



## **EFFECT OF CALYX EXTRACT OF *HIBISCUS SABDARIFFA* AGAINST CADMIUM-INDUCED LIVER DAMAGE**

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### **ABSTRACT**

*This study was conducted to elucidate the protective properties of calyx extract of Hibiscus sabdariffa against cadmium toxicity. A total of 16 male rats grouped into 4 were used for this study that lasted for 2 weeks. Group A animals received water and served as the control. Animals in groups B, C and D received cadmium sulfate 10mg/kg body weight orally, once daily throughout the study period. Group C and D animals additionally received calyx extract of Hibiscus sabdariffa twice daily orally at 2.5 and 4.6g/kg body weight respectively. Animals in group B were observed to have continuous loss of hair and were less active compared with the control. Animals in groups C and D were relatively active. Serum activities of alkaline phosphatase (ALP), alanine transaminase (ALT) and aspartate transaminase (AST) showed significant increase ( $P<0.05$ ) in group B compared with the control group; indicating the hepatotoxic effect of cadmium. Serum ALT, AST and ALP activities of animals in group C were  $24.53\pm 2.80$ ,  $53.25\pm 9.46$  and  $234.60\pm 35.63$  respectively. Serum ALT, AST and ALP activities of animals in group D were respectively  $22.09\pm 2.05$ ,  $46.75\pm 4.50$  and  $165.60\pm 22.54$ . Even though the activities of the serum enzymes in groups C and D showed significant increase ( $P<0.05$ ) as compared with the control, they are significantly lower ( $P<0.05$ ) compared with group B. There is no significant difference ( $P<0.05$ ) in serum bilirubin levels for groups C, D and B as compared with the control. The decrease in the activities of serum ALT, AST and ALP of groups C and D that received the calyx extract as compared with group B indicates the potential protective action of the extract against cadmium toxicity. The results thus indicate that the calyx extract of Hibiscus sabdariffa has potential protective properties against cadmium-induced liver damage.*

**Key Words:** *Hibiscus sabdariffa*, sorrel, cadmium-sulphate, toxicity, liver damage

### **INTRODUCTION**

*Hibiscus sabdariffa* is also known as sorrel, roselle and *zoborodo* (Hausa). There are basically two varieties: the red and the white varieties. Researches have confirmed the calyces to be hypotensive, antispasmodic, anthelmintic and antibacterial (Wikipedia, 2008). Sorrel drink consumption was reported to decrease serum cholesterol, blood pressure and increase serum ascorbic acid in healthy subjects (Atiku *et al.*, 2005). The calyces infusion was also found to lower significantly both systolic and diastolic pressures in spontaneously hypertensive and normotensive rats (Onyenekwe *et al.*, 1999). The nutritional and medicinal uses of sorrel may be attributed to its vitamin C content; the calyces of the red sorrel variety contain more ascorbic acid than most fruits (Sarkin Fada *et al.*, 1997).

Cadmium is usually present in the environment as cadmium oxide, cadmium chloride, cadmium sulphate and cadmium sulphide. In areas not known to be polluted, cadmium concentration in air is usually less than  $1\text{ng}/\text{m}^3$  and in the range of  $0.2\text{-}0.4\text{mg}/\text{Kg}$  in the soil (Elinder, 1985). It is estimated that approximately 3.4 billion pounds of sewage sludge transferred to soil annually contains up to  $1,000\mu\text{g}/\text{g}$  cadmium (Elinder, 1985). Cadmium

contaminated topsoil is the most likely mechanism for the greater human exposure through uptake into edible plants which results in elevated concentrations in vegetables, fruits and grains (Elinder, 1985).

Numerous articles and publications have raised concern over the consequence of industrial and environmental pollutants such as heavy metals and various chemicals. These pollutants have been linked to various degrees of damages of human subjects exposed to them. Due to the exposure of people working or living in places where industrial and environmental pollutants are common, it is then imperative to pay special attention to the effect of these pollutants to organs, tissues and cells of the body. When considering environmental impact of metallic species, mercury, lead and cadmium are in focus (Wilson, 1988).

Cadmium toxicity has numerous effects on cells and organs of the body and it has been shown to be associated with lipid peroxidation (Yiin *et al.*, 1999). Cadmium toxicity is increasing in incidence due to zinc deficiency in most commonly eaten foods, as zinc antagonises the uptake of cadmium. Vitamin C was reported to be protective against cadmium toxicity (Shiraishi *et al.*, 1993).

This work is aimed at ascertaining the protective effect of water extract of sorrel (*H. sabdariffa*) calyces on cadmium-induced liver damage in rats.

**MATERIALS AND METHODS**

**Plant material**

Dried calyces of red sorrel were obtained from a local market in Kano metropolis. Water extract of the calyces was obtained by soaking in distilled water for six (6) hours followed by sieving to obtain calyx extract of concentration 0.2g/ml. Appropriate volume corresponding to weight/kg body weight of the extract was administered to the research animals.

**Chemicals and Reagents**

Commercially produced analytical reagents kits (Randox Analytical Reagents) were used for the analyses. All other reagents used were of analytical grade.

**Animals**

Adult male Wistar rats (average weight 150g) were used for the study. The animals had free access to feed and water throughout the study period. The animals were grouped into four (4). Group A served as control and received only distilled water. Animals in groups B, C and D were administered cadmium sulphate 10mg/kg body weight daily. In addition, group C animals were administered sorrel (*H. sabdariffa*) calyx extract of 2.5g/kg body weight twice daily while group D were administered calyx

extract 4.6g/kg body weight twice daily. At the end of the administration period which was two (2) weeks, the animals were sacrificed, blood collected and serum obtained.

**Analyses**

Serum activities of aspartate aminotransferase and alanine aminotransferase were determined by the method of Reitman and Frankel (1957), alkaline phosphate by the method of Recommendation (1972) and serum bilirubin by the method of Jendrassik and Grof (1983).

**Statistical Analysis**

t distribution test was used for the statistical analysis of the results obtained.

**RESULTS**

Physical observation of the animals: animals in group B were less active compared to the other groups. Animals in group B also suffered from severe loss of body hair, while the same observation in groups C and D was less prominent.

The results of the analyses are presented in table 1 for group A (control), group B (10mg/kg body weight cadmium sulphate), group C (10mg/kg cadmium sulphate daily + sorrel calyx extract 2.5g/kg body weight twice daily) and group D (10mg/kg cadmium sulphate daily + sorrel calyx extract 4.6g/kg body weight twice daily).

**Table 1: Serum activities of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP) and bilirubin (BIL) in rats orally administered with 10mg/kg cadmium sulphate (group B), 10mg/kg cadmium sulphate + sorrel calyx extract 2.5g/kg (group C) and 10mg/kg cadmium sulphate + sorrel calyx extract 4.6g/kg (group D) and control (group A)**

GROUP	ALP (U/L)	ALT (U/L)	AST (U/L)	BIL (µmol/L)
A	151.80±15.93 <sup>abc</sup>	20.94±3.35 <sup>abc</sup>	41.25±4.50 <sup>ace</sup>	6.48±1.69
B	282.90±34.73 <sup>ade</sup>	33.23±2.48 <sup>ade</sup>	82.50±7.51 <sup>ade</sup>	11.10±3.42
C	234.60±35.63 <sup>bd</sup>	24.53±2.80 <sup>bd</sup>	53.25±9.46 <sup>bd</sup>	8.63±1.15
D	165.60±22.54 <sup>ce</sup>	22.09±2.05 <sup>ce</sup>	46.75±4.50 <sup>ce</sup>	7.4±3.42

Results are: mean ± standard deviation

Values in the same column bearing similar superscript are significantly different at p<0.05

From Table 1, it can be perceived that the activities of the enzymes ALP, ALT and AST in group B were significantly higher (p<0.05) than in group A. BIL was also lower in group A compared to the other groups. Serum activities of all the three enzymes were also higher in groups C and D compared to A.

The activities of the enzymes were significantly higher (p<0.05) in group B compared to groups C and D. This decrease in the enzyme activities in the groups administered sorrel extract in addition to cadmium sulphate points at the possible effect of the calyx extract in counteracting the toxic effect of cadmium sulphate. It can also be seen from the table that the serum activities of the enzymes and BIL level are lower in group D compared to C, indicating a dose related effect of the sorrel calyx extract.

**DISCUSSION**

The exposure of the study animals to cadmium sulphate led to increased activities in the serum activities of ALP, ALT and AST indicating that the cadmium sulphate administration led to liver damage, as increased activities of these enzymes in the serum are indices of liver damage (Price and Alberti, 1979). Exposure to cadmium has been shown to cause increase in the activities of liver enzymes in the plasma, indicating damage to liver membrane and leakage of the enzymes to the plasma (Nomiya, 1979). The mechanism of cadmium toxicity that can lead to tissue damage has been reported to be associated with oxidative stress and thiol depletion (Ercal *et al.*, 2001). Cellular damage results from cadmium binding to sulfhydryl groups in tissues, the production of lipid peroxides and the depletion of glutathione.

Cadmium binds irreversibly to the sulfhydryl groups on the exposed active sites of intracellular enzymes, inactivating and rendering them functionally useless. Cadmium also has a very high affinity for glutathione and can form complex with glutathione that is eliminated in bile. Cadmium also inhibits the activity of antioxidant enzymes, including catalase and superoxide dismutase. Cadmium can also substitute for zinc or selenium in metallo-enzymes (Pope and Rall, 1995). Cadmium's ability to generate free radicals has led to the expression of inflammatory chemokines and cytokines, oxidation of nucleic acids and alteration of DNA repair mechanisms and eventual cell death (Dong *et al.*, 1998).

As was seen from the physical observation of the animals in the different groups throughout the administration period and from the results of the

biochemical analyses (Table 1), the animals administered sorrel calyx extract in addition to cadmium sulphate were less susceptible to the toxic effects of the cadmium. Sorrel is a good source of natural antioxidants: highly bioavailable ascorbic acid,  $\beta$ -carotene and phenolic compounds especially anthocyanins (Tee *et al.*, 2002).

## CONCLUSION

The administration of sorrel (*H. sabdariffa*) calyx extract alleviated the toxic effects induced by cadmium. This points to the potential of sorrel in protecting the toxic effects of cadmium. The consumption of the popular sorrel drink "zobo" is thus encouraged as that may help guard the populace from the toxic effects of environmental cadmium exposure.

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