



POTENCY OF AQUEOUS STEM BARK EXTRACT OF *KHAYA SENEGALENSIS* AGAINST LIVER DISEASES IN RATS

*M.S. Sule,¹ R.B. Abdulraheem¹ and B.M. Aminu²

¹Department of Biochemistry, Bayero University, Kano

²Department of Biology, Kano University of Science and Tech., Wudil.

*Correspondence Author

ABSTRACT

In order to assess the potency of aqueous stem bark extract of Khaya senegalensis (KS) against liver diseases, serum aspartate transaminase (AST), alanine transaminase (ALT) and alkaline phosphatase (ALP) were assayed in rats treated with two (2) different doses of the extract after the induction of liver damage in the rats using carbon tetrachloride, CCl₄. The rats treated with a daily dose of 80mg/kg for six (6) days had serum liver enzymes activities not significantly different from those in control rats; whereas those treated with a daily dose of 200mg/kg for nine (9) days had serum liver enzymes activities significantly higher (P<0.05) than those in control rats. Thus, a dose of 80mg/kg aqueous bark extract of KS for 6 days could be potent against liver disease, but a higher dose of 200mg/kg for 9 days could induce liver toxicity.

Key words: *Khaya senegalensis*, potency, liver diseases, carbon tetrachloride.

INTRODUCTION

The use of herbal medicine is a very historic and widespread phenomenon. In spite of the common use of herbal medicine in the healthcare delivery in many countries, like Nigeria, and the availability of medicinal herbs in local markets, herbal concoctions are not in use in government health centres (Tella, 1986). This is partly due to lack of adequate information and detailed scientific analyses of the commonly used herbal medicines.

Khaya senegalensis, Desr. (common name: Dry-zone mahogany) is one of the plants commonly used in Nigeria, and several West African countries, as medicine. It is an evergreen tree, which grows up to 40m high in climates ranging from savannas to humid forests (Maydell, 1986). The bark extract is used for treating jaundice, dermatoses, hookworm infection and malaria (Maydell, 1986; Gill, 1992). The seeds and leaves are used to treat fever and headache; and the roots are used to treat mental illness, syphilis and leprosy (Mayell, 1986).

The liver of mammals serves the important roles of detoxification of foreign compounds and regulation of blood glucose level, among others. It, therefore, receives blood draining the gastrointestinal tract and becomes exposed to chemicals, poisons and toxins absorbed from the gut. Many chemicals cause toxic effects to the liver when administered even in small concentrations. One of these chemicals is carbon tetrachloride (CTC). It induces liver damage by the formation of trichloromethyl radical ($\cdot\text{CCl}_3$), which reacts with molecular oxygen to form trichloromethylperoxy radical ($\text{CCl}_3\text{-OO}\cdot$). It is the trichloromethylperoxy radical which reacts with lipids in the membrane bilayer causing lipid peroxidation and liver damage (Packer *et al.*, 1978; McCay *et al.*, 1984 and De Zwart

et al., 1997). The effect of CTC on the liver was reported to provide an effective model with which natural plant products are assessed for hepatoprotective function (Hase *et al.*, 1996; Obi and Uneh, 2003).

Since the aqueous stem bark extract of KS has been reported to be used as medicine against at least one form of liver disease, the work reported in this paper was carried out to investigate its potency against CTC – induced liver damage in rats.

MATERIALS AND METHODS

KS stem bark was obtained from Jogana, Gezawa Local Government Area, Kano State. It was authenticated at the Department of Biological Sciences, Bayero University, Kano. The stem bark was dried at room temperature and crushed into powder. The aqueous bark extract was prepared as reported previously (Sule and Mohammed, 2006).

Commercially prepared reagent kits for AST, ALT and ALP obtained from Randox Laboratories, Antrim, U.K. were used to assay the enzymes.

Treatment of Rats.

Twenty (20) albino rats weighting between 170 – 290g obtained from Department of Pharmacology, Bayero University, Kano were used for the study. They were divided into three (3) groups.

Group 1 rats, consisting of twelve (12) rats, served as control Group.

Group 2 rats, consisting of four (4) rats, were subcutaneously injected with 50 mg/kg CTC. The animals were sacrificed 24 hours later, along with four (4) rats from Group 1, and their serum AST, ALT and ALP were assayed.

Group 3 rats, consisting of four (4) rats, were also administered with 50 mg/kg CTC and were given 80 mg/kg bark extract of KS daily for 6 days starting from 24 hours after the CTC administration. The animals were sacrificed 24 hours after the last dose, along with 4 rats from Group 1, and their serum AST, ALT and ALP were determined.

Group 4 rats, consisting of 4 rats, were administered with 50 mg/kg CTC and were given 200 mg/kg bark extract of KS daily for nine (9) days starting from 24 hours after the CTC administration. The animals were sacrificed 24 hours after the last dose, along with 4 rats from Group 1, and their serum AST, ALT and ALP were determined.

All the rats were allowed free access to food and water *ad libitum*.

Analyses of Serum AST, ALT and ALP.

The method of Reitman and Frankel (1957) was used to determine AST and ALT activities. DL aspartic acid or alanine was allowed to react with 2 – oxoglutarate at pH 7.4 in the presence of serum for AST and ALT assay respectively. The resulting oxaloacetate or pyruvate was treated with 2,4 – dinitrophenylhydrazine to form their respective hydrazone derivatives, which were measured colorimetrically at 546 nm.

The method of Kind and King (1954) was used to determine ALP activity. The serum was incubated with phenylphosphate buffered at pH 10.0. The hydrolysis product, phenol, was condensed with 4-aminophenazone and then oxidized with alkaline ferricyanide to give a complex, which was measured colorimetrically at 510 nm.

Student 't' test was used to compare the activities of the enzymes in the test and control rats.

RESULTS AND DISCUSSION

From Table 1, the rats administered with 50 mg/kg CTC had significantly higher (P<0.05) mean serum AST, ALT and ALP activities than those in control rats, 24 hours after administration. AST and ALT are non – plasma specific enzymes involved in deamination of aspartic acid and alanine respectively, mostly in the liver (Price and Stevens, 2003). The enzymes were

reported to reach higher than normal levels in the blood when there is necrosis of the parenchymal cells of the liver as in viral or toxic hepatitis, cirrhosis etc (Price and Stevens, 2003). ALP is also a non – plasma specific enzyme involved in the hydrolysis of a variety of phosphate esters at alkaline pH (Price and Stevens, 2003). The enzyme was reported to reach higher than normal level in the blood in the events of either impaired liver function, especially obstructive jaundice, or necrosis of osteoblasts or both (Price and Stevens, 2003). The fact that the administration of 50mg/kg CCl₄ resulted in higher than normal activities of AST, ALT and ALP confirms the previous reports that the chemical causes lipid peroxidation and liver damage (Obi and Uneh, 2003; Sule *et al.*, 2006).

The rats administered with 50 mg/kg CTC followed by treatment with 80 mg/kg aqueous bark extract of KS for six (6) days had mean serum AST, ALT and ALP activities not significantly higher than the levels in control rats (Table 2). This showed possible curative effect of the KS bark extract on the liver damage caused by the CTC.

The rats administered with 50 mg/kg CTC followed by treatment with 200 mg/kg aqueous bark extract of KS for nine (9) days had mean serum AST, ALT and ALP activities significantly higher (p<0.05) than those in control rats (Table 3). These high enzymes activities could be as a result of the toxic effect of high concentration of the KS bark extract. The stem bark extract of KS was reported to contain phytochemicals such as scopoletin, scoparone, limonoid, tannins, saponins, and sterols (Gbile, 1986). High concentrations of some of these phytochemicals could also induce lipid peroxidation and liver damage, just like the CTC. In addition, the bark extract was reported to contain varying quantities of Ca²⁺, K⁺, Na⁺ and Cl⁻ ions (Full *et al.*, 1999). Higher concentration of cations with respect to anions or vice-versa, exceeding the acid – base balance capacity of the body, is known to cause electrical imbalance, which could impair with the integrity of cell membranes and cause cell lysis. Since the liver is the first organ receiving the blood draining the gastrointestinal tract, its cells are more at risk from this impact than cells of other organs.

Table 1: Serum AST, ALT and ALP activities in rats 24 hrs after administration of 50mg/kg CTC.

| Group | AST(U/L) | ALT(U/L) | AL(U/L) |
|---------------|---------------------|-----------------------|-----------------------|
| Control (n=4) | 11.5 ±2.2 | 4.0±1.1 | 217±9.3 |
| Test (n=4) | 31.5±6 ^b | 15.5±2.2 ^b | 287±22.6 ^b |

Values are mean ± standard deviation. n= number of animals
Values with superscript b are significantly different from control at P<0.05.

Table 2: Serum AST, ALT and ALP activities in rats administered with 50mg/kg CTC followed by treatment using 80mg/kg aqueous bark extract of KS for 6 days.

| Group | AST(U/L) | ALT(U/L) | ALP(U/L) |
|---------------|-----------------------|-----------------------|----------------------|
| Control (n=4) | 8.3±6.7 | 12.5±4.1 | 207±5.1 |
| Test (n=4) | 23.0±7.2 ^a | 17.4±0.6 ^a | 281±7.1 ^a |

Values are mean ± standard deviation. n= number of animals
Values with superscript a are not significantly different from control (P>0.05).

Table 3: Serum AST, ALT and ALP in rats administered with 50 mg/kg CTC followed by treatment using 200mg/kg aqueous bark extract of KS for 9 days.

| Group | AST(U/L) | ALT(U/L) | ALP(U/L) |
|---------------|------------------------|-----------------------|-----------------------|
| Control (n=4) | 11.5 ±2.1 | 2.4±1.1 | 207±5.1 |
| Test (n=4) | 78.0±15.6 ^b | 11.7±1.6 ^b | 304±39.0 ^b |

Values are mean ± standard deviation. n= number of animals

Values with superscript b are significantly different from control at p<0.05.

CONCLUSION

In conclusion, it can be seen that the aqueous bark extract of KS administered at dose of 80mg/kg daily for 6 days could be potent against lipid peroxidation

and liver damage. However high dose of the extract, 200mg/kg daily for 9 days, could cause toxicity to the liver through induction of lipid peroxidation or electrical imbalance across cell membrane.

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