*Original Research Article*

# Hepatotoxic Nature of Potash (Kaun) in Wistar Rats



**ABSTRACT**

**Background**: The use of potash as food additive without a recourse to its adverse effect is on the increase in Nigeria.

**Aim**: This study is designed to assess its effect on hepatic indices of Wistar rats.

**Methodology**: Potash was locally sourced in a market in Owerri, Imo State, Nigeria. Thirty Wistar rats were acclimatized for seven days and divided into five groups of six each. Animals in group A were administered distilled water while those in groups B, C, D and E were administered 250, 500, 750 and 1000 mg/kg body weight of potash for twenty-eight days via oral route of administration. At the end of 28 days of treatment, animals were anaesthetized using diethyl ether and were sacrificed and blood samples were collected *via* cardiac puncture. Hepatic indices were determined using standard methods.

**Results**: Potash was observed to adversely perturb hepatic biomarkers especially at high doses making it hepatotoxic.

**Conclusion**: From the results of this study, potash is hepatotoxic; thus, it is recommended that its continuous consumption should be discouraged.

**Keywords:** Food Addictive, Hepatotoxic, Potash

## 1. INTRODUCTION

Liver is the major organ which plays key roles in processing critical biochemical and physiological phenomena including metabolism and detoxification of endogenous and exogenous compounds, such as drugs and xenobiotics, homeostasis, growth, energy and nutrient supply [1]. Hepatic injury could occur by hepatotoxic agents such as drugs, alcohol, hydrocarbon and viral infections [2]. Liver diseases like jaundice, cirrhosis and fatty liver have been public health concern across the world [3]. Prevalence of chronic liver disease worldwide is 18.5% and cirrhosis is 4.5 to 9.5% while 2 million people die each year. Food and nutrition has contributed greatly in liver injuries or damage.

Potash is any of various mined and manufactured salts that contain potassium in water-soluble form, the name derived from pot ash, refers to plant ashes soaked in water in a pot, the primary means of manufacturing the product before the industrial era [4]. It is produced worldwide at amounts exceeding 30 million tonnes per year, mostly for use in fertilizers. Various types of fertilizer-potash constitute the single largest global industrial use of the element potassium. Potassium was first derived by electrolysis of caustic potash (aka potassium hydroxide), in 1807 [5]. The old method of making potassium carbonate ($K_2CO_3$) was by collecting or producing wood ash (an occupation carried out by ash burners), leaching the ashes and then evaporating the resulting solution in large iron pots, leaving a white residue called pot ash [6]. Approximately 10% by weight of common wood ash can be recovered as pot ash. Later, potash became the term widely applied to naturally occurring potassium salts and the commercial product derived from them [7]. Locally known as “kaun” or “Akanwu”, Potash is used commonly for culinary purposes. It is used for cooking pulses like beans, akidi (black Mexican beans), fiofio (cowpea beans etc. in order to tenderize the pulsesso easily [8]. “Kaun” is also added in ewedu and okro soup (a Nigerian delicacy) during preparations in order to increase the greenness and texture of the vegetables [9]. No data exist about the quantity or dosage of potash consumed in the average daily meal of Nigerians. This study is designed to examine the likely effect of potash on the liver.

## 2. METHODOLOGY

### 2.1 Experimental Design

Potash was locally sourced in a market in Owerri, Imo State, Nigeria and was carefully preserved to avoid contamination. Thirty Wistar rats weighing between 145 and 160 g were used for this study. They were acclimatized for seven (7) days during which they were fed *ad libitum* with standard feed and drinking water and were housed in clean cages placed in well-ventilated housing conditions (under humid tropical conditions) throughout the experiment. All the animals received humane care according to the criteria outlined in the ‘Guide for the Care and Use of Laboratory Animals’ prepared by the National Academy of Science and published by the National Institute of Health [10]. They were randomly divided into five (5) groups of six (6) rats each. Animals in group A were administered distilled water while those in groups B, C, D and E were administered 250, 500, 750 and 1000 mg/kg body weight of potash for twenty-eight (28) days via oral route of administration. At the end of 28 days of treatment, animals were anaesthetized using diethyl ether and were sacrificed and blood samples were collected *via* cardiac puncture.

### 2.2 Determination of Hepatic Indices

Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) activities were determined using Randox commercial Enzyme kits according to the method of Reitman and Frankel [11]. Alkaline Phosphatase (ALP) activity was determined by Phenolphthalein Monophosphate method described by Babson et al. [12]. Amylase inhibition assay was determined by the method of Bernfield [13]. Lipase activity was determined using Biorex diagnostic kit according to the methods of Lorentz [14]. Total bilirubin concentration was determined by diazo method described by Royden and Alfred [15]. Conjugated bilirubin concentration was determined by the method of Compernolle [16]. Unconjugated bilirubin was determined by subtracting conjugated bilirubin from total bilirubin.

### 2.3 Statistical Analysis

Results are expressed as mean ± standard deviation. The levels of homogeneity among the groups were assessed using One-way Analysis of Variance (ANOVA) followed by Tukey’s test. All analyses were done using Graph Pad Prism Software Version 5.00 and P values $<$ 0.05 were considered statistically significant.

## 3. RESULTS

The results of this study are presented in figures 1-11. No significant difference was observed when the activities of ALT and AST in animals treated with lower doses (250 and 500 mg/kg) of potash were compared with those in the control group at P<0.05. A significant increase was however observed in the activities of ALT and AST in animals treated with higher doses (750 and 1000 mg/kg) of potash when compared with those in the control group (Figures 1 and 2). ALP activity was observed to increase in experimental animals when compared with those of the control animals. This elevation was however not significant when animals treated with 250 mg/kg body weight of potash were compared with the control group at P<0.05 (Figure 3). No significant difference was observed in the concentrations of total protein and albumin in animals treated with lower doses (250 and 500 mg/kg) of potash when compared with that of the control group at P<0.05. A significant increase was however observed in the concentrations of total protein and albumin in animals treated with higher doses (750 and 1000 mg/kg) of potash when compared with those in the control group (Figures 4 and 5). The concentration of globulin was only significant when animals treated with 500 and 1000 mg/kg body weight of potash were compared with those of the control animals (Figure 6). Administration of potash increased total bilirubin concentration when compared with those in control animals. The increase was significant when animals treated with 500 and 1000 mg/kg of potash were compared with those in the control group at P<0.05 respectively (Figure 7). No significant difference was observed in the levels of conjugated bilirubin in experimental animals when compared with those in control group at P<0.05 (Figure 8). A significant increase was observed in the level of unconjugated bilirubin (except the group treated with 750 mg/kg) when compared with those in control group (Figure 9). The potash was observed to inhibit the activities of amylase and lipase (Figures 10 and 11) respectively in a dose-dependent manner.

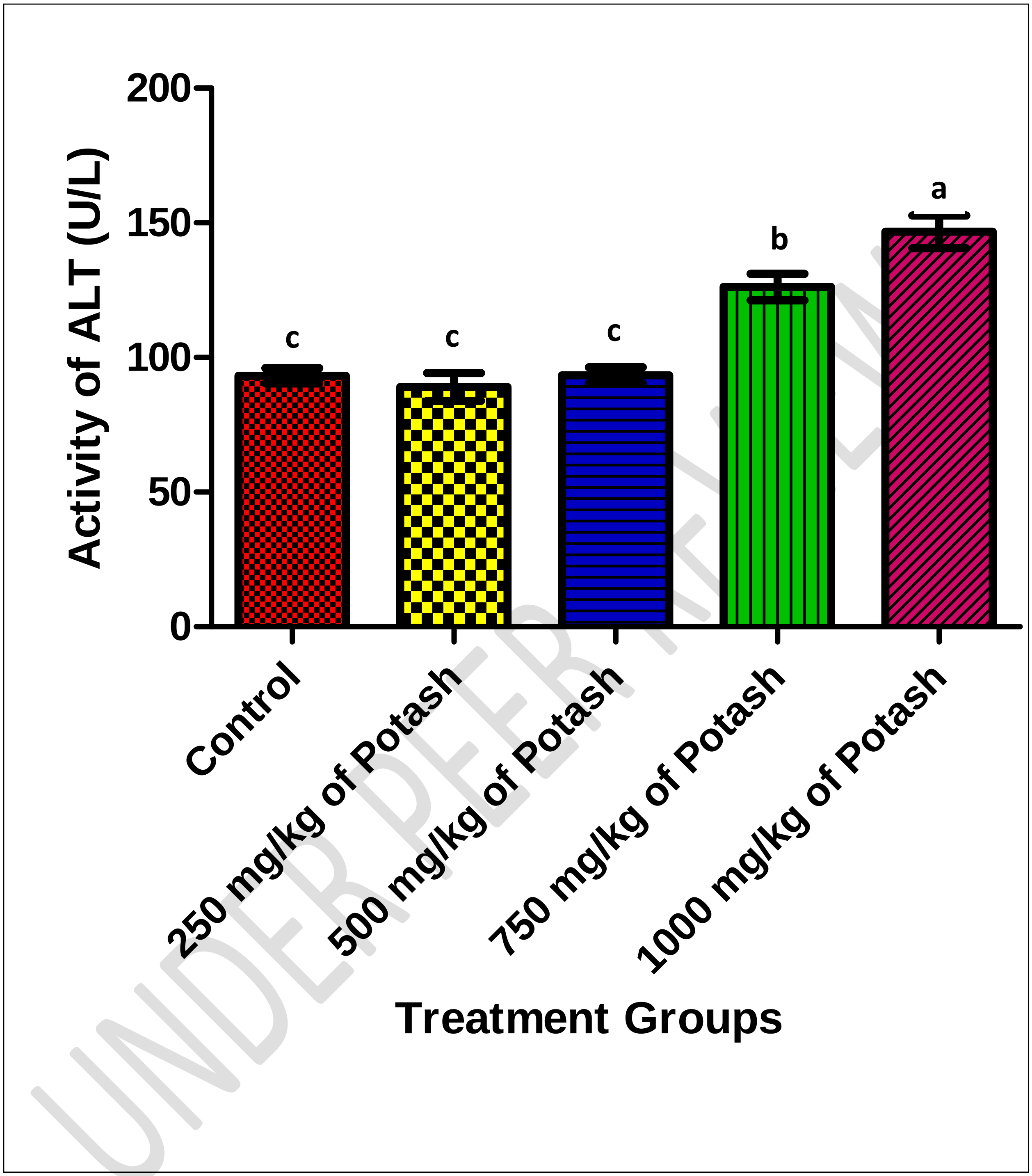


**Figure 1: Effect of Potash on the Activity of Alanine Amino Transferase (ALT) of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

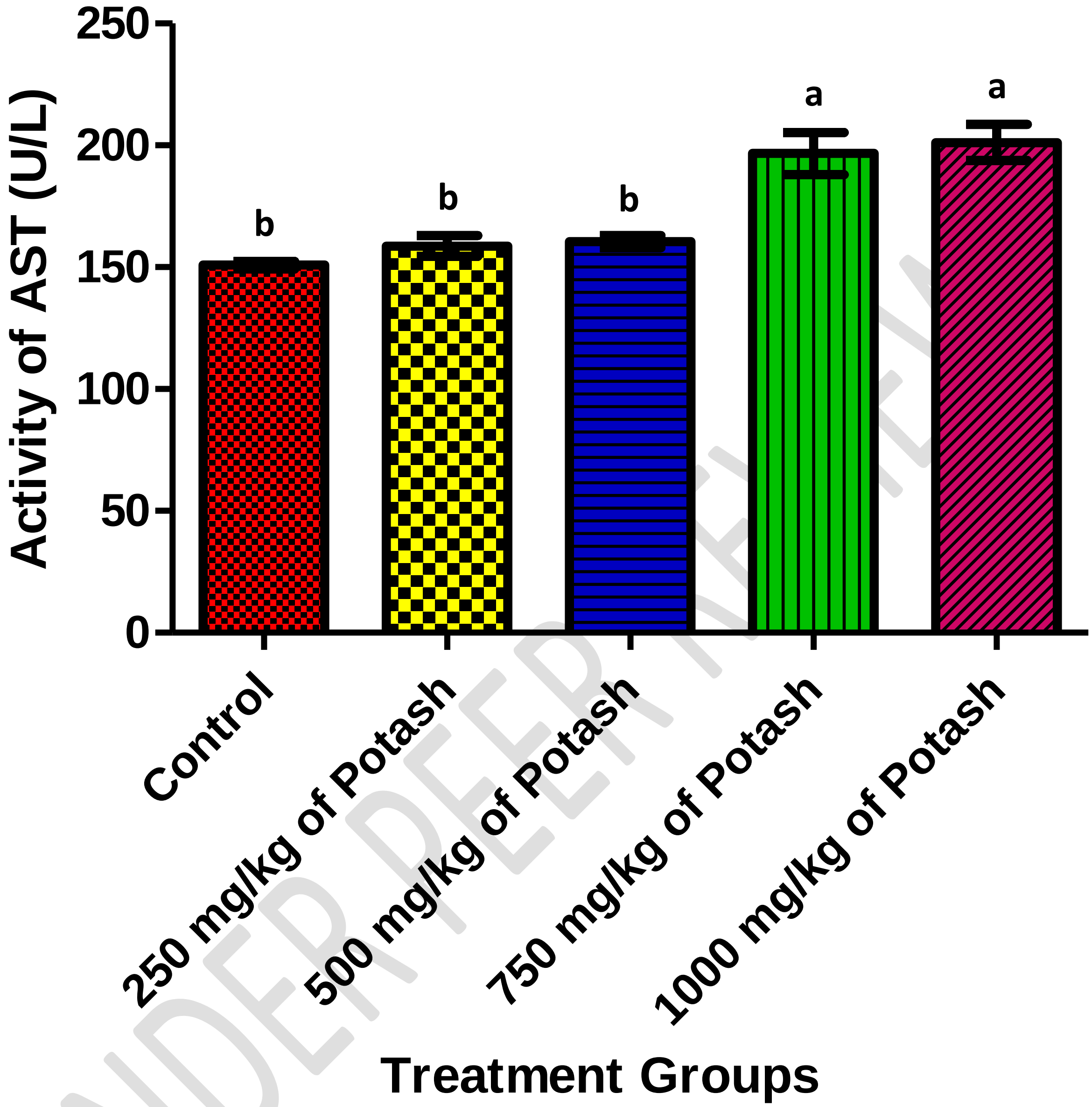


**Figure 2: Effect of Potash on the Activity of Aspartate Amino Transferase (AST) of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at P<0.05

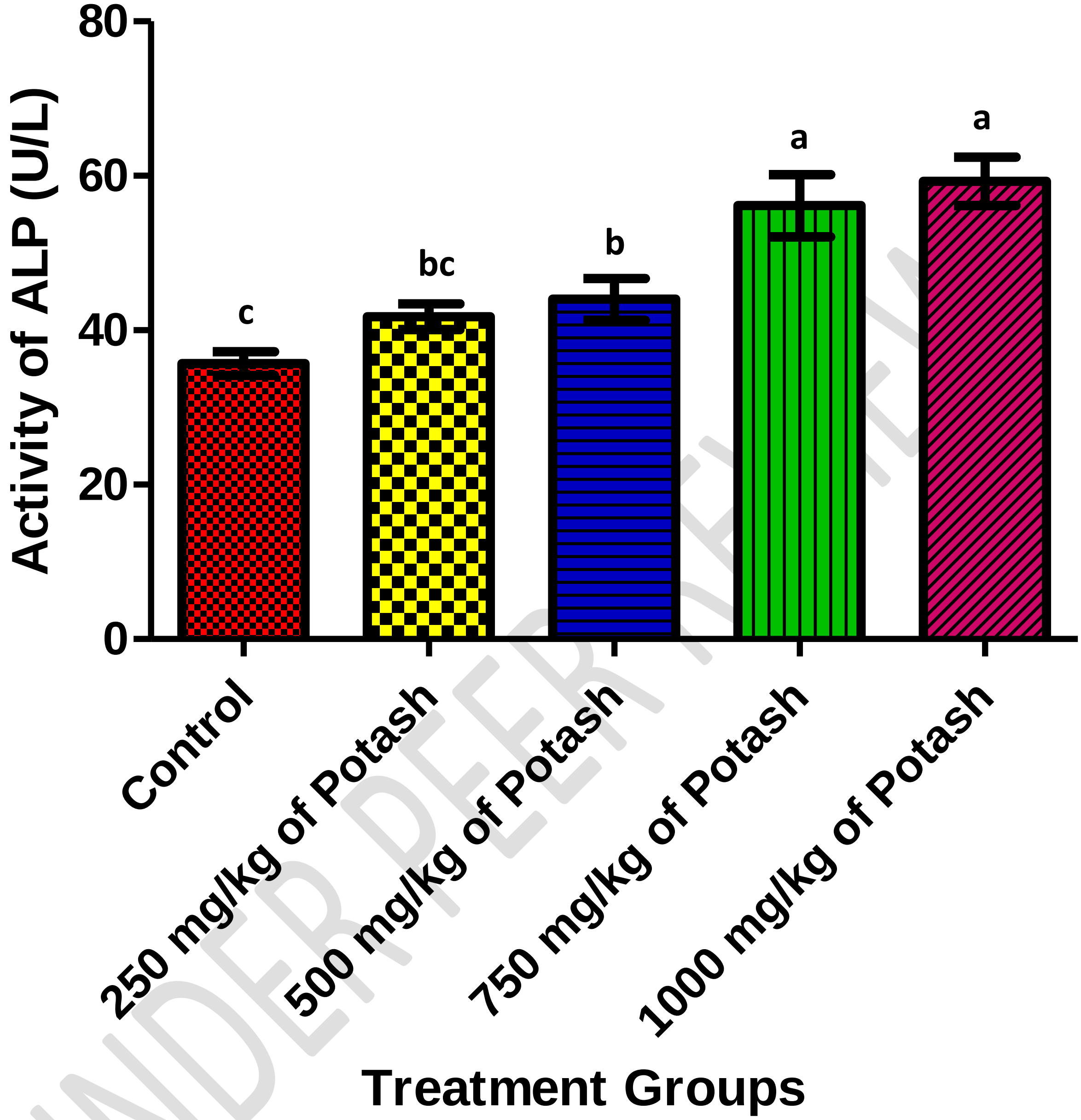


**Figure 3: Effect of Potash on the Activity of Alkaline Phosphatase (ALP) of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

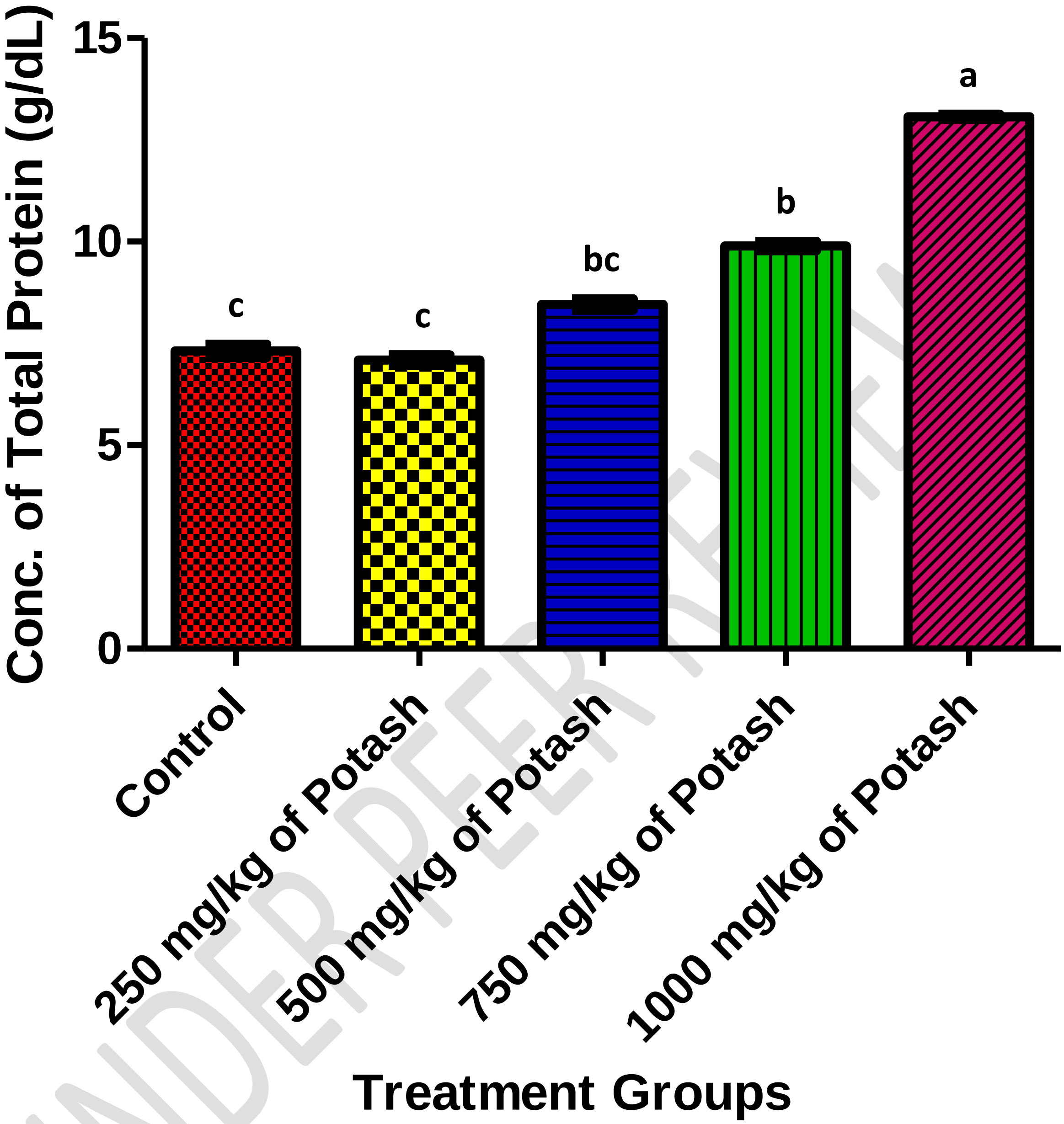


**Figure 4: Effect of Potash on the Concentration of Total Protein of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

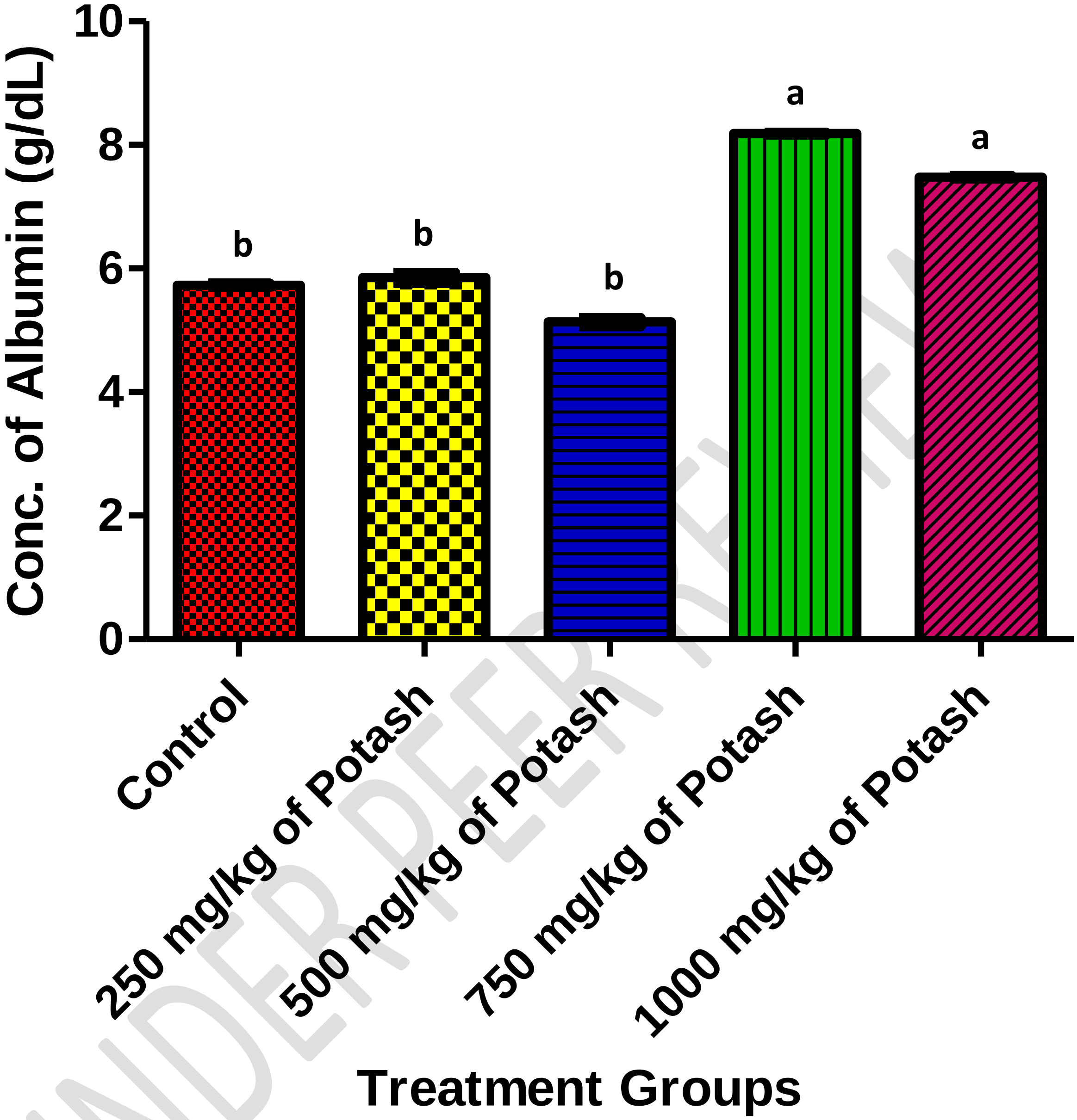




**Figure 5: Effect of Potash on the Concentration of Albumin of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at P<0.05

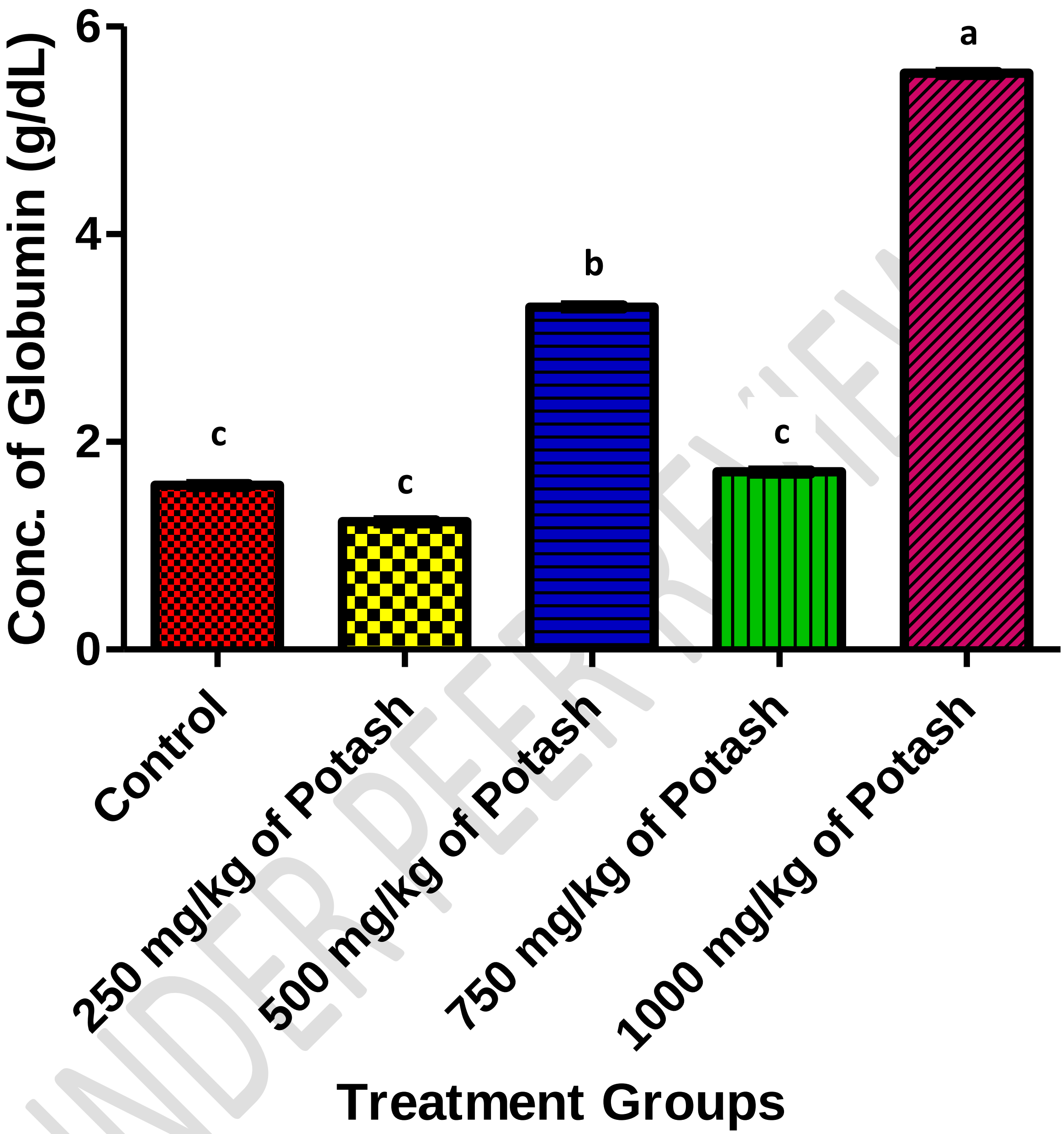


**Figure 6: Effect of Potash on the Concentration of Globulin of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at P<0.05

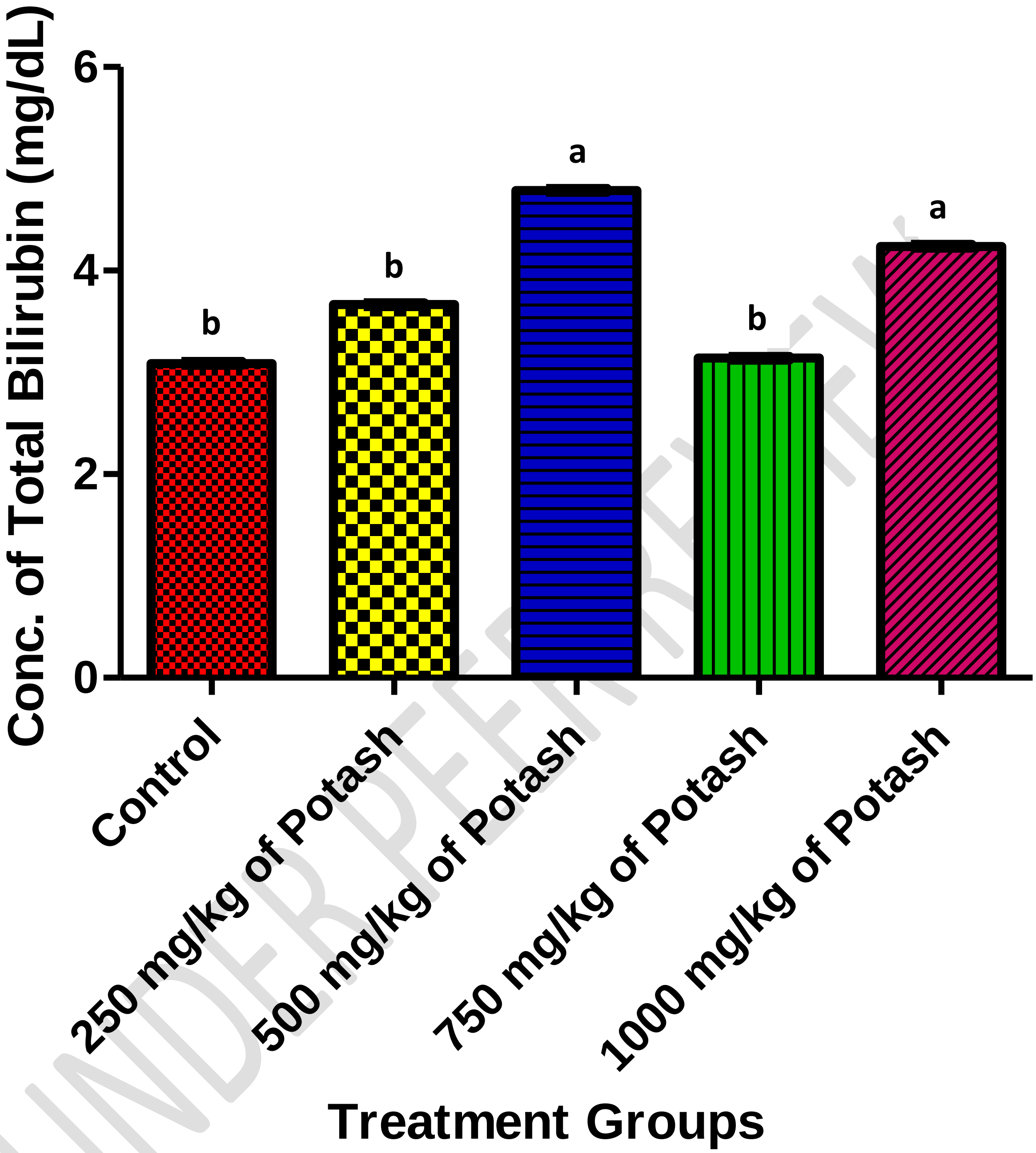




**Figure 7: Effect of Potash on the Concentration of Total Bilirubin of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

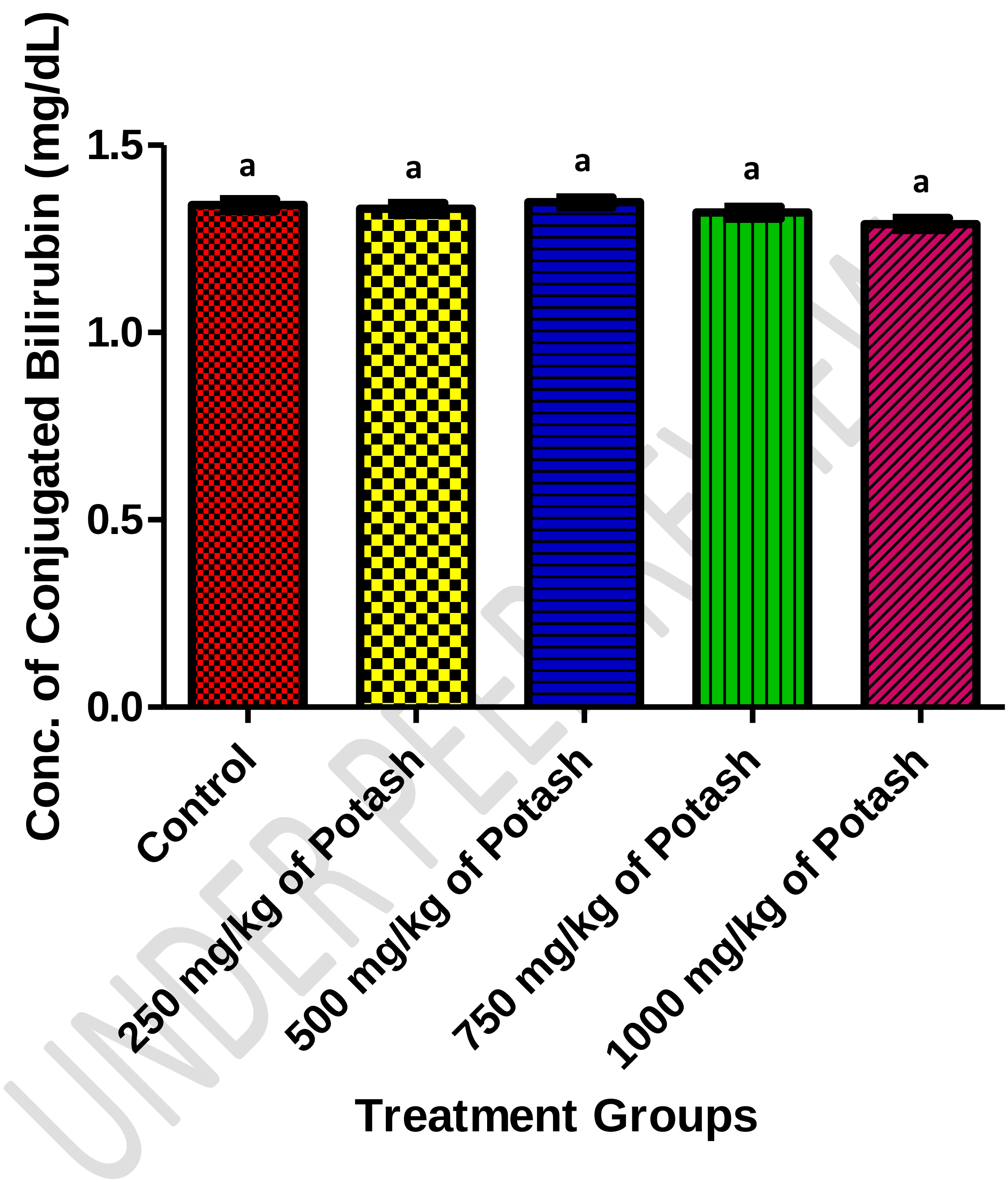



**Figure 8: Effect of Potash on the Concentration of Conjugated Bilirubin of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

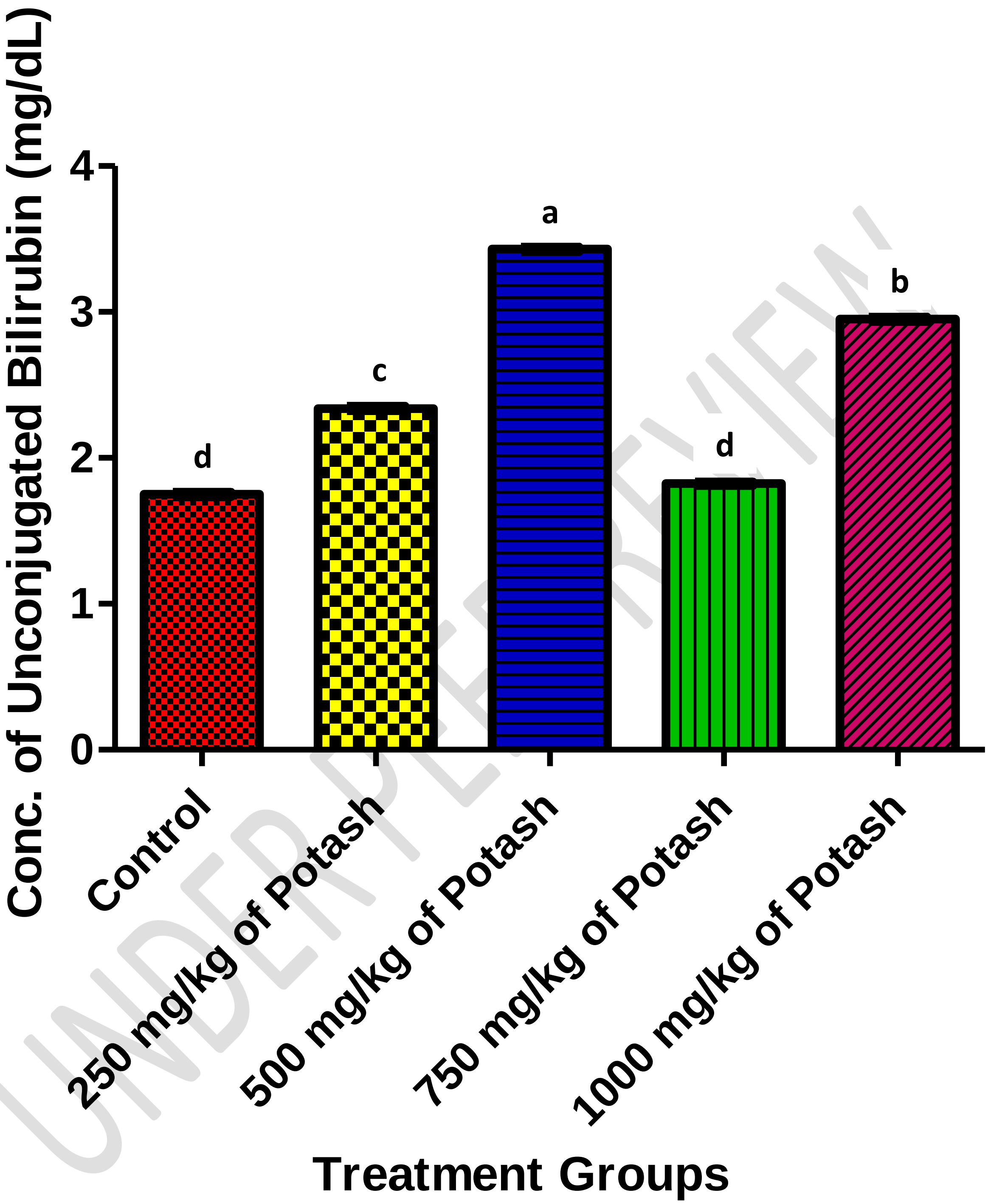




**Figure 9: Effect of Potash on the Concentration of Unconjugated Bilirubin of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

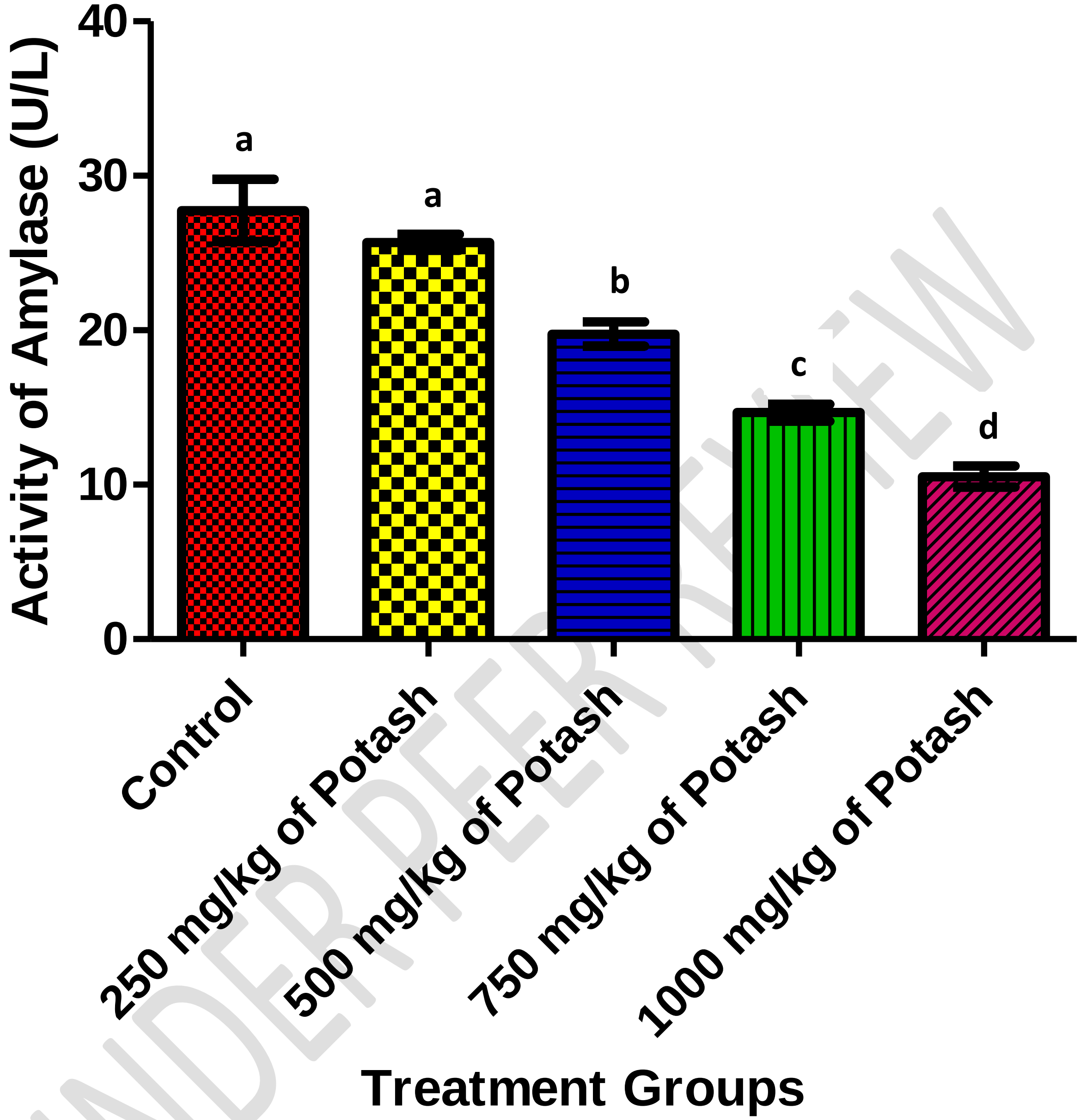


**Figure 10: Effect of Potash on the Activity of Amylase of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at P<0.05

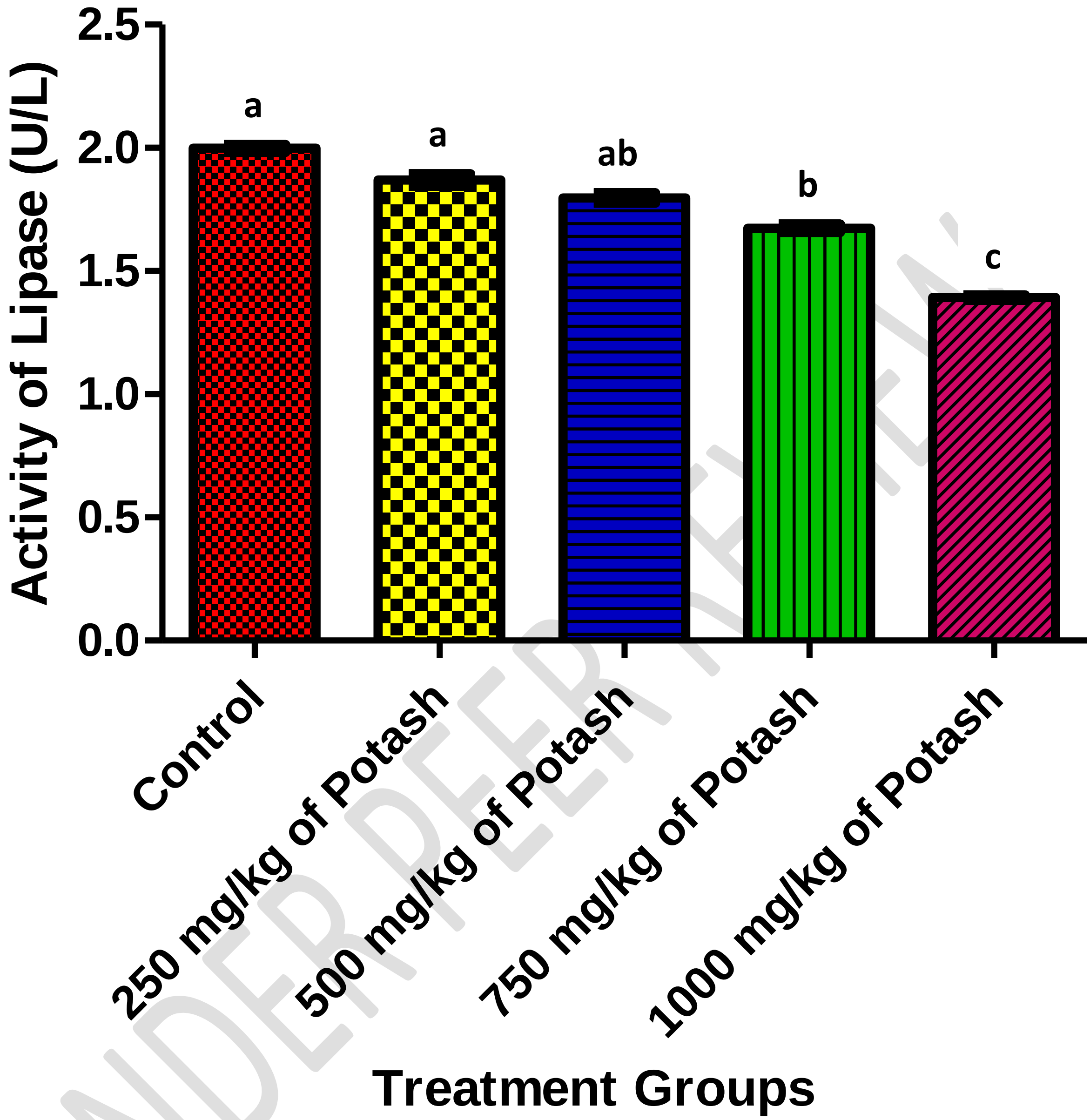


**Figure 11: Effect of Potash on the Activity of Lipase of Animals after 28 days of Treatment**

Results are presented as mean ± SD with n = 6. Bars with different letters are significantly different at $P<0.05$

## 4. DISCUSSION

Results of this study showed that administration of potash to animals for 28 days resulted in a significant increase in the activities of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in animals treated with 750 and 1000 mg/kg body weight of potash when compared with those of control animals at $P<0.05$ (Figures 1 and 2). At lower doses (250 and 500 mg/kg), potash had no significant effect on the activities of ALT and AST. A dose-dependent increase was also observed in the activities of ALP when experimental animals were compared with control animals (Figure 3). This increase was however nonsignificant at the lowest dose of 250 mg/kg body weight. It has been reported that an increase in the enzymatic activity of ALT, AST and ALP in the serum directly reflects hepatocellular damage [17]. Results of this study therefore suggest that potash may be hepatotoxic at high doses. This is similar to the finding of Iweka *et al*. [8] who reported a significant increase in the activities of AST, ALT and ALP when they exposed albino rats to 0.4, 0.6 and 0.8g/kg body weight of potash for 21 days. This could be that exposure of animals to potash stimulated the transcription of the genes involved in glucose uptake, glycolysis and lipogenesis [18]. Glucose represses the induction of inducible operons by inhibiting the synthesis of cyclic Adenosine monophosphate (cAMP) a nucleotide that is required for the initiation of transcription of a large number of inducible enzyme systems including the Lac operon [19]. Cyclic AMP (cAMP) is required to activate an allosteric protein called catabolite activator protein (CAP) which binds to the promoter CAP site and stimulates the binding of ribonucleic acid (RNA) polymerase to the promoter for the initiation of transcription, but cAMP must be available to bind to CAP which binds to deoxyribonucleic acid (DNA) to facilitate transcription [20]. In the presence of glucose, adenylase cyclase (AC) activity is blocked. AC is required to synthesize cAMP from Adenosine Triphosphate (ATP) [21]. Therefore, if cAMP levels are low, CAP is inactive and transcription does not occur. Thus, the effect of glucose in suppressing these inducible enzymes is by lowering cyclic AMP level. Administration of potash at high doses might have elevated cAMP in treated rats, thus the significant increase in these inducible enzymes. ALT is considered most reliable marker of hepatocellular injury because it is solely confined to the liver, unlike AST which is also abundantly present in other body organs such as the kidneys, brain, and hearts [22,23]. The significant increase observed in the activities of ALT, AST and ALP in animals treated with high doses of potash when compared to the control groups showed that potash is hepatotoxic.

Similarly, concentrations of total protein and albumin were observed to have significantly increased in animals treated with 750 mg/kg and 1000 mg/kg body weight of potash when compared with those of control animals at $P<0.05$ (Figures 4 and 5) respectively. This elevation might suggest a compromise of the synthetic ability of the liver arising from the administration of potash at higher doses. At high dosage, potash might have increased the functional activity of the liver by interfering with the equilibrium in the rate of synthesis and destruction, removal or clearance of total protein and albumin from the system of the animals [24]. Such increase in total protein could, however, lead to dehydration which is detrimental to cellular homeostasis [25]. This will negatively affect the metabolic activities of the liver and consequently the health of the animals. Albumin binds and transports metal ions, bilirubin, and drugs. Its level is used to assess the synthetic function of the liver [26]. Significant increase in the level of these parameters might be an indication that potash may had stimulated their synthesis in the liver at dosage of 750 mg/kg and 1000 mg/kg body weight. Serum protein levels are regulated *via* synthesis in the liver and its levels thus reflect the synthetic ability of the liver [26].

Bilirubin refers to the breakdown product of heme moiety of hemeoglobin; other hemeoproteins include cytochromes, catalase, peroxidase, tryptophan pyrrolase and a small pool of free heme. Increase in concentration of direct reacting bilirubin in blood causes hyperbilirubinaemia, which is toxic under certain conditions inducing jaundice, hyperbilirubinemia-induced auditory dysfunction and neurotoxicity resulting in brain damage [27]. On the other hand, mild unconjugated hyperbilirubinaemia behaves as mild antioxidant and might offer protection against cardiovascular diseases and tumour development [28]. Recent research survey has reported that low concentration of direct reacting bilirubin induces stroke in body and sometimes causes cardiac problems too. Serum bilirubin levels are often enhanced under a variety of clinical conditions. In the circulation of blood, bilirubin is bound to serum albumin, which prevents its potential toxicity thought to be caused by free bilirubin [29]**.** Despite its high-affinity of binding to albumin, bilirubin is rapidly and selectively taken up by the liver, biotransformed upon conjugation with glucuronate, and secreted into bile [28]. Thus bilirubin is converted into bilirubin glucuronic acid in the liver and excreted along with bile. In this study, there was no significant change in the serum conjugated (direct) bilirubin concentrations. However, there was a significant increase in the serum levels of total and unconjugated (indirect) bilirubin in the treated rats compared to the control animals. The observed increase in indirect serum bilirubin (unconjugated bilirubin) might have resulted from tissue injuries or damage [30].

It was observed that the potash used in this study inhibited the activity of amylase in a dose-dependent manner. Amylase is a key enzyme involved in starch breakdown [20]. In humans, the diabetogenic process may be caused by immune destruction of the β-cells in the Islets of Langerhans in the pancreas and this is apparently mediated by white blood cell production of Reactive Oxygen Species (ROS) [31,32]. It is believed that inhibition of the enzymes involved in the digestion and uptake of carbohydrates can significantly decrease the postprandial increase of blood glucose level after a mixed carbohydrate diet and therefore can be an important strategy in the management of hyperglycemia linked to type 2 diabetes [33,34].

In the same vein, lipase activity was also observed to be inhibited by potash in a dose-dependent manner as observed for amylase. Lipase is the enzyme responsible for digestion and absorption of triglycerides [20,26]. Its inhibition is one of the widest studied methods used to determine the potential activity of natural products to inhibit dietary fat absorption. Decrease in energy intake from dietary fat through inhibition of this enzyme may be an excellent strategy to prevent and treat obesity [35].

## 5. CONCLUSION

The results of this study showed that administration of potash is hepatotoxic especially at high doses. Consequently, it is recommended that its consumption should be discouraged.

## ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.



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