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ASSESSMENT OF THE THERAPEUTIC IMPACTS OF ETHANOL RHIZOMES EXTRACT OF *Curcuma longa* ON LIVER ENZYME ENZYMES OF DIABETES-INDUCED MALE ALBINOS WISTAR RATS

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ABSTRACT

The therapeutic impacts of ethanol rhizomes extract of *Curcuma longa* on liver enzymes of male albino Wistar rats (198-225g) induced by alloxan, diabetes were assessed. Thirty healthy animals, were randomly assigned six groups of five rats each. Diabetes mellitus were induced in groups 1 – 5 via peritoneum. Thereafter, groups 1, 2 and 3 received daily oral administration of 200mg/kg, 500mg/kg and 700mg/kg of *C. longa* extract respectively, for one month. Group 4 (positive control received 500mg/kg metformin, a typical anti-diabetes medication, whereas groups 5 and 6 were untreated, serving as negative and normal controls respectively. Serum AST level recorded a significant decrease ($P>0.05$) was found in group 3 when compared to group 6. There was no significant difference ($P>0.05$) of serum ALT level between and among the groups. Serum ALP level showed significant increase ($P<0.05$) in group 1 when compared to group 4. Group 2 showed no significant difference ($P>0.05$) when compared to groups 3, 4, 5 and 6 respectively. A significant increase ($P<0.05$) was recorded in group 4 when compared to groups 5 and 6. These results implied that diabetes mellitus impacted the liver enzymes in the animals, while ethanol rhizomes extract appeared to ameliorate the effects.

Key words:*Curcuma longa*, AST, ALP, ALT, Diabetes mellitus, therapeutic impact, Albino Wistar rats

1.0 Introduction

Curcuma longa, commonly known as turmeric, is a perennial herbaceous plant in the family, *Zingiberaceae*. It is indigenous to South Asia and widely cultivated in tropical and sub-tropical regions around the world (Aggarwal and Harkumar, 2024). Traditionally used in Ayurvedic and Chinese medicine, the rhizomes of the plant is renowned for its rich content of bioactive compounds, particularly, curcuminoids, such as curcumin, which exhibits potent antioxidant, anti-inflammatory, antimicrobial, andantidiabetic properties (Jain *et al.*, 2022). The therapeutic relevance of *Curcuma longa* rhizomes has gained increased attention in modern medicine, especially for the management of chronic diseases with oxidative stress and inflammation, including diabetes mellitus (Aggarwal and Harkumar, 2024) Diabetes, mellitus is a persistent metabolic disorder characterized by chronic hyperglycemia, resulting from defective insulin secretion, insulin action or a combination of both condition (American Diabetes Association, 2023). The disease is a global public health concern, leading to numerous systemic complications that impair biochemical and physiologic mechanisms in living organisms and increase mortality rates (World Health Organization, 2022). Among its

many implications, liver dysfunction stands out as a frequent and significant concern (Kumar *etal.,* 2021): The liver plays a central role in metabolism, such as glucose metabolism and protein synthesis; thus in diabetic states, hepatic abnormalities often manifest as altered. Serum concentrations of vital proteins (Kumar *etal.,* 20.21).

Hyperglycemia induced oxidative stress and induced metabolic disturbances in diabetic patients contribute to hepatocellular damage, impairing the liver's ability to function properly.Diabetes significantly impacts the liver, often leading to metabolic, dysfunction associate with steatotic liver disease (MASLD)- formerly NAFLD-caused by high insulin resistance, inflammation, and fat build up (Ayoola*et al.,* 2016) .

Elevated liver enzymes (ALT, AST, ALP) are common, signaling cellular injury. Diabetes mellitus has been reported to have resulted in elevated ALT (Alanine Aminotransferase). This is the most common indicator, reflecting hepatocellular injury and inflammation, especially in MASLD. AST (Aspartate Aminotransferase) has also been reported to elevate in diabetes condition. This often got raised along with ALT indicating ongoing liver damage. Diabetes mellitus generally reads to an elevation of Serum Alkaline Phosphatase (ALP) levels.This increase is often associated with poor glycemic control, indicating that higher blood sugar levelscorresponds to higher ALP levels, frequently prompting to underlying bone of liver compilations (Hoofnagle*et al.,* 2013).

However, experimental evidence suggests that plant-based interventions particularly those rich in antioxidants like *Curcuma longa,* may mitigate liver damage by cointerracting oxidative-stress and supporting metabolisms (Jain *et al.,* 2002). Animal Studies have demonstrated that administration of *Curcuma longa* extracts in diabetes models result in improvements is in glucose regulation, lipid profiles, and hepatic enzyme activity. Indicating its hepatoprotective potentials (Patel and Shan, 2023).Despite these promising findings, there remains limited information on the specific effects of *Curcuma longa* rhizoid extracts on liver enzymes in diabetic condition (Ojo*et al*., 2025). This study therefore seeks to explore the ameliorative potentials of *Curcuma longa* extracts on serum liver enzymes (AST, ALT and ALP) in male albino Wister rats induced with diabetes mellitus. This research may offer insights into the mechanisms through which this medicinal plant alleviates liver-related complications in diabetic states and support its integration into complementary therapeutic strategies.

2.0 Materials and Methods

2.1 Collection and Preparation of Plant Sample

Fresh rhizoids of Curcuma longa were harvested in a farm in IkotEkpene, AkwaIbom State, Nigeria. The sample was authenticated by a taxonomist in the Department of Botany and Ecological Studies, Faculty of Science, University of Uyo,AkwaIbom State,Nigeria (Essien*etal.,* 2022). The scales, were removed from the rhizoids with the aid of knife, washed with distilled water to get rid of dirt, cut into small pieces, and dried at room temperature for three days. The Sample was then ground with a clean, dry mortar and pestle. Subsequently, 1000g of the ground sample was soaked in 200ml of 70% ethanol for 72 hours at room temperature (Essien*etal.,* 2025). The mixture was filtered using a funnel and Whatman No. 1 filter paper. The filtrate was concentrated for three days in a water bath, then, the slurry extract was stored in a refrigerator at 4°C for later usage (Essien*etal.,* 2022).

2.2 Procurement of Alloxam and Induction of Diabetes

Alloxan was bought from a drug warehouse in London and used in this work. From groups 1 to 5, 180mg/kg of alloxan was injected into the peritoneum of albino Wistarrats that had been fasting overnight. This was done based on the average body weight of the rats in each group. After three days of induction, a glucometer and strips were used to confirm diabetic condition.

2.3 Experimental Design, Grouping and Treatment of the Animals

A total of thirty (30) healthy adult malealbino Wistar rats, (198 to 225g) were obtained from the disease free stock of the animal house, Biochemistry Unit, Department of Chemical Science, AkwaIbom State Polytechnic, IkotOsurua. The animals were housed in a cage with sizeable compartments of wooden bottom and wire mesh top, and were randomly assigned five animals per six groups. The rats were maintained under

standard conditions of temperature and natural, light-dark cycle for 7 days acclimatization in the animal house, AkwaIbom State Polytechnic, IkotOsurua. The use of animals for the study was carried out in accordance with guidelines set by Institute for Laboratory Animal Research (Institute for Laboratory Animal Research, National Research Council, 2000). Groups 1 to 5 animals were induced diabetic peritoneally with alloxan, then groups 1-3 were given 200mg/kg, 500mg/kgand 700mg/kg of *Curcuma longa* rhizomes extracts daily for 30days. Group 4 was treated with 500mg/kg of metformin, a common antidiabeic drug (positive control). Groups 5 and 6 were not treated as negative and normal controlsrespectively.After one month treatment, the animals were anaesthetized with chloroform vapour and sacrificed via medioventrically and whole blood obtained by cardiac puncture by means of syringe and needle and the blood put into EDTE bottle, centrifuged using a centrifuge at 4000rpm for 10minutes to separate serum from the plasma.The serum was used to determine the levels of ALP, AST ALT.

3.0 Methods

3.1 Determination of Serum level of Aspartate Aminotransferase (AST).

To two clean sample tubes labeledblank and sample, 0.1ml of distilled water and serum sample were poured into respectively. Thereafter,0.5ml of the substrate prepared (RI) was added into each tube and incubated at 37°C for 30mimutes. Then, 0.5ml of 2,4-dinitro phenyl hydrazine solution (R2) was added, mixed and allowed to stand for 20minutes at 20-25°C and finally, 5.0ml of sodium hydroxide was added to each tube, mixed and the absorbance of the sample was read, against the reagent blank after 5 minutes using spectrophotometer at a wavelength of 456nm (Reitman and Frankel, 1975).

3.2 Determination of Alanine Transferase (ALT)

To two sampletubes labeled blank and sample, 0.1ml of distilled water and serum sample was measured into each respectively. Then, 0.5ml of the substrate prepared (R1), wasalso added, mixed, an incubated at 37°Cfor 30minutes. Thereafter, 0.5ml of 2,4-dinitrophenyl-1-hydrazine solution (R2) was added to all the tubes, incubated and allowed to stand at room temperature for 20 minutes. Finally, 5.0ml of sodium hydroxide (0.4M) was added to each tube and the absorbance of the sample was read against a reagent blank with a Spectrophotometer at 546nm (Reitman and Frankel,1975).

3.3 Determination of Alanine Phosphatase (ALP)

Exactly 0.1ml of serum sample was pipetted into a test tube, then, 0.5ml of the reagent was added to the sample and it was mixed and the initial absorbance was read immediately, then, it was mixed further and the absorbance was at 1, 2, and 3 minutes intervals all at 405nm with a spectrophotometer at room temperature (Englauhondt, 1970).

3.4 Statistical Analysis Tests

Data obtained from the were subjected to one-way analyses of Variance (ANOVA). Statistical significant differences were obtained at $P<0.05$ by Bonferoni multiple range test. The results were expressed as Standard error of mean (SEM) estimated, using istatistical package of Social Science (SPSS) version 26

4.0 Results

Table 1.0 Mean Serum liver enzymes in Alloxan, diabetes-induced albino Wistar rats treated with ethanol rhizomeextract of *Curcumalonga*.

Group	AST (IU/L)	ALT (IU/L)	ALP (IU/L)
1	119.20±11.99	48.60±6.79	485.20±52.18
2	113.60±14.65	50.40±4.76	279.20±15.36
3	96.60±10.63	75.60±3.01	239.40±29.52
4	116.40±20.08	53.80±5.39	405.20±94.37

5	118.80±21.08	49.40±6.43	207.00±32.40
6	61.20±1294	60.60±26.27	198.20±37.40

Results are expressed as mean ± SEM (N=5)

5.0 DISCUSSION

The liver is the body is a crucial organ in the body of human, responsible for various functions that help support metabolism immunity, digestion, detoxification and storage amongother functions.Liver enzymes are biochemical markers used to assess liver integrity and functions. When liver cells (hepatocytes) or bile ducts are damages, enzymes leak into the blood stream and increase their levels above normal ranges. Elevated levels point to underlying conditions like hepatitis, fatty liver disease, or use or bile duct obstruction (Al-Harbi*etal.*, 2021;Alam*etal*., 2021). Most disease are also generated from the exposureof the overall metabolic or biochemical function of the body, cells, tissues or organs to certainsubstances such as drugs.

Meanwhile, in this work, the therapeutic impacts of ethanol rhizomes extract of*Curcuma longa*on liver enzymes of diabeticinduced male albino Wistar rats was assessed. Serum levels of Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT), and Alkaline phosphatase (ALP) where the liver enzymes assayed. The results revealed significant decrease in serumAST level in group 6(normal control) when compared to groups 1,2, 4and 5 respectively. No significant difference was observed in group 3 (treated with 700mg/kg) when compared to group 6. Though group 3, treated with 700mgkg,*Curcuma longa* rhizome extract exhibited the lowest serum AST level among all the treatment groups, the level was above normalrange of 8 to 48µ/L for human adult. Meanwhile elevated AST oftenindicate ongoing liver tissue damage caused by the diabetes-induced condition of the animals. Diabetes frequently causes elevated liver enzyme - primarily ALT, AST and GGT due to insulin resistance, oxidative stress, and the toxic effects of excessive fat and glycogen storage in the liver, (Alam*et al.*, 2021; Atkinson *et al.*, 2014; Anguizola*etal.*, 2013).

Furthermore there was no significant difference in Serum ALT levels between the groups ofanimals and among the groups. Aside from group up1 (treated 200mg/kg) with serum ALT level of 48.60µ/L which is within the normale range of 7 to 56µ/L for human adult, Other treatment groups recorded elevated serum ALT above normal range. Highly concentrated serum ALT level indicates elevated signals for liver cells inflammation or injury (Chainanu-Wu, 2003). ALT is the primary marker used to assess for fatty liver disease in diabetes patient (Danes *et al.*, 2015; Liu *et al.*, 2019; Kumar *et al.*, 2021). Moreso,Serum ALP level showed a significant increase in group I when compared to groups 2, 3, 5, and 6 respectively. There was no significantdifference in group1 when compared togroup 4. Group 2 showed no significant difference when compared to groups 3,4,5, and 6 respectively.But, there was a significant increase in group 4 when compared to groups 5 and 6 respectively. All treatment groups and negative control group (group 5) exhibited serum ALP levels above the normal range (44 to 147 µ/L) for human adult.

However, all *C. longa*rhizome extract treatment groups tried to reduce serum AST, ALT, and ALP most especially treatment at a highest dose (700mg/kg). Again, the metformin treatment group (group 5) – positive control also showed better response. It seems that *Curcuma longa* rhizomes extract treatment groups exerted potential antidiabetic effects, primarily through it active compound curcumin. Research shows that curcumin improves, glucose metabolism, reduces insulin resistance, and protects pancreatic B-cells from oxidative damage (Chattopad-hyay*etal.*, 2004; Barati*et al*., 2021; Jain *etal.*, 2022; Ehrahim -Zadeh*etal.*, 2022). According to Gupta *etal.*, (2013), the above antidiabeticfunction exhibited by *C. longa* rhizomes extract is achieved by suppressing inflammatory pathwaysand modulating key enzymes involved in blood sugar regulation which is linked with liver enzymes levels in the treatment groups of the animals. Gupta *et al.*, (2013) also observed the clinical trials and systematic reviews which indicate that *C. longa* extract can significantly reduce fasting blood glucose and glycated hemoglobin ((HbAlc) levels. Hoonagle*et al.* (2013) and Ojo*etal*. (2025) also reported that elevated serum ALP often occur in individuals with diabetes frequently pointing to restricted bile flow (cholestasis) or underlying metabolic bone issues. Therefore, the high serum liver enzymes (AST, ALT, und ALP) witnessed in the treatment groups and in the negative

control group of animals was caused by adverse acute effect of diabetes condition, though the extract at highest dose tried regulate the condition.

6.0 Conclusion

There was not much ameliorative impacts of ethanol rhizomes extract of *Curcuma longa* extract at low concentrations against the effect of diabetes on serum liver enzymes levels. However, at the highest treatment dose of the plant extract, appreciable therapeutic impacts was indicative.

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