Impacts of Aluminium Chloride in Locomotion and Motor Coordination and the Protective Effects of Hippophae Salicifolia

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Abstract

The present study was to investigate the toxic impacts of aluminium chloride in locomotion and motor coordination in Wistar rats and to evaluate the protective effects of hydro alcoholic extract of fruit pulp of Hippophae salicifolia D. Don. (HAHS). Wistar Albino rats were assigned into four groups (n=6) and were administered respectively the vehicle, aluminium chloride 300 mg/kg (Aluminium chloride is proven to induce oxidative stress), HAHS 400 mg/kg (To check the impacts of extract on locomotion and motor co-ordination if any), aluminium chloride 300 mg/kg + HAHS 400 mg/kg respectively for 21 days (HAHS is already been proven to be effective against aluminum toxicity at the dose of 400mg/kg by combating oxidative stress). The animals were evaluated for their locomotion and motor coordination abilities using Actophotometer and Rota rod apparatus respectively.No significant toxic effects were observed on locomotion and motor coordination with chronic administration of aluminium chloride. Since the toxic impact of aluminium chloride was not prominent, HAHS has no significance in combating the impairments.

Keywords: Locomotion, Motor Co-ordination, Aluminium Chloride

1. INTRODUCTION

Aluminum is ubiquitous in environment and one of the trace elements with a moderate toxic effect on living organism. Chronic exposition to this trace element can cause alterations in skeletal, nervous, haematopoietic and respiratory systems [1-4].

Sources of aluminium include deodorants, baby wipes, skin creams, suntan lotions, toothpaste, aluminium cans, foils, containers, baking powder, cake mixes, frozen dough, pancake mixes, self-rising flour, grains and **processed cheese.**

With increasing industrialization and urbanization, the chemicals for industrial use as well as domestic purposes have increased many folds. Aluminium as metal has replaced many other metals like copper for use in appliances of many kinds. Salts of aluminium are also used in many industries and environmental pollution due to their discharge into air and ground water has increased. Reports related to aluminium toxicity are many, which include memory loss, biochemical changes etc.

Indian traditional system of medicine especially Aurveda has got many medicinal plants that are used in poisoning due to various causes. *Hippophae salicifolia* has been quoted to possess many medicinal properties which include immunomodulatory, anti-oxidant, anti-bacterial activity, and is used to treat coronary heart diseases, skin disorders and gastric ulcers. Apart from impacts consequent to exposure to chemicals, food and lifestyle play a vital role in determining the health of human.

Serum aluminum correlates with encephalopathy; red cell aluminium correlates with microcytic anemia, and bone aluminium correlates with bone disease. It is a commonly exposed neurotoxin and possesses multiple mechanisms of action on the central nervous system (neurodegenerative disorders like Parkinson and Alzheimer's diseases, encephalopathy) [5, 6]. Aluminium-induced neurotoxicity is well known and different salts of aluminium have been reported to accelerate oxidative damage to biomolecules like lipids, proteins and nucleic acids [7].

Administration of aluminium chloride solution in drinking water (80 mg/L) to rats for three months resulted in statistically significant increase in blood serum urea and creatinine concentrations.

Aluminum chloride was reported to cause a decrease in the size of testes, seminal vesicle and epididymis weights, sperm concentration, motility, testosterone level and the activities of 17-ketosteroid reductase, CAT and GST, and GSH content [8].

Considering these facts, the present study has been designed to investigate the toxic impacts of aluminium in locomotion and motor co-ordination and to study the protective effect of HAHs on biological changes caused by aluminium.

1.1 *Hippophae salicifolia*

Hippophae salicifolia D. Don *(H. salicifolia)* is a deciduous, usually spinescent, shrubs-tree species belonging to the family of Elaeagnaceae. It is distributed in the southern slope of Himalayan Mountain, Bhutan, Nepal, India [9]. *H. salicifolia* is willow-like small tree with height 6 to 10 m [10].

Ripe berries are orange/red in color and have diameter of 10–15 mm with soft, fleshy edible outer tissue enclosing a hard seed. The berries are rich in vitamins, polyphenols, organic acids and bioactive lipids. It also has a wide spectrum of

physiological effects of berries including inhibition of oxidation of low-density lipoprotein (LDL), antioxidant and immunomodulation effects.[9, 10]

The fruit is a natural source of vitamin A and several other carotenes, vitamin E and several other tocopherols and flavonoids. The vitamin C content of the juice ranges from 300 to 1600 mg per 100gm of juice [11,12]. Quercetin, kaempherol, and isorhamnetin are the major flavonoid compounds reported in berries [13].

In the traditional systems of medicine, the juice of the fruit was used to relieve cough, aid digestion, invigorate blood circulation, treat lung complaints, tuberculosis and alleviate pain. Bark and leaves were used for treating diarrhea and dermatological disorders like wounds and ulcers [14].

1.2 Plant material

The plant material was collected from north Sikkim, India during November 2009. It was authenticated by taxonomist and the voucher specimen (#MG-3/10) was deposited at Institute of Pharmacology, Madras Medical College, Chennai for reference.

Preparation of hydroalcoholic extract: Fruit pulp was shade dried and pulverized to coarse powder using conventional grinder. Extraction was done in a soxhlet extractor using ethanol and water in the ratio of 80:20. The extracts were filtered and the filtrate was concentrated under reduced pressure (yield 52.3% w/w). The extract was stored in a refrigerator at 4˚C till further use. The extract solution was prepared in double distilled water in concentration of 250 mg/mL.

Preparation of Aluminium chloride solution: Aluminium chloride solution was prepared in a concentration of 100 mg/ml in double distilled water.

2. METHODOLOGY

The work has been designed to study the toxic impacts of aluminum on locomotion and motor co-ordination and to evaluate the protective effect of hydroalcoholic pulp extract of *Hippophae salicifolia*. The present study was conducted after obtaining the approval of the experimental protocol by the Institutional Animal Ethics Committee and CPCSEA (PROPOSAL NO: 01/ 038/2010, dated 1st June 2009). This protocol met the OECD Guidelines for testing of chemicals. All rats used in this study were procured from Central Animal House Facility, Dr. A. L. M. Post Graduate Institute of Basic Medical Sciences, Taramani, Chennai (Reg No: 205/CPCSEA)

2.1. Experimental animals: Group 1 received double distilled water and served as Control. Group II received 300 mg/kg body weight of aluminium chloride and served as positive control. Group III received HAHs 400 mg/kg body weight (In order to differentiate any influence of HAHs on Locomotion and motor co-ordination). Group IV received aluminium chloride (300 mg/Kg) and hydroalcoholic extract of pulp of *Hippophae salicifolia* (400 mg/Kg) [15].

2.2. Administration of doses: The HAHs and aluminum chloride were administered in the form of solution with double distilled water using 16 gauge oral feeding tube for 21 days daily.

2.3. Evaluation of Motor Co-ordination [16]

i) Rotarod: The test is used to evaluate the activity of drugs interfering with motor co-ordination. The skeletal muscle relaxation induced by a test compound could be evaluated by testing the ability of mice or rats to remain on the revolving rotarod**.** The apparatus consists of a horizontal metal rod, attached to motor with the speed of 15 rotations per minute (rpm). Experimental rats were tested for normal motor co-ordination prior to test drug administration. They were administered with desired dose of aluminium chloride, test drug and both orally. After 1 hour, animals were placed on the rotarod for 3 mins. The "fall off" time was counted.

k) Photoactometer: The locomotor activity can be an index of alertness and mental activity. The locomotor activity can be easily measured using photoactometer. Photoactometer operates on photoelectric cells (Digital photoactometer) which are connected in circuit with a counter, when a beam of light falling on the photo electric cell is "cut off" by the movement of the animal, a count was automatically recorded. All the drug treated animals were individually placed in the locomotor activity chamber. The movements were recorded over a period of 3 mins.

Experimental rats were tested for normal motor co-ordination prior to test drug administration. They were administered with desired dose of aluminium chloride, test drug and both orally and evaluated on 7th, 14th and 21st day of treatment.

RESULTS AND DISCUSSION

The mean of motor co-ordination activity of all the study groups is shown in figure 1. There was no statistical significant difference in motor co-ordination in all groups and also no statistical significant difference in motor co-ordination within the groups on comparing with 0 day.

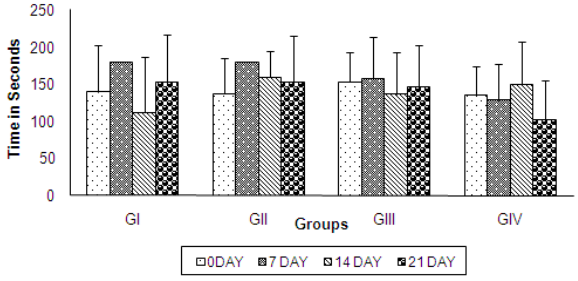

Fig 1. Mean motor co-ordination activity

Figure 2 shows the mean of motor activity in all the study groups at 0,7th, 14th, & 21st days. There was no statistical significant difference in motor activity in all groups and also no statistical significant difference in motor activity within the groups on comparing with 0 day.

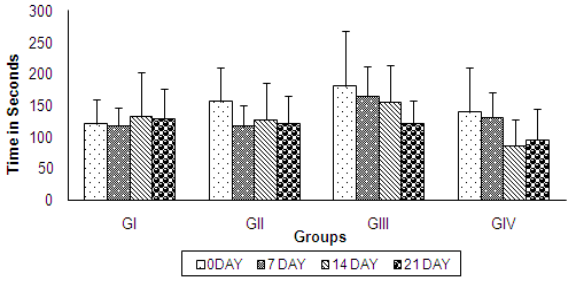

Fig 2. Mean motor activity

Investigations to screen for the influence of aluminium on motor activity and motor co-ordination are indicative of absence of any toxic impact. No significant change was seen in these aspects after treatment with *Hippophae salicifolia* also. However considering the short duration of the present study, a longer duration study is required to get concrete information regarding the impact of aluminium chloride and the information regarding the long-term effect of *Hippophae salicifolia*.

3. CONCLUSION

Chronic administration of aluminium chloride is known to produce oxidative stress but no impairments were observed in locomotion and motor coordination with the present study. Short duration of the study is postulated to be cause of the absence of any toxic impacts of aluminum in locomotion and motor co-ordination which necessitates for further study of long duration.

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