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The biochemical effects of Kola Nitida on the Liver of Lipid-Induced Wistar Rats

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Abstract

This study investigates the biochemical effects of Kola Nitida on the liver of Wistar rats subjected to a high lipid diet. A High lipid diet induces oxidative stress, inflammation, and pancreatic dysfunction. This study evaluated whether Kola Nitida, known for its bioactive compounds such as flavonoids, caffeine, and theobromine, could protect the liver from lipid-induced damage. The study was conducted within 6 months (April – September 2024). The effect of bioactive compounds from kola nut extracts on liver functions of Wistar rats was investigated using standard methods. Twenty Wistar rats were used for the study. They were randomly divided into five groups 1, 2, 3, control, and toxicity made up of 4 rats each. The control group received water food, Group 1 received kola nitida extract 100mg/kg body weight water food, group (B) received kola nitida extract 200mg/kg body weight water food, and Group (C) received kola nitida extract 300mg/kg body weight water food by oral administration for 14 days. The results showed that caffeine from kola nuts had effects on the liver functions of the Wistar rats. Administration of kola nitida (vera) significantly decreased aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), GGT, Total bilirubin (TB), Total protein (TP), Albumin (ALB), activities, consumption of HFD increased total bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP)activity. Body weight, organ weight, and histopathological study were significantly reduced. This study seems to suggest that consumption of HFD and reversal with kolanut (kola nitida) will significantly cause positive effects on the biological and histological liver functions of humans.

Keywords: Hyperlipidemia; Kola-Nitida; Liver; AST; ALT; GGT; Biochemical; Caffein; Lipid-induced

1. Introduction

The liver is essential for various metabolic processes, including the regulation of carbohydrates, fats, and proteins. It detoxifies harmful substances, synthesizes plasma proteins, and produces bile necessary for digestion (3).

Elevated levels of these enzymes indicate hepatocellular damage, often resulting from conditions like NAFLD (2). One of the liver's primary functions is to manage and process nutrients absorbed from the digestive tract, making it essential for maintaining metabolic homeostasis (5).

Hyperlipidemia is highly prevalent across Nigeria, affecting between 60% and 89% of various populations, including healthy individuals and those with conditions like diabetes and hypertension. (4).

Kola nitida, belonging to the Malvaceae family, also popularly known as kola nut is a tropical tree native to the rainforests of Africa. More recently, scientific investigations have focused on its potential health benefits, including antioxidant, anti-inflammatory, and hepato-protective properties (1).

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2. Materials and methods

2.1. Study area

The study was carried out at Joseph Ayo Babalola University, Ikeji-Arakeji

2.2. Ethical approval

Ethical considerations were received from the College of Health Science Ethical Committee and Research, Joseph Ayo Babalola University, Ikeji-Arakeji in Osun state, Nigeria, and ensured following the guidelines and regulations approved for the use care of Wistar rats.

2.3. Scope of experimental design

This research is a controlled experiment, from the laboratory animal house of Joseph Ayo Babalola University, 20 male Wistar rats were purchased. The animals were fed with a high-lipid diet.

2.3.1. Control group

This group consisted of four (4) Wistar rats that were fed with a normal diet.

2.3.2. Toxicity group

This group consisted of four (4) Wistar rats that were fed with a high lipid diet.

2.3.3. Experimental group

This group consisted of fifteen (15) Wistar rats that were divided into groups of 100mg/kg, 200mg/kg, and 300mg/kg

2.4. Exclusion criteria

Wistar rats with underlying illness and other conditions were not used for this study.

2.5. Specimen collection and processing

Blood was collected from the retro-orbital plexus using heparinized capillary tubes under light anesthesia to minimize stress and pain to the rats. The collected blood was immediately transferred into two types of tubes: Lithium heparin tubes for biochemical analysis and plain tubes for serum separation. The serum was obtained by allowing the blood to clot at room temperature for 30 minutes, followed by centrifugation at 3000 rpm for 10 minutes to separate the serum from the clotted blood. The serum samples were aliquoted and stored at -80°C until further biochemical analysis.

2.6. Statistical analysis

For statistical analysis, data were analyzed by both one-way (for weight analysis) and two-way analysis of variance (ANOVA) (acetaminophen consumption analysis) using Graph Pad Prism (version 9.5.1) software. The results were expressed as mean standard deviation and Statistical significance was considered at a 95% confidence interval ($P<0.05$).

3. Results and discussion

Table 1 Results (Mean±SD) of Liver Function Parameters in Rats Treated with Varying Doses of Bitter Kola after HFD

Parameters	Group 1	Group 2	Group 3	Positive Control	Negative Control	F value	P value	Remark
Total Bilirubin (µmol/L)	2.67±0.57[a]	2.01±0.002[a]	2.33±0.58[a]	3.01±0.001[b]	2.02±0.003[a]	4.250	0.0289	S
Conjugated Bilirubin (µmol/L)	1.27±0.46	1.33±0.58	1.33±0.58	2.17±0.29	1.17±0.29	2.346	0.1250	NS

AST (U/L)	181.3±46.09[a]	228.3±1.53[a]	142.3±2.31[b]	147.0±1.73[b]	178.7±1.16[a]	8.334	0.0032	S
ALT (U/L)	63.67±3.06[a]	76.0±4.58[b]	71.33±2.31[b]	77.00±1.73[b]	76.67±0.58[b]	12.34	0.0007	S
ALP (U/L)	184.0±38.04[a]	194.0±21.43[a]	252.0±23.40[b]	445.0±24.3[c]	481.0±32.21[d]	207.7	<0.0001	S
GGT (U/L)	2.333±0.58[a]	5.333±0.58[b]	3.667±1.16[a]	3.333±0.58[a]	4.333±0.58[c]	7.063	0.0057	S
Total Protein (g/dl)	66.67±3.51[a]	66.33±1.16[a]	67.67±0.58[a]	61.67±1.17[b]	60.67±1.15[b]	9.170	0.0022	S
Albumin (g/dl)	32.01±1.02[a]	30.67±1.16[a]	33.67±0.58[a]	32.67±1.16[a]	29.33±0.5774[b]	10.00	0.0016	S

PostHoc: Values in the same row with different superscripts differ significantly at p<0.05. HFD=High Fat Diet.

Table 2. Results (Mean±SD) of Body Weight and Liver Organ in Rats Treated with Varying Doses of Kola nitida after HFD

Parameters	**Group 1**	**Group 2**	**Group 3**	**Positive Control**	**Negative Control**	**F value**	**P value**	**Remark**
Weight of Rats	120.0±0.28[a]	135.9±2.315[b]	127.9±0.31[c]	141.9±0.47[d]	129.0±0.48[c]	233.1	<0.0001	S
Weight of Liver	5.68±0.06[a]	5.12±0.02[b]	4.82±0.03[c]	6.30±0.02[d]	3.79±0.02[e]	3277	<0.0001	S

PostHoc: Values in the same row with different superscripts differ significantly at p<0.05. HFD=High Fat Diet, S=Significant at p<0.05.

Consumption of calories-rich results in lipid accumulation excess production of inflammatory cytokines, and macrophage infiltration that favor the progression of liver disease (Odegbarao, 2012) High-fat diet could induce hyperlipemia in rats and hyperlipidemia could alter the related liver makers in serum and liver tissue which then progress to liver cirrhosis (Oguntuga, 2010). In this study, hyperlipidemia-induced liver injury was investigated by the detection of liver biomarkers which include AST, ALP, ALT, GGT, CB, TB, ALB, and TP. This study aimed to evaluate the effects of Kola nitida on liver function parameters, body weight, and liver histology in rats subjected to a high-fat diet (HFD). The findings suggest that Kola nitida has potential hepatoprotective properties, although its effects appear dose-dependent.

4. Conclusion

This study concludes that Kola nitida exhibits significant hepatoprotective effects in rats subjected to a high-fat diet. The findings demonstrate that Kola nitida positively influences liver function parameters, body weight, and liver histology. Lower doses appear beneficial, enhancing liver function and mitigating damage, while higher doses may lead to inflammation and structural damage. Therefore, careful consideration of dosing is essential for maximizing the health benefits of Kola nitida.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest was disclosed.

Statement of ethical approval

Ethical considerations were received from the College of Health research and ethical committee, Joseph Ayo Babalola University Osun state, Nigeria.

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