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Original article

The antiplatelet activity of camel milk in healthy and aluminum chloride-intoxicated rats

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ABSTRACT

This study examined the effect of camel milk on some marker of blood coagulation markers in aluminum chloride (ALCl₃)-treated rats. Rats (n = 6) were assigned as control, control + fresh camel milk (1 ml), ALCl₃ (0.5 mg/kg), and ALCl₃ + fresh camel milk (1 ml and 0.5 mg/kg, respectively). Treatments were conducted orally for 30 days and daily. Administration of camel milk to control and ALCl₃-intoxicated rats significantly increased platelet count, bleeding time, and collagen epinephrine (CEPI)-induced platelet aggregation. It also lowered plasma levels of thromboxane B2 and hepatic levels of glutathione (GSH) and the activities of antioxidant enzymes, catalase (CAT) and superoxide dismutase (SOD). While the treatment with camel milk has no effect on the liver structure, values of activated partial prothrombin time (aPPT), and levels of prothrombin time (PT) in control rats, it improved liver architectures and decreased serum levels alanine and aspartate aminotransferases (ALT and AST, respectively), and reduced values of both aPTT and PT in ALCl₃-intoxicated rats. In conclusion, camel milk inhibits platelets activity and aggregation in both control and ALCl₃-intoxicated rats.

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1. Introduction

The hemostatic system in mammals prevents excessive blood loss and spontaneous thrombosis by balancing the prothrombotic events with antithrombotic processes (Periyah et al., 2017). One major function of the liver is to regulate primary and secondary blood hemostasis by modulating the synthesis of clotting factors, coagulation inhibitors, and fibrinolytic protein (Forkin et al., 2018). Therefore, liver dysfunction leads to thrombocytopenia, platelet dysfunction, and impaired coagulation of either severe bleeding or unexpected thrombosis (Munoz et al., 2009; Periyah et al., 2017).

Exposure to heavy metals can directly affect blood hemostasis by promoting liver damage (Al-hashem, 2009). Aluminum (Al⁺³) hepatic toxicity is well established in both animals and humans

(Al-hashem, 2009). Exposure to Al⁺³ ions has dramatically increased during the last decades due to its high abundance in the environment and drinking water, as well as many industrial and food products (Al-hashem, 2009). These include yellow cheese, tea, spices, corn, food additives, drugs, toothpaste, in-household cookware, and storage utensils (Al-hashem, 2009). Although Al⁺³ ions are non-redox metals, they can cause hepatic damage by substituting other trace elements, thereby inhibiting metabolic and antioxidant enzymes, promoting oxidative stress, and triggering cell damage and death (Belaïd-Nouira et al., 2012; Exley and Medicine, 2004). In addition, Al + 3 ions intoxication is associated with some hematological disturbances and microcytic anemia in both animals and humans (Al-hashem, 2009; Short et al., 1980). Despite this extensive research, the impacts of exposure to Al + 3 ions on primary and secondary hemostasis are poorly described. The only available *in vitro* evidence has shown that physiological levels of Al⁺³ could potentiate sodium fluoride (NaF)-induced platelet aggregation (Rendu et al., 1990), whereas at higher levels, it induced lipid peroxidation-induced platelet aggregation, independently of NaF (Neiva et al., 1997).

Nonetheless, camel milk has many beneficial health effects by acting as strong antibacterial, antiviral, antifungal, anti-hepatitis properties (Al-Juboori et al., 2013; Mihic et al., 2016). Besides, camel milk ameliorated diverse chronic and infectious disorders

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such asthma, as diabetes, hypertension, jaundice, Autism, diarrhea, leishmaniasis, and dropsy (Swelum et al., 2021). Also, dietary intake of camel milk attenuated hepatitis B and hepatitis C in patients (Saltanat et al., 2009). In addition, camel milk prevented oxidative stress-induced hepatic, neural, renal, and cardiac damage in a several animal models exposed to heavy metals and toxins (i.e. carbon tetrachloride, cadmium chloride, and aluminum) by scavenging reactive oxygen species (ROS) and upregulation of antioxidants (Al-hashem, 2009; Althnaian, 2012).

Of note, the effect of $AlCl_3$ intoxication and camel milk on primary and secondary hemostasis remain largely unknown. Given its well-known hepatotoxicity, in this study, we assumed that $AlCl_3$ intoxication can adversely affect the hemostasis process in rats whereas the administration of camel milk can alleviate this. Also, we aimed to investigate the hemostatic effect of camel milk in control healthy.

2. Materials and methods

2.1. Animals

Both males and females Wistar rats (250 ± 17 g) were included in this study. All animals were supplied from and maintained at the animal house of King Khalid University (KKU), Abha, KSA. Housing conditions were always maintained constant at 22 ± 2 °C and humidity of $55 \pm 3\%$. All animals were housed also under a 12-h light/dark cycle and had free access to their diet and drinking water. All procedures included in this study such as treatments, blood sampling, anesthesia, tissue collection, and other experiments were approved by the animal ethical committee at the College of Medicine of KKU (REC # 2015-03-02).

2.2. Experimental design

Rats were divided into groups ($n = 6$ /group) as follows: 1) a control group: orally administered normal saline, as a vehicle; 2) **camel milk treated group**: orally administered freshly collected camels milk (1 ml) (Al-hashem, 2009; Althnaian, 2012); 3) **an $AlCl_3$ -intoxicated group**: orally administered $AlCl_3$ solution (0.5 mg/kg) (Al-hashem, 2009); and 4) **An $AlCl_3$ + camel milk-treated group**: orally administered 0.5 mg/kg $AlCl_3$ saline solution and 1 ml of camel milk. All treatments were conducted for 30 days and daily. In a separate positive control group to measure platelets function and aggregation, an additional group was also added ($n = 6$) and received normal saline (NS) for the first 23 days (1 ml/kg) and then administered aspirin (25 mg/kg) for the remaining 7 days on daily basis (**aspirin-treated group**).

2.3. Measurement of bleeding time (BT)

On day 30, BT was measured as previously shown by Shatoor et al. (2012). In brief, concourse rats were restrained in plastic cylindrical restrainers and their tails were exposed, maintained in warm isotonic saline (37 °C), and cut at the tip. BT was measured and identified as the time required for the bleeding to stop.

2.4. Collection of sera and biochemical measurements

All rats were then anesthetized with ketamine (80 mg/kg) and blood samples (0.5 ml each) were withdrawn into EDTA or serum-collecting tubes. All samples were then centrifuged at 3000 rpm (5 min) to isolate the supernatants (serum or plasma, respectively) which were transferred to new tubes. All serum samples were kept at -20 °C and used later to measure levels of alanine and aspartate aminotransferase (ALT and AST, respectively)

(Human Co., Germany), as well levels of thromboxane B2 (TXB2) (Cat. No. 900-002, Stressgen, Ann Arbor, MI, USA) as per the supplier's instructions. EDTA-blood tubes were used directly for routine hematological analysis using Beckman Coulter (model DxH 690 T) as per the manufacturer's instruction.

2.5. Collection of citrated blood samples

The chest of all rats was then opened and 3 ml of blood were withdrawn from the abdominal aorta into a sodium citrate-filled tube. Citrated tubes were then forwarded to the coagulation lab (within 1 h after collection) and used to study platelets aggregation and other coagulation assays.

2.6. Platelet function analyzer (PFA-100) assay (aggregation)

Platelet function in all collected samples was assessed using a PFA-100 analyzer (Dade Behring Inc., Miami, FL, USA) as described by the manufacturer and explained by others (Shatoor et al., 2012). In the test, platelets adhesion and aggregation are induced by exposure to adenosine diphosphate (ADP) or collagen epinephrine (CEPI) and the closure time (CT) is measured. Values more than 300 sec were considered non-closure. The normal values for CT are 84–198 sec and 52–153 sec for the ADP and CEPI, respectively.

2.7. In vitro anticoagulation assay

Another blood sample was withdrawn in sodium citrate-containing tubes and used directly to measure the time intervals of both the prothrombin time (PT) and activated partial thromboplastin time (aPTT). Briefly, the collected blood was centrifuged at (3000 rpm/10 min/4 °C) and platelet-poor plasma was obtained. This plasma was stored immediately at -20 °C. Values of both PT and aPTT were measured with the help of a special analyzer (model CA-1500, Sysmex Corporation, Kobe, Japan) following the supplier protocol.

2.8. Liver collection and preparation of homogenates

Directly after blood collection, livers from all rats were dissected out on ice, washed with phosphate buffered saline PBS (pH 7.4), and kept at -80 °C. To prepare cell homogenates, liver samples (40 mg) were homogenized in 500 μ l PBS, centrifuged (10000 rpm/10 min/4 °C) to get the supernatants. At the same time, other parts of freshly collected livers were fixed in buffered formalin and used later for histological evaluation.

2.9. Hepatic biochemical analysis

Hepatic levels of thiobarbituric acid reactive substances (TBARS) were measured using a commercially available kit (cat. no. NWK-MDA01, NWLSS, USA). Hepatic levels of total reduced glutathione (GSH) were determined using a colorimetric kit (cat. no. ab156681, Abcam, UK). Hepatic activities of catalase (CAT) and superoxide dismutase (SOD) activities were measured using commercial kits from (cat. no. K773- K335-100, Biovision, CA, USA respectively) according to manufacturer's instruction and were presented as U/mg tissue.

2.10. Histopathological studies

Freshly-collected liver samples were fixed for 24 h in 10% buffered formalin. Ascending concentrations of alcohol (100–70%) were used to deparaffinized the tissues. The tissues were then embedded in a paraffin, cut at 5 μ M, and routing stained with

hematoxylin and eosin (H &E) (Al-hashem, 2009). All slides were examined and photographed under light microscope at 200x.

3. Results

3.1. Camel milk prevents AlCl₃-induced reductions in RBC's count and Hb levels

The effect of AlCl₃ on red blood cells (RBCs), hemoglobin (Hb) levels, and blood indices including mean cell volume (MCV), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC) are shown in Table 1. While daily administration of camel milk for consecutive 30 days didn't affect RBC's count, Hb levels nor any of the blood indices. On the other hand, daily administration of AlCl₃ for the same period significantly lowered both RBC's count and Hb levels in intoxicated rats without altering the levels of MCV, MCH, and MCHC, as compared to control rats, received the vehicle. However, concomitant administration of camel milk with AlCl₃ for 30 days significantly increased RBC's count and restored Hb levels as compared to AlCl₃-intoxicated rats (Table 1). Although RBC's count remained slightly but significantly lower than its levels measured in the control rats, Hb levels in AlCl₃ + camel milk were returned to their normal levels detected in the control rats.

3.2. Camel milk increases platelet count, prolongs bleeding time (BT), induces platelets aggregation, and inhibits TBXB2 release in both control and AlCl₃-intoxicated rats

Platelets function was assessed by measuring BT, whole blood platelets count and plasma levels of TBXB2 (Fig. 1) whereas platelets aggregation was studied by measuring closure time (CT) after collagen-ADP (CADP-CT) or collagen-epinephrine (CEPI-CT) induced aggregation (Fig. 2). In this part of the experiments, aspirin was used as a positive control. In comparison to control received the vehicle, administration of camel milk to control rats significantly increased platelet count, prolonged BT, and significantly reduced plasma levels of THXB2 (Fig. 1). It also increased the time needed to measure CEPI-CT (42.9%) without altering the time needed to measure CADP-CT (Fig. 2), indicating inhibition of platelets activity and aggregation. On the other hand, AlCl₃ didn't affect platelets count but significantly decreased BT and significantly enhanced TBX-B2 levels (Fig. 1). Concomitantly, AlCl₃ only and significantly reduced CEPI-CT, indicating an acceleration of aggregation (Fig. 2). On the contrary, groups of rats that received aspirin as a positive control had increased BT, reduced TBX-B2 levels (Fig. 1), and slightly reduced CADP-CT but showed significant increases in CEPI-CT, indicating inhibition of aggregation (Fig. 2). As compared to AlCl₃-intoxicated rats, AlCl₃ + camel milk-treated rats had shorter BT, less TBXB2 levels (Fig. 1), and significant increases in values of CEPI-CT (Figs. 1 and 2). ANOVA analysis revealed that all measured parameters were returned to their normal levels measured in the control group except that of THXB2 which remained slightly but significantly lower.

Table 1

Red blood Cells (RBC's) count, Hemoglobin (Hb) levels and blood indices in all experimental groups.

Parameter	Control	C. milk	AlCl ₃	AlCl ₃ + C. milk
RBC's (X10 ⁶)/mm ³	8.46 ± 0.30	8.18 ± 0.43	5.56 ± 0.46 ^{ab}	7.28 ± 0.48 ^{abc}
Hb (g/dl)	49.2 ± 2.1	46.5 ± 4.5	32.1 ± 2.7 ^{ab}	44.9 ± 3.4 ^c
MCV (fl)	57.4 ± 1.8	58.1 ± 2.9	57.4 ± 5.5	61.6 ± 3.1
MCH (pg)	18.0 ± 0.6	18.96 ± 0.5	18.30 ± 1.1	18.84 ± 1.0
MCHC (g/dl)	31.1 ± 0.9	33.3 ± 1.5	32.1 ± 3.1	30.6 ± 2.6

Values are presented of means ± SD (n = 6/each). ^a:vs. control group. ^b: vs. camel milk-treated control group (C. milk). ^c: vs. AlCl₃-treated group.

3.3. Cadmium chloride resorts PT and aPTT values in AlCl₃-intoxicated rats

Administration of camel milk to control rats didn't affect the time needed to measure both prothrombin time (PT) and activated prothrombin time (aPTT) (Fig. 3). However, significant increases in both PT and aPTT were noticed in rats intoxicated with AlCl₃ indicating prolonged clotting as compared to the control group. On the other hand, concomitant administration of camel milk along with AlCl₃ significantly restored PT and aPTT to their normal levels seen in the control rats (Fig. 3).

3.4. Camel milk enhances hepatocytes antioxidant potential in both control and AlCl₃-intoxicated and reduces serum levels of ALT and AST in the serum of AlCl₃-intoxicated rats

While administration of camel milk to control rats didn't affect serum levels of ALT and AST (Fig. 4), it significantly lowered hepatic levels of TBARS and significantly increased hepatic levels of GSH and activities of SOD and CAT (Fig. 5). Administration of AlCl₃ to rats for 30 consecutive days significantly raised serum levels of ALT and AST, increased hepatic levels of TBARS, and reduced hepatic levels of GSH and activities of SOD and CAT (Figs. 4 and 5). On the contrary, co-administration of camel milk with AlCl₃ for the same period significantly restored liver enzymes (ALT and AST) (Fig. 4) to their basal levels, lowered hepatic levels of TBARS, and increased hepatic levels of GSH and activities of SOD, as compared to their levels measured in AlCl₃-intoxicated rats (Fig. 5).

3.5. Camel milk restores the liver structure in AlCl₃-intoxicated rats

Histologically, animals of the control groups that received the vehicle or camel milk had a normal liver structure with normal hepatocytes, sinusoids, and central veins. (Fig. 6, A&B, respectively). AlCl₃-intoxicated rats showed severe degeneration in most of the hepatocytes with moderate-severe constricted and congestive central vein (with some degeneration) and severe swelling of the hepatocytes. Many nuclei showed pyknosis (shrunken and dark satin) and some of them underwent karyolysis (dissolution) with the loss of cellular integrity (Fig. 6, C). However, the liver section of AlCl₃ + camel milk showed significant improvements in their architectures like those seen in control rats (Fig. 6, D).

4. Discussion

This study tested if sub-acute administration of AlCl₃ can adversely affect the rat's hemostasis system and examined whether co-treatment with camel milk can prevent it. Also, the effect of camel milk alone on parameters of blood hemostasis in control healthy rats was investigated.

Confirming our hypothesis, AlCl₃ lowered RBC's count, induced severe hepatic damage, and enhanced hepatic oxidative stress in treated model rats. In association, it increased THXB₂ release and shortened the bleeding time (BT) and platelets aggregation, thus confirming a state of platelets hyperactivity and hyper-

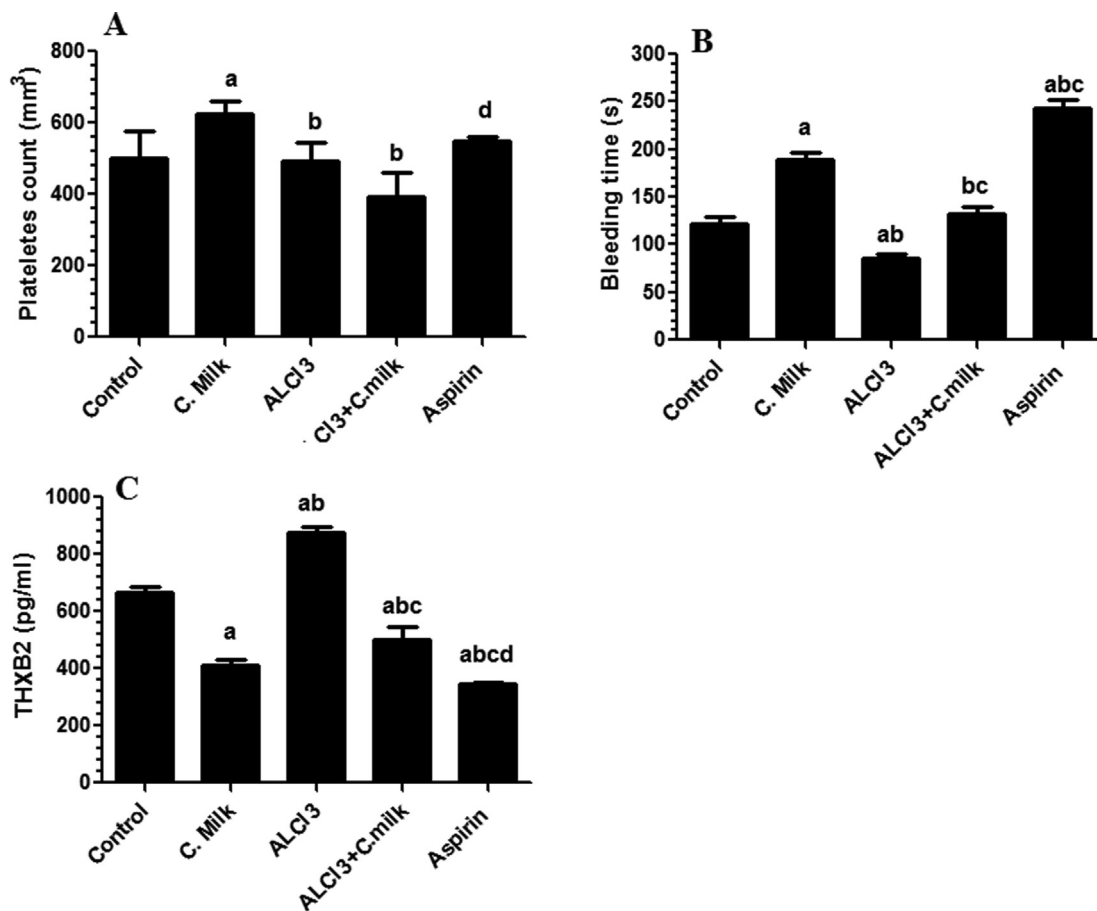


Fig. 1. Whole blood platelets (A) count and bleeding time (BT, B) as well as plasma thromboxane B2 levels (C) in all experimental groups. Values are presented of means ± SD (n = 6/each). ^a:vs. control group. ^b: vs. camel milk-treated control group (C. milk). ^c: vs. AICl₃-treated group.

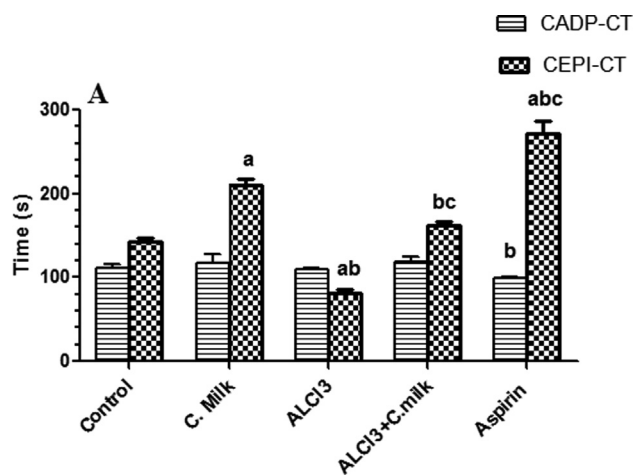


Fig. 2. Results of the PFA-100 test obtained from all groups of rats in all experimental groups. Values are presented of means ± SD (n = 6/each). ^a:vs. control group. ^b: vs. camel milk-treated control group (C. milk). ^c: vs. AICl₃-treated group.

aggregation. Also, AICl₃ prolonged intervals of PT and aPTT, thus suggesting hypercoagulation. Meanwhile, without having any adverse effect on the liver architectures in control healthy rats, treatment with camel milk to healthy or AICl₃-intoxicated rats improved hepatic activities of SOD, CAT, boosted levels of GSH levels, increased platelets count, and had an antiplatelet activity

as confirmed by the decreases in THXB₂ levels and prolonged BT and inhibited platelets aggregation. Interestingly, all the hemostatic effects afforded by camel milk in control rats were comparable but less profound to those treated with aspirin. In addition, but only in the AICl₃-intoxicated rats, camel milk restored normal liver architectures and RBC's count and shortened levels of PT and aPTT indicating a protection against AICl₃-induced oxidative stress damage and hypercoagulation.

In this study, repetitive administration of a toxic dose of AICl₃ induced hepatotoxicity and necrosis as seen by the obvious liver damage and significant elevations in the levels of the transaminases, ALT and AST. Associated with this, we have found that AICl₃ exaggerated hepatic oxidative response by increasing levels of TBARS, suppressing the activities of SOD and CAT, and reducing GSH levels, suggesting the success of our model as shown previously by many authors (Al-hashem, 2009; Exley and Medicine, 2004). Also, we have found a significant decreases in RBC's count and Hb levels in AICl₃-intoxicated animals, indicating destruction of RBC's. Similar results were previously observed by Al-Hashem (Al-hashem, 2009). Indeed, although Al⁺³ is not a redox reactive metal, it can generates massive amount of ROS and induced tissue liver by its ability to substitutes for almost all trace elements by inhibiting antioxidant enzymes and altering pro-oxidant/antioxidant ratios (Al-Hashem et al., 2009; Mukke et al., 2012).

Interestingly, treatment with camel milk was able to prevent liver damage and the reduction in the RBC's count and Hb levels in the AICl₃-treated rats. In parallel, it resulted in a significant increment in the levels /activities of GSH, SOD, and CAT in the liv-

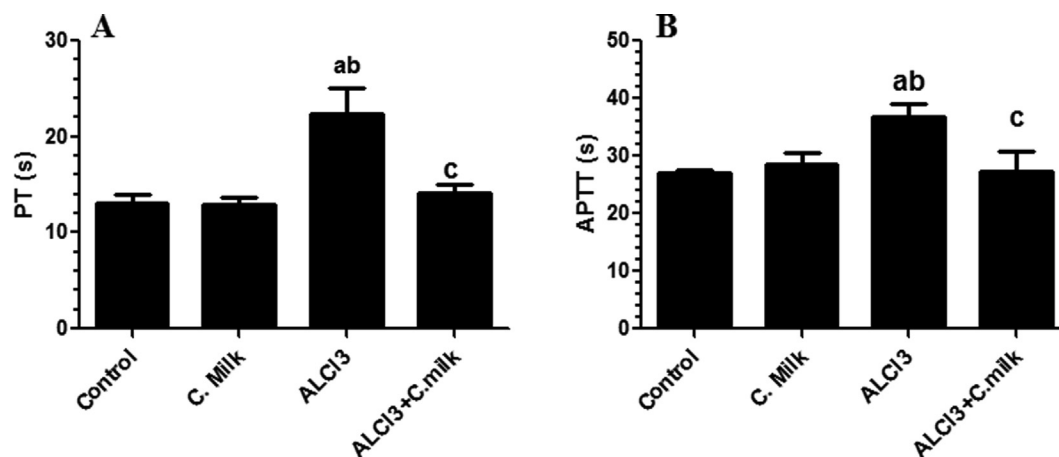


Fig. 3. Values of prothrombin time (PT, A) and activated prothrombin times (aPTT, B) in all experimental groups. Values are presented of means \pm SD (n = 6/each). ^a:vs. control group. ^b: vs. camel milk-treated control group (C. milk). ^c: vs. AlCl₃-treated group.

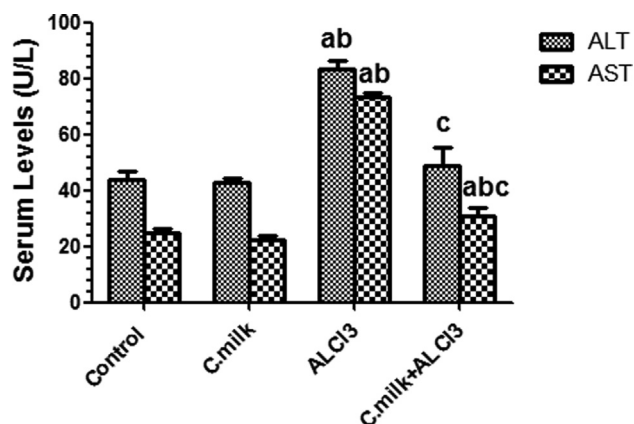


Fig. 4. Levels of circulatory transaminases (ALT and AST) (A&B) in all experimental groups. Values are presented of means \pm SD (n = 6/each). ^a:vs. control group. ^b: vs. camel milk-treated control group (C. milk). ^c: vs. AlCl₃-treated group.

ers of both healthy and AlCl₃-intoxicated rats treated or co-treated with camel milk, respectively, indicating a potent antioxidant abilities under normal conditions and hepatotoxicity.

This also supports many other studies in the literature which suggested the ability of camel milk to alleviate oxidative stress by reducing ROS and upregulation of antioxidants. In this context, Al-Hashem (Al-Hashem et al., 2009) have shown that camel milk can ameliorate both aluminum and CdCl₂-induced liver and testicular damage by boosting cellular antioxidant potential. In the same line, Dallak (2009) has shown that administration of camel milk prevents cadmium chloride induced-RBC's oxidative damage by suppressing ROS generation and increasing their antioxidant potential. This antioxidant power of camels milk was explained previously by the its high content of vitamins C and E and magnesium (Mg²⁺) which can protect cells by free radicals scavenging and boosting GSH levels and other antioxidants enzymes (Al-hashem, 2009; Dallak, 2009). It could be also that camel milk may prevent the hepatotoxic effect of AlCl₃ by chelating these heavy metals or increasing excretion as suggested by other authors (Al-hashem, 2009; Dallak, 2009).

Nevertheless, liver disease impairs primary hemostasis, an effect that depends on the cause, etiology, and severity of the liver damage (Munoz et al., 2009). In general, thrombopoietin is the major liver-derived hormone responsible for platelet production (Witters et al., 2008). The liver disease significantly lowers platelet

counts by decreasing the platelet production (Witters et al., 2008). In this study, platelets count remained unchanged in AlCl₃-intoxicated rats, despite the reported liver damage. This can be explained by the severity of the liver damage produced in our model using this AlCl₃ regimen procedure. In support, thrombocytopenia is less common in patients with acute liver failure as compared to those with chronic stages (i.e. cirrhosis) (Munoz et al., 2009). Interestingly, treatment with camel milk in control rats significantly increased platelet count in both the control and AlCl₃-treated rats. These data suggest a potential stimulatory effect of camel milk on renal thrombopoietin production. However, this can't be concluded based on our data and needs further research.

Primary homeostasis depends mainly on normal platelets count and function. Plug formation is the first event in primary hemostasis which requires platelet activation and aggregation (Forkin et al., 2018). Within this view, platelet activation is mediated by some agonists including collagen and thrombin, and is propagated by the release of platelet-derived ADP and TXA₂. In addition, platelet aggregation and formation of the plug require the bridging of fibrinogen and vWF. Hypoaggregability and platelets dysfunction is very common in patients and animal models with liver disorders who showed a decrease in collagen, thrombin, epinephrine, and ADP-induced aggregation (Laffi et al., 1988). In the same line, we are showing shortened BT and CEPI-CT in rats intoxicated with AlCl₃, indicating accelerated aggregation (hyper-aggregation). Also, AlCl₃ significantly decreased the release of THXB2 in these rats. These data completely contradict those expected to be seen in liver disease suggesting an independent effect of AlCl₃ to induced platelets hyperactivity and aggregation mainly mediated by increased THXB2 synthesis and /or secretions. Supporting our finding but in mechanisms not related to THX B2, it has Al³⁺ ions also potentiated NaF-elicited platelet aggregation (Rendu et al., 1990). Later, Independently of NaF, other authors reported that Al³⁺, at a higher concentration promoted platelet aggregation by the high generation of ROS and induction of platelets lipid peroxidation (Neiva et al., 1997). Indeed, superoxide and hydrogen peroxides are produced in the platelets and can induce platelet aggregation (Marcus et al., 1977).

However, a novel finding of our study is the significant increases in BT and CEPI-CT and the significant reduction in plasma levels of THXB2 in healthy rats or AlCl₃-intoxicated rats which were administered camel milk. These effects were comparable to those depicted by aspirin. This suggest that the antiplatelet activity of camel milk is mediated by suppressing THXB2 synthesis, which support other authors. Unfortunately, a limitation in this study is

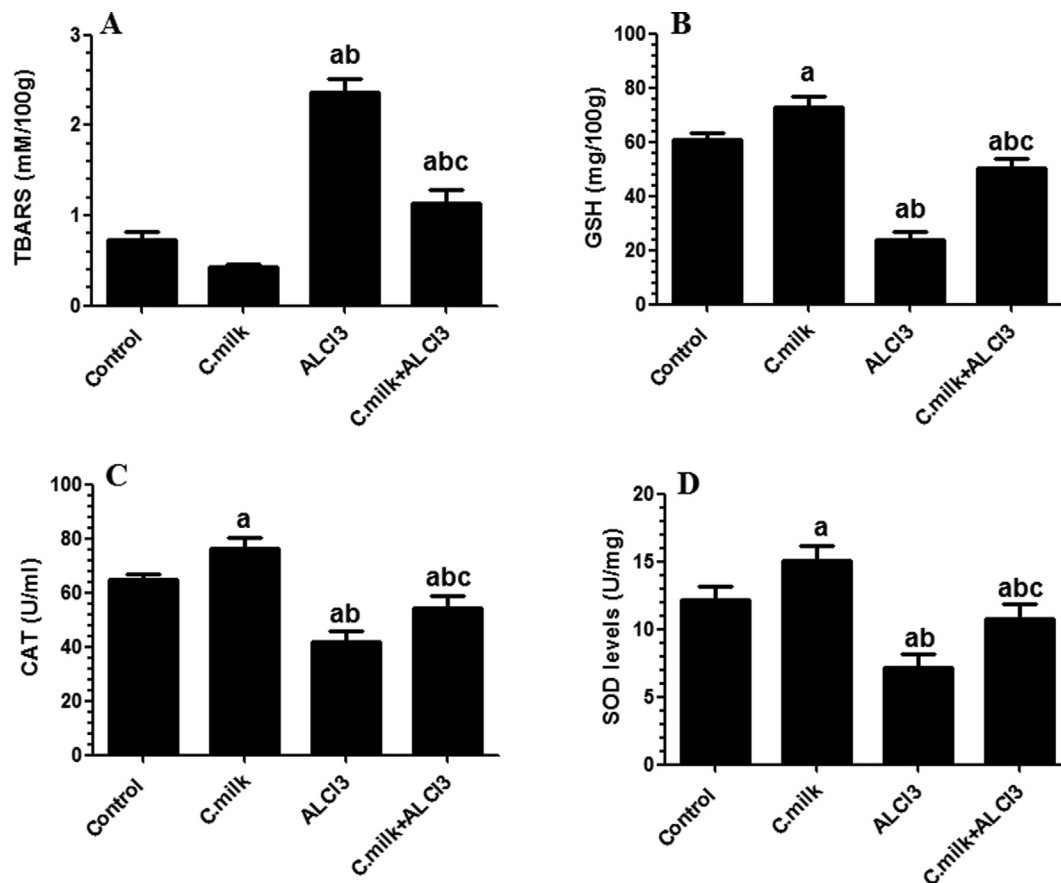


Fig. 5. Levels of TBARS (A) and reduced glutathione (GSH, B) and activities of catalase (CAT, C) and superoxide dismutase (SOD, D) in the liver homogenates of all experimental groups. Values are presented of means \pm SD (n = 6/each). ^a:vs. control group. ^b: vs. camel milk-treated control group (C. milk). ^c: vs. AlCl₃-treated group.

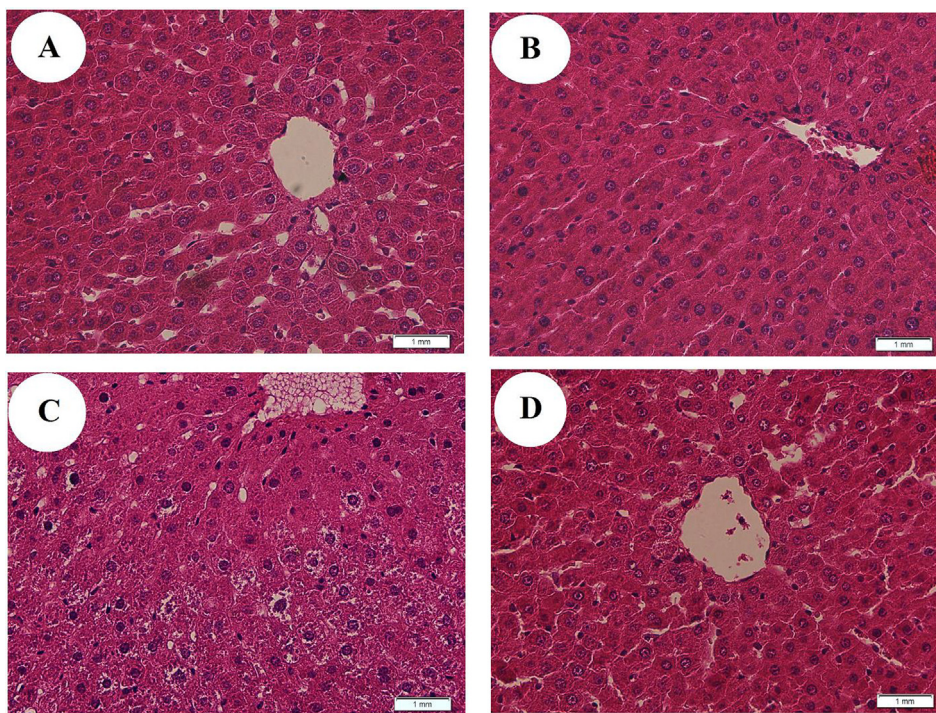


Fig. 6. Histological Photomicrographs stained with Haematoxylin and Eosin and E from all groups of rats. A and B were taken from the control rats received the vehicle or co-treated camel milk, respectively. They are showing normal hepatic architecture with normal hepatocytes, sinusoids, and central vein lined with endothelium. C and D represent AlCl₃ intoxicated rats showing severe obstructed degenerated central vein with highly dilated sinusoids (C). Degenerative changes with cell swelling were dominant in most of the hepatic. Many nuclei are pyknotic (shrunken and dark satin) and some of them showed karyolysis (dissolution) with the loss of cellular integrity. 200X.

that we couldn't be able to measure ROS in the platelets of AlCl₃ intoxicated rats to confirm if they could also mediate this effect.

Also, the liver regulates secondary hemostasis by synthesizing multiple clotting factors and fibrinolytic proteins (Al-hashem, 2009). Patients with liver disorders have reduced levels of majority of clotting factors, higher levels factor VIII, and impaired fibrinolysis (Lisman and Leebeek, 2007). They also had prolonged PT and aPTT (Ahmadhamed et al., 2006; Lisman and Leebeek, 2007). In this investigation, and as expected, AlCl₃ sub-acute administration significantly prolonged PT and aPTT in intoxicated rats. An effect that could be attributed, at least, due to AlCl₃-induced hepatic damage. In healthy rats and the absence of any liver damage, camel milk didn't affect periods of PT nor aPTT, which is expected. However, camel milk significantly shortened AlCl₃ increases in PT and aPTT periods. This is expected with the improved liver function. Since AL³⁺ ions can substitute most enzymes in the liver, the inhibitory role of AL + 3 chloride on clotting factors is possible and needs further investigation. However, even with this increased PT and aPTT.

In conclusion, our interesting findings suggest an antiplatelet activity of camel milk in both healthy and AlCl₃-intoxicated rats. It also shows a protective effect of camel milk against AlCl₃-induced decreases in RBCs and hypocoagulation. Mechanism of action is at least due to increases antioxidant system in rat's liver and amelioration of liver damage.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Further Reading

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