

Effects of *Garcinia kola* on the Lipid Profile of Alloxan-Induced Diabetic Wistar Rats

E.K. Nwangwa

Department of Physiology, Faculty of Basic Medical Sciences College of Health Sciences,
Delta State University, P.M.B. 001 Abraka. Delta State. Nigeria

Abstract: In this study, the effects of *Garcinia kola* on the lipid profile of alloxan-induced diabetic Wistar rats were studied. A total of twenty four (24) albino rats of wistar strain weighing between 100-150g were made diabetic by single freshly prepared intraperitoneal injection of 150 mg/dL of alloxan monohydrate. Eight (8) weeks after confirmation of diabetes, the rats were randomly divided into four (4) experimental groups (n = 6). Group I (Control) rats were treated with 1ml of 5% ethanol, Group II (diabetic rats received 1ml of 5% ethanol), Group III (Diabetic rats treated with 400 mg/kg of extract of *Garcinia kola* and 1mL of 5% ethanol) and Group IV, (Diabetic rats received 400 mg/kg of extract of *Garcinia kola*, 1mL of 5% ethanol and 1ml of honey). The extracts were administered twice daily for four (4) weeks. The blood glucose level and Lipid profile was analysed. The results shows that *Garcinia kola* has a significant ($p < 0.05$) hypoglycaemic effect on diabetic rats and significantly ($p < 0.05$) decreased the level of Total Cholesterol (TC), Low Density Lipoprotein (LDL) and Triglyceride (TG) and significantly ($p < 0.05$) increase in the level of High density lipoprotein compared with the diabetic non-treated group. These findings if applied can be of help in the management of diabetic patients.

Key words : Diabetes mellitus, *Garcinia kola*, lipid profile

INTRODUCTION

World Health Organization (1999) estimated that there were 135 million people in the world with diabetes and that this would rise to 380 million by 2025, this report also highlighted the fact that low and middle income countries will bear the brunt of the increase with Africa contributing significantly to this rise (King *et al.*, 1998). In Nigeria, World Health Organization has disclosed that more than 1.71 million citizens above 15 years are diabetic, 70, 000 children under 15 years develop insulin dependent diabetes each year, if nothing is done, diabetes sufferers will grow to about 484 million by 2030 (Winifred, 2008). Diabetes mellitus and other numerous pathological events such as atherosclerosis and inflammatory processes are associated with the generation of Reactive Oxygen Species (ROS) and consequently the induction of several chain reactions among them, lipid peroxidation (Grober, 2010). Evidence suggests that oxidative cellular injury caused by free radicals contributes to the complications of diabetes mellitus (Baimbolkar and Sainani, 1995). Some of these radicals are extremely reactive and therefore interact with some vital macromolecules including lipids, nucleic acids and protein (Nia *et al.*, 2003).

Historically, plants have served as a source of herbs for drugs development. Several plants are now being used in parts or whole to treat many diseases (Adedeji *et al.*, 2006). Before the introduction of insulin in 1922, the treatment of diabetes mellitus relied heavily on the use of tradition plants therapies (Gray and Flatt, 1999). In Africa and beyond, application of traditional medical practices to the treatment of diabetes is quite popular; several plant species have been used for this purpose Nwaegerue *et al.* (2007). Active components of these plants are now being investigated and their extract are developed into drugs and little or no negative effects as contraindications, one of such plants is *Garcinia kola* (Adedeji *et al.*, 2006).

Garcinia kola commonly called "Bitter Kola" widely distributed in Africa, Asia and Europe (Plowden, 1972) can be used as an antidiabetic agent, it could exert a beneficial effect in the diabetics by enhancing insulin secretion or improving the mimicking of insulin secretion action (Gray and Flatt, 1999), the plant phytochemical constituents include dimeric flavoid, biflavoid, xanthone and benzophenones (Alaba, 2007). Hydroxycitric acid is the principal acid of the fruit, this acid was shown to be a potent inhibitor of ATP-dependent citrate lyase which catalyses the cleavage of citrate to oxaloacetate and Acetyl-CoA (Manhendran *et al.*, 2000). Acetyl-CoA is

used by Acetyl-CoA carboxylase, the regulatory enzyme of lipogenesis in the Liver Vance and Vance (1996).

Before the remarkable bioactivities were explored, it was initially consumed as a stimulant Atawodi *et al.* (1995). The plant has been cultivated for various medical uses such as an antidote for strophanthus gratus infection Holmes (1960); bronchitis, throat infection, anti-purgative and anti-purgative and anti-parasitic (Madubuyi, 1995); others include guinea worm remedy, antiatherogenic effect and antilipoperoxative effects, anti-hepatotoxic effects (Holmes, 1960; Madubuyi, 1995; Okunji and Iwu, 1991; Lewis, 1997; Iwu, 1993; Tita *et al.* 2001), it is been reported of been capable of treating infection such as cough among the Yoruba race of West Africa Iwu and Igboko (1993).

Therefore, the aim of the present study is to investigate the effects of *Garcinia kola* on the lipid profile parameters of alloxan-induced diabetic Wistar rats.

MATERIALS AND METHODS

Plant materials: The *Garcinia kola* were purchased from a local Market in Abraka, Delta State and then authenticated at the department of Botany, Delta State University, Abraka. They were sun dried after removal of the seed coats and ground to a fine powder, this powder was transferred into a 70% ethanol solution in an air tight jar and kept for one week after which it was filtered and the extract concentrated using a rotary evaporator at 70°C by method of distillation. The resulting residue was further air-dried to finally produce a 100% *Garcinia kola* extract. The research was conducted in the department of Physiology, College of Medicine, Delta State University Abraka, in the year 2010.

Animals: A total of twenty four (24) albino rats of wistar strain weighing between 100-150 g were purchased from the animal house unit of Faculty of Basic Medical Science, Delta State University, Abraka where they were also habited for a week for acclimatization. They were allowed free access to water and standard feed diet *ad libitum*.

After one week of acclimatization, the rats were weighed and subjected to 12 h fast. Diabetes was induced with a single subcutaneous injection of 150 mg/kg of Alloxan monohydrate as a 5% w/v in distilled water Williamson *et al.* (1996). The animals were fed normally for five days and the diabetic state was confirmed by fasting blood glucose ≥ 250 mg/dL using a Glucometer (Glaxo-Germany).

After 8 weeks of confirmation of diabetes, the rats were randomly divided into four groups, each made of six rats. The control group, non diabetic rats were treated with 1ml of 5% ethanol; Group II, diabetic rats received

1 mL of 5% ethanol; Group III, diabetic rats treated with 400 mg/kg of extract of *Garcinia kola* and 1 mL of 5% ethanol; Group IV, diabetic rats received 400 mg/kg of extract of *Garcinia kola*, 1 mL of 5% ethanol and 1mL of honey. extract was administered twice daily consecutively for four (4) by the use of suitable oro-gastric cannula and calibrated hypodermic syringe.

The animals were sacrificed under chloroform anaesthesia and blood specimens were collected by cardiac puncture. The serum triglyceride, total cholesterol, High Density Lipoprotein and Low Density Lipoprotein levels were analysed using standard laboratory techniques by spectrophotometer at Eku Baptist Hospital, Delta State.

Biochemical analyses: Total lipids were estimated according to method described by Knight *et al.* (1972), serum cholesterol was estimated according to method described by Stein (1986), serum triglycerides was estimated according to method described by Chawla (2003). The Low Density Lipoprotein (LDL), high density lipoprotein (HDL) was estimated according to method described by Kostner *et al.* (1985)

Statistical analysis: The values were recorded as Mean \pm Standard Deviation. Students t-test and computer software package SPSS was also used for the analysis. $p < 0.05$ was considered statistically significant.

RESULTS

Table 1 shows blood glucose level of normal control albino rats, diabetic controlled rats (induced with alloxan without treatment, diabetic rats treated with *Garcinia kola* and diabetic rats with *Garcinia kola* and honey. The result showed that *Garcinia kola* caused a significant ($p < 0.05$) reduction in glucose level when compared with the post alloxan glucose level.

Table 2 shows body weights of normal control albino rats, diabetic controlled rats (induced with alloxan without treatment with *Garcinia kola*, diabetic rats treated with *Garcinia kola* and diabetic rats with *Garcinia kola* and honey. The results shows that diabetes mellitus caused a significant ($p < 0.05$) reduction in the weight of the rats but treatment with *Garcinia kola* and/or honey did not show any significant difference.

Table 3, shows the lipid profile of normal control adult albino wistar rats (Group I), diabetic controlled rats (induced with alloxan without treatment of *Garcinia kola* (Group II), diabetic rats treated with *Garcinia kola* (Group III) and diabetic rats with *Garcinia kola* and honey (Group IV). The result shows that there was a significant ($p < 0.05$) increase in the level of total cholesterol, LDL and Triacylglyceride and a significant ($p < 0.05$) decrease in the level of HDL. Also, the result

Table 1: The Mean \pm Standard deviation on effect of *Garcinia kola* extract on the blood glucose of diabetic rats

Groups	Treatment received	Initial glucose level (mg/dL)	Post alloxan glucose level (mg/dL)	Post <i>Garcinia kola</i> glucose level (mg/dL)	Final glucose level (mg/dL)
Control (I)	Non diabetic rats	62.0 \pm 0.71	-	-64.2 \pm 1.06	
Two (II)	Diabetic rats	70.6 \pm 6.14	276.0 \pm 38.10	-369.0 \pm 29.87	
Three (III)	Diabetic rats treated with <i>Garcinia kola</i> extract	74.6 \pm 6.83	253.6 \pm 21.14	230.0 \pm 22.37	226.0 \pm 22.66*
Four (IV)	Diabetic rats with <i>Garcinia kola</i> and honey	71.2 \pm 3.14	288.0 \pm 6.45	284.2 \pm 8.40	288.4 \pm 9.22

Values are presented as means \pm SD; *: p<0.05 compared with the post alloxan glucose level

Table 2: The Mean \pm Standard deviation of effect of *Garcinia kola* on the body weight of diabetic rats

Groups	Treatment received	Initial weight (g)	Post alloxan weight (g)	Final weight (g)
Control (I)	Non diabetic rats	100.2 \pm 2.61	-	103.2 \pm 1.93
Two (II)	Diabetic rats	104.0 \pm 5.95	84.0 \pm 5.92	80.5 \pm 6.11*
Three (III)	Diabetic rats treated with <i>Garcinia kola</i> extract	131.8 \pm 14.22	124.6 \pm 14.24	128.6 \pm 14.11
Four (IV)	Diabetic rats with <i>Garcinia kola</i> and honey	138.6 \pm 10.29	135.4 \pm 10.58	127.8 \pm 14.80

Values are presented as means \pm SD; *: p<0.05 compared with initial weight

Table 3: The Mean \pm Standard deviation on effect of *Garcinia kola* on the blood lipid profile of diabetic rats

Groups	Treatment received	Total Cholesterol (TC) (mg/dL)	High Density Lipoprotein (HDL) (mg/dL)	Low Density Lipoprotein (LDL) (mg/dL)	Triacylglyceride (TAG) (mg/dL)
Control (I)	Non diabetic rats	79.6 \pm 7.20	61.20 \pm 2.44	6.20 \pm 2.061	5.4 \pm 3.85
Two (II)	Diabetic rats	92.8 \pm 4.5*	42.6 \pm 1.33*	20.84 \pm 4.24*	24.00 \pm 5.67*
Three (III)	Diabetic rats treated with <i>Garcinia kola</i> extract	64.6 \pm 2.66+	59.4 \pm 0.87+	12.0 \pm 4.21+	34.40 \pm 5.50+
Four (IV)	Diabetic rats with <i>Garcinia kola</i> and honey	71.8 \pm 5.85+	54.6 \pm 3.39+	19.0 \pm 2.17	22.4 \pm 2.50

Values are presented as means \pm SD; *: p<0.05 compared with group I; +: p<0.05 compared with group II

shows that treatment with *Garcinia kola* significantly improved the above named parameters (TC, HDL, LDL, TAG). The concomitant administration of honey did not cause any significant difference.

DISCUSSION

In this present study, it was observed that *Garcinia kola* has a significant (p<0.05) hypoglycaemic effect in alloxan-induced diabetic wistar rats (Table 1). This observation is in line with the previous report of Chandrika *et al.* (2006) who reported a hypoglycaemic effects of *Garcinia kola* especially as it is said to contain a complex mixture of phenolic compounds such as biflavonoids, xanthenes and benzophenone known to cause a reduction in glucose level

Also observed (Table 2) is a significant (p<0.05) loss of weight in the diabetic rats which is also in accordance with other reports Fatemeh *et al.* (2009). The treatment with *Garcinia kola* and/or honey did not cause any significant change in the final body weight. This observation is contrary to a previous report by Dada and Ikuero (2009) who reported that ethanolic extract of *Garcinia kola* in *C. Gariepinus* broodstock of fish, improved their growth and weight.

Furthermore, the present study observed that alloxan-induced diabetes mellitus caused a significant (p<0.05) increase in the levels of Total cholesterol, Low density

Lipoprotein and Triglyceride and a significant (p<0.05) decrease in the level of High density lipoprotein compared with the control group (Table 3, Group I). This observation is in agreement with previous reports that diabetes causes dyslipidaemia Grober (2010). The treatment of the diabetic rats (Table 3, Group III) with *Garcinia kola* lead to a significant (p<0.05) decrease in the levels of Total cholesterol, Low density Lipoprotein and Triglyceride and a significant (p<0.05) increase in the level of High density lipoprotein compared with the diabetic group (Table 3, Group II). The addition of honey in the treatment did not show any significant change in the parameters.

CONCLUSION

It is therefore, concluded from this present study that *Garcinia kola* seeds extract has both hypoglycemic and Lipid attenuating effects in alloxan-induced diabetic Wistar rats. The administration of Honey did not improve the blood glucose level or the lipid profile. Hence, it could be recommended as an antidiabetic and lipid modifying agent in the management of diabetic patients.

ACKNOWLEDGMENT

The researcher wish to express his appreciation to Dr. Arimoro for the statistical analysis and Ehitare Ekhoeye for

arranging and typesetting this manuscript and to the staff of the laboratory department of Eku Baptist hospital for the technical assistance.

REFERENCES

- Adedeji, O.S., G.O. Farimi, S.A. Ameen and J.B. Olayemi, 2006. Effects of bitter kola (*Garcinia kola*) as growth promoters in Broiler Chicks from day old to four weeks old. *J. Anim. Vet Adv.*, 5(3): 191-193.
- Alaba, K.O., 2007. Erythropoietic and anti-obesity effects of *Garcinia cambogia* (bitter kola) in Wistar rats. *Biotechnol. Appl. Biochem.*, 46: 69-72.
- Atawodi, S., P. Mende, B. Pfundstein, R. Preussmann and H.B. Spiege, 1995. Nitrosatable amines and nitrosamide formation in natural stimulants, cola acuminata C, nitida and *Garcinia kola* food. *Chem. Toxicol.*, 33(8): 625-630.
- Baimbolkar, S. and G.S. Sainani, 1995. Evaluation of oxidative stress in diabetic without vascular complication. *J. Ass. Phys. India*, 43: 10-12.
- Chandrika, U.G., W.S. Wedage, S.M.D.N. Wickramasinghe and W.S. Fernando, 2006. Hypoglycaemic action of the flavonoid fraction of *Artocarpus heterophyllus* leaf. *Afr. J. Trad. CAM*, 3(2): 42-50.
- Chawla, R., 2003. *Practical Clinical Biochemistry (Methods and Interpretation)*. 3th Edn., Jaypee Brothers, New Delhi, India, 75: 216-221.
- Dada, A.A. and M. Ikuerowo, 2009. Effects of ethanolic extracts of *Garcinia kola* seeds on growth and haematology of catfish (*Clarias gariepinus*) broodstock. *Afr. J. Agric. Res.*, 4(4): 344-347.
- Fatemeh, N.R., A. Soheila, V.A. Zakieh, V.A. Jalal and G. Payam, 2009. Effects of diabetes mellitus on gastric motility in rats. *Pak. J. Physiol.*, 5(1): 43-47.
- Gray, A.M. and P.R. Flatt, 1999. Insulin secreting activity of the traditional antidiabetic plant viscum album (mistletoe). *J. Endocrinol.*, 160: 409-414.
- Grober, U., 2010. Vitamin D-an old vitamin in a new perspective. *Med. Monastsschr. Pharm.*, 33(10): 376-383.
- Holmes, E.H., 1960. Notes on the medicinal plants of liberia. *Pharm. J. Tr. 3rd. Series*, 8: 1877-1879.
- Iwu, M., 1993. *Hand Book of African medicinal plants*. Crc press, Boca Raton, Flip, pp: 183-184.
- Iwu, M.M. and O. Igboko, 1993. Flavonoid of *Garcinia kola* seeds. *J. Nat. Prod.*, 45: 650-651.
- King, H., R.E. Aubert and W.H. Herman, 1998. Prevalence numerical estimates and projection. *Diabetes Care*, 21: 1414-1431.
- Knight, J.A., S. Anderson and M.R. James, 1972. Chemical basis of the sulphophovanillin reaction for estimating total lipid. *J. Clin. Chem. Naringenin*, 18: 199-202.
- Kostner, G.M., E. Molinari and P. Piechler, 1985. Evaluation of HDL, HDL and VLDL quantitative methods based on precipitation with polyethelene glycole. *Clin. Chem. Act.*, 148: 139-147.
- Lewis, W.H., 1997. *Medic Botany: Plants Effecting Mainsheath*. John Wiley-Int. Pub., New York, pp: 231-232.
- Madubuyi, I.I., 1995. Antimicrobial activities of the constituents of *Garcinia kola* Seeds. *Int. J. Pharmacog*, 33(3): 232-237.
- Manhendran, P., A.J. Vanisree and D.C.S. Shyamala, 2000. *Garcinia cambogia* extract aganist indomethacin-induced gastric ulcer in rats. *Phyther. Res.*, 16: 80-83.
- Nia, R., D.H. Paper, E.E. Essien, O.H. Oladimoji, K.C. Lyado and B. Franz, 2003. Investigation into in vitro radical scavenging and *in vivo* inflammatory potential of trio procumbens. *Nig J. Physiol. Sci.*, 18(1-2): 39-43.
- Nwaegerue, I., C. Ezeala and C. Unekwe, 2007. Glucose lowering effect of leaf extract of viscum album in normal and diabetic rats. *J. Res. Med. Sci.*, 12(5): 235-240.
- Okunji, C.O. and M.M. Iwu, 1991. Molluscidal activity of *Garcinia kola* biflavanones. *Fitoterapia*, 62: 74-76.
- Plowden, C.C., 1972. *A Manual of Plants Names*. 3rd Edn., George Ltd., London, pp: 239.
- Stein, E.A., 1986. *Textbook of Clinical Chemistry*. Tietz, N.W., (Ed.), W.B. Saunders Co. Philadelphia, pp: 879-886, 1818-1829.
- Tita, R.K., P.G.C. Odeigah, P.U. Agomo and E. Bassey, 2001. Some Properties of Medicinal Plants Used by the Igbos of Nigeria. In: Wolfgang, K., (Ed.), *Triats, tracts and Traces*. (Germany). Kreis, pp: 209-210.
- Vance, D.E. and J.E. Vance, 1996. *Biochemistry of Lipids, Lipoprotein and Membranes* 4th Edn., (New Comprehensive Biochemistry, 36: 573-581.
- Williamson, E.M., D.T. Okpoko and F.J. Evans, 1996. *Pharmacological Methods in Phytotherapy Research*. John Wiley and Sons, Inc., Third Ave. New York, pp: 155-167.
- Winifred, O., 2008. Leadership of all Rights. Distributed by all Africa Global Media Retrieved from: <http://www.allafrica.com>.
- World Health Organization, 1999. Department of Non-communicable Disease Sureveillance, Definition Diagnosis and Classification of Diabetes Mellitus and its Complication. WHO/NCD/NCS/99.2.