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Original Article

Effect of Aqueous Extract of *Salacia Reticulata* on Aluminum Chloride Induced Cellular Changes on Cerebral Cortex of Wistar Rats

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ABSTRACT

Background: Aluminum chloride is a potent neurotoxic compound that is being implicated in several neuropathological disorders. Considering the unavoidable exposure to $AlCl_3$ in several manufactured foods and medicines, there is a need to combat this threat through affordable natural products like herbs.

Aims: This study aimed at investigating if Salacia reticulata ameliorates aluminum chloride-induced cellular changes in the cerebral cortex of Wistar rats.

Methods: Animals were assigned into three groups: Group A control (distilled water 1 ml/kg), Group B $AlCl_3$ 65 mg/kg b.w., and Group C $AlCl_3$ (65 mg/kg b.w.) plus Salacia reticulata (250 mg/kg b.w.), respectively. Rats were orally administered their respective doses daily for 14 days.

Results: The effect of these treatments was studied on harvested brain tissues stained using H&E and the slides obtained were mounted on a microscope. The film obtained from the slides showed cellular and neutrophil profile in Group B, which was absent in Group A on the administration of Salacia reticulate Group C a full recovery of cellular and neutrophil was observed.

Conclusion: Aqueous extract of Salacia reticulata has the potency to revert structural degeneration of cerebral cortex neuron caused by aluminum chloride.

Keywords: aluminum chloride, cerebral cortex, cellular changes, *Salica reticulata*

INTRODUCTION

Aluminum is a common cation, present in several manufactured foods and medicines and is also used in water purification [1]. It represents, approximately 8% of total mineral components and ranked as the third most prevalent element and the most abundant metal in the earth's crust [2]. Due to its reactivity, aluminum in nature is found only in combination with other elements such as sulphate and chloride. When combined with chloride it is called Aluminum Chloride ($AlCl_3$). Aluminum chloride is a potent neurotoxic compound that can cross the blood-brain barrier via iron-binding protein and transferrin [3, 4]. It is being

implicated in several neuropathological alterations observed memory deficits, biochemical and pathological alterations in rats exposed for 25 days to $AlCl_3$ [5]. It increases the presence of atrophied and karyorrhexis cells with loss of Nissl substance in the temporal cortex of rats as an indication of nervous degeneration [6]. It results in oxidative and nitrosative stress in the cerebral cortex, hippocampus, and striatum of rats [7]. Considering its deleterious effect on the nervous system and the unavoidable exposure to $AlCl_3$, there is a need to combat this threat through affordable natural products like herbs.

Local herbs have curative property, less toxic and minimal side effects [8]. *Salacia reticulata* also known as Kothala himbutu is an indigenous Sri Lankan plant, but also grown in parts of Southern India and other parts of Africa; like Nigeria. *Salacia reticulata* (Kothala himbatu) is a large woody climbing shrub that belongs to the family Hippocrateaceae [9]. The constituents of *Salacia* are numerous and may vary depending on the species and place of origin such as 1.3-diketones, dulcitol, and leucopelargonidin among others [10]. *Salacia reticulate* has been found potent in preventions and amelioration of various metabolic disorders. It is observed that the preventive roles it plays against deleterious effects of cognitive and behavioural changes [11]. This indicates other prospective roles it can play on the nervous system. Hence, this study is being aimed to investigate the role of *Salacia reticulata* on aluminium chloride-induced cellular changes in the cerebral cortex of Wistar rats.

MATERIALS AND METHODS

Animals

The subjects we used in this experiment were male and female Wistar rats weighing 70 to 90g. They were purchased from the animal house of Bingham University, Karu, Nasarawa state, always kept at a standard condition of room temperature, and the research was conducted at the same venue. The Wistar rats were fed with mesh and water *adlithium*.

Experimental Protocol

The experimental protocol was approved by Bingham University Animal ethical committee. Fifteen Wistar rats were randomly divided into three groups of five animals each (n=5). Group A was administered with 2ml of distilled water, this served as normal control, Group B was administered with 65mg/kg $AlCl_3$ and animals in Group C were administered with 65mg/kg $AlCl_3$ + 250mg/kg BW extract *Salacia reticulata*. Dried roots of *Salacia reticulata* (1 kg) was obtained from a market in Karu, Nasarawa, Nigeria were crushed and extracted (80°C, 3 h) with 10 L water 3 times according to the protocol of [12]. All administration was done orally using oral gavages for 14 days. On day 15 animals were humane sacrificed, and brain tissues were harvested for histological analysis.

Histological Analysis

The tissue sample (brain) was harvested and fixed in 10% formal calcium. Samples were taken for histological staining in the Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Samaru, Zaria. The tissues (brain) were stained using H&E for general histological architecture and specifically for neurological cells and fibers using Bielchowsky's silvers stain for neurons and neurofibrils. The slides obtained were mounted on a microscope and studied using an Olympus microscope. Photomicrographs were taken using a digital camera (Amscope, MD 900) placed in an Olympus microscope eye piece and image were taken using an application installed in a Dell laptop Latitude 2120.

RESULTS

The image for plate I (Group A) shows a normal cellular profile of the cerebral cortex (**Figure 1**), while that of plate II (Group B) indicates degeneration of the cerebral cortex (**Figure 2**) and that of plate III (Group C) shows a full recovery of cellular and neutrophil (PC) (**Figure 3**). Plate IV (Group A; normal) photomicrograph of the cerebral cortex normal pyramidal cell (**Figure 4**). Plate V (Group B) shows the degeneration of pyramidal cell (**Figure 5**). Plate VI (Group C) shows the recovery of the pyramidal cells (**Figure 6**).

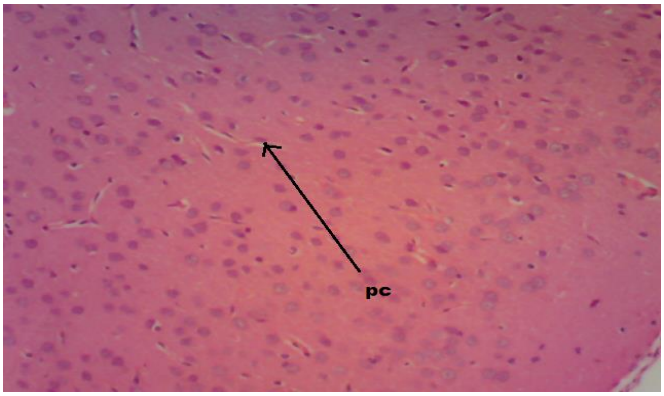

Figure 1. Plate 1: Photomicrograph of the cerebral cortex Group A, normal cellular profile (PC) (H&E)100

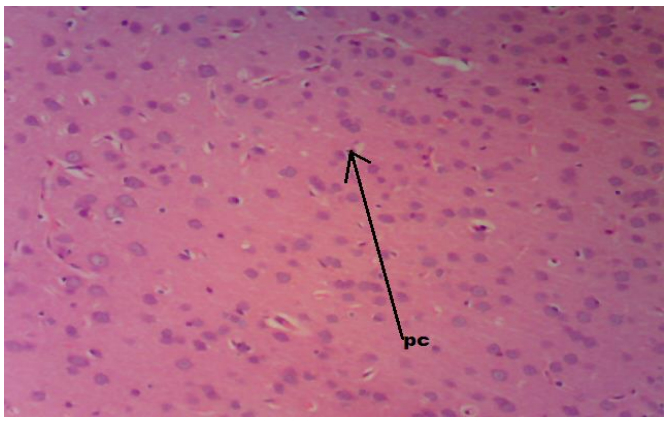

Figure 2. Plate 2: Photomicrograph of the cerebral cortex Group B, degeneration of cellular and neutrophil profile (PC) (H&E)×100

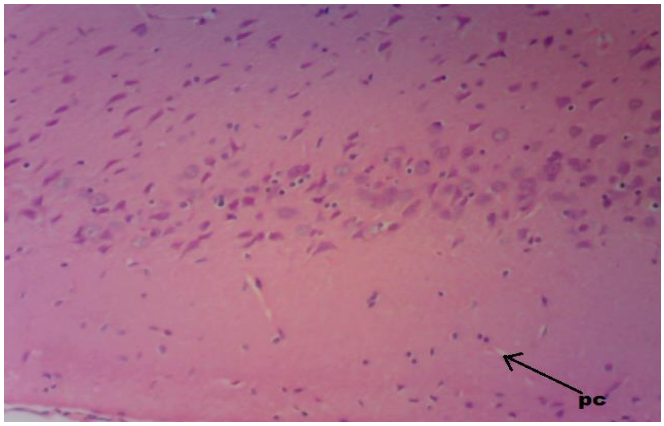

Figure 3. Plate 3: Photomicrograph of the cerebral cortex group C, shows a full recovery of cellular and neutrophil (PC) (H&E)100

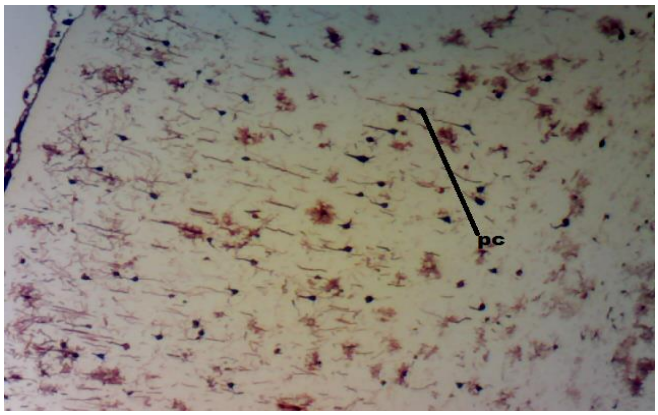

Figure 4. Plate 4: Photomicrograph of the cerebral cortex Group A (control), normal pyramidal cell (PC) (H&E)×100

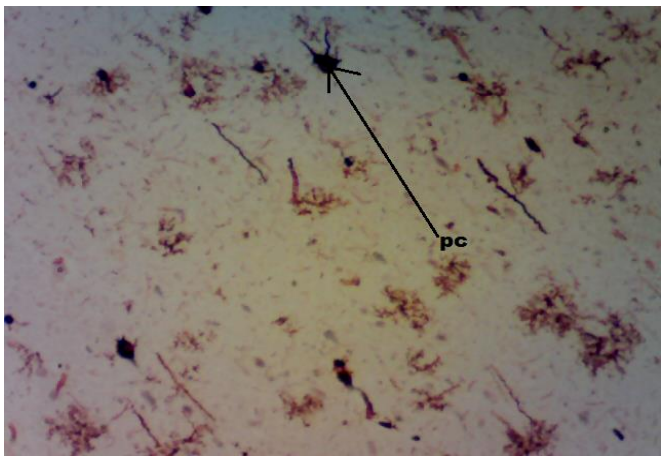

Figure 5. Plate 5: Photomicrograph of the cerebral cortex Group B, degeneration of pyramidal cell (H&E)100

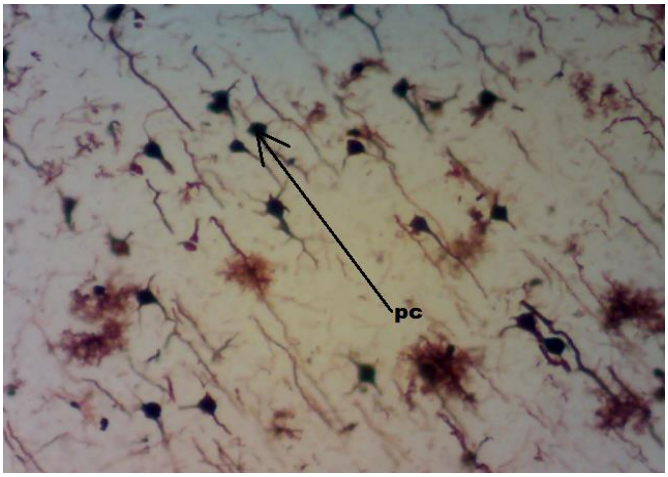

Figure 6. Plate 6: Photomicrograph of the cerebral cortex Group C, recovery of the Pyramidal cells (PC), (H&E)×100

DISCUSSION

Aluminum chloride ($AlCl_3$) is a potent neurotoxic compound that can cross the blood-brain barrier via iron-binding protein, transferrin [13, 14]. It is being implicated in several neuropathological alterations. It is observed memory deficits and biochemical and pathological alterations in rats exposed for 25 days to $AlCl_3$ [5]. It increases the presence of atrophied and karyorrhetic cells with loss of Nissl substance in the temporal cortex of rats as an indication of nervous degeneration [6]. It results in oxidative and nitrosative stress in the cerebral cortex, hippocampus, and striatum of rats [7]. Considering its deleterious effect on the nervous system and the unavoidable exposure to $AlCl_3$, there is a need to combat this threat through affordable natural products like herbs. One herb that has proven to be beneficial based on availability and therapeutic advantage is *Salacia reticulata* [15], it has been observed to ameliorate histological change of hepatocytes in rats [16]. In this study aluminum chloride induces degeneration in plate II (Group B) cells of the cerebral cortex; however, in the group treated with *Salacia reticulata* (Group C) plate III, it was observed to revert the degeneration of the neuron of the cerebral cortex and this agrees with the findings from the study of [17, 18]. In plate V (Group B), it shows degeneration of pyramidal cells when treated with *Salacia reticulata* (Group C) plate VI shows the recovery of the pyramidal cells [19].

CONCLUSION

In conclusion, the result from this study has shown that aluminum chloride alters neuronal cells of the cortex; however, this alteration can be reverted through the administration of aqueous extract of *Salacia reticulata* in a dose dependent manner.

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Declaration of interest: Authors declare no competing interest.

Data availability: Data generated or analysed during this study are available from the authors on request.

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