

**Research Article**

Influence of *Aframomum sceptrum* Treatment on Hepatic Toxicity Induced by Monosodium Glutamate in Albino Rats

Precious Iyeh¹, Joel Okpoghono^{2*}, Betty O. George³¹Department of Chemical Sciences, University of Delta, Agbor, Nigeria²Department of Biochemistry, Delta State University of Science and Technology, Ozoro, Nigeria³Department of Biochemistry, Delta State University, Abraka, Nigeria**OPEN ACCESS*****CORRESPONDENCE**Okpoghono, J.
okpoghono@gmail.com
+234-806-461-8605**ARTICLE HISTORY**Received: 23/6/2023
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Published: 30/06/2024**CITATION**Iyeh P., Okpoghono J. and George B.O. (2024). Influence of *Aframomum sceptrum* treatment on hepatic toxicity induced by monosodium glutamate in albino rats. *Nigerian Journal of Biochemistry and Molecular Biology*. 39(2), 39-43 <https://doi.org/10.4314/njbmb.v39i2.1>**ABSTRACT**

Monosodium glutamate (MSG) is commonly used as a culinary flavouring, although research suggest that it is toxic to people and laboratory animals, especially in high dosages. The study goal is to determine the impact of *Aframomum sceptrum* (ataiko) treatment on hepatic induced toxicity by MSG. Thirty-six albino rats (male) with weight of 120 to 210 g were used for the study. The rats were separated into 6 groups in which each group contains six rats. Group 1: normal control. Group 2: MSG only. Group 3 and 4 were given MSG and then treated with 250 and 350 mg/kg b.wt of *A. sceptrum* extract respectively. Group 5 and 6 were administered only 250 and 350 mg/kg b.wt of *A. sceptrum* extract, respectively. The MSG groups were given intra-peritoneal injection of MSG solution at single dose of 4253 mg/kg b.wt. *A. sceptrum* extract was administered three times a week for four weeks beginning two days after the MSG induction. Liver function markers such as aspartate aminotransferase (AST) and alanine aminotransferase (ALT) and oxidative stress markers such as reduced glutathione (GSH) and malondialdehyde (MDA) were determined in serum and liver. Also, glucose was determined in the serum. The results showed that there were significant ($p < 0.05$) increased in glucose, AST, ALT and MDA in serum and liver, and decreased in GSH level in the liver of rats given MSG only when compared with normal control. However, *A. sceptrum* administration significantly ($p < 0.05$) decreased glucose, AST, ALT and MDA in the serum and liver, and increased GSH level in the liver when compared with MSG only. In conclusion, aqueous extract of *A. sceptrum* may have beneficial effect in MSG induced toxicity in rats by improving GSH level as well as liver function markers in a dose dependent manner.

Keywords: *Aframomum sceptrum*, *Ataiko*, *Hepatic toxicity*, *Monosodium glutamate*, *Reduced glutathione***INTRODUCTION**

Monosodium Glutamate (MSG) is an additive that enhances the flavour of food. It is a white powder that dissolves quickly in water or saliva. It is also known as "Ajinomoto" and is the sodium salt of glutamic acid (Abd-Elkareem *et al.*, 2022). MSG contains 78% glutamic acid and 22% of sodium and water (El-Hak *et al.*, 2021).

Numerous proteins and peptides found in the majority of tissues are primarily made up of glutamate, one of the frequently occurring amino acids in nature. The body also produces glutamate, which is crucial to human metabolism. It is a major component of many protein-rich food products of animal origin such as meat, fish, milk, and cheese or vegetable origins such as mushroom and tomato, either in free or bound state. MSG could produce symptoms such as numbness, weakness, sweating, flushing, dizziness and headache (Abd-Elkareem *et al.*, 2022; El-Hak *et al.*, 2021; Swaminathan *et al.*,

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2021). MSG administration has also been associated with hyperglycemic conditions based on parameters tested in the brain, serum and liver of experimental animals (Diniz *et al.*, 2005). Additionally, administration of monosodium glutamate is connected to increased body weight, dysfunctional locomotor functions, and altered lipid metabolism (Thuy *et al.*, 2020).

The health advantages of majority of spices are mediated by their antioxidant properties (Otuaga *et al.*, 2020a; Okonta *et al.*, 2021), or ability to stop free radical generation, get rid of radicals, fix oxidative damage, and get rid of damaged molecules (Ekakitie *et al.*, 2021). A wide range of chemical components are connected to the antioxidant action of spices. The best antioxidants work by stopping the chain reaction caused by free radicals. These substances give off hydrogen radicals, which are stabilized by the resonance delocalization of the electron within the aromatic ring, to the free radicals produced during oxidation (George *et al.*, 2015; Ekakitie *et al.*, 2021). Ataiko, Uda, African nutmeg, turmeric, and ginger are some of the classic spices that are currently gaining popularity due to their flavour profiles and health advantages (Otuaga *et al.*, 2020b; Okpoghono *et al.*, 2018; Okpoghono *et al.*, 2023; Okpoghono *et al.*, 2024).

Aframomum sceptrum (Oliv. and Hanb.) *K Schum* is one of the regional spices eaten in southern Nigeria. It is generally recognized as Guinea grains of paradise or black amomum in English. It is known as Ataiko among the Urhobos of southern Nigeria (Ejueyitsi *et al.*, 2022). *A. sceptrum* belongs to the family of *Zingiberaceae* which constitute a family of terrestrial rhizomal herbs with over 1400 species distributed in over 50 genera (Hepper, 1996). They are typically seen in tropical environment (Africa and Asia). *A. sceptrum* is widely spreading, inflorescence, at foot of leafy shoots or at some distance away. The seeds of *A. sceptrum* are traditionally used as condiments, flavourings and spice in the preparation of soups (Ejueyitsi *et al.*, 2023). *A. sceptrum* has been found to have antiparasitic, antifungal, antibacterial, and antiviral properties (Cousins and Hoffman, 2002; George *et al.*, 2011; George *et al.*, 2012; Anigboro, 2019). Additional studies have showed its effectiveness as an analgesic, anti-inflammatory, antioxidant, antiulcer, and antiprotozoal (Cheikh *et al.*, 2011). The major classes of phytochemical compounds found in the seeds of *A. framomum* include diterpenoids, flavonoids and alkaloids (Tane *et al.*, 2000). This study was designed to look into *A. sceptrum* comforting effects in the liver and serum of rats administered MSG.

MATERIALS AND METHODS

Care and maintenance of the experimental animals

Male albino Wistar rats of three months old weighing between 120g-210g were obtained at the Animal House, Faculty of Basic Medical Sciences, Delta State University, Abraka, Nigeria. They were given growers mash (poultry feed) and water *ad libitum*. The animals were kept in cages constructed with wood and wire gauze, under control condition of 12h light / 12h dark cycle. The animals were maintained in agreement with the guidelines approved by the Animal ethnical committee, Delta State University, Abraka.

Preparation of *A. sceptrum* extract

A. sceptrum was purchased in the local market in Abraka, Delta State, and botanical authentication was carried out at the Forestry Research Institute of Nigeria (FRIN), Ibadan, Oyo State, Nigeria, with the voucher specimen number 109938. As previously described by George *et al.* (2012), *A. sceptrum* was pulverized to coarse form with Warren blender. One hundred grams (100g) of the ground *A. sceptrum* was soaked in 400 mL of distilled water and boiled for five minutes then permitted to cool. The sample was stirred for ten minutes and filtered. The extract was then concentrated with water bath under reduced pressure (40-50°C). The extracts were stored at 8°C until required.

Experimental design

Thirty-six (36) rats were used for the study. They were separated into 6 groups with each comprising of 6 rats after one-week acclimatization as follows:

Group One: Normal control: the rats were not administered MSG and *A. sceptrum* extract.

Group Two: MSG control: the rats were administered 4253 mg/kg bwt MSG and *A. sceptrum* extract was not given.

Group Three: MSG plus 250 mg/kg b.wt *A. sceptrum*: the rats were administered 4253 mg/kg bwt MSG and 250 mg/kg b.wt of *A. sceptrum* extract.

Group Four: MSG plus 350 mg/kg b.wt *A. sceptrum*: the rats were administered 4253 mg/kg bwt MSG and 350 mg/kg b.wt of *A. sceptrum* extract.

Group Five: Normal plus 250 mg/kg b.wt *A. sceptrum*: the rats in this group was not administered MSG, and 250mg/kg b.wt *A. sceptrum* extract was given.

Group Six: Normal plus 350 mg/kg b.wt *A. sceptrum*: the rats were not administered MSG, and 350mg/kg b.wt of *A. sceptrum* extract was given.

Administration of MSG to experimental animals

Ajinomotor which is a trade name of the concentrated (3g/sachet containing 99+% of MSG) forms of MSG was obtained from the local market in Abraka, Delta State, Nigeria. The experimental animals were given the appropriate volumes of the MSG preparation. The LD₅₀ of 4,253 mg/kg body weight was used as the basis for MSG preparation as described by (Hoppe, 1955). The administration of the extract was carried out orally (three times a week beginning two days after the MSG route of injection at a single dose of 4,253 mg/kg body weight) using syringe and cannula for a period of four weeks (28 days), on the last day the rats were subjected to overnight fast, and then slain by cervical decapitation and the blood and tissue (liver) were collected for various biochemical analysis.

Serum and liver tissue homogenate

One gram (1 g) of wet tissue (liver) was homogenized in 9.0ml of normal saline. Blood sample was collected into plain tubes and serum was separated by centrifugation at 1000xg for 15 minutes. Liver tissue homogenate was also separated by centrifugation at 1000xg for 15 minutes. The serum and tissue

homogenate supernatant obtained were stored in the freezer (-20°C) until required.

Biochemical analysis

Aspartate and Alanine aminotransferase activities were determined by Method of Reitman and Frankel (1957). The reduced glutathione concentration was assessed by method of Ellman (1959). Serum glucose concentration was determined by method of Trinder (1969). Lipid peroxidation in form of malondialdehyde (MDA) was determined in liver by method of Buege and Aust (1978).

Statistical analysis

All the results were expressed in mean bars. All data were analyzed using Analysis of variance (ANOVA). Significant difference between means were determined at p-value ($p < 0.05$) confidence level using Duncan's Multiple Range Test (DMRT), (Duncan, 1955). The SPSS-PC programme package (version 16.0) was used for the statistical analysis.

RESULTS AND DISCUSSION

In this research, the possible effects of *Aframomum sceptrum* (ataiko) treatment on hepatic toxicity caused by MSG on some markers of oxidative stress parameters in serum and liver and glucose level in serum of rats was investigated. In Figures 1 and 2, rats in group 2 have a significantly higher ($p < 0.05$) AST and ALT activities in serum and liver when compared to rats in group 1. Groups 3, 4, and 5 showed a significant decrease ($p < 0.05$) in the activity of AST and ALT when compared to rats in group 2. Group 6 showed significant increase in AST and ALT activities when compared with group 1. Abd-Elkareem *et al.* (2022) reported that the ALT enzyme is a sensitive indicator of liver injury and AST levels are predictive of damage to the liver. Hence any necrosis or membrane impairment to the liver may lead to leakage of these enzymes into the blood circulation (Abd-Elkareem *et al.* 2022). The findings of this study demonstrated that rats given MSG were more sensitive to hepatotoxicity as indicated by elevated serum levels of AST and ALT. Administration of *A. sceptrum* significantly reduced the elevated AST and ALT levels which could be attributed to the protective effect on hepatic tissues. Monosodium glutamate is a popular food enhancer, which many manufacturers believe can be used as the consumer likes (Diniz *et al.*, 2005).

In Figure 3, the glucose level in the serum of group 2 were significantly higher ($p < 0.05$) compared to group 1. Group 3 and 4 had significant decrease in glucose concentration when compared to group 2. A significant increase in glucose level was observed in groups 5 and 6 when compared with group 1. Thus, the elevated sugar level that followed MSG administration was attributed to increased gluconeogenesis from glutamate and glutamine (Diniz *et al.*, 2005). This shows a possible link between oxidative stress and altered glucose metabolism, and might have contributed to the increased hepatic oxidative stress in MSG-treated rats (Diniz *et al.*, 2005).

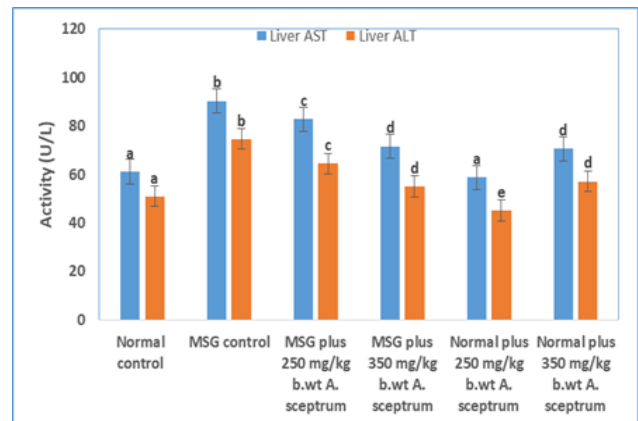


Figure 1. Liver AST and ALT Activities of Rats Administered MSG Treated with Aqueous Extract of *A. sceptrum*.

Bars of parameter that do not share the same superscript alphabet letter differ significantly ($p < 0.05$).

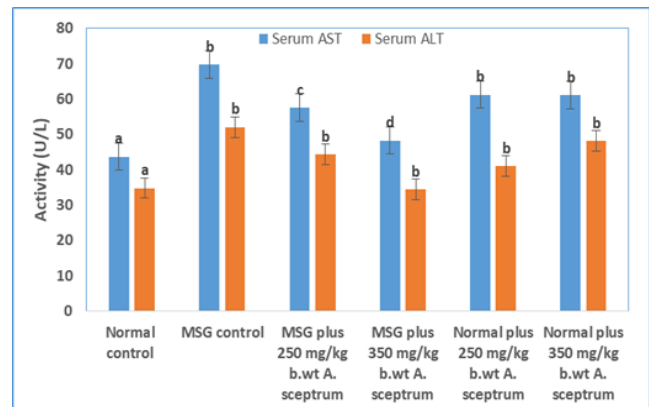


Figure 2. Changes in Serum AST and ALT activities of Rats Administered MSG and Aqueous Extract of *A. sceptrum*.

Bars of parameter not sharing a common superscript alphabet letter of the same parameter differ significantly ($p < 0.05$).

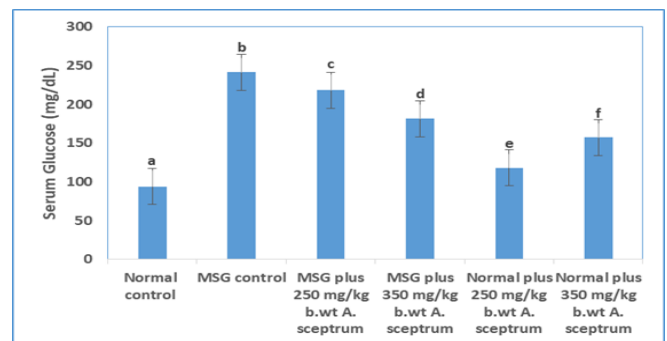


Figure 3. Serum Glucose Concentration of Rats Administered MSG and Aqueous Extract of *A. sceptrum*.

Bars not sharing a common superscript alphabet letter differ significantly ($p < 0.05$).

In Figure 4, group 2 had a significant ($p < 0.05$) high MDA and lower GSH level in the liver compared to group 1. Groups 3 and 4 showed significant decrease in MDA and increase in GSH level in the liver when compared to rats in group 2. A significant ($p < 0.05$) decrease in GSH concentration was observed when groups 5 and 6 were compared with group 1. The increase in MDA level observed in this study may be

attributed to a direct effect of increased generation of ROS resulting from MSG action. Lipid peroxidation is a major indicator of oxidative damage initiated by ROS and causes impairment of membrane function (Fujii *et al.*, 2022). A decrease in antioxidant status in an attempt by the tissues to restore their normal oxidative state may also subject the tissues to lipid peroxidation. GSH is an important cellular antioxidant. Its depletion in this study correlates with the increase in lipid peroxidation observed in the liver tissues. Decreased level of GSH in the liver of the experimental animals, are similar to previous observations that MSG caused oxidative stress in tissues (Onyema *et al.*, 2006; Swaminathan *et al.*, 2021).

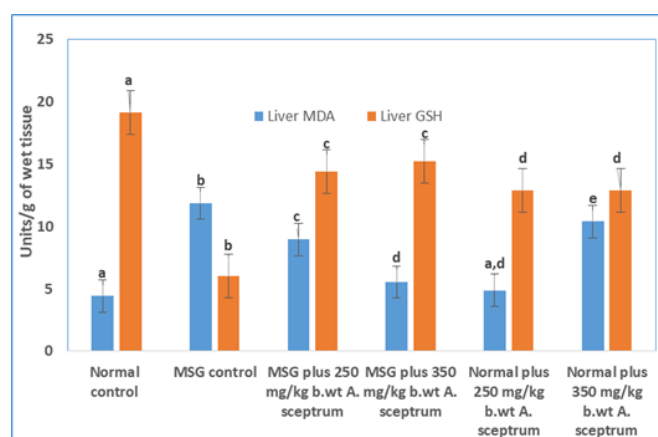


Figure 4. Changes in Liver MDA and GSH levels of Rats Administered MSG Treated with Aqueous Extract of *A. sceptrum*.

Bars not sharing a common superscript letter of the same parameter differ significantly ($p < 0.05$).

CONCLUSION

The present data indicated that chronic administration of MSG results in oxidative stress, and altered liver function markers and glucose metabolic processes in the hepatic tissues of rats. However, intake of *A. sceptrum* spice may be safe at moderate dose of 250 mg/kg b.wt. in comparison to 350 mg/kg b.wt. for the prevention of MSG induced hepatic dysfunction. Therefore, further evaluation of *A. sceptrum* pharmacodynamics in MSG induced toxicity should be carried out.

AUTHORS' CONTRIBUTIONS

PI and JO performed the laboratory tasks and generated results. JO and PI wrote the draft manuscript and analysed the results, while BOG designed, supervised and vetted the draft manuscript. All authors endorsed the manuscript for submission and publication.

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Not applicable.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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