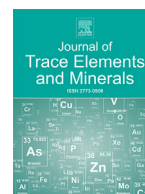




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## Journal of Trace Elements and Minerals

journal homepage: [www.elsevier.com/locate/jtemin](http://www.elsevier.com/locate/jtemin)Ethyl acetate fraction of *Tamarindus indica* leaf ameliorates aluminium chloride induced neural damage in neonatal Wistar rats

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## ABSTRACT

**Background:** *Tamarindus indica* (TI) extract is known to possess important phytochemical composition. The study aimed to assess the effects of ethyl acetate fraction of TI leaves (EATI) on memory and learning, traced element and brain sialic acid levels, and hippocampal Nissl substance expression following prenatal (PN) AlCl<sub>3</sub> exposure in Wistar rat pups.

**Methods:** Pregnant rats were divided into 5 groups ( $n = 4$ ); Group I received distilled water (negative control), Group II-V were experimental groups treated with 200 mg/kg of AlCl<sub>3</sub>. Group II (positive control), Groups III, and IV received 400 mg kg<sup>-1</sup> and 800 mg kg<sup>-1</sup> of EATI, respectively, and Group V received 300 mg kg<sup>-1</sup> of Vitamin E (comparatively control) for 2 weeks (PN day 7–21). On postnatal (PoN) day 19, male pups were subjected to novel object recognition test ( $n = 5$ ). Some pups were euthanized on PoN days 7 and 21; and samples were collected for quantification of trace element ( $n = 5$ ), brain sialic acid concentration ( $n = 5$ ), and Nissl staining using cresyl fast ( $n = 3$ ).

**Results:** The results of the trace elements quantification on PoN days 7 and 21 revealed significantly lower mean copper, zinc, and iron, and significantly higher calcium level in the group treated with 400 and 800 mg kg<sup>-1</sup> of EATI when compared with the positive control group. EATI at a dose of 800 mg kg<sup>-1</sup> showed improvement in memory and increased brain sialic acid. EATI 400 mg kg<sup>-1</sup> increased only free sialic acid and had no effect on memory. Improvement in Nissl staining was observed in the EATI treated group on PoN day 7 and 21.

**Conclusion:** The administration of EATI ameliorated AlCl<sub>3</sub>-induced neural toxicity.

## Introduction

Aluminum (Al) is an important metal used in the production of vaccines and drugs for the management of diarrhea, hemorrhoidal, douche, and antacids [1,2]. Al is used in water treatment and the production of Al foils for food wrapping [3]. The major route of human Al exposure is through the ingestion of water and food contaminated with Al [4].

Patients on long-term parental nutrition and dialysis are at high risk of bioaccumulation aluminum-related toxicity [5]. Various organs of the body are reported to be vulnerable to aluminum accumulation both in adults and during prenatal development including the bones, liver, kidney, and the different parts of the brain [6].

The hippocampus is an essential regions of the brain necessary for human and animal adaptation to their environment [7,8]. The

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signaling, neural transmission, and apoptosis [27,28]. The observed improvement in the present study suggests a possible involvement of EATI modulation and/or restoration of tissue biochemical and physiological functions. Trace elements are generally needed in well-regulated quantities for normal cellular function [18,19]. This study offers a preview of the role of EATI in preventing heavy metal toxicity, and the fact that A1 toxicity was associated with the elevation of mean brain concentration of various traced element except Ca, suggesting a need to investigate the responsible cellular ionic efflux/influx mechanisms.

The administration of EATI was associated with a dose-dependent improvement in Nissl staining in neonates following prenatal AlCl<sub>3</sub> exposure in the present study. The administration of vitamin E was also associated with improvement in Nissl staining following prenatal AlCl<sub>3</sub> exposure. Disruption of Nissl substance distribution has been associated with interference with cellular protein synthesis, with consequent implications on cellular activities [68]. The observed higher Nissl substance expression may serve as a pointer to the resultant biochemical activity of EATI at the level of the different traced element, with a consequent improvement in neuronal viability and survival. Previous study reported improvement in GFAP expression and oxidative stress biomarker following the administration of EATI during prenatal AlCl<sub>3</sub> [45]. Treatment with EATI during prenatal AlCl<sub>3</sub> exposure was also associated with improved motor coordination and myelin staining in the cerebellar cortex [46]. A Significant improvement in anxiety-like behavior, motor activities and pyramidal cell count following prenatal EATI administration during AlCl<sub>3</sub> exposure [47]. The observed improvement in Nissl staining is in line with the finding of Usman et al. [69] who reported increased Nissl staining in sections of Wistar rat cerebral cortex administered ethanol extract of *Tamarindus indica* during prenatal ethanol exposure.

This study did not investigate *in vitro* trace element concentrations for specific brain parts or quantitatively investigate the expression of Nissl substances following challenges in infrastructure, thus forming part of the study limitation in the current investigation.

## Conclusion

Administration of EATI ameliorated alterations in memory and learning, traced element, and brain sialic acid concentration, and protected the hippocampus following prenatal exposure to AlCl<sub>3</sub> neurotoxicity in rats. Beneficial properties of EATI could be associated with the activity of important phytochemicals. Therefore, suggesting further studies on the molecular mechanism responsible for the observed improvement in the traced element, brain sialic acid concentration, and Nissl staining during prenatal AlCl<sub>3</sub> exposure.

## Declaration

Ethics approval and consent to participate

Expediated ethical approval from Ahmadu Bello University Committee on Animal Use and Care was acquired and registered as ABU-CAUC/2019/001.

## Consent for publication

Not applicable.

## Availability of data and materials

Data files for the study can be accessed at <https://figshare.com/s/327de6b61acf74ed5e09>

Competing interests

The authors declare no conflicts of interest.

Funding

Not applicable.

## Ethical statement

Expediated ethical approval from Ahmadu Bello University Committee on Animal Use and Care was acquired and registered as ABU-CAUC/2019/001. The experimental rats received human care following the Code of Ethics of the World Medical Association (Declaration of Helsinki) and National Institute of Health guidelines for the care and use of laboratory animals.

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The authors did not receive any funding.

## Declaration of Competing Interest

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

## CRediT authorship contribution statement

**Ibe Michael Usman:** Conceptualization, Data curation, Writing – review & editing. **Abel Nosereme Agbon:** Conceptualization, Writing – review & editing. **Andrew Ekpeyong Ivang:** Conceptualization, Formal analysis, Writing – review & editing. **Akwu Bala Peter:** Data curation, Formal analysis, Writing – review & editing. **Adam Moyosore Afodun:** Data curation, Formal analysis, Writing – review & editing. **Akeem Ayodeji Okesina:** Data curation, Writing – review & editing. **Victor Fischer:** Data curation, Writing – review & editing. **Bot Yakubu Sunday:** Data curation, Formal analysis, Writing – review & editing. **Eric Osamu Aigbogun Jr.:** Data curation, Formal analysis, Writing – review & editing. **Ismail Onanuga:** Data curation, Formal analysis, Writing – review & editing. **Caroline Asekenye:** Data curation, Formal analysis, Writing – review & editing. **Ann Monima Lemuel:** Data curation, Formal analysis, Writing – review & editing. **Keneth Iceland Kasozi:** Data curation, Formal analysis, Writing – review & editing.

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