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EFFECT OF ETHANOLIC EXTRACTS OF Persea americana SEED AND Zea mays SILK ON BLOOD GLUCOSE LEVELS, BODY AND ORGAN WEIGHTS OF ALLOXAN- INDUCED HYPERGLYCEMIC ALBINO WISTAR RATS.

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ABSTRACT

The effect of ethanolic extracts of Persea americana seed and Zea mays silk on blood glucose levels, body and organ weights of alloxan- induced hyperglycemic Wistar rats was investigated using standard analytical techniques. Thirty male albino rats weighing 120-161g were randomly assigned to six groups of five rats each. Groups 3- 6 were test groups which received 400 mg/kg body weight Persea americana seed single extract, 400 mg/kg body weight Zea mays silk single extract, 400 mg/kg body weight combined extract of Persea americana seed and Zea mays silk and 500 mg/kg body weight combined extract of Persea americana seed and Zea mays silk repectively. Group 1 and 2 served as normal and diabetic controls respectively. Diabetes was induced using 170mg/kg body weight alloxan monohydrate. All the rats received their normal diet and distilled water daily for a period of 28 days. At the end of the experiment, the groups administered 400 mg/kg body weight Zea mays silk single extract and 400 mg/kg body weight combined extract of Persea americana seed and Zea mays silk showed significant ($P< 0.05$) decrease in fasting blood glucose when compared with the diabetic control. The highest body weight change was observed in the high dose combined extract group followed by the Zea mays silk single extract group. Apart from the kidney and spleen weights, which were significantly reduced in the Zea mays single extract group, there was no significant difference ($P> 0.05$) in organ weights of the experimental groups compared with the diabetic and normal controls. Persea americana seed increased body and organ weights of experimental animals whereas Zea mays silk decreased same. It may therefore be concluded that Persea americana seed and Zea mays silk are probable hypoglycemic agents.

KEYWORDS: Persea americana seed, Zea mays silk, glucose, body weight, organ weight

INTRODUCTION

Diabetes mellitus is a metabolic disorder of the endocrine system that precipitates disturbances in glucose, lipid and protein homeostasis (Van den Berghe et al., 2006). The disease is found in all parts of the world and is increasing rapidly worldwide. It is secondary to a deficiency of the number of pancreatic β-cells of the islets of langerhans or resistance of tissue cells to insulin (Kelly and Fabtus,1995). People suffering from diabetes cannot produce or properly use insulin, and so they persistently have high blood glucose. Diabetes is generally characterized by hyperglycemia, glucosuria, polyuria, body weight loss, disability, coma, and even death (Cockram et al., 1993). Diabetes is a global epidemic with an estimated worldwide prevalence of 246 million people in 2007 and forecasts to rise to 300 million by 2025 (Whiting et al., 2011); consequently, diabetes presents a major challenge to healthcare systems around the world. Diabetes is a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbance of carbohydrate, fat, and protein metabolism resulting from defects in insulin secretion, insulin action, or both (Nayak and Roberts, 2006). Many oral antihyperglycemic agents, such as sulfonylurea and biguanides, are available along with insulin for the treatment of diabetes, but these agents have significant side effects, and some are ineffective in chronic diabetes patients (Pari and Saravanan, 2004). Thus, there is an increasing need for new natural antihyperglycemic products especially nutraceuticals with less side effects, safe, and high antihyperglycemic potential.

Plants are well known in traditional medicine for their hypoglycemic effect and available literature indicate that there are more than 800 plant species showing hypoglycemic activities in vivo (Maton et al., 1993). Traditional medicines derived mainly from plants play an important role in the management of diabetes. Persea americana seed is reported to be high in ash crude fats,

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carbohydrate, energy, zinc, iron, manganese and magnesium (Kawagishi et al., 2001). They are also rich in bioactive substances such as phenols, alkaloids, saponins and flavonoids and have been reported to possess anti-cancer, anti- microbial and hypoglycemic properties. The Zea mays (corn) silk are the thread-like styles and stigmas on the corn cob enclosed by the leafy husk. They are known for their soothing, relaxing, diuretic, anti inflamatory and hypoglycemic properties. The constituents of Zea mays silk are flavonoids, alkaloids, phenols, steroids, glycosides, terpenoids, Vitamins C, E and K, calcium, magnesium and iron, tannins, carbohydrates and amino acids (Sommerfied et al., 2004). The aim of this study was to evaluate the effects Persea americana seed and Zea mays silk on the glucose levels, body and organ weights of alloxan-induced hyperglycemic rats.

MATERIALS AND METHODS

Collection of samples

Persea americana seeds were extracted from ripe fruits obtained from a farm land in Abak Ukpom, Obot Akara LGA of Akwa Ibom State and Zea mays silk were removed from matured maize cobs obtained from a farm land in Obot Akara LGA.

Preparation of samples

The Persea americana seeds and Zea mays silk were washed and air dried for one day after which the Persea americana seeds were cut into smaller pieces. Both samples were further air-dried under shade for two weeks and then blended into powder and stored for analysis.

Extraction of samples

Three hundred and sixty one grams (361g) and 109g of ground Persea americana seed and Zea mays silk were weighed out respectively into different volumetric flasks, 90% ethanol and distilled water were added to each flask to make up the 100ml mark and soaked for 48hours at room temperature (25^{o}C). The extracts were separately filtered using funnel and Whatman No.1 filter paper into separate well-labeled beakers and were concentrated in a water bath at 40 ^{o}C for three consecutive days. Afterward, the slurry obtained from the extracts was preserved in a refrigerator at 4 ^{o}C for use in the experiment.

Experimental Animals

Thirty (30) male albino rats weighing 120-161g were obtained from the disease free stock of the animal house of the Biochemistry Unit, Department of Science Technology, Akwa Ibom State Polytechnic and used for the study. The animals were housed in wooden cages (18 x15 inches) with stainless steel mesh at the bottom to ensure that faeces and feed droppings were inaccessible to the animals. The environment was under standard conditions of temperature (28± 2 ^{o}C) and relative humidity (46±5%) with 12hours light-dark cycle and adequate ventilation. The animals were fed daily with rat mash and water throughout the treatment.

Induction of diabetes

The animals were prepared for diabetes induction by alloxan monohydrate. After 18 hours over night fast, the body weights and blood glucose levels of the animals were taken. Before inducement with alloxan monohydrate, all experimental animals were tested and ascertained to have normal blood sugar levels. The animals except those for the normal control group were intra- peritoneally injected with 170mg/kg body weight of alloxan monohydrate. The glucose levels of the animals were taken daily for 7 days to obtain a stable blood glucose level (Antia et al., 2005) only animals with fasting blood glucose levels from 200mg/dl and above were considered diabetic and selected for the diabetic study.

Grouping and Treatment of Animals.

Seven days after the inducement of diabetes which was when the blood glucose levels of the rats were stable, drug treatment commenced and continued for 28 days. The thirty animals were assigned to six groups of five animals each. Group 1 served as normal control and was fed the commercial rat mash and water only. Group 2 was taken as the diabetic control and was fed the commercial rat mash and water only. Groups 3-6 were the diabetic test groups. Group 3 was orally administered with 400mg/kg single extract of Persea americana seed, Group 4 received 400mg/kg body weight Zea mays silk, Group 5 was administered with 400mg/kg body weight of combined extract of Persea americana seed and Zea mays silk (50:50 ratio), Group 5 was treated with 400mg/kg body weight Zea mays silk, Group 6 was administered with 400mg/kg body weight of combined extract of Persea americana seed and Zea mays silk (50:50 ratio). The experimental groups were also fed the commercial rat mash and water throughout the period of study.

Collection and handling of blood sample

After the 28 days treatment, the rats were made to fast overnight after which their fasting blood glucose was determined.

Determination of blood glucose concentration

The blood glucose was determined using a one touch glucometer (ACCU-Ceck, Johnson- Johnson, California, USA).

Proceedure:

Blood samples were obtained from the rats by a prick of the tail using lancets. The blood was dropped on the test area of the glucometer analyzer and the values recorded accordingly. This procedure was repeated weekly throughout the period of the experiment.

Change in fasting blood glucose (mg/dl) was calculated as:

Final blood glucose concentration - Initial blood glucose concentration

Determination of body weight

The body weights of rats in each group was measured weekly using a weighing balance.

The change in body weight (g) was calculated as:

Final body weight - Initial body weight

Determination of organ weight

At the end of the experiment, the rats were anaesthetized using chloroform fumes and sacrificed.

After the animals were sacrificed, the kidney, liver, spleen, lung and heart from the animals were carefully removed. The weight of each organ was taken using a sensitive balance and filter paper.

Statistical analysis

Data from the experiment were subjected to one-way analysis of variance (ANOVA). Results were expressed as mean ± standard error of mean. Significant differences among treatment were detected using LSD test at probability level of 0.05 as provided by SPSS version 20.0 programmes.

RESULTS

Table 1: Effect of ethanolic extracts of P. americana seed and Z. mays silk on fasting blood glucose of alloxan induced hyperglycemic albino Wistar rats

	FBS OF GROUPS (mg/dl)					
	1	2	3	4	5	6
pre- experimental FBG	81.00±7.12	76.60±4.51	82.80±10.90	76.20±10.75	64.80±3.12	59.40±2.69
Week 1 FBG (Initial)	92.80±2.65	238.60±15.00	261.00±76.57	286.75±66.58	361.67±150.99	206.00±94.50
Week 2 FBG	75.00±5.81	226.63±71.26	217.25±68.31	124.00±32.50	274.33±91.19	162.67±68.49
Week 3 FBG (Final)	85.20±7.74	290.67±114.35	84.25±20.48	74.25±13.71	59.67±17.84	160.67±90.50
Change in FBG	-7.60±8.25	49.33±125.64	-176.75±80.77	-212.50±53.27	-302.00±132.28	-45.33±9.17
% Change in FBG	-14.80±7.74	190.69±114.35	-15.75±20.48	-25.75±13.71	-40.33±17.84	60.67±90.50

Results are expressed as mean ± standard error of mean (SEM)

Key:
FBG = Fasting blood glucose Group 1 = Normal control Group 2 = Diabetic control
Group 3 = Group given 400mg/ kg body weight Persea americana seed extract
Group 4 = Group given 400mg/ kg body weight Zea mays silk extract
Group 5 = Group given 400mg/ kg body weight Persea americana seed and Zea mays silk respectively
Group 6 = Group given 500mg/ kg body weight Persea americana seed and Zea mays silk respectively

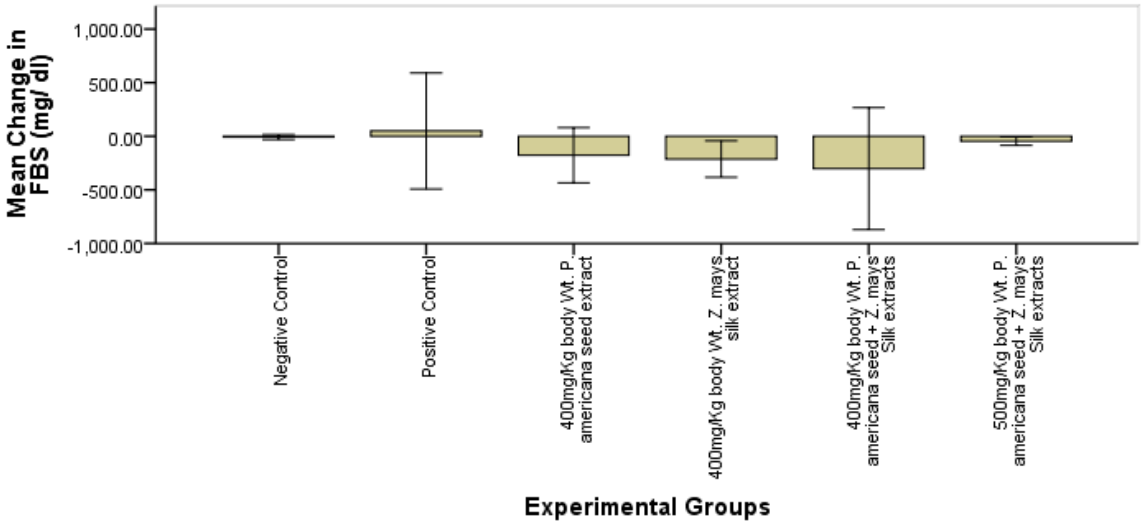

FIG. 1: Bar chart showing change in fasting blood glucose of experimental groups

Table 2: Effect of ethanolic extracts of P. americana seed and Z. mays silk on body weights of alloxan induced hyperglycemic albino Wistar rats

	BODY WEIGHT OF GROUPS (g)					
	1	2	3	4	5	6
Pre-experimental BWT	129.60±4.70	134.50±17.02	161.75±40.25	154.00±36.74	120.33±9.94	146.67±33.95
Week 1 BWT(Initial)	127.60±4.31	125.33±24.40	154.75±35.96	152.00±29.31	130.00±6.56	184.00±35.70
Week 2 BWT	137.00±6.54	132.67±25.90	162.25±37.10	162.70±31.02	144.33±7.31	174.00±23.03
Week 3 BWT (Final)	143.20±6.95	130.33±26.97	163.50±33.93	134.00±4.92	138.33±13.54	164.67±19.43
Change in BWT	15.60±10.75	5.00± 11.02	8.75±2.50	-18.00±25.39	8.33±19.80	-19.33±18.35
% Change in BWT	43.20± 6.95	30.33±26.95	63.50±33.93	34.00±4.92	38.33±13.54	64.67±19.43

Results are expressed as mean ± standard error of mean (SEM)

Key:
BWT = Body weight Group 1 = Normal control Group 2 = Diabetic control
Group 3 = Group given 400mg/ kg body weight Persea americana seed extract
Group 4 = Group given 400mg/ kg body weight Zea mays silk extract
Group 5 = Group given 400mg/ kg body weight Persea americana seed and Zea mays silk respectively
Group 6 = Group given 500mg/ kg body weight Persea americana seed and Zea mays silk respectively

Table 3: Effect of ethanolic extracts of P. americana seed and Z. mays silk on organ weights of alloxan induced hyperglycemic albino Wistar rats

GROUPS	ORGAN WEIGHT (g)				
	Kidney	Liver	Spleen	Lung	Heart
1	0.96±0.05^{bd}	4.59±0.32	0.72±0.06^{cb}	0.89±0.05	0.53±0.09
2	1.04±0.14^{d}	4.69±0.90	0.58±0.07^{b}	0.99±0.13	0.52±0.10
3	1.14±0.09^{d}	6.09±0.56	0.78±0.05^{cb}	1.11±0.22	0.63±0.05
4	0.95±0.04^{bd}	5.16±0.49	0.45±0.14^{ab}	1.07±0.39	0.56±0.14
5	1.14±0.07^{d}	5.58±0.39	0.59±0.05^{b}	0.96±0.06	0.62±0.09
6	1.26±0.15^{ad}	5.40±0.83	0.53±0.03^{b}	1.31±0.26	0.67±0.05

Results are expressed as mean ± standard error of mean (SEM)
Values in the same column with different superscripts are significantly different ($P < 0.05$)

Key:
Group 1 = Normal control Group 2 = Diabetic control
Group 3 = Group given 400mg/ kg body weight Persea americana seed extract
Group 4 = Group given 400mg/ kg body weight Zea mays silk extract
Group 5 = Group given 400mg/ kg body weight Persea americana seed and Zea mays silk respectively
Group 6 = Group given 500mg/ kg body weight Persea americana seed and Zea mays silk respectively

DISCUSSION

The effect of ethanolic extracts of Persea americana seed and Zea mays silk on blood glucose levels, body and organ weights of alloxan- induced hyperglycemic albino Wistar rats were determined. At the end of the experiment, a significant ($P< 0.05$) decrease in fasting blood glucose was observed in groups 4 and 5 when compared with that of the diabetic control group. Figure 1 shows that the diabetic test group administered 400 mg/ kg body weight Persea americana seed and Zea mays silk combined extract (i.e. the group administered the lower dose of the combined extract), had the highest decrease in blood glucose when compared with the other diabetic test groups. This was followed by the group given 400mg/ kg body weight Zea mays silk extract (Table 1). Guo et al. (2009) observed that corn silk extract markedly reduced hyperglycemia in alloxan-induced diabetic mice. They assert that the action of corn silk extract on glycaemic metabolism is not via increasing glycogen and inhibiting gluconeogenesis but through increasing insulin level as well as enhancing the recovery of injured beta-cells. Their results suggest that corn silk extract may be used as a hypoglycemic food or medicine for hyperglycemic people.

Corn silk is also reported to be rich in phenolic compounds, particularly flavonoids which have antioxidant and anti diabetic effects (Saxena and Kishore, 2004; Sommerfied et al., 2004). N'guessan et al. (2009), in their experiment observed that after oral administration of corn silk extract, the blood glucose was significantly decreased in alloxan induced hyperglycemic rats.

A non significant decrease in fasting blood sugar was also observed in the group administered the single dose of Persea americana extract and the higher dose of the combined extract. The findings of this study were also similar to the studies of Minari (2012) and Akah and Okafor (1992) who had variously demonstrated that extracts of Persea americana seed possess antidiabetic properties. As purported by Alhassan et al. (2012), the hypoglycemic effect of the avocado pear seed extract may be due to elemental contents such as calcium, potassium, magnesium, zinc, chromium etc which play key roles in blood homeostasis by regulating the key enzymes such as glucose- 6- phosphatase, fructose - 1,6- diphosphatase and phosphoenol pyruvate carboxykinase involved in gluconeogenesis, thereby blocking gluconeogenesis and enhancing glucose utilization in the body. It was however observed that at a higher dose of the combined extract, 500mg/ kg body weight P. americana seed and Z. mays silk, the change in fasting blood glucose was less. Both the P. americana seed and Z. mays silk extracts were found to reduce blood glucose levels of all the test groups when compared with the diabetic control group.

The effect of the combined extracts may be due to a synergy between the bioactive secondary compounds from these two plants. This supports the assertion of Atangwho et al. (2009), that there appears to be complement bioactive principles in plants. This may account for the hypoglycemic action of the two plants in the present study.

Table 2 indicates that at the dosage of alloxan administered in this study, there was a non significant increase in body weight of all the diabetic test groups except the group administered the single extract of Z. mays silk (group 4) and the higher dose of the combined extract (group 6). Alloxan has been reported to increase weight of experimental animals (Gorus et al., 2008). The increase also observed in the groups treated with P. americana seed could be due to certain compounds and mineral elements that may stimulate effective utilization of nutrients in addition to nutrients such as proteins and fats which may be present in the P. americana seed (Alhassan et al., 2012). The decrease in body weight of groups given the Z. mays silk is consistent with the findings of the research conducted by Ahmed et al. (2006), who recorded significant decrease in body mass index of rats fed aqueous and methanolic extracts of corn silk. This, he asserts could be due to its natural constituents such as total flavonoids which could cause reduction of dietary fat absorption. Lee et al. (2006) conclude from their research that high maysin corn silk extract inhibits expression of genes involved in adipocyte differentiation, fat accumulation, and fat synthesis as well as promotes expression of genes involved in lipolysis and fat oxidation, further inhibiting body fat accumulation and body weight elevation in experimental animals.

Table 3 shows that no significant differences ($P> 0.05$) were observed in the liver, lungs and heart of all the test groups when compared to the normal and diabetic control groups. However there were non- significant decreases in the weights of these organs especially in the group administered the single extract of corn silk when compared with the normal and diabetic control groups. The spleen weights were significantly reduced in the group given the single dose of the corn silk extract when compared to that given the Persea americana single extract and the normal control. Mathuramon et al. (2009) found that the weight of the spleen is positively correlated to body weight and height in males and not in females.

The kidney weight was however significantly increased in the group given the higher dose of the combined extract when compared to the corn silk single extract group and the normal control. Mubbunu et al. (2018) also observed a positive correlation between kidney weight and body weight.

CONCLUSION

This study investigated the effect of ethanolic extracts of Persea americana seed and Zea mays silk on blood glucose levels, body and organ weights of hyperglycemic rats. The results showed a significant decrease in fasting blood glucose in groups 4 and 5 when compared with the diabetic control group. The diabetic test group administered 400 mg/ kg body weight P. americana seed and Z. mays silk combined extract had the highest decrease in blood glucose. This was followed by the group given 400mg/ kg body weight Z. mays silk extract. It may therefore be concluded that P. americana seed and Z. mays silk are probable hypoglycemic agents at a dose of 400mg/ kg body

weight. In the present study, P. americana seed has been observed to increase body and organ weights of experimental animals whereas Z. mays silk decreased same.

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