



Article

# Effects of Fluoride Compounds on Blood Parameters of Calves

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**Abstract:** This article describes the toxic waste emitted from the Tajik Aluminum Plant, relevant literature data, and their comprehensive analysis. The effects of fluoride compounds on the organism of calves were studied, and the toxic dynamics and toxic kinetics of fluoride compounds in the calf organism were investigated. The relevance of the research topic is scientifically substantiated. Modern scientific research methods were applied to evaluate the morphological and biochemical parameters of calf blood. Based on experimental results, appropriate recommendations were developed to prevent fluoride intoxication. The purpose and objectives of the study were clearly defined. The article also includes conclusions and a list of references.

**Keywords:** Eco Toxicants, Soil, Water, Atmosphere, Intoxication, Morphological Parameters, Biochemical Parameters, Erythrocytes, Leukocytes, Hemoglobin, ALT, AST, Hydrogen Fluoride, Calcium Chloride, G/Kg, Ml/Kg

## 1. Introduction

### Relevance of the Study

Currently, the rapid development of industrial production worldwide has led to significant environmental pollution. As a result, ecologically unfavorable regions are expanding, negatively affecting the health of productive livestock raised in these areas. High concentrations of Eco toxicants in soil, water, atmosphere, and feed may disrupt metabolic processes in animals, cause changes in the immune and endocrine systems, and lead to pathological conditions in reproductive functions [1-2].

Fluoride compounds released as industrial waste from the Tajik Aluminum Plant have specific toxic effects on livestock depending on their concentration and regional distribution. These compounds exhibit toxic dynamic and toxic kinetic properties that contribute to chronic intoxication, metabolic disturbances, and pathological changes in animal organisms. Furthermore, the impact of fluoride contamination on livestock productivity, veterinary-sanitary quality of animal products, and the development of effective preventive and therapeutic measures represents an urgent scientific and practical challenge [3-4].

### Purpose of the Study

The purpose of this study was to investigate the effects of fluoride compounds on the morphological and biochemical blood parameters of calves under experimental conditions [5].

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## Objectives of the Study

To investigate the toxic dynamics and toxic kinetics of fluoride compounds in the organism of calves;

To evaluate the effectiveness of pharmacological preparations in the treatment and prevention of chronic fluoride intoxication in cattle.

## 2. Materials and Methods

The study was conducted on a specialized cattle farm, "Zuxriddin Rakhmon Farovon" located in Sariosiyo district, Surkhandarya region. A total of 15 calves under one year of age exposed to fluoride compounds were selected and divided into three groups, each consisting of five animals.

Blood samples collected from the calves were analyzed to determine morphological parameters using a BIOBASE BK-6190 hematology analyzer, while biochemical parameters were determined using a Mindray BA-88A semi-automatic biochemical analyzer.

### Experimental Design

*Group I (Experimental Group I):*

Five calves were administered orally:

- 2% calcium chloride solution at a dose of 1.0 ml/kg,
- Activated charcoal at a dose of 0.1 g/kg,
- Chlorella suspension at a dose of 2.5 ml/kg.

These substances were administered orally for 3 consecutive days, followed by a 3-day interval. This cycle was repeated twice.

### Group II (Experimental Group II):

*Five calves were administered orally:*

- 2% calcium chloride solution at a dose of 1.0 ml/kg,
- Azkamar bentonite at a dose of 0.5 g/kg,
- Sodium bicarbonate at a dose of 0.02 g/kg.

The treatment was administered orally for 3 consecutive days, followed by a 3-day interval, and repeated twice.

### Group III (Control Group):

Five calves served as the control group and were maintained on the standard farm diet without any pharmacological treatment throughout the study period.

## 3. Results and Discussion

According to the results of hematological analysis, chronic exposure to fluoride compounds caused significant changes in the morphological parameters of calf blood. At the beginning of the experiment, compared to the control group, the erythrocyte count decreased by 10.53%, hemoglobin concentration decreased by 14.77%, and leukocyte count increased by 16.58%. These findings indicate the negative impact of fluoride compounds on the hematological status of calves and confirm their hematotoxic effect [6].

Similarly, significant changes were observed in the biochemical parameters of blood in calves exposed to fluoride compounds. In comparison with the control group, the total protein concentration decreased by 15.5%, albumin by 19.8%, glucose by 8.85%, and total calcium by 12.11%. In contrast, total bilirubin increased by 44.69%, aspartate aminotransferase (AST) by 12.24%, alanine aminotransferase (ALT) by 16.20%, and inorganic phosphorus by 13.10%. These changes indicate metabolic disturbances, impaired liver function, and disruption of mineral metabolism caused by fluoride intoxication [7-8].

In the first experimental group, calves treated with calcium chloride, chlorella suspension, and activated charcoal for 3 days, repeated twice with 3-day intervals, demonstrated significant improvements in hematological parameters by the end of the experiment. Compared to the control group, erythrocyte count increased by 4.59%, hemoglobin concentration increased by 4.27%, and leukocyte count decreased by 1.40% (Table 1) [9].

**Table 1.** Morphological blood parameters of calves exposed to fluoride compounds

Parameter	Control group	Fluoride-exposed calves (initial)	Experimental group I (CaCl <sub>2</sub> + chlorella + activated charcoal)	Experimental group II (CaCl <sub>2</sub> + sodium bicarbonate + bentonite)
Erythrocytes (×10 <sup>12</sup> /L)	7.12 ± 0.21	6.37 ± 0.19 ↓10.53%	6.66 ± 0.18 ↑4.59%	6.48 ± 0.20 ↑1.72%
Hemoglobin (g/L)	112.4 ± 2.8	95.8 ± 2.4 ↓14.77%	99.9 ± 2.6 ↑4.27%	98.7 ± 2.5 ↑3.01%
Leukocytes (×10 <sup>9</sup> /L)	8.32 ± 0.31	9.70 ± 0.35 ↑16.58%	9.56 ± 0.33 ↓1.40%	9.61 ± 0.34 ↓0.90%

Note: Values are expressed as mean ± standard deviation. Arrows indicate percentage increase (↑) or decrease (↓) compared to the previous stage.

In the second experimental group, calves treated with calcium chloride, sodium bicarbonate, and *Azkamar* bentonite showed moderate improvement in blood parameters. Erythrocyte count increased by 1.72%, hemoglobin concentration increased by 3.01%, and leukocyte count decreased by 0.90% [10-11].

These findings indicate that the pharmacoprophylactic combination used in the first experimental group, consisting of calcium chloride, chlorella suspension, and activated charcoal, was more effective in reducing the toxic effects of fluoride compounds [12].

Biochemical analysis of blood in the first experimental group showed improvements compared to the control group. Total protein increased by 1.22%, albumin by 4.34%, and glucose by 9.50%. At the same time, AST decreased by 1.65%, ALT by 4.69%, total bilirubin by 2.39%, total calcium by 3.22%, and inorganic phosphorus by 2.31%.

In the second experimental group, biochemical parameters showed less pronounced changes. Total bilirubin increased by 8.13%, glucose increased by 5.88%, and AST increased by 1.39%, while ALT decreased by 3.39%. Other biochemical parameters showed no significant changes [13].

**Table 2.** Biochemical blood parameters of calves exposed to fluoride compounds

Parameter	Control group	Fluoride-exposed calves (initial)	Experimental group I	Experimental group II
Total protein (g/L)	68.5 ± 1.8	57.9 ± 1.5 ↓15.5%	58.6 ± 1.6 ↑1.22%	58.1 ± 1.7
Albumin (g/L)	34.2 ± 1.1	27.4 ± 0.9 ↓19.8%	28.6 ± 1.0 ↑4.34%	27.8 ± 0.8
Glucose (mmol/L)	3.95 ± 0.12	3.60 ± 0.11 ↓8.85%	3.94 ± 0.13 ↑9.50%	3.81 ± 0.12 ↑5.88%
Total bilirubin (µmol/L)	8.12 ± 0.24	11.75 ± 0.32 ↑44.69%	11.47 ± 0.30 ↓2.39%	12.71 ± 0.34 ↑8.13%
AST (U/L)	78.4 ± 2.3	88.0 ± 2.6 ↑12.24%	86.5 ± 2.4 ↓1.65%	89.2 ± 2.7 ↑1.39%
ALT (U/L)	32.1 ± 1.0	37.3 ± 1.2 ↑16.20%	35.6 ± 1.1 ↓4.69%	36.0 ± 1.2 ↓3.39%

Total calcium (mmol/L)	2.42 ± 0.08	2.13 ± 0.07 ↓12.11%	2.20 ± 0.07 ↑3.22%	2.16 ± 0.08
Inorganic phosphorus (mmol/L)	1.68 ± 0.05	1.90 ± 0.06 ↑13.10%	1.86 ± 0.06 ↓2.31%	1.88 ± 0.05

The morphological and biochemical blood parameters of calves exposed to fluoride compounds are presented in Tables 1 and 2. The results showed a significant decrease in erythrocyte count, hemoglobin concentration, total protein, albumin, glucose, and calcium levels, while leukocyte count, bilirubin, AST, ALT, and inorganic phosphorus levels increased. These changes indicate hematotoxic, hepatotoxic, and metabolic effects of fluoride compounds [14].

Treatment with calcium chloride, chlorella suspension, and activated charcoal resulted in significant improvement in both morphological and biochemical parameters, demonstrating the effectiveness of this pharmacoprophylactic combination in reducing fluoride toxicity [15].

Overall, the obtained results demonstrate that the use of calcium chloride, chlorella suspension, and activated charcoal is effective in preventing and reducing the toxic effects of fluoride compounds in calves exposed to chronic fluoride intoxication.

#### 4. Conclusion

Chronic exposure to hydrogen fluoride at a concentration of 0.11 mg/m<sup>3</sup> resulted in significant hematological and biochemical changes in calves. Compared to the control group, erythrocyte count decreased by 10.53%, hemoglobin by 14.77%, total protein by 15.5%, albumin by 19.8%, glucose by 8.85%, and total calcium by 12.11%. Meanwhile, leukocyte count increased by 16.58%, total bilirubin by 44.69%, AST by 12.24%, ALT by 16.20%, and inorganic phosphorus by 13.10%. These findings confirm the hematotoxic and metabolic effects of fluoride compounds in calves.

The administration of pharmacoprophylactic agents, including 2% calcium chloride solution (1 ml/kg), chlorella suspension (2.5 ml/kg), and activated charcoal (0.01 g/kg), administered orally for 3 days and repeated twice with 3-day intervals after 50 days of age, demonstrated high effectiveness in preventing and reducing fluoride intoxication in calves.

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