ASSESSMENT OF TOXICITY OF ALUMINUM FLUORIDE ON SOME SELECTED HEMATOLOGICAL PARAMETERS OF MALE WISTAR RATS

Dharmendra Pratap Singh and Kusum Kushwah*
Department of Zoology, Agra College, Agra, Uttar Pradesh
Email: drkusumkushwaha@gmail.com

Date of Received 26 November, 2021
Date of Revised 13 December, 2021
Date of Acceptance 25 December, 2021
Date of Publication 31 December, 2021

DOI: https://doi.org/10.51514/JSTR.3.4.2021.12-15
ASSESSMENT OF TOXICITY OF ALUMINUM FLUORIDE ON SOME SELECTED HEMATOLOGICAL PARAMETERS OF MALE WISTAR RATS

Dharmendra Pratap Singh and Kusum Kushwah*
Department of Zoology, Agra College, Agra, Uttar Pradesh
Email: drkusumkushwaha@gmail.com

ABSTRACT

Aluminum fluoride has the potential to improve the bioavailability of water to humans. The elimination of aluminum from the body is extremely slow [Varner et al., (1994)]. The half-life of total body aluminum was estimated to be 7 years for humans and reflects the redistribution of bone reserves. (Yokel et al., 2001). Aluminum may be a neurotoxin at levels as low as 0.08 ppm (Hewitt et al., 1990) and also has an impact on hematology (Turgut et al., 2007). The relationship between fluoride and aluminum and their effects on hematological parameters is a concern that has not been extensively investigated. There were 30 male rats in this study. Fifteen who were used because the treatment group was given a combination of aluminum fluoride. Treatment of mice with aluminum fluoride (AIF₃, 200 mg/kg body weight/day) for 30 days caused marked hematological changes within the Erythrocyte Sedimentation Rate (ESR), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and mean Corpuscular Hemoglobin Concentration (MCHC). Result also observed that very same hematological parameters decreased levels of MCH and MCHC and increase level of ESR and MCV. The rise in ESR and MCV are significant. Our determinations on AIF₃ revealed that several toxic effects on animal hematology.

Keywords: Aluminum Fluoride, ESR, MCV, MCH, MCHC

INTRODUCTION

Aluminum is that the most broad distributed trivalent caution generally found in ionic form in most varieties of plant, animal, tissue and in natural water. Aluminum metal primarily in the kind of alloys with other metals has many uses, including in cooking utensils, food packing and consumer appliances [1, 2]. Aluminum has no known biological functions [3]. Aluminum enters within the physique by food (cheese, banking powers, cake mixes), Air, water, drugs and pharmaceutical products and particularly antacids. Industrial companies are increasing the bioavailability of aluminum as a result of the continued acidification of the environment. Today, aluminum has been identified as a neurotoxic representative [4, 5]. Aluminum has also been shown to be non-essential to human metabolism at any concentration [6]. It has been reported that aluminum causes progressive neurologic disorders in learning and memory, while impairing motor function [7]. The half-life of aluminum removal in the brain is estimated to be more than 100 days, which could explain the neuro degeneration from aluminum [8]. Varner found that the binding of aluminum to fluoride can increase the bioavailability of aluminum through drinking water in humans [9]. Administration of fluorine and aluminum in potable at the same time increased plasma aluminum levels in rats [10]. Fluoride may be a loaded non-metallic halogen that will be obviously presented in water, soil and rocks [11]. Fluoride can also be added unnaturally to the potable, which is the most important source of fluoride for human consumption in conjunction with fluoridated dental products [11]. After consumption, fluoride is absorbed through the gastrointestinal tract, circulates through the body and is primarily haunted by mineralized tissues and a lesser extent by soft tissues. The remaining quantity is excreted mostly in the urine [12]. The prolonged ingestion of fluoride from different sources, primarily drinking, led to fluorosis [13]. Chronic fluorosis may be a worldwide trouble both in personalities and animals [14, 15]. The issue of excess fluorine in drinkable is a recent issue in most parts of India. Fluoride is commonly found in minerals and geochemical deposits and is typically released to subsurface reference waters through slow natural degradation of fluorinated rocks. Long-term ingestion of high concentrations of fluoride causes a variety of
pathological changes in all over organs and tissues [16].

**MATERIALS AND METHODS**

Healthy adult Albino rats (*Rattus Norvegicus*) weighing in the midst of 130g to 150g were obtained for experiments.

**Collection of experimental animals**
The colony of albino rats were breed in the animal house of Zoology Department, School of life science, Dr. Bhimrao Ambedkar University, Agra. The animals were placed in polypropylene cages measuring 12”x10”x8” with sawdust to soak the excretory fluids and expelled debris. Cages offered enough spaces for movement under controlled environmental conditions with sufficient light, darkness and the temperature ranges from 22 ± 2c. There was a standard diet for rats & were fed hardened maize, wheat and ad libitum water. Static bioassays were used to determine their value [17, 18].

**Experimental Compound**
Aluminum Fluoride (AIF$_3$) purchased from local laboratory chemical suppliers.

IUPAC Name:- Aluminum Fluoride
Synonyms:- Aluminum Fluoride and Aluminum Trifluoride
Molecular weight:- 83.98
Molecular formula:- AlF$_3$

**Structural formula:**

\[
\begin{array}{c}
F \\
\text{Al} \\
F
\end{array}
\]

**Dose of Experimental Chemical**
Composed of aluminum fluoride used as an investigational chemical. The dose will be administered daily via the oral route using a hypodermic syringe attached to the angular needle. 1/5 part of the Lethal Dose 50 (LD$_{50}$) dose will be taken. [Chinoy *et al.*, (2000)] Aluminium fluoride: 200 mg/kg bw [Chinoy *et al.*, (2004)]

**Experimental protocol**
Thirty rats were randomized and evenly distributed into two groups in a control group and a second treated group. The control rats were able to have free access to clean water for the entire duration of the experiment. The 1$^{st}$ group of albino rats were treated as control group for 7, 15 and 30 days, while next groups of albino rats were treated with aluminum fluoride for 7, 15 and 30 days respectively.

**Hematology**
Blood was obtained in 10% Ethylenediamine tetraacetic acid (EDTA) solution from all the groups at every sacrifice for the calculation of the total of below tests.

- Erythrocyte Sedimentation Rate (ESR)
- Mean Corpuscular Volume (MCV)
- Mean Corpuscular Hemoglobin (MCH)
- Mean Corpuscular Hemoglobin Concentration (MCHC)

Absolute counts were also calculated. Tubes were labeled properly to avoid confusion.

**Statistical analysis:**
The data shall be expressed in the form of an ± S.E. average (standard error). The ‘t’ test or ANOVA will be used for analyzing the statistical significance among the groups.

**RESULT AND DISCUSSION**

**ERYTHROCYTE SEDIMENTATION RATE**
(a) Control groups: The erythrocyte sedimentation rate in the control group ranged from 0.86-1.90 with an average of 1.19 mm/hr (Table-I).
(b) Treated groups: The erythrocyte sedimentation rate in the aluminum fluoride treated groups after 7 days ranged from 2.10-4.30 with an average of 3.39 mm/hr, after 15 days aluminum fluoride water ingested treated group ranged from 2.10-5.20 with an average of 5.10 mm/hr, after 30 days Aluminum fluoride water ingested treated ranged from 8.24-12.12 with an average of 9.22 mm/hr; (Table-I).

**MEAN CORPUSCULAR VOLUME**
(a) Control groups: The mean corpuscular volume in the control group ranged from 65.27-72.00 with an average of 70.10 fl (Table-II).
(b) Treated groups: The mean corpuscular volume in the aluminum fluoride treated groups after 7 days ranged from 57.50-80.97 with an average of 73.15 fl, after 15 days aluminum fluoride water ingested treated group ranged from 68.33-81.33 with an average of 74.00 fl , after 30 days Aluminum fluoride water ingested treated ranged from 66.35-72.64 with an average of 68.44 fl; (Table-II).
**MEAN CORPUSCULAR HAEMOGLOBIN**

(a) Control groups: The mean corpuscular hemoglobin in the control group ranged from 21.50-25.10 with an average of 23.20 pg (Table-III).

(b) Treated groups: The mean corpuscular hemoglobin in the aluminum fluoride treated groups after 7 days ranged from 19.10-25.80 with an average of 23.50 pg, after 15 days aluminum fluoride water ingested treated group ranged from 24.35-26.32 with an average of 24.62 pg, after 30 days Aluminum fluoride water ingested treated ranged from 21.00-25.50 with an average of 23.50 pg, (Table-III).

**MEAN CORPUSCULAR HAEMOGLOBIN CONCENTRATION**

(a) Control groups: The mean corpuscular hemoglobin concentration in the control group ranged from 32.50-35.50 with an average of 34.00 g/dl (Table-IV).

(b) Treated groups: The mean corpuscular hemoglobin concentration in the aluminum fluoride treated groups after 7 days ranged from 29.50-34.50 with an average of 31.10 g/dl, after 15 days aluminum fluoride water ingested treated group ranged from 29.66-35.75 with an average of 32.89 g/dl, after 30 days Aluminum fluoride water ingested treated ranged from 32.50-34.50 with an average of 33.33 g/dl (Table-IV).

---

**Table 1:** Erythrocyte Sedimentation Rate (Esr) In Blood Of Albino Rat After Aluminum Fluoride Intoxication

<table>
<thead>
<tr>
<th>S.No.</th>
<th>No. of Albino rats</th>
<th>Experimental Period</th>
<th>ESR (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Control</td>
<td>0.86-1.90</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>7 days aluminum fluoride</td>
<td>2.10-4.30</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>15 days aluminum fluoride</td>
<td>2.10-5.20</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>30 days aluminum fluoride</td>
<td>8.24-12.12</td>
</tr>
</tbody>
</table>

± S.Em. = Standard Error of mean.

* = non significant; ** = significant; *** = highly significant; **** = very highly significant

\( (p \geq 0.05) \quad (p \leq 0.05) \quad (p \leq 0.01) \quad (p \leq 0.001) \)

**Table 2:** Mean Corpuscular Volume (MCV) In Blood Of Albino Rat After Aluminum Fluoride Intoxication

<table>
<thead>
<tr>
<th>S.No.</th>
<th>No. of Albino rats</th>
<th>Experimental Period</th>
<th>MCV (fl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Control</td>
<td>65.27-72.00</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>7 days aluminum fluoride</td>
<td>57.50-80.97</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>15 days aluminum fluoride</td>
<td>68.33-81.33</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>30 days aluminum fluoride</td>
<td>66.35-72.64</td>
</tr>
</tbody>
</table>

± S.Em. = Standard Error of mean.

* = non significant; ** = significant; *** = highly significant; **** = very highly significant

\( (p \geq 0.05) \quad (p \leq 0.05) \quad (p \leq 0.01) \quad (p \leq 0.001) \)

**Table 3:** Mean Corpuscular Hemoglobin (MCH) In Blood Of Albino Rat After Aluminum Fluoride Intoxication

<table>
<thead>
<tr>
<th>S.No.</th>
<th>No. of Albino rats</th>
<th>Experimental Period</th>
<th>MCH (pg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Control</td>
<td>21.50-25.10</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>7 days aluminum fluoride</td>
<td>19.10-25.80</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>15 days aluminum fluoride</td>
<td>24.35-26.32</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>30 days aluminum fluoride</td>
<td>21.00-25.50</td>
</tr>
</tbody>
</table>

± S.Em. = Standard Error of mean.

* = non significant; ** = significant; *** = highly significant; **** = very highly significant

\( (p \geq 0.05) \quad (p \leq 0.05) \quad (p \leq 0.01) \quad (p \leq 0.001) \)

**Table 4:** Mean Corpuscular Hemoglobin Concentration (MCHC) In Blood Of Albino Rat After Aluminum Fluoride Intoxication

<table>
<thead>
<tr>
<th>S.No.</th>
<th>No. of Albino rats</th>
<th>Experimental Period</th>
<th>MCHC (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Control</td>
<td>32.50-35.50</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>7 days aluminum fluoride</td>
<td>29.50-34.50</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>15 days aluminum fluoride</td>
<td>29.66-35.75</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>30 days aluminum fluoride</td>
<td>32.50-34.50</td>
</tr>
</tbody>
</table>

± S.Em. = Standard Error of mean.

* = non significant; ** = significant; *** = highly significant; **** = very highly significant

\( (p \geq 0.05) \quad (p \leq 0.05) \quad (p \leq 0.01) \quad (p \leq 0.001) \)
CONCLUSION

In this work observed that aluminium fluoride administration toxic effects on hematological parameters in male albino rats. The ESR (values of Erythrocyte sedimentation rate), The MCV (Mean corpuscular volume) increase and the MCH (Mean corpuscular hemoglobin), the MCHC (Mean corpuscular hemoglobin concentration) decrease compared to control group. This research shows various hematological diseases in rats like hematopoiesis.

REFERENCES


