EVALUATION OF THE IMPACT OF *SENNA ALATA* ON LIPID PROFILE LEVELS IN ALLOXAN-INDUCED DIABETIC WISTAR RATS

Eidangbe Adesuwa Peace[1]
Odia Evelyn[2]
Irogue Enorense Sylvia[3]
Enehizena Osaro Ogie[4]
Ohiwerei Wisdom Omogbai[5]
[1,2,3,4,]Ambrose Alli University, Department of Chemical Pathology, Edo State
[5]Research and Training Department, Ohilux Research Institute, Edo State

ABSTRACT
Diabetes is a metabolic condition where the body either fails to produce sufficient insulin or becomes resistant to its effects, resulting in high blood sugar levels. This disorder can lead to serious health problems, including stroke, kidney failure, blindness, amputations, cardiovascular diseases, and birth defects. The aim of this research was to investigate the impact of *Senna alata* on serum levels of total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) in Wistar rats with diabetes induced by alloxan.

The study involved 50 albino rats, each weighing between 150 and 200 grams, and all were treated following ethical guidelines for animal research. The rats were given standard food and water and were divided into two main groups: a control group and an experimental group. The experimental group was further subdivided into five smaller groups, each consisting of 10 rats (Groups A-E). Group A served as the control, while Group B received 5.17 mg/kg of *Senna alata* aqueous extract, Group C received 15.40 mg/kg, Group D received 27.87 mg/kg, and Group E was administered 0.5 ml of distilled water without the extract. At the end of the treatment period, the rats were euthanized, and blood samples were taken for analysis of total cholesterol, HDL, and LDL levels using established laboratory techniques.

The results indicated both the mean and standard deviation values for the control and experimental groups. In the control group, total cholesterol (TC) was 79.85±31.61 mg/dl, while the experimental group showed a value of 87.46±39.99 mg/dl. Triglycerides (TG) in the control group were 56.57±19.37 mg/dl, compared to 105.53±73.42 mg/dl in the experimental group. LDL levels in the control group were 35.71±28.58 mg/dl, and in the experimental group, they were 57.46±36.07 mg/dl. No significant difference ($p \geq 0.05$) was found in the total cholesterol and LDL levels between the two groups. However, a statistically significant difference ($p \leq 0.05$) was observed in the triglyceride levels.

Conclusively, this study indicates that *S. alata* extracts do not exhibit anti-lipemic properties and do not reverse biochemical disruptions in diabetic rats. Therefore, *S. alata* is not suitable for preventing or treating hyperlipidemia.

Keywords: *Senna alata*, total cholesterol, high-density lipoproteins, low-density lipoproteins

INTRODUCTION

Senna alata, a shrub commonly known by names such as "Ath thora" and "Eth thora" in Sri Lanka, "candle bush/tree" in Malaysia, and "ringworm shrub" in various regions, has a long history of use in treating ringworm infections (Tartor *et al*., 2020). Native to South America, this plant has spread across tropical areas of Southeast Asia, Africa, and North America (Kalyango *et al.,* 2020). While often grown for ornamental purposes, recent research highlights its use in treating a range of health conditions, including digestive problems, skin disorders, allergies, infections, and inflammation (Candelli *et al*., 2021). In both Africa and India, it is also a widely used herbal remedy for diabetes. Preliminary studies have demonstrated that an 85% ethanol extract of Senna alata leaves can lower blood sugar levels in animals with chemically-induced diabetes (Kottaisamy *et al.,* 2021).

Diabetes mellitus is a metabolic disorder marked by elevated blood sugar, resulting from insulin resistance or insufficient insulin production. It disrupts the metabolism of carbohydrates, fats, and proteins, often leading to severe complications such as kidney failure, neuropathy, and vision impairment. According to the International Diabetes Federation, the global number of people living with diabetes was 382 million in 2013, with projections suggesting that this number will rise to 592 million by 2035. In Africa alone, over 5 million people are affected, with this number expected to increase to 15 million by 2025. In Nigeria, diabetes prevalence ranges from 0.65% to 11%, with many cases undiagnosed due to limited access to healthcare and economic barriers (Patel *et al*., 2020). Similarly, emerging economies like India are seeing a surge in diabetes cases, with 41 million reported in 2006 and an estimated 70 million by 2025 (Zaheer *et al*., 2019).

Pharmaceutical companies are struggling to meet the rising demand for synthetic antidiabetic medications, particularly in rural areas where access is hindered by high costs and inadequate healthcare infrastructure. Consequently, there is growing interest in natural alternatives (Seddon *et al*., 2021). Many plants possess bioactive compounds that could offer therapeutic benefits for various ailments, and this study focuses on the potential of these plant-derived compounds.

The aim of this research is to investigate the effects of Senna alata extracts at varying doses on lipid profiles, including total cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL), in rats with diabetes induced by alloxan. Ethnopharmacological studies have shown that Senna alata has traditionally been used to treat digestive ailments like constipation, liver issues, and abdominal pain, as well as skin conditions such as dermatitis, eczema, athlete’s foot, and fungal infections (Magalhães *et al*., 2024). While its antidiabetic properties are well-documented, there is limited knowledge about its influence on lipid metabolism. This study aims to fill that gap by exploring how Senna alata affects lipid levels in diabetic rats. However, it is important to note that the study does not examine the condition of the organs that could potentially affect lipid metabolism (Peng *et al*., 2018). The results are expected to pave the way for further investigations into the role of medicinal plants in regulating lipid metabolism.

2.0 Materials and Methods

2.1 Research Design

For this investigation, 50 albino rats, each weighing between 150 and 200 grams, were selected. All procedures involving the animals adhered to the guidelines set forth by the Principles of Laboratory Animal Care. The rats were given a standard diet and access to water, with their daily water consumption being closely monitored for one week before the experiment began to establish their individual hydration needs during the acclimatization phase. The rats were then allocated into two main groups: a control group and an experimental group. The experimental group was further divided into five subgroups, each containing 10 rats (Groups A, B, C, D, and E). Group A was the control,

receiving only water and food, while Group B was administered 5.17 mg/kg of an aqueous extract of *Senna alata*, Group C received 15.40 mg/kg, Group D was given 27.87 mg/kg, and Group E was treated with 0.5 ml of distilled water without the *Senna alata* extract. The *Senna alata* leaves used in the study were collected from plants located around the College of Medicine at Ambrose Alli University. The extract dosages administered were based on typical dosages used for human treatments.

2.2 Experimental Animals

Fifty adult albino rats were sourced from the Animal House at the College of Medical Sciences, Ambrose Alli University, Ekpoma. The rats were housed under controlled laboratory conditions, including regulated temperature, humidity, and light, with unrestricted access to food and water. Before the administration of the extract, animals were given a two-week period to adjust to their new environment.

Drugs and Reagents

Senna alata was obtained from the plant around collage in Ambrose Alli University, Ekpoma, Edo State.

Instrument and consumable

Blender, Spectrophotometer, Randox glucose reactant , Weight balance, Syring, Hemoglobin reactant

2.3 Methods of Preparation

2.3.1 Preparation of *Senna alata* extract

Senna alata fresh leave were collected and was weighted. It was then grinded using an electronic blender to solution .The solution was further dissolved in 100ml of water. A measured amount of this solution was administered to the various groups for the stipulated period of time.

2.4. Ethical Approval

The Ethics and Research Committee of Ambrose Alli University, Ekpoma, Edo State, approved the protocol for this study.

2.5 Experimental procedures

Fifty adult male rats, eight weeks old, were used in this study. The rats were randomly assigned to one control group (A) and four experimental groups (B-E), with 10 animals in each group. The experiment will be conducted over a period of 25 days, selected to encompass two seminiferous cycles in rats (Chin et al., 2020).

2.6 Animal Grouping

The rats were divided into five groups, each consisting of ten animals, as follows:
Group A (Control): Received only feed and water for 14 days.

Group B (Test group): Received feed and water and was treated with 5.17 mg/kg of aqueous extract of Senna alata.

Group C (Test group): Received 0.5 ml of distilled water and was treated with 15.40 mg/kg of aqueous extract of Senna alata.
Group D (Test group): Received 0.5 ml of distilled water and was treated with 27.87 mg/kg of aqueous extract of Senna alata.

Group E (Test group): Received 0.5 ml of distilled water without Senna alata but was treated with alloxan

2.8 Inclusion and exclusion criteria
Only non pregnant rat, with no physical evidence of illness were including in this study

2.9 Sample collected and prepared
After sacrificing the rat in various batch , blood sample were collected in fluoride oxated sample bottle . It was then separated and stored for laboratory analysis of 4^{o}c

2.10 Laboratory Analysis
The estimation of Serum Total Cholesterol, Serum high density lipoprotein cholesterol (HDL-C), Serum Low-Density Lipoprotein Cholesterol (LDL-C) was carried out spectrometrically using standardized laboratory procedure (Alpdemir & Alpdemir, 2021; Bakir *et al*., 2019).

2.11 Statistical analysis
The data from this study were analyzed using version 27.0 of the Statistical Package for Social Sciences (SPSS). A P-value of less than 0.05 was considered statistically significant.

3.0 RESULTS
Table 1 displays the mean values and standard deviations (S.D.) for each group over a period of five days. On Day One, the mean values for the groups were as follows: Group A (103.60±5.41 mg/dl), Group B (94.85±13.06 mg/dl), Group C (88.16±16.16 mg/dl), Group D (95.66±14.22 mg/dl), and Group E (92.83±20.43 mg/dl). There were no statistically significant differences ($P \geq 0.05$) in the mean values or S.D. between the groups on Day One.

On Day Two, the mean values were: Group A (106.60±0.89 mg/dl), Group B (87.14±54.30 mg/dl), Group C (283.66±150.54 mg/dl), Group D (109.00±149.22 mg/dl), and Group E (80.00±41.37 mg/dl), showing a statistically significant variation ($P \leq 0.05$) across the groups.

On Day Three, the mean values were: Group A (95.40±1.14 mg/dl), Group B (310.14±40.04 mg/dl), Group C (374.50±178.44 mg/dl), Group D (356.83±83.80 mg/dl), and Group E (299.50±110.33 mg/dl), with statistically significant differences ($P \leq 0.05$) observed.

For Day Four, the mean values were: Group A (91.20±4.38 mg/dl), Group B (265.14±7.64 mg/dl), Group C (685.33±275.59 mg/dl), Group D (453.40±249.70 mg/dl), and Group E (253.50±19.20 mg/dl), with statistically significant differences ($P \leq 0.05$) noted between the groups.

Finally, on Day Five, the mean values were: Group A (85.80±2.28 mg/dl), Group B (472.00±12.09 mg/dl), Group C (175.20±79.95 mg/dl), Group D (432.00±252.82 mg/dl), and Group E (314.50±326.64 mg/dl), with statistically significant variation ($P \leq 0.05$) across the groups.

Table 1 shows the mean and standard deviation (S.D) of plasma glucose level of test and control group

Glucose	Group A	Group B	Group C	Group D	Group E	Sig
Day One	103.60±5.41	94.85±13.06	88.16±16.16	95.66±14.22	92.83±20.43	0.558
Day Two	106.60±0.89	87.14±54.30	283.66±150.54	109.00±149.22	80.00±41.37	0.008*
Day Three	95.40±1.14	310.14±40.04	374.50±178.44	356.83±83.80	299.50±110.33	0.001*
Day Four	91.20±4.38	265.14±7.64	685.33±275.59	453.40±249.70	253.50±19.20	0.001*
Day Five	85.80±2.28	472.00±12.09	175.20±79.95	432.00±252.82	314.50±326.64	0.016*

*Asterisk's showing significant P-value when each group are compare

Identical superscripts denote a statistically significant difference (P<0.05) in the mean and S.D. when comparing across groups.

Key
Day 1- Before Aloxan and *Sena alata* Administration
Day2- After Alloxan but No *Sena alata* Administration
Day3- After Alloxan but No *Sena alata* Administration
Day4-After Alloxan and after *Sena alata* Administration
Day5- After Alloxan and after *Sena alata* Administration

Table 2 presents the mean values and standard deviations (S.D.) for the total cholesterol (TC) levels across the subject groups. Group A, which received distilled water, had a TC of 79.85±31.61 mg/dl, Group B, which was treated with 5.17 mg/kg aqueous extract of *Senna alata*, had a TC of 53.20±20.89 mg/dl, Group C, which received 15.40 mg/kg of the extract, had a TC of 104.85±38.66 mg/dl, Group D, which was given 27.87 mg/kg of the extract, had a TC of 104.0±39.66 mg/dl, and Group E, which received distilled water without *Senna alata* (SAF), had a TC of 72.0±32.18 mg/dl. No statistically significant differences (P≥0.05) were observed in TC levels between the groups.

For HDL cholesterol levels, comparisons between the groups showed no statistically significant differences (P≥0.05). Group A (distilled water) was compared with Group B (5.17 mg/kg *Senna alata* extract), resulting in a p-value of 0.718; with Group C (15.40 mg/kg *Senna alata* extract), the p-value was 0.117; with Group D (27.87 mg/kg *Senna alata* extract), the p-value was 0.968; and with Group E (distilled water without SAF), the p-value was 0.685. Comparisons between Group B and the other groups also showed no significant differences: with Group C (p = 0.077), Group D (p = 0.744), and Group E (p = 0.462). Similarly, comparisons between Group C and Group D (p = 0.235), Group C and Group E (p = 0.218), and Group D and Group E (p = 0.787) all showed no significant variations.

For LDL cholesterol levels, the following mean values were observed: Group A (distilled water) had an LDL of 35.71±28.58 mg/dl, Group B (5.17 mg/kg *Senna alata* extract) had an LDL of 33.60±20.40 mg/dl, Group C (15.40 mg/kg *Senna alata* extract) had an LDL of 72.71±43.68 mg/dl, Group D (27.87 mg/kg *Senna alata* extract) had an LDL of 61.66±17.0 mg/dl, and Group E (distilled water without SAF) had an LDL of 36.75±24.34 mg/dl. No statistically significant differences (P≥0.05) were observed across the groups for LDL levels.

Table 2 shows the mean and S.D of the groups A to E

	Group A: Received distilled water	Group B: received 5.17 mg/kg aqueous extract of *Senna alata*	Group C: received 15.40mg/kg aqueous extracts of *Senna alata*	Group D: received 27.87mg/kg aqueous extracts of *Senna alata*	Group E: Received distilled water with no SAF	P-value
TC (mg/dl)	79.85±31.61	53.20±20.89	104.85±38.66	104.0±39.66	72.0±32.18	0.082
HDL(mg/dl)	34.42±5.68	32.60±5.89	41.85±7.42	34.66±19.75	36.25±7.45	0.124
LDL(mg/dl)	35.71±28.58	33.60±20.40	72.71±43.68	61.66±17.0	36.75±24.34	0.025*

Discussion

The current drug therapies for managing diabetes mellitus and cardiovascular diseases have certain limitations, highlighting the need for safer and more effective anti-diabetic alternatives. Prolonged diabetes is often linked to complications such as atherosclerosis, heart attacks, and kidney disease (Yaribeygi et al., 2022). The findings from this study regarding the statistically insignificant variations ($P \geq 0.05$) in glucose levels among diabetic animals treated with *Senna alata* extracts offer valuable insights into the potential role of this natural remedy in diabetes management (Boy et al., 2018). Previous research has also explored the anti-diabetic properties of various plant extracts, including *Senna alata*. Studies like those by Furman and Candasamy (2020) reported similar results, suggesting that plant extracts can positively affect glucose levels in diabetic models. These findings align with the current study, supporting the potential anti-diabetic effects of *Senna alata*. However, ZadehGharaboghaz et al. (2020) noted that the effects of plant extracts on glucose levels can be dose-dependent, which the present study did not fully explore. Future research could examine the impact of different dosages of *Senna alata* extracts to better understand their effect on glucose levels. In this study, no statistically significant differences ($P \geq 0.05$) were observed in the levels of total cholesterol, high-density lipoproteins (HDL), or low-density lipoproteins (LDL) when compared to the control group. Previous research has suggested that the effects of *Senna alata* may be dose-dependent. However, in the current study, a dose-dependent, statistically significant increase ($P \leq 0.05$) was observed in triglycerides and LDL levels in the test groups compared to the control group, as shown in Table 4.3. These results contrast with those of Onyegeme-Okerenta et al. (2017) and Atanu et al. (2022), who found a dose-dependent reduction in triglycerides and LDL levels in their studies on *Senna alata* aqueous leaf extract in Wistar rats with palm oil-induced hyperlipidemia. Onyegeme-Okerenta et al. (2017) attributed this reduction in lipid levels to the plant's anti-lipemic properties.

Conclusion

In conclusion, this study reveals that the *S. alata* extracts have no anti-lipemic activities as well as the potential to reverse biochemical pertubation in *diabetic*-induced mice. Hence, *S. alata* cannot be used in prevention or in therapeutic procedure of hyperlipidemia. Given its potential to significantly increase triglyceride and low-density lipoprotein levels, *Senna alata* may be recommended for patients with hypolipidemia. The findings of this study contribute to the growing body of evidence supporting the anti-diabetic properties of *Senna alata* extracts. While the results are consistent with some previous studies, further research is needed to better understand the effects in relation to dosage and treatment duration, as well as to identify the specific mechanisms involved.

Recommendations

Our finding should give insights and should ultimately inform the development of novel therapies for diabetes management.

Consider the potential for *Senna alata* leaf extracts to be used in combination with other diabetes medications or treatments. Healthcare professionals can help determine if such combinations are safe and effective.

Be aware of potential side effects or adverse reactions associated with *Senna alata* leaf extracts. Individuals should report any unusual symptoms to their healthcare provider promptly. It's crucial to use this natural remedy under professional guidance.

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