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Corn silk: An antidiabetic agent in alloxan induced diabetic rats

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Abstract

Diabetes mellitus is a metabolic disease with serious complications that leads to increase in the world mortality rate. Corn silk are mostly abandoned by the farmers as waste during corn (*Zea mays*) harvest. The study aimed to evaluate the phytoconstituents and ameliorative effects of methanol extract of corn silk in alloxan induced diabetic rats. The experimental animals were grouped into five of five animals each, Group I; Non-diabetic treated with normal saline, Group II; diabetic treated with standard drug; Metformin at 100 mg/kg body weight, Group III; diabetic not treated while Group IV and V were diabetic treated with extract at 200 and 400 mg/kg body weight respectively. The fasting blood glucose of the animals were measured and were sacrificed at the day 14th of treatment and blood samples collected were subjected to antioxidant assay. The result obtained showed that there was significant ($P < 0.05$) decrease in the blood glucose level of animals treated with the extract and standard drug. There was also significant ($P < 0.05$) increase in the level of SOD and CAT as compared to the negative control, however, a significant reduction in the level of MDA was observed in the treated groups. These suggests that methanol extract of Corn silk may have relevant antidiabetic and antioxidant properties, hence the evaluated studies will be useful for the management of diabetes mellitus.

Keywords: Corn silk, Diabetes mellitus, phytoconstituents, antioxidant

Introduction

Diabetes mellitus is a metabolic disease due to either the pancreas not producing enough insulin, or the cells of the body becoming unresponsive to the produced hormone (WHO, 2023) ^[1]. Type 2 diabetes (T2DM) caused by the inefficient use of insulin is characterized by hyperglycemia, decreased glucose tolerance, insulin resistance and hyperlipidemia (Duarte *et al.*, 2020) ^[2]. It was estimated that 537 million people had diabetes worldwide accounting for 10.5% of the adult population, with type 2 making up about 90% of all cases. It is estimated that by 2045, approximately 783 million adults, or 1 in 8, will be living with diabetes, representing a 46% increase from the current figures (IDF, 2023) ^[3].

The use of medicinal plants in the treatment of diabetes mellitus is a common practice especially in the western states, where people depend solely on herb treatment (Sani, 2016) ^[4]. *Zea mays* also known as maize or corn, is an annual grass plant with a fibrous root system and long narrow leaves. The corn silk (*Stigma maydis*) is the elongated stigma of the corn, which is soft and smooth, and looks like a thread. The color of the corn silks, at first are usually light green and later turn into red, yellow or light brown. The corn silk function to capture pollen grains for pollination. Corn silk elongates beyond the cob covering the edible part of the plant, the length can reach 30 cm or more (Haslina *et al.*, 2017) ^[5].

The parts of the plant; maize grains, leaves, stalk, husk and corn silks, are used in ethnomedicine. The ash of the cob is used for the treatment of cough (Shosan *et al.*, 2014) ^[6] and inflammatory diseases (Okokon *et al.*, 2016) ^[7]. The husks are used for the treatment of pains and arthritis (Owoyele *et al.*, 2010) ^[8]. Warm tea of the husks is used for the treatment of malaria and diabetes (Okokon *et al.*, 2016) ^[9]. Corn silk is used as an antidiabetic or diuretic, and decoction of the silk is consumed for the treatment of urinary troubles and gallstones (Abo *et al.*, 2008) ^[10]. This study was therefore aimed at investigating the Ameliorative effect of methanol extract of corn silk in alloxan induced diabetics.

Methodology

Sample collection: Fresh corn silk was collected from a local market of Kurfi, in Kura Local Government Area Kano state, Nigeria in July 2023.

The plant was identified by the Department of Biology, Federal University Dutsin-ma, Katsina, Nigeria with a voucher number FUDMA/PSB/00241.

Sample Extraction

Collected sample of corn silk was cleaned and kept under room temperature to dry for 7 days. The dried corn silk was then ground to powder using an electric blender. The powder was divided into two portions of 100 g each soaked in 600 ml of methanol each. The bottles were occasionally shaken for 7 days to obtain a reasonable amount of extract, the extract was filtered with a filter cloth and then a whatmann filter paper. The extract was subjected in the rotary evaporator to obtain a methanol extract (brownish-black paste) and solvent.

Phytochemical Screening

The presence or absence of various phytoconstituents was determined using the method described by Trease and Evans (1989) [11].

Induction of Experimental Rats

A total of twenty-five albino rats weighing between 100 – 150 g were used for the experiment. They were housed in Aluminium cages at room temperature with free access to drinking water and feed. The animals were fasted over-night prior to induction and alloxan dissolved in normal saline at a dose of 150 mg/kg body weight was administered intraperitoneally. Rats were maintained with 5% glucose for 24 hours to prevent alloxan induced hypoglycemia due to the massive release of insulin from pancreas. After 72 hours of alloxan injection, the fasting blood glucose (FBS) concentrations of the animals were determined and animals with FBS of 200 mg/dL and above were considered diabetic (Sornalakshmi *et al.*, 2016) [12].

Experimental Design

The animals were grouped into five (5) of 5 animals each.

Group I: Non-diabetic (Normal control)

Group II: Diabetic treated with Metformin at 100 mg/kg body weight (Positive control)

Group III: Diabetic not treated (Negative control)

Group IV: Diabetic treated with extract at 200 mg/kg body weight

Group V: Diabetic treated with extract at 400 mg/kg body weight

Determination of Fasting Blood Glucose and other Biochemical Parameters

The FBS concentration of the animals were checked at the 7th, and 14th day using a glucometer (Accu-Check Active). All blood samples used for the determination of FBS were collected by first cleaning the tail of the rats with cotton wool containing a disinfectant (Methylated spirit) and the tip was pricked with a syringe. A drop of blood was placed on the test strip already inserted in the glucometer and the results were recorded. Chloroform-inhalation anesthesia was performed on all the experimental animals at the end of treatment period and the blood samples were collected. The collected blood samples were centrifuge for four minutes and the resultant sera was harvested into plain sample bottles for further biochemical analysis (Asif *et al.*, 2019) [13]. The biomarkers of antioxidant activity such as catalase (CAT), superoxide dismutase (SOD) and Malondialdehyde (MDA) concentrations were determined using Agappe diagnostics Switzerland GmbH kits as describe by the manufacturer.

Statistical Analysis

All the values of fasting blood glucose level and estimation of biochemical parameters were expressed as mean \pm standard error of mean (SEM) and was analyzed for significance by one-way analysis of variance (ANOVA) and groups were compared by Duncan multiple comparison testing using Statistical Package for Social Sciences (SPSS) and p values are considered significant when $P < 0.05$.

Results

Table 1: Phytochemical constituent

Phytochemical	Observation
Flavonoid	+
Saponins	-
Steroids	+
Terpenoids	+
Cardiac glycoside	+
Tanins	-
Phenols	+
Alkaloids	+

Key: + Presence - Absent

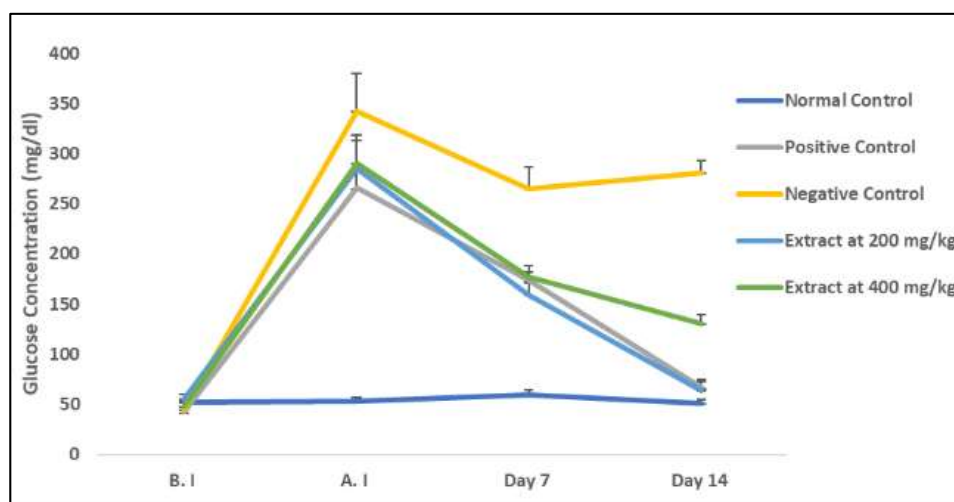


Fig 1: Effect of methanol extract of corn silk on fasting blood glucose
B. I= Before induction, A. I= After induction

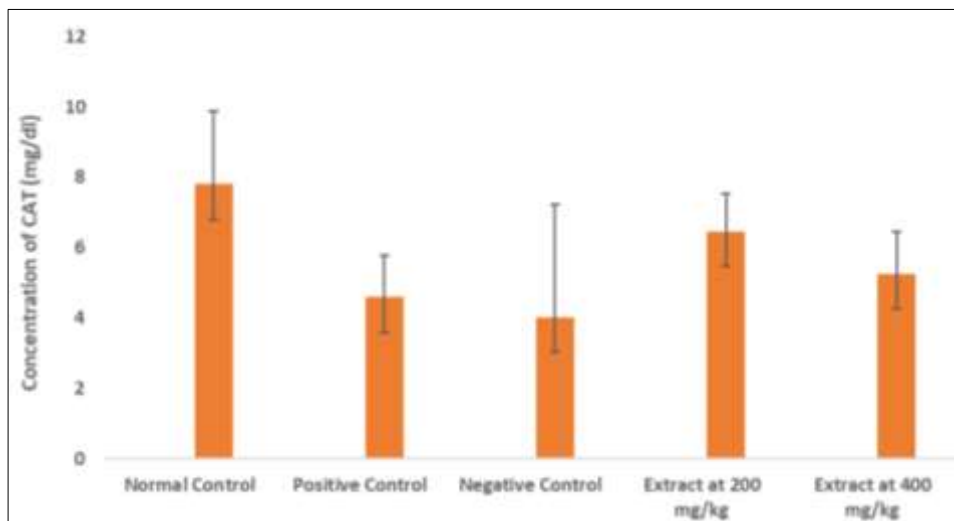


Fig 2: Effect of methanol extract of corn silk on Catalase (CAT) concentration

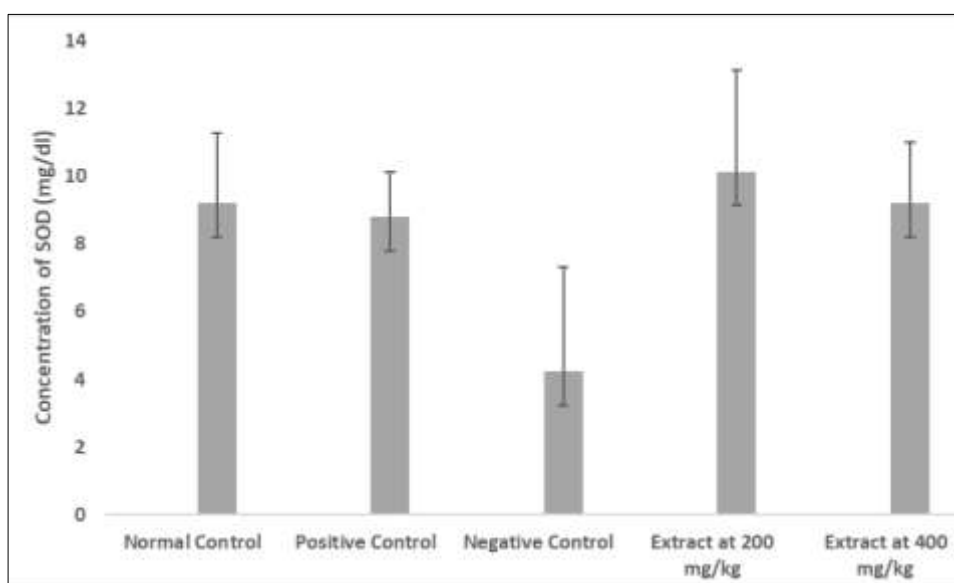


Fig 3: Effect of methanol extract of corn silk on super oxide dismutase (SOD) concentration

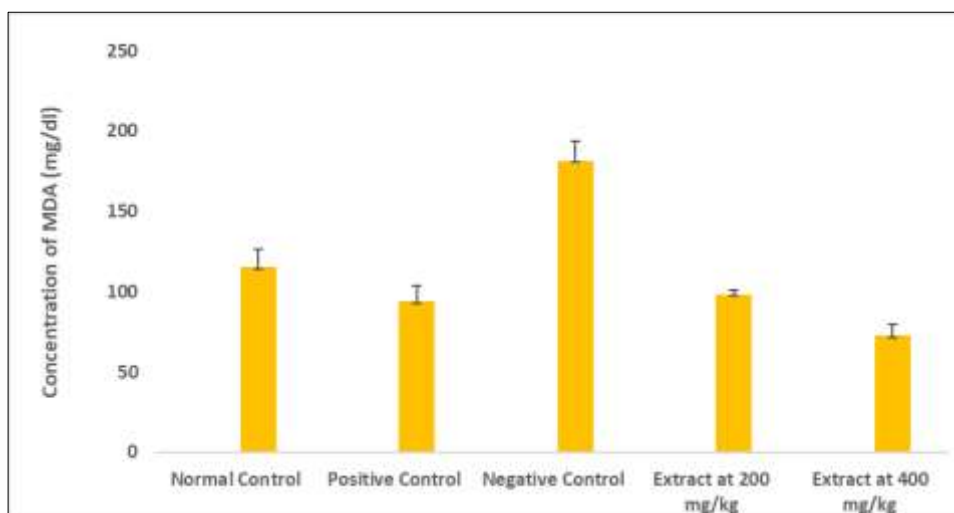


Fig 4: Effect of methanol extract of corn silk on Malondialdehyde (MDA) concentration

Discussions

The results of photochemical screening of the methanol extract of corn silk (Table 1) have shown the presence of flavonoids, steroids, terpenoids, cardiac glycosides, phenols, and alkaloids. Several studies have shown that Corn silk is

rich in phenolic compounds, particularly flavonoids (Maksimovic *et al.*, 2004) ^[14]; (Liu *et al.*, 2011) ^[15]. The antidiabetic and antioxidant activities of the extracts tested in this study could therefore be attributed to the phytochemicals found in the extract, some of which was reported severally to

be antihyperglycemic (Sharma *et al.*, 2010)^[16] (Tiwari & Madhusudana, 2002)^[17].

The methanol extract of Corn (*Zea mays*) silk significantly ($P < 0.05$) decreased the blood glucose level as observed in this present study (Figure 1) especially at the dose of 200 mg/kg body weight. This observed activity could be as a result of the presence of flavonoids, steroids, saponins, terpenoids and tannins in different plant parts which have also been previously reported (Ngan *et al.*, 2020)^[18]. This result agrees with the previously reported study that was carried out to investigate the hypoglycemic activity of the aqueous extract of corn silk and was found to reduce hyperglycemia (Guo *et al.*, 2019)^[19]. Furthermore, another study gave insight to the antidiabetic and antihyperlipidemic activity of flavonoids from corn silk in which the mice were given streptozotocin to induce diabetes and flavonoids from corn silk showed positive results to all categories that was investigated (Zhang *et al.*, 2016)^[20].

Among the most useful and reliable markers of oxidative stress in an *in vivo* experimental model are catalase (CAT), glutathione (GSH) and superoxide dismutase (SOD) while malondialdehyde (MDA) is a sensitive and reliable marker for lipid peroxidation (Kumar *et al.*, 2010)^[21]. Lipid peroxidation is slowed by antioxidants, which neutralize free radicals by termination of radical chain reaction (Huang *et al.*, 2022)^[22]. Several findings have shown that the activities of these antioxidants' biomarkers (SOD and CAT) are reduced during diabetes (Paradies *et al.*, 2011)^[23]; (Kostolanska *et al.*, 2009)^[24]. The result obtained in the present study (Figure 2 and 3) showed that there was significant ($P < 0.05$) increase in the level of SOD and CAT as compared to the negative control. This implies that the reduced activity of these biomarkers as a result of diabetes (negative control) was reversed upon treatment with the methanol extract of corn silk. However, there was significant ($P < 0.05$) reduction (Figure 4) in the level of MDA in animals treated with extract and metformin as compared to the negative control. Similar trend was observed, as it was previously reported that Antioxidant activity of crude flavonoid extract of corn silk using STZ induced diabetic mice showed a significant reduction in MDA values^[20]. Studies have also shown that flavonoids in corn silk have good antioxidant effects, which are mainly manifested in reducing free radical generation and scavenging free radicals (Maksimovi & Kovacevi, 2003)^[25]. These suggest that treatment of alloxan induced diabetic rats with methanol extract of corn silk has an obvious improving effect on the activity of SOD and CAT at the same time reduce MDA level, as such neutralize the free radicals produced in diabetes.

Conclusion

The results showed that the corn silk extract contained bioactive constituents that may have relevant antidiabetic and antioxidant property that could be a natural source for the management of diabetes.

Conflict of Interest

There was no conflict of interest among all the authors.

Authors Contribution

The idea was brought by Mudassir Lawal and the experimental design was done by Gunnjeet kaur. The research was carried out by Abdullahi Shehu Usman and Musa M. Liman while the manuscript was written by Ahmad Ali and Linus O. Ameh.

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