Original Research

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Anti-hyperglycemic effect of *Canarium schwenfurthii* fruit oil on wistar rats

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ABSTRACT

Aim: The effect of oil got from the fruit pulp of *Canarium schweinfurthii* on normal and STZ-induced diabetic rats was evaluated. **Methodology:** Twenty four rats were divided into six groups of four each. Group 1 (normal rats) received 5 ml of distilled water, group 2 diabetic rats received STZ + 5 ml / kg b.w glibenclamide; groups 3,4 and 5 STZ-induced diabetic rats received 5 ml, 10 ml and 20 ml per b.w of C.s oil respectively while group 6 STZ-induced diabetic rats received no treatment. All treatments were orally administered using an oral-gastric tube for two weeks. Changes in blood glucose concentration were compared to positive (STZ + glibenclamide) and negative (STZ only) controls. **Results:** The oil showed positive effect against STZ-induced diabetic rats after 2 hrs at all dose levels tested. Daily administration of 10 ml / b.w of C.s oil showed similar activities as the reference drug (glibenclamide) and glucose reduction compared to STZ only. At 20 ml / b.w daily administration of C.s oil, mortality was observed. **Conclusion:** In conclusion, *Canarium schweinfurthii* fruit oil may be considered as a remedy for diabetes mellitus when administered at low doses (10 ml / bw and below) for long-term use. Further research is recommended.

KEY WORDS: *Canarium schweinfurthii* oil; STZ-induced diabetes; Glibenclamide.

INTRODUCTION

Plants have been used from ancient times for the treatment of various diseases of man [1]. In Ayurveda, a number of medicinal plants have been used for the treatment of diabetes [2]. About 880 plants are believed to possess hypoglycemic activity and nearly 343 plants have been reported in scientific papers [3]. The pharmacological treatment of disease began long ago with the use of herbs [4]. Plants not only possess hypoglycemic property but also reduce cholesterol; triglyceride and alkaline phosphatase levels while it increases total protein content [5]. Ascorbic acid and α-tocopherol cause reduction in glycosylated haemoglobin concentration which is an indicator of diabetes mellitus and its concentration increases linearly with the duration of the disorder [6]. *Diabetes mellitus* is the most common type of chronic metabolic disorder characterized by hyperglycemia. It may be due to relative or absolute deficiency of insulin action on blood sugar [7]. According to World Health Organization (WHO), in 2000, there were 171 million persons in the world with diabetes and this is projected to increase to 366 million by 2030.

Canarium schweinfurthii Engl (Burseraceae) is a large forest tree characterized by a straight and cylindrical bole exceeding 50 m; thick bark on young tree fairly smooth, reddish to light brown slash with turpentine-like odour, exuding a heavy, sticky oleoresin yellowish in colour; pinnate leaves (up to 15- 65 cm long); 8-12 pairs of leaflets, mostly opposite, oblong, cordate at base, 5-20 cm long and 3-6 cm broad. Its creamy white flowers are unisexual about 1 cm; the fruit is a small drupe, bluish-purple, glabrous, 3-4 cm long and 1-2 cm thick containing a hard spindle-shaped, trigonous stone that eventually splits releasing 3 seeds [8]. The decoction of *C. schweinfurthii* tree bark is used against colic in Ivory Coast, cough and chest pains in Sierra Leone, venereal diseases in Cameroon and to mature abscesses, treat dysentery in Nigeria. In Angola, it constitutes one of the ingredients of the insecticidal powders and perfumes [9]. Koudou et al [10] have reported that *C. schweinfurthii* possesses anti- malaria and anti- diarrhea activities. The analgesic effect of resin essential oil of *C. schweinfurthii oil* has also been reported [10]. *C. schweinfurthii* have also been implicated to have a measure of anti-sickling [11] and anti-diabetic [12-14] activities. This research is aimed at testing the anti-hyperglycemic effect of *Canarium schwenfurthii* fruit oil on STZ-induced diabetic wistar rats.

MATERIALS AND METHODS

Collection and Preparation of *Canarium schweinfurthii* oil: Fresh *Canarium schweinfurthii fruits* were collected from a farmland in Vom village of Jos, Plateau state, Nigeria. The fruits were positively identified at the Department of Biological Sciences, University of Abuja, FCT Abuja. Fruits were sorted, damaged and rotten ones were discarded. The fruits were washed and extracted following methods described by Olawale [15].

Induction of Diabetes: The experimental animals were fastened overnight and the diabetes was induced by a single intraperitoneal injection of streptozotocin (Zayo-Sigma (ZSA) Ltd, Jos, Nigeria), dissolved in a freshly prepared

citrate buffer. Fasting blood glucose levels were measured by puncturing the tail of each animal and spilling few blood drops on a glucose strip already inserted in a glucometer before and after 48 hours of injection with STZ. Animals with blood glucose levels lesser than 300 mg/dl were rejected while those above were considered diabetic and used for this experiment.

Experimental animals/ Experimental Design: Twenty four healthy wistar rats of both sexes with average body weight between (175–400) g were obtained from the animal house of National Vertinary Research Institute, Vom-Jos, Nigeria. The rats were housed in an animal room with well aerated cages. They were fed with standard rat-pellets and water *ad libitum*. The rats were divided into 6 groups of 4 animals each as follows;

Group 1: Normoglycaemic rats (normal control) received distilled water only.

Group 2: STZ-induced rats (standard drug) received glibenclamide dissolved in distilled water as treatment. (5ml/kg b.w)

Group 3: STZ-induced rats received 5 ml of *Canarium schweinfurthii* oil as treatment.

Group 4: STZ-induced rats received 10 ml of *Canarium schweinfurthii* oil as treatment.

Group 5: STZ-induced rats received 20 ml of *Canarium schweinfurthii* oil as treatment.

Group 6: STZ-induced rats received no treatment.

All of the experimental groups received the treatments orally once daily for a period of 2 weeks.

The blood glucose level was checked at intervals. On the first day of treatment; after 30 minutes, 2 hours, 5 hours, 8 hours and 12 hours. Then readings were taken after 3 days, 7 days, 10 days, and 14 days. Animals were sacrificed on the 14th day by suffocating them in a chloroform saturated glass container with a glass lid. Blood was collected in plain bottles and centrifuged at 3000 rpm for 20 minutes. Serum was collected and stored at -20°C for further biochemical analyses which was done using appropriate kits.

Statistical Analysis

Analysis of variance (ANOVA) and multiple comparisons between the mean of each column and every other column was done using graph-pad version 6.1 computer software package. Statistical significances were determined at *P<0.05. Results are presented as Mean ± Standard Error of Mean (S.E.M). Where, the number of animals per experimental group equals 4.

RESULTS

The effects of *Canarium schweinfurthii* on diabetic-induced rats are shown below. Table 1 shows the acute effects of 5 ml, 10 ml and 20 ml of *C. schweinfurthii* oil and glibenclamide on STZ diabetic induced rats at time intervals. A general reduction in the glucose levels in all treatment groups compared to negative control (STZ only) was observed.

Table 2 shows the effects of 14 days daily administration of 5 ml, 10 ml and 20 ml of *C. schweinfurthii* oil and glibenclamide on STZ diabetic-induced rats. STZ + 10 ml *C. schweinfurthii* oil and STZ + glibenclamide groups showed a dose and time-dependent reduction in the glucose levels to compare to STZ only.

Table 1. The acute effect of *C. schweinfurthii* oil and glibenclamide on STZ induced rats after 30 minutes, 2 hours, 5 hours, 8 hours and 12 hours of administration.

Dose	Glucose level				
	30 min	2 hrs	5 hrs	8 hrs	12 hrs
Control	94.33±14.52	92.33±5.46	98.33±0.67	96.67±5.04	98.67±3.18
STZ + 5 ml C.s oil	333.7±49.08	293.7±59.14*	326.0±72.97	392.7±52.92	382.0±36.00
STZ + 10 ml C.s oil	481.0±37.55	406.3±16.22	302.3±7.42*	349.7±21.93*	415.0±17.16
STZ + 20 ml C.s oil	558.7±18.49	475.7±35.22	317.0±26.89*	358.3±10.90	375.7±22.26
STZ + Glibenclamide	506.7±26.44	466.7±40.81	452.3±63.80	387.0±27.06*	394.0±76.85
STZ only	350.0±9.02	358.3±7.69	314.0±11.24*	320.0±14.00	409.0±36.51

Key; C.s = Canarium schweinfurthii oil; Statistical significances are expressed as *P<0.05 where n=4.

Table 2. The effect of 14 days daily administration of *Canarium schweinfurthii* oil and glibenclamide on STZ diabetic induced rats.

Dose	Glucose level			
	3 days	7 days	10 days	14 days
Control	84.33±9.91	67.33±3.71	67.33±3.71	74.67±4.49
STZ + 5 ml C.s oil	429.0±31.47	263.3±114.3*	263.3±114.3*	323.7±127.2
STZ + 10 ml C.s oil	436.7±21.62	414.7±29.55	414.7±29.55	386.7±14.31*
STZ + Glibenclamide	469.0±44.84	340.3±52.83	450.3±42.15	251.0±52.70*
STZ only	409.0±36.51	411.0±35.59	412.0±35.04	486.3±62.68

Key; C.s= Canarium schweinfurthii oil; Statistical significances are expressed *P<0.05; n=4.

DISCUSSION

Diabetes mellitus (DM) is the commonest endocrine disorder affecting about 100 million people worldwide [16]. The current study on the effect of *Canarium schweinfurthii* oil (extracted from the fruit pulp) on STZ-induced diabetic rats, show that *C. schweinfurthii* oil possesses anti-hyperglycaemic activities at a dose as low as 5ml (acute) effect on diabetic rats (Table 1). After 2 hours administration, a significant ($P<0.05$) reduction in glucose level from 333.7 ± 49.08 to 293 ± 59.14 was seen in the group treated with STZ + 5 ml C.s oil. Group administered STZ + 10 ml C.s oil showed similar activities after the first 5 hours of administration in contrast to the group administered STZ only. Consequently, in the group of animals treated with "STZ + 20 ml C.s oil" and "STZ + Glibenclamide", a time dependent reduction of blood glucose level was observed between 30 minutes and 8 hours after administration (Table 1). This infers that C.s oil has an after a while (sub-acute) anti-hyperglycaemic effect on rats. Daily administration of *C. schweinfurthii* oil on diabetic rats (Table 2) shows that by day 7 and 10, STZ + 5ml C.s oil was able to reduce blood glucose levels from 429.0 ± 31.47 to 263.3 ± 114.3 while STZ +10 ml C.s oil in comparison with "STZ only" and "STZ + Glibenclamide" was able to drop glucose level from 436.7 ± 21.62 to 386.7 ± 14.31 by the 14th day of the experiment. Glibenclamide is reported to be useful in the treatment of type-2 diabetes [17]. Glibenclamide acts by binding to and activating the ATP-sensitive potassium channels (K_{ATP}) inhibitory regulatory sub-unit sulfonylurea (SUR) in pancreatic beta cells. This inhibition leads to cell membrane depolarization, opening voltage-dependent calcium channels resulting in an increase in intracellular calcium of beta cells and subsequent stimulation of insulin release [18].

This present study corroborates with the findings of Dimo et al. [12], Kouambou et al. [13] whose researches show that the aqueous and hexane bark extract of *C. schweinfurthii* possses hypoglycemic effect ($P<0.05$). in 2 hours post-dosing during acute treatment with 75 and 150 mg/kg respectively. Dimo et al. [12] further reported that daily administration of *C. schweinfurthii* aqueous stem extract at 150 and 300 mg/kg p.o, significantly decreased blood glucose levels by 74 and 65% compared to initial values. Gbolade et al. [19] have also reported that *C. schweinfurthii* stem bark show persistent effect ($P<0.05$) on alloxan-induced diabetic rats. Tables 1 and 2 show significant differences in the activity of *C. schweinfurthii* on diabetic-induced rats as the oil got from the fruits of the plant present dose and time-dependent anti-hyperglycaemic activities. Daily administration of higher doses of *C. schweinfurthii* (10 ml and above) was observed to be lethal. Thus, this study concludes that a lower dose (10 ml and below) of *C. schweinfurthii* is safer for use in long-term use for handling diabetes while 20 ml of C.s fruit oil maybe considered for use for a short period to handle diabetes mellitus.. Further research is recommended on the anti-hyperglycaemic and hypoglycaemic activities on the fruit oil of *C. schweinfurthii* to understand its mechanism of action. This will help to fully harness the therapeutic goodness it has to offer mankind.

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