

Effects of Aqueous Extract of Pentaclethra Macrophylla Leaves on Blood Pressure and Oxidative Stress in Albino Wistar Rats

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ABSTRACT

This study investigated the effect of aqueous extract of *pentaclethramacrophylla* leave on blood pressure in Albino wistar rats. This research was carried out using twenty (20) Albino wistar rats weighing between 80g and 120g, divided into four groups; group (1) served as the control group and was administered orally with normal chow and water *ad libitum*. Groups (2), (3), and (4) served as the test groups, with oral administration of the extract (20mg/kg) for group 2, (50mg/kg) for group 3, and (100mg/kg) for group 4, for four (4) weeks. Blood pressure parameters were taken at the end of each week. The result showed a significant decrease ($p < 0.05$) in systolic BP in groups 2 and 4, however group 3 demonstrated an insignificant decrease in the four weeks. Diastolic BP showed a significant decrease ($p < 0.05$) in group 2, 3, and 4 in week one, and two, but an insignificant decrease in week 3 and 4. In conclusion, the aqueous extract of *pentaclethramacrophylla* leave has a reducing effect on both Systolic and Diastolic blood pressure and no significant change in the Heart rate of albino wistar rat.

INTRODUCTION

Pentaclethramacrophylla is a large woody plant abundant in the rain forest areas of west and central Africa. It's origin in Nigeria is believed to be around 193 ; where it is found in the South Nigeria.[1]

In Nigeria, several trees which yield fruits of nutritional and medicinal importance have been identified within the forest and savannah regions. One such important but less known legume protein source is the African oil bean tree.

Pentaclethramacrophylla is one of the plants in Africa used in traditional herbal practice for the treatment of disorders of both domestic and wild animals and human diseases [2] *P. macrophylla* Benth: (Mimosaceae) is also known as the African oil bean tree. The plant is mostly found in the forests of Eastern, Western and Central Africa [3]. All the parts of the plant are used for various human ailments. The bark, fruits, seeds and the leaves are used as anthelmintics, for gonorrhoea, convulsion and as analgesic. Whole leaves are always given to domestic and wild animals and ruminants while the aqueous extract of the leaves is administered to man orally [2]. Antimicrobial property and the fixed oil extracted from the seeds is used in the preparation of formulation against pruritus, worms and dysentery. Its richness in vitamins and minerals makes it a highly sought after food supplement for both local consumption and export. The seed serves as

source of oils for candle making, cooking and soap [5]. The seed shells are decorative and are often used to craft beads which are worn as necklace, rosaries and sometimes for local dancing apparels [4]. Every part of this multipurpose plant has numerous useful applications. The seed of this plant when crushed and eaten with redants can induce abortion [4][5]. The seed is rich in alkaloids, saponins, flavonoid phenols and tannins [7]. The pod and leaf are used to treat convulsion. The aqueous leaf and stem bark extract of the plant have anti-nociceptive, anti-inflammatory and cytotoxic activities in mice. The bark, fruits, seed and leaves are used as anthelmintics, for gonorrhoea treatment and for convulsion as well as analgesics [8][9]. Works by Okunruboet *al.*, (2009) has

demonstrated that the methanolic extract and aqueous fractions of the stem bark of *Pentaclethra macrophylla* showed marked antinociceptive activities.

Works on aqueous and ethanolic extract of *Pentaclethra macrophylla* have shown that the extracts have antidiarrheal potentials. The works of [10], on the anti-microbial properties of the oil of *Pentaclethra macrophylla*, *Chrysophyllum albidum* and *Persea gratissima* seed on *E. Coli*, *P. mirabilis*, *P. aeruginosa*, *S. aureus* and *S. epidermidis* have shown that the oils of *Pentaclethra macrophylla* have marked antimicrobial properties as none of the organisms showed complete resistance to the oil. The leaves of this plant when boiled with bush pepper produce a liquid given for the treatment of fever, extracts of the leaves seed and bark are used to treat itching and pains in animals and man and improving the anti-inflammatory response [11]. Oils from the leaves have anti-inflammatory qualities and aid in wound management. The seed when ground into paste/lotion renders antimicrobial effects promoting healing while extracts from the bark are applied to leprosy sores. The rich mineral composition of the fermented seed makes it a low cost source of protein. Increase intake of the seed as food increases the hemoglobin value in test animals, increased oxygenation of tissue, enhances specific hormone and stimulates the production of red blood cells important in proper cardiac function. The plant is a source of dietary estrogens (phyto estrogens) which can be employed in nutritional supplement and pharmaceutical preparation and vitamin supplement in the control of obesity. Though the plant has been used for various ethnomedical applications, its constituents have not been fully documented

Pentaclethra macrophylla is used in Africa in traditional human and veterinary medicine. The ripe fruits are applied externally to heal wounds. The root bark is used as a laxative, as an enema against dysentery and as a liniment against itching.

Pentaclethra macrophylla is occasionally planted along roads. It plays a role in various traditional ceremonies, Production and international trade. Most production is for home or local consumption and no information on production and trade of oil, 'ugba' or timber is available.

3.0 Materials and Methods

3.2.1 Identification of plant material

The fresh *pentaclethra macrophylla* leaves was identified and collected in large quantity from the University of Port Harcourt teaching hospital (UPTH) garden.



Figure 3.1 Showing *pentaclethramacrophylla* leaves and pods

3.2.2 Preparation of aqueous extract of *pentaclethramacrophylla* leaves

The fresh leaves were sorted to remove any contaminants, dead matter, sand particles and then air dried for some days.

About 2Kg is which is two thousand grams of the plant was oven dried at 45⁰C and grinded using a grinding machine. The grinded plant was macerated in a maceration jar for twenty four hours; during the period of maceration it was well shaken three times before filtration to enable a proper absorption filtration. Using a glass funnel, 1000ml beaker, whatman filter paper, the filter paper was folded into four portion and place in the funnel with the beaker under the funnel, then the content is carefully poured into the funnel which gradually filter through the paper into the beaker, the filtration process was repeated for about 2-3 times to have a clear filtrate.

After obtaining a clear filtrate, it was then transferred into a clean evaporating dish and heated on a steam bath at 45⁰C, the water gradually evaporate out leaving the extract in a paste form.

3.2.3 Experimental Animals

A total number of 20 Albino wistar rats made up of both male and females weighing between 80-120g were procured from the animal house of the department of Pharmacology, faculty of basic medical science, University of Port Harcourt.

The animals were kept in well ventilated cage with 12hours natural light/dark cycle.

The animals were divided into groups and allowed to acclimatize for 7 days to enable them get used to the handling process during the research process. At this period, they were fed with poultry finishers feed and tap water.

3.2.4 Experimental Design

The 20 rats were divided into four groups:

Group 1(control group) made up of 5 rats with average weight of 80g and receiving the normal feed and water *ad libitum*.

Group 2(test control) made up of 5 rats with average weight of 84g, and each receiving 20mg/kg dose of *pentaclethramacrophylla* leaf extract orally once a day with feed and tap water.

Group 3 (test control) made up of 5 rats with average weight of 80g, and each receiving 50mg/kg dose of *pentaclethramacrophylla* leaf extract orally once a day with feed and tap water.

Group 4 (test control) made up of 5 rats with average weight of 82g, and each receiving 20mg/kg dose of *pentaclethramacrophylla* leaf extract orally once a day with feed and tap water.

3.2.5 Administration of test solution

Oral administration of *pentaclethramacrophylla* leaves extract was used,

The experiment was designed in two phases, and the Administration of the test solution ran for four weeks after acclimatization.

Phase one lasted for two weeks, after which rat 1 and two of each of the groups were sacrificed to note the progress of the effect of the extract while administration continues in phase two for the remaining rats, which lasted for more two weeks.

3.2.6 Blood pressure measurement

The UgoBasilenoninvasive blood pressure recorder was used throughout the experiment. The machine measures the Systolic blood pressure, Diastolic blood pressure and Heart rate of the Albino wistar rats.

The blood pressure measurement was done weekly to see the progression of the effect of the *pentaclethramacrophylla* leave extract on the blood pressure and Heart rate of the animals, and hence this was done as follows:

Preliminary readings (week 0): These readings were taken before the administration started, to know the initial status of the rats.

Week 1: these readings were done a week after administration of the extract

Week 2: measurement was taken after 2 weeks of administration

Week 3: measurement was taken after 3 weeks of administration

Week 4: measurement was taken after 4 weeks of administration which was the final readings

Procedure for Blood pressure and Heart rate measurement:

The blood pressure and heart rate measurement was done using the UgoBasile noninvasive blood pressure recorder. The rat is kept inside the restrainer; the tail cuff is then fixed to the tail of the rat followed by the transducer, then the start button is pushed.

Pressure is transmitted to the tail cuff; as soon the cuff pressure exceeds the diastolic pressure and starts to narrow the tail artery, the amplitude of the recorder pulse wave gradually decreases until the artery is completely constricted (ischemic), the graph becoming a straight line.

This point indicates the maximum internal pressure of the artery (**systolic pressure**) on the paper grid, on which the **actual pressure** of the system is **digitally printed in 10mm Hg steps**.

At the end of the recording a second pressure measurement can be started, with decreasing pressure. The systolic pressure is indicated, this time, by the return of the pulse tracing.

The animal **pulse rate** can be assessed in real time by a pulse rate counter which picks the signal from the pulse transducer.

RESULT AND DISCUSSION

The data showed the results obtained from the experimental studies of the effect of oral administration of aqueous extract of *pentaclethramacrophylla* leaves (oil bean tree leaves) on blood pressure and oxidative stress parameters following a four weeks of oral administration in Wistar Albino rats.

The results were presented as mean ± (SEM) standard error of mean and the significance of difference between mean was determined by the student-one way ANOVA test.

Table 4.1 showing result for Systolic blood pressure measurement across the groups for the four weeks

GROUPS	SYSTOLIC BLOOD PRESSURE (mmHg±sem)				
	Week0	Week1	Week2	Week3	Week4
Group1 (control)	284.4 ±1.78	226.6±28.29	115.8±47.70	118.0±48.19	114.0±46.00
Group2 20mg/kg	259.4±23.6	132.±29.86 *	68.80±28.8	33.00±13.52	52.40±21.40
Group3 50mg/kg	201.4±50.68	178.0±14.5	41.40±17.05	42.00±17.33	46.00±19.39
Group4	239.2±13.95	101.±27.50 *	50.00±24.10*	36.80±15.8	30.40±12.48

100mg/kg

Values are sem. n= 5. * means values are statistically significant when compared to the control. (p<0.05)

Keys:

Group 1= control group (normal chow and water *ad libitum*)

Group2 = 20mg/kg of aqueous extract of *pentaclethramacrophylla* leave was administered.

Group3 = 50mg/kg of aqueous extract of *pentaclethramacrophylla* leave was administered

Group4 = 100mg/kg of aqueous extract of *pentaclethramacrophylla* leave was administered

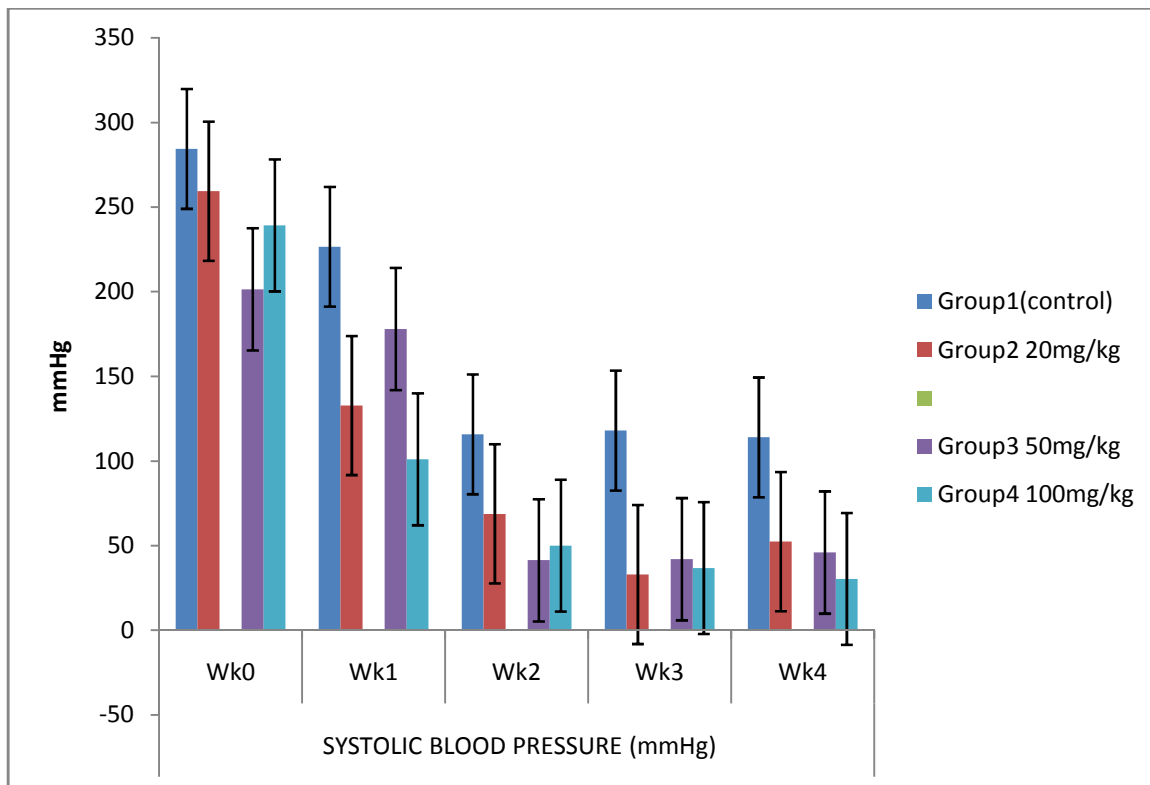


Figure4.1. Bars showing results from systolic blood pressure measurement across the test groups and the control for the four weeks of administration

Table 4.2 showing result for Diastolic blood pressure measurement for the four weeks of administrations of aqueous extract of pentaclethramacrophylla leave.

GROUPS	DIASTOLIC BLOOD PRESSURE (mmHg±sem)				
	Week0	Week1	Week2	Week3	Week4
Group1 (control)	106.20±9.45	86.20±8.73	49.40±20.18	46.60±19.09	62.80±25.74
Group2 20mg/kg	82.20±1.02*	66.8±3.38*	47.40±19.46	41.60±17.24	48.20±19.79
Group3 50mg/kg	90.20±3.78	70.60±4.06	46.80±19.14 *	45.60±18.72	46.60±19.04
Group4 100mg/kg	77.60±3.44*	68.40±2.80 *	44.20±18.13	39.00±15.92	35.20±14.61

Values are sem. n= 5. * means values are statistically significant when compared to the control. (p<0.05)

Keys:

Group 1= control group ()

Group2 = 20mg/kg of aqueous extract of pentaclethramacrophylla leave was administered.

Group3 = 50mg/kg of aqueous extract of pentaclethramacrophylla leave was administered

Group4 = 100mg/kg of aqueous extract of pentaclethramacrophylla leave was administered

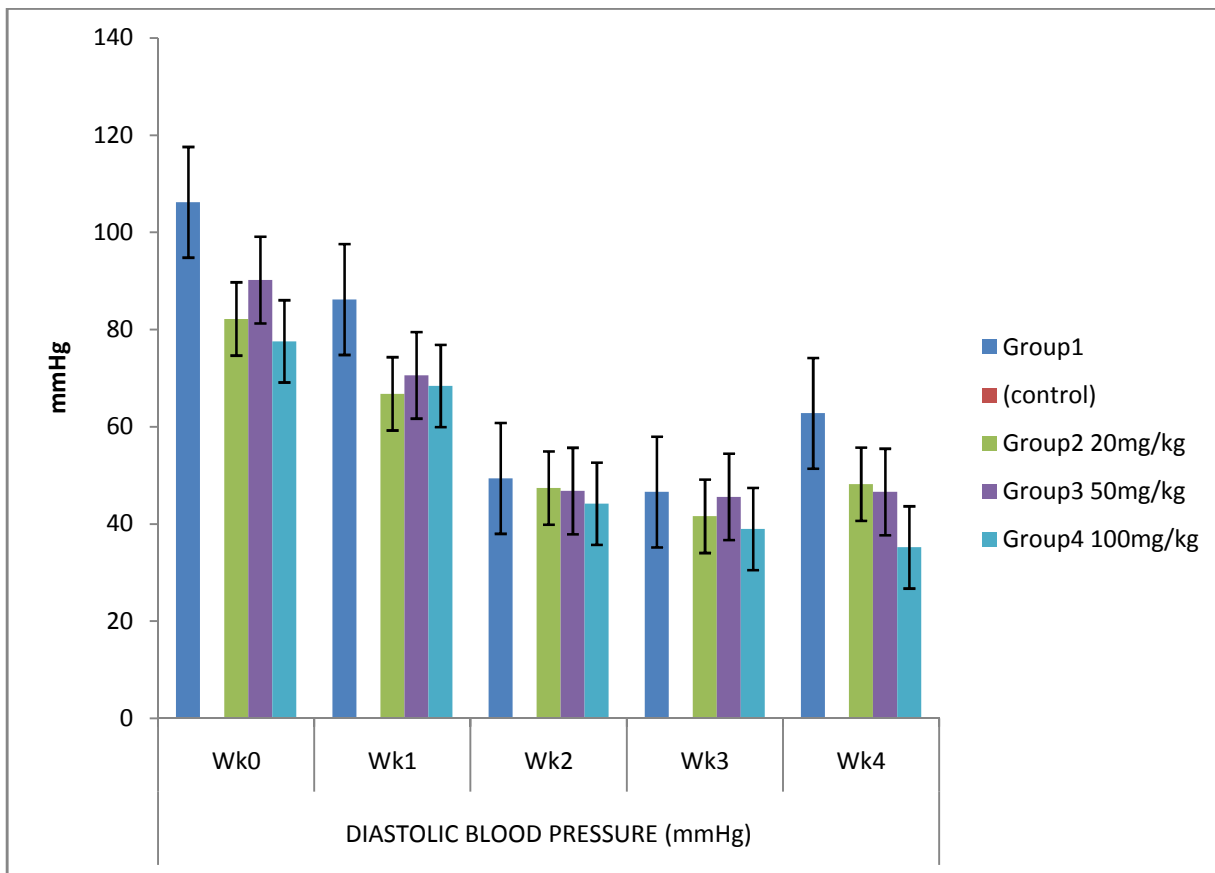


Figure 4.2. Bar showing results from diastolic blood pressure measurement across the test groups and the control for four weeks.

Table 4.3 showing result for Heart rate measurement across the groups for the four weeks of administration

GROUPS	HEART RATE (Bpm±sem)				
	Week0	Week1	Week2	Week3	Week4
Group1 (control)	568.0±37.79	369.60±3.06	217.6±89.21	227.6±92.93	214.80 ± 87.82
Group2 20mg/kg	466.80±24.24 *	358.40±12.14	219.2±89.71	210.60±86.27	214.80±87.82
Group3 50mg/kg	498.40±21.27 *	375.8±4.07	222.0±90.60	214.60±87.65	231.60±95.27
Group4 100mg/kg	419.20±16.02	372.8±6.60	237.0±97.71	219.80±90.21	227.40±95.03

Values are sem. n= 5. * means values are statistically significant when compared to the control. (p<0.05)

Keys:

Group 1= control group

Group2 = 20mg/kg of aqueous extract of pentaclethramacrophylla leave was administered.

Group3 = 50mg/kg of aqueous extract of pentaclethramacrophylla leave was administered

Group4 = 100mg/kg of aqueous extract of pentaclethramacrophylla leave was administered

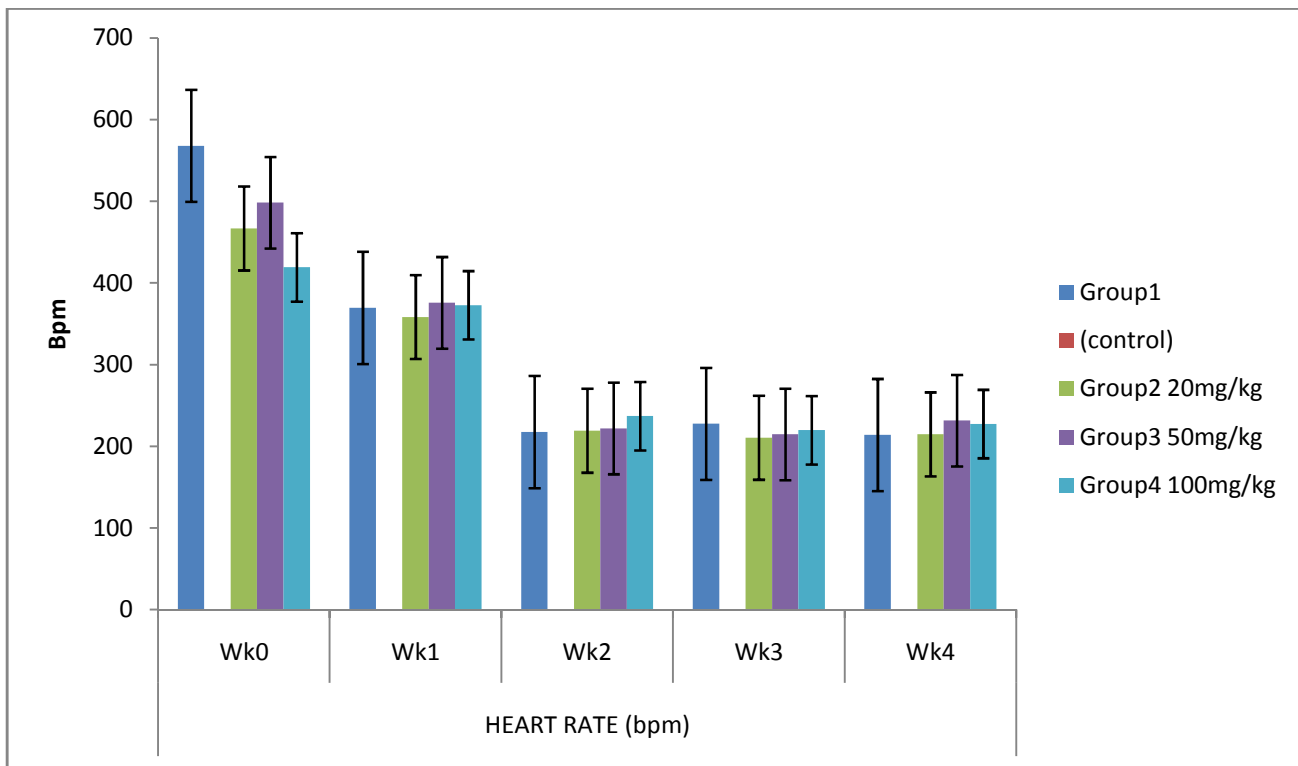


Figure 4.3. Bars showing results from Heart rate measurement across the test groups and the control

5.0. DISCUSSION

This research study demonstrated the effect of aqueous extract of *pentaclethramacrophylla* leaves on blood pressure and oxidative stress of Albino wistar rats.

The mean value of the systolic blood pressure presented in table 4.1 for the control group was compared with other groups, for the first week of administration. Group two showed significant decrease ($p < 0.05$) prior to administration of 20mg/kg of the extract for one week.

In the second week of administration, an insignificant decrease ($p < 0.05$) was recorded and at the third week, a significant decrease was observed. However an insignificant increase was recorded for the fourth week

Group 3 that receives 50mg/kg of the extract exhibited a similar progress with an insignificant decrease in the mean value in the first, second and third week of administration.

Group four that received 100mg/kg of the extract showed significant ($p < 0.05$) decrease after the first week of administration and insignificant decrease in the other weeks.

The result for systolic blood pressure showed that the aqueous extract of *pentaclethramacrophylla* has a dose/duration dependent decreasing effect on the systolic blood pressure. The higher the concentration, the higher the reducing effect of the extract on systolic pressure, the longer the duration, the higher the effect, nevertheless, at the fourth week no significant changes was recorded.

The extract has an effect on the diastolic blood pressure in rats following comparison of the test group to the control group as demonstrated in Table 4.2.

Group 2 with 20mg/kg of extract received, demonstrated significant ($p < 0.05$) decrease of the mean value ($p < 0.05$) was recorded for the first week of administration, a non-significant decrease was recorded for the second week, and the third week, and insignificant increase was recorded for the fourth week but not statistically significant ($p > 0.05$).

Group 3 (50mg/kg), a decrease of the diastolic blood pressure from the preliminary result after first week of administration was significant ($p>0.05$).and on the second week, to 45.60 ± 18.72 third week and a slight increase 46.60 ± 19.04 for the fourth week but the decrease is statistically insignificant. i.e.($p>0.05$).

Group 4 (100mg/kg) also showed significant ($p<0.05$) decrease that is dose and duration dependent; weeks 1, 2, 3 and 4 progressively.

The result for Heart rate measurement after two weeks of administration showed an inconsistent increase and decrease for all the groups in the four weeks as recorded in Table 4.3. In other words, there was no significant change in Heart rate of the animals. This shows that the extract has little or no effect on the heart rate of the animals.

Observation from the blood pressure measurement tend to confirm the report of [12] on the potential of antihypertensive effect of *pentaclethramacrophylla*.

5.1 SUMMARY

This research study focused on the effect of aqueous extract of *pentaclethramacrophylla* leaves on blood pressure and oxidative stress parameters (Malondialdehyde, superoxide dismutase, catalase, and glutathione peroxidase and glutathione reductase) in Albino wistar rats. 20mg/kg, 50mg/kg and 100mg/kg of the extract was given in different groups and compared with a control group which receives normal chow and water *ad libitum*.

Based on the result extrapolated above, the extract decreases systolic blood pressure significantly and more effect was recorded at higher dose.

The extract showed a significant ($p<0.05$) decrease in Diastolic blood pressure that is dose dependent and as duration of administration increases, more significant decrease was recorded.

However, there was no significant change recorded for the Heart rate measurement after oral administration of *pentaclethramacrophylla* leave extract

5.2 CONCLUSION

The aqueous extract of *pentaclethramacrophylla* leave has a dose dependent reducing effect on both systolic and Diastolic blood pressure; however, it has no significant change in the Heart rate of albino wistar rat

ACKNOWLEDGEMENT

My unalloyed gratitude goes to Almighty God for his faithfulness and grace over me throughout my stay in the University of Port Harcourt.

My unreserved thanks go to my parent MR and MRS Ezekiel Ukoro, and my siblings for their relentless effort to making sure my stay in the University of Port Harcourt is successful.

I acknowledge with thanks the motivation, helpful suggestions, and excellent supervision of my supervisor Prof. C.P.R Chike.

With all sincerity, I acknowledge the motivation, helpful suggestions, and valuable contributions of my lecturer, Dr J.O Olorufemi throughout the period of this research work

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