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Original Research Article

Host-Plant Species Effect on Anti-Diabetic Activity of African Mistletoe (*Loranthus bengwensis*) in STZ induced Diabetic Rats

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ABSTRACT

African mistletoe (*Loranthus bengwensis*) is a hemi-parasitic plant which grows in all parts of Nigeria. It is used in the form of tisane (decoction), as a traditional herbal treatment for various forms of ailments especially as an anti-diabetic. The present study evaluated the host-plant effect on the anti-diabetic activity of the African mistletoe growing in the Northern part of Nigeria. Streptozotocin (STZ)-induced diabetic male Wister rats were orally administered with decoction (0.01 g/cm^3) of African mistletoe, parasiting on lemon (*Citrus limon*), guava (*Psidium guajava*) and jathropha (*Jathropha curcas*) trees respectively for 28 days (*ad libitum*) as the only source of fluid. The decoction from African mistletoe parasiting on lemon and guava trees were found to cause a significant reduction in the blood glucose level (40%) of the diabetic rats while the decoction prepared from the jathropha tree caused a significant elevation of blood glucose (60%) in the STZ-induced diabetic rats. The results obtained indicated that Africa mistletoe possesses significant anti-diabetic activity and this anti-diabetic activity may be influenced by the host-plant species.

***Keywords*:** Peels, Anti-diabetic, Glycemic indices, Antioxidants, Plantain, Whole flours.

Introduction

African mistletoes, (*Loranthus bengwensis*) belong to the *Loranthaceae* family. It is a shrubby green leaved epiphytic, partial parasite, living attached to the branches of trees and shrubs in the forest. The plant is attached to its host by means of suckers regarded as modified adventitious root, resulting often in a large out-growth from where the parasite root enters the host tissue.[1] The plant has small tough green leathery leaves but still draws much of its nutrients from its host.[2]

It has been shown that it threatens the lives of these plants on which it parasites,[1] while it remains green all year round. Total parasitic plants lack chlorophyll and are dependent entirely on a living host for all nutrients while the partial parasitic plants possess some chlorophyll and are only partially dependent on their host. African mistletoe, a hemi- parasite, therefore abstracts water and minerals from its host.

African mistletoes are acclaimed to be effective in folklore medicines and its anti-diabetic activities have been scientifically investigated (our earlier investigation inclusive), [3, 4] but not the effect of the host plant on its anti-diabetic activity.

The aim of this investigation was to evaluate the effect of the host-plant species on the anti-diabetic activity of the African mistletoes, using streptozotocin-induced diabetic rats. The host-plant species used were lemon (*Citrus limon*), guava (*Psidium guajava*) and jatropha (*Jatropha curcas)* tress. The lemon and guava are edible fruit trees while the jatropha tree is a flowering, deciduous poisonous plant species.

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Materials and Methods

Chemicals and reagents

Glucose kit, (from Eagle Diagnostic Desoto, Texas, USA); cholesterol and creatinine kits (from Sigma Chemical Company, London) and Streptozotocin (from UpJohn Company, Kalamazoo, USA) were used. All other reagents used were of analytical grade.

Plant material

Fresh leaves of African Mistletoes of the same species were collected from *Citrus limon*, *Psidium guajava* and *Jatropha curcas* as host plants from the environs of the University of Jos, Nigeria in November 2019, during the dry harmattan season. The leaves of the African mistletoe and jathropha species were duly confirmed at the Botany Department of the University of Jos.

Preparation of plant decoction

The apparently healthy African mistletoe leaves were collected separately from each host-plant, washed and sun dried daily until about 80% moisture was removed respectively. The dried leaves were coarsely powdered and separately packaged in air tight plastic containers until required. About 10.0 gram each of the coarsely powdered samples was soaked separately in 1 litre of water for about six hours. This was heated to 70°C and allowed to cool to room temperature. The cooled decoctions were filtered and the filtrate stored respectively at 4°C until used.

Animal handling and treatment

Male Wister rats weighing 168.42 ± 7.62 gram were obtained from the National Institute of Trypanosomiasis and Veterinary Research Institute, Vom. The rats were feed with commercial rat chow (Pfizer feed, Kaduna, Nigeria) and were maintained under standard conditions (12 h light/dark cycles at 27 ± 2°C) and also allowed water *ad-libitum*. They were left to acclimate for 10 days before used. The experimental protocols of this study were in accordance with approved Institutional and National guidelines for care and use of laboratory animals and with the permission of the University Animal ethical committee.

The rats were randomly put into eight groups consisting of 6 rats each. Diabetes was induced in four groups by a single intraperitoneal dose of streptozotocin (70 mg/kg body weight) using 0.1M citrate buffer as the

vehicle (14 mg/ml). Three of the remaining groups were administered 0.1M citrate buffer based on their weight while the remaining group was used as the normal control group that was allowed food and water *ad-libitum*. All the rats in each of the six groups (except the normal control and diabetic control groups) were administered the decoction as their only source of water for a period of 28 days respectively. The rats were fed the decoction from a fluid dispenser bottle to avoid contamination or loss by spillage from the fluid bottle and fresh decoction was served to the rats daily. The rats were individually housed in metabolic cages (Becker and co. GmbH animal model cages) and observed closely.

Collection, preparation and analysis of blood and urine:
Urine was collected separately from each rat daily and volume noted. The rats were sacrificed on the 29th day after a 12 hour fast and blood was collected by cardiac puncture. The serum from the blood was used for analysis.

Statistical analysis
The results are expressed as mean ± SEM. Data from the groups were analysed using analysis of variance (ANOVA) and student's t-test. The level of significance was determined at $p < 0.05$

Results and Discussion

The dose of streptozotocin (STZ) administered to the rats and the serum glucose levels (74.0 ± 1.30 non-diabetics and 150 ± 4.20 diabetic), obtained after 24 and 72 hours treatment was confirmation of a diabetic state and suggestive of pancreatic damage, since streptozotocin is a diabetic agent which acts by producing irreversible damage to the pancreas. [5, 6] The fluid intake by the non-diabetic groups was significantly higher ($p < 0.05$) in the rats administered with the decoctions compared with the non-diabetic control while there was significant increase in fluid intake by the diabetic rats compared with the non-diabetic in all groups as shown in Figure 1. The fluid intake was highest in the diabetic group administered *jathropha carcus* decoction as also shown in Figure 1. There was also a significant increase ($P < 0.05$) in the urine output in the diabetic rats compared with the non-diabetic rats irrespective of group treatment as shown in Figure 1. Increased fluid intake is characteristic of a diabetic state but the increased polydipsia and polyuria exhibited by the jathropha treated animals comparable to the untreated diabetic animals is as a result of excessive or abnormal thirst, which is an indication of a worsening diabetic state.

The administration of the decoction caused a non-significant decrease, in the serum glucose level of the non-diabetic rats for the lemon and guava trees as shown in Figure 2, but a non-significant increase in the group treated with *jathropha carcus*. Also as shown in Figure 2, a significant increase ($P < 0.05$) in serum glucose level was observed in the diabetic control and jathropha treated diabetic groups compared with the lemon and guava decoction treated diabetic group. The results indicated that the mistletoe decoctions from the guava and lemon trees were effective in lowering the glucose level non-significantly in the non-diabetic animals but significantly ($P < 0.05$) in the diabetic animals compared with the non-diabetic control animals. This supports the hypoglycaemic effect of the decoction from the lemon and guava trees. The diabetic control rats and those administered *Jathropha carcus* decoction showed significantly increased levels of serum glucose, compared to the non-diabetic control animals. This indicated a non-hypoglycaemic effect of the jathropha decoction and suggested a worsening diabetic state.

A non-significant difference in the cholesterol level for all the non-diabetic rats was observed, but a significant increase ($P < 0.05$) was observed in the cholesterol level of the diabetic control rats and jathropha treated diabetic rats compared with all other groups as shown in Figure 3. The increased cholesterol level observed in the diabetic rats which received jathropha decoction can be suggested to be as a result of the attenuated diabetic state of the rats in these groups.

A significant increase ($P<0.05$) was observed in the urinary protein level of the diabetic control rats and jathropha treated diabetic rats compared with all other groups administered the decoctions, as shown in Figure 4. The AST and ALT activities for both diabetic and non-diabetic groups showed a non-significant difference as shown in Figure 5. There was a non-significant decrease in the creatinine level of the lemon and guava treated rats in both the non-diabetic and diabetic rats compare to the control group and jathropha treated rats in each group as shown in Figure 6. The results obtained for both the urinary protein and creatinine levels for the diabetic control and the rats administered jathropha decoction further suggested that the jathropha decoction did not support the hypoglycaemic effect of the decoction from the lemon and guava trees.

African Mistletoe is a partial parasite which grows on various plant species in Nigeria. The hypoglycaemic effect has been widely reported.[3,7-9] This present study was a preliminary investigation of the effect of the host-plant on the anti-diabetic properties of the African mistletoe (*Loranthus bengwensis*) species commonly found in the Northern part of Nigeria. (Follow up of our earlier work,[3]). The decoction of African mistletoe from the guava and lemon trees exhibited almost the same potential of anti-diabetic effect (about 40% decreases in serum glucose levels respectively). These trees are edible fruit bearing trees with various health benefits. The *Psidium guajava* species–is the most eaten of the different guava species and has a history in folk medicine.[10]

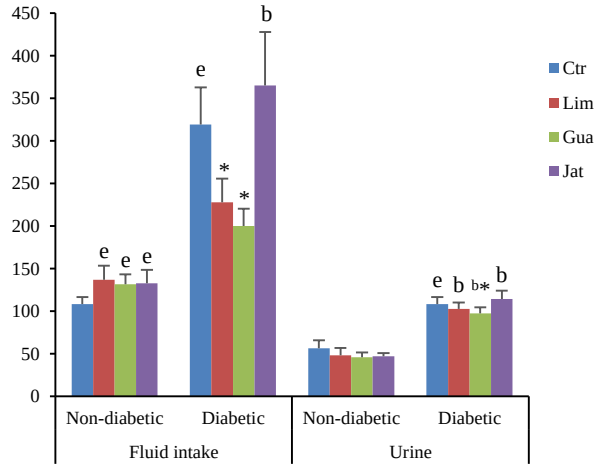

Figure 1: Fluid intake and urine produced during treatment with decoction in diabetic and non-diabetic rats. (*P < 0.05 compared with diabetic control; ^{e}P < 0.05 compared with non-diabetic control; ^{b}P < 0.05 compared with non-diabetic on decoction)

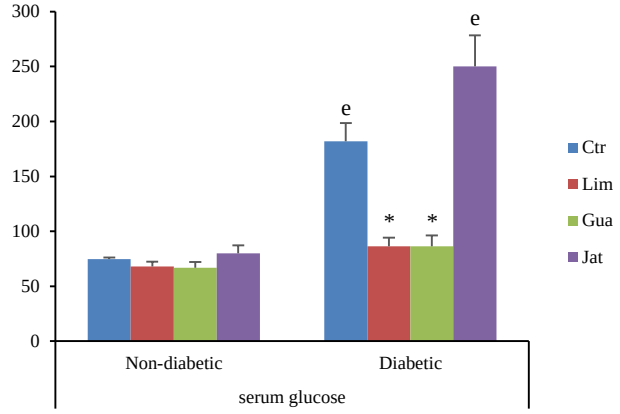

Figure 2: Effect of mistletoe decoctions on serum glucose level in diabetic and non-diabetic rats. (* P <0.05 compared with diabetic control; ^{e}P < 0.05 compared with non-diabetic control)

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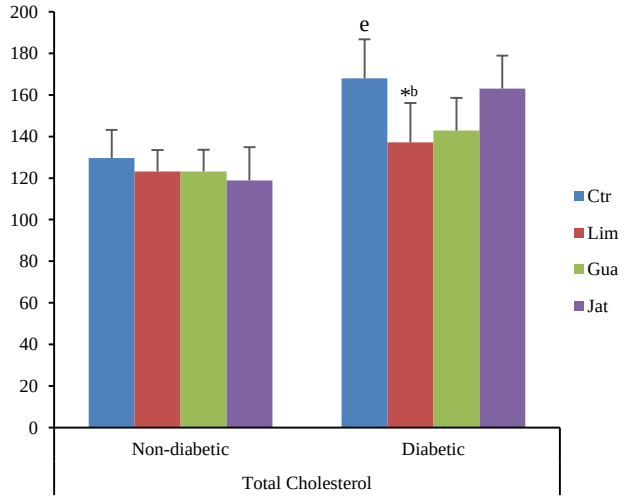

Figure 3: Effect of mistletoe decoction on total cholesterol in diabetic and non-diabetic rats. (*P < 0.05 compared with diabetic control; [e]P < 0.05 compared with non-diabetic control; [b]P 0.05 compared with non-diabetic on decoction)

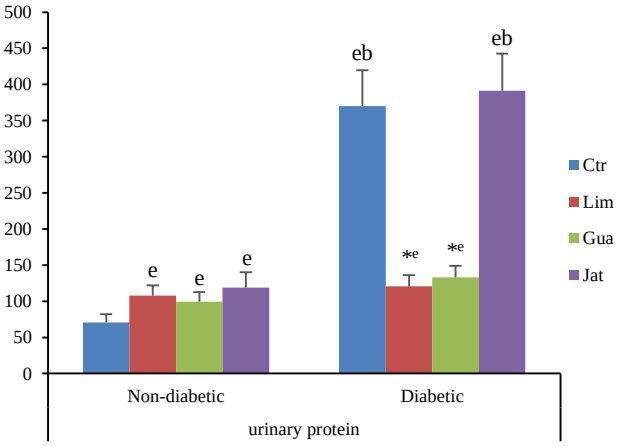

Figure 4: Effect of mistletoe decoctions on urinary protein in diabetic and non-diabetic rats. (*P < 0.05 compared to diabetic control; [e]P < 0.05 compared with non-diabetic control; [b]P 0.05 compared with non-diabetic on decoction).

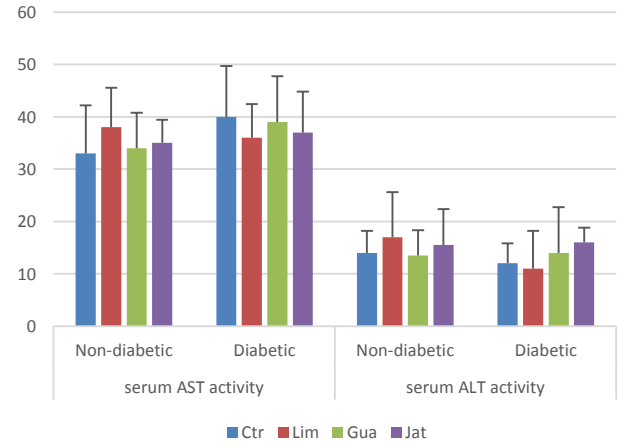

Figure 5: Effect of mistletoe decoctions on AST and ALT activities in diabetic and non-diabetic rats.

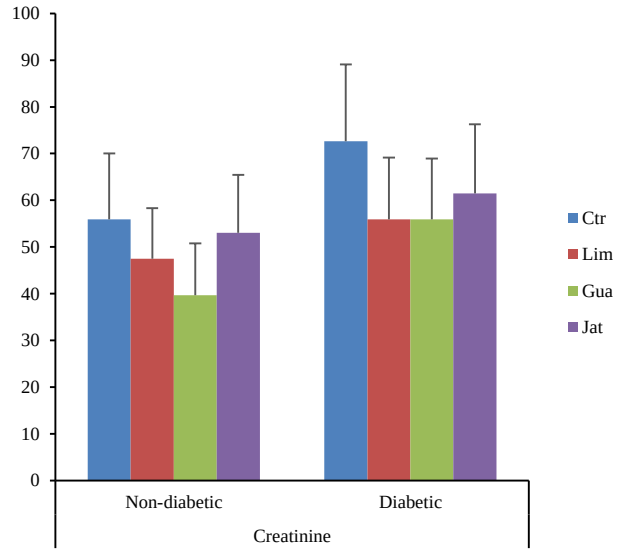

Figure 6: Effect of mistletoe decoctions on serum creatinine level in diabetic and non-diabetic rats.

The fruit, leaves and juice of the guava tree have been reported to be used in medicine for colic,[11] diarrhoea, diabetes, cough, cataracts, high cholesterol, heart disease and fever.[12] The fruit and leaves of the lemon tree are important in food industries, and are reported to be great sources of calcium, vitamin C, magnesium, potassium and antioxidants.[13] The *Jathropha carcus* used in this study was the poisonous species.

Jathropha is an oil producing plant belonging to the *Euphorbiaceae* family with several species. Most Jathropha species are reported as containing numerous toxic components which result in acute toxicity.[14, 15] The plant and its by-products when not detoxified are deleterious to humans and livestock.[16,17] Hemi-parasitic plants are connected to the host xylem suggesting that water and mineral nutrients are the primary resources that are abstracted from the host,[18] but it had been shown that many "mistletoes thought to be only water parasites actually derive some or most of their carbon requirements from their hosts as dissolved compounds in host xylem"[19] This indicates that hemi-parasitic plants derive more than water and nutrients from the host plant and this could influence their chemical composition.[18]

Conclusion

Decoction of the African Mistletoe from guava and lemon possessed significant anti-diabetic properties while decoction from the poisonous *Jathropha carcus* species exhibited significant increase in the serum glucose level of diabetic rats.

It can be suggested from this study that the anti-diabetic properties of the African Mistletoe may be influenced by the host-plant species. These preliminary findings provide a basis for further investigations into host-plant species effect for the use of hemi-parasitic (and parasitic) medicinal plants.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

References

1. Richardson INK. Lorantaceae (Mistletoe). In: Flowering plant of the world (Heywood, V. H. et al eds). Oxford University Press, Oxford London Melbourne 1979. 174 - 175.
2. Adesina SK, Iloh HC, Johnny II, Jacobs I.African Mistletoe (Loranthacae) Ethnopharmacology, chemistry and medicinal value: An update. Afri. J. Trad. Compl. And Altern. Med. 2023; 10(4):161-170
3. Obatomi DK, Bikomo EO, Temple VJ. Antidiabetic properties of the African mistletoe in streptozotocin induced diabetic rabbits. J. Ethnopharmacol. 1994; 43: 13–17.
4. Osadolor HB and Ojewe DD. Aqueous extracts of African mistletoe (*Loranthus bengwensis*) leaves exert hypoglycaemic effects in normal rabbits. Int J. Nig. Soc Expt. Biol. 2014; Vol. 26 (3) 85–87.
5. Rossini AA, Like AAA, Chick WL, Appel MC, Cahill Jr GF. Studies of streptozotocin-induced insulitis and diabetes. PNAS. 1977; 74 (6): 2485-2489. Doi:10.1073/pnas.74.6.2485
6. Szkudelski T. "The mechanism of alloxan and streptozotocin action in B cells of the rat pancreas". Physiol Res. 2001; 50(6):537–546.
7. Tarfai FD. Amos S, Temple VJ, Ochekpe NA and Gamaniel KS. Hypoglycemic effects of the aqueous extract of African Mistletoe, *Tapinanthus sesselifolius* (P. Beauv) van Tiegh (Loranthaceae). Int. J. Biochem Sci. 2012; 6(1): 408-414.
8. Osadolor HB, and Ojewe DD. Hypoglycaemic effect of aqueous extract of African mistletoe (*Loranthus bengwensis*) leaves in normal rabbits Cont. J. Appl Sci. 2008; 3: 21 – 24.
9. Ozougwu C. Nigerian Medicinal Plants with Anti-Diabetic and Anti-hypertensive Properties. European J. Med Plants. 2017; (3): 1-9 DOI: 10.9734/EJMP/2017/37468.
10. deBoer HJ; Cotingting C. "Medicinal plants for women healthcare in Southeast Asia: A meta-analysis of their traditional use, chemical constituents and pharmacology." J Ethnophamacol. 2014; 151 (2): 747-767.
11. Gupta P and Birdu T. *Psidium guajava* leaf extract prevents intestinal colonization of *Citrobacter rodentium* in mouse model: J-AIM. 2015; 6 (11): 50-52.
12. Mathur R, Dutta S, Velpandian T and Mathur SR. Psidium guajava Lin leaf extract affect hepatic glucose transporter -2 to attenuate early onset of insulin resistance consequent to high fructose intake: An experimental study. Pharmacol Res. 2015; 7(2):166-175.
13. Constantin RP, Bracht A, Yamamoto NS, Ishii-Iwamoto EL, and Constantin J. Molecular mechanisms of citrus flavonoids on hepatic gluconeogenesis. Fititerapia. 2014; 92: 148-62.
14. Mukkar GG, Harinder PS, George F, Klaus B. "Phorbol Esters Structure Biological Activity and Toxicity in Animals." Int. J. Toxicol. 2016; 26 (4): 279 – 288.
15. Moshobane MC, Wium C, Mokgola LV. Acute poisoning in children from *Jatropha curcas* seeds. SAJCH 2017; Vol. 11 No. 3 DOI**:** 10.7196/SAJCH.2017; v11i3.1401.
16. Kulkarni ML, Sreekar H, Keshavamurthy KS, Shenoy N. *Jatropha curcas*-poisoning. Indian J Pediatr. 2005; **72:**75–76.
17. Gupta A, Kumar A, Agarwal A, and Osawa M. Acute accidental mass poisoning by jatropha curcas in Agra, North India. EJFS 2016; 6(4): 496–500.
18. Irving LJ, Cameron DD. You are what you eat: interactions between root parasitic plants and their hosts. Adv Bot Res. 2009; 50:87–138.
19. Těšitel J; Plavcová L and Cameron, DD. Interactions between hemi-parasitic plants and their hosts. The importance of organic carbon transfer. Plant Signal Behav. 2010; 5 (9) 1072-1076.doi: 10.4161/psb.5.9.12563