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Preliminary Study of Hypoglycemic Effect of Locust Bean (*Parkia biglobosa)* on Wistar Albino Rat

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Authors' contributions

This work was carried out in collaboration between all authors. Author OJS designed the study, wrote the protocol, and author JG wrote the first draft of the manuscript. Authors OJS and ARA managed the literature searches for present study, analysed and made statistical analysis for the study. All authors read and approved the final manuscript.

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ABSTRACT

The hypoglycemic effect of locust bean (*parkia biglobosa*) in Wistar Albino rats was assessed. Blood glucose concentrations were determined for each group using glucose oxidase method. Group A (Control) received growers mash, while groups B,C and D received 20%, 40% and 50% of locust bean respectively for 21 days. There was significant decrease in the blood glucose concentrations of rats in groups C (5.5±0.03) and D (5.1±0.03) when compared with control (5.8±0.07mM/L), p≤0.05 on the 7th day of the treatments. However rats in group B only showed

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significant decrease in blood glucose concentrations on the 14th and 21st days (5.4±0.03mM/L and 5.3±0.03mM/L) respectively, when compared with the control (5.8±0.04mM/L and 5.8±0.06mM/L) respectively, p≤0.05. The validation of the hypoglycemic activity of locust bean suggest that it may be useful in the treatment of diabetes mellitus.

Keywords: Hypoglycemic effect; Parkia biglobosa; glucose oxidase; diabetes mellitus etc.

1. INTRODUCTION

Elevated blood glucose concentration is characteristic feature of diabetes mellitus. It is a disorder that occur in the B-cells of the pancreas due to either; insufficient secretion of insulin or cellular resistance to insulin. There are two types of diabetes mellitus. Type I diabetes (Insulin Dependent Diabetes Mellitus, IDDM), and Type II diabetes (Non-insulin Dependent Diabetes Mellitus, NIDDM). Their classification depends on the variation in onset, severity and complications [1,2,3]. In type I diabetes, the insulin secreted by the B-Cells of the pancreas is insufficient to metabolize glucose which raises blood glucose level as a result of hepatic overproduction of glucose by glycogenolysis and gluconeogenesis and a decrease in the removal of glucose from the circulation into adipose tissues and muscles Murray et al. [4]. Type II diabetes is as a result of insensitivity to insulin, that is, the insulin produced by the B-Cells may be normal or even elevated, but owing to the shortage of insulin receptors, they are not responsive to insulin. However, some forms of diabetes are known and are classified as secondary diabetes. These include, diabetes caused by the destruction of the pancreas by drugs, diseases or surgery and diabetes due to ineffectiveness in hormonal activities [1,3]. Also, diabetes have been shown to be a hereditary disease, some members of the family of known diabetics have been found to have a number of peculiar diabetic characteristics even though their blood sugar may be normal at the time of examination, but develops it some years later [5,6]. Diabetes is a major threat to global public health that is on the increase [7]. It is estimated that more than 170 million people are suffering from diabetes globally and the number is expected to double by 2030. The greatest increase in prevalence follows the trend of sedentary lifestyle [8]. Diabetes mellitus is controlled by the use of agents that exhibit hypoglycemic activities. The most popular hypoglycemic agent used clinically to control diabetes is insulin (injection). This mode of treatment cannot reach the rural populace and poor urban dwellers because of the cost of the drug and other factors like easy availability. Therefore, there is urgent need for alternative agents that could curb the disease at low cost and easily available. Medicinal plants are plants in which one or more of its organs contain substances that can be used for the management of certain illness or which are precursors for the synthesis of useful drugs [9]. Eddouks et al. [10] asserts that before the introduction of synthetic drugs, plants were used in the treatment and prevention of diseases. Balunas and Kinghorn [11] also noted that plants were the very first and only medicines used in curing diseases by human since ages. Many people in Nigeria also rely on medicinal plants in their natural environments for the treatment of diabetes. Among the leguminous plants used by man particularly in some African countries, is the African Locust Bean (*Parkia biglobosa*). The seeds are well known for their uses in the production of local condiment commonly known as *DAWADAWA* (Hausa) or *IRU* (Yoruba). Furthermore, *Parkia biglobosa* is a plant with an outstanding protein quality taking into account its protein and amino acid composition [12,13,14]. The plant is commonly found both in the Northern and Western part of Nigeria. Throughout the West African savannah, *dawadawa* is eaten regularly in soups and porridge made of sorghum or millet. It is also used like stock cubes or cheese in European and North American cooking. The economic importance of locust bean plant are; The locust-bean tree plays a vital role in stabilizing soil in farming areas and cycling nutrients from deeper solid layers as well as by providing shade [15,16], as a leguminous plant, it fixes atmospheric nitrogen through the root-noddles [17,18], the yellow pulp around the seeds is a high-energy food which is also rich in vitamin c, the pods and bark are used in traditional medicines, an extract from the pod shield is used to harden beaten earth floors and as a glaze for pottery and the bark yields red tannin used for dying leather.

In this study, hypoglycemic properties of locust bean were examined in wistar albino rats aiming to ascertain its hypoglycemic activity and

consequently its potential use as a blood glucose lowering agent.

2. MATERIALS AND METHODS

2.1 Animals

Twenty Wistar male albino rats weighing 200-250g were used for this study and were purchased from Animal House, Department of Biochemistry University of Port-Harcourt, Rivers state, Nigeria. They were grouped into A, B, C and D, each group containing five rats in standard cages (Griffin and George Modular System) and left to acclimatize for 7 days to laboratory conditions before the commencement of the experiment. During the acclimatization the animals were fed with growers mash and water *ad libitum.*

2.2 Locust Bean (*Parkia biglobosa*)

Fermented and dried locust bean were used as a medicinal plant. The locust beans were purchased from herbs dealers at Sapele main market, Sapele, Delta State, Nigeria and was authenticated in the Department of Pharmacognosy, Faculty of Pharmacy, Niger Delta University, Bayelsa State, Nigeria.

2.3 Feed (Growers MASH)

Grower mash was obtained from Pfizer Nigeria Plc.

2.4 Reagents/Apparatus

Glucose oxidase, peroxidase, 4-aminophenazone and phenol were obtained from Randox laboratories Ltd, diamond road crumlin, co. antrim U.K. All chemicals and reagents used for the study were of analytical grades.

2.5 Experimental Procedure

The fermented locust beans were sun-dried for 7 days and ground into powder with a blending machine. During 21 days, Group A (Control) were fed with growers mash and Group B, C and D (with mixtures of 20% locust bean + 80% growers mash), (40% locust bean and 60% growers mash), and (50% locust bean and 50% growers mash), respectively The animals were allowed free access to food and water in the containers.

2.6 Blood Collection

Blood was collected from each rat through intra-orbital plexus with the aid of heparinzed capillary tube into heparinized bottles containing sodium floride to a final concentration of 5mM. The tubes were centrifuged at 800g for 5 minutes at a temperature of 37℃ to obtain serum (supernatant layer) for glucose analysis.

2.7 Glucose Assay (Principle of Reaction)

Portions (0.5ml) of the serum were assayed for glucose by the glucose oxidase procedure of Trinder, (1969). Glucose oxidase is an enzyme extracted from the growth medium of *Aspergillus niger*. Glucose oxidase catalyse the oxidation of Beta D- glucose present in the plasma to D glucono -1 ,5 - lactone with the formation of hydrogen peroxide; the lactone is then slowly hydrolysed to D-gluconic acid. The hydrogen peroxide produced is then broken down to oxygen and water by a peroxidase enzyme. Oxygen then react with an oxygen acceptor such as ortho toluidine which itself converted to a coloured compound, the amount of which can be measured colorimetrically. Results are expressed as mean ± SEM mm/L. Data were statistically evaluated by students t-test.

3. RESULTS

The results of the preliminary study of the hypoglycemic effect of *Parkia biglobosa* on wistar albino rats are presented in Table 1 below. The results indicated that rats group B that were pretreated with 20% locust bean showed a significant decrease ($p \leq 0.05$) in the levels of serum glucose concentrations. On days 14 and 21 when compared with the normal control. However, in rat groups C and D,(pretreated with 40 and 50% of *Parkia biglobosa* respectively), there were significant decreases ($p \leq 0.05$) in the serum glucose concentration levels on day 7 while, on days 14 and 21 there were significant decreases ($p \leq 0.01$) in the serum glucose concentrations in the same rat groups, when compare with the controls.

4. DISCUSSION

The results of the study showed that locust bean (*parkia biglobosa*) exhibited hypoglycemic activities to the treated rats. There was significant decrease in the serum glucose concentrations of the test groups (B, C and D) when compared to the control ($p \leq 0.05$, $p \leq 0.01$).

Table 1. Comparison of serum glucose concentrations of different groups of rats. Serum glucose concentrations ($mmolL^{-1}$)

Days	A(control)	B(20%*I.biglobosa*)	C(40%*I.biglobosa*)	D(50%*I.biglobosa*)
O	5.8±0.07	5.8±0.03	5.8±0.04	5.8±0.08
7	5.8±0.07	5.7±0.02	5.5±0.03*	5.1±0.03*
14	5.8±0.04	5.4±0.03*	5.1±0.03**	4.8±0.03**
21	5.8±0.06	5.3±0.03*	5.0±0.03**	4.6±0.03**

Values represent the means ±SEM of the determinants.

- ** significant difference at p≤0.05*
- *** significant difference at p≤0.01*

However, the decrease in serum glucose concentrations within and among the groups could be attributed to the varied treatments given to the various groups and also the periods of treatments. Serum glucose concentrations in groups C (5.5±0.03) and D (5.1±0.03) were significantly decreased at p≤0.05 when compared with the control (5.8±0.07), on the 7th day of treatments. While on the 14th and 21st days, there were significant decreases in the serum glucose concentrations (5.1±0.03 and 5.0±0.03) and (4.8±0.03 and 4.6±0.03) respectively when compared with the control (5.8±0.06), p≤0.01. This observation was supported by the earlier reports of Manayi et al. [19], who established a direct relationship between the hypoglycemic activity of the medicinal plant *Lythrum salicaria* and the increased presence of insulin in the blood of normal Wistar rats administered with extracts of the plant. Group B only showed significant reduction in the serum glucose concentration after 14days of consecutive treatments, p≤0.05. The decrease in the glucose concentration recorded in this study confirms the report of hypoglycemic activity of the extracts of various medicinal plants which includes *Aloe barbadensis* Mill. (Liliaceae) and *Achyranthes aspera* L (Amaranthaeeae) as reported by Kavishankar et al. [20]. In addition, Omega et al. [21] reported that *Treculia africana* in normal animals stimulates the release of insulin and thus, mimicking the action of the hormone. These reductions may be due to the blood glucose lowering properties of locust bean with regards to the concentration differences in each group. Moreover, the hypoglycemic agents used in the treatment of diabetes, such as sulphonylureas or insulin injection cannot be afforded by many rural populace and poor urban dwellers, therefore, it is this understanding that lead to the investigation of hypoglycemic properties of locust bean so that the disease can be controlled at low cost. The mechanisms by which the plant in this study provoke hypoglycemia remains to be investigated. However it is possible that it decreases blood glucose concentration by mechanisms similar to those reported by earlier studies: including [22,23,24], cited by El-Abhar and Schaalan [25] for the medicinal plants of *Campomanesin xanthocarpa* (Berg) leaf, *Annona seuamosa* (Annonaceae), and *Trigonella foenum-graecum*res pectively. Thus, the plant may act by enhancing the release of insulin from the pancreas of the rats or by insulinomimetic effect or by combination of these actions as already described for other medicinal plants [26,27]. Diabetes mellitus is a major threat to global public health that affects3% of the population worldwide. Effective management of the disease is based on the use of agents that possess blood glucose lowering properties.

5. CONCLUSION

In conclusion, the present study shows that, locust bean (*Parkia biglobosa*) can be used as a medicinal plant, and the results indicated that it possesses blood glucose lowering properties that could control the disease. Thus, the blood glucose lowering properties of locust bean may be efficacious in the treatment of diabetes mellitus.

ETHICAL CONSIDERATION

"All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the Ethical Committee of the College of Health Sciences, Niger Delta University, Wilberforce Island, Amassoma, Bayelsa-State.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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