



## Effect of Aqueous Extract of African Star Apple (*Chrysophyllum Albidum*) on the Glucose and Triacylglycerol Concentrations in Albino Rats

Authors

Agbonson<sup>1</sup>, O.P., Inegbedion<sup>2</sup>, A., Prohp<sup>3</sup>, T. P.\*

<sup>1,3</sup>Department of Biochemistry, Faculty of Basic Medical Sciences, College of Health Sciences, Niger Delta University, Wilberforce Island, Bayelsa State.

<sup>2</sup>Department of Medical Biochemistry, Faculty of Basic Medical Sciences, Ambrose Alli University, Ekpoma, Edo State, Nigeria

\*Corresponding Author

**Prof. T. P. Prohp.**

Department of Biochemistry, Faculty of Basic Medical Sciences, College of Health Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

### Abstract

*This study investigated the effects of aqueous bark extract of unripe Chrysophyllum albidum on plasma glucose and triacylglycerol concentrations in albino rats. Six normal male albino rats of average weight 160g obtained at eight weeks were randomly categorized into two groups of three rats each after one week of acclimatization. Aqueous bark extract of unripe Chrysophyllum albidum was administered to the test rats for 28 days. Blood samples collected periodically from the tail of the rats were analyzed for glucose and triacylglycerol levels by spectrophotometric method. Statistical analysis of results showed that the extract caused significant decreases in glucose and triacylglycerol concentrations on days 6, 12, 18, 24 and 28 when compared with the normal control ( $P < 0.05$ ). Histological report showed that the aqueous bark extract of unripe Chrysophyllum albidum was neither hepatotoxic nor nephrotoxic and was well tolerated by the heart. Therefore, this extract may also be useful in the treatment of diabetes mellitus.*

**Keywords:** *Chrysophyllum albidum, diabetes, glucose, triacylglycerol, plasma.*

### Introduction

Diabetes which is a potential life threatening condition in mammals is a group of metabolic disease in which an individual has a high glucose (blood sugar), either because insulin production is inadequate or the body cells does not respond properly to insulin, or both. Patients with high blood sugar will typically experience polyuria (frequent urination), increase in thirst (polydipsia) and hunger (polyphagia). Diabetes mellitus is a group of metabolic disorders in which there is

high blood sugar level over a prolonged period. It is a disorder of metabolism in which glucose in the body is oxidized to produce energy due to the deficiency of the pancreatic hormone called insulin. It could also be seen as defect in the body's ability to convert glucose to energy (Kitabchi *et al.*, (2009).

Since ancient times, many individuals from developing countries depend on herbs and concoctions derived from plants and fruits for the treatment of ailments. These fruits and plants

continue to be of paramount importance to this present day. *Chrysophyllum albidum* (African star apple) is one fruit of great economic value in tropical Africa due to its diverse industrial, medicinal and food uses. It is a group of tropical plants that belong to the *Sapotaceae* family (Osuntokun, *et al.*, 2017).

*Chrysophyllum* trees usually grow approximately 10 to 20 meters in height with round, pear shaped or sub-spherical shaped fruits that measure up to 3cm in diameter. The small flowers measure between 3 to 8mm while the greenish (above) and golden pubescent (underneath), oval shaped leaves measure between 3cm to 15cm (Okpala, 2016). The fleshy pulp of the fruits is eaten especially as snack and its fruit has been found to have higher contents of ascorbic acid than oranges and guava. It is also reported as an excellent source of vitamins, irons and flavors to diets. The seeds are also used for local games or discarded (Muanya, 2011).

Studies have shown that methanol extract of dried barks of *Chrysophyllum albidum* and its chromatographic fractions (250 mg/kg) possess potent therapeutic and healing efficacy against acetic acid induced colitis in rats, possibly due to its anti-oxidant and anti-inflammatory properties (Salami, 2012). Olorunnisola, *et al.*, also evaluated the anti-hyperglycemic and hypolipidemic effect of ethanol extract of *Chrysophyllum albidum* seed cotyledon in model of alloxan-induced diabetic rats. In this study, aqueous bark extract of *Chrysophyllum albidum* was investigated for plasma glucose and triacylglycerol concentrations in albino rats over a period of 28 days, with a view to establish the effect of aqueous bark extract of *Chrysophyllum albidum* on plasma glucose and triglyceride concentration, as indices of diabetes mellitus.

## Materials and Methods

### Experimental Animals

Male albino rats (6) of wistar strain obtained from the animal house of the Department of Pharmacology, Niger Delta University, Bayelsa

State, Nigeria weighing 150-190g (8 weeks old) were used in this study. They were kept in a standard animal house condition and allowed free access to food (pelleted grower's mash) and water *ad libitum*. The animals were acclimatized for one week. All animals were treated with humane care.

### Experimental Design

Six healthy albino wistar rats obtained at 8 weeks after acclimatization for a period of one week were randomly put into two (2) groups of three rats each. Group 1 served as the control and received pelleted grower's mash and water *ad libitum* throughout the experiment (28 days). Group 2 served as the test group and was administered aqueous extract of unripe African star apple orally twice daily. They also had access to pelleted grower's mash and water *ad libitum* throughout the experimental period (28 days).

### Chemicals/Reagents

Glucose and triacylglycerol kits obtained from Randox Laboratories United Kingdom were used. Other chemicals used were obtained from a standard commercial supplier and were of analytical grade.

### Medicinal Plants

The African star apples were procured from a commercial outlet at Ahoada Local Government area of Rivers State, Nigeria.

### Extraction and Preparation of plants

Fresh unripe fruits of *Chrysophyllum albidum* were washed with distilled water; the bark was peeled off with a clean knife. A weighing balance was used to weigh out 20g of the peeled bark, and blended with 200ml of distilled water; the homogenate was sieved with a cheese cloth. The filtrate was preserved in the refrigerator until used.

### Blood Collection

Blood was collected from the tail of the immobilized rats. The tail of the rat was cleansed with a ball of cotton wool soaked in methylated spirit. Vaseline (petroleum jelly) was applied to the tail to aid lubrication during massage. The tail was gently massaged towards the tip till it turned

red. The red tip was incised with a new and sterilized blade and further massaged as blood flowed down into the sample tubes (lithium-heparin and fluoride-oxalate) till required amount was obtained. The incised area of the tail was again cleansed with cotton wool soaked in methylated spirit. Blood samples were centrifuged for 20 minutes at 3,000g to obtain plasma for experimental analysis.

### Experimental procedure

Male albino rats after acclimatization for a period of one week were fasted overnight and blood was collected as the day 0 test and extracts were administered to the group rats. Blood was collected the next day and experiment for day 1 test was conducted. Thereafter, blood was collected every six days for a period of 28 days to analyze the effect of the unripe bark extract.

### Administration of aqueous extract

Unripe bark extract of *Chrysophyllum albidum* were administered to the experimental rats in the test cage orally, twice daily (morning and evening) throughout the duration of experiment (28days) with the aid of the gavage at the dose 2ml per kg body weight of rat.

### Biochemical Assays

The glucose and triacylglycerol concentrations were estimated as outlined with the procedure

described by Randox Laboratories manual, United Kingdom.

### Principle

Glucose is determined after enzymatic oxidation in the presence of glucose oxidase. The hydrogen peroxide formed reacts, under catalysis of peroxidase, with phenol and 4-amino phenazone to form a red-violet quinoneimine dye as indicator.

### Statistical Analysis

Statistical analysis was done using one-way analysis of variance (ANOVA) followed by post-hoc LSD.

### Result

Results on the analyses of plasma glucose and triacylglycerol concentrations in albino rats treated with aqueous bark extract of *Chrysophyllum albidum* are presented in tables (1 and 2). Both extracts caused significant decrease in plasma glucose and triacylglycerol concentrations when compared to control. Plates 1 to 5 are photomicrographs of tissue sections investigated. The aqueous bark extract of unripe African star apple have been found to be of clinical value in lowering mean plasma glucose and triacylglycerol concentrations.

**Table 1:** Mean plasma glucose concentration in male albino rats administered aqueous bark extract of *Chrysophyllum albidum* for 28 days.

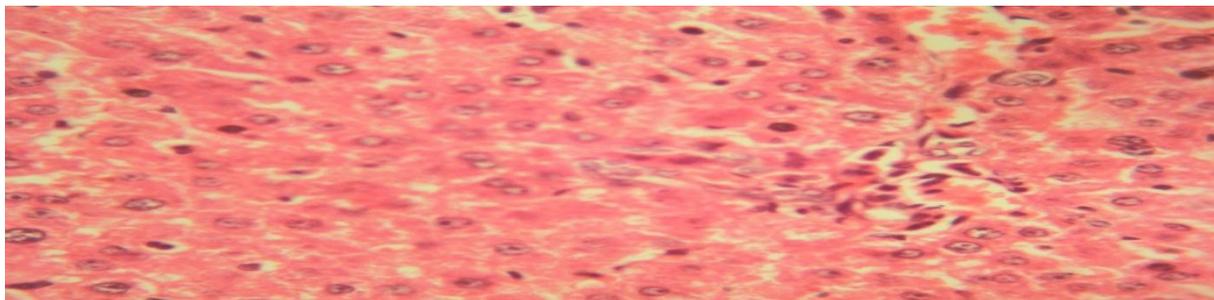
Group	Day 0	Day 1	Day 6	Day 12	Day 18	Day 24	Day 28
Control	67.53±2.87	68.10±2.84	67.45±3.00	65.92±2.35	68.01±1.86	65.95±1.60	65.82±1.18
Test	64.08±0.97	66.8±3.51	54.08±2.32	44.7±1.62	37.43±1.31	35.88±1.86	34.13±1.64

Each value represents the mean ± SEM of three separate determinations. Values are statistically different from control at  $p < 0.05^*$  One Way Analysis of Variance (ANOVA) followed by post-hoc LSD.

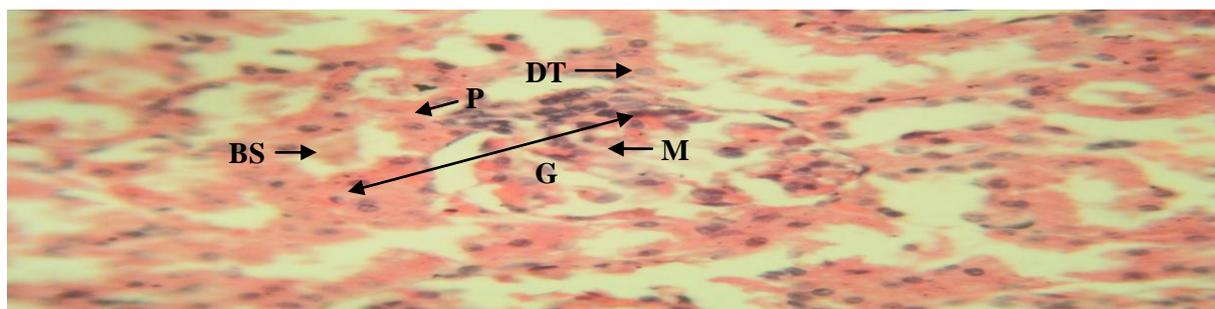
**Table 2:** Mean plasma triacylglycerol concentration in male albino rats administered aqueous bark extract of *Chrysophyllum albidum* for 28 days.

Group	Day 0	Day 1	Day 6	Day 12	Day 18	Day 24	Day 28
Control	56.63±2.64	54.04±3.57	55.38±0.99	55.26±0.80	54.64±1.53	54.90±0.97	55.28±0.73
Test	62.24±1.59	53.58±2.47	48.07±1.07	40.99±0.56	33.49±1.75	33.05±1.88	32.96±2.18

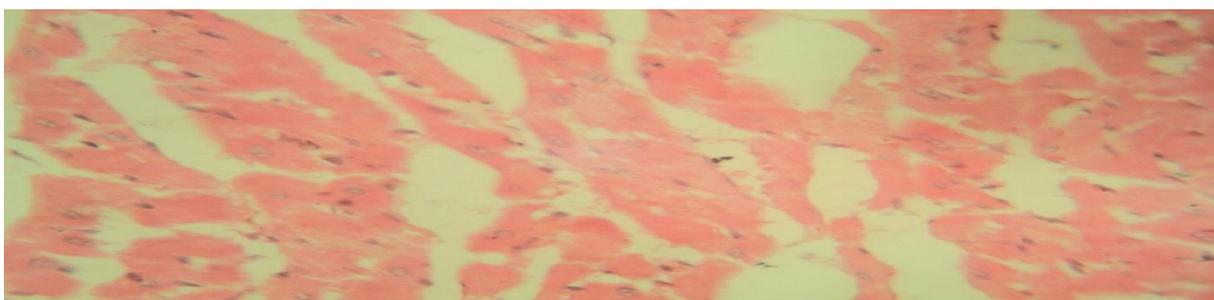
Each value represents the mean ± SEM of three separate determinations. Values are statistically different from control at  $p < 0.05^*$  One Way Analysis of Variance (ANOVA) followed by post-hoc LSD.



Photomicrograph of liver section of normal rats treated with aqueous bark extracts of *Chrysophyllum albidum* at the dose of 2ml/kg bw. Section shows normal histology. H & E Stain X 400.



Photomicrograph of kidney section of normal rats treated with aqueous bark extracts of *Chrysophyllum albidum* at the dose of 2ml/kg bw. Section shows an abnormal renal corpuscle, depletion of the mesangial cells, disorientation of the podocytes and swelling of the tubules. H & E Stain X 400.



Photomicrograph of heart section of normal rats treated with aqueous bark extracts of *Chrysophyllum albidum* at the dose of 2ml/kg bw. Section shows normal histology. H & E Stain X 400.

### Discussion

Results from this study show that the administration of aqueous bark extracts of African star apple significantly decreased glucose and triacylglycerol levels in Wistar rats. This is consistent with the result of Olorunnisola et al, (2008). The phytochemistry of *Chrysophyllum albidum* has been extensively studied (Mc Donald et al, 1973; Imaga and Urua, 2013; Egharevba et al, 2015) and has been reported to contain tannins, phenols, flavonoids, cardiac glycosides, terpenoids, reducing sugar and phlobatannins. The medicinal effect of these phytochemicals have been documented and flavonoids have been found

to be an active principal agent in many herbal medicines (Duke, 1992; Bonilla and Gilbertsville, 2009; Arshad, 2014). Flavonoids are known to be powerful antioxidants that may help protect organs against toxicity or oxidative stress (Lukacinova et al, 2008). Saponins have also been reported to possess hypoglycaemic activity (Nakashima et al; 1993). The vitamins analysed in mg/100g of *Chrysophyllum albidum* by Imaga and Urua (2013) indicated vitamin K (35.36), vitamin B (18.68), folate (2.02) and vitamin C (3.084). Report by Dekker et al (1996) shows that antioxidant vitamins act synergistically to reduce blood glucose. Therefore, the finding from this

study that *Chrysophyllum albidum* significantly decreased blood glucose level may be as a result of its rich phytochemicals.

Loss of appetite and general body weakness were observed in the rats administered the aqueous bark extract of the experimental sample. *Chrysophyllum albidum* contain tannins (Imaga and Urua, 2013; Egharevba et al, 2015) and tannins have been reported to decrease feed intake (chung et al, 1998). Loss of appetite may be contributory to the decrease in the body weight observed in the experimental rats. The impact of body weight and obesity on insulin resistance makes weight loss a major therapeutic objective in the management of diabetes. Therefore, *Chrysophyllum albidum* extract may be a good therapeutic agent against diabetes.

The histological result shows that the aqueous bark extract of African star apple was not hepatotoxic and was well tolerated by the heart. However, mild nephrotoxicity was observed with the kidneys of the experimental rats showing abnormal renal corpuscle, depletion of the messangial cells, disorientation of the podocytes and swelling of the tubules which may have been caused by other sources like metabolic acidosis and allergic reactions.

### Conclusion

Results from this study show that the aqueous bark extract of *Chrysophyllum albidum* has ability to reduce plasma glucose and triacylglycerol concentrations in normal rats, indicative of its possible usefulness in the treatment of diabetes mellitus.

### References

1. Arshad, H.R; Salah, M.A; Habeeb, A.L; Ali, Y.B; Sauda, S. (2014). Therapeutic effects of date fruits (*Phoenix dactylifera*) in the prevention of diseases via modulation of anti-inflammatory antioxidant and anti tumour activity. *Int. J. Clin. Exp. Med.* 7:483-491
2. Bonilla, J.V. and Gilbertsville, K.Y. (2009). Methods and composition for regulation of blood cholesterol. *Afri. J. Traditional complement Altern. Med.* 6(4):573-578.
3. Chung, K.T; Wong, T.Y.; Wei, C.I; Huang, Y.W.; and Lin, Y. (1998). Tannins and human health: a review. *Crit. Rev. Food SCI.Nutr.* 38(6):421-464.
4. Dekker, J.C; Van Doornen, L.J.P. and Han Kemper, C.G. (1996). The role of anti oxidant vitamin and enzymes and the prevention of exercise- induced muscle damage. *Sport medicine.* 21:213-238
5. Duke, J.A. (1992). Data base of Biologically active phytochemical and their activity.
6. Boca Raton, Fla: CRC Press. Pp 183-191
7. Egharevba, H.O; Ibrahim, J.A; Naduaguba, G. A; Kunle, O.F;(2015)
8. Phytochemical proximate pharmacognosy analyses and thin layer chromatography of chrysophyium albidum seed. *EW.J.Herb. Chem. Pharmacol. Res.* 1a: 6-12
9. Imaga, N.O.A; Urua, E.E (2013). Chemical and antioxidant evaluation of star apple fruit (*chrysophyium albidum*) crude extracts. *Planta med. Congress Abstract.* Pp : 79-83
10. Kitabchi, A.E., Umpierrez, G.E., Miles, J.M. and Fisher, J.N (2009). "Hyperglycemic crises in adult patients with diabetes". *Diabetes Care.* 32(7):1335. doi:10.2337/dc09-9032.Kraut, J.A. and Nagami, G.T. (2009), "Metabolic acidosis of chronic kidney disease". *Science Direct,* 29(10):4.
11. Lukacinova, A.J., Mojzis, R; Benacka, J; Keller, T; Maguth, P; Kurila L. (2008). Nistiar: Preventive effects of flavonoids on Alloxan- Induced Diabetes Mellitus in Rats. *Acta vet Brno.* 77(2):175-182.
12. Mc Donald p,Edwards, R.A; Greenhalgh, J.F.D.(1973). *Animal nutrition.* T and A constable ltd. Edinburgh Pp:2-5

13. Muanya, C. (2011). African star apple; Agbalumo to treat diabetes, heart disease. Infections.”*Inform Africa*, 1(3):1-3.
14. Nakashima, S.L; Azian, A.L; Das, S.(2010). Histological changes in the kidneys of experimental diabetic rats fed with *Momordicacharantia* (bitter gourd) extract. *Romanian J.Morphol Embryo*. 51(1):91-95
15. Okpala, B. (2016). “Distinctive benefits of *Chrysophyllum* fruits”. *Global FoodBook*, viewed 9 march 2016, <http://globalfoodbook.com>.
16. Olorunnisola, O.S., Amao, S., Ehigie, L.O. and Ajayi, A.F. (2008). “Anti-Hyperglycemic and hypolipidemic effect of ethanolic extract of *Chrysophyllum-albidum* seed cotyledon in alloxan induced-diabetic rats”. *Research Journal of Applied Sciences*, 3(2):123-127.
17. Osuntokun, O.T., Ayegbusi, B.L., Yusuf-Babatunde, A.M. and Ige, O.O. (2017). “Assessment of Antimicrobial, Phytochemical Screening and Gas Chromatography-Mass Spectrophotometric Profile of Crude *Chrysophyllum Albidum* Essential Oil”. *Chemistry Research Journal*, 2 (5):68-85.
18. Salami, A.T., Adewoye, E.O. and Emikpe, B.O. (2012). “Effect of methanolic extract of *Chrysophyllumalbidum* bark on hematological indices in mice with experimental hemorrhagic anemia”. *African Journal of Biochemical Research*, 15(2):2.