



# IMPACT OF CAMEL'S MILK ON ALUMINUM CHLORIDE TOXICITY INDUCED ON SOME HEMATOLOGICAL PARAMETERS OF RATS

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## Abstract

The present study was carried out to evaluate the efficiency of camel's milk to ameliorate the toxicity of aluminum chloride  $AlCl_3$  on some hematological parameters. Forty rats were divided into 5 treatment groups (8 rats each) : Group1 : Normal rats (negative control); Group2:  $AlCl_3$  induced toxicity rats (positive control); Group3:  $AlCl_3$  induced toxicity rats fed with raw camel milk; Group4:  $AlCl_3$  induced toxicity rats fed with heat treated camel milk; and Group5:  $AlCl_3$  induced toxicity rats fed with sweet acidophilus camel milk. Rats were treated by 5ml camel's milk 10 min before the administration of 1 ml  $AlCl_3$  (0.5 mg/kg body weight) and had their respective doses daily for 30 successive days orally.  $AlCl_3$  oral administration resulted in a significant decrease in red blood cells count (RBC's), significant increase in mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH); while hemoglobin (Hb), hematocrite (Hct), platelets(plt), reticulocytes (Ret), mean corpuscular hemoglobin concentration (MCHC) did not revealed significant changes; the obtained anemia was macrocytic normochromic.

**Key words:** aluminum chloride, camel's milk ,red blood cells.

## Introduction

Aluminum (Al), the third most abundant element of the Earth's crust, is found in combination with oxygen, silicon, fluorine and other elements in the soil, rocks, clays and gems; nonessential and toxic metal in humans (Schetinger *et al.*, 2003). With the industrialization and consequent pollution, Al is increasingly taken into our bodies through foods, air, water and even drugs(Kim *et al.*, 2001). Food is the primary common source of Al; include yellow cheese, salt, herbs, spices, tea leaves, food additives (El-Demerdash 2004). The use of Al and its compounds in processing (cooking utensils and containers); wrappings, packaging (Al foil); storage of food products (almost 95% beverage cans), cosmetics and toothpaste may contribute to its presence (Greger 1992, Abbasali *et al.*, 2005). Al compounds are widely used in medicine *e.g.*, antacids, phosphate binders, buffered aspirins, vaccines and allergen injections (Kaehany *et al.*, 1977). Al has been recognized to be toxic for humans and animals and is involved in the

etiology of some diseases(Abdel-Wahab 2012). Chronic exposure to Al ions may result in mood changes, dysmnnesia, convulsions, muscular weakness, pathological fractures of bones. Al accumulates mainly in bones, spleen, liver and lungs (Chen *et al.*, 2002). Daily injections of Al into rats produced severe anemia within 2-3 weeks (Magieu *et al.*, 2000). Al has a direct effect on hematopoiesis (Wills and Savory 1983). Al-induced damage to body organs has been reported in several studies which pointed out the toxic effect of  $AlCl_3$  such as hepatotoxicity, nephrotoxicity and neurotoxicity (Ibraheem *et al.*, 2016).

Fresh camel milk and its products are a good bioactive adjuvant for the people living in the arid and semiarid areas. Awareness and utilization of camel milk as health adjuvant are gradually increasing as the camel milk has been found to have unique properties of its proteins, fatty acids, richer in microminerals and vitamin C compared to milks of other animal species, such as bovine milk. Fresh and fermented camel milk are reported for

improving immunity and provides particular health benefits to the consumer depending on the unique bioactive substances in milk (Singh *et al.*, 2017). It has high concentration of iron which makes it panacea for those who have iron deficiency anemia. Camel milk is unique from other ruminant milk in terms of composition as well as functionality. Moreover, it is also used for its potential therapeutic properties such as efficacy against diabetes and cancer as well as having anti-hypertensive properties (Sakandar *et al.*, 2018).

This study aims to evaluate the effectiveness of camel's milk towards the induced toxicity of aluminum chloride  $AlCl_3$  on some hematological parameters.

## Materials and Methods

### Materials

- Aluminum Chloride anhydrous 98% ; M.W. 133.34 ( Alpha Chemika India) El-Gomhouria Co. For Trading Chemicals and Medical Appliances (Egypt).

- Dromedary camel milk fresh and frozen (Animal Production Research Institute, Agricultural Research Center, Dokki, Giza, Egypt).

### Animals and Experimental diets

Forty male Sprague – dawely albino rats were obtained from Animal House at Food Technology Research Institute, Agricultural Research Center, Giza , Egypt .Rats weighing (200-250 g) were housed in plastic cages under standard condition temperature (25-27°C, humidity 30-70% and 12 hour light/dark cycles) and fed with standard pellet diet and water ad libitum. All rats were fed on basal diet for one week before starting the experiment (acclimatization period). The basal diet consisted of corn starch (60%), casein (20%), corn oil (10%), cellulose (5%), salt mixture (4%) and 1% vitamin mixture (Lane-Peter and Pearson 1971).

### Animal Grouping and Experimental Design

The rats were divided into five groups comprising 8 rats in each group as follows:

Group1: Negative control rats (normal, fed with basal diet only)

Group2: Positive control rats ( $AlCl_3$  induced toxicity)

Group3:  $AlCl_3$  induced toxicity rats fed with raw camel milk.

Group4:  $AlCl_3$  induced toxicity rats fed with heat treated camel milk (72! for 15 sec. and cooling)

Group5:  $AlCl_3$  induced toxicity rats fed with sweet acidophilus camel milk (10% of starter culture added to heat treated camel milk).

Daily  $AlCl_3$  oral dose given to rats was 1 ml  $AlCl_3$  (0.5 mg/kg body weight) (Al-Hashem 2009). Rats were treated by 5ml camel's milk 10 min before the administration of 1 ml  $AlCl_3$ . Rats received a single dose of the selected treatment daily; and had their respective doses for 30 successive days orally by using a cavage needle. Twenty Four hours after the last administration fresh blood samples were collected from orbital plexus venous into heparinized test tubes for hematological analysis. A second blood fraction was collected without anticoagulant into centrifuge tubes and the serum was separated into eppen dorf tubes and stored at -20°C for analysis. Then the animals were sacrificed and some organs were collected for histopathological examination.

All the experiment was approved by the ethical committee of Cairo University in accordance with the guidelines of the National Institute of Health (NIH) for the care and use of laboratory animals in scientific investigations.

### Haematological Studies

The evaluated hematological parameters in this study included estimation of red blood cells (RBC's), hemoglobin concentration (Hb), hematocrite (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin ( MCH), mean corpuscular hemoglobin concentration (MCHC), reticulocytes counts (Retics) and blood platelets (plt). These parameters were performed according to the adopted routine haematological procedures (Feldman *et al.*, 2000).

### Statistical Analysis

Data were analyzed by means of one way (ANOVA) using the software statistical program (SPSS, *ver.* 16, USA). Data are expressed as the mean  $\pm$  SE and results were statistically significant at  $p \leq 0.5$  (SPSS 2008).

### Results

Results of erythrogram, blood platelets and reticulocytes are shown in table 1 and Figs. 1-3, revealed a significant difference in Hb, RBC's, Hct, MCV, MCH, MCHC between different groups, while platelets and reticulocyte count showed no differences. Referring to the obtained data we can deduce that:

Relative to control group 1;

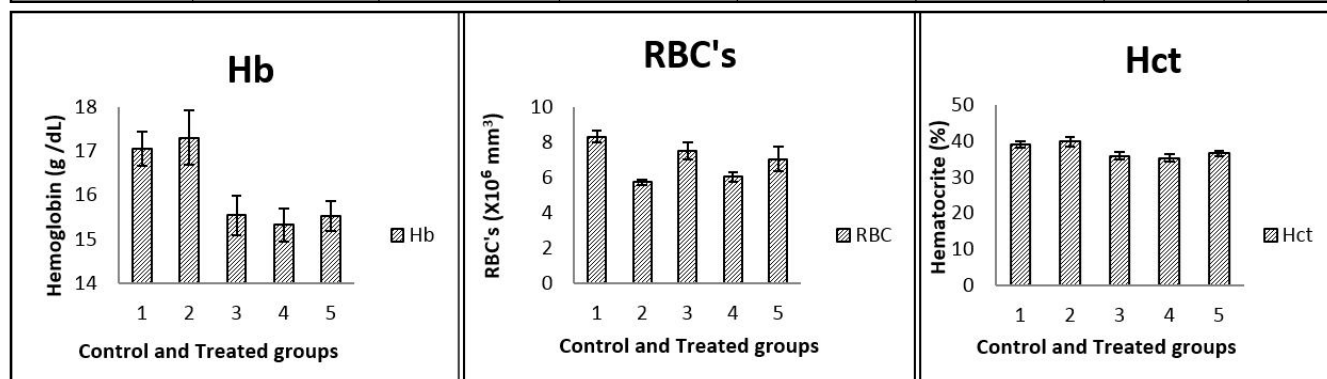
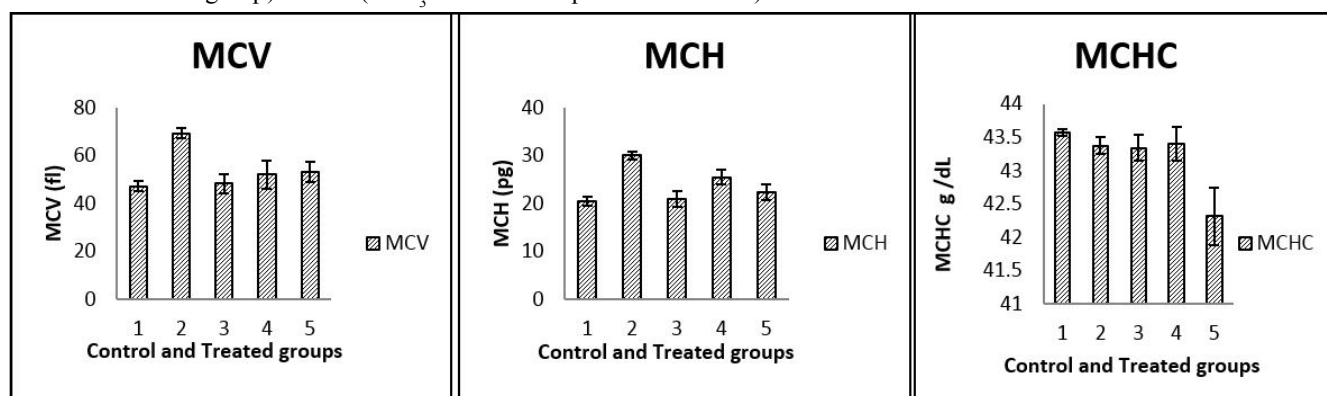
- RBC's of groups 2, 3, 4 and 5 is lower by 30.9%, 9.7%, 27.5%, 15.2% respectively.

- MCV of groups 2, 3, 4 and 5 is higher by 46.9%, 2.5%, 10.5%, 12.6% respectively.

- MCH of groups 2, 3, 4 and 5 is higher by 46.2%, 2.02%, 24.4%, 9.2% respectively.

**Table 1:** Results of erythrogram, blood platelets and reticulocyte count in control and treated Rats.

Biochemical test	G1	G2	G3	G4	G5	Prop.	LSD
Hemoglobin (g/dL)	17.05 <sup>a</sup> ±0.389	17.31 <sup>a</sup> ±0.611	15.55 <sup>b</sup> ±0.455	15.33 <sup>b</sup> ±0.374	15.53 <sup>b</sup> ±0.348	0.0292 S at p ≤ 0.05	1.470
RBC's (X10 <sup>6</sup> mm <sup>3</sup> )	8.33 <sup>a</sup> ±0.327	5.76 <sup>b</sup> ±0.152	7.52 <sup>a</sup> ±0.455	6.04 <sup>b</sup> ±0.262	7.06 <sup>ab</sup> ±0.678	0.0104 S at p ≤ 0.05	1.410
Hematocrite (%)	39.13 <sup>ab</sup> ±0.848	39.90 <sup>a</sup> ±1.408	35.88 <sup>bc</sup> ±1.050	35.33 <sup>c</sup> ±0.974	36.70 <sup>abc</sup> ±0.734	0.0424 S at p ≤ 0.05	3.351
MCV (fl)	47.20 <sup>b</sup> ±2.077	69.34 <sup>a</sup> ±2.152	48.40 <sup>b</sup> ±3.884	52.17 <sup>b</sup> ±6.018	53.16 <sup>b</sup> ±4.115	0.0064 S at p ≤ 0.01	11.10
MCH (pg)	20.57 <sup>c</sup> ±0.917	30.08 <sup>a</sup> ±0.882	20.98 <sup>c</sup> ±1.699	25.58 <sup>b</sup> ±1.474	22.46 <sup>bc</sup> ±1.595	0.0031 S at p ≤ 0.01	4.493
MCHC g/dL	43.57 <sup>a</sup> ±0.055	43.38 <sup>a</sup> ±0.126	43.34 <sup>a</sup> ±0.193	43.41 <sup>a</sup> ±0.252	42.32 <sup>b</sup> ±0.436	0.0256 S at p ≤ 0.05	0.767
Platelets (x10 <sup>9</sup> /L)	409.75 <sup>a</sup> ±22.295	292.25 <sup>a</sup> ±19.598	384.50 <sup>a</sup> ±58.506	399.00 <sup>a</sup> ±29.637	318.00 <sup>a</sup> ±56.006	0.2587 ns	130.9
Reticulocyte count %	3.00 <sup>a</sup> ±0.220	2.90 <sup>a</sup> ±0.058	3.20 <sup>a</sup> ±0.071	3.13 <sup>a</sup> ±0.155	3.08 <sup>a</sup> ±0.103	0.4054 ns	0.341

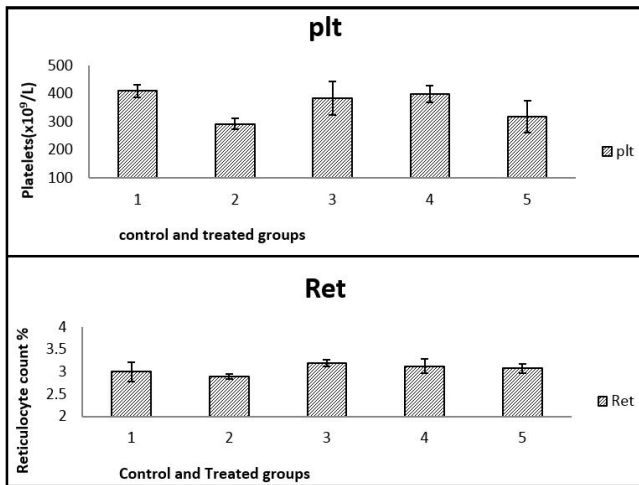
**Fig. 1:** Effect of Aluminum and different oral camel milk treatments on Hemoglobin concentration; Red Blood Cells count; Hematocrite %. G1 (control group), G2 (AlCl<sub>3</sub> treated group), G3 (AlCl<sub>3</sub> + raw camel milk group), G4 (AlCl<sub>3</sub> + heat treated camel milk group) and G5 (AlCl<sub>3</sub> + sweet acidophilus camel milk).**Fig. 2:** Effect of Aluminum and different oral camel milk treatments on Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC). G1 (control group), G2 (AlCl<sub>3</sub> treated group), G3 (AlCl<sub>3</sub> + raw camel milk group), G4 (AlCl<sub>3</sub> + heat treated camel milk group); and G5 (AlCl<sub>3</sub> + sweet acidophilus camel milk).

Relative to AlCl<sub>3</sub> group 2:

· RBC's of groups 3, 4 and 5 is higher by 30.6%, 4.8%, 22.6% respectively.

· MCV of groups 3, 4 and 5 is lower by 30.2%, 24.8%, 23.3% respectively.

· MCH of groups 3, 4 and 5 is lower by 30.2%, 14.9%,



**Fig. 3:** Effect of Aluminum and different oral camel milk treatments on Blood Platelets and Reticulocyte count. G1 (control group), G2 (AlCl<sub>3</sub> treated group), G3 (AlCl<sub>3</sub> + raw camel milk group), G4 (AlCl<sub>3</sub> + heat treated camel milk group); and G5 (AlCl<sub>3</sub> + sweet acidophilus camel milk).

25.3% respectively.

The following bar charts is showing the degree of alterations in some hematological parameters that induced by oral administration of AlCl<sub>3</sub> (group2) and the alleviating degree of different oral camel milk treatments by (groups 3, 4, 5) compared to the control (group1).

### Discussion

Aluminum in its metallic form has many useful roles, such as in construction, packaging and transport vehicles. Aluminum salts are included in pharmaceuticals, processed foods and vaccines to enhance their qualities. Many cities use aluminum sulfate or poly aluminum chloride to clarify their drinking water. According to the World Health Organization, aluminum additives are the main source of exposure for most humans (Walton 2011).

Camel milk is full of balanced nutritional constituents and also displays a wide variety of biological actions that influence growth and development of particular body organs, metabolic responses towards nutrients absorption, digestion and fight against diseases (Korhonen and Pihlanto-Leppala 2001).

The present study was carried out to evaluate the efficiency of camel's milk to ameliorate the toxicity of AlCl<sub>3</sub> on some hematological parameters.

Our results showed a significant decrease in red blood cells count (RBC's), significant increase in mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH)  $5.76 \pm 0.152$ ,  $69.34 \pm 2.152$ ,  $30.08 \pm 0.882$ , respectively in AlCl<sub>3</sub> group compared with the control group values that were  $8.33 \pm 0.327$ ,

$47.20 \pm 2.077$ ,  $20.57 \pm 0.917$ , respectively; while hemoglobin (Hb), hematocrite (Hct), platelets (plt), reticulocytes (Ret), mean corpuscular hemoglobin concentration (MCHC) did not revealed significant changes between two groups; the obtained anemia was macrocytic normochromic. Similar results more or less were reported in a previous studies (Osman *et al.*, 2012), which denoted that AlCl<sub>3</sub> had led to a significant decrease ( $P < 0.05$ ) in red blood cells count (RBCs), hemoglobin (Hb), mean corpuscular hemoglobin concentration (MCHC), hematocrite (Hct) and iron level and a significant increase in the mean cell volume (MCV) and no significant change in the platelets (plt); while another study (Al-Hashem 2009), showed that oral AlCl<sub>3</sub> treatment caused a significant decrease ( $P < 0.05$ ) in red blood cells count (RBCs), blood hemoglobin (Hb) and hematocrite (Hct), whereas the values of mean corpuscular volume (MCV), mean hemoglobin concentration (MHC), mean corpuscular hemoglobin concentration (MCHC) didn't change. The differences between records may be due to the experimental design adopted by the investigator. Administration of camel's milk with AlCl<sub>3</sub> significantly increased red blood cells count (RBCs) and decreased mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) compared with the results in rats orally administered AlCl<sub>3</sub> alone. Thus brought the altered blood parameters to near normal levels. The obtained macrocytic normochromic anemia (megaloblastic - pernicious anemia) may be due to vitamin B<sub>12</sub> deficiency (Aslinia *et al.*, 2006). The term macrocytosis is a disease in which not enough red blood cells are produced therefore red blood cells (RBC) are larger than normal so macrocytosis is reported in terms of mean corpuscular volume (MCV).

### Conclusion

Indeed, it could be concluded that total oral administration camel's milk at a dose of 5 ml camel's milk 10 min before the administration of AlCl<sub>3</sub> alleviated its toxic effect. We can suggest that the best treatment was raw camel milk group followed by sweet acidophilus group, while the last one was the thermally treated camel milk. Therefore, supplementation with camel milk may be useful as a protective therapy in cases intoxication with aluminum.

### Conflict of interest

The authors declared that present study was performed in absence of any conflict of interest.

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### Author Contributions

All authors contributed equally in all parts of this study.

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