Effect of the aqueous extract of the leaves of *Clerodendrum thomsoniae* Linn (*Verbenaceae*) on type 2 diabetic wistar rats induced by the MACAPOS1 type diet and Dexamethasone.

Abstract:

Clerodendrum thomsoniae leaves are used in Cameroon to manage diabetes and its complications. Antioxidant ability *in vitro* (using DPPH radical scavenging effect, reducing power) and *in vivo*, total phenolic and total flavonoid content, lipid lowering activity have been investigated. However, antidiabetic effect has not even been determined. To investigate the antidiabetic effect of the aqueous extract of *Clerodendrum thomsoniae* Linn leaves in normal and type 2 diabetic rats induced by MACAPOS 1, AECT was administered orally to normoglycemic rats at 312.5 mg/kg, 625 mg/kg and 1250 mg/kg and fasting blood glucose monitored for 2 h. antihyperglycemic effect in normoglycemic rats was also determined at the three doses and with glibenclamide. After 10 weeks of induction of type 2 diabetes by MACAPOS 1 type diet, diabetic rats were also treated orally with AECT during 30 days at the various doses (312.5, 625 and 1250 mg/kg) and with metformin. Feeding of rats led to a significant increase in the average blood glucose level. After a single oral administration, *C. thomsoniae* significantly reduced blood glucose levels in normoglycemic rats ($p<0.05$) two hours after, from 83 ± 2 mg/dL to 57.39 ± 1.7 mg/dL with the dose of 1250 mg/kg. given the highest reduction rate of 30,86%. In normoglycemic rats 30 minutes after oral glucose overload, the maximum reduction rate was observed with glibenclamide 5 mg / kg and calculated at 49.90% followed by 36.39%, for the extract at doses 1250 mg / kg. After 30 days of repeated oral administration, *C. thomsoniae* produced a potent reduction on blood glucose levels ($p<0.05$) in type 2 diabetic rats. This diminishing in blood sugar was much more expressed with the higher dose of the extract 1250mg/kg (73.52 ± 0.71 mg / dL) followed by metformin 38mg/kg (70.21 ± 0.89 mg / dL) as the normal control with no significant difference ($P < 0.05$). These different results show that the antidiabetic activity of *C. thomsoniae* aqueous extract can be explained by insulin stimulating effect, inhibiting glycogenogeneses in liver and also give support to the traditional use of this plant as antidiabetic medicinal plant.

Key words: *Clerodendrum thomsoniae* leaves, aqueous extract, MACAPOS 1 diet, Dexamethasone, hypoglycemic, antidiabetic.

INTRODUCTION

In the tropics and in Africa many plants are used by people to alleviate diabetes-related disorders and especially type 2 diabetes. Diabetes is a serious metabolic disorder and plenty of medical plants are used in traditional medicines to treat diabetes. African traditional pharmacopoeia offers alternative to synthetic antidiabeticDiabetes is a metabolic disorder due to insufficiency or improper use of insulin characterized by fasting blood sugar above 1.26g / L checked twice[1]. The increasing worldwide incidence of diabetes mellitus constitutes a global public health problem. It is predicted that by 2025 the world will have an increase of 72% of diabetic patients[2].The number of people with diabetes in urban areas is expected to increase to 472.6 million by 2045, largely due to global urbanization[3]. Type 2 diabetes is the most representative, accounting for about 80% of all forms of diabetes in both sexes [4]. Type 2 DM is a chronic and progressive syndrome characterized by metabolic abnormalities such as insulin resistance and decreased pancreatic b-cell function that modifies fuel-sensing

processes in the body [5]. Diabetes is primarily treated with insulin and oral antidiabetic drugs such as biguanides, alphaglucosidase inhibitors, sulphonylureas and glinides [6].

Since ancient times, different medicinal plants, their extracts or any other form are used in the treatment of many diseases including diabetes mellitus [7]. Since more than 80% of the population uses traditional medicine, phytomedicines can be used effectively in this context to treat diabetes [8]. At least 12 000 plants in the world are used for medicinal purposes, but less than 10% of them are investigated from pharmacological point of view [9]. Nowadays, more than 1200 plants species are world wild used in diabetes phytotherapy and experimental studies support the hypoglycaemic activity of a large number of these plants [10]. Today, many treatments that involve the use of medicinal plants are recommended [11]. Most plants contain carotenoids, flavonoids, terpenoids, alkaloids, glycosides and can often have anti-diabetic effects [12]. Therapeutic management of diabetes is currently based on strict diets and oral anti-diabetic medication. This solution is obviously expensive on an individual scale given the low purchasing power in most developing countries. The traditional pharmacopoeia offers a solution within the reach of all budgets. This is how extracts from some plants have been tested for their anti-diabetic activity *Anacardium occidental* [13], *Allium sativum* [14].; *Allium cepa* [15]. Among all the medicinal plants, the plants under the genus of *Clerodendrum* belonging to family Lamiaceae have strong therapeutic potentials[16] *Clerodendrum thomsoniae* much better known and cultivated for its ornamental character [16] is used by traditional healers in Ngaoundere-Cameroon to treat diabetes. It is also traditionally used in the treatment of intestinal worms and other illnesses. A thorough the literature does not reveal any prior investigation of the capacity of *C. thomsoniae* in the treatment of type 2 diabetes. The general objective of this work is to evaluate the hypoglycemic and antidiabetic activities of aqueous extracts of *C. thomsoniae* on type 2 diabetic rats induced by MACAPOS 1 type diet and dexamethasone.

MATERIAL AND METHODS

Sampling and production of *Clerodendrum thomsoniae* extract

The plant material (leaves) was collected Mbideng, a neighborhood of Ngaoundéré, in Adamawa region of Cameroon. The plant was identified at the national herbarium (N° Letouzey 11090 from the herbarium collection NO 28476 / SRF / Yaoundé, Cameroon). Young mature leaves of the plant were carefully cleaned, sorted, graded according to size and dried in a ventilated electric turning dryer (brand Riviera & Bar) at 40 ± 2 °C for 48 h. After drying, the leaves were ground to make a fine powder using an electric grinder (Culatti, Polymix, France) equipped with a sieve of diameter 500 µm mesh.

Preparation of Clerodendrum thomsoniae aqueous extract

The obtained powder (2.5 g) was blended with 40 mL distilled water. The different mixtures were placed in a water bath at 70 ± 2 °C and extracted for 30 min under stirring. The mixture was then cooled for 30 min and centrifuged at 1500 g for 15 min at 20 °C using refrigerated centrifuge. The supernatant was collected and the residue was solubilized in 40 mL and re-extracted as mentioned above. The supernatants were combined and concentrated under vacuum in a rotary evaporator and dried in a desiccator at 40 °C. The crude extract was weighed and used to prepare 31.25, 62.5 and 125 mg/mL aqueous extract of *Clerodendrum thomsoniae* (AECT) corresponding to the 3 tested doses (312.5, 625 and 1250 mg/kg).

Animal experiments

Healthy male albino Wistar rats (6 -8 weeks old) weighing about 150 - 200 g were raised in the animal house of the Faculty of Science of the University of Ngaoundéré (Cameroon) at an ambient temperature of 22 ± 3°C and relative humidity of 54±2% under a 12 h/12 h light/dark cycle. The animals were acclimatized to laboratory condition for four days before the experiment starts and were fed with a standard diet made of casein as a

protein source and tap water *ad libitum*. The experiment was carried out as per the guidelines of Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) and ethically approved by the Institutional Committee of the Ministry of Scientific Research and Innovation of Cameroon.

Effect of single oral administration of AECT in normal healthy rats

This study was done as reported by Kouambou *et al.* [17] with some modifications. Twenty rats were divided into four experimental groups with five animals in each group: normal controls (NC) rats that received only distilled water 10 mL/kg; 3 test groups (AECT312.5 mg/kg; AECT625 mg/kg; and AECT1250 mg/kg). For this study, administration of the aqueous extract was done by gavage using a 2.5 mL goading probe. Blood samples were collected from the tail vein periodically at t_o= 0 min, t_1= 60 min, t_1= 90 min and t_2= 120 min after the administration of aqueous extract. Their glucose contents were assessed using glucose oxidase method.

Oral Glucose Tolerance Test (OGTT) in normal Rats

The anti-hyperglycemic effect of the AECT was studied as described by Nkono *et al.* [18] with some modifications at doses of 312.5, 625 and 1250 mg/kg. 25 rats were fasted for 16 h and treated with the AECT and glibenclamide. Normal controls rats (NC) were treated with the vehicle. At 0 min, blood samples were collected from the tip of tail. Then the animals were treated with the AECT, the normal control rats were treated with the vehicle alone. Glibenclamide (5mg/kg) was used as positive control. All the treatments were given orally. 30 min after the treatment, all groups received glucose (2.5 g/kg b.m) orally and the blood glucose concentrations were determined from the tip of a tail before drug administration and at 60, 90, 150 min thereafter.

Induction and Treatment of Hyperglycemia

Diabetes induction

Induced Diabetes Rats MACAPOS 1 was produced as Kamgang *et al.*[19] with some modifications. Healthy rats were divided in two groups. One group (normal control) was submitted to standard diet, another group submitted to Sweetened high-calorie diet (SHCD), also received per os 0.8 g/kg of dextrose (Gwaudan Lavirette et Cie, Glucose pure Anhydre) and 4 g/kg of sucrose (SOSUCAM, Bandjock-Cameroon) every two days. One month after the beginning of SHCD, the animals received the dexamethasone (25 µg/kg b.m i.m.) once every 2 days during 3 weeks. During the induction period, fasting glycemia was estimated at the beginning and at the end of each phase. After 10 weeks of diet, to confirm the onset of diabetes, an oral glucose tolerance test (OGTT) was carried out by administration of 4g / kg b.m. of D-glucose in rats of different groups. Blood sugar was monitored for 120 minutes. The animals with fasting total blood glycemia ≥ 126 mg/dL were considered as diabetic and were selected for the next stage of experiment.

Evaluation of antidiabetic activity of AECT

The rats were divided into 6 groups of 5 animals each: normal controls, negative controls diabetic rats receiving water, positive controls diabetic rats treated with Metformin (38 mg/kg b.m: Met38), diabetic rats treated with 312.5, 625 and 1250 mg/kg b.m of aqueous extract of *C. thomsoniae* (AECT312.5, AECT625, AECT1250*)*. The animals were treated once daily by intra-gastric gavages for 30 consecutive days. During the treatment, fasting glycemia was estimated at the beginning and every fifteen days. Other parameters such as food intake, water intake and change in body mass were also measured. At the end of treatment, treated rats was divided into two sub-group, the first one was use to verify the effectiveness of the different doses of the extract administered. Then, an oral glucose tolerance test (OGTT) was carried out in induced diabetes rats MACAPOS 1 after 4 weeks of treatment as described previously for normal rats. Otherwise, the second sub-group were

sacrificed and dissected, the visceral adipose, hepatic, cardiac and testicular tissues removed were weighed.

Statistical analysis

The experiments for which data is reported in the table and figures were carried out in triplicate or more replicate determinations. All data were expressed as mean ± standard deviation and were statistically analyzed using one-way analysis of variance (ANOVA). When statistical differences were found, the Duncan's Multiple Range Test was applied in order to classify samples at the significance level of 5%. The Statgraphics Program (Statically Graphics Educational, version 6.0, 1992, Manugistics, Inc. and Statistical Graphics Corp., USA) was used for the statistical analysis.

RESULTS

Hypoglycaemic effect of aqueous extract of *C. thomsoniae* on normoglycaemic rats

The effect of AECT on blood glucose levels in fasting normal rats is presented in Figure 1. A single administration of AECT at all the doses (of 625 and 1250 mg/kg exhibited a significant hypoglycaemic effect after 2 hours ($p < 0.05$). The extract at 1250 mg/kg produced the most significant reduction (29.1 %) ($p < 0.05$) of treatment which was comparable to the effect of the two others doses (15.5 %, 21.8 % respectively) 90 min after administration. Consequently, blood sugar tends to stabilize until the 120th minute when there has been no significant change compared to the 90th minute regardless

Acute Effects of AECT on Glucose-Induced Hyperglycemia in normal rats

Blood glucose levels returned to baseline or even lower 2 hour after glucose administration in all animals. Animals treated with glibenclamide and AECT showed marked decreases in blood glucose level 2 hours after glucose administration as shown in figure 2. In particular, the rats given glibenclamide and AECT at 1250 mg/kg dose showed significant reductions in blood glucose level 30 min after glucose administration compared with the normal control rats. In the acute test, the glucose load increased blood sugar in the normal control group. The basal glucose in rats in this group fell from 85.8 ± 2 to 149.6 ± 1.43 mg / dL at 30 min after glucose administration and returned to 111.0 ± 1.1 mg / dL after 150 min. Glibenclamide significantly prevented the rise in blood glucose throughout the experiment followed by AECT at dose of 1250 mg / kg.

Oral glucose tolerance test at the end of induction of type 2 diabetes

The oral glucose tolerance test was used to confirm the onset of diabetes. Figure 3 shows the glycemic response of our sweetened high-calorie rats compared to normal rats. Administration of glucose 2.5 g / 100 mL in normal rats results in an increase in blood sugar at 60 min (122.50 mg / dL), then a decrease within 120 min to an identical value (72.33 ± 2.80 md / dL) at baseline blood sugar. in sweetened high-calorie diet rats, the glycemia increases significantly ($P < 0.05$) according to a linear relationship of 130 ± 2 to 148 ± 2 mg / dL, passing by a value of 137.33 mg / dL at 60 min. This high blood sugar value and the subsequent increase in glucose overload means that we will consider

Diabetes treatment

Effect of C. thomsoniae extract on fasting glucose in type 2 diabetic rats

The table presents the effect of AECT on each period of 15 days measured blood glucose levels of normal and type 2 induced diabetic rats during the experimental period of 30 days. The administration of Sweetened high-calorie diet (MACAPOS 1) caused a sharp increase in the blood glucose levels in induced rats compared with those of normal controls. However, treatment during 30 days with AECT at the three selected dose levels resulted in a marked decrease in blood glucose. For the diabetics' rats receiving placebo glycemia remained very high compared to the normal control (128±2,6 vs 74,2±1,92 mg/dL). The glycemia of test groups receiving AECT decreased whatever the dose (-22.14±1.67 %; - 24.73±1.1 %; -

43.90±1.73 % and -44.9±1.35 %) respectively for AECT312.5, AECT625, AECT1250 and metformin. These reductions were significant (P< 0.05) compared to the negative control. The decrease was more pronounced with AECT1250 and glycemia became comparable to normal control group the 30th day (73,5±0,7 and 74,2±1,9 mg/dL respectively). No significant (P< 0.05) different was observed between normal control, positive control and AECT1250 at the end of treatment.

The Effects of aqueous extract of C. thomsoniae on gain in body mass, water intake, food intake and glycemia parameters in induced type 2 diabetic rats

The Effects of aqueous extract of *C. thomsoniae* on change in body mass, water intake, food intake parameters on induced type 2 diabetic rats are summarized in the TABLE. During the experimental period 30 days, the body mass of diabetic rats treated with metformin (PC) and those treated with the extract whatever the dose gradually decreased. The statistical study at the end of the treatment also shows a significant reduction (p<0,05). This drop-in body mass is much more observed with the extract at the dose 1250 mg / kg and metformin (respectively -16.07 ± 10.00 g and -18.39 ± 4.74 g). It has been also observed a significant reduction in food intake and water intake during the treatment whatever the dose of AECT compared to the diabetic group (NC) (p<0.05) as showed in the table.

Assessment of abdominal fat at the end of treatment

The effects of AECT on abdominal fat are presented in figure 4 . It appears from this figure that the relative mass of abdominal fat decreased during treatment. Administration AECT reduce abdominal fat whatever the dose. But the most significant reduction was observed with AECT at 1250 mg / kg. (64.52%) compared to Met.38mg/kg (59%).

DISCUSSION

Plants have always been the major source of drugs thanks to the richness of what is called secondary metabolism [20]. Herbal remedies have been used for centuries as a remedy for human disease because they contain components of therapeutic value [21]. In this vein, thousands of plants are traditionally used to treat diabetes mellitus and its complications, however to our knowledge, this is the first study to report on the hypoglycemic and antidiabetic of AECT *in vivo*.

The effect of the AECT on normoglycemic animals suggests that the leaves of *C. thomsoniae* has a mild lowering effect on normal glucose levels. This effect was comparable to that of glibenclamide, an insulin secretagogue, which also lowers blood glucose in normal animals. Provided the β-cells are fully functional, sulphonylureas, such as glibenclamide, can cause hypoglycemia since insulin release is initiated even when glucose concentrations are below the normal threshold for glucose stimulated insulin release (approximately 5 mmol/L or 90 mg/dl) [22]. The results of this study showed a dose-dependent hypoglycaemic activity of the aqueous extract of *C. thomsoniae*. Two hours after administration in normoglycemic rats. These results also suggest that water-soluble compounds with hypoglycemic effect are present in this extract. It has been established by many studies that the genus *Clerodendrum* is rich in total phenolic compounds, flavonoids, terpenoids, alkaloids, tannins, saponosides and anthraquinones [23,24]. Our previous studies have also confirmed that AECT contains these secondary metabolites [25]. As reported by Adeneye *et al.*[23] with aqueous extract of *Clerodendrum capitatum* we can suggest that secondary metabolites present in AECT are responsible of the lowering blood glucose level in dose dependant manner.

The OGTT measures the body's ability to utilize blood glucose. The AECT exhibited a dose-dependent effect on the glycemic status of rats. An OGTT study in normal rats and diabetic rats showed that administration of AECT reduced blood glucose levels significantly (p <0.05) as we also observed in rats treated with a standard drug, glibenclamide. In the normal rats, administration of AECT at 312.5 mg/kg, 625 mg/kg and 1250 mg/kg doses

significantly ($p < 0.05$) reduced blood glucose levels within 1 to 2 hours. This antihyperglycemic activity of the aqueous extract suggests that *C. thomsoniae* extract contains compounds with a mechanism of action similar to that of glibenclamide. It can therefore be compared to an insulin-secreting agent which stimulates the beta cells of the Langerhan islets of the pancreas for insulin production.

According to Arumugam *et al.*[26], antihyperglycemic effects resulting from treatment with plants are generally attributed to their ability to improve the performance of pancreatic tissue, which is done by increasing insulin secretions or reducing intestinal absorption of glucose. In the case of AECT, in addition to the flavonoids, the presence of tannins and saponins which have an antihyperglycemic effect was noted[25]. The antihyperglycemic activity of the aqueous extract of *C. thomsoniae* could be explained by the presence of these compounds.

Type 2 diabetic rats treated with 1250 mg/kg AECT showed significantly ($p < 0.05$) reduction of blood glucose levels during the two-last week of 30 days of treatment. The hypoglycemic activity of AECT might be the result of an improved insulin level, which is observed in the AECT-treated rats. This suppression of hyperglycemia may result from the inhibition of α-glucosidase and α-amylase enzymes by phenolic compounds of AECT as reported by [27]. for polyphenol rich extract of *Garcinia pedunculata* fruit.

In the present study, we found a relative stability in blood glucose in the diabetic control group which may be due to the insulin resistance very often encountered in obese or type 2 diabetes [28]. However, oral administration of AECT showed significant improvement in blood glucose levels. Our findings indicate that the 1250 mg/kg AECT dose significantly ($p < 0.05$) reduced blood glucose within the third and fourth week of the experiment. This finding strongly supports the antidiabetic effects of AECT. The antidiabetic role of AECT may result from insulin-like action such as improving the uptake of cellular glucose or enhancing glycogenolysis. Both insulin deficiency and resistance are responsible for the pathogenesis of diabetes mellitus (DM). Hence, increasing insulin secretion and maintain its level within the normal physiological range are very important for antidiabetic therapy. In this study, hyperglycemia provoked by the combined effect of MACAPOS 1 type diet and dexamethasone was associated with food intake, water intake body mass increase after 10 weeks. Our results are in accordance with the one of [29]. Glucocorticoids are known to have particularly significant metabolic side effects on carbohydrate metabolism [30]. The insulin resistance responsible for chronic hyperglycemia results from the action of dexamethasone (exogenous glucocorticoid) which increases the production of glucose by the liver from amino acids and glycerol (neoglucogenesis) and promotes the redistribution or differentiation of adipocytes into stimulating lipolysis [31]. Dexamethasone also promotes insulin resistance by inhibiting the secretion and expression of the adiponectin gene (a hormone produced by adipose tissue and involved in the regulation of carbohydrate and lipid metabolism) insulin-sensitizing and by causing dysfunction of this hormone receptor [32] This could explain the insulin resistance caused by dexamethasone in the target tissues (liver, muscle and adipose tissue) of insulin [33]. However, like metformin, AECT significantly decreases ($p < 0.05$) blood sugar levels of diabetic rats to normal value with a maximum decrease on rats treated with AECT 1250 mg/kg dose with no significant difference ($p < 0.05$) with those treated with metformin. This result suggested that, like metformin, extracts might not only decrease hepatic glucose production, and ameliorate the peripheral insulin sensitivity, but could also act by many other means than metformin [34]. This indicates that phytochemicals present in AECT might also have effects on both insulin secretion and insulin action. In fact, flavonoids work by improving the sensitivity of cells in the body to insulin, which can reduce the incidence of type 2 diabetes [35,36].

Concerning abdominal fat, AECT reduce the quantity in a dose-dependant manner with the highest reduction of quantity at 1250 mg/kg of AECT compared to the group of rats treated with metformin. In the normal state, insulin activates the lipolytic actions of the hormones on the peripheral fat depots, hydrolyzing triglycerides and preventing mobilization of free fatty acids [37,38]. In the diabetic state, lipoprotein lipase, which hydrolyzes triglycerides, does not function properly due to the shortage of insulin. In this experimental study, type 2 diabetic rats- showed significantly elevated quantity of abdominal fat. In contrast, treatment with AECT significantly decreased the quantity of fat in the diabetic animals. Sarma *et al*.[27] reported a similar hypolipidemic potential of polyphenol-rich *Garcinia pedunculata* extract in high-fat diet (HFD) rats. Moreover, our previous studies [25] established the lipid-lowering nature of AECT in dyslipidemic rats, thanks to the bioactive compounds it contains. In summary, the aqueous extract of *C. thomsoniae* appears to possess insulin-stimulating activity, which would be useful in reducing the incidence of fat-related complications. According to Cryer [39] the decrease in fluid intake observed in rats treated with the extract and those with metformin could be linked to the restoration of blood glucose homeostasis. Indeed, the drop-in blood sugar results in a decrease in the osmolarity of the blood which is accompanied by a reduction in need for water and consequently, a decrease in fluid intake.

CONCLUSION

On the basis of the current investigation, it could be concluded that aqueous extract of the leaves of *C. thomsoniae* possess hypoglycaemic and antidiabetic properties, in both normal animals and in diabetic animals. This present review gives an overview on anti-hyperglycaemic effects of the aqueous extract of *C. thomsoniae*. Previous phytochemical screening revealed the phenolic content of *C. thomsoniae* that can justify the *in vitro* antioxidant potency already demonstrated in the literature. The hypoglycaemic and antidiabetic effects of the plant extract could be due to the presence of flavonoids, saponins, alkaloids, tannins, and other compounds. To establish the actual antidiabetic principle(s) however, the putative compound(s) have to be isolated and evaluated. It is therefore, suggested that further purification steps would be necessary to isolate and further evaluate the antidiabetic principles of the plant on animal models. It would be more interesting to study the toxicity of the extract in order to guarantee the safety of its use.

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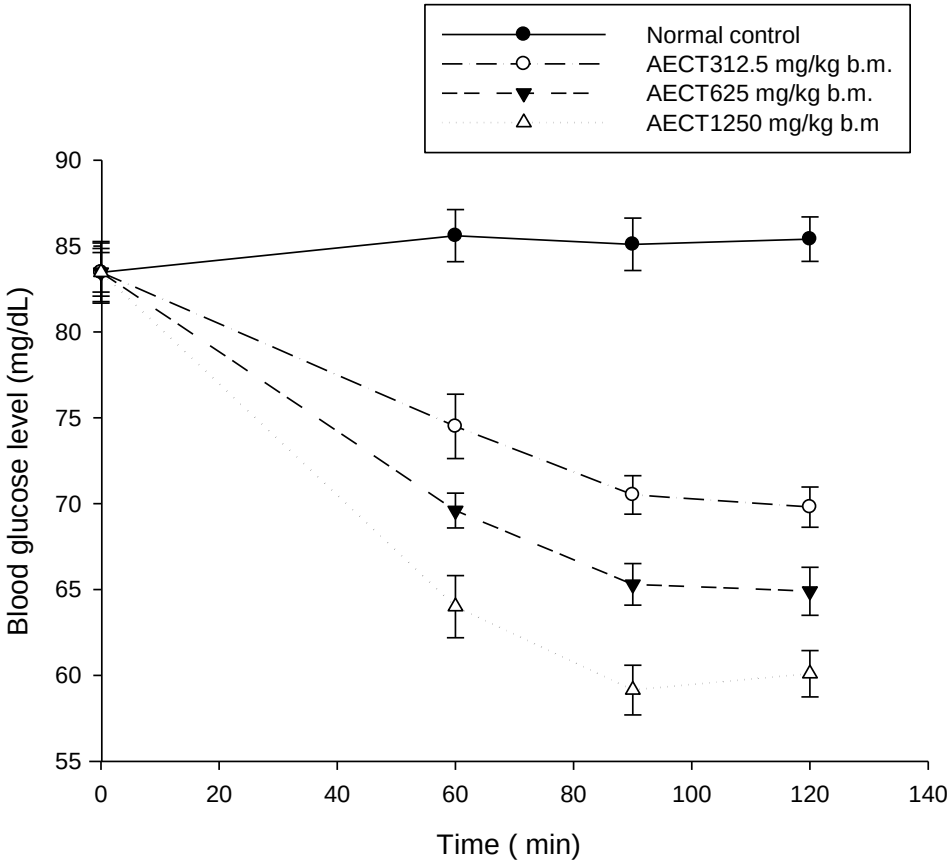
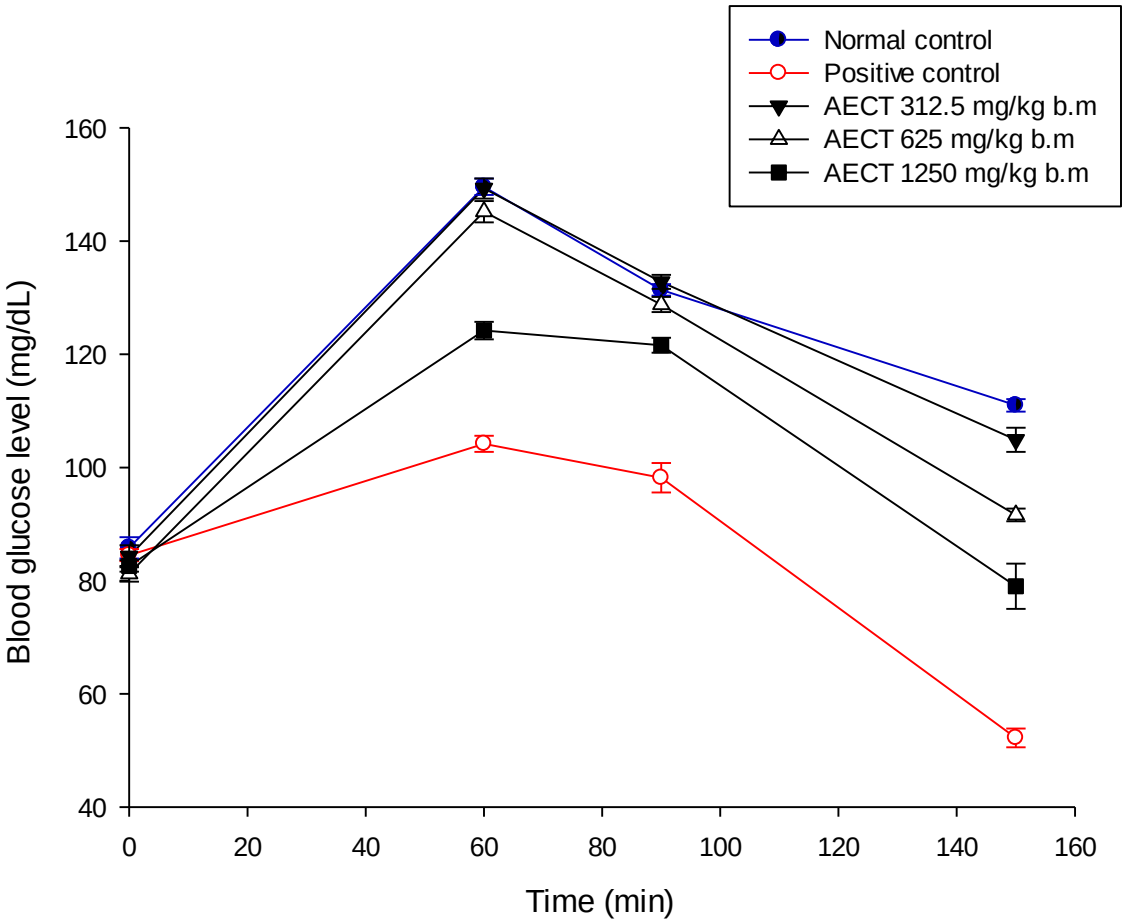


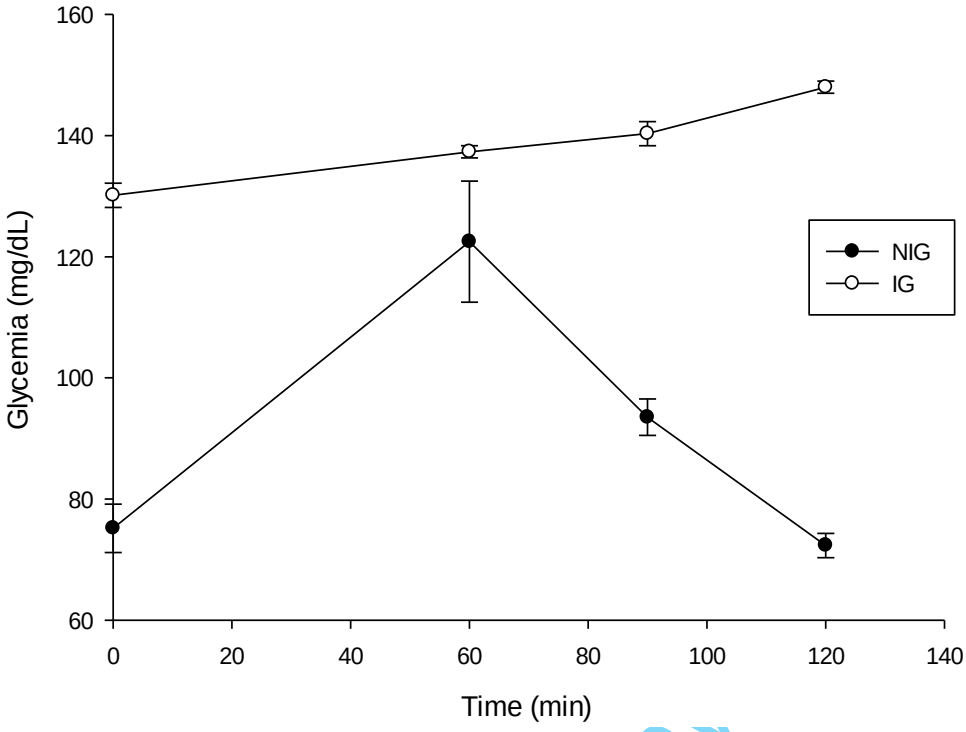
Value are means ±SD (n=5) significantly different ($p < 0.05$) as determined by Duncan's multiple range test.Normal: group of normal rats received distilled water; AECT312.5: group of rats receiving*C. thomsoniae extract* at dose of 312.5 mg/kg; AECT625: group of rats receiving*C. thomsoniae extract* at dose of 625 mg/kg; AECT1250: group of rats receiving*C. thomsoniae extract* at dose of 1250 mg/kg. b.m= body mass.

Figure 1: Effect of the aqueous extract of *C. thomsoniae* on blood glucose of normoglycemic rats



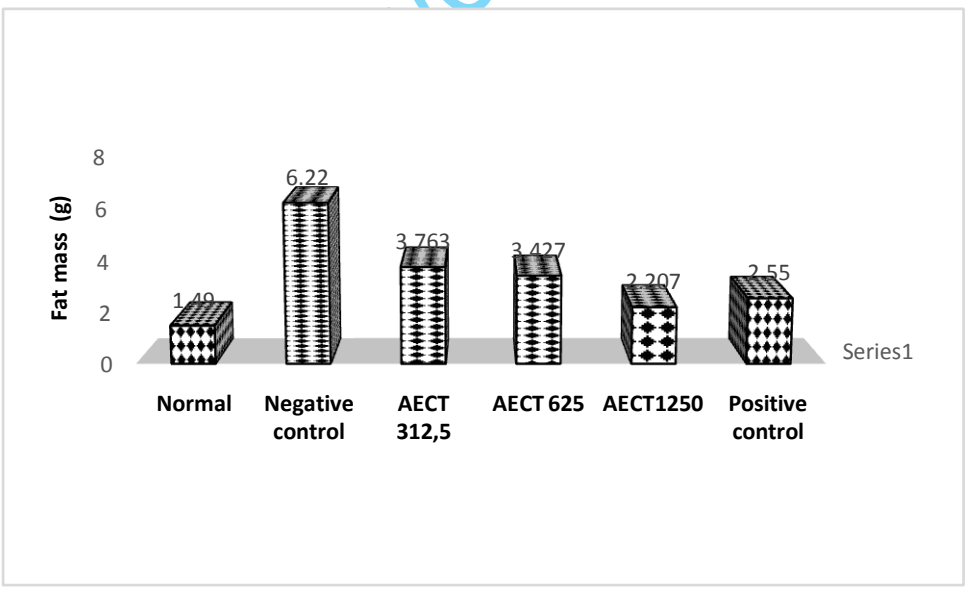
Value are means ±SD (n=5) significantly different ($p< 0.05$) as determined by Duncan's multiple range test. Normal control: group of normal rats received distilled water; AECT312.5: group of rats received *C. thomsoniae extract* at dose of 312.5 mg/kg; AECT625: group of rats received *C. thomsoniae extract* at dose of 625 mg/kg; AECT1250: group of rats received *C. thomsoniae extract* at dose of 1250 mg/kg. Positive control: Group of rats received glibenclamid. AECT=Aqueous extract of *Clerodendrum thomsoniae*. b.m = body mass

Figure 2: Effect of the aqueous extract of *C. thomsoniae* on oral glucose overload



NIG: Non-Induced Group; IG: Induced Group; min: minute; The means are significantly different (P <0.05); Values were expressed as mean ± standard deviation; n = 5.

Figure3: Change in blood sugar after an oral overload of a glucose solution at the end of induction period (4g / kg b.m).



AECT312.5: group of rats received *C. thomsoniae extract* at dose of 312.5 mg/kg; AECT625: group of rats received *C. thomsoniae extract* at dose of 625 mg/kg; AECT1250: group of rats received *C. thomsoniae extract* at dose of 1250 mg/kg. PC=Positive control: Group of rats received metformin. AECT=Aqueous extract of *Clerodendrum thomsoniae* N.C: Negative control;

Figure4: Evolution of abdominal fat mass during treatment

TABLE: Parameters measured during treatment

Parameters	Water intake			Food intake			Changes in body mass			Glycemia		
	D0	D15	D30	D0	D15	D30	D0	D15	D30	D0	D15	D30
Normal	136±0,71^{a}	129,28±0,84^{b}	129,71±1,92^{b}	91,74±0,71^{a}	78,51±0,84^{b}	77,93±1,92^{b}	212,2±10,9^{a}	222,5±8,8^{e}	226,6±1,4^{ac}	75,00±0,71^{a}	74,8±0,84^{a}	74,2±1,92^{a}
NC	264±1,22^{a}	255,8±3,97^{b}	255±2,61^{b}	135,96±1,22^{a}	124±3,97^{b}	123,00±2,61^{b}	261,8±11,1^{ab}	255,9±4,4^{d}	249,3±3,6^{b}	131±1,22^{b}	131,00±3,97^{b}	128±2,61^{b}
PC	262±1,67^{a}	136,28±1,14^{ab}	131,85±0,89^{ac}	135,88±1,67^{a}	76,93±1,14^{b}	75,32±0,89^{b}	257,2±15,1^{ab}	233,7±8,3^{b}	219,3±6,7^{a}	131±1,67^{b}	121,00±1,14^{ab}	70,2±0,89^{a}
AECT312.5	269±1,14^{a}	135,71±0,84^{b}	130,57±0,55^{c}	136,87±1,14^{a}	73,36±0,84^{b}	74,29±0,55^{b}	262,9±10,4^{ab}	240,1±5,8^{ac}	236,4±3,9^{bc}	131,00±1,14^{b}	126,4±0,84^{c}	102,4±0,55^{bc}
AECT625	260±1,30^{a}	137,57±1,00^{b}	132,28±1,14^{c}	135,83±1,30^{a}	74,85±1,00^{b}	75,26±1,14^{b}	260,1±13,6^{ab}	244,8±7,5^{bc}	231,7±2,4^{c}	131,00±1,3^{b}	125,4±1^{ab}	98,6±1,11^{d}
AECT1250	260±1,14^{a}	135,71±0,84^{ab}	130,85±0,71^{b}	135,9±1,14^{a}	76,09±0,84^{b}	74,59±0,71^{c}	260,2±12,8^{ab}	239,9±8,6^{ac}	221,8±5,1^{ac}	131,00±1,14^{b}	123,8±0,84^{ab}	73,5±0,71^{a}

The values entered in the table are means ± standard deviation, with a sample number of "n = 5. The means with different letters are significantly different (P <0.05). AECT: aqueous extract of *Clerodendrum thomsoniae (*1250mg/kg m.c; 625mg/kg m.c; 312mg/kg b.m) N.C: Negative Control (subjected to a Normal Diet + Distilled Water during treatment); P.C: Positive control subjected to a Normal Diet + metformin.