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Pancreatic islet regeneration and some liver biochemical parameters of leaf extracts of *Vitex doniana* in normal and streptozotocin-induced diabetic albino rats

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PEER REVIEW

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Comments

This paper shows the plant not just has antidiabetic property but it most likely works by regeneration of the pancreatic islet which is very imperative in determining the type of plant extract a patient may require when compared to the level of damage due to diabetes.
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ABSTRACT

Objective: To test two water soluble extracts (aqueous and ethanolic) obtained from the leaves of *Vitex doniana* in normal and streptozotocin-induced diabetic rats for their effects on pancreatic endocrine tissues and serum marker enzymes for a period of 21 d.
Methods: A total of 55 rats divided into 11 groups of 5 rats each were assigned into diabetic and non-diabetic groups and followed by a daily administration of ethanolic and aqueous extracts for 21 d. Group 1 was the normal control while group 7 was treated with standard drug.
Results: The histopathological studies of the diabetic rats indicated increase in the volume density of islets, percent of β-cells and size of islet in the groups that received the plant extracts, which suggested regeneration of β-cells along with β-cells repairs, as compared with the non-treated diabetic control which showed complete degeneration of the islet cells. There was significant reduction ($P<0.05$) in the serum activities of marker enzymes, alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase in diabetes treated rats, whereas an insignificant increase ($P>0.01$) in the serum activities of marker enzymes was observed for non-diabetic treated rats. Results of total bilirubin, direct bilirubin and unconjugated bilirubin showed that diabetic control group was significantly higher ($P<0.05$) in total bilirubin and unconjugated bilirubin compared with treated groups while non-diabetic treated groups showed no significant increase ($P>0.01$) in total bilirubin and direct bilirubin compared with the normal control.
Conclusion: This herbal therapy appears to bring about repair/regeneration of the endocrine pancreas and hepatic cells protection in the diabetic rat.

KEYWORDS

Vitex doniana, Pancreatic islet, Marker enzymes, Diabetes, Hepatoprotection

1. Introduction

Diabetes mellitus is a global health crisis, which has been affecting the humanity irrespective of the socioeconomic profile and geographic location of the population[1]. Though different types of oral hypoglycemic agents are available for the treatment of diabetes mellitus, there is increasing demand by patients to use antidiabetic natural products because of the undesirable side effects of the existing drugs[2]. After all, many of the currently available drugs have been derived directly or indirectly from plants[3]. In addition, herbal remedies continue to be more accessible

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and affordable than conventional drugs and represent the first line of treatment available for many of the world's population[4]. In many countries, much attention has been paid to find novel type of natural antidiabetic drugs from various medicinal plants[5-8]. Because of their effectiveness, limited side effects, and relatively low cost, herbal drugs are widely prescribed even when their biologically active compounds are unknown[9].

Data on ethnobotanicals suggest that about 800 plants may possess anti-diabetic potentials[3,10], however, very few of the ethnobotanicals for diabetes have received scientific or medical scrutiny, which invariably affect our knowledge of their mechanism of action[11]. Several mechanisms have been adduced for the hypoglycemic action of medicinal plants. They include inhibition of renal glucose reabsorption, enhanced secretion of insulin from β-cells of the pancreas, increased tissue uptake of glucose by enhancement of insulin sensitivity, regeneration/repair of the β-cells, stimulation of glycogenesis and hepatic glycolysis, increasing the size and number of cells in the islets of langerhans, protective effect on the destruction of the β-cells and/or prevention of oxidative stress that is possibly involved in pancreatic β-cells destruction[2,12,13]. The fiber of plants may also interfere with carbohydrate absorption, thereby affecting blood glucose[14].

Vitex is a perennial herb belonging to the dicotyledonous family of Verbenaceae. There are several reports on the medicinal applications of *Vitex doniana* (*V. doniana*). Research reported by James *et al*. showed that aqueous leave and stem bark extracts of the plant was effective against carbon tetrachloride induced liver injury in rats[15]. The anti-microbial activities of acetone, ethanol, methanol, hot and cold water extracts of leaves of *V. doniana* have been reported by Ejikeme and Henrietta[16]. The anti-hypertensive effect of extract of stem bark has also been reported by Ladeji *et al*[17]. In addition, the stem bark extracts demonstrated some level of *in vitro* trypanocidal activity against *Trypanosoma brucei brucei*[18]. The effects of aqueous root-bark extracts on hematological parameters have also been reported[19]. The aqueous and methanolic extract of the plant have been reported to exhibit anti-diarrhea activity[20], and they also have significant analgesic and anti-inflammatory activities mediated through sequential inhibition of the enzymes responsible for prostaglandin synthesis from arachidonic acid[21]. *V. doniana* has also been reported to possess a concentration-dependent inhibition of both acetylcholine and histamine-induced contractions[22]. The phytochemical studies of *V. doniana* shows that it has flavonoids, tannins, saponins, anthraquinones, balsam, carbohydrates and resin[23,24]. However, to the best of our knowledge, no research has been carried out to investigate the effect of aqueous and ethanolic leaf extracts of *V. doniana* on pancreatic islet regeneration. Therefore, the objective of this study was to evaluate the pancreatic islet regeneration of the aqueous and ethanolic leaves extracts of *V. doniana* and also find out its effects on some serum biochemical parameters.

2. Materials and methods

2.1. Plant samples collection and identification

Fresh leaves of *V. doniana* were collected from Ankpa, Kogi State, Nigeria in the month of April 2011. The plant was identified and authenticated at the Herbarium Unit of the Department of Biological Sciences, Ahmadu Bello University Zaria, Nigeria, where a voucher specimen (900076) was deposited.

2.2. Experimental animals

Adult albino rats weighing between 140-220 g of both sexes were obtained from the laboratory animal house, Department of Pharmacology, ABU, Zaria. The animals were acclimatized for 2 weeks under ambient environmental conditions. They had access to grower's mash (Vital feed, Grand Cereal Plc., Bukuru, Jos, Plateau State) and water *ad libitum*.

2.3. Preparation of plant sample

The plant leaves were rinsed in clean water and shade-dried at ambient temperature for two weeks. The dry plant sample was ground into powder using pestle and mortar. The powder obtained was then used to prepare the extracts.

2.4. Aqueous extraction

To 100 g of powdered plant material, 500 mL portion of distilled water was added and the mixture was then boiled in a conical flask for 2 h. After the set time, the suspension was filtered using cloth with fine pore, and the filtrates were then concentrated in a crucible using a water bath set at 45 °C and the weight of the sample was taken. The concentrated extracts were then stored in an air-tight sample bottle in a refrigerator until required for analysis.

2.5. Ethanolic extraction

Five hundred grams of the powdered plant material were soaked in 2.5 L of 70% ethanol at room temperature in a conical flask for 72 h. After the set time, the suspension was filtered using cloth with fine pore and the filtrates were then concentrated in a crucible using a water bath set at 45 °C and the weight of the sample was taken. The concentrated extracts were then stored in an air-tight sample bottle in a refrigerator until required for analysis.