

Original Research Article

ACUTE TOXICITY ASSAY AND ANTI-DIABETIC ACTIVITIES OF SHEMMECO EXTRACT IN *Drosophila melanogaster*

Abstract

In this study the acute toxicity assay and anti-diabetic properties of Shemmeco extract were examined. The LC50 in this study was conducted using the concentrations: 5mg, 10mg, 25mg, 50mg, 100mg, 250mg, 500mg, 1000mg, 2500mg and 5000mg of extract, each per 10g fly diet. For ten days, *Drosophila melanogaster* was fed a high diet of sucrose (2.5g/10g diet) to elicit insulin resistance type 2 diabetes. The diabetic flies were treated with 5mg, 10mg, 25mg, 50mg and 250mg per 10g diet each of Shemmeco extract being safe concentrations from result of acute toxicity and 16mg of metformin/10g diet as standard drug. Glucose content significantly elevated ($p < 0.05$) in diabetes untreated compared to control group. Metformin significantly declined ($p < 0.05$) the glucose content of fruit flies treated with 5mg(S1) of Shemmeco extract compared to diabetic untreated and metformin treated. The slight decline of glucose content of fruit flies treated with 5mg (S1) of Shemmeco extract therefore indicates that the extract is promising in the treatment of diabetes type 2 if developed further.

Keywords: Diabetes; Shemmeco extract; toxicity; insulin; *Drosophila melanogaster*;

1.0 Introduction

Herbal medicine has been growing steadily and if properly harnessed can be put to much better use. Currently, several herbal formulations which are used for curative purposes have not been put to scientific investigation and this has continued to keep these formulations (some of which may actually be therapeutic) away from the public acknowledgement and reception as it should have been [1]. Furthermore, most herbal formulation are kept as secrets with most persons not willing to acknowledge that they actually turn to them for curative need and practitioners not being able to explain the mechanisms by which the formulations carry out their curative activities [2]. Package and safety concerns of herbal formulations is another factor which has affected the growth of the sector, although some progress has been made in this area, it is still open. Shemmeco Nobel Resources has identified this problem and aims to elucidate the positive role herbal formulation may have in the treatment and management of diabetes type 2 with the goal to improve the fight against this disease. Shemmeco Nobel Resources also hopes that actual mechanisms of action of Shemmeco formulation will be made available to the scientific community and pave the way for other researches too. Shemmeco Nobel Resources reserves the right to keep unpublished the procedures of formulation for Shemmeco herbal extract and result of its phytochemical composition until the patent is obtained.

The fruit fly, *Drosophila melanogaster* has been extensively studied for decades. It was introduced as a decisive method in biology about a century ago. Application of the *Drosophila* model is empowered by the fundamental fact that it shares basic biological, biochemical, neurological and physiological similarities with mammals. It is documented that about 75% of human disease-causing genes have functional homologs in *D. melanogaster* [3].

Drosophila processes systems which control nutrient uptake, storage and metabolism; and these systems have been reported to be analogous to those of humans. *Drosophila* is well known for its high sensitivity to toxic substances and is thus considered a useful model for toxicity studies as well as evaluating the biological action of pharmacological agents [4].

The LC50 is the concentration of toxicant that is lethal to 50% of sampled fly population, and it is primarily conducted to determine the safe concentration of the toxicant that the flies can survive on during treatment [5].

2.0 Materials and methods

The flies used for this study was collected from the Federal Capital Territory (FCT), Abuja, Nigeria following the procedures below.

2.1 Collection, rearing and culturing of *D. melanogaster*

Fly samples were collected using a setup that involved clean plastic bottles (750 mL volume with a small opening in the middle). Flies were collected using the setup for 48. The collected samples were transferred from bait bottles into a collection tube. In moving flies away from the bottles to collection tubes, opening of the bottle was kept under bright light directing the flies towards the light. The flies were kept at room temperature (25 °C) at 70% relative humidity with a 12 hr light/dark clock cycle in vials containing standard corn meal medium.

2.2 Determination of acute toxicity for Shemmeco extract (LC50)

The LC50 in this study was conducted following the methods described by other researchers [6, 7] with slight modifications. The flies were divided into eleven groups of twenty flies each and administered the following concentrations (mg extract/10 g fly diet): 5, 10, 25, 50, 100, 250, 500, 1000, 2500 and 5000 respectively representing groups 2 to 11) while group 1 which served as control no extract was administered.

2.5 Induction and treatment of diabetes in the flies.

The methods described by [8] were used to induce type 2 diabetes in the *D. melanogaster*. Briefly, sucrose (2.5g sucrose/10g diet) was incorporated into a regular fly diet to induce diabetes type 2. All other ingredients of the standard fly food (1% agar, 3.4% yeast and 8.3% corn mill were kept constant). The flies were then observed after 10 days for symptoms of diabetes, which include delayed egg production, delayed emergence of L3 larvae, decreased body size for both larvae (L3) and adult flies and decreased locomotor activities. The glucose concentration of the fly-homogenate was quantified using the glucose oxidase method [9]. Fifty flies each (both gender) divided into eight groups were used as follows (where S-Shemmeco extract and S1-S6 is increasing concentration of the extract): group 1-control (Non-diabetic flies in 10g diet), group 2 (diabetic flies, untreated), group 3 (diabetic flies treated with 16mg of metformin/10g diet), group 4 (diabetic flies treated with S1/10g diet), group 5 (diabetic flies treated with S2/10g diet), group 6 (diabetic flies treated with S3/10g diet), group 7 (diabetic flies treated with S4/10g diet) and group 8 (diabetic flies treated with S6/10g diet).

3.0 Statistical analysis

Statistical analyses of data was done using Statistical Package for Social Sciences (SPSS) (version 21). Results were presented as means and standard deviation.

4.0 Results and Discussion

The result of the studies are shown in the tables and charts below. The results include acute toxicity assay (LC50) and results of anti-diabetic study.

Table 1: Acute toxicity assay (LC50) for Shemmeco extract in *D. melanogaster*.

Concentration of Shemmeco extract per 10g diet			Start population	Cumulative Mortality Record							
				Day 0	Day 1	2	3	4	5	6	7
CONTROL	C	C1	20	0	0	0	0	0	0	0	0
		C2	20	0	0	0	0	0	0	0	0
		C3	20	0	0	0	0	0	0	0	0
5mg/10g	S1	S11	20	0	0	0	0	0	0	0	0
		S12	20	0	1	1	1	1	1	1	1
		S13	20	0	0	0	0	0	0	0	0
10mg/10g	S2	S21	20	0	0	1	2	2	2	2	2
		S22	20	0	0	0	1	1	1	1	1
		S23	20	0	0	1	2	2	2	2	2
25mg/10g	S3	S31	20	0	0	0	0	1	1	3	
		S32	20	1	1	1	1	1	1	1	1
		S33	20	0	0	0	0	0	1	1	1
50mg/10g	S4	S41	20	0	0	0	0	1	1	1	1
		S42	20	0	0	0	0	0	0	0	1
		S43	20	0	0	0	0	1	1	1	1
100mg/10g	S5	S51	20	0	0	2	2	2	2	2	2
		S52	20	0	1	1	1	1	1	1	1
		S53	20	0	0	0	1	2	2	2	2
250mg/10g	S6	S61	20	0	0	0	1	1	1	1	1
		S62	20	0	0	0	1	1	1	1	1
		S63	20	0	0	0	0	1	1	1	1
500mg/10g	S7	S71	20	0	0	1	1	1	1	1	1
		S72	20	0	0	2	2	2	3	3	3
		S73	20	0	0	1	1	2	2	3	3
1000mg/10g	S8	S81	20	0	1	2	2	9	16	20	
		S82	20	1	1	2	4	5	15	19	
		S83	20	0	1	1	3	3	9	20	
2500mg/10g	S9	S91	20	1	1	1	3	11	18	20	
		S92	20	1	2	2	4	9	13	20	
		S93	20	2	3	3	3	11	19	20	
5000mg/10g	S10	S101	20	1	4	6	8	14	20	20	
		S102	20	3	6	9	11	13	18	20	
		S103	20	3	9	11	13	20	19	20	

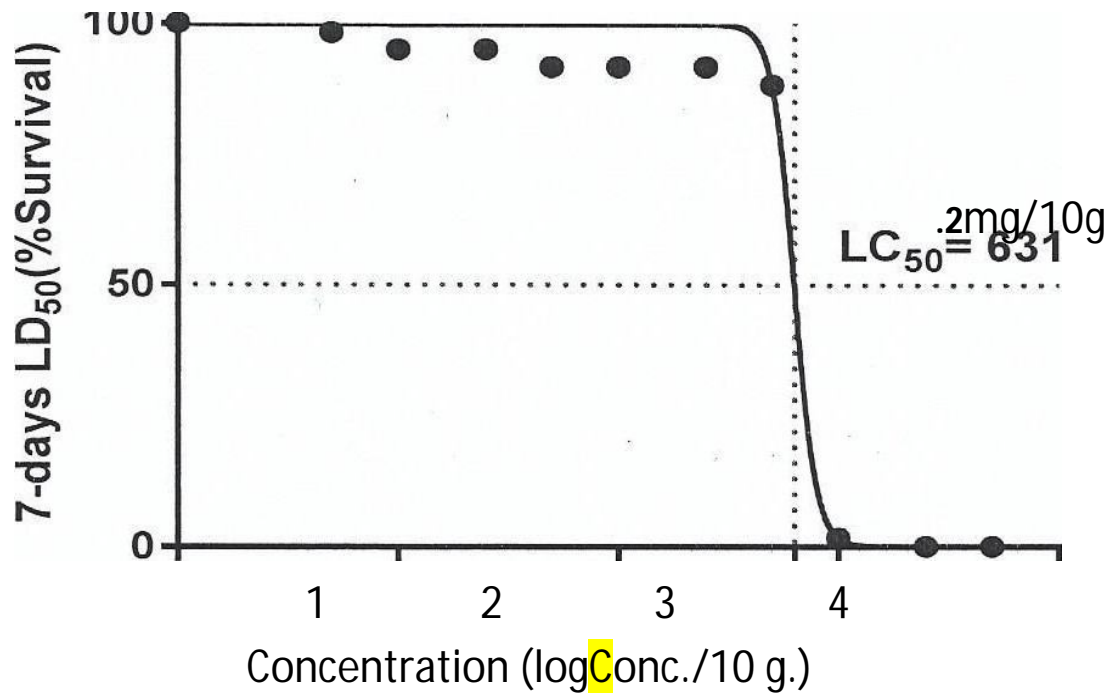


Fig. 1: LC50 curve obtained from the result of acute toxicity assay of Shemmeco extract

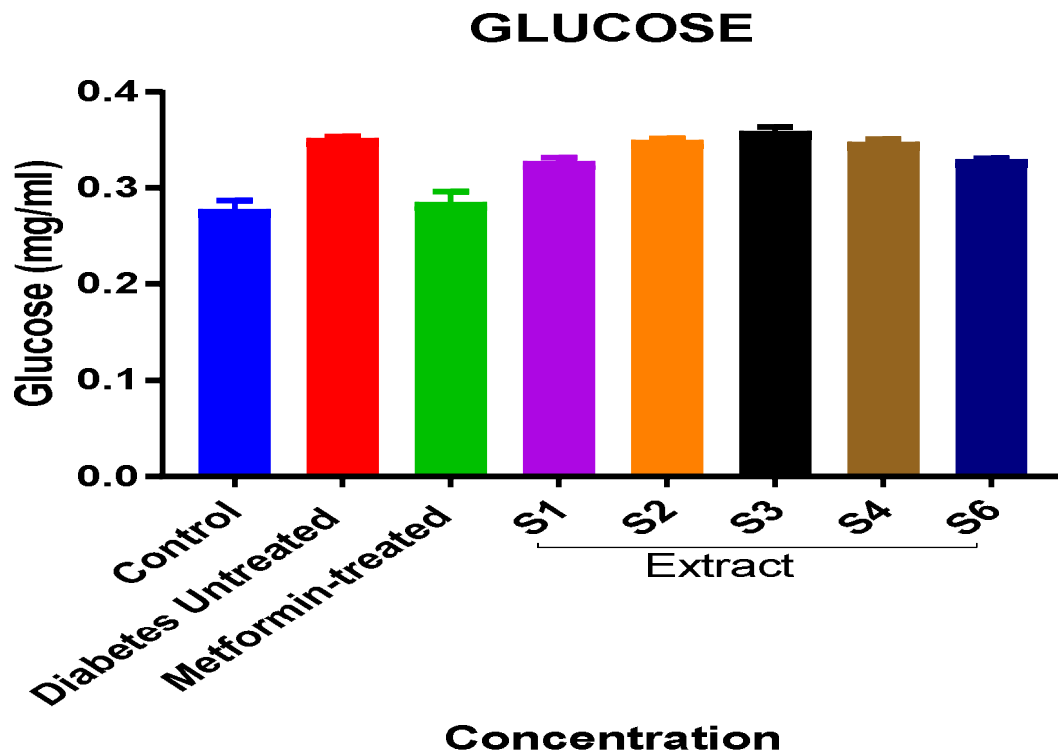


Fig. 2: The glucose content of fruit flies (diabetic) treated with Shemmeco extract

Table 2: Glucose (mg/ml) concentration of *D. melanogaster*

Group	Glucose concentration
Group 1 (Control)	0.28±0.02
Group 2 (Diabetic, untreated)	0.35±0.01
Group 3 (Diabetic, Metformin Treated)	0.28±0.02
Group 4 (S1)	0.33±0.01
Group 5 (S2)	0.35±0.01
Group 6 (S3)	0.36±0.01
Group 7 (S4)	0.35±0.01
Group 8 (S6)	0.33±0.00

Values are presented as mean ± standard deviation (n=5)

In comparison to the control group, flies fed with a diet high in sucrose (consisting of 2.5g sucrose per 10g fly diet) developed insulin resistant diabetes, which was characterized by a reduction in the size of both adult and larval flies. The relatively sluggish movements of both adult flies and the roving L3 larvae were also noticed, and this was explained by a neurovascular abnormality in type 2 diabetes. By measuring the glucose content of the flies using the glucose oxidase method, it was discovered that the flies fed with a high-sucrose diet on their own had higher glucose levels than the control group when given Shemmeco extract doses of 5, 10, 25, 50, and 250 mg along with 16 mg of metformin.

This experiment used metformin, an oral hypoglycemic medication and insulin sensitizer that is frequently used in the treatment of insulin-resistant diabetes. Shemmeco extract has a good potential for treating type 2 diabetes based on the observation in this study that it caused a small drop in glucose content.

The findings of this investigation demonstrated the safety of the various doses (mg extract/10 g fly diet) of 5, 10, 25, 50, 100, 250, 500, 1000, 2500 and 5000 respectively. It was observed that doses 5mg, 10mg, 25mg, 50mg, and 250mg was considered safe in that the mortality rate recorded are highly negligible to treat the flies. This study's limitation is in its inability to pinpoint the precise mechanism underlying the extract's anti-diabetic effects. The investigation was unable to identify the active ingredient that was responsible for the anti-diabetic effects. Therefore, further analysis and

characterization of the active ingredients in Shemmeco extracts is advised as a potential basis for enhancing its efficacy development and synthesis.

5.0 Conclusion

It is important to draw the conclusion that Shemmeco extract had anti-diabetic effects in *Drosophila melanogaster* based on the findings of this study on the anti-diabetic properties of Shemmeco extract. Shemmeco extract is also risk-free at the various dosages used for treatment in this study as evidenced from the LC50 study.

6.0 Significance statement

This study's support of an extract's anti-diabetic and acute toxicity properties may help scientists create new medications for different conditions using the *Drosophila melanogaster* model which many researchers of ethnopharmacology were not as now able to explore. The study also provides an open opportunity to investors, donor agencies and philanthropists worldwide who wants to invest into the efficacy development and synthesis of Shemmeco extract as part of their contribution and fight against diabetes type 2.

Declaration of Competing Interest

The author declares that there is no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Garai A, Sarkar B. Economically independent reverse logistics of customer-centric closed-loop supply chain for herbal medicines and biofuel. *J Clean Prod.* 2022; 334:129977.
2. Eshete MA, Molla EL. Cultural significance of medicinal plants in healing human ailments among Guji semi-pastoralist people, Suro Barguda District, Ethiopia. *J Ethnobi Ethnomed.* 2021;17(1):1-18
3. Adesola RO, Lawal JT, Oladele OE. *Drosophila melanogaster* (Meigen, 1830): A potential model for human diseases. *World News Nat Sci Int Sci J.* 2021;36: 42-59.
4. Adedara IA, Abolaji AO, Rocha JBT. Diphenyl Diselenide Protects Against Mortality, Locomotor Deficits and Oxidative Stress in *Drosophila melanogaster* models of Manganese-Induced Neurotoxicity. *Neurochem Res.* 2016; 41:1430-1438
5. Rizzo R, Pistillo M, Germinara GS, Lo Verde G, Sinacori M, Maggi F,,...Benelli G. Bioactivity of *Carlina acaulis* essential oil and its main component towards the olive fruit fly, *Bactrocera*

oleae: Ingestion toxicity, electrophysiological and behavioural insights. *Insects*. 2021;12(10):880.

6. Mohammad,F, Singh PA. *Drosophila* Systems Model of Pentleneterazole Induced Locomotor Plasticity Responsive to Antiepileptic Drugs. 2009;Doi 10.1186/1752-0509-3-1
7. Charpentier G, Louat F, Bonmatin JM. Lethal and Sub-Lethal Effects of Imidacloprid After Chronic Exposure on the Insect Model, *Drosophila melanogaster*. *Env Sci Technol*. 2014:2014.
8. Omale SO, Aguiyi JC, Adejunle OG, Johnson TO, Ochala SO, Etuh MA, Eze MC. Evaluation of the antidiabetic effects of the stem bark extract of *Barinari curatellifolia* (planch. Ex Benth) in *Drosophila melanogaster*. *J Pharm Toxicol*. 2021;16 (1): 9-21.
9. Ekun OA, Ogunyemi GA, Azenabor A, Akinloye O. "A comparative analysis of glucose oxidase method and three point-of-care measuring devices for glucose determination." *Ife J. of Sci.* (2018); 20(1): 43-49.