha extract might help lessen the negative consequences of arsenic-induced hepatopathy. Singh *et al*. (2012) investigated the impact of groundwater arsenic on albino rat liver. For seven, fourteen and twenty one day groups of Albino Rats were given 0.02 mg/l of drinking water containing arsenic. However, in comparison to the control groups, there was a noteworthy elevation in the SGOT, SGPT, ALP and ACP. Portal cirrhosis, sinusoidal gaps, ruptured hepatocytes, hypertonic nucleus, severe necrosis, vascular lesions and balloon cells, ascular lesions and central vein lesions were all visible in the liver histology. Lakshmi *et al*. (2015) looked into the effectiveness of *Triticum aestivum* Linn. In protecting male Albino Rats from experimentally induced arsenic toxicity. Rats were given oral Wheatgrass extract (400 and 200 mg/kg) for 20 days in a row, followed 8 days of oral sodium arsenite (10 mg/kg). Glutathione reductase, superoxide dismutase, and total protein levels were notably lower in the toxin group than in the control group, whereas ALT, ALP and AST and creatinine were notably higher. Histological analysis of the liver shows sinusoidal disruption and hepatic deterioration. The current research concludes that wheat grass extract had a remarkable effect on male Albino Rats organ toxicity caused by arsenic. This effect was mediated by both detoxifying the body free radicals and reducing oxidative stress caused by arsenic by strengthening the antioxidant defence mechanism.

An investigation of how arsenic affects tissue histology and the distribution of its accumulation in various organs in Wistar Albino Rats was observed by Chowdhury *et al*. (2016). Four groups of Wistar female rats were given Sodium Arsenite (50 ppm, 100 ppm, 150 ppm) and control for a total of 28 days. Rats intoxicated with arsenic have a substantial rise in serum ALT and AST. Liver histology reveals edema and necrosis in the treated groups. Klibet *et al*. (2016) investigated how sodium arsenite damages the liver by causing oxidative stress and how *Pistacia lentiscus* oil helps. In the first, rats were divided into four equal groups and given either a regular dose of sodium arsenite (5.55 mg/kg body weight), *Pistacia lentiscus* oil (3.3 mL/kg body weight), or a combination of both. While protein, albumin, triglycerides and superoxide dismutase were dramatically reduced, ALT, AST and cholesterol were significantly raised. There have also been reports of histological changes, including ballooning degeneration, mononuclear cell infiltration and sinusoidal dilatation and vascular congestion. The current study concluded that *Pistacia lentiscus* oil had a significant hepatoprotective effect against oxidative damage and hepatic dysfunction brought on by sodium arsenite. Its antioxidant qualities, which chelate arsenic ions and scavenge the produced free radicals, are probably responsible for this protection. Kalantari *et al*. (2017) observed that Red Lentil extract was found to have positive effects on rat oxidative stress caused by sodium arsenite. Four groups of twenty-four male Wistar rats were created. For 25 days, control group was given regular saline (2 mL/kg). Following 10 days of treatment with sodium arsenite (10 mg/kg) for groups 2-4, Red lentil extract was administered to groups 3 and 4 at doses of 100 and 200 mg/kg, respectively for 15 days. Hepatic lipid peroxidation and serum levels of aspartate transferase, alanine transferase and alkaline phosphatase rose in those treated with sodium arsenite. In contrast, the intervention group liver superoxide dismutase activity was considerably lower than that of the control group. Red Lentil extract treatment dramatically lowers the liver serum level while increasing the antioxidant enzymes activity. Compared to the control group, a number of histological changes were noted in the groups treated with sodium arsenite, including hepatocyte necrosis, inflammatory cell accumulation in the pre-portal area and hepatocytes surrounding the major vein exhibit cell edema. It can be inferred that the red lentil extract therapeutic action, which most likely reduced oxidative stress and scavenged free radicals as an antioxidant, restored the treated animals' serum markers and antioxidant enzyme activity. Mohammadian *et al*. (2018) observed that supplementing with Olive oil had an impact on the hepatotoxicity caused by sodium arsenate in mice. For 30 days, adult male BALB/c mice were selected as random to one of four groups in this experimental study: the control group, which received normal saline; the Olive oil group, which received 0.4 mL/day, gavage; the Sodium Arsenite group, which received 15 mg/kg, gavage and the Olive oil+Saline group, which received Olive oil one hour prior to Sodium Arsenite. Significant increases in ALT, ALP, AST and lipid peroxidation were indicative of hepatic injury caused by sodium arsenite. Disarray and severe localized necrosis were noted in the histopathology of the hepatic tissues, along with fibrosis, Kupffer cell, hyperproliferation, granulomatous forms, vacuolization, and periportal leucocyte infiltration and pyknotic cellular nuclei of hepatocytes. It was determined that olive oil antioxidant properties have a hepatoprotective effect on hepatic injury caused by sodium arsenite. According to Ahmed *et al*. (2019), biochemical, histological and immunehistochemical investigations show that Male rats' exposure to arsenic is lessened by *Spirulina platensis*. Four groups of Wistar Albino Rats were used, including a negative control group and three treatment groups that obtained oral gavages of *Spirulina platensis* (300 mg/kg body weight), arsenic (5 mg/kg bwt), and *Spirulina platensis* +arsenic daily for two months. According to the results of the biochemical examination, arsenic markedly elevated creatinine, lipid peroxidation, aspartate transferase and alanine transferase. Lipid peroxidation, creatinine, AST and ALT were all markedly improved by co-intervention with *Spirulina platensis.* A histological evaluation of the livers of rats given arsenic showed a deformed hepatic anatomy, with the hepatic sinusoids and central veins enlarged and

congested. In practically every part that was analyzed, kupffer cell activation and noticeable hepatocyte cytoplasmic vacuolization were seen. It was also evident that hepatocyte apoptosis and focal necrosis were linked to mononuclear cell infiltration. Hepatocytic nuclei karyomegaly was seen in several sections that were analyzed. Newly generated bile ductules were seen in portal areas with portal fibrosis. Biswas *et al*. (2019) investigated how an ethanolic seed extract of *Trigonella foenum graecum* could alter the toxicity caused by sodium arsenite in mice. Six groups of mice (*Mus musculus*) were arbitrary designed; Group 1 was the untreated control and Group 2 was given drinking water containing just Sodium Arsenite (100 ppm) for two months. Group 3 to 6 mice were treated as in Group 2 and then given 50, 150 and 250 mg/kg of *Trigonella foenum graecum* seed extract daily for 15 and 30 days respectively. Group 4 mice were given Sodium Arsenite for two months, similar to Group 2, and thereafter administered a vehicle consisting of a 1:10 alcohol to distilled water ratio for 15 and 30 days, respectively. The liver enzymes alanine transaminase, acid phosphatase, aspartate transaminase, and alkaline phosphatase all increased following sodium arsenite toxicity. Similarly, superoxide dismutase dropped as urea, BUN and lipid peroxidation levels rose. *Trigonella foenum graecum* seed extract increased antioxidative parameters and decreased the activity of toxicity marker enzymes. Because of its strong antioxidant qualities, it can be utilized as a preventative measure against toxicity caused by sodium aresenite. Rat hepatic and renal damage from sodium arsenite is lessened by gallic acid, according to Gholamine *et al*. (2019). Groups 3 and 4 were given gallic acid (10 and 30 mg/kg/day, respectively) for seven days prior to being exposed to sodium arsenite; Group 5 was given gallic acid (30 mg/kg/day for 21 days); Group 1 was given normal saline (2 ml/kg/day for 21 days); and Group 2 was given sodium arsenite (10 mg/kg/day for 14 days). The rats were randomly assigned to each of the five groups. Following sodium arsenite induction, there is a rise in BUN, creatinine, ALT, SOD, AST, and ALP. Liver pyknosis, lipid accumulation, inflammatory cell infiltration and red blood cell congestion are examples of histological changes. Gallic acid treatment significantly improved the biochemical and histological parameters altered by sodium arsenite. According to the findings, gallic acid may prevent kidney and liver damage brought on by sodium arsenite by increasing the antioxidant activity inside cells and scavenging reactive free radicals. Korany *et al*. (2019) studied the consequences of prolonged exposure to arsenic on female Albino Rats, paying particular attention to the ameliorating function of *Spirulina platensis*. Rats were differentiated into four groups: an untreated group, three groups that received oral gavages of *Spirulina platensis*, Sodium Arsenate and Sodium Arsenate+*Spirulina platensis*, respectively, for three months. Serum levels of liver enymes were markedly elevated after arsenic treatment. The injection of *Spirulina platensis* led to a considerable recovery of the serum ALT and AST values. Endometrial gland necrosis, mucosal inflammatory cell infiltration, hepatic sinusoidal dilatation, hepatocyte vacuolar degeneration, portal fibroplasia and mononuclear inflammatory cell infiltration are all shown in liver histology. Using sodium arsenite to induce oxidative stress in rats, Nozohour and Jalilzadeh-Amin (2019) reported the state of antioxidant enzymes and histopathological alterations. Sodium Arsenite was administered to the animals (100 ppm) daily and another, control group. The liver histology of treated rats shows hepatocyte cell degeneration, bleeding, infiltration, focal hepatocyte necrosis surrounding the central vein and kupffer cell nodule development at the location of cellular demise, along with a decrease in SOD. Hepatoportal blood vessel congestion, portal vein congestion, moderate hepatocyte cell degeneration and mononuclear cell infiltration in the portal region. According to the current study findings, administering sodium arsenite resulted in severe tissue damage, reduced antioxidant enzyme activity and considerable oxidative stress. *Holarrhena floribunda* (G.Don) leaf extract in methanol: its ability to shield wistar rats against sodium arsenite caused toxicity was noticed by Akeem *et al*. (2021). Before being exposed intraperitoneally to Sodium Arsenite (5 mg/kg body weight) 24 hours after the final dose, two doses of the extract were conducted to the animals beforehand (100 and 200 mg/kg body weight) for 14 days. The outcome demonstrated that arsenate only causes a significant elevation in lipid peroxidation, creatinine and urea. Arsenate, on the other hand, dramatically decreased SOD activity in comparison to the unexposed control. In rats, methanol leaf extract inhibited the negative effects of arsenate on urea and creatinine levels as well as lipid peroxidation and SOD activity. The polyphenolic chemicals in the leaf extract might be in charge of the extract defence qualities. Resveratrol therapeutic potential against arsenic intoxication was observed biochemically by Irshad *et al*. (2021). Four groups of Wistar rats were assigned: the Control group, Resveratrol (8 mg/kg), Arsenic Trioxide (3 mg/kg) and Ascorbic acid (25 mg/kg) 30 minutes prior to the administration of Arsenic Trioxide. Because of its high antioxidant properties, in the rat model exposed to arsenic, resveratrol dramatically decreased the damage to the liver and kidneys, according to the study findings. ALP, AST, ALT, BUN and creatinine all rised while SOD falls. Steatosis, localized necrosis, cytoplasmic vacuolization and inflammatory cell infiltration are the outcomes of the histological changes of liver tissue. Raeeszadeh *et al*. (2022) studied the effect of broccoli extract on the biochemical, haematological and electrolytic parameters of rats in kidney and liver in arsenic-induced poisoning. Four groups of Wistar rats were stated: the Control group, a group that received oral Arsenic at a dose of 5 mg/kg, a group that obtained 300 mg/kg of Broccoli and a group that received both. Albumin, globulin, total protein and superoxide dismutase levels were dropped in the arsenic group, but urea, creatinine, alanine aminotransferase, and aspartate aminotransferase levels rose. Additionally, there was an increase in superoxide dismutase and a larger increase in albumin and globulin concentrations in the AS+B group contrasted to the AS group. Broccoli appears to be quite successful at improving the haemato-biochemical aspects of arsenic toxicity situations as well as lowering liver and kidney damage. Histological modifications were observed in the liver tissues, leading to hepatocyte necrosis, cytoplasmic vacuolation, central venous congestion and inflammatory infiltration. Sesame oil supplementation reduces the histopathogenicity, enterotoxicity, and genotoxicity that sodium arsenite causes in rats, according to Akinrinde *et al*. (2023). For eight days in a row, Wistar Albino Rats were distributed into Control, Sodium Arsenite only (2.5 mg/kg), Sodium Arsenite+Sesame oil (4 ml/kg), and Sesame oil alone. Findings indicate sodium arsenite frequently caused the morphology of hepatic tissues to change significantly and increase the serum activities of

alanine and aspartate transferases. Necrosis, hepatocyte degeneration, apoptotic body appearance and central vein congestion and sinusoids are all seen in the histology of liver tissues. Enzymes of liver were considerably lower after co-treatment with sesame oil, indicating protective effects against damage caused by sodium arsenite. According to the research, sesame oil may be used therapeutically to treat chemical toxicities brought on by arsenic. In a biochemical and histological investigation, Biram *et al*. (2023) noted the detrimental effects of sub-chronic arsenic on the mature male albino rat liver and the improving effect of cerium oxide nanoparticles. Group I control rats obtained 250 µl of intraperitoneal Phosphate Buffered Saline; Group II (Arsenic group) received 3 mg/kg body weight/day of arsenic trioxide via gavage tube every day for 8 weeks and Group III (CeONPs+Arsenic) received intraperitoneal injections by gastric tube daily for 8 weeks. Protein, albumin, globulin and SOD decrease while AST, ALP and ALT rise. Histopathology of the liver revealed sinusoid dilatation, cellular necrosis, fatty infiltration and inflammatory infiltration.

Effects on Biochemical Parameters

Jana *et al*. (2006) reported how long-term being exposed to sodium arsenite affected adult rats hypothalamo-pituitary-testicular functions and whether it had an estrogenic mode of action. In this research, adult male rats were given drinking water containing Sodium Arsenite (5 mg/kg body weight) for four weeks, six days a week to evaluate the consequences of long-term oral exposure. Treatment with sodium arsenite led to a substantial elevation in acid phosphatase, while alkaline phosphatase indicates tissue deterioration. In wistar rats, Odunola *et al*. (2007) observed an interaction and an intensification of the harmful effects of lead acetate and sodium arsenite. For 14 consecutive days, the rats in this study were given a gavage dose of Sodium Arsenite at a rate of 2.5 mg/kg body weight. Sodium arsenite significantly raised serum ALT, ALP, and AST activity. An increase in these enzymes indicates that the hepatocytes are under oxidative stress and hepatotoxicity. Curcumin has a mitigating effect on the metabolic disruptions caused by sodium arsenite in rats, according to Yousef *et al*. (2008). The groups were separated into Sodium Arsenite (5 mg/kg B.W), Sodium Arsenite+Curcumin, Control and Curcumin (15 mg/kg B.W). The findings indicated that while albumin, high density lipoprotein and total protein were reduced in the sodium arsenite group, the activities of AST, ALP, ALT, urea, creatinine, low density lipoprotein, cholesterol and triglycerides were markedly elevated. According to the results of the experiment, curcumin shields rats against the metabolic changes caused by arsenic. In male *wistar* Albino Rats, Aliyu *et al*. (2012) found that the effects of sodium arsenite are inhibited by ethanol. Nine groups of Albino Rats were given distilled water, 2.5 mg/kg of Sodium Arsenite and 3% and 6% (v/v) Sodium Arsenite respectively. Sodium arsenite raises ALT, AST and ALP levels. As opposed to the groups treated with sodium arsenite and ethanol alone, the combined therapy with these two substances considerably reduced the activity of the liver enzymes. This could indicate that sodium arsenite action is being suppressed by ethanol.

Sarker *et al*. (2012) found that adding powdered water hyacinth (*Eichornia crassipes*) root to mice diets dropped the negative impact of sodium arsenite. Four sets of *Swiss albino mice* were used in this investigation viz. Water hyacinth (8% wt/wt), Sodium Arsenite (0.2 g/L), Sodium Arsenite+Water Hyacinth and the Control group. SGPT and ALP were both increased by ingested arsenic. Thus, hyacinth root ability to protect arsenic-poisoned mice indicated that hyacinth might be used in the future to lessen arsenic toxicity in both animals and humans. The capacity of *Tephrosia purpurea* extract to lessen the toxicity that arsenic causes in wistar rats was investigated by Gora *et al*. (2013). When Sodium Arsenite (10 mg/kg) was taken orally for 28 days, cholesterol levels significantly increased. *Tephrosia purpurea* treatment at 500 mg/kg dramatically changes the course of arsenic toxicity. Being exposed to sodium arsenite in rats, Adedosu *et al*. (2015) examined the impacts of *Corchorus olitorius* extract on specific biochemical and antioxidant indicators. For 21 days, extracts were given to this group at a dose of 100 mg/kg body weight, whereas Arsenite intoxication was conducted at 2.5 mg/kg body weight. The levels of the marker enzymes aspartate aminotransferase and alanine aminotransferase, as well as cholesterol, were lower than inebriated animals. The antioxidant properties of the extract indicate the presence of bioactive polyphenol components, which may be studied as a potential therapeutic agent for the prevention, management, and treatment of age-related diseases. Ola Davies and Akinrinde (2016) used an ethanol extract of *Ageratum conyzoides* to prevent acute sodium arsenite-induced hematological and biochemical alterations in wistar rats. Four groups of wistar rats were randomly selected. Group II rats were given EEAC (100 mg/kg b.w.) orally for seven days, while Group I rats were given propylene glycol. Sodium Arsenite ($NaAsO_2$) was administered orally to Group III once at a dose of 2.5 mg/kg b.w. Group IV animals received a single oral dose of Sodium Arsenite after being pretreated for seven days with 100 mg/kg EEAC. The amounts of albumin, globulin and total protein were marginally decreased by arsenic exposure. Changes in urea, creatinine, cholesterol and triglyceride levels, as well as activities of alanine transferase, aspartate aminotransferase and alkaline phosphatase were not statistically significant. The decrease brought on by sodium arsenite was significantly reversed by *Ageratum conyzoides*. Dilruba *et al*. (2017) noticed the potential benefits of *Raphanus sativus* leaves in reducing the disruption of blood indices caused by sodium arsenite in Swiss albino mice. Four equal groups of Swiss albino mice were created: control, *Raphanus sativus* leaves (50 mg/kg b.w./day), Sodium Arsenite (10 mg/kg b.w./day) and *Raphanus sativus* leaves+Sodium Arsenite. In comparison to control group, treated mice showed considerably lower HDL and remarkably rised levels of liver enzymes and urea activity. The study findings imply that the preventive effects of *Raphanus sativus* leaves on blood index perturbations caused by sodium arsenite are linked to kidney, cardiovascular and liver dysfunction. Aqueous tomato extract possible ability to shield albino rat hemato-biochemical parameters from sodium arsenite toxicity was examined by Sharma and Rani (2022). Four groups of female rats were assigned: Control, rats treated with Sodium Arsenite (10 mg/kg body weight), rats administered a combination of Sodium Arsenite and Aqueous Tomato Extract and rats treated with solely Aqueous Tomato Extract (50 mg/kg body weight). Arsenic was found to considerably increase the activities of serum transaminases like ALT and AST. Rats treated with arsenic exhibited recovery when given aqueous tomato extract, and their values closely matched those of the control group. Thus, it can be inferred from this study that in Albino Rats, the

vitamins and antioxidants in the aqueous tomato extract provide protection contrary to arsenic toxicity.

In male wistar rats given sodium arsenite, David *et al*. (2024) observed the impact of *Nelsonia canescens* ethanolic stem extract on a few biochemical markers. A control group received 5 mg/kg body weight of Sodium Arsenite, while other groups received 50 mg, 100 mg, and 200 mg/kg of *Nelsonia canescens* ethanolic stem extracts. They found that whereas protein and albumin were decreased, ALP, AST, ALT, urea and creatinine significantly increased. The findings show that individuals who received ethanol stem extracts of *Nelsonia canescens* demonstrated a relatively significant liver protection against sodium arsenite-induced damage in comparison to those who received sodium arsenite. In adult rats given sodium nitrite, Mahmoud *et al*. (2024) studied the impact of quercetin on a number of metabolic markers. In this experiment, three sets of *Wistar* Albino Rats were employed. Group I was given water, Group II was given Sodium Nitrite (80 mg/kg body weight) orally and Group III was given Quercetin (50 mg/kg) combining with Sodium Nitrite while HDL and LDL dramatically dropped, cholesterol, triglycerides and VLDL notably rised. The impact of ethanol-based *Irvingia gabonensis* leaf extract on wistar rats liver damage caused by arsenic trioxide were documented by Olukayode and Innih (2024). Following the injection of arsenic trioxide, there was a notable rise in blood bilirubin and a considerable decrement in the activities of albumin, globulin, protein and aspartate aminotransferases (AST). When *Irvingia gabonensis* extract was administered, the liver histological and biochemical manifestations improved. According to this study, ethanolic leaf extract from *Irvingia gabonensis* shows hepatoprotective effect, most likely due to its bioactive components that have antioxidant qualities and the capacity to lower plasma lipid.

Effects on Antioxidant Indices of Liver

The effect of ginger, or *Zingiber officinale*, on male rat reproductive impairment caused by sodium arsenite was examined by Morakinyo *et al*. (2010). Adult male rats were used to test the effects of co-treating with sodium arsenite and *Zingiber officinale*, exposing them to Sodium Arsenite (10 mg/kg body weight/day) and administering Aqueous Ginger Extract (500 mg/kg body weight/day). Both the concentration of lipid peroxidation and SOD activity were found to be declining. When arsenite and aqueous ginger extract were administered together, antioxidant activity rose and peroxidation decreased. In mice ovaries, Kumar and Sinha (2018) documented oxidative DNA damage and histopathological damage brought on by sodium arsenite. The experimental animal was chosen to be a female Swiss albino mouse. For five months, distilled water was given orally through gavage to the control group and Sodium Arsenite (1.8 mg/kg body weight) to the treatment group. Lipid peroxidation increases and superoxide dismutase decreases following sodium arsenite ingestion. Yousuf *et al*. (2023) reported the neuroprotective effects of *Zingiber officinale* and quercetin on rats neurotoxicity caused by sodium arsenate. Adult mice were distributed into five groups which includes group V received quercetin (50 mg/kg) for 18 days, whereas groups II and IV received *Zingiber officinale* (300 mg/kg). Beginning on day 15, groups III, IV, and V received intraperitoneal injections of Sodium Arsenate (20 mg/kg) every day for four days. Glutathione reductase and superoxide dismutase were significantly reduced after sodium arsenate was administered. Nevertheless, quercetin or *Zingiber officinale* effectively restored these arsenic-induced changes in the treatment groups, suggesting their potential for amelioration. *Salvia hispanica* was evaluated by Omar *et al*. (2024) as a treatment for testicular poisoning induced by sodium arsenic in a male rat model. The groups were separated as follows: group 2 was given a normal meal and injections of sodium arsenite (NaAsO2) intraperitoneally in a 0.9% NaCl solution at a dosage of 4 mg/kg body weight. A basic diet with different amounts of pulverized Chia Seeds-5%, 10%, 15%, and 20% per 100 g of the diet was administered to groups 3, 4, 5 and 6. SOD has significantly decreased. *Salvia hispanica* seeds flavonoid concentration and antioxidant qualities suggest that they may have therapeutic value in treating arsenite-induced damage.

Effects on Histopathology of Liver

Olive oil beneficial effects on the gross and qualitative histological alterations in Albino Rats' livers brought on by arsenic observed by Cheema *et al*. (2019). Rats in the control group exhibit firm consistency, a dark brown colour and a spongy look among gross characteristics. Rats exposed to arsenic exhibit white necrosed look and soft consistency but the olive oil-treated group liver is usually spongy, soft to firm, and pale brown with a few white dots. The following qualitative histological indicators were noted: haemorrhage, congestion and necrosis. Ijaz *et al*. (2021) conducted a cross-sectional investigation to examine the hepato-protective impact of vitamin E on microscopic hepatic alterations caused by arsenic in Albino Rats. Three groups of rats were given Sodium Arsenite (0.5 mg/100 g/day), Sodium Arsenite+Vitamin E and control. The liver tissues of the treated group exhibit inflammatory cells, pyknosis and fatty changes. The histological consequences of consuming water containing arsenic on Albino Rats liver and kidney were examined under a light microscope was studied by Shangloo *et al*. (2021). There were three groups of Wistar rats. For four weeks, the Arsenic group received oral doses of 50 ppm and 100 ppm in drinking water, whereas the control group was given simply distilled water. Rat livers treated to low doses displayed dilated portal veins, portal haemorrhage and minor central venous dilatation and congestion. Rats given higher dosages, however, showed signs of haemorrhage, necrosis, vacuolated cytoplasm, mononuclear infiltration and distortion of tissue architecture in their livers. According to Concessao *et al*. (2023), rat's testicular toxicity and hepato-renal histopathology caused by sodium arsenite were lessened by *Mucuna pruriens* seed extract. Both long-term (90 days) and short-term treated groups were included in the study, and each group was further subdivided into nine groups. N-acetyl Cysteine (NAC) and normal controls were represented by subgroups 1 and 2, respectively. 50 mg/L of Sodium Arsenite was added to the drinking water for subgroups 3-9. NAC (210 mg/kg body weight) was administered orally once day to Subgroup 4. *Mucuna pruriens* aqueous seed extract (700, 530 and 350 mg/kg body weight respectively) was administered orally once day to subgroups 5-7. NAC and Aqueous Seed Extract (530 and 350 mg/kg BW respectively) were administered orally once daily to subgroups 8 and 9. The group exposed to arsenic had dilated central veins, an increase in sinusoidal gaps and harm to the lining of the sinusoids. Hepatocyte cellular necrosis and damage to the central vein wall were observed.

Conclusion

The hepatotoxic effects of sodium arsenite in Albino Rats have been thoroughly investigated in this detailed review.

The results of numerous investigations clearly show that exposure to sodium arsenite causes severe hepatic damage, which is manifested by oxidative stress, increased liver enzymes and histological changes. The creation of reactive oxygen species, interference with antioxidant defence and activation of inflammatory pathways are the processes behind sodium arsenite-induced hepatotoxicity. Additionally, it has been emphasized how necrosis and apoptosis mediate hepatocyte mortality. The reviewed studies further highlight the significance of exposure duration and dose in assessing the degree of hepatotoxicity. Furthermore, it has been observed that sodium arsenite may worsen liver damage by interacting with other toxicants. The review conclusion has important health ramifications, especially in areas where drinking water pollution by arsenic is common. The hepatotoxic effects of sodium arsenite have been studied using the albino rat model and the knowledge gathered from these investigations can help create mitigation measures for arsenic-induced liver damage. To sum up, this critical evaluation offers strong proof of sodium arsenite hepatotoxic potential in Albino Rats. In order to prevent or reverse arsenic-induced liver damage, more study is required to clarify the molecular mechanisms behind this toxicity and investigate the therapeutic potential of antioxidants and other therapies.

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