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Research Article

Effect of Nutraceuticals of Dried Date Palm (*Phoenix dactylifera*) Fruit on Streptozotocin Induced *Diabetes mellitus* in Albino Rats

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Abstract

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. A nutraceutical is any substance that is a food or part of food that provides medical or health benefits. This research was targeted to approaching the problem of diabetes mellitus in developing countries like Nigeria by studying the neutraceticals of date palm fruits for their potentials in combating diabetes mellitus. The plant material was collected, identified and extracted using organic solvents (petroleum ether and methanol. Experimental animals (Albino Wister rats) were induced with diabetes mellitus using streptozotocin and treated with the crude extract and the various purified fractions. The treatment with the bioactive compounds showed a significant ($P < 0.05$) reduction in the treatment groups 3, 4 and 5(131.20± 2.49, 133.60± 6.50 and 123.40± 3.58) when compared with the control groups 1 and 2(111.00± 5.29 and 195.60± 12.38). The neutraceuticals at the dose of 400 mg/Kg body weight were able to reduce hyperglycemia. It is therefore possible to say that the neutraceuticals present in *P. dactylifera* fruit extract are anti-diabetic agents as seen by the significant changes in the study.

Keywords: Neutraceuticals; *Diabetes mellitus*; Date palm fruit; *P. dactylifera;* Hyperglycemia.

Introduction

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both [1]. High blood glucose levels are symptomatic of diabetes mellitus as a consequence of inadequate pancreatic insulin secretion or poor insulin-directed mobilization of glucose by target cells. Diabetes mellitus is aggravated by and associated with metabolic complications that can subsequently lead to premature death [2]. Such complications arise due to derangements in the regulatory systems for storage and mobilization of metabolic fuels, including the catabolism and anabolism of carbohydrates, lipids and proteins emanating from defective insulin secretion, insulin action, or both. A nutraceutical is any substance that is a food or a part of food and provides medical or health benefits, including the prevention and treatment of disease. Such products may range from isolated nutrients, dietary supplements and specific diets to genetically engineered designer foods and herbal products. The concept of nutraceutical was stared from the survey in U.K., Germany and France and it concluded that diet is rated more highly by consumer than exercise or hereditary factors to achieving a good health [3].

The date palm *(Phoenix dactylifera* L.*)* is a palm extensively cultivated for its edible fruit. This plant species is a monocotyledonous, perennial tree belonging to the family Arecaceae (Palmae). In Nigeria, date fruit is commonly called Dabino, as it is mainly consumed in the Northern part of the country and it strives well in this region above latitude 10° North of the Equator. Date is rich in phytochemicals like sterols, phenolics, carotenoids, procyanidins, anthocyanins, flavonoids, glycosides, and tannins. The concentrations and ratio of these constituents depend on the stage of fruit picking, type of the fruit, location and soil. Diabetes Mellitus is a very common disease in Nigeria and Benue state is not an exception to this. Diabetics suffer several complications which range from acute life threatening hyperglycemia with ketoacidosis to other chronic complications [4].

Date palm is rich in phytochemicals which may be vital neutraceuticals for managing

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diabetes mellitus. Certain mineral elements are also found in seeds of plants which play important role in the maintenance of normal glucose tolerance and in the release of insulin from beta islets of Langerhans [5]. Against this background, the research was aimed at testing the efficacy of the neutraceuticals of date palm (*phoenix dactylifera*) fruits for their potentials in combating diabetes mellitus.

Materials and methods

Collection of plant

The dried fruits of *P.dactylifera* were purchased from Wurukum market in Makurdi local government area of Benue State. The identification and authentication of the plant was done by Mr. Ojobo of the Department of Botany, University of Agriculture, Makurdi. The dried fruits of *P. dactylifera* were washed and air-dried in laboratory, department of Biochemistry, University of Agriculture, Makurdi.

Experimental animals

Thirty (30) albino rats (male only) weighing between 200 g – 250 g were bought from the animal farm of the college of health science, Benue State University, Makurdi and were acclimatized in the animal house of department of Biochemistry, University of Agriculture, Makurdi for 2 weeks while allowing them free access to standard feeds (Chikum feed PLC, Lagos, Nigeria), and allowed water and libitum [6].

Preparation of plant extract

The dried fruits of *P.dactylifera* were ground into fine powder and preserved in moisture-free, airtight laboratory containers for further use. The powered plant material (400 g) was macerated with 2.4 liters (2400 ml) of petroleum ether/Methanol (4:6). The maceration was carried out in a ratio of 1:10 and was agitated intermittently for 48 h and filtered into a clean glass jar. The extract was evaporated to complete dryness in a stream of air [7].

Induction of diabetes

Thirty adult Wistar rats weighting above 200 g were used for inducing diabetes. The animals were injected by streptozotocin at the dose of 65 mg/kg body weight intraperitonealy. Streptozotocin induces diabetes within 3 days by destroying the beta cells. Induction was done according to the method described by [8].

Experimental design

NC: The rats were not induced with streptozotocin
HYPERC: The rats were induced with streptozotocin (65 mg/kg) and were not treated
HYPER+Crude 400: The rats were induced with streptozotocin and were treated with crude extract (400 mg/kg)
HYPER+F1400: The rats were induced with streptozotocin and were treated with the partially purified extract 1 (400 mg/kg)
HYPER+F2400: The rats were induced with streptozotocin and were treated with the partially purified extract 2 (400 mg/kg)

Result and discussion

Collection of sera sample

The rats were starved for 24 h prior to the sacrifice. They were anesthetized with chloroform and cardiac puncture performed at different intervals to obtain blood sample. The blood samples were stored in a plain bottle (i.e. without anticoagulant).

Determination of blood glucose

Estimation of blood glucose was done according to the method described by [9].

Glucose test post induction

Table 1 shows the effect of the induction of Streptozotocin on the glucose levels of rats. There was a significant ($P<0.05$) increase in the mean of the groups induced with streptozotocin down the group compared to the normal control. The mean of the groups induced with streptozotocin were significantly ($P<0.05$) higher, (HYPERC 149.60±14.19, HYPER+Crude400 159.80±16.25, HYPER+$F_1$400 163.20±23.10, HYPER+$F_2$400 138.60±7.73) when compared with the normal control (NC 110.60±5.18).

Glucose tolerance test post treatment

Table 2 shows the effect of treatment with partially purified and crude extract of date palm (*Phoenix dactylifera*) on the glucose levels of rats. There was a significant ($P<0.05$) decrease in the mean of the groups treated with the extract down the group compared with the hyperglycemic control. The mean of the groups treated with the extract were significantly ($P<0.05$) reduced, (HYPER+Crude400 131.20±2.49, HYPER+$F_1$400 133.60±6.50, HYPER+$F_2$400 123±3.58) when compared with

the hyperglycemic control (HYPERC 195.60±12.38).

Table 1. Glucose test post induction

Group	Glucose level
NC	110.60±5.18
HYPERC	149.60±14.19
HYPER+Crude 400	159.80±16.25
HYPER+F_1 400	163.20±23.10
HYPER+F_2 400	138.60±7.73

KEY: NC: Normal rat control, HYPERC: Hyperglycemic rat control, HYPER + Crude 400: Hyperglycemic rat + crude extract (400mg/kg), HYPER+$F_1$400: Hyperglycemic rat + fraction 1 (400 mg/kg), HYPER+ F_2 400: Hyperglycemic rat + fraction 1 (400 mg/kg).

Table 2. Glucose tolerance test post treatment with the plant

Group	Glucose level
NC	111.00±5.29[a]
HYPERC	195.60±12.38[*]
HYPER+Crude 400	131.20±2.49[*a]
HYPER+F_1 400	133.60±6.50[*a]
HYPER+F_2 400	123.40±3.58*[a]

KEY: NC: Normal rat control, HYPERC: Hyperglycemic rat control, HYPER + Crude 400: Hyperglycemic rat + crude extract (400mg/kg), HYPER+$F_1$400: Hyperglycemic rat + fraction 1 (400 mg/kg), HYPER+ F_2 400: Hyperglycemic rat + fraction 1 (400 mg/kg).Values indicated by asterisk down the group are statistically different compared to the Normal control at ($P<0.05$) whereas all values indicated by the superscript (a) down the group are statistically different compared to the diabetic control group.

Results of glucose tolerance test from table 2 above show the effect of partially purified and crude extract of *P. dactylifera* fruit on hyperglycemia in diabetic rats, results showed that there was a significant ($P < 0.05$) reduction in the glucose levels of group 3, group 4 and group5 (131.20± 2.49, 133.60± 6.50 and 123.40± 3.58) when compared group 1; normal control and group2; diabetic control (111.00± 5.29 and 195.60± 12.38).

Conclusions

In the present study, the extract of *P. dactylifera* at the dose of 400 mg/kg body weight was able to reduce hyperglycemia. It is therefore possible to say that the neutraceuticals present in *P. dactylifera* fruit extract are anti-diabetic agents as seen by the significant changes of the glucose level in the study. It is recommended that further studies be carried out on the bioactive compounds found in *P. dactylifera* so that they may effectively be used as treatment for *diabetes mellitus*.

Conflict of interest

The authors declare that there is no competing interest.

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