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RESEARCH ARTICLE

Investigation of the methanol root extract of *Cochlospermum planchonii* for pharmacological activities *in vitro* and *in vivo*

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Abstract

Some pharmacological activities of *Cochlospermum planchonii* Kunth (Cochlospermaceae) root extract were studied. The extract yielded 3.4% w/w dry matter. The extract was well tolerated in all doses (250- 3000 mg/kg bw, per os) used in the experiment. Brine shrimps lethality test gave LC_{50} of 4.42 ppm at 95% confidence interval. The extract significantly ($p < 0.05$) increased pentobarbital-induced sleeping time at all doses. The extract (250, 500, and 1000 mg/kgbw, p.o.) significantly ($p < 0.05$) decreased the paw licking time in the second (late) phase of the formalin test. Also, it significantly ($p < 0.05$) decreased the number of acetic acid-induced writhings in all doses used. The anti-inflammatory study showed that the extract caused a biphasic inhibition of carrageenan-induced paw edema, similar to indomethacin (20 mg/kgbw). Despite the potent analgesic effect of the extract, it did not protect mice from leptazole-induced convulsions. The extract (250, 500, 1000 mg/kgbw p.o.) significantly ($p < 0.05$) decreased blood glucose levels in alloxan-induced hyperglycemic mice in a dose- and time-dependent manner. The phytochemical tests showed the presence of saponins, tannins, glycosides and carbohydrates. In conclusion, *C. planchonii* root extract contains very potent bioactive compounds, which showed CNS depressant, analgesic, anti-inflammatory, and antihyperglycemic effects with minimal toxicity. Therefore, it is endowed with a potential for pharmacological control of pain, inflammation, and diabetes mellitus.

Keywords: *C. planchonii; analgesic; anti-inflammatory; bioactive; antihyperglycemic; CNS depressant; potent bioactive; minimal toxicity*

Introduction

Cochlospermum planchonii Kunth Bixaceae (Cochlospermaceae) (Mabberley, 1981) has been an important economic medicinal plant in some parts of Africa. It is a low shrubby plant and a common weed of cultivation in both Guinea and Sudan savannah zones (Burkill, 1985). It is widespread from Senegal to East and West Cameroon up to Nigeria (Akobundu & Agyakwa, 1987). In Benue State of Nigeria, where the plant is found in abundance in the wild, it is used traditionally in the management of some ailments such as jaundice, pre-menstrual pain, infertility, diabetes mellitus, gonorrhea and enteric fever (Burkill, 1985; Igoli et al., 2002). The decoction of the root bark of the plant is used for treating hepatic fever, hepatobiliary affections (black toilet fever), and hemolytic anemia in Burkina Faso (Aliyu et al., 1995). Economically, the stem bark of *C. planchonii* is used in northern Sierra Leone and Nigeria for rope and string production. The root material is a very good source of reddish yellow dyes used by the traditional textile mills in the Nupe tribe and as culinary colorant in Lagos, Nigeria (Burkill, 1985).

The leaf oil of *C. planchonii* showed a superior antiplasmodial effect *in vitro* when compared to chloroquine, with LC_{50} of 22-35 μg/mL against *Plasmodium falciparum* (Benoit-Vical et al., 1999). Also, Atawodi (2005) showed that the petroleum extract of the stem bark (4 mg/mL) has trypanocidal properties *in vitro*. Phytochemical analysis of the root extract showed the

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presence of egallic acid, zinc salt, and manganese (Aliyu et al., 1995). The zinc salt showed hepatoprotective effect because it inhibited cytochrome P450 enzyme in the liver.

The present study further investigated the pharmacological activities of the methanol root extract of *C. planchonii in vivo* and *in vitro* to confirm the analgesic and antidiabetic uses.

Materials and methods

The experimental protocols used in this study were approved by the Ethics Committee of the University of Nigeria, Nsukka, in accordance with the guide to the care and use of laboratory animals in research and teaching in the university. Freshly prepared solutions of drugs and physiological solutions were used in all experiments.

Plant collection and extraction

The root material of *C. planchonii* was collected in November, 2005 from the premises of the University of Agriculture, Makurdi, Benue State, Nigeria. The plant was identified by Patrick Ekwuno of the Department of Wildlife and Forestry, University of Agriculture, Makurdi, Benue State, Nigeria. A voucher specimen (voucher no. DWF-H1105-97) was deposited in the departmental herbarium of the same university.

Dried and pulverized root material of *C. planchonii* (270 g) was extracted by cold maceration for 48 h at room temperature (27°C) using 70% aqueous methanol. The methanol solution was evaporated under reduced pressure and dried to give a crude residue (9.1 g). The extract was stored at 4°C throughout the duration of this study.

Experimental animals

Albino Wistar mice (190) of either sex (20-35 g) and 25 albino Wistar rats (65-100 g) of either sex were procured from the Animal Unit of the Faculty of Veterinary Medicine, University of Nigeria, Nsukka. They were kept in stainless steel cages and were fed *ad libitum* with standard laboratory animal feed (Guinea Feed®) and with access to tap water, except in situations where fasting was required. They were maintained in accordance with the recommendation in the *Guide for the Care and Use of Laboratory Animals* (DHHS, 1985). They were allowed two weeks to acclimatize before the commencement of the experiments.

Brine shrimps lethality test (BSLT)

The method of McLaughlin and coworkers (1991) was used to study the toxicity of *C. planchonii* extract. Briefly, *Artemia salina* eggs obtained from a pet shop in Davis, California, were incubated in natural sea water (from Bar Beach, Lagos, Nigeria) in a dam-well under room conditions. About ten 48 h - shrimp nauplii in 1 mL of autoclaved sea water were put into each Bijou bottle using a Pasteur pipette under a stereo-microscope with a light source. They were separated into 4 groups of three.

Increasing concentrations (10, 100, 1000 ppm) of the methanol root extract of *C. planchonii* were added into each of the groups, and distilled water was added into the control group. The nauplii were incubated at room temperature (28°C) for 24 h, after which the survivors in each well were counted. The results were analyzed using Finney Probit Analysis (MS-DOS computer-program) to determine the LC_{50} at 95% confidence interval. Weak nauplii were noted as an indication of central nervous system depression.

Acute toxicity test

Thirty albino Wistar mice (21-39 g) of either sex were used for the study. They were randomly divided into six groups of five mice each. They were kept in stainless steel cages and were provided feed and water ad libitum. The mice in the different groups were orally dosed with increasing doses (50,100, 200, 400, and 1000 mg/kgbw) of the *C. planchonii* extract, while the control group received distilled water (10 mL/kg bw). The mice were observed for mortality and toxic signs for 48 h (Anaga et al., 2006).

Effect of the extract in pentobarbital-induced sleeping time

The method of Shetty and Anika (1982) was used for the study. Twenty-five albino Wistar mice (22-31 g) of either sex were used for the study. The mice were randomly divided into five groups of five mice each. They were treated with increasing doses (250, 500, 750, and 1000 mg/kg bw of the extract by the oral route, while the control group received distilled water (10 mL/kg bw). After 30 min, all mice were given sodium pentobarbital (35 mg/kg bw) intraperitoneally. The time of injection, time of sleep (loss of righting reflex) and the time of awakening (regain of righting reflex) were recorded.

Anti-nociceptive (analgesic) effects of C. planchonii *extract*

The method of Marchioro et al. (2005) was used for the acetic acid-induced writhing test. Five groups of mice consisting of five mice each were fasted for 12 h, but given free access to drinking water. Mice in group A received distilled water (10 mL/kgbw), which served as the negative control, while mice in group B received 400 mg/

kgbw acetyl salicylic acid (ASA), which served as the positive control. Mice in groups C-E were treated with 250, 500 and 1000 mg/kg bw of the extract by oral administration respectively. After 45 min, the mice were treated with acetic acid (0.7%, 10 mL/kg bw) through intraperitoneal administration. The number of writhings or abdominal stretches produced in each mouse was counted for 30 min. Antinociception was calculated by the method described by Dambisya and Lee (1995) as percentage inhibition of abdominal constrictions using the formula:

$$\frac{\text{distilled water control mean} - \text{test group mean}}{\text{distilled water control mean}} \times 100$$

The formalin test was studied according to the method of Marchioro et al. (2005). Thirty mice (21-32 g) of either sex were randomly divided into five groups (A-E) of six mice each. Mice in group A received distilled water (10 mg/kgbw) orally, which served as the negative control, while those in group B were treated with ASA (400 mg/kgbw p.o.), which served as the positive control. Groups C-E received graded doses (250, 500, 1000 mg/kgbw) of *C. planchonii* extract by oral administration, respectively.

After 30 min of the drugs and extract administration, the mice were injected with 50 µL of 1% formalin into the sub-plantar area of the hind limb. The paw licking time (PLT) was recorded using a stop watch after the administration of formalin. The duration the mice continued licking or biting the paws during the first phase (0-5 min) and second phase (20-25 min) of the reaction was recorded. Antinociception was calculated by the method described by Dambisya and Lee (1995) as percentage inhibition of abdominal constrictions using the formula:

$$\frac{\text{distilled water control mean} - \text{test group mean}}{\text{distilled water control mean}} \times 100$$

Anti-inflammatory effect of C. planchonii *extract*

The anti-inflammatory effect of the extract of *C. planchonii* was studied using carrageenan-induced paw edema in rats (Winter et al., 1962). Twenty-five albino Wistar rats (149-199 g) of either sex were randomly divided into five groups (A-E) of five rats each. Rats in group A were treated with indomethacin (20 mg/kgbw, orally) suspended in 1% carbonated buffer solution, which served as the positive control. Rats in groups (B-D) were treated with graded doses (250, 500, 1000 mg/kgbw) of the extract by oral administration, while mice in group E received distilled water (10 mL/kgbw), which served as the negative control. Before the treatment, the volume displacement by the normal paw (V_o) was measured for each rat. After 45 min of the extract and indomethacin administration, 50 µL of carrageenan (1%) in normal saline was injected into the sub-plantar area of the hind paw. The change in volume due to carrageenan-induced paw swelling (V_t) of the paw was measured at 1, 2, 3, 4, and 5 h after treatment, using an improved method of Garcia et al. (2004). The percentage inhibition was calculated using the modified formula (Dambisya & Lee, 1999; Ojewole. 2004) below:

$$\text{Percentage inhibition} = \frac{(V_t - V_o)\text{control group} - (V_t - V_o)\text{treated group}}{(V_t - V_o)\text{control group}} \times 100$$

where, V_t = volume displacement by carrageenan-induced paw edema in treated animal, V_o = volume displacement by normal paw in untreated rats. The result was presented as percentage edema inhibition of the mean of each group of rats.

Anticonvulsant effect of C. planchonii *extract*

Briefly, 15 mice (22-29 g) of either sex were divided into three groups of five mice each. Mice in group A were treated with sodium pentobarbital (35 mg/kg bw, i.p.) and leptazole (90 mg/kg bw, i.p.) simultaneously, while group B mice were pre-treated with the extract (1000 mg/ kg bw, p.o.) and after 45 min with leptazole (90 mg/kg, i.p.). Mice in group C received leptazole (90 mg/kg bw) only by intraperitoneal route, which served as the negative control. The duration of clonic convulsions and mortality were recorded and percentage protection was recorded (Hossein & Fatemeh, 2005).

Effect of C. planchonii *extract in normoglycaemic mice*

Twenty-five male albino Wistar mice (19-24 g) were used for the study. They were fasted for 16 h and fasting blood glucose level was determined. They were divided into five groups of five mice each. The mice were treated as follows: mice in group I received distilled water (10 mL/kg bw), which served as the negative control, while group II received glibenclamide (2.5 mg/kg bw, p.o.), which served as the positive control. Mice in groups (III-V) were treated with graded doses (250, 500, and 1000 mg/kg bw, p.o.) of the extract, respectively. Blood glucose

levels were determined at 60, 120, 180, and 360 min after administration of the extract and drug.

Blood glucose levels were determined using blood glucose meter (Roche Diagnostics, London, East Sussex, UK) with ACCU-CHEK (Advantage II) strips using the protocol in the Quick Reference Guide (Atkins et al., 1991). Briefly, a snip was made on the tip of the tail of each mouse to produce a drop of blood and then placed on the strip already inserted into the blood glucose meter, to read off the blood glucose level. The result was presented in mg/100 mL blood.

Effect of C. planchonii *extract in alloxan-induced hyperglycemia in mice*

Thirty male albino Wistar mice (24-27 g) were used. They were fasted for 16 h and the fasting blood glucose levels were determined. Hyperglycemia was induced by a single intraperitoneal injection of 150 mg/kg of alloxan monohydrate (AM) in 10 mM citrate buffer (pH 4.5) (Anaga et al., 2004). The blood glucose levels were determined 7 days post-administration of AM. Mice having high blood glucose (> 400 mg/100 mL of blood) were considered hyperglycemic.

The hyperglycemic mice were randomly divided into five groups of six mice each and were treated as follows: Group I, distilled water (10 mL/kg bw, negative control); Group II, glibenclamide (2. 5 mg/kg bw, positive control); Groups (III-V), graded doses (250, 500 and 1000 mg/kgbw) of the extract respectively. The extract and the drug were given orally. The blood glucose levels were determined 60, 120, 180, and 360 min after administration of the drug and the extract. The blood glucose level was determined following the procedure described above.

Phytochemical spot test

The methanol extract of *C. planchonii* roots was tested for the presence of alkaloids, flavonoids, tannins, glycoside, saponins, proteins, and carbohydrate using the standard procedures (Trease & Evans, 2002).

Data analysis

The results were presented as mean ± SEM and subjected to one-way analysis of variance (ANOVA) followed by post-hoc multiple-comparison Dunnett's test to determine the level of significance between "test" and "control" group data means. Values of $p < 0.05$ were considered statistically significant.

Results

The yield of the extract of *C. planchonii* roots after the removal of the methanol *in vacuo* was 3.4% w/w dry matter. The extract was dark brown in color with a syrupy consistency and pleasant odor.

No mortality was recorded in the acute toxicity test. The clinical signs observed in the treated mice include drowsiness, depression, reduced activity and clumping together. The effect of the methanol extract of *C. planchonii* roots on brine shrimp nauplii showed that the LC_{50} was 4.45 ppm at 95% confidence interval. The surviving nauplii were very sluggish in movement.

The effect of *C. planchonii* extract on pentobarbital-induced sleeping time is presented in Figure 1. The extract significantly ($p < 0.05$) increased the sleeping time at the doses (500, 750, and 1000 mg/kg bw) when compared with the control. The result of the effect of the *C. planchonii* extract on acetic acid-induced abdominal constrictions in mice is presented in Table 1. The extract significantly ($p < 0.05$) decreased the number of abdominal writhings in all the doses of the extract and the drugs used in the study. Also, the extract at 500 mg/kg bw (p.o.) gave the highest activity (74%) when compared with the control (Table 1). The extract (500 mg/kg bw, p.o.) significantly ($p < 0.05$) decreased the number of abdominal writhings when compared with ASA (400 mg/kg bw, p.o.), the reference drug. The result of the effect of the extract on formalin-induced nociception is presented in Table 2. The extract (250, 500, 1000 mg/kg bw, p.o.) and ASA (400 mg/kg bw, p.o.) significantly ($p < 0.05$) decreased the number of paw licking by the mice in both early (0-5 min) and late phases (25-20 min) of formalin-induced nociception, when compared with the control group. The percentage inhibition of pain showed that the extract was more potent in late phase (70-88%) than early phase (44-77%) of nociception (Table 2). On comparing the extract-treated groups with the group that received ASA, reference drug, extract in all doses was more effective than the reference drug. The extract had

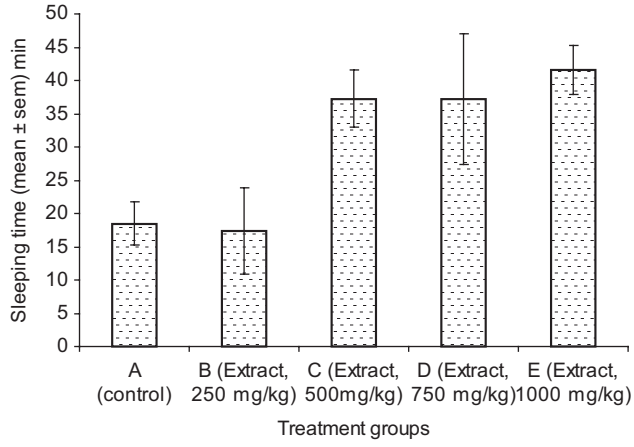

Figure 1. Effect of the methanol root extract of *C. planchonii* on pentobarbital-induced sleeping time. *Significant at $p < 0.05$ compared with the control group.

Table 1. Effect of the methanol root extract of *C. planchonii* on acetic acid-induced writhing (analgesic test).

Group	Dose (mg/kg bw, p.o.)	Mean abdominal writhings ± SEM	% Inhibition
A Dist. water	10 (mL/kg bw)	78.6 ± 6.38	0
B ASA	400	44.8 ± 3.51*	43
C Extract	250	27.4 ± 4.49*	65.14
D Extract	500	20.4 ± 4.31*	74.05
E Extract	1000	49.8 ± 3.51*	35.16

*Significant difference at P<0.05 (ANOVA) compared with the untreated group; bw, body weight; p.o., per os; SEM, standard error of the mean; and ASA, acetyl salicylic acid.

Table 2. Effect of the methanol root extract of *C. planchonii* on formalin (analgesic) test.

Group	Dose (mg/kg bw, p.o.)	PLT (mean ± SEM) seconds 0-5 min	25-30 min
A Dist. water	10 (mL/kg bw, p.o.)	15.5 ± 2.55	25.6 ± 10.33
B ASA	400	47.4 ± 5.07*	31.2 ± 12.61
C Extract	250	19.4 ± 4.75	15.4 ± 7.29*
D Extract	500	33.8 ± 16.32*	13.4 ± 6.06*
E Extract	1000	31 ± 10*	13.4 ± 6.06*

*Significant difference at P <0.05 (ANOVA) compared with the untreated group; bw, body weight; p.o., per os; SEM, standard error of the mean; ASA, acetyl salicylic acid; PLT, paw licking time.

Table 3. Effect of the methanol root extract of *C. planchonii* on leptazole-induced convulsions.

Treatment group		Duration of convulsion(min)	% mortality
A	Pentobarbital (35 mg/kg bw, i.p.) + Leptazole (90 mg/kg bw, i.p.)	18.6 ± 14.62	0
B	Extract (1,000 mg/kg bw p.o.) + 45 min + Leptazole (90 mg/kg bw, i.p.)	37 ± 11.84	100
C	Leptazole (90 mg/kg bw, i.p.)	37.8 ± 9.56	100

no protection against leptazole-induced convulsion in mice (Table 3).

The anti-inflammatory effect of the methanol extract of *C. planchonii* roots on carrageenan-induced paw edema is presented in Figure 2. The extract at the dose of 250 mg/kg bw (p.o.) and the reference drug, indomethacin (20 mg/kg bw, p.o.) induced biphasic inhibition of paw edema development. The first phase of edema inhibition occurred in the first 2 h and the second phase occurred between 4-6 h post-administration of the drug and the extract. The extract (250 mg/kg bw, p.o.) caused about 40% inhibition of carrageenan-induced paw edema at 1 h, which declined to zero at 3 h post-administration of the extract in the first phase observation. The second phase of paw edema inhibition by the extract commenced immediately, gradually

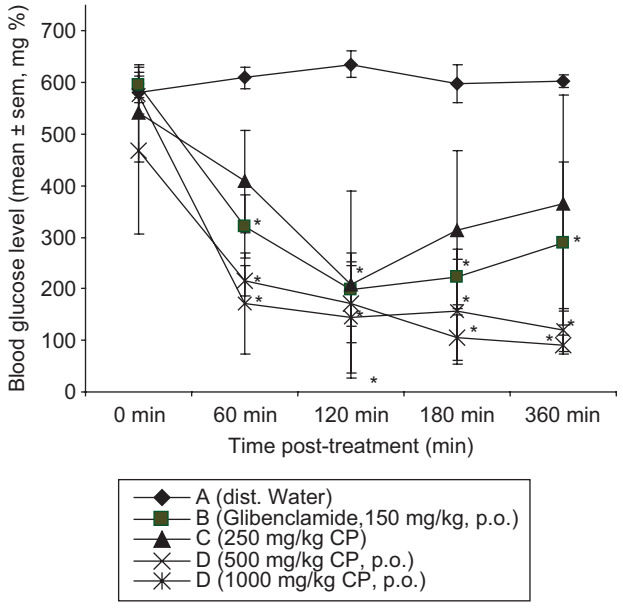

Figure 2. Effect of the methanol root extract of *C. planchonii* in carrageenan-induced paw edema in rats (anti-inflammatory test). CP, *C. planchonii* extract, p.o., per os.

increased, and peaked (50%) at 6 h after administration of the extract (Figure 2). Indomethacin (20 mg/kg bw, p.o.) caused about 45% edema inhibition at 2 h (first phase) and about 60% activity (second phase) at about 4 h after administration of the drug (Figure 2).

The extract had no significant effect on blood glucose level in normoglycemic rats (Table 4). The effect of the methanol root extract of the plant on AM-induced hyperglycemia is presented in Figure 3. The extract (250, 500, 1000 mg/kg bw, p.o.) and glibenclamide (2.5 mg/kg bw, p.o.) significantly (p <0.05) decreased the blood glucose level throughout the duration of the study. The antihyperglycemic effect of the plant extract was very prominent at 60 min post-administration, which continued throughout the period of study. At 360 min after administration, the extract (1,000 mg/kg bw, p.o.) reduced the blood glucose level slightly below the normoglycemic level (Figure 3). Weight loss and decrease in feed intake were observed during the period of the study, but improved in recovered mice (data not provided).

The phytochemical spot test result showed the presence of saponins, tannins, glycosides, and carbohydrates.

Discussion

The present investigation was studied to scientifically confirm the ethno-medicinal uses of *C. planchonii in vivo* and *in vitro*. The oral administration of the methanol root extract of *C. planchonii* was well tolerated in all doses (250- 3000 mg/kg bw, p.o.), as no mortality

Table 4. Effect of the methanol root extract of *C. planchonii* on blood glucose level in normoglycemic rats.

Group	Normal blood glucose level (mean ± SEM) mg%				
	0 min	60 min	120 min	180 min	360 min
I Dist. water (10 mL/ kg bw)	74.21 ± 5.50	81.34 ± 3.98	84.94 ± 10.77	82.58 ± 9.36	78.54 ± 12.64
II glibenclamide (2. 5 mg/kg bw)	67.10 ± 2.56	62.75 ± 5.32	64.23 ± 2.21	61.98 ± 9.99	60.98 ± 12.74
III *C. planchonii* (250 mg/kg bw)	60.45 ± 7.89	67.38 ± 8.92	65.34 ± 5.34	62.69 ± 7.93	64.44 ± 5.67
IV *C. planchonii* (250 mg/kg bw)	90.14 ± 8.18	94.67 ± 10.91	85.45 ± 9.34	91.99 ± 21.78	85.56 ± 21.55
V *C. planchonii* (1000 mg/kg bw)	87.43 ± 10.76	85.42 ± 11.19	91.98 ± 19.87	80.48 ± 9.77	85.99 ± 1.65

*Significant at p <0.05 compared with the control group.

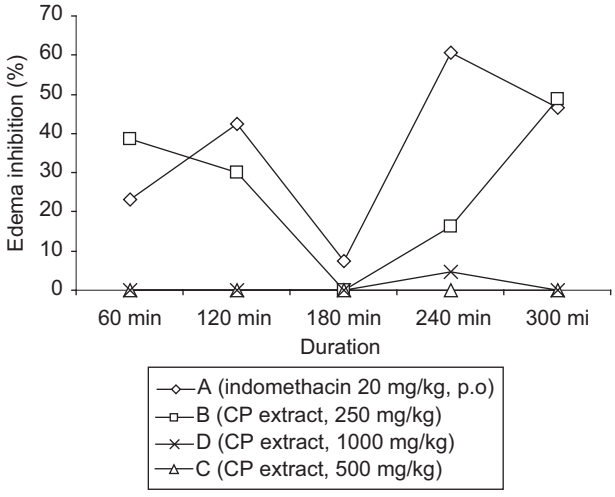

Figure 3. Antihyperglycemic effect of the methanol root extract of *C. planchonii* in alloxan-induce hyperglycemic mice. Significant at p < 0.05 with the control group; CP, *C. planchonii* extract; p.o., per os.

was recorded over 48 h duration. The animals exhibited clinical signs such as drowsiness, depression, reduced activity and clumping together, which may be due to the involvement of the nervous system. Full recovery was 48 h post-administration of the extract. The result of BSLT established that the extract contains very potent bioactive compounds. The bioactivity was rated very high due to the very low LC_{50} (4.42 ppm) of the extract. The ED_{50} value for general bioactivity is approximately one tenth of the value of the LC_{50} in BSLT (McLaughlin et al., 1991). Therefore, the ED_{50} of *C. planchonii* extract was approximated to 0.44 ppm (440 μg/mL). The surviving nauplii were dull and inactive, which is a sign of CNS depression (Allurin et al., 2005; McLaughlin et al., 1991).

The extract caused CNS depression in mice because it significantly increased the pentobarbital-induced sleeping time by more than 200% at the highest dose (1000 mg/kg bw, p.o.). Though the extract of *C. planchonii* depressed the CNS, it was expected that it would protect mice from leptazole-induced convulsions and mortality, but the result of the anticonvulsant study showed that the extract did not protect the mice from leptazole toxicity (Table 3). The CNS depressant effect of the extract corroborates with some of the clinical observations in the acute toxicity study and BSLT.

Two anti-nociceptive models were used to determine whether the analgesic effect was central or peripheral in origin, inflammatory or non-inflammatory. The extract showed a promising anti-nociceptive effect because it significantly decreased the number of acetic acid-induced abdominal constrictions in all the doses (250, 500, and 1000 mg/kg bw, p.o.) of the extract. The percentage pain inhibition showed that the extract (250 and 500 mg/kg bw, p.o.) was more effective than ASA (400 mg/kg bw, p.o.) (Table 1). Further increase in the dose (1000 mg/kg, p.o.) led to decrease in activity as observed in the study. Since the extract increased pentobarbital-induced sleeping time and weakened the movement of surviving nauplii in BSLT, it is presumed that the extract has central nervous system depressant effect, as central depressants and antihistamines are known to reduce the number of abdominal writhings (Onasanwo & Elegbe, 2006).

In an effort to further classify the type of analgesia – inflammatory or non-inflammatory, the formalin model was used. Conversely, the extract (500 and 1000 mg/kg) potentiated the direct effect of formalin by more than 250% increase in the PLT in the early (0-5 min) phase reaction. The methanol extract of *C. planchonii* roots at all doses (250, 500, 1000 mg/kg bw) significantly decreased the PLT in the late phase (20-25 min) when compared with the positive and negative controls (Table 2). This effect observed in the late phase showed the involvement of inflammatory nociception (Hunskaar & Hole, 1997; Olajide et al., 2000). Also, the percentage pain inhibition showed that the extract was similar to ASA (400 mg/kg bw, p.o.) in decreasing formalin-induced pain. Therefore, the analgesic effect of *C. planchonii* extract is presumed to be mediated by inflammatory mechanism.

To confirm the inflammatory involvement of the extract in relieving pain, the effect of the extract on carrageenan-induced paw edema (anti-inflammatory effect)

was studied. The methanol root extract of *C. planchonii* at the dose of 250 mg/kg bw (p.o.) produced a typical biphasic inhibition of paw edema induced by carrageenan in rats (Figure 2). *C. planchonii* extract induced about 40% reduction in paw edema at 60 min post-administration (early phase). The early phase begins after the injection of carrageenan and lasts for 60 min, characterized by the release of histamine and serotonin, which are blocked by antihistamine and antiserotonin agents (Crunkhon & Meacock, 1971). Therefore, extract is presumed to be mediated via antihistamine and antiserotonin mechanisms as observed in the early phase. The effect of the plant extract was similar in time and pattern with indomethacin (20 mg/kg bw). Hence, the effect was indomethacin-like in action, by reducing carrageenan-edema in the delayed phase, probably by inhibiting tissue prostaglandins and plasma kinins (Vinegar et al. 1969; Ferreira et al., 1991; Mahgoub, 2002). Therefore, the results of the present study suggest that the methanol root extract of *C. planchonii* induced analgesic and anti-inflammatory effects, probably by inhibiting the release, synthesis and/or production of inflammatory mediators such as prostaglandins, histamine and other polypeptide kinins (Gamache et al., 1986, Hunskaar & Hole, 1997; Olajide et al., 2000).

Acute treatment of the control group of mice with distilled water alone did not produce any change in blood glucose level throughout the duration of the study in AM-diabetic mice (Figure 3). However, the methanol root extract of *C. planchonii*, like glibenclamide produced significant reductions in the blood glucose levels of the fasted AM-treated diabetic mice in all the doses used and over the duration of the study. The extract at 1000 mg/kg bw (p.o.) showed the highest activity by decreasing the blood glucose level by more than 500%. The effect was superior to that of glibenclamide that was used as a standard. The antihyperglycemic effect of *C. planchonii* confirmed its use in Benue State, Nigeria, in traditional management of diabetes mellitus (Igoli et al., 2002). Unlike some oral sulfonylureas, the extract did not cause any significant effect in blood glucose level in normoglycemic rats, which is an advantage in preventing hypoglycemic coma in normal patients (Johnson & Bressler, 1981). Therefore, the antihyperglycemic effect of the extract would appear to be mediated via a mechanism that is similar to glibenclamide, an oral hypoglycemic sulfonylurea (Ojewole, 2004).

Finally, the extract of *C. planchonii* contains saponins, tannins, glycosides and carbohydrates. The presence of alkaloids and flavonoids was questionable. The extract contains very high concentration of saponins, which have been associated with some of the CNS effects. Aliyu et al. (1995) have isolated zinc and manganese from *C. planchonii*, and these minerals have been associated with antidiabetic effect in experimental animals (Marles & Farnsworth, 1995).

In conclusion, the methanol root extract of *C. planchonii* contains very potent biologically active compounds, which have moderate sedative property, a potent analgesic effect mediated by neurogenic and inflammatory mechanisms, a good anti-inflammatory activity, potent antihyperglycemic effect in hyperglycemic rats, and low toxicity. Further studies to systematically isolate the active metabolites from the root of *C. planchonii* will be needed. The extract or its isolated chemical components could present a new resource for the development of new plant-based therapy useful in the control of pain, inflammation, and diabetes mellitus.

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