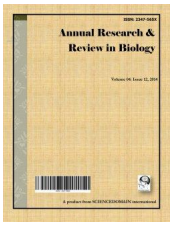

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Evaluation of Anti-Obesity Potentials of *Sphenostylis stenocarpa* Ethanolic Seed Extract

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Authors' contributions

This work was carried out in collaboration between all authors. Authors VCE and EFO provided all used materials. Authors VCE, EFO, EIN and BCI designed this research. Authors EFO, BCN and EIN were responsible for drug administration, feeding and taking care of the experimental animals. Author VCE, EFO and EIN were responsible for the statistical analysis. Finally, authors EFO and EIN drafted the manuscript while authors VCE and EIN proof read and corrected. All authors read and approved the final manuscript.

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ABSTRACT

Aim: Evaluation of the anti-obesity potentials of *Sphenostylis stenocarpa* ethanolic seed extract in albino rats.
Study Design: Experimental design.
Place and Duration of the Study: Department of Zoology and Environmental Biology, University of Nigeria, Nsukka, Nigeria, from October to December, 2017.
Methodology: The rats were assigned into 6 groups (A- F) of 12 rats per group replicated three times. Obesity was induced in rats of groups B to F, by daily feeding with high fat diet for 5 weeks. Only rats with an abdominal circumference (AC) of 20 cm, thoracic circumference (TC) of 17 cm and

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body mass index (BMI) of 0.68 g/cm^2 and above respectively were considered obese and used for the study. The extract obtained by standard methods was screened phytochemically. Whereas the rats in the normal control (group A) received normal growers mash diet and distilled water, the obese negative control (group B) received the high fat diet and distilled water only, while the positive control (group C) received high fat diet, distilled water and 60 mg/kg b.wt of Orlistat. Graded doses of 200, 400 and 600 mg/kg b.wt of the extract were administered to groups D, E and F respectively.
Results: Evidently, 400 mg/kg of *Sphenostylis stenocarpa* treatment proved to be the most effective dose in all parameters assayed. The treatments proved to be more effective when compared with the negative control than as compared with the positive control.
Conclusion: The ethanolic seed extract of *Sphenostylis stenocarpa* proved to possess some anti-obesity potentiality which evidently seems to be most effective with longer duration of treatment.

Keywords: Anthropometrical; obesity; high fat diet; ethanolic seed extract; Sphenostylis stenocarpa.

1. INTRODUCTION

Obesity is an abnormal fat accumulation that may have adverse effects on the health and well-being of an individual [1]. This occurs when energy intake surpasses energy expenditure in an individual hence the storage of energy as adipose tissues [2]. Obesity involves both or either, an increase in the number of adipocytes (hyperplasia) and their size (hypertrophy) [3]. A person is considered obese when his or her weight is 20% or more above normal weight. The most common measure of obesity is the body mass index (BMI). A person with BMI between 25 and 29.9 is considered overweight and obese at a BMI ≥ 30 [4].

Obesity is a disease state and a risk factor for many chronic disease conditions. It reduces life expectancy, increases the risk of coronary heart disease, stroke and gout [5]. It strongly predicts increased risk of type 2 diabetes, insulin resistance, hypertension, dyslipidaemia, gall bladder disease and non-alcoholic fatty liver disease [6]. It is considered as a major leading cause of unnecessary deaths and in spite of the number of studies to prevent or treat obesity, its prevalence continues to increase with an estimated 400 million obese and 1.6 billion overweight adults around the world [7].

Evaluating overweight and obesity in organisms is usually based on the measurement of morphometric indicators (abdominal circumference, thoracic circumference, body weight, weight gain and BMI) as well as serum biochemical and hormonal profiles [8].

Different approaches such as dietary control, physical exercise and medications have been employed in the attempt to prevent or control overweight and obesity. At present, only five medications are approved by the Food and Drug Administration (FDA) in USA for the treatment of obesity, namely phentermine, diethylpropion, phendimetrazine, orlistat and lorcaserin [9]. Many of these drugs showed relative lack of efficacy, with most patients achieving only 5 - 10% weight loss over a one-year period of medication. This is further complicated by severe cardiovascular and/or neurological side effects, which have largely limited their use to short term therapy, as highlighted by the dramatic approval and withdrawal of sibutramine, rimonabant and fenfluramine [9]. This anomaly underlines the urgent and intense medical interest in the search for alternative forms of obesity treatment. Therefore, there is a pressing need globally for alternatives with minimal or no side effect. This informed the current research effort to assess the anti-obesity potentials of S*phenostylis stenocarpa* ethanolic seed extract with particular reference to the anthropometrical parameters in albino rats.

2. MATERIALS AND METHODS

2.1 Procurement of *Sphenostylis stenocarpa,* Experimental Drug and Animals

The seeds of *Sphenostylis stenocarpa* were purchased from Nkwo Ibagwa Market in Igbo-Eze south local government area of Enugu State. Its identity was authenticated at the Taxonomy Unit, Department of Plant Science and Biotechnology, University of Nigeria, Nsukka. Seventy-two adult albino rats (*Rattus norvegicus*) were used for the study. The rats were purchased from the Genetics and Animal Breeding Laboratory, Department of Zoology and Environmental Biology, University of Nigeria, Nsukka. They were allowed free access to

commercial Growers' feed and water and were allowed to acclimatize for two weeks. Orlistat was purchased from Elofex Pharmaceutical shop in Nsukka, Enugu State. The ethical conditions governing the use and conduct of experiments with live animals were strictly observed and the experimental protocol was approved by the University of Nigeria, Nsukka Senate committee on Medical and Research ethics.

2.2 Preparation of Ethanolic Extract

Five kilograms of the dry *Sphenostylis stenocarpa* seed was pulverized with a commercial blender. One thousand five hundred grams of the powdered product was macerated in 2000 ml of ethanol for 24 hours. It was then filtered using Whatman No. 1 filter paper. The percentage yield was calculated by dividing the weight of concentrated extract with the weight of dried-ground seed and multiplied by 140. Thereafter, the extract was concentrated using a rotary evaporator at low temperature (30-40ºC). The concentrated extract was used to prepare a stock solution of 1,600 mg/kg with Tween 80. Thereafter, graded doses used for the experiment were calculated based on the body weight of the rats.

2.3 Phytochemical Analysis

The analyses of alkaloid, tannin and saponins constituents of the plants followed the methods of [10]. Similarly, steroid, flavonoid, soluble carbohydrate and hydrogen cyanide analyses followed the procedures employed [11].

2.4 Lethal Dose (LD_{50}) Determination

The lethal dose (LD_{50}) of *S. stenocarpa* was determined according to the method of [12]. A preliminary test using three graded doses of the extract (10, 100 and 1000 mg/kg) was performed. Each dose served as a group with three mice each with mean weight of 70g ± 7.64. No death was recorded after 24 hours. Thereafter, three higher doses (1600, 2900 and 5000 mg/kg of body weight) were administered to groups of two mice each. The mice were closely observed for 72 hours for any mortality nor delayed toxic effect. Their food consumption, behaviour and weight were also examined once daily up to three days.

2.5 Obesity Inducement

Obesity was induced in rats in groups 2 - 6 with high fat diet (HFD) (comprising of fat (46%), carbohydrates (24%), proteins (20.3%), fibre (5%), salt mixture (3.5%), and vitamin mixture (1%) as described by [13]. Obesity was confirmed in the animals after five weeks by the measurement of the anthropometrical parameters. Animals with abdominal circumference of 20 cm, thoracic circumference of 17cm and a body mass index (BMI) of about 0.68 g/cm^2, were selected as described by [14].

2.6 Experimental Design

A total of 72 adult albino rats was used for the experiment and were kept in rat cages with lid and bottom. The animals were divided into six groups (A - F) of 12 animals each with three replicates comprising of four rats each. Group A (normal control) received normal growers mash diet and distilled water, group B (obese, negative control) received high fat diet and distilled water, group C (positive control) received high fat diet, distilled water and 60 mg/kg of body weight of orlistat, while groups D, E and F received high fat diet, distilled water and graded doses of 200 mg/kg, 400 mg/kg and 600 mg/kg respectively of *Sphenostylis Stenocarpa* seed extract. All treatments were administered using plastic syringes attached to metal oropharyngeal cannula. The rats were differentially marked for easy identification. The animals were fed once daily while their water was changed anytime in the day when the need arose. Blood samples were collected from randomly sampled rats at each group on days 0, 7, 14, 21 and 28 following the method described by [15].

2.7 Determination of Morpometric Variables

The abdominal circumference (AC) (immediately anterior to the forelimb) was measured using a tape rule in all rats at weekly intervals [14]. Thoracic circumference (TC) (immediately behind the fore limb) was measured weekly intervals [14]. The body weight (g) was measured before the start of treatments and on sample collection days using Metler sensitive weighing balance. The rats were anaesthetized prior to all measurement by administering 0.1 ml 1% sodium barbiturate intraperitoneally. The body weight and body length were used to determine the body mass index (BMI) of animals using:

$$\text{Body mass index (BMI)} = \frac{\text{body weight(kg)}}{\text{lenght (m}^2\text{)}}$$ [14].

Specific weight gain (the ratio of the gain in body weight and the change in time) was determined at weekly intervals using:

Specific weight gain (g/kg) = dM / Mdt_1.

(dM represents the gain of body weight ($dT = t_2 - t_{1)}$ and Mdt_1 is the rats body weight at t_1; t_2 means final body weight; t_1 means initial body – before treatment).
[14].

2.8 Statistical Analysis

Data analysis was carried out with statistical package for social sciences SPSS, IBM Statistics UK version 16.0 one–way analysis of variance (ANOVA). The means were separated using Duncan's new multiple range test while differences in the means were considered significant at probability values less than 5 % ($P > 0.05$). The results were presented as mean ± SEM.

3. RESULTS

3.1 Qualitative and Quantitative Phytochemical Composition of Ethanolic Extract of *Sphenostylis stenocarpa* Seed

The phytochemical composition of the ethanolic extract of *Sphenostylis stenocarpa* seed showed a large proportion of flavonoids, alkaloids and moderate proportions of saponin and reducing sugar. Glycosides, tannin, steroids, hydrogen cyanide, reducing sugars were found in small amounts while soluble carbohydrates were absent (Table 1).

3.2 Effects of Ethanolic Extract of *Sphenostylis stenocarpa* Seed on the Abdominal Circumference (AC) (cm) of Obese Rats

The comparative effects of graded doses (200, 400 & 600 mg/kg) of *Sphenostylis stenocarpa* and the three controls on AC of the rats were shown in Table 2. The dose-dependent analyses showed that, AC of 200 mg/kg, 400 mg/kg and 600 mg/kg treatment groups were significantly higher ($P < 0.05$) than the AC of normal control in all the weeks. There was no significant difference in all treatments as compared with negative and positive controls at week 0. At week 1, the activities of *S. stenocarpa* at dose 400 mg/kg caused a non-significant decrease ($P > 0.05$) in AC of the obese rats compared with the negative and positive control groups while AC of 200 mg/kg and 600 mg/kg treatment group had no significant decrease ($P > 0.05$) as compared with the negative and positive control groups. At week 2, whereas a significant decrease ($P < 0.05$) occurred at treatments 200 mg/kg and 400 mg/kg as compared with the negative control, there was no significant difference in all experimental groups as compared with the positive control. At Week 3, a significant decrease ($P < 0.05$) occurred in AC at all experimental groups as compared with negative control. Whereas treatments 400 and 600 mg/kg had a non-significant ($P > 0.05$) effect, 200 mg/kg treatment increased AC significantly compared with positive control. At week 4, a significant decrease ($P < 0.05$) occurred in AC at all experimental groups as compared with negative control. Whereas treatments 400 mg/kg had a non-significant ($P > 0.05$) decrease, 200 and 600 mg/kg treatment increased AC significantly compared with positive control. There was no significant ($p > 0.05$) time dependent effect in all treatments as compared with the control groups.

3.3 Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on the thoracic circumference (TC) (cm) of obese rats

The comparative effects of graded doses (200, 400 & 600 mg/kg) of *Sphenostylis stenocarpa* and the three controls on TC the rats were shown in Table 3. The dose-dependent analysis showed that, TC of 200 mg/kg, 400 mg/kg and 600 mg/kg treatment group were significantly higher ($P < 0.05$) than the AC of normal control in all the weeks. There was no significant difference in all treatments as compared with negative and positive controls at week 0. In weeks 1 and 2, whereas there was a significant decrease ($p < 0.05$) in TC in all treatments compared with negative control, there was no significant difference ($p > 0.05$) in all treatments as compared with positive control. At week 3, a significant decrease ($p < 0.05$) occurred in all treatments compared with negative control, 200 and 400 mg/kg treatments increased significantly while 600 mg/kg *S. stenocarpa* caused no significant difference as compared with positive control. A similar trend occurred at week 4, whereas a significant decrease ($p < 0.05$) occurred in all treatments compared with negative control, a significant increase was observed in all treatments as compared with positive control. There was no significant ($p > 0.05$) time dependent effect in all treatments as compared with the control groups.

3.4 Effects of Ethanolic Extract of *Sphenostylis stenocarpa* Seed on the Body Weights (BWT) (g) of Obese Rats

The comparative effects of graded doses (200, 400 & 600 mg/kg) of *Sphenostylis stenocarpa* and the three controls on body weights of the rats were shown in Table 3. There was no significant ($p > 0.05$) time dependent effect in all treatments as compared with the control groups. The dose-dependent analysis showed that, BWT of 200 mg/kg, 400 mg/kg and 600 mg/kg treatment group were significantly higher ($P < 0.05$) than the BWT of normal control in all the weeks. A similar trend was observed at weeks 0, 1 and 2. There was no significant difference in all treatments as compared with negative and positive controls except at 400 mg/kg rats where a significant decrease ($p < 0.05$) occurred. At week 3, whereas an observed significant decrease ($p < 0.05$) occurred in all treatments as compared with negative control, there was no significant difference ($p > 0.05$) among treatments compared with the positive control. Week 4 recorded a significant decrease ($p < 0.05$) among treatments compared with negative control, another significant decrease ($p < 0.05$) in 400 and 600 mg/kg *S. stenocarpa* treatment compared with positive control and a non-significant difference ($P > 0.05$) at 200 mg/kg treatment.

3.5 Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on body mass index (BMI) (g/cm^2) of obese rats

The comparative effects of graded doses (200, 400 & 600 mg/kg) of *Sphenostylis stenocarpa* and the three controls on BMI of the rats were shown in Table 3. There was no significant ($p > 0.05$) time dependent effect in all treatments as compared with the control groups from week 0 to 4. The dose-dependent analysis showed that, BMI of 200 mg/kg, 400 mg/kg and 600 mg/kg treatment group were significantly higher ($P < 0.05$) than the BMI of normal control in all the weeks. There was no significant difference in all treatments as compared with negative and positive controls at week 0. A similar trend was observed in all treatments at weeks 1, 2, 3 and 4. The activities of *S. stenocarpa* caused a significant decrease ($p > 0.05$) in BMI at treatments as compared with negative control except at week 2 where 200 mg/kg and 600 mg/kg increased significantly ($p > 0.05$) while 400 mg/kg decreased significantly ($p < 0.05$). Additionally, treatments 200 mg/kg and 600 mg/kg showed no significant difference ($p > 0.05$) while 400 mg/kg caused a significant decrease ($p < 0.05$) as compared with positive control.

3.6 Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on the specific weight gain (SWG) (g) of obese rats

The comparative effects of graded doses (200, 400 & 600 mg/kg) of *Sphenostylis stenocarpa* and the three controls on SWG of the rats were shown in Table 3. There was no significant ($p > 0.05$) time dependent effect in all treatments as compared with the control groups from week 0 to 4. The dose- dependent analysis showed that, SWG of 200 mg/kg, 400 mg/kg and 600 mg/kg treatment group were significantly higher ($P > 0.05$) than the SWG of normal control except at week 0 where a significant increase ($p < 0.05$) occurred at the treatment groups and week 1 a significant decrease ($p < 0.05$) occurred. There was no significant difference ($p > 0.05$) in

Table 1. Qualitative and quantitative phytochemical compositions of ethanolic extract of *Sphenostylis stenocarpa* seed

Parameter	Quality	Quantity (mg/100 g)
Flavonoid	+++	10.86 ± 0.0032
Alkaloid	+++	36.00 ± 0.0025
Saponin	++	12.92 ± 0.0036
Tannin	+	8.28 ± 0.0035
Hydrogen cyanide	+	4.66 ± 0.0038
Reducing sugar	+	3.92 ± 0.0045
Soluble Carbohydrate	-	Nil
Glycoside	+	0.005 ± 0.0045
Steroid	+	1.292 ± 0.0025

+++ = present in large amount; ++ = Moderately Present; + = Present in small amount; - = absent

Table 2. Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on the abdominal circumference (AC) (cm) of obese rats

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
Normal Control	8.67 ± 0.22^{a2}	8.67 ± 0.21^{a1}	8.67 ± 0.21^{a2}	8.67 ± 0.33^{a2}	8.67 ± 0.21^{a2}
Negative Control	20.50 ± 0.22^{b2}	19.17 ± 0.30^{b1}	20.00 ± 0.26^{d2}	20.50 ± 0.22^{d2}	21.60 ± 0.46^{d2}
Positive Control	20.67 ± 0.21^{b4}	19.00 ± 0.37^{b3}	18.17 ± 0.17^{bc2}	16.67 ± 0.33^{b1}	15.67 ± 0.83^{b1}
200 mg/Kg b.wt	20.67 ± 0.49^{b2}	19.33 ± 0.49^{b1}	18.33 ± 0.42^{bc1}	18.00 ± 0.37^{c1}	16.67 ± 0.33^{c1}
400 mg/Kg b.wt	20.17 ± 0.17^{b2}	18.50 ± 0.56^{b1}	17.67 ± 0.33^{b1}	17.50 ± 0.34^{bc1}	14.33 ± 0.32^{b1}
600 mg/Kg b.wt	21.17 ± 0.60^{b3}	19.67 ± 0.67^{b23}	19.00 ± 0.68^{cd12}	17.67 ± 0.42^{bc1}	16.00 ± 0.33^{c1}

Values with different alphabet superscript in a column are significantly different at $p < 0.05$
Values with different number superscript in a row are significantly different at $p < 0.05$

Table 3. Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on the thoracic circumference (TC) (cm) of obese rats

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
Normal Control	10.50 ± 0.22^{a1}	10.67 ± 0.21^{a1}	10.67 ± 0.33^{a1}	10.83 ± 0.31^{a1}	10.85 ± 0.21^{a1}
Negative Control	18.00 ± 0.45^{b1}	20.50 ± 0.56^{c1}	21.00 ± 0.36^{c2}	21.17 ± 0.31^{d2}	21.60 ± 0.46^{d2}
Positive Control	17.83 ± 0.40^{b3}	16.83 ± 0.31^{b2}	16.17 ± 0.17^{b12}	15.67 ± 0.21^{b1}	16.67 ± 0.33^{b2}
200 mg/Kg b.wt	18.33 ± 0.33^{b3}	17.67 ± 0.33^{b23}	17.00 ± 0.26^{b12}	16.67 ± 0.21^{c1}	14.33 ± 0.32^{c1}
400 mg/Kg b.wt	17.33 ± 0.42^{b1}	17.00 ± 0.37^{b1}	17.00 ± 0.37^{b1}	16.67 ± 0.42^{c1}	16.00 ± 0.33^{c1}
600 mg/Kg b.wt	18.17 ± 0.40^{b2}	17.50 ± 0.43^{b12}	17.00 ± 0.37^{b12}	16.33 ± 0.33^{bc1}	15.67 ± 0.83^{c1}

Values with different alphabet superscript in a column are significantly different at $p < 0.05$
Values with different number superscript in a row are significantly different at $p < 0.05$

Table 4. Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on the body weights (BWs) (g) of obese rats

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
Normal Control	156.07 ± 9.78^{a1}	159.70 ± 9.81^{a1}	162.27 ± 9.63^{a1}	164.85 ± 9.44^{a1}	166.72 ± 9.01^{a1}
Negative Control	404.13 ± 28.38^{c1}	414.82 ± 27.91^{c1}	420.25 ± 27.94^{c1}	423.08 ± 2.10^{d1}	424.18 ± 2.60^{d1}
Positive Control	388.57 ± 13.49^{c1}	376.83 ± 12.83^{c1}	367.02 ± 12.92^{bc1}	354.67 ± 12.80^{bc1}	350.67 ± 13.00^{c1}
200 mg/Kg b.wt	385.77 ± 21.95^{c1}	382.67 ± 22.24^{c1}	361.17 ± 29.99^{bc1}	357.88 ± 24.13^{c1}	355.88 ± 9.60^{c1}
400 mg/Kg b.wt	328.10 ± 16.77^{b1}	319.27 ± 17.58^{b1}	315.05 ± 18.69^{b1}	294.93 ± 23.09^{b1}	290.62 ± 23.09^{b1}
600 mg/Kg b.wt	373.20 ± 15.21^{bc1}	363.87 ± 13.30^{bc1}	357.43 ± 15.22^{bc1}	348.93 ± 15.45^{bc1}	348.93 ± 9.67^{b1}

Values with different alphabet superscript in a column are significantly different at $p < 0.05$
Values with different number superscript in a row are significantly different at $p < 0.05$

Table 5. Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on body mass index (BMI) (g/cm^2) of obese rats

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
Normal Control	0.63 ± 0.05^{a1}	0.61 ± 0.06^{a1}	0.63 ± 0.06^{a1}	0.61 ± 0.05^{a1}	0.63 ± 0.02^{a1}
Negative Control	1.51 ± 0.06^{c1}	1.55 ± 0.06^{d1}	1.54 ± 0.07^{b1}	1.57 ± 0.07^{d1}	1.57 ± 0.06^{d1}
Positive Control	1.29 ± 0.04^{b2}	1.21 ± 0.04^{c2}	1.16 ± 0.05^{c2}	0.99 ± 0.06^{c1}	0.76 ± 0.01^{c1}
200 mg/Kg b.wt	1.43 ± 0.10^{bc2}	1.35 ± 0.13^{c2}	1.17 ± 0.07^{c12}	0.95 ± 0.08^{bc1}	0.90 ± 0.05^{c1}
400 mg/Kg b.wt	1.29 ± 0.06^{b2}	0.95 ± 0.04^{b1}	0.90 ± 0.05^{b1}	0.80 ± 0.05^{b1}	0.60 ± 0.03^{a1}
600 mg/Kg b.wt	1.38 ± 0.07^{bc2}	1.24 ± 0.07^{c2}	1.17 ± 0.05^{c1}	1.07 ± 0.04^{c1}	0.80 ± 0.03^{c1}

Values with different alphabet superscript in a column are significantly different at $p < 0.05$
Values with different number superscript in a row are significantly different at $p < 0.05$

Table 6. Effects of ethanolic extract of *Sphenostylis stenocarpa* seed on the specific weight gain (SWG) (g) of obese rats

Parameter	Week 0	Week 1	Week 2	Week 3	Week 4
Normal Control	0.86 ± 0.11^{a2}	0.02 ± 0.01^{c1}	0.02 ± 0.01^{a1}	0.02 ± 0.01^{a1}	0.02 ± 0.01^{a1}
Negative Control	3.69 ± 0.36^{b2}	0.03 ± 0.07^{c1}	0.01 ± 0.00^{a1}	0.02 ± 0.00^{a1}	0.02 ± 0.05^{a1}
Positive Control	3.64 ± 0.20^{b2}	-0.03 ± 0.01^{a2}	-0.03 ± 0.01^{a2}	-0.04 ± 0.01^{a2}	-0.05 ± 0.05^{a1}
200 mg/Kg b.wt	3.45 ± 0.34^{b2}	-0.01 ± 0.04^{b1}	-0.01 ± 0.00^{a1}	-0.06 ± 0.02^{a1}	-0.01 ± 0.02^{a1}
400 mg/Kg b.wt	2.91 ± 0.22^{b2}	-0.01 ± 0.06^{b1}	-0.66 ± 0.65^{a1}	-0.06 ± 0.05^{a1}	-0.66 ± 0.30^{a1}
600 mg/Kg b.wt	3.36 ± 0.16^{b2}	-0.02 ± 0.01^{ab1}	-0.01 ± 0.01^{a1}	-0.02 ± 0.00^{a1}	-0.02 ± 0.00^{a1}

Values with different alphabet superscript in a column are significantly different at $p < 0.05$
Values with different number superscript in a row are significantly different at $p < 0.05$

all treatments as compared with negative and positive controls at week 0. Whereas weeks 2 to 4 recorded no significant difference ($p > 0.05$) in all treatments compared with controls, week 1 recorded significant decrease ($p < 0.05$) in all treatments compared with negative control, significant increase ($p < 0.05$) at 200 and 400 mg/kg treatment then a non-significant difference ($p < 0.05$) at 600 m/kg treatment as compared with positive control.

4. DISCUSSION

The phytochemical analyses of *Sphenostylis stenocarpa* ethanolic seed extracts showed that flavonoid and alkaloids among others were present and in different quantities. These secondary metabolites were reported to be bioactive anti-obesity agents [16].

The thoracic and body circumferences were among parameters used to identify obese rats among the high fat diet fed rats used for this assay. Obviously as displayed at tables 2 & 3, 200 and 400 mg/kg treatments of the extract used proved to be more effective in reducing the increased thoracic and body circumferences observed among the high fat diet fed rats. However, past researchers suggested that TC and BC are not good enough to serve as markers of obesity in rats [14]. We therefore report that the TC/BC increase could be as a result of fat deposited due to variation between the energy intake and energy expenditure in the obese rats.

Relatedly, 400 mg/kg treatment of *S. Stenocarpa* ethanolic extract was most effective in reducing the body weight, body mass index and specific weight gain of the obese rats (Tables 4, 5 & 6). This result is in consonant with [17,14] concluded after researching on "Anthropometrical Parameters and Markers of Obesity in Rats" that body mass index showed the effectiveness of serving as a threshold in dictating an abnormal increase in body weight / obesity in rats. In view of the above findings, we therefore report that 400 mg/kg treatment of *S. Stenocarpa* ethanolic extract proved to possess the potential of reversing obesity in rats as seen in Table 5 week 4 (0.60 ± 0.03^{a1}).

5. CONCLUSION

Conclusively, the ethanolic seed extract of *Sphenostylis stenocarpa* seems *to* possess some anti-obesity potentiality which effect may become very evident with longer duration of treatment.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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