

HYPOGLYCAEMIC EFFECTS OF *Cocos nucifera* (Coconut) HUSK EXTRACT ON ALLOXAN INDUCED FEMALE DIABETIC WISTAR RATS

Emojevwwe Victor

Department of Physiology, Faculty of Basic Medical Sciences, Delta State University, Abraka, Delta State Nigeria, emojevwwevictor@gmail.com

ABSTRACT

The hypoglycaemic effects of *Cocos nucifera* (Coconut) Husk was studied on 20 alloxan-induced diabetic female rats which were randomly grouped into two (n=10). Group I served as control while group II served as experimental groups. The rats were made diabetic by intraperitoneal administration of 150 mg/kg of alloxan. The extract was obtained by cooking the husk in boiling water for 45 minutes in a gas stove flame at a 100 degree Celsius and the fluid was filtered out and kept as the tea for the experiment. The control group was given 2 ml of 0.9% (normal) saline daily and group II was given 2 ml of the coconut husk tea only daily by Oro-gastric tube and random blood sugar was measured daily in the rats. The weights of the rats were checked daily using a digital electronic weighing balance. At the end of the experiments the animals were sacrificed and the pancreas harvested and histopathological slides made. In the treated diabetic rats, blood glucose levels were significantly reduced ($p < 0.05$) on consumption of the *Cocos nucifera* (Coconut) Husk extract. The weight also reduced. The Histopathological study showed same regenerative ability in the rats that received the extracts (coconut husk tea). It was therefore concluded that *Cocos nucifera* (coconut) husk tea has a significant hypoglycemic and anti-diabetic effects in alloxan-induced diabetes. It is therefore recommended that a study of this nature be done using human subjects.

KEYWORDS: *Diabetics mellitus, hypoglycaemia, coconut husk, Cocus nucifera, alloxan, Wistar rat*

INTRODUCTION

Diabetes mellitus is a serious lifelong condition that affects an estimated population of about 15 millions and a third of these goes about undiagnosed until many years after the onset (Nwangwa, 2012), and has been described as an endocrine /metabolic syndrome resulting from absolute or relative deficiency of insulin and characterized by hyperglycemia, polyuria, polyphagia and polydipsia (Edward *et al.*, 1996). Associated with acute metabolic decomposition that may lead to permanent and irreversible functional and structural changes in the cells of the body (Edward *et al.*, 1996). Complications of diabetes' characteristically affect the eyes, kidneys, nervous system, reproductive organs etc (Nwangwa, 2012).

Diabetes mellitus is a group of metabolic disorders with a common biochemical manifestation; hyperglycaemia, hence, it is thus a derangement of carbohydrate metabolism (Murray, 2000). Uncontrolled diabetes mellitus causes varied histopathological changes in different organs (Harold, 1978), and incidences of diabetic neuropathy has been on the increase (Adewole *et al.*, 2006; Carrington and Litchfield, 1999; Clements and Bell, 1982). The underlying causes of diabetic complications have been attributed to hyperglycemia which results in oxidative stress, alterations in enzyme activities, protein glycosylation and several structural changes (Akpan *et al.*, 2007). Alloxan induces diabetes in experimental animals through beta cells destruction (Singh and Gupta, 2007). It has been shown that beta cell apoptosis is related to alloxan-induced inhibition of pancreatic glucokinase function and there is selective beta cell loss, leading to insulinopaenic diabetes, analogous to *type I* diabetes (Kavitha *et al.*, 2007; Salihu *et al.* 2009)

Plant medicine or phytomedicine (the sum total of practices, using herbal preparations produced by physical or biological processes, to treat diseases relying on past experience/ observations handed down from generation to generation) has been used in healthcare delivery in many parts of Africa and the rest of the world (Edem, 2009). Today, medicinal plants are increasingly being used in most parts of the world as: hypolipidemic (Ugochukwu *et al.*, 2003; Ogbonnia *et al.*, 2008; Yadav *et al.*, 2008); contraceptive, abortifacients, emmenagogues or oxytocic (Yadav *et al.*, 2008).

Among the usefulness of plants in medicine are the uses in the treatment of diabetes mellitus.

Diabetes is a major degenerative disease in the world today (Ogbonnia *et al*, 2008), affecting at least 15 million people and having complications which include hypertension, atherosclerosis and microcirculatory disorders. There has been increasing demand for the use of plant products with antidiabetic activity. The high cost, low availability, uncertainty of use during pregnancy and undesirable side effects of synthetic drugs have been some of the factors leading to a strong preference for hypoglycaemic drugs of plant origin, which are believed to be suitable for chronic treatments (Berger; 1985; Okigbo and Mmeka, 2006). Plants which have been shown to have hypoglycaemic action, act on blood glucose through different mechanisms. Some of them may inhibit endogenous glucose production (Eddouks *et al*, 2003) or interfere with gastrointestinal glucose absorption (Musabayane *et al* 2006); some may have insulin-like substances (Collier *et al* 1987; Gray and Flatt, 1999); some may inhibit insulinase activity and some may increase secretion of insulin from the β cells of the pancreas i.e. pancreatotropic action (Khan *et al*,1990; Trivedi *et al.*, 2004; Yadav *et al*, 2008), while others may increase beta cells in pancreas by activating regeneration of these cells (Shanmugasundaram *et al*, 1990; Jelodar *et al*, 2007).

Very few traditional treatments for Diabetics mellitus have been scientifically scrutinized hence this study.

The coconut husk being the combination of the exocarp and the mesocarp of the coconut fruit has never been attributed with any medical value. But have been said to have the following industrial, commercial, household and agricultural uses. It covers about 35% of the coconut fruit.

The coconut husk is that 5-10 cm thick fibrous covering of the coconut fruit which envelops the hard shell structure of 3.5 mm thickness. The external appearance of the husk varies from decidedly dull brown when fully ripe to bright green when immature. There are other varieties whose husks are golden yellow or yellow brown. The husk is full of long, coarse fibres, all running in one direction. The fibres are embedded in a matrix of material called coir dust. Since husks are porous, they absorb or retain water (Tejano 1985).

METHODOLOGY

Preparation of the Extract: A dry coconut husk was cooked for 50 minutes in a gas stove flame at a 100 degree Celsius. After cooking, the fluid if filtered out and kept as the tea for the experiment

The animal procedure was carried out according to the guidelines of Delta State University, Abraka, Nigeria, and Medical Ethics Committee for the use of experimental animals in research. Twenty (20) Female Wistar rats weighing between 160 - 202 g were randomly divided into two (n=10) groups after allowing the rats to acclimatize for seven days.

Each group were kept in separate cages which were cleaned daily and washed weekly with proper identification with 12:12 hour light and dark cycle, at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$. They were allowed access to water ad libitum and normal rat chow with standard composition supplied by Pfizer Nigeria Ltd. Warri.

All the rats in the experimental groups were made diabetic by intraperitoneal administration of 150 mg/kg of alloxan (Katsumata *et al.*, 1992; Katsumata *et al.*, 1993) and 48 h later, blood glucose oxidase strip was used to confirm the diabetic levels of the rats using blood samples collected from the tails of the rats. The control group was given 2 ml of 0.9% (normal) saline daily and group II was given 2 ml of the coconut husk tea only. At the end of the experiments the animals were sacrificed and the pancreas was extracted and histopathological slides were prepared.

All the substances were given for five days by Oro-gastric tube. The random blood sugar was measured daily in the rats and values recorded using the strip testing method and The weight of the rats were checked daily and documented using a digital electronic weighing balance. Histological slides prepared according to the international research standard.

For statistical data comparisons, data were evaluated by Student paired *t*-Test. All values are given as mean \pm SD with n values indicating the number of subjects analyzed. $P < 0.05$ are considered significant.

RESULTS

There was an initial inactivity in the rats following administration of the extract and their appetite was low except for the control group. There were weight changes within the experimental groups and the control (Table 1). The blood glucose levels of the rats at the start to the end of the experiment for the groups are given in Table 2. The histopathology of the pancreas is shown in Figure 1, 2 and 3 with figure 1 showing the normal non-diabetic pancreas

Table 1: Weight (g) in control and diabetic rats before and after experiment (Mean ±SD)

| | Before Treatment | After Treatment | Paired t-Test |
|--------------------------------|------------------|-----------------|---------------|
| Control (2ml of normal saline) | 181 ± 1.7 | 183 ±2.0 | 0.64 |
| Coconut husk tea only (2ml) | 187 ± 2.6 | 172 ±1.0* | 3.82 |

*Significant compare to the mean from the control group (P<0.05)
 (Table1) shows reduction in weight in the group treated with extract

Table 2: Mean Blood Glucose levels (mmol/L) of the diabetic wistar rats on daily basis

| Group | Initial level | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 |
|---|---------------|-------|-------|-------|-------|-------|
| Control (2 ml of normal saline) | 10.0 | 9.2 | 9.7 | 9.6 | 9.0 | 8.2 |
| <i>Cocos nucifera</i> (coconut) husk tea. (2ml) | 10.8 | 8,1 | 6.1 | 3.5 | 2.2 | 1.7 |

Normal range for blood glucose: 2.5 to 5.0mmol/L. The hypoglycaemia noticed in the group treated with the extract was so high that three of the rats in the group died of hypoglycaemia at the Day five of the experiment as a result of the high hypoglycaemic effects of the extract. Paired t-test was used to compare mean of initial glycaemia values and Day five glycaemia values.

Histopathology

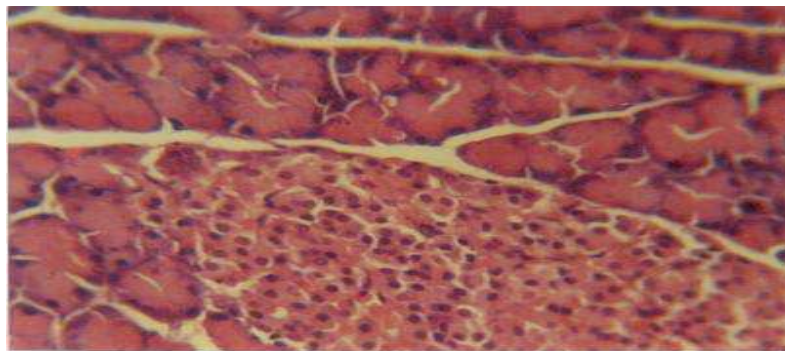


Figure 1: Histology of Pancreas of Normal Healthy Rat, H & E Staining (x40)

Fig 1 shows the various cell of the normal non diabetic pancreas

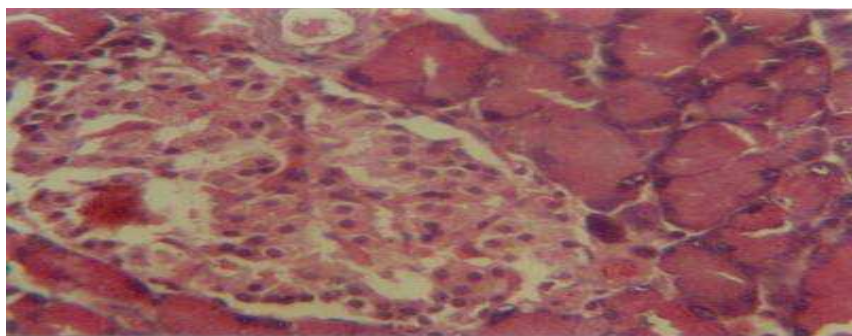


Figure 2: Histology of Pancreas of Diabetic Control Rat, H & E Staining (x 40)

Fig 2 showed degeneration of pancreatic cells, which was due to the effects of the alloxan used in this study

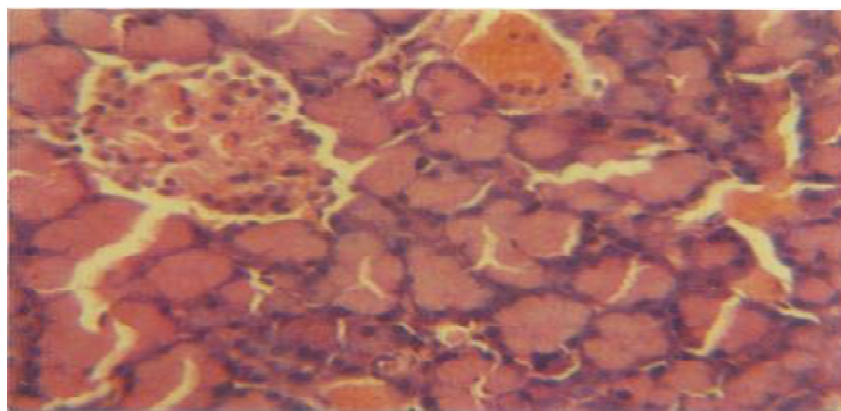


Figure 3: Histology of diabetic Rats treated with coconut husk tea. H & E Staining (x 40)

As shown, (Fig 3) there is a great regeneration of the pancreatic cells, which was due to the healing ability of the *Cocos nucifera (coconut) husk*

DISCUSSION

Majority of the modalities available for treatment of diabetics mellitus are diets, exercise, use of hypoglycemic agents/drugs, and some cases, insulin therapy.

The results from the effects of the *Cocos nucifera (coconut) husk* used as hypoglycaemic agent in this study indicate reduction in weight and drastic decrease in the glucose levels of the rats for all the groups except for the control group as seen in Tables 1 and 2.

The decrease in weight noticed in the *Cocos nucifera (coconut) husk* group could be as a result of high glucose uptake by the body cell above the available one as a result of the effects of the extract, thereby causing breakdown and conversion of body stored fat into glucose to meet with the body need leading to weight loss.

The decrease in glucose level noticed in the *Cocos nucifera (coconut) husk tea* group was so fast and drastic to the extent that it caused hypoglycaemia that led to the death of some of the rats within five days of administration. The mechanism by which it does this may be independent of the availability of insulin from pancreatic cells (Inya-Agha, 1999) and the mechanism of action to reduce the blood glucose may be due to stimulation of influx of glucose into the cells for metabolism or by providing an enabling medium that facilitate the glucose uptake in the rats. The death recorded here is as a result of low availability of glucose to the body cell leading to glucose starvation in the brain tissues of the rats. This means that whenever the extract is used as hypoglycaemic agent; regular glucose test should be done to avoid effect resulting from over consumption of the substance.

The Histopathological study of diabetic untreated rats (Fig. 2) showed degeneration of pancreatic islet cells, which was due to alloxan used in this study. This probably gave rise to insulin deficiency which causes excessive elevation of blood glucose and underutilization leading to hyperglycaemia (Standl *et al*, 2003). The histopathological study of diabetic treated group showed in Figure 3 indicated increased volume density of islets and increased percentage of beta cells, in the diabetic rats that received the extracts (coconut husk tea) which may be a sign of regeneration of β cells and potentiating of insulin secretion from surviving β cells of the islets of Langerhans.

CONCLUSION

It is therefore concluded that *cocos nucifera (coconut) husk tea* has significant hypoglycemic effects in alloxan-induced diabetes and could serve as an effective adjunct in the management of diabetes mellitus. It is therefore recommended that a study of this nature be done using human subjects

ACKNOWLEDGEMENT

The author wish to acknowledge Mrs Grace Siloko and Hon. D. O. Siloko for supplying the Finances needed for this research and Revd Evang. & Mrs A. O. Eteuvwe and also to Miss Favour Itobore

REFERENCES

Adewole SO, Caxton-Martins EA, Ojewole JAO (2006). Histochemical and Biochemical Effects of Melatonin on Pancreatic cells on Streptozocin –treated Diabetic Rats. *Online Journal of Pharmacology*- 2: 1-21.

Adewole, S.O. and Ojewole, J.A.O. (2007). Insulin- induced immunohistochemical and morphological changes in pancreatic β -cells of streptozotocin-treated diabetic rats. *Journal of Methods and Findings in Experimental and Clinical Pharmacology* 29(7): 447 – 455.

Akpan HB, Adefule AK, Fakoya FA, Caxton-Martins EA (2007).Evaluation of LDH and G6-PDH Activities in Auditory Relay Centers of Streptozocin-induced Diabetic Wistar Rats. *Journal of Anal. Sci.* 1(1): 21-25.

Bethesda MD (1995). Diabetic Statistics, US Department of Health and Human Services, Public Health Services, National Institute of Health, NIDDK, 1:NIH Publication.

Carrington AL, Litchfield JE (1999). The Aldose Reductase Pathway and Non-enzymatic Glycation in the Pathogenesis of Diabetic Neuropathy: A Critical Review for the End of the 20th Century. *Diabetes Review.* 7: 275-299.

Clements RS (Jr), Bell DSH (1982). Diabetic Neuropathy: Peripheral and Autonomic Syndrome. *Journal of Diabetic Neuropathy.* 71: 50-67.

Collier, E., Watkinson, A., Cleland, C.F. and Roth, J. (1987). Partial purification and characterization of an insulin-like material from spinach and lemna gibba G3. *Journal of Biology and Chemistry.* 262: 6238 -6241.

Eddouks M, Jouad H, Maghrani M. Lemhadri A & Burcelin R (2003). Inhibition of endogenous glucose production accounts for hypoglycemic effect of *Spergularia purpurea* in streptozotocin mice. *International Journal of Phytotherapy and Phytopharmacology* 10 (6-7): 594-599.

Edem D. O (2009): Hypoglycemic Effects of Ethanolic Extracts of Alligator Pear Seed (*Persea Americana Mill*) in Rats. *European Journal of Scientific Research* 33 (4) 669-678

Edward, CRW., Bouchier, IAD.,Haslett, ER (ed) (1996). Davidson's Principle and practice of medicine 17th ed. Churchill Livingstone Great Britain Pp 724-764.

Gray, A.M. and Flatt, P.R. (1999). Insulin – releasing and insulin – like activity of the traditional antidiabetic plant *Coriander sativum* (coriander). *British Journal of Nutrition.* 81: 203-208.

Harold E (1978). Clinical Anatomy, Black Well Scientific Publication, pp. 107-109.

Inya-Agha SI (1999). The Hypoglycemic Properties of *Picralima nitida*. *Niger. J. Nat. Prod. Med.* 3: 66-67.

Jelodar, G., Mohsen M and Shahram S. (2007). Effect of walnut leaf, coriander and pomegranate on blood glucose and histopathology of pancreas of alloxan – induced diabetic rats. *African Journal of Traditional Complementary and Alternative Medicines* 4 (3): 299 – 305.

Katsumata K, Katsumata K (Jr), Katsumata Y (1992). Protective Effects of Diliaziem Hydrochloride on the Occurrence of Alloxan-or Streptozocin-induced Diabetes in Rats. *Hormone Metab. Res.* 24: 508-510.

Katsumata K, Katsumata Y, Ozawa T, Katsumata K (Jr) (1993). Potentiating Effects of Combined Usage of Three Sulfonylurea Drugs on the Occurrence of Alloxan Diabetes in Rats. *Hormone Metab. Res.* 25: 125-126.

Kavitha JV, Rosario JF, Chandran J, Anbu P, Bakkiyanathan D (2007). Hypoglycemic and other related effects of *Boswellia glabra* in Alloxan – induced diabetic rats, *Indian J. Physiol. Pharmacol.* 51(1): 29-39.

Khan, A., Bryden, N.A., Polasky, M.N. and Anderson, R.A. (1990). Insulin- potentiating factor and chromium content of selected spices. *Biol. Trace Elem. Res.* 24:183-188.

Murray RK (2000). *Hepers Biochemistry*, Lange Medical Publication, 25th edition, pp. 216-218.

Musabayane, C.T., Bwititi, P.T., Ojewole, J.A.O. (2006). Effect of oral administration of some herbal extracts on food consumption and blood glucose levels in normal and streptozotocin-treated diabetic rats. *Methods and Findings in Experimental and Clinical Pharmacology* 28 (4):223-228.

Nwangwa E. K. (2012). Ph.D dissertation, Delta State University, Abraka

Ogbonnia S. O, Odimegwu, J.I. and Enwuru, V.N. (2008). Evaluation of hypoglycemic and hypolipidemic effects of ethanolic extracts of *Treulia africana* Decne and *Bryophyllum pinnatum* Lam and their mixture on streptozotocin (STZ) - induced diabetic rats. *African Journal of Biotechnology* 7(15): 2535-2539.

Okigbo, R.N., Mbajiuka, C.S. and Njoku, C.O. (2005). Antimicrobial potentials of *Xylopiya aethiopyca* (“uda”) and *Ocimum gratissimum* L on some pathogens of man. *International Journal of Molecular Medicine and Advanced Science* 1 (4): 392-397.

Shanmugasundaram, E.R., Gopith, K.I., Radha, S.K. and Rajendram, V.M. (1990). Possible regeneration of the islets of Langerhans in streptozocin diabetic rats given *Gymnema sylvestere* leaf extracts. *Journal of Ethnopharmacology.* 30:265 -269.

Standl, E., Ballestshoffer, B., Dahl, B. and Shagler, H. (2003). Predictors of 10 years macrovascular and overall mortality in patients with NIDDM: the Munich practitioner project. *Diabetologia* 39: 540 -545

Tejano E.A.1985, State of the Art of Coconut Coir Dust and Husk Utilization (General Overview). *Paper presented during the National Workshop on Waste Utilization, Coconut Husk held on November 12, 1984 at the Philippine Coconut Authority, Diliman, Quezon City, PHILIPPINES.* © Philippine Journal of Coconut Studies, 1985

Trivedi, N.A., Mazumder, B., Bhatt, J.D. and Hemavathi, K.G. (2004). Effect of Shilajit on blood glucose and lipid profile in alloxan induced diabetic rats. *Indian Journal of Pharmacology*, 36: 373 -376.

Ugochukwu, N.H., Babady, N.E., Cobourne, M. and Gasset, S.R. (2003). The effect of *Gangronema latifolium* extracts on serum lipid profile and oxidative stress in hepatocytes of diabetic rats. *Journal of Biosciences* 28 (1): 1-5.

Yadav, J.P., Saini, S., Kalia, A.N. and Dangi, A.S. (2008). Hypoglycemic activity of ethanolic extract of *Salvadora oleoides* in normal and alloxan – induced diabetes rats. *Indian Journal of Pharmacology.* 40 (1): 23 – 27.

Received for Publication: 24/07/2012

Accepted for Publication: 27/09/2012