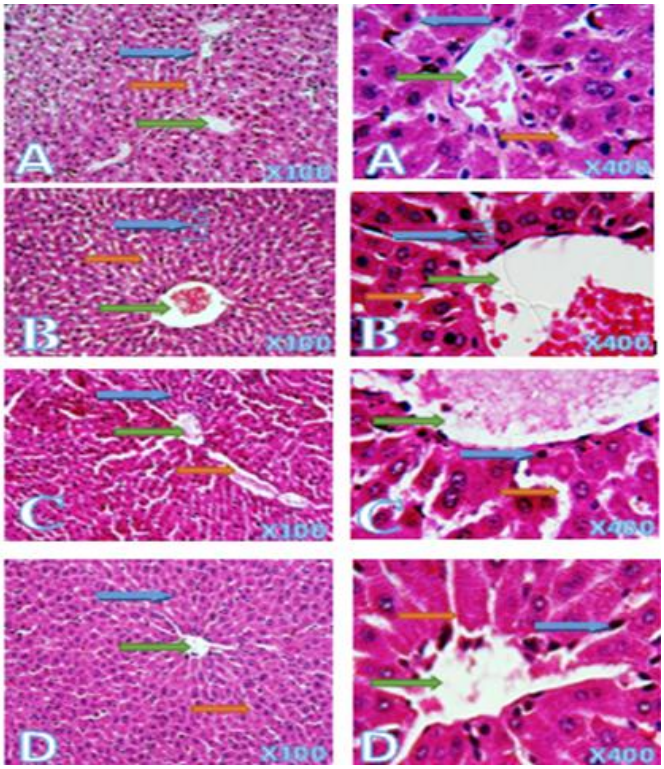

Plate 1: Hepatic histology after three weeks of treatment (H&E stain)
A: Normal control; B: STZ-induced untreated; C: STZ-induced + ML D: STZ-induced + MH

A photomicrogragh of liver sections of the normal control group (group A) showed normal liver microarchitecture, central vein(green arrow), sinusoids (red arrow), hepatocytes(blue arrow), no haemorrhage and there is no infiltration of inflammatory cells.A photomicrograph of liver sections of group B induced with 60mg/kg STZ showed peroportal fatty infiltration(PFI) with focal necrosis of hepatocytes(blue arrow), enlarged sinusoids(red arrow) and central vein(green arrow). A photomicrograph of liver sections of group C induced with 60mg/kg STZ and treated with 150mg/kg of methanolic extract of *Sennaalata* leaves showed normal central vein(green arrow), reduced distortion in the histology of the hepatocytes(blue arrow), enlarged sinusoids with perivenous fatty infiltration (red arrow). A photomicrograph of liver sections of group D induced with 60mg/kg STZ and treated with 300mg/kg of methanolic extract of *Sennaalata* leaves showed normal liver microarchitecture featured hepatocytes(blue arrow), sinusoids(red arrow) and central vein(green arrow) no haemorrhage and there is no infiltration of inflammatory cells compared with normal control group.
STZ: streptozotocin; ML: methanolic low dose; MH: methanolic high dose

4. Discussion

The result obtained in this study indicated that exposure of rats to STZ resulted in significant decrease ($P < 0.05$) in the activity of superoxide dismutase (SOD) and concentration of reduced glutathione (GSH) as well as significant ($P < 0.05$) increasein malondialdehyde (MDA) concentration compared with the control group. This is consistent with the results of previous researchers on the effect of STZ on the oxidative status of STZ- exposed rats (Nakhaee*etal*., 1999; Coskun*etal*., 2005; Tavares de Almeida *etal*., 2012). The observed significant decrease ($P < 0.05$) in the activity of superoxide dismutase (SOD) and concentration of reduced glutathione (GSH) along sides significant ($P < 0.05$) increase in malondialdehyde (MDA) concentration indicates oxidative stress in STZ-induced rats (Ujowundu*etal*., 2012).SOD catalyses the consumption of superoxide anion (O_2) which peroxidises cell membrane. The activity of SOD in the cell is therefore a predictor of oxidative status of that cell. The significantly low SOD activity recorded in the liver of the STZ- induced untreated rats could mean the tissue was undergoing oxidative attack occasioned by superoxide anions (Table 1 and Figure 1). However, treatment with 150mg/kg and 300mg/kg of methanolic extract of *Sennaalata leaves* significantly increased superoxide dismutase activity in dose dependent manner in group C (STZ-induced +ML) and group D (STZ-induced + MH).

In organ and tissue damage, GSH makes up the first line of defense against free radicals resulting from the ingestion of xenobiotics (Ujowundu*etal*., 2012). The significantly low GSH level in the Streptozotocin induced untreated group compared with the normal control group might have confirmed damage to the liver presumably by the oxidant (Table 1 and Figure 1). Nonetheless, treatment with chloroform extract of *Sennaalata also* significantly increased the reduced glutathione concentration in dose dependent manner. The observed increase in malondialdehyde (MDA) concentration in STZ-induced untreated group as compared to the controlindicates increased lipid peroxidation which could have resulted from depletion of GSH concentration. Again treatment with 150mg/kg and 300mg/kg of methanolic extract of *Sennaalata leaves* significantly reduced the MDA levels in both group C (STZ- induced +ML) and group D(STZ-induced +MH), with higher reduction in group D(STZ-induced +MH).

The observed significant increase in SOD activity and reduced glutathione concentration with corresponding significant decrease in MDA level in rats induced with STZ and treated with methanolic extract of *Sennaalata leaves*indicates the ameliorative effect of methanolic extract of *Sennaalata leaves* on STZ-induced oxidative stress and hepatotoxicity.Methanolic extract of *Sennaalata* leaves may have conferred protection against oxidative damage of the hepatocytes by the antioxidant activity of its phytoconstituents as the preliminary phytochemical screening of methanolic extract of *Sennaalata leaves revealed* the presence of antioxidants such as flavonoids, alkaloid, glycosides and saponins(Wegner andFintelmann, 1999, Manjunath, 2006, Trans *etal*., 2001,Vijayan*etal*., 2003). Previous studies have established antioxidant compounds such as vitamin E (Tavares de Almeida et al., 2012) and quercetin (Coskun*etal*., 2005) , and antioxidant-containing plant *Eucalyptus globules* (Nakhaee*etal*., 1999) to prevent and ameliorate streptozotocin-induced oxidative stress and hepatotoxicity. Moreover,flavonoids,alkaloids,saponins,glycosidehave been reported to possesshepatoprotective activity(Wegner andFintelmann, 1999, Manjunath, 2006, Trans*etal*., 2001,Vijayan*etal*., 2003).

The result of this present study also indicated hepatic injury as evident by a significant increase ($P<0.05$) in the activities of serum marker enzymes namely serum alanine transaminase (ALT) and serum aspartate transaminase (AST) in the group treated with streptozotocin only when compared with the normal control (Table 2 and Figure 2). Increased levels of serum ALT and AST have been reported to be sensitive marker of hepatic damage(Ochei, Kolhatkar, 2005;Achuba and Ogwumu, 2014). Thismay be due to leakage from the cells through peroxidative damage of the membrane. However,the reduction in the levels of these marker enzymes in groups administered with methanolic extract (Groups C andD) is suggestive of regeneration process and repair of hepatic damage induced by streptozotocin.

Histological findings showed normal histoarchitecture in the normal control group. Photomicrograph plates of Group A(Plate 1) reflects normal hepatocytes separated by sinusoids. The central veins show normal histoarchitecture, no haemorrhage and there is no infiltration of inflammatory cells seen within the liver parenchyma. The histological section of STZ –induced untreated group showed enlarged central vein, periportal fatty infiltration (PFI) with focal necrosis of hepatocytes. The sinusoids were enlarged with fatty infiltration (Plate 1).

However, treating rats with methanolic extract of *Sennaalata*leaves improved the histological features of the liver cells. Although the liver of rats treated with 150mg/kg(group C) still featured some lesionsas seen in group B, the liver of the group treated with 300mg/kg(group D) showed normal histological features as observed in the normal control group. This suggests the antioxidativeactions and hepatoprotective potential of *Sennaalata leaves* extract is dose-dependent and more efficient at higher doses.

5. Conclusion

This study demonstrated that methanolic extract of *Sennaalata leaves* through its marked antioxidant properties salvagedstreptozotocin-induced oxidative stress and hepatic damage. Therefore,*Sennaalata*leaves can be used for the treatment of oxidative stress-induced hepatic disorders.

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