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EVALUATION OF ANALGESIC, ANTI-INFLAMMATORY AND TOXIC EFFECTS OF *LANTANA CAMARA L.*

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ABSTRACT

Lantana camara has been used traditionally to manage several diseases such as wound healing, inflammation and pain. However, its efficacy and safety has not been scientifically evaluated and clarified. The aim of this study was to determine the anti-inflammatory and antinociceptive activity as well as toxicity of aqueous extract of the plant using animal models. The anti-inflammatory activity assay was carried out using carrageenan induced lung edema and pleurisy mice. Analgesic effect assay was carried out using formalin pain test while the safety of this aqueous plant extracts was determined by intraperitoneal administration of 450, 670 and 1000 mg daily for 28 days after which the changes in selected organ and body weight, hematological and biochemical parameters were determined. Both qualitative and quantitative phytochemical composition was determined using standard procedures. The doses showed significant ($p < 0.05$) anti-inflammatory and analgesic activity and minimal toxic effects. Phytochemical analysis showed that the extract contained various amount of tannins, phenolics, flavonoids, saponins, and alkaloids. Therefore, the extract may possess substances with anti-inflammatory, analgesic and minimal toxic effects. The result from this study supports traditional use of this plant for pain and inflammatory ailments. It also serves as awake up call for researchers to do more and establish its mode of action and to elucidate the metabolites responsible for theses effects in hope of developing a novel remedy for these signs and symptoms.

Key words: *Lantana camara*, Analgesic, Antinociceptive, Anti-inflammatory, Phytochemical, Pain.

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INTRODUCTION

Lantana camara is an erect branching perennial shrub 0.5 – 2 meters in height that belong to Verbenaceae family (Ross IA, 2003) that is found growing wildly in many hot parts of the world. The shrub has many folklore medicinal uses across the world such as a cure for respiratory problems (JohnT *et al*., 1990; Ross IA, 2003), skin disorders, wounds, and malaria. It is also used to as an abortifacient as a remedy for wounds, toothache, headache and rheumatism (Ross IA, 2003).

It essential oil showeda wide spectrum antibacterial and antifungal activities (Deena MJ & Thoppil TE, 2000) besides increasing the mortality rate of *Sitophilus zeamais* (Bouda H *et al*., 2001). It contains Triterpenes such as 22β-acetoxylantic acid, lantic acid, 22β-dimethylacryloyloxylantanolic acid, 22β-dimethylacryloyloxylantanolic acid, 22β-angeloyloxylantanolic acid and lantanolic acid with 22β-Acetoxylantic acid showing antimicrobial activity. The latter compound and 22β-dimethylacryloyloxylantanolic acid also exhibited antimutagenic activity (Barre JT, 1997). The flowers exhibited mosquitoes repelling effect (Dua VK *et al*., 2003). The plant was also found to contain protein a kinase C inhibitory activity, phenylpropanoid glycosides; verbascoside, isoverbascoside, derhamnosylverbascoside, isonuomioside A and calceolarioside E (Taoubi K *et al*., 1997). Aqueous extract of the leaves reduced carrageenan

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induced paw edema and had analgesic effect on hot plate test a supra spinally integrated nociceptive process (Gidwani BK, 2009).

Use of this plant parts for wounds, toothache, headache and rheumatism is suggest that the plant posses anti-inflammatory as well analgesic effects. However scientific studies have not been conducted to evaluate the analgesic effect on clinical pain test model and the toxicity of this plants extract. The aim of this study was to evaluate the analgesic and anti-inflammatory, toxicity effects of *L. camara* leaves using animal models.

METHODS

Preparation of plant materials

Fresh leaves of *L. camara* were collected in the month of April 2014 in Kogelo, Siaya County. It was identified at the Kenyatta University herbarium air dried at room temperature and ground into powder. About 4 kg of the powdered a was soaked in distilled water and placed in a water bath at 60ºC for 6 hours then filtered using Whatman No.1 filter paper. The filtrate was freeze dried and the powder placed in water tight containers then placed in refrigerator at 0^0 C. The powder obtained weighed about 80 grams.

Experimental animals

Male albino rats weighing 100-120 g were used for analgesic study while Swiss Albino mice 8-22 g were used for anti-inflammatory assay. They were housed in cages in a room with ambient temperature of 20 - 25°C and with 12 hour light and dark cycle. Food (mice pellets from Unga feeds) and tap water was provided *Ad libitum*. The experiments were performed in accordance with treatment and care of experimental animals (Wolfensohn& Lloyd, 2008).

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BIOASSAYS

Antinociceptive assay

The Antinociceptive assay was carried out using formalin test as described by Hunskaar *et al.* (1985), where five groups of white Wister rats (n =5) were pretreated with 25, 50, 100 mg doses of *L. camara* extract, 15 mg of diclofenac and normal saline through the peritonium (i.p). Sixty minutes later, each rat was given an injection of 50 µl of 1% formalin into the dorsal surface of the right hind paw. They were then placed in an plexiglass observation chambers with a mirror behind to assist in visualization. Pain was quantified as the time spent in licking and biting the injected paw and was measured from 0 to 5 minutes (first phase) representing neurogenic pain or direct stimulation of the nerve by the formalin and then from 15 to 30 minutes (second phase) representing inflammatory pain and central sensitization of nociceptive pathways (Hunskaar S *et al*., 1985).

Anti-inflammatory assay

Pulmonary edemaand pleurisy as described by Oyebanji *et al.* (2014) were used as models of acute inflammation. Pulmonary edema was induced according to the method described by. The 25, 50, and 100 mg of *L. camara* were administered intraperitonially to three groups of mice in (n = 5) while the control receive normal saline for negative control and diclofenac (positive control). Thirty minutes after the treatments, 0.25 ml of 1% carrageenan solution was injected into the right pleural cavity of each mouse. Four hours later the animals were sacrificed by dipping them into a bottle containing cotton soaked in chloroform. They were dissected pleural fluid collected and numbers of white blood cells in the pleural fluid determined using improved Neubauer chamber. The lungs were then harvested and their weight determined using an analytical balance. The mean weight of the lungs and number of WBC of test was compared with the vehicle treated animals.

Data analysis

The data was expressed as mean and their standard errors. It was then analyzed using one way *Anova* with *Scheffes'* as apost *hoc* test. A value of $p < 0.05$ was considered significant.

PHYTOCHEMICAL ANALYSIS

Qualitative phytochemical analysis

Saponins

Quantification of saponins was carried out using the method by Obadoni & Ochuko but with some modifications where 1.0 g each of the samples powder was extracted with methanol in Soxhlet apparatus for eight hours. Then the methanolic extracts was filtered using Whatman No. 1 filter paper then concentrated using a rotor evaporator under reduced pressure. The methanolic extract was then partitioned using hexane and water. The aqueous layer was partitioned twice with diethyl ether followed by further partitioning with n-butanol thrice. The combined butanol extracts were washed twice with 15 ml of 5% sodium chloride and then evaporated in vacuo to obtain the saponins whose contents were expressed as percentage.

Alkaloids

The alkaloid content was determined using the method described in (Harborne S, 1998) with some modifications where 1.0 g the sample was defatted thrice using hexane then extracted using 50 ml of 10% acetic acid in ethanol. The mixtures were shaken thoroughly, covered and allowed to stand for 4 hours. It was then filtered and concentrated using a water bath to a quarter of the original volume. Then concentrated ammonium solution was added drop wise to precipitate the alkaloids. The precipitate was washed with 1% ammonium hydroxide solution. and dried in an oven at 60^oC for 30 minutes. It was then weighed and placed in a desiccator constant weights were obtained. The weights of the alkaloid were determined by weight differences of the filter.

Total flavonoids assay

The total flavonoid concentration assay was determined using aluminum chloride colorimetric assay (Marinova S *et al*., 2005). Briefly the 0.15 g of the extract was added to 4 ml of double distilled water followed by 0.3 ml of 5% sodium nitrite. Five later, 0.3 ml of 10% aluminum chloride was added followed by 2 ml of 1 M sodium hydroxide six minutes later. The total volume made up to 10 ml with double distilled water. After thorough mixing, the absorbance was taken at 510 nm using quercetin as the standard.

Tannins

The tannins were determined as follows 2g of powder was extracted thrice in 70% acetone then the extract was centrifuged. Different aliquots of supernatant and adjusted to a final volume to 3 ml by addition of distilled water then vortexed. The solution was then mixed with 1 ml of 0.016M $K_3Fe(CN)_6$, followed by 1 ml of 0.02 M $FeCl_3$in 0.10 M HCl and revortexed for 15 minutes after which 5 ml of stabilizer (3:1:1 water:H_3PO_4:1% gum arabica were added before revortexing again. The optical density was read at 700 nm after which it was reweighed periodically until three against blank. Standard curve was plotted using various concentrations of tannic acid (Gurib BK, 2006)**.**

Total phenols

The total phenolic content was determined using Folin-Ciocalteau reagent and tannic acid as the standard according to the method by Rasineni *et al.* (2008). About 500 mg of milled plant material powder was weighed and homogenized in 10ml of aqueous acetone (70%). The homogenate was centrifuged at 10, 000 × g for 20 minutes and the supernatant was used in the determination of total phenols as follows. About 0.5 ml of Folin-Ciocalteau 2 N reagent was added to 2.5 ml of the supernatant and then 2 ml of 10% sodium carbonate in ethanol. The mixture was incubated for 5 minutes at 20ºC and then the absorbance read in triplicates at wavelength of 750 nm.

RESULTS

The average weekly weight of and average weekly changes in the body weight of rats were measured in grams and the results are expressed as a Mean ± standard deviation (SD) for the animals at each dose. $\rho < 0.05$ is considered statistically non-significant when the mean weight of the experimental group of each dose of the plant extract is compared to its relevant control group by ANOVA and post-ANOVA. Growth of the animals treated with 450mg, 670mg and 1000mg/kg are similar, and this therefore indicates that the extract was not toxic.

Table 1. Analgesic effect of aqueous extract of *L. camara* on formalin induced nociception in rats

Treatment	Phase 1	Phase 2
Vehicle (normal saline) + formalin	220.6 ± 8.6	611.4 ± 55.9
Diclofenac + formalin	165.0±20.8	88.0±15.9**
12.5mg/kg bw +formalin	60.0±11.1**	122.2±3.1**
25mg/kg bw +formalin	41.6±5.8**	27.0±1.9***
50mg/kg bw +formalin	83.2±5.0*	31.4±14.0***

Values are expressed as Means ± SD for five animals per group. Significantly different values are indicated by $\rho \leq 0.05$ according to ANOVA and post ANOVA. Very significant different values are indicted by $\rho < 0.001$.

Table 2. Anti-inflammatory effect of the aqueous extract of *Lantana camara* on carrageenan induced pulmonary edema in mice

Treatment	Lung weight (g)	Percentage inhibition
Vehicle(N/saline)	0.67±0.01	0%
Diclofenac	0.17±0.02	75% **
25mg/kg	0.22± 0.03	67% **
50mg/kg	0.21±0.03	69% **
100mg/kg	0.22±0.02	67% **

Values are expressed as Means ± SD for five animals per group. Significantly different values are indicated by $\rho \leq 0.05$ according to ANOVA and post ANOVA. Very significant different values are indicted by $\rho < 0.001$.

Table 3. Effect of the aqueous extract of *L. camara* on carrageenan induced pleurisy in mice

Treatment	Number of White Blood Cells
Baseline (normal control)	2210.0 ± 123.7
N/saline (vehicle) + carrageenan	3632.0 ± 114 1

Diclofenac + carrageenan	2320.0 ± 136.8
25mg + carrageenan	2368.0 ± 55.7**
50mg + carrageenan	3520.0 ± 275.1
100mg + carrageenan	2270.0 ± 130.0**

Values are expressed as Means ± SEM of the number of leukocyte infiltration for five animals per group. Significantly different values are indicated by *$\rho \leq 0.05$ according to ANOVA and post ANOVA statistical analysis and ** $\rho < 0.001$ for very significantly different values.

Table 4. Effects of intraperitoneal administration of high doses of aqueous extracts of *L. camara* daily in rats for 28 days on the average weekly weight change

Drug Dose	Average weekly weight					Δweight/Week
	0	1	2	3	4	
Control	116.0±25.2	130.5±16.2	140. 6±21.0	154.7±17.7	162.6±16.4	11.68±2.94
450mg/kg	96.7±11.7	98.7±12.3	100.3±14.3	127.6±12.9	131.0±11.4	9.68±4.14
670mg/kg	112.7±19.3	114.3±18.7	103.7±18.6	137.1±13.2	140.1±12.9	9.14±2.02
1000mg/kg	138.5±23.7	147.0±25.2	165.6±32.5	169.2±26.3	171.2±26.1	9.04±2.30

Table 5. Effects of intraperitoneal administration of high doses of aqueous extracts of *L. camara* in rats daily for 28 days on the percent organ to body weight

Drug Dose	Percent organ to body weight					
	Brain	**Liver**	**Kidney**	**Lungs**	**Spleen**	**Heart**
Control	3.87±0.16	9.88±0.50	3.11±0.07	4.26±0.35	1.97±0.09	3.04±030
450mg/kg	5.04± 0.14	4.06±0.57	**5.42±0.17[a]**	**9.47±0.43[a]**	**3.04±0.30[a]**	2.86±0.17
670mg/kg	**9.09±1.70[a]**	4.74±4.47	**9.37±1.72[b]**	**11.71±1.43[a]**	3.62±0.57	3.93±0.63
1000mg/kg	**9.66±2.29[a]**	15.50±0.75	3.82±0.14	6.05±0.42	2.29±0.18	1.79±0.10

The results are expressed as Mean± standard Deviation (SD) for five animals for each parameter; $\rho < 0.05$ is considered statistically non-significant when the mean of the experimental group of each dose of the plant extract is compared to the relevant control group by ANOVA and post-ANOVA.

Table 6. Effects of intraperitoneal administration of aqueous extracts of *L. camara* of high doses daily in rats for 28 days on the hematological parameters

Parameter	Hb (g/dl)	RBC (x10^6/μL)	PCV (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)	PLT (x10^3/μL)
Control	10.84±0.82	7.15±0.60	39.5±2.1	55.4±3.2	15.2±0.5	27.4±0.8	501.0±129.9
450 mg	9.13±1.65	6.04±1.31	33.2±13.3	55.8±6.5	15.2±1.2	27.4±1.3	675.5±198.7
670 mg	8.40±3.30	5.78±2.29	30.5±12.1	52.5±2.9	14.5±0.5	27.7±0.9	852.2±269.1
1000 mg	9.90±1.90	7.18±1.32	35.4±6.1	49.5±1.2	13.8±0.4	27.8±0.7	754.4±125.3

The results are expressed as a Mean ± standard Deviation (SD) for the animals at each dose. $\rho < 0.05$ is considered statistically non-significant when the mean of the experimental group of each dose of the plant extract is compared to its relevant control group using different hematological parameters by ANOVA and post-ANOVA

Table 7. Effects of intraperitoneal administration of aqueous extracts of *L. camara* of high doses daily in rats for 28 days on the differential White blood cell count

Parameter	WBC (x10^3/μL)	NEU (x10^3/μL)	LYM (x10^3/μL)	EOS (x10^3/μL)	MON (x10^3/μL)	BAS (x10^3/μL)
Control	6.08±2.11	3.42±1.47	1.57±0.94	0.54±0.14	0.37±0.25	0.20±0.14
450mg	11.43±6.05	5.01±2.10	4.67±3.26	0.53±0.34	0.95±0.64	0.28±0.23
670mg	13.48±7.47	6.74±4.37	3.79±2.41	1.43±1.45	1.14±0.39***	0.39±0.38
1000mg	5.75±1.73	3.66±0.56	1.44±1.14	0.11±0.28	0.52±0.08	0.03±0.08

The results are expressed as a Mean ± standard Deviation (SD) for the animals at each dose. ***$\rho<0.05$ is considered statistically significant when the mean of the experimental group of each dose of the plant extract is compared to its relevant control group using different parameters by ANOVA and post-ANOVA

Table 8. Effects of intraperitoneal administration of aqueous extracts of *L. camara* of high doses daily in rats for 28 days on the liver function test

Parameter	I-Bil(µM)	T-Bil (µM)	D-Bil (µM)	AST (U/L)	ALP (U/L)	ALT (U/L)
Control	3.14±1.62	7.76±3.59	4.62±1.98	253.4±67.3	1.4±3.58	95.2±33.0
450mg	1.96±0.68	5.56±1.25	3.60±0.60	261.0±49.7	1.8±0.84	174.8±33.0
670mg	1.38±0.73	4.75±1.03	3.38±0.95	396.0±80.3***	2.25±1.26	311.0±120.6***
1000mg	1.875±0.5	4.52±1.27	2.88±0.73	208.2±55.0	2.2±2.17	117.6±24.7

The results are expressed as Mean ± Standard Deviation (SD) for five animals in each treatment; [a]$\rho < 0.05$ is considered significant when the mean of control animals is significantly different from that of the extract at different doses for different parameters as can be observed in treatment with 670mg/kg body weight.

Table 9. Effects of intra-peritoneal administration of aqueous extracts of *L. camara* of high doses daily in rats for 28 days on the lipid profiles

Parameter	T-Chol (mM)	Trigly (mM)	HDL-Chol (mM)	LDL-Chol (mM)	GLU (mM)	LDH (U/L)	AMYL (U/L)
Control	0.98±0.28	0.48±0.24	0.76±0.25	0.28±0.08	3.86±0.95	737.0±438.7	1172.4±422.3
450mg	1.44±0.11	0.89±0.16	1.13±0.10	0.41±0.05	5.88±1.74	542.2±155.0	1543.4±284.1
670mg	1.25±0.37	1.40±0.60	0.97±0.26	0.32±0.16	4.75±0.75	860.8±348.1	963.5±272.3
1000mg	1.1±0.19	1.21±0.19	0.86±0.14	0.25±0.07	6.34±1.79	534.2±217.1	1430.8±303.2

The results expressed as Mean ± Standard Deviation (SD) for the five animals in each treatment group. $p<0.05$ is considered non-significant when the mean of the control animals is compared to the experimental group at each dose of the plant extract.

Table 10. Effects of intraperitoneal administration of aqueous extracts of *L. camara* of high doses daily in rats for 28 days on the kidney function test

Parameter	Urea (mM)	Creat (µM)	BUN (mM)	CA (mM)	UA (µM)
Control	6.42±0.71	27.0±4.2	0.04±0.04	2.58±0.55	103.6±40.23
450mg	7.44±0.58	30.8±3.4	3.46±0.25***	0.08±0.01***	263.4±69.53***
670mg	6.43±0.75	26.8±3.3	3.00±0.37***	0.05±0.01***	206.25±78.72
1000mg	5.52±0.71	27.0±4.6	0.02±0.02	2.58±0.35	225.8±32.78***

The results expressed as Mean ± Standard Deviation (SD) for the five animals in each treatment group. $\rho < 0.05$ is considered non-significant when the mean of the control animals is compared to the experimental group at each dose of the plant extract using different parameters.

Table 11. Results of the preliminary phytochemical screening of water extracts

Test/Reaction	Observation	Presence/Absence
Saponins	Leather formation	+++
Tannins	White precipitate	++
Steroids	No bluish green	---
Flavonoids	Yellow color	+++
Carbohydrate	Violet ring	---
Alkaloids	Orange brown color	++++

Results are expressed as +which indicates the presence of a particular phytochemical constituent. The more the number of + the higher the amount of a particular constituent while – indicates absence of that particular substance.

Phytochemical Analysis

Table 12.Preliminary Phytochemical Screening of water extracts

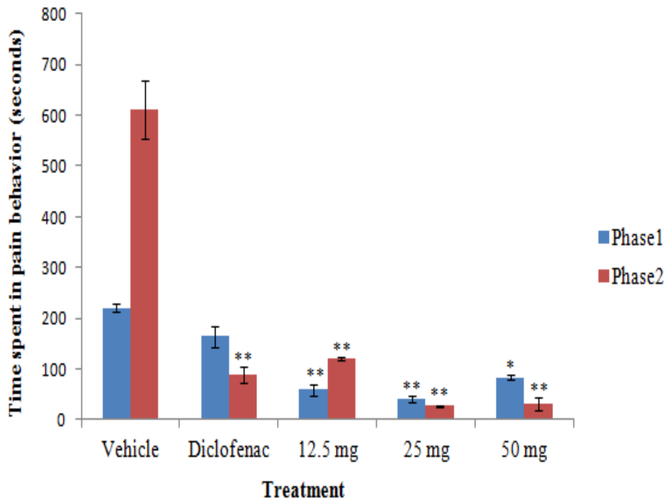
Test reaction	Observation	
Saponins	Leather formation	+++

Tannins	White precipitate	++
Steroids	No bluish green	-
Flavonoids	Yellow colour	+++
Carbohydrates	Violet ring	-
Alkaloids	Orange brown colour	++++
	+++ = Present --- = Absent	

Table 13. Quantities of various groups of secondary metabolites present in *L. camara*

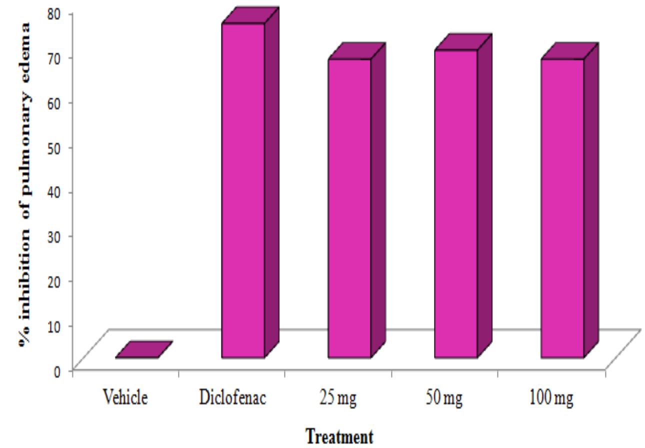
Tanninsmg/g	Total Phenols mg/g	Flavonoidsmg/g	Saponinsmg/g	Alkaloidsmg/g
6.38 ± 0.11	4.93 ± 0.04	16.62 ± 0.05	51.73 ± 1.50	137.10 ± 1.71

Fig 1. Analgesic effect of the aqueous extract of *L. camara* aqueous extract in formalin induced nociception in rats



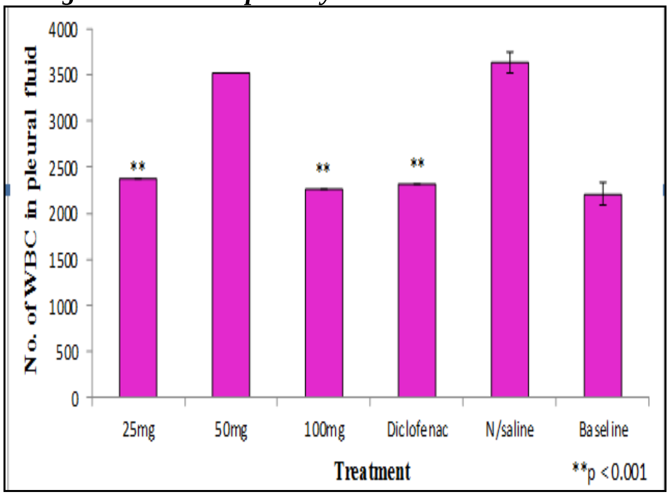
The symbols ** are used to indicate significantly difference values ρ ≤0.05; the two different color bars represent the different phases of pain for different groups of animals that is the first phase (acute phase) which occurs 0-5 minutes and the second phase which occurs between 15-30 minutes.

Fig 2. Effect of aqueous *L. camara* extract on carrageenan induced lung edema in rats.



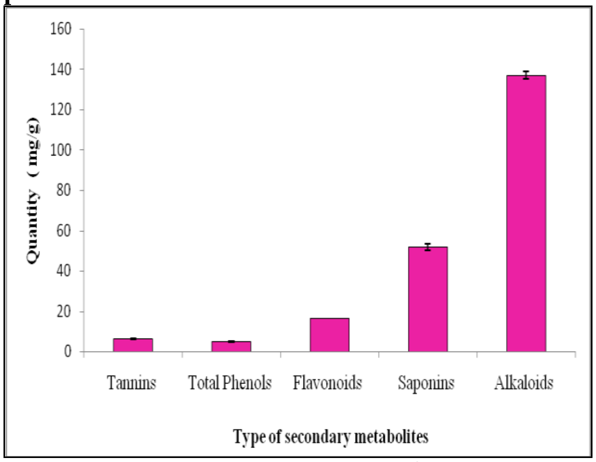
The percent lung weight to body weight was assessed one hour after carrageenan injection. Each bar represents the Mean ± SEM of *five mice each*. *p < 0.05, ANOVA followed by *scheffe*'s post hoc. At 25 and 50 mg/kg body weight doses of the herb, significant reduction (**ρ < 0.05) of pulmonary inflammation was observed just like in Diclofenac treated mice.

Fig 3. Effect of aqueous extract of *L. camara* on *carrageenan-induced pleurisy in mice*



Each bar represents the mean ± SEM. of five mice each. **p < 0.05, ANOVA followed by *Scheffe's* post hoc. At 25 mg/kg and 100 mg/kg body weight doses, a very significant reduction (**p < 0.001) in number of leukocytes in the pleural fluid was observed just like in diclofenac treatment.

Fig 4. Quantity of various types of secondary metabolites present in *L. camara*.



The plant contained relatively large quantities of alkaloids, saponins and Flavonoids.

DISCUSSION AND CONCLUSION

All the doses of the extract showed significant ($p < 0.001$) analgesic effect in both phases of nociception (Figure 1; Table 1). The 25 mg dose was the most potent followed by the 50 mg dose. The first phase which is recorded in the first five minutes represents acute pain due to direct action of formalin on pain receptors (nociceptors) while the second phase occurring between 15-30 minutes represents the inflammatory or chronic pain it also has a neurogenic component (Hunskaar S, 1995). Carrageenan stimulates release of interleukin 1β and Tumor necrotic factor α (TNF-α) which are the pro-inflammatory cytokines that mediate formalin induced nociception in the late phase (Granados S *et al*., 2000). The TNF-α causes the release of interleukin-1β and interleukin-6 that which stimulates COX activity. Production of proinflammatory cytokines is inhibited by steroids which may explain the effect of glucocorticoids in alleviation of inflammatory hyperalgesia (Cunha *et al*., 1992). The pivotal role of tumour necrosis factor α in the development of inflammatory hyperalgesia. It is believed that interleukin-1β acts via COX-2 during in the inflammatory phase hence it is not involved in the early phase of nociception it is no wonder then selective COX-2 inhibitors normally have no effect on pain sensation in the early phase of nociception (McNamara *et al*., 2007). The extract from the plant inhibited both the early and the late phase of nociception an observation that may indicate that it directly or indirectly inhibited the nociceptors or may have blocked the production of either the proinflammatory cytokines or perhaps the cyclooxygenase activity in the second phase.

In the study, all the doses of the plant extract exhibited highly significant edema diminishing effect (Figure 2; Table 2). The 25 and 100 mg doses of the herb showed very significant reduction ($p < 0.001$) in number of white blood cells infiltration in the pleural fluid just like the diclofenac. However, the 50 mg dose showed no effect (Figure 3; Table 3). Carrageenan phlogistic activity has been studied for a long time and was first shown to induce edema (Winter *et al.*, 1962). It elicits an inflammatory response that involves edema formation and neutrophil infiltration (SalveminiD *et al.*, 1996). The capacity of leukocytes to infiltrate tissues in response to immune or inflammatory stimuli is a cardinal feature of host defence system (Spertini O *et al.*, 1991), it is essential for the generation of effective inflammatory and rapid immune responses (Steeber DA&Tedder TF, 2000). The process involve neutrophil recruitment, lymphocyte recirculation and monocyte trafficking, adhesion, slow rolling, adhesion strengthening, intraluminal crawling and transmigration through vascular wall. Additional steps include and paracellular and transcellular migration (Ley K *et al*., 2007). The ultimate effect of this cellular chemotaxis is degranulation and release of vasoactive amines that increase fluid exudates from the blood vessels resulting in edema formation (Guyton B & Hall K, 2015) this increase in vascular permeability is followed by phagocytic cells infiltration, mainly neutrophils that aggregate the inflammatory response via production inflammatory mediators (Fantone& Ward, 1985). Carrageenan-induced mouse paw edema is biphasic (Henriques MG *et al.*, 1986) with cyclooxygenase (COX-1) activity expression upregulated from 4 to 24 hours after injection (Posadas I *et al*., 2004). Similary, pleural exudation occurs in two phases, the first exudative phase is attenuated by neutrophil mobilization and cyclooxygenase (COX) inhibitors while the second phase is not affected by COX inhibitors but is highly susceptible to steroids action (Vinegar R *et al*., 1982). In this study carrageenan attenuated both edema and pleurisity development by the 4th hour just like diclofenac (Figure 2 & 3). Hence it can be postulated that both activities may have been inhibited via inhibition of COX activity. However it is also possible that it may have acted via inhibition of white blood cells mobilization.

Phytochemical screening revealed the presence of tannins, proteins, terpenoids, flavonoids, quinine, and starch cardiac glycosides in the aqueous extract of *L. camara* (Table 4), which were quantified as shown in Figure 4. Activity of observed with the extract of this plant may be attributed to presence of these metabolites. Anti-inflammatory effects have been reported in with flavonoids (Rotelli AE *et al*., 2003; García , 2009) and alkaloids (Souto AL *et al.*, 2011) similarly, antinociception has been reported with flavonoids (Rylski M *et al*., 1979; Calixto JB *et al*., 2000) and alkaloids (Calixto JB *et al*., 2000; Casy&Parfitt, 2013) and to some extent terpenoids (Calixto JB *et al*., 2000). *L. camara* extracts contained relatively large amount of alkaloids and substantial amount of flavonoids which meant that the anti-inflammatory and analgesic activity observed with the extracted could be attributed to these metabolites. The current study demonstrated that *L. camara* extracts posses both anti-inflammatory and analgesic effects and hence support the folklore use of the herb in alleviation of the two conditions. Therefore more research with the aim of isolation and elucidation of the active metabolites is necessary.

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CONFLICT OF INTEREST

No interest

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