Abstract—Liver disorders are one of the major problems of the world. Despite its frequent occurrence, high morbidity and high mortality, its medical management is currently inadequate. This study was designed to evaluate the hepatoprotective effect of saponin extract of the root of *Garcinia kola* on the integrity of the liver of paracetamol induced wistar albino rats. Twenty five (25) male adult wistar albino rats were divided into five (5) groups. Group I was the Control group that received distilled water only, group II was the negative control that received 2 g/kg of paracetamol on the 13th day, and group III, IV and V were pre-treated with 100, 200 and 400mg/kg of the saponin extract before inducing the liver damage on the 13th day with 2 g/kg of paracetamol. Twenty four (24) h after administration, the rats were sacrificed and blood samples were collected. The serum Alanine Transaminase (ALT), Aspartate Transaminase (AST), Alkaline Phosphatase (ALP) activities, Bilirubin and conjugated bilirubin, glucose and protein concentrations were evaluated. The liver was fixed immediately in Formalin and was processed and stained in Haematoxylin and Eosin (H&E). Administration of saponin extract from the root of *Garcinia kola* significantly decreased paracetamol induced elevated enzymes (H&E). A. Plant Materials

The root of *Garcinia kola* (Bitter kola) was collected from Are-Ekiti, Ekiti state, Nigeria. The samples were thoroughly...
examined to ensure that they were diseases free before they were identified by at the Herbarium section of Plant Science Department, Ekiti State University, Ado-Ekiti, Nigeria. A voucher specimen was deposited in the Departmental Herbarium. The roots were cut into bits and air-dried at room temperature; the dried roots were then crushed into coarse Powder with a pestle and mortar and further milled into a fine powder using an electric grinding machine.

B. Preparation of Saponin Extract

100g of the ground sample was extracted with 500ml of petroleum ether (40-60°C) in a soxhlet extractor for 12h. The air-dried defatted sample was similarly extracted with methanol (600ml) for 13h. The method of [9] was used to purify the saponin from the methanolic extract. This was partitioned between 1:1 (v/v) mixtures of n- butanol and water. After shaking very well and allowing standing, the n-butanol layer was separated as a brownish green layer. The aqueous layer was washed with n-butanol until it became colourless. The pooled butanolic layer was evaporated in vacuo to give a residue which was dissolved in 100ml of methanol and precipitated by adding a large amount of diethyl ether to obtain a solid crystalline dark brown saponin compound [10].

C. Animals

Adult male albino rats (190-200g) were obtained from the Animal House of the University of Ilorin, Kwara State, Nigeria. The animals were maintained in a well ventilated room under 12 h light: 12 h dark cycle and were acclimatized for 2weeks in the animal house of Biochemistry Department, Ekiti State University before the start of the experiment. Animals were allowed to freely feed on their standard pellet diet and water ad libitum. The authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee.

D. Experimental Design for Hepatotoxicity and Hepatoprotective Activity Study

Twenty (25) albino rats were divided into 5 groups of 5 rats each and subjected to different doses of saponin extract. The experiment was designed with five groups (A-E) each containing 5 rats. The experimental groups were:

Group A- Negative Control group: Rats were fed with normal rat pallets and water.

Group B- Positive Control group: Rats were injected intraperitoneally with a single dose of 2g/kg of paracetamol on the 13th day of the experiment.

Group C: Rats were pre treated with 100mg/kg body weight of saponin extract from the root of Garcinia kola for 14days and injected intraperitoneally with a single dose of 2g/kg of paracetamol on the 13th day of the experiment.

Group D: Rats were pretreated with 200mg/kg body weight of saponin extract from the root of Garcinia kola for 14days and injected intraperitoneally with a single dose of 2g/kg of paracetamol on the 13th day of the experiment.

Group E: Rats were pre treated with 400mg/kg body weight of saponin extract from the root of Garcinia kola for 14days and injected intraperitoneally with a single dose of 2g/kg of paracetamol on the 13th day of the experiment.

The rats were kept in fasting condition overnight before the test was performed. The animals were sacrificed 24 hours after paracetamol administration by cervical dislocation.

E. Assessment of Liver Functions

After sacrifice, blood samples from each group of rats were collected in centrifuge tubes, allowed to clot at room temperature and the serums were separated by centrifugation (3000rpm, 15 minutes). Serum samples were subjected to liver function tests of serum enzymes such as serum Alanine aminotransferase (ALT), Aspartate aminotransferase (AST) [11], Alkaline phosphatase (ALP), Total and Direct bilirubin by Standard enzymatic colorimetric method [12]. Liver specimens of rats were sliced (few mm thickness) and fixed in 10 % buffered formalin for days and histological study carried out as described by [13].

III. RESULTS

![Fig. 1 Serum enzyme activity (U/L) of paracetamol induced rats treated with Saponin extract of the root of Garncia kola. The results are means ± SD](image)

![Fig. 2 Serum concentrations of Total and conjugated bilirubin, Glucose (mg/dl) of paracetamol induced rats treated with Saponin extract of the root of Garncia kola. The results are means ± SD](image)
The results of hepatoprotective activity Saponin extract of the root of *Garcinia kola* on paracetamol treated rats are shown in Figs. 1-3. The hepatic enzymes ALT, AST and ALP and biochemical parameters Total and conjugated bilirubin in serum was significantly increased in paracetamol treated animals when compared to control. The Saponin extract of the root of *Garcinia kola* treatments significantly reversed the levels of ALT, AST, ALP, Total bilirubin and conjugated bilirubin when compared to paracetamol alone treated rats. Also the reduction observed in the levels of Total protein, albumin and glucose in the group of rats given paracetamol only were increased in the saponin treated rats.
Fig. 8 Photomicrograph of the paracetamol induced group pre-treated with 100mg/kg saponin after 48hr of induction showing a very mild periportal cellular infiltration at x 400 magnification

Fig. 9 Photomicrograph of the paracetamol induced group pre-treated with 200mg/kg saponin after 24hr of induction showing a mild to moderate diffuse vacuolar degeneration of the hepatocytes at x 400 magnification

Fig. 10 Photomicrograph of the paracetamol induced group pre-treated with 200mg/kg saponin after 48hr of induction showing a very mild diffuse vacuolar degeneration of the hepatocytes at x 400 magnification

Fig. 11 Photomicrograph of the paracetamol induced group pre-treated with 400mg/kg saponin after 24hr of induction showing a moderate and diffuse vacuolation at x 400 magnification

Fig. 12 Photomicrograph of the paracetamol induced group pre-treated with 400mg/kg saponin after 48hr of induction showing a very mild diffuse vacuolar degeneration of the hepatocytes, at x 400 magnification

IV. DISCUSSION

The liver is the key organ regulating homeostasis in the body. It is involved with almost all the biochemical pathways related to growth, fight against disease, nutrient supply, energy provision and reproduction [14]. The ability of the liver to perform these functions is often compromised by numerous substances we are exposed to on a daily basis; these substances include certain medicinal agents which when taken in over doses and sometimes when introduced within therapeutic ranges injures the organ [15]. Inspite of tremendous scientific advancement in the field of hepatology in recent years, liver problems are on the rise. Liver disease is a worldwide problem. Conventional, drugs used in the treatment of liver diseases are sometimes inadequate and can have serious adverse effects. Therefore, it is necessary to search for alternative drugs for the treatment of liver disease in order to replace currently used drugs of doubtful efficacy and safety [3].

Paracetamol is a well known anti-pyretic and analgesic agent, which is safe in therapeutic doses but can produce fatal hepatic necrosis in man, rats and mice with toxic doses [5]-[16]. At therapeutic levels, paracetamol is primarily metabolized in the liver by glucuronidation and sulphation;
Saponin extract from the root of Garcinia kola exhibited a reasonable hepatoprotective ability against paracetamol induce hepatotoxicity. It could be explored in the synthesis of drugs for the treatment of liver disorders.

REFERENCES