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Anti diabetic Activity Of Ethanolic Seed Extract Of Corchorus olitorius

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Abstract

The ethanolic seed extract of *Corchorus olitorius* was studied to ascertain its possible antidiabetic effect. *Corchorus olitorius* seeds were pulverized to powder and Soxhlet extractor was used for extraction of the seed compound with ethanol. The study was carried out using normoglycaemic, glucose challenged and alloxan induced diabetic albino rats. The dose range tested for the extract was between 100- 1000mg/kg body weight of the rats. The effects were compared with a glibenclamide (0.2mg/kg) treatment and a normal saline treatment control groups. A repeat dose study was carried out for 14 days at a fixed dose of 500mg/kg and the glycosylated haemoglobin and insulin level determined. The ethanolic seed extract of *Corchorus olitorius* was found to contain alkaloids, tannins, flavanoids, glycocides, saponin, cardiac glycocides, anthraquinons, steroids and volatile oil. The extract significantly ($p \leq 0.01$) reduced blood sugar levels in normoglycaemic, OGTT and diabetic rats. This was further supported by reduction in the glycosylated haemoglobin and increase in the insulin level determined. In Conclusion, the results of this study showed that the ethanolic seed extract of C.O has great potentials as an anti diabetic remedy due to the ability of the extract to lower blood glucose levels in normal rats, diabetic rats and also suppress postprandial rise in blood glucose levels.

Keywords: *Corchorus olitorius*; alloxan induced diabetic rats; oral glucose tolerance test

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1. Introduction

Medicinal herbs have consistently been considered the leading source of pharmaceuticals, employed in the treatment of various human diseases due to their high chemical diversity and broad biological functionality [1]. Approximately 80% of the peoples in the rural African communities still rely on the use of plant remedies to control and/or treat diabetes mellitus [2]. It is now common place to include herbal or botanical extracts as a part of medical treatment (as an adjunct to hypoglycemic agents). In Africa, hundreds of plants are used traditionally for the management of diabetes mellitus. To date, however, only a few of these African medicinal plants have received scientific scrutiny, despite the fact that the World Health Organization has recommended that medical and scientific examinations of such plants should be undertaken [2]. Pharmacology and toxicological evaluations of medicinal plants are essential for drug discovery. Despite appreciable progress made in the management of diabetes mellitus using the conventional antidiabetic management strategies, the search for plant based products for the control of diabetes mellitus continues. Most of these medicinal plants with hypoglycaemic properties are being used immensely as alternative forms of treatment of diabetes since the use of oral hypoglycemic drugs is associated with problems such as rigid and multiple dosing regimens, high cost, inaccessibility and untoward effects [3]. These motivated our team to select *corchorus olitorius*, a plant widely used locally in this environment for the treatment of a plethora of diseases for scrutiny, for its anti diabetic and safety profile, as a means to validate its local use and possible development of a potential anti diabetic.

Corchorus olitorius (C.O) is an annual, much-branched herb 90-120 cm tall with glabrous stems, leaves 6-10 cm long and 3.5-5 cm broad, with pale yellow flowers and black trigonous seeds [4].The leaves of C.O was reported to have hypoglycaemic effect [5] and high antibacterial activity [6].The seed protein enriched diet was found to increase rats body weight [7]. There was a failure to produce adverse effects in young chicken, with levels of seeds (C.O) up to 5% of the diet [8]. The seeds were found to contain reasonable percentage of biologically active cardiac principals [9]. The plant stem is a source of jute fibre,and folkloric uses includes, seeds for purgative, leaves for dysentery,fever,gonorrhea and demulcent [10]. The part of the plant targeted in this study is the seed believed to have a greater hypoglycaemic effect (ethanolic extract).

2. Materials and methods

2.1. Laboratory animals

Albino Rats of both sexes from the Biological Sciences Department of Usmanu Danfodiyo University (UDUS) were used for the study. The rats were housed in metal cages in the laboratory at temperature between 35-37^{o}C; 12hr/12hr light/dark cycle and maintained with free access to standard rat feeds and water, for 7 days before experimentation. 12hrs before experimentation, food was withdrawn but water available *ad libitum*.

2.2. Preparation of plant extract

The *Corchorus olitorius* seeds were pulverized to powder. Soxhlet extractor was used for extraction of the seed compound. After extraction the solvent was removed by means of a rotary evaporator, yielding the extracted compound. The Extract isolated was kept at −20 ^{0}C until tested.

2.3. Phytochemical analysis

The phytochemical constituents of the C.O was conducted using methods outlined by Odebiyi and Sofowora [11]

Antidiabetic Studies

2.3.1 Induction of diabetes in rats

The rat in the alloxan monohydrate induced diabetics (AIDR) group was injected with alloxan monohydrate

dissolved in sterile normal saline solutions at a dose of 150mg/kg body weight after overnight fast [12]. And animals with moderate hyperglycemias, blood glucose of 150mg/dl and above were considered diabetic and employed in the study 3 days after alloxan induction.

The normal control was injected intraperitoneally with sterile normal saline (2ml/1kg). A commercial available Glucometer (Accu Chek Active, Roche Diagnostics GmbH, D-68298 Germany) was used to determine Blood glucose estimation in mg/dl (10-600) (Glucose dye oxidoreductase mediator reaction method). Blood glucose was measured through tail tipping blood sample technique [13]

2.3.2 Hypoglycemic activity of extract in normal rats

For determination of prophylactic activity, normal rats (n=5) were used per group. In this study, there were 6 groups A, B, C, D, E and F administered orally with 100, 250, 500 and 1000mg/kg body weight of extract respectively. Group A. control; consist of normal rats treated with a similar volume of the vehicle (saline) used to dilute the extract. The animals in group F were treated with glibenclamide (0.2mg/kg).

Blood glucose levels were then measured just prior to, 30 minutes, and 1, 2, and 4hours after administration. Blood glucose levels were compared with those of the control group. Results were calculated as percentage decrease of the initial value [14].

2.3.3 Effect of extract on oral glucose tolerance test (OGTT)

Hyperglycemia was induced by oral administration of glucose (10g/kg,) (t/0min) to 5 rats. Thirty minutes before the administration of glucose, the animals (n=5) received a single oral administration of extract (mg/kg). Blood glucose levels were determined for 3 h, at 1 h intervals, and 30 minutes after glucose administration. The blood glucose levels were compared with the negative control group (n=5), which received a similar volume of the vehicle (saline) used to dilute the extract and a glibenclamide treatment (0.2mg/kg) group, a positive control. [14].

2.3.4 Hypoglycemic activity in alloxan induced diabetic rats

In this experiment the groups were with 5 alloxan induced diabetic rats each.Group 1 consisted of alloxan induced diabetic rats to which no extract was administered. Groups 2, 3, 4 and 5 consisted of diabetic rats to which 125, 250, 500 and 1000mg/kg doses of extract were administered orally.Group 6 consisted of alloxan induced diabetic rats to which glibenclamide (0.2mg/kg) were administered orally. Glucose levels were measured just prior to and 1, 2 and 4hours after extract/ drug were administered (adm) (t=0min). And results were calculated as percentage decrease of the initial value [14].

2.3.5 Repeat dose effect test

Three groups consisting of 10 rats each were used for this study.

A. Alloxan induced diabetic rats administered 500mg/kg body weight dose of extract orally daily for 14 days

B. Alloxan induced diabetic rats administered glibenclamide 0.2mg/kg body weight orally daily for 14 days

C. Alloxan induced diabetic rats administered normal saline 1ml orally daily for 14 days

Five of the rats per group were sacrificed on the 15th day and blood collected via cardiac puncture for glycosylated Hb and insulin level assay. The remaining 5 rats in each group were left without any form treatment for more 7 days but allowed free access to feeds and water. The previous parameters above were then collected after sacrificing the rats on the 22nd day. Before commencement of the experiment 5 diabetic rats and 5 non diabetic rats were sacrificed and the above parameters were assayed for baseline record.

Glycosylated heamoglobin(HbA_1)

Ionic exchange resine method [15] was used.

2.3.6 Insulin assay

Grassi and Pradelles method [16] was used with Rat insulin immunoassay kit (A05105- 96 wells of spi bio bertin pharma France) was used.

2.4 Statistical methods

Results were expressed as Mean+ S.D. The instat statistical software was employed. ANOVA was used to compare means using turkey Kramer test. Significance level was set at $p \leq 0.05$

3. Results

3.1. Phytochemical of Corchorus olitarius

All the phytochemicals found in the raw powdered seed were also seen in the ethanol extract, with exception of Anthraquinone which was absent in the ethanolic seed extract (table 1).

3.2. Hypoglycaemic activity of extract in normoglycemic rats

There was a significant reduction in the blood sugar between the treatments and the control groups from the 1st hour through to the 4th hour (table 2).

The blood sugar levels reductions in the 100, 250, 500 and 1000mg/kgextract administered groups were 111.4mg/dl to 97.2mg/dl; 97.6mg/dl to 79.8mg/dl; 92.6mg/dl to 79.8mg/dl and108.2mg/dl to 87.0mg/dl respectively. Though the glibenclamide treated group had a better reduction of blood sugar level from 101.8mg/dl to 71.6mg/dl. The reduction in blood sugar levels were not dose dependent as the 100mg/kg extract treated group produced a higher reduction than the 250mg/kg treated and the 500mg/kg treated group did not produce any effect different from the control group.

3.3. Effect of extract on oral glucose tolerance test (OGTT)

The blood sugar at the 0 hour (FBS) in all the groups had no significant difference. At the 30 minutes mark, the

1000mg, 100mg and the glibenclamide groups all had a significantly less raised blood sugar with respect to the control while the 500mg and 250mg were significantly highly raised. At the1 hour mark, only the 100mg and glibenclamide groups were significantly different from the control with ($p<0.01$). At the 2nd hour, 100mg group had p- value of less than 0.05 and glibenclamide group, $p<0.01$. At the 3rd hour mark, there was no significant difference in the sugar levels, though the100mg, glibenclamide and 1000mg groups had a better control on comparism with the other groups (table 3).

3.4. Hypoglycemic effect of C.O on Diabetic rats

There was a significant change in the treatment group as compared to the control and the glabenclamide treatment group. There was a decrease in the blood sugar level and percentage glycemic change in the 250mg/kg and 500mg/kg extract treatment group, likened to the glibenclamide treatment group at the 2^{nd} and 4^{th} hour. While the 1000mg and125mg treatment groups had no significant glycemic control in diabetic rats (table 4 and 5).

3.5. Repeat Dose Effect Test of C.O. on alloxan induced diabetic rats:

3.5.1. Effect of repeat dose treatment of extract on the body weights of alloxan induced diabetic rats (AIDR)

There were no significant changes in the body weight of rats throughout the test period (whether during treatment or on withdrawal of treatment, table 6). There was however an insignificant ($p>0.05$) weight loss of rats in the extract treated group (12.83g), than the glibenclamide (1.32g) and the normal saline treated group (0.18g).

3.5.2. Effect of repeat dose treatment of extract on the FBS of alloxan induced diabetic rats (AIDR)

The percentage reduction in fasting blood sugar showed that the glibenclamide treated group had a better reduction in FBS at the 5^{th} , 10^{th} ,15^{th} and 22^{nd} day of experiment that is 50%, 56%, 32% and 59% respectively, while the extract group had 41%, 40%, 33%, and 47% respectively and the normal saline control group had 14%, 19%,18% and 27% respectively (table 7). There was no rebound effect following the withdrawal of the extract and the drug on the 15^{th} day.

3.5.3. Effect of repeat dose treatment of extract on the glycated hemoglobin of rats

There were no significant differences in the glycosylated hemoglobin of rats (table 8).

3.5.4. Effect of repeat dose treatment of extract on the on insulin of rats

There were no significant differences in the insulin level of rats (table 9). It was noticed that there was a higher insulin level with the extract treated group than the glbenclamide and the normal saline group in that order. While the normal rats had almost twice the value of the treated rats and the alloxan induced diabetic rats (baseline value). The level of insulin began to fall following the withdrawal of the extract in the last week while that of glibenclamide treated even continued to increase.

Table 1: Phytochemical of *Corchorus olitorius* seed

Phytochemical	Powdered seed	Ethanol extract
	+++	+++
Alkaloids		
	+	++

Tannins	+++	+++
Flavonoids	++	+++
Glycosides	++	+
Saponins	–	–
Saponin glycoside	++	+++
Steroids	++	++
Cardiac glycoside	+	–
Anthraquinone	+++	+++
Volatile oil		

Foot note: +++ means high concentration

++ means medium concentration

+ means low concentration

Table 2: Hypoglycaemic activity of extract in normal rats

Blood Sugar mg/dl	Control	100 mg/kg	250 mg/kg	500 mg/kg	1000 mg/kg	Glib. Treated	Stat. (one-way ANOVA)
	A	E	D	C	B	F	
0hrs	101.6± 12.05	111.4± 4.04	97.6± 12.20	92.6± 8.17	108.2± 5.85	101.8+-15.91	P=0.0981 $F_{5,24}$=2.117
1	92.8± 9.50	101.0± 8.22#	84.0± 5.79	90.0± 4.0	106.6± 3.85*###	85.8+-4.60	P=0.0001* $F_{5,24}$=9.623
2	87.4± 8.36	94.0± 7.75	81.2± 7.66	82.8± 5.98	102.8± 9.26#	82.4± 13.15	P=0.0051* $F_{5,24}$=4.461

3	85.4± 8.39	95.2± 11.45##	77.0± 5.43	82.0± 6.82	96.4± 10.14##	74.6± 5.77	P=0.001* $F_{5,24}$=6.024
4	89.0± 6.60#	92.2± 5.17##	79.8± 7.26	79.8± 4.55	87.0± 9.22#	71.6± 10.31*	P=0.0024* $F_{5,24}$=5.134
Diff	12.6± 5.77##	18.6± 4.22	17.8± 9.36	12.8± 4.76#	21.2± 9.25	30.2± 8.25**	P=0.0086* $F_{5,24}$=4.017

Values are mean ± SD (n=5). *significant difference(p<0.05) **significant difference (p<0.01) and ***significant difference(p<0.001) with reference to control.# significant difference(p<0.05)## significant difference (p<0.01) and ### significant difference(p<0.001) with reference to glibenclamide.

* In stat column indicate column means is significantly greater than expected by chance.

Table 3: Effect of extract on oral glucose tolerance test.

Blood Sugar mg/dl	Control A	100 mg/kg	250 mg/kg	500 mg/kg	1000 mg/kg	Gliben-clamide
0hr	96.8 ±4.604	103 ±9.17	102.0 ± 13.34	97.8 ±8.98	106.8 ±1.924	95.4 ±3.715
30mins	242.2± 12.40	159.2*** ±19.77	228.2### ± 13.61	216.4## ±19.77	186.2*** ±23.97	168.2*** ±12.696
1hr	193.2± 21.70	146.8** ±12.83	177.0 ± 1.73	190.0# ±14.00	183.4 ±23.734	153.4** ±14.415
2hrs	195.6± 12.32	158.8* ±13.01	194.6## ± 12.62	182.0 ±22.39	174.6 ±17.44	151.8** ±13.791
3hrs	183.6 ±14.89	144.4 ±19.54	174.4 ± 30.20	164.0 ±35.181	157.2 ±31.68	143.0 ±15.199

Values are mean ± SD (n=5). *significant difference(p<0.05) **significant difference (p<0.01) and ***significant difference(p<0.001) with reference to control.# significant difference(p<0.05)

significant difference (p<0.01) and ### significant difference(p<0.001) with reference to glibenclamide.

Table 4: Calculated percentage reduction in blood sugar

Treatment	1hour	2hours	3hours	4hours
Control	-0.6%	0.9%	0.6%	0.1%
125mg/kg	-5.5%	-4.5%	-1.1%	-5.7%
250mg/kg	0.9%	7%	17.1%	29.3%
500mg/kg	12.4%	14%	20%	21%
1000mg/kg	-16.1%	-19.2%	-8.2%	0.6%
Glibenclamide	-8.8%	-3.3%	12.2%	30%

Table 5: Effect of C.O. on blood glucose level of alloxan-induced diabetic rats / % reduction in blood sugar

()percentage reduction in blood sugar

Treatment	0 hour	A 1 hour	B 2 hour	C 3 hour	4 hour
Control	387.8 ± Weight (wt) in Gram	390± (extract treated 500mg/kg) 126.05 (-0.6%)	384.4± (glibenclamide Treated0.2mg/kg) 127.67 (0.9%)	385.4± 127.67 (0.6%)	387.4± 124.27 (0.1%)
125mg/kg	368.8±	389.2±	385.4±	372.8±	390.0±
	109.82	82.62	82.33	84.06	106.40
		(-5.5%)	(-4.5%)	(-1.1%)	(-5.7%)
250mg/kg	369.2±	366.0±	343.4±	306.2±	261.0±
	86.16	108.92	133.35	136.13	143.54
		(0.9%)	(7%)	(17.1%)	(29.3%)
500mg/kg	489.6±	428.8±	421.0±	391.8±	386.6±
	110.91	44.4	82.77	100.1	110.35
		(12.4%)	(14%)	(20%)	(21%)
1000mg/kg	326.4±	379.0±	389.0±	353.2±	324.6±
	121.21	105.16	103.89	104.29	110.74
		(-16.1%)	(-19.2%)	(-8.2%)	(0.6%)
Glibenclamide	436.2±	474.8±	450.4±	383.2±	305.2±
	113.84	107.89	106.19	134.62	114.59
		(-8.8%)	(-3.3%)	(12.2%)	(30%)
Stat.	P=0.2578	P=0.5472	P=0.7127	P=0.8576	P=0.4229
(one-way	$F_{5,25}$=1.406	$F_{5,25}$=0.8205	$F_{5,25}$=0.5829	$F_{5,25}$=0.3798	$F_{5,25}$=1.029
ANOVA)					

Values are mean ± SD (n=5).

Table 6: Effect of repeat dose test on body weight of AID rats

Baseline Wt g	217.53±27.12	207.70±36.90	186.90±13.27
5th Day of experiment	203.84±20.36	198.11±34.60	186.18±16.28
10th Day of experiment	200.88±19.89	202.64±32.80	186.44±13.61
15th Day of experiment	202.37±16.87	207.48±36.71	192.37±14.75
Last day of experiment	204.70±19.26	206.38±37.59	186.72±16.89
Weight Loss	12.83	1.32	0.18

mean ± SD *significant ($p<0.05$) Values are (n=5). difference

Table 7: Effect of c.o. on blood glucose level of alloxan-induced diabetic rats / % reduction in blood sugar on repeat dose study

()percentage reduction in blood sugar

FBS	Baseline	5th Day of experiment	10th Day of experiment	15th Day of experiment	Last day of experiment
A	364.90±	214.10±	218.50±	245.30±	195.20±
(Ext)	89.43	68.37	67.34	60.06	29.37
		(41%)	(40%)	(33%)	(47%)
B	429.00±	213.20±	190.40±	292.30±	174.00±
(Glb)	146.73	136.62	81.01	126.52	68.27
		(50%)	(56%)	(32%)	(59%)
C	341.10±	297.70±	277.40±	281.30±	249.40±
(N/S)	91.62	80.76	117.55	131.17	128.86
		(14%)	(19%)	(18%)	(27%)

Values are mean ± SD (n=5).

Table 8: Glycosylated hemoglobin of rats on repeat dose treatment of extract

Glycated haemoglobin	A (extract)	B (glibenclamide)	C (normal saline)
Baseline (0 day)	14.92±1.05	14.92±1.05	14.92±1.05
15th day	13.94±1.74	11.58±2.96	14.10±2.81
post withdrawal of treatment(22nd day)	12.16±3.25	13.16±3.99	13.18±2.20

Baseline normal rats= 12.92 ± 3.50

Values are mean ± SD (n=5)

Table 9: insulin of rats on repeat dose treatment of extract

Groups	A Extract Teated	B Glibenclamide Treated	C Normal Saline treated
Baseline (0 day)	2.124±1.851	2.124±1.851	2.124±1.851
15th day	2.862±3.118	1.902±1.753	1.000±0.8230
post withdrawal of treatment(22nd day)	2.112±1.683	2.912±1.349	0.7500±0.3750

The insulin of non diabetic rats was noticed to be 4.832±5.194.

Values are mean ± SD (n=5) *significant difference($p<0.05$)

4. Discussion

This research enumerated the hypoglycaemic activity of *Corchorus olitorius* seed extract (ethanolic) using single and repeat dosing in normal, glucose-loaded hyperglycaemic and alloxan induced diabetic albino rats.

In the single dose normoglycaemic study, in which normal rats were dosed orally with ethanolic extract of C.O and blood sugar measured up to 4 hours post treatment, there was a significant change between the treatment and the control groups from the 1st hour through to the 4th hour, as well as with the difference in blood sugar (4th hour-0hour).Though the glibenclamide treated group had a better control (with reduction of 30.2mg/dl)of blood sugar level on comparison with the C.O treatment groups (1000mg having 21.2 mg/dl reduction; 100mg having 18.2 mg/dl reduction; 250mg having 17.8 mg/dl reduction ; and 500mg having 12.8 mg/dl) . The hypoglycaemic effect in normoglycaemic rats was noticed to be dose independent.

In the glucose-loaded hyperglycaemic test (OGTT) in which normal rats were loaded orally with glucose 30 minutes post oral administration of ethanolic extract of C.O, there was a significant Change ($p<0.001$) in the blood sugar level between the control and the treatment group from the 30th minute up to the 2nd hour (table 3). At the 30th minute mark, the significance showed the treatment groups 1000mg and 100mg to have $p<0.001$. At the 1st hour mark, the significance value for 100mg group $p<0.01$ and $p<0.05$ at the 2nd hour. The superior control in the treatment group of blood sugar handling inferred a tolerance of glucose loading due to the effect of the ethanolic C.O seed extract.

In the alloxan induced diabetic rats, during the single dose test, there was a significant percentage glycemic change

in the 250mg/kg and 500mg/kg extract treatment group, likened to the glibenclamide treatment group (table 5, 6) at the 2nd and 4th hour. The % reduction in blood sugar at the 4th hour was in this order; glibenclamide (30%), 250mg treatment group (29.3%), the 500mg treatment group (21%), 1000mg (0.6%), control (0.1%) and 125mg treatment group (-5.7%). While in the 3rd hour the order was 500mg group (20%), 250mg (17.1%), glibenclamide (12.2%), control (0.6%), 125mg group (-1.1%), and the 1000mg group (-8.2%). At the 2nd hour, the best reduction was 500mg group (14%) and 250mg group (7%), and control (0.9%).

In the repeat dosing testing of the alloxan induced diabetic rats, there was a highly significant percentage reduction in fasting blood sugar though the glibenclamide treated group had a better reduction in FBS at the 5th , 10th ,15th and 22nd day of experiment that is 50%, 56%, 32% and59% respectively, while the extract group (500mg/kg) had 41%, 40%, 33%, and 47% respectively and the normal saline control group had 14%, 19%, 18% and 27% respectively (table 7). These were further supported by the Glycated heamoglobin (glycosylated heamoglobin) formed in a non enzymatic glycation pathway by heamoglobin's exposure to plasma, (a form of heamoglobin which is measured primarily to identify the average plasma glucose concentration over prolonged periods of time). As the average amount of plasma glucose increases, the fraction of glycated heamoglobin increases in a predictable manner. It should be mentioned that once a heamoglobin molecule is glycated, it remains that way. In the current study the glycated heamoglobin was seen to be 12.92 in normal rats. After 2 weeks of treatment, the levels of glycated heamoglobin showed the normal saline treated group having a high value (14.10), followed by the extract treated group (13.94), the best or lowest value being glibenclamide treated group (11.58). On withdrawal of treatment (7days), the extract treated group was seen to have a better level (12.16) than the glibenclamide treated group (13.16), indicating a long acting effect of the extract and short term effect of glibenclamide. Similarly, *Acacia catechu* was found to reduce glycated heamoglobin in alloxan induced diabetic rats [17]. And there was a higher insulin level with the extract treated group than the glibenclamide treated group and than the normal saline treated group (table 9). Similarly, *Raphia hookeri* seed extract [18] and *Origanium vulgare* leaves [19] in separate studies in alloxan and Streptozotocin-induced diabetic rats respectively, were seen to increase insulin levels and as well cause reduced glycated heamoglobin. Owing to the higher insulin level seen on withdrawal of treatment, and the reduction of glycated heamoglobin, the possible mechanism of action of the extract may be that, the extract may stimulate the release of insulin from the remaining beta cells of the islet cells of the pancreas not destroyed by the alloxan. This proposed mechanism is supported by the fact that the extract improved glucose tolerance in the OGTT test.

The action of the seed extract can be attributed to phytochemical content of the extract. Of these flavanoids [20][21], alkaloids [22], saponins [23] have been reported to have hypoglycaemic effect. Several researchers have reported plant extracts (hypoglycaemic agents) with several combinations of phytochemicals to which the reported phytochemicals (table 1) belong [24][25][26], of these Adeneye and Adeyemi [27] reported the phytochemicals, alkaloids, flavonoids, tannins and glycosides possessed by the aqueous seed extract of *Hunteria umbellate* has hypoglycaemic effects in normoglycaemic, glucose and nicotine-induced hyperglycaemic rats. It therefore would mean that the hypoglycaemic action of the the seed extract of C.O could be due to the phytotochemicals present singly or in combination.

In Conclusion, the results of this study showed that the ethanolic seed extract of C.O has great potentials as an anti diabetic remedy due to the ability of the extract to lower blood glucose levels in normal rats, suppress postprandial rise in blood glucose levels in glucose loaded rats and lower blood glucose level in diabetic rats. This validates it use locally for diabetes. There is the prospect that further research (ongoing) on the exact fraction/ agent responsible for the ethanolic seed extract anti diabetic potential would be discovered, with the possibility of a novel anti diabetic agent.

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