Evaluation of Moringa’s Effects Against Lead-Induced Disruption of the Hippocampus in Animal Models

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ABSTRACT [ENGLISH/ANGLAIS]

This study was carried out to observe the nature, potency and extent of effects of Moringa oleifera leaf extract on the hippocampus of adult Wistar rats. Twenty four (n=24) adult Wistar rats were grouped into four; the rats in group A, the control, were administered Moringa oleifera leaf extract only; Group B were administered lead only; Group C were administered lead for the first half and moringa was administered for the second half of the administration period; while Group D were administered lead and moringa simultaneously throughout the period of administration. After thirtieth day of administration, animals were sacrificed and histological specimens of the hippocampus of the animals across the groups were prepared using the routine haematoxyline and eosin staining technique. Photomicrography and histological analysis revealed that lead produced deleterious effects on tissues of the hippocampal formation disrupting its general histoarchitecture and cellular integrity; Moringa oleifera leaf extract ameliorates the severity of lead toxicity. Thus, moringa at the dosage employed produced positive effects against lead toxicity.

Keywords: Moringa, lead poisoning, hippocampus, neurons, wistar rats

INTRODUCTION

Moringa oleifera, or the horseradish tree, is a pan-tropical species that is known by such regional names as benzoilive, drumstick tree, kelor, marango, mlonge, mulangay, nébéday, saijhan, and sajna. There have been reports in the past two decades in reputable scientific journals describing its nutritional and medicinal potentials [1].

Many studies have shown that Lead is a very poisonous metal that affects almost every organ system of the body [2]. Exposure to lead both before and after birth could damage short-term and long-term memory ability of young rats and hippocampal ultrastructure [3]. Lead is a shiny, blue-white soft metal, when its surface is fresh. Otherwise, lead would react rapidly with the oxygen and carbon dioxide in the air. Acute lead poisoning results from ingesting soluble lead compounds. The damage
Moringa leaves contain more Vitamin A than carrots, more calcium than milk, more iron than spinach, more Vitamin C than oranges, and more potassium than bananas, the protein quality of Moringa leaves rivals that of milk and eggs when compared on the basis of equal mass [1]. While these compounds are relatively unique to the Moringa family, it is also rich in a number of vitamins and minerals as well as other more commonly recognized phytochemicals such as the carotenoids [1]. This study was carried out to observe the nature, potency and extent of effects of Moringa Oleifera extract on the hippocampus of adult Wistar Rats.

MATERIALS AND METHODS

Twenty four (n=24) adult Wistar rats were grouped into four; the rats in Group A are the control that were administered moringa leaf extract only. The Rats in group B were administered Lead only; Group C were administered Lead for the first half and Moringa was administered for the second half of the administration period; Group D were administered Lead and Moringa simultaneously throughout the period of administration. Dosages of Moringa oleifera extract (100mg/kg body weight) and lead (50mg/kg body weight) were adopted. After thirtieth day of administration, animals were sacrificed by cervical dislocation with adequate considerations for ethics and research design [9].

Histological specimens of the hippocampus of the animals across the groups were prepared using the routine haematoxyline and eosin staining technique [10].

RESULTS AND DISCUSSIONS

Group A hippocampus histoarchitecture is normal; cell morphology and population also appear normal, healthy and adequate. This hippocampus is suitable for the purpose of reference in this investigation. It is important to note that the rationale behind the treatment of the Group A with moringa leaf extract only is to observe its basic effects, if any, on the hippocampus in this particular group. This would help in effective analysis of the results of moringa leaf extract interaction with lead toxicity in the other treated groups. Group A hippocampus histology has no signs of neuronal damage or histological disruption. Hippocampus thus appears normal and healthy, suggesting that the administered substance had no observable deleterious effects. Group B would give histomorphological information about the precise effects of lead toxicity on the hippocampus. Obvious observations include gross disruption of the hippocampus and loss of its basic histological form. The superior and inferior plates are hardly distinguishable, so also the intermediate layer of pyramidal neurons. Photomicrograph presents extensive vacoulations which are irregular in morphology. The vacoulations, being large suggest extensive damage to the neuropil. Glia are not well distinguishable, showing that the effects also affected the glia population. These damaging effects are obviously due to lead toxicity. The healing or regenerative effects moringa leaf extract was tested in Group C by administering the extract for the second half of total treatment duration after the animals had been intoxicated by lead in the first half. At the lower magnification, the general overall histoarchitecture shows that there are no vacoulations observable. Though neurons stain relatively pale, they present a monomorphic morphology across their population. Pyramidal cells also appear relatively sparse. These observations are indications of the healing effects produced by moringa oleifera when administered to counter the effects of lead toxicity on the hippocampus. The few noticed variations especially appearance and staining intensities of cells, and number of pyramidal cells are indications that this healing effect is not absolute or rather, that the hippocampus in this case is not absolutely healthy.
Group A: Group A Photomicrograph of the hippocampus of the control Group A: 1 illustrates the normal hippocampus X64; 2 illustrates the dentate gyrus X160; 3 illustrates the tip of the dentate gyrus and its cells while 4 illustrates a lip of the dentate gyrus granular layer and the intermediate polymorphic layer. Hippocampal general histoarchitecture and cellular integrity appear normal, hence healthy.

Group D investigated the possible prophylactic effects of the extract or rather its chemical interactive dynamics and kinetics with lead in this context. In this Group D; the histoarchitecture of the hippocampus is being preserved. Neurons are prominent, presenting normal and healthy morphology; they are also predominantly monomorphic. Pyramidal cells are sparse in this group. Glia are however normal in appearance and population. Comparatively, neurons in this group by virtue of staining intensity and morphology appear healthier than those in Group C while cells in Group D appear almost unaffected all along. Group C cells appear to have been affected or assaulted, and rather, healing. This suggests that moringa presents better prophylactic effects against lead toxicity, than healing or regenerative effects.

Basically, lead produced severely deleterious effects on the brain hippocampus in forms that include general disruption of the hippocampus histological architecture, cell death, vacoulations and gliosis. These effects would mean that the basic functional units of the organ is compromised and most likely their functions. In both cases of moringa leaf extract administration, the
hippocampus was preserved. While most granular layer neurons in the Group C (Figure C 3 and 4) appear unaffected but recently proliferated; cell of the Group D hippocampus (Figure D 3 and 4) have a few dark neurons comparatively. This suggests that the cells in the Group C having been treated with moringa oleifera leaf extract might have undergone healing or regeneration; the cells in the Group D treated concurrently with lead and moringa oleifera leaf extract are majorly being preserved but a few are showing signs of chemical assault and affected morphology.

Group B: Photomicrograph of the hippocampus of the Group B animal models exposed to lead poisoning: Figure 1 illustrates the hippocampus X64, there is gross disruption of the general hippocampus histoarchitecture, neurons are not distinguishable and large glia population suggest gliosis; vacoulaations are also observable indicated by purple arrows. Figure 2 illustrates the dentate gyrus X160; orange arrows indicate positions of dentate gyrus lips while the purple arrows indicate large vacoulaations. Figure 3 illustrates the grossly disrupted hippocampus; orange arrows indicate lips positions while the purple arrows show vacoulaations. Histoarchitectue is largely disrupted, neurons are destroyed and gliosis is being induced.
Results correlate with the report of Selvin-Testa [11] suggesting that chronic lead exposure induces an astrocytic reaction as a result of a direct action of lead on astroglial cells or as a response to underlying neural damage. Also, it share resemblance with the work of Xu et al., [3] that lead toxicity before and after birth could damage short-term and long-term memory ability of young rats and hippocampal ultrastructure. Though Gilbert et al., [12] reported that chronic developmental lead exposure reduces neurogenesis in adult rat hippocampus but does not impair spatial learning; it is obvious that postnatal short term and medium duration exposure such as for the time employed for this investigation might produce effects that would seriously compromise neuronal morphology, causing death and consequently result in the compromise of the whole hippocampus functions. Cells deaths as well as processes degeneration would compromise commissural interconnections which is vital to hippocampal functions and integrity [13]. Very importantly various forms of learning and memory consolidation among other hippocampus functions might be compromised. The nature and extent of such would however require further investigations.
CONCLUSION

Lead caused serious disruption of the hippocampus in the treated animals in forms of histological disruption of whole hippocampus, cell death, gliosis and vacuolations. Moringa oleifera leaf extract at the dosage employed produced observable positive effects against lead toxicity by preserving most neurons and glia when administered concurrently with lead and by restoring cell population and ensuring normal morphology when administered after lead exposure. Further investigation on the exact mechanism of healing and preservation will be very useful.

REFERENCES

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CONFLICT OF INTEREST
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