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Mini Review
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Antidiabetic and other Pharmacological Studies on *Lucas inflata* Benth

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Mini Review

The genus Leucas (family: Lamiaceae) is represented by over 116 members, which are broadly distributed throughout Asia, Africa, and India [1]. Members of this genus have been widely used as remedies in folk medicine in Africa and India for many diseases, and, thus, they have received considerable attention. Species, e.g., L. lavandulaefolia, have been described to have hepatoprotective, antipyretic, anti-diarrheal, hypoglycemic, antitussive, and wound healing activities [2-7]. Moreover, L. aspera was found to have antimicrobial, anti-inflammatory, antinociceptive, antioxidant, and cytotoxic activities [8-10]. L. martinicensis showed antibacterial, anthelmintic, and antimalarial activities [11-13]. Leucas inflata, the native range of this species is NE. Tropical Africa to Arabian Peninsula. It is a subshrub or shrub and grows primarily in the desert or dry shrubland biome (Figure 1).

Figure 1: *Leucas inflata*.

The plant is used in traditional medicine to cure many diseases such as cough, cold, diarrhea, and inflammatory skin disorders. A variety of phytoconstituents have been isolated from the Leucas species, which include lignans, flavonoids, coumarins, steroids, terpenes, fatty acids, and aliphatic long-chain compounds. Anti-inflammatory, analgesic, anti-diarrheal, antimicrobial, antioxidant, and insecticidal activities have been reported in the extracts of these plants and their phytoconstituents. An overview of the ethnobotanical, phytochemical, and pharmacological investigations on the Leucas species is presented in a big review [14]. The plants of the genus Leucas have been used by the tribals in various parts of Asia, Africa, and India.

The phytochemical work on the genus Leucas revealed the presence of variety of phytoconstituents like terpenoids, flavonoids, steroids, saponins, coumarins, fatty acids, tannins, and others from the acetone extract of the roots of Leucas inflata, four coumarins (siderin, coumarsabin, 8-methoxycoumarsabin and coumarleucasin) and one chromone were isolated. One of the coumarins, coumarleucasin (5-formyl-4,7,8-tri methoxy-3-methyl-coumarin), and the chromone, leucasone [(2,8-dimethyl (2,2-dimethyl ethenyl)-5,6-benzo-4-pyrone)], have not been reported previously [15]. The aerial parts of Leucas spp. also contain volatile oil, consisting of a variety of compounds. The analgesic activity of the methanol and acetone extracts of Leucas inflata L. (family Labiatae) was evaluated in mice using different experimental models [16]. Leucas species have been used in traditional medicine for various purposes, including treating fever, pain, inflammation, and respiratory disorders. Many species of Leucas have been found to possess pharmacological activities, such as antidiabetic, antimicrobial, antioxidant, analgesic, and anti-inflammatory properties. Some species have also been shown to have antitumor and neuroprotective effects. In the present study, different pharmacological activities of the genus Leucas inflata are dealt to verify its medicinal values (Table 1-10) & Figure 2).

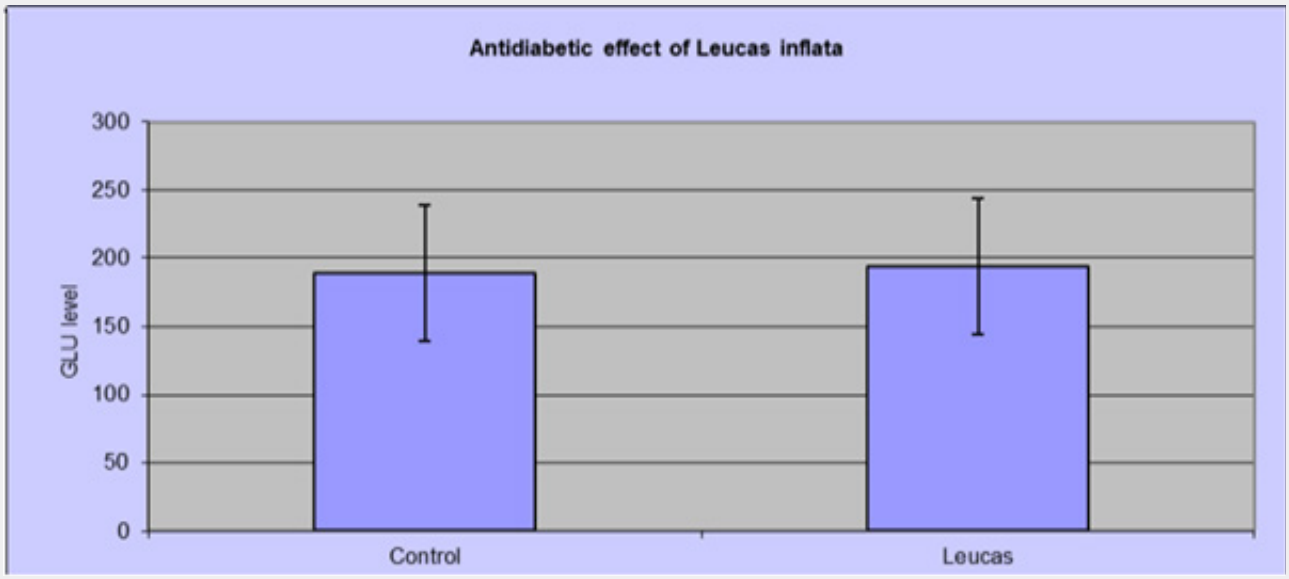

Figure 2: Antidiabetic effect of *Leucas inflata*.

Table 1: Antidiabetic activity (STZ) of *Leucas inflata*.

	Control			Treated		
S. No	Initial	2nd Reading	3rd Reading	Ammi	Tribulus	Leucas
1	144.1	170	197.6	164	211.2	264.4
2	153.5	155.4	217.2	230.8	165.8	246
3	141.6	171.5	184.9	137.3	180.7	198.1
4	157.3	218.4	209.4	127.7	161.9	172.3
5	136	188.7	211.8	141.9		201.4
6	167.7	198.1	255.5	169.6	171.4	191.1
7	124.8	187.8	165.3	150.4	160.9	196.6
8	175.6	191.6	119.2	146.9	141.3	218.3
9	142.8	182	201.6	204	169.9	193.5
10	150.2	200.8	251.9	175	177.4	241.5
11	128.3	147.3	160.6	135	115	156.3
12	135.9	145.8	164.1	146.1	120	150.1
13	124.7	184.3	174.2	124	139	132.4
14	127.3	154.4	157.7	125.1	132.9	150.7
15	135	145.2	162.7			
n	15	15	15	14	13	14
x	142.9867	176.0867	188.9133333	155.5571	157.4923	193.7643
sd	15.43363	22.64858	36.94594249	30.99334	26.90581	39.30351
se	3.984946	5.847839	9.539401332	8.283319	7.462328	10.5043
p				0.1876	0.061734	0.735142

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Table 2: Rectal temperature activity for *Leucas inflata* extract.

Rectal temparature activity for Leucas inflata extract		
S. No.	Control	Leucas inflata
1	36.9	36.7
2	37	37
3	38.4	36.5
4	37.9	36.8
5	36.8	38
6	37.2	37.5
7	37.6	37.8
8	37	37.1
n	8	8
x	37.35	37.18
sd	0.57	0.54
se	0.20	0.19
p		0.54
Control	37.35	
cas inflata	37.18	

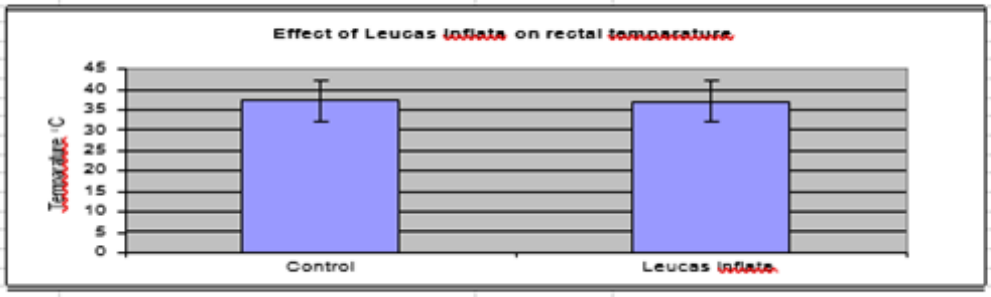

Table 3: Antidepressant activity of *Leucas inflata* (2g/kg) p.o. TST method.

Antidepressant activity of Leucas inflata (2g/kg p.o. TST method			
S.No	Control Group		Leucas inflata trated grouop
1	80		43
2	79		
3	70		132
4	90		108
5	60		110
6	98		78
7	90		103
8	89		
9	86		
10			
n	9		6
x	82.44444444		95.66666667
sd	11.66309469		31.03975945
se	3.88769823		12.67192873
p			0.357311592
	Control	82.444444	
	Leucas inflata	95.666667	

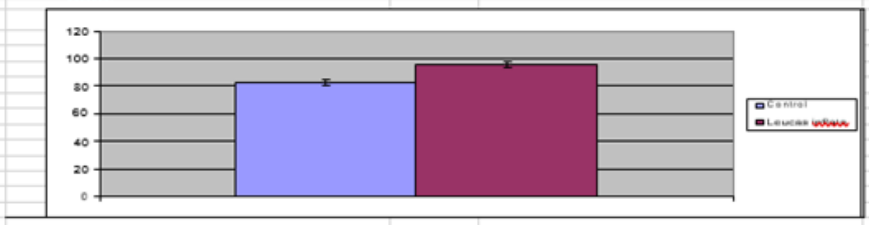

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Table 4: Rota rod activity for extract.

Rota rod activity for Extract		
S. No.	Control	Extract 248 treated group
1	10	0
2	6	5
3	7	2
4	4	2
5	0	1
6	6	1
7	2	1
8	1	1
n	8	8
x	4.5	1.625
sd	3.380617019	1.505940617
se	1.195228609	0.532430411
p		0.053567269

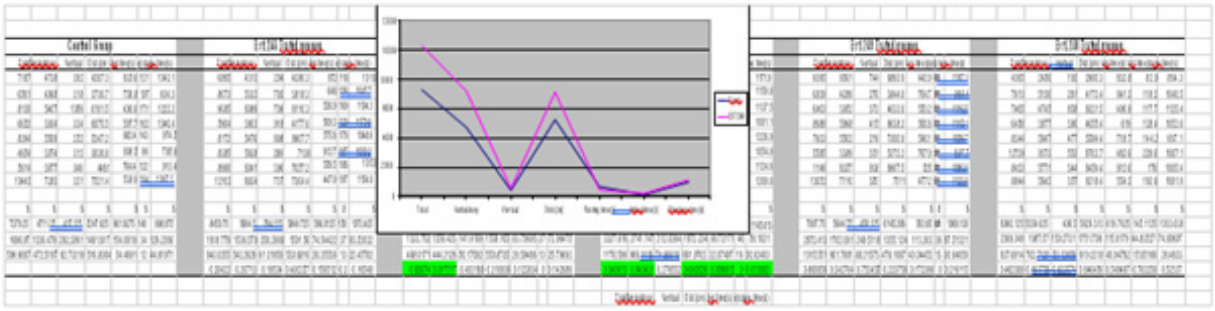

Table 5: Organ weight studies of *Leucas inflata*.

Organ Weight Studies of Leucas inflata																
Extract Treated Group																
BW	Liver	Ratio	Spleen	Ratio	R Kidney	Ratio	L Kidney	Ratio	T kidneys	Ratio	R Testes	Ratio	L Testes	Ratio	2 Testes	Ratio
41.5	2.074	0.049976	0.76	0.018313	0.283	0.006819	0.293	0.00706	0.576	0.01388	0.089	0.0021	0.09	0.0022	0.179	0.0043
44.4	2.11	0.047523	0.126	0.002838	0.389	0.008761	0.403	0.009077	0.792	0.017838	0.112	0.0025	0.095	0.0021	0.207	0.0047
39.4	1.801	0.045711	0.102	0.002563	0.302	0.007665	0.309	0.007843	0.611	0.015508	0.091	0.0023	0.084	0.0021	0.175	0.0044
33	1.456	0.044121	0.101	0.003848	0.206	0.006242	0.183	0.005545	0.389	0.011788		0		0		
30.2	1.354	0.044834	0.127	0.004636	0.19	0.006291	0.19	0.006291	0.38	0.012583		0		0		
34.3	1.7	0.049563	0.14	0.004082	0.205	0.005977	0.194	0.005656	0.399	0.011633		0		0		
6	6	6	6	6	6	6	6	6	6	6	3	6	3	6	3	3
37.133	1.749167	0.046955	0.226	0.006047	0.2625	0.006959	0.262	0.006912	0.5245	0.013871	0.097333	0.0012	0.089667	0.0011	0.187	0.0045
5.4808	0.310781	0.002463	0.262051	0.006059	0.07712	0.001067	0.088431	0.001371	0.165337	0.002426	0.012741	0.0013	0.005508	0.0012	0.01744	0.0002
2.2375	0.126876	0.001005	0.106982	0.002474	0.031484	0.000436	0.036102	0.00056	0.067499	0.00099	0.007356	0.0005	0.00318	0.0005	0.01007	0.0001
0.9877	0.806153	0.337975	0.375185	0.320246	0.987628	0.989794	0.775141	0.637995	0.874387	0.799246	0.877367	0.9819	0.689661	0.9717	0.07875	0.0773

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Table 6: APTT study for Lucas sample.

APTT study for Lucas sample		
S. No.	Control	248 sample treated group
1	25.5	29.8
2	26.4	33.3
3	26.1	23.8
4	23.7	24.2
5	20.7	35.8
6	22.3	45.4
7	21.4	28.2
8	23.3	34.2
n	8	8
x	23.675	31.8375
sd	2.161183538	7.047580639
se	0.764093768	2.49169603
p		0.013337221
Control	23.675	
248	31.8375	

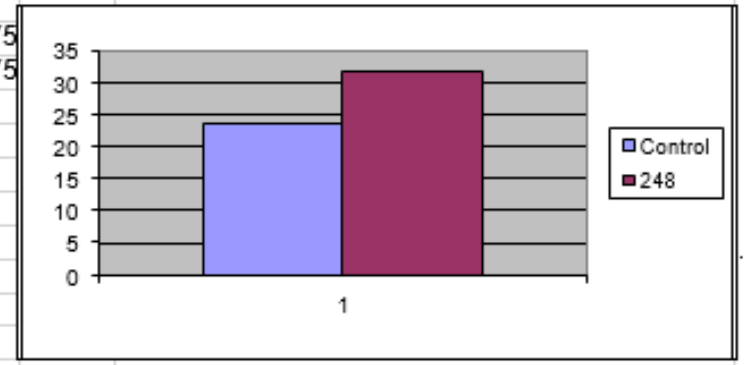

Table 7: Haematology study on *Leucas inflata* Ext.

S. No.	Haematology Study on *Leucas inflata* Ext.															
Control group						*Leucas inflata* Ext. 248 treated group										
	WBC	RBC	HGB	HCT	MCV	MCH	MCHC	PLT	WBC	RBC	HGB	HCT	MCV	MCH	MCHC	PLT
1	11.5	9.61	12.3	46.3	48	12.8	26.6	276	17.8		13.4	50.9	47	12.5	26.4	409
2	13.1		12.7	48.8	47	12.3	26.1	500	16		13.3	49.7	49	13	26.7	404
3	14.3	9.85	12.6	48.3	49	12.8	26.1	451	12.2	9.88	13.4	50	51	13.6	26.9	330
4	12.1	9.94	12	46	47	12	25.7	487	14.1	9.86	12.5	48.1	49	12.7	26	438
5	9.9		13.3	49.2	48	12.8	27	335	12.3		13.4	53.1	50	12.7	25.3	283
6	9.3	9.64	12.1	46	48	12.5	26.3	281	10.7	9.99	13.3	48.7	49	13.3	27.4	334
7	10.2	8.97	12	44.7	50	13.4	26.9	173	12.7		14.1	55.3	50	12.7	25.6	313
8	6.3		13.2	48.8	48	13.1	27	4.2	11.4		13.6	54.8	50	12.3	24.8	293
n	8	5	8	8	8	8	8	8	8	3	8	8	8	8	8	8
x	10.8375	9.602	12.525	47.2625	48.125	12.713	26.463	313.4	13.4	9.91	13.375	51.325	49.375	12.85	26.1375	350.5
sd	2.48937	0.3797	0.51755	1.70037	0.99103	0.4422	0.4868	169.93	2.421334	0.07	0.439968	2.748896	1.187735	0.427618	0.874949	58.43433
se	0.88013	0.16981	0.18298	0.60117	0.35038	0.1563	0.1721	60.078	0.856071	0.040415	0.155552	0.971881	0.419928	0.151186	0.309341	20.65966
p									0.055661	0.1453	0.003389	0.004127	0.038935	0.537436	0.378341	0.57418

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Table 8: Gastric ulcer activity of Leucas inflata , 1g/kg p.o. Ethanol induced.

Control	*Leucas inflatat* 248
4	0
5	0
3	3
4	1
2	3
3	
2	
1	
8	5
3	1.4
1.309307	1.516575
0.534522	0.619139
	0.088871

Table 9: Biochemical activity of Leucas inflata.

S. No.	Boichemical Activity of Leucas inflata																			
	Control Group										Leucas Treated Group									
	BUN	CREA	TP	ALB	TBIL	CHOL	ALP	AST	ALT	LDH	BUN	CREA	TP	ALB	TBIL	CHOL	ALP	AST	ALT	LDH
1	26	0.2	5.6	1.3	0.09	103	40	68	12	355			5.4		0.11	119	7	76	11	
2	15	0.2	3.6	0.8	0.02	64	21	41	10	257	18	0.5	5.3	1.2	0.11	109	36	54	18	203
3	22	0.4	4.3	1	0.04	94	39	50	10	260	14	0.3	4.2	1	0.03	79	54	45	10	221
4	14	0.2	4.4	1	0.09	104	34	46	8	183	19		5.4	1.3	0.07	123	44	73	13	275
5	24	0.4	5.7	1.7	0.15	91	59	48	8	203	19	0.3	5.5	1.5	0.07	78	58	78	10	275
6	11	0	2.8	0.8	0.01	42	33	31	9	82	19	0.3	5.8	1.6	0.16	91	54	65	9	241
7	25	0.4	5.4	1.5	0.1	110	38	54	11	252	18	0.3	5	1.3	0.06	61	48	60	11	220
8	10	0.3	4.4	1.1	0.01	65	42	41	16	172	19	0.3	5.7	1.6	0.1	85	68	85	12	268
n	8	8	8	8	8	8	8	8	8	8	7	6	8	7	8	8	8	8	8	7
x	18.375	0.2625	4.525	1.15	0.06375	84.125	38.25	47.375	10.5	220.5	18	0.333333	5.2875	1.357143	0.08875	93.125	46.125	67	11.75	243.2857
sd	6.56696	0.14079	1.01524	0.32514	0.05125	24.234	10.634	10.875	2.6186	80.376	1.825742	0.08165	0.502671	0.222539	0.039799	21.85954	18.45796	13.45893	2.815772	29.69127
se	2.32177	0.04978	0.35894	0.11495	0.01812	8.5679	3.7595	3.8449	0.9258	28.417	0.645497	0.028868	0.177721	0.07868	0.014071	7.728513	6.525876	4.758451	0.995526	10.49745
p											0.880698	0.261001	0.08541	0.170784	0.295352	0.448516	0.317802	0.006629	0.373505	0.474631

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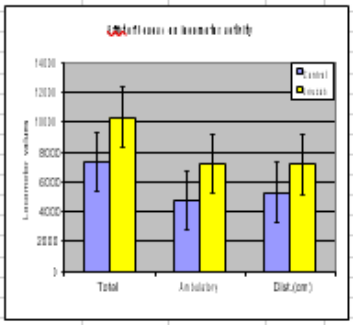
Table 10: Lcomotor activity of Leucas inflata extract.

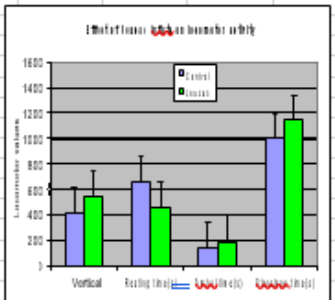
Locomotor activity of Leucas inflata extract

	Control							Leucas extTrated groupp						
S.No.	Total	Ambulatory	Vertical	Dist./(cm)	Resting time(s)	Ambul time(s)	Stereotype time(s)	Total	Ambulatory	Vertical	Dist./(cm)	Resting time(s)	Ambul time(s)	Stereotype time(s)
1	7187	4738	382	4287.3	635.6	121.3	1043.1	8801	5784	500	7213.3	427.9	200.2	1171.9
2	6661	4068	318	3730.7	758.8	106.9	934.3	9889	6761	633	8335.3	458	172.2	1159.8
3	8130	5407	1059	6101.5	406.8	171	1222.2	7892	5169	479	6473.7	483.9	178.8	1137.5
4	6652	3934	334	6875.5	597.7	162.2	1040.4	5300	3047	153	3719.8	612	106.9	1081.1
5	8394	5509	252	5347.2	682.4	143.1	974.5	16117	11817	757	9405.1	323.2	249.9	1226.9
6	4954	3074	312	3638.8	908.5	95.6	795.9	10241	7269	401	7099.3	557	188.1	1054.9
7	5914	3677	349	4481	764.4	122.2	913.4	13325	9903	776	9711.2	422.1	253.3	1124.6
8	10442	7283	321	7521.4	538.9	193.9	1067.2	11125	7832	713	7148.3	402.4	187.8	1209.8
n	8	8	8	8	8	8	8	8	8	8	8	8	8	8
x	7279.25	4711.25	417.125	5247.925	661.6375	139.525	998.875	10311.25	7197.75	561.5	7138.225	462.0625	192.125	1146.8125
sd	1698.870473	1338.479143	262.2890649	1461.817073	154.0618887	34.01754799	126.2036968	3327.916412	2741.146515	212.036385	1872.334468	90.7217085	46.3275219	59.18210245
se	599.9886844	472.5167325	92.73318821	516.8303824	54.46910309	12.02701943	44.61970957	1176.596131	969.1416443	74.96618285	661.9701988	32.07496764	16.37925245	20.92403298
p								0.04361257	0.043430808	0.279552222	0.042025544	0.008814998	0.022664843	0.013883121

	Total	Ambulatory	Dist./(cm)
control	7279.25	4711.25	5247.925
eucas.	10311.25	7197.75	7138.225

	Vertical	Resting time(s)	Ambul time(s)	Stereotype time(s)
control	417.125	661.6375	139.525	998.875
eucas.	561.5	462.0625	192.125	1146.8125





Evaluation of Anti-Diabetic Activity in STZ Diabetic Mice

The hypoglycaemic activity of the plant extract in mice made diabetic by streptozotocin (STZ) was investigated. The plant extract administered at doses of 1g/g/kg daily for 7 days failed to reduce blood glucose levels in STZ induced diabetic mice as compared to the control group. The present study clearly shows that the oral administration of plant extract did not possess significant antihyperglycemic activity.

Effect of Plant Extract on the Guinea-Pig Isolated Ileum

A male guineapig is killed by a blow on the head and exsanguinated. The abdomen is opened and the caecum is lifted. A part of the ileum, attached to the rear of the caecum, is removed, placed in a dish and covered with modified Tyrode solution. The mesentery was trimmed away and the ileum is cut into pieces of 2 - 3cm (in relaxed condition). A thread is attached to each end of the piece of ileum by inserting a needle from the inside of the ileum to the outside. The piece of ileum is firmed in a vertical position in a 10ml organ bath filled with modified Tyrode solution, kept at 37°C, and bubbled through with oxygen/carbon dioxide (95% O2 + 5% CO_2).

One end is tied to a fixed pin and the other one to an isotonic transducer loaded with 1g. The ileum preparation is equilibrated in the bath fluid for at least 10 minutes to stabilize the baseline value. Every 5 minutes it is washed. All washes consist of 3 replacements of bath fluid.

Extract of *Leucas inflata* L., given at single oral doses of 0.25, 0.5, 1.0, or 2.0g/kg, significantly and dose-dependently, reduced formal in induced pain, acetic acid-induced abdominal constrictions and increased the reaction time in the hot-plate test. The extract caused significant and dose-related impairment in the sensorimotor control and ambulatory and total motor activity of treated mice. Both extracts exhibited anti-inflammatory action by reducing paw edema of treated mice. The extracts did not significantly affect the rectal

temperature of normothermic mice. However, it was effective in preventing Brewer's yeast-induced pyrexia. It is concluded that the extract of *Leucas inflata* has CNS depressant properties, manifested as antinociception and sedation. The extract has anti-inflammatory and antipyretic actions.

The analgesic activity of the extract of *Leucas inflata* was evaluated in mice using different experimental models. The effect of the two extracts on pentobarbitone-sleeping time, motor activi-

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ty, sensorimotor coordination, carrageen-induced inflammation, and brewer's yeast-induced pyrexia has also been investigated. The crude extract has been phytochemically analyzed and some constituents isolated and characterized. These included stigmasterol's, chromone, and coumarins. Extract of *Leucas inflata*, given at single oral doses of 0.25, 0.5, 1.0 or 2.0g/kg, significantly and dose-dependently, reduced formalin-induced pain, acetic acid-induced abdominal constrictions and increased the reaction time in the hot-plate test. Both extracts caused significant and dose-related impairment in the sensorimotor control and ambulatory and total motor activity of treated mice. The extract exhibited anti-inflammatory action by reducing paw edema of treated mice. The extract did not significantly affect the rectal temperature of normothermic mice. However, it was effective in preventing Brewer's yeast-induced pyrexia. It is concluded that the crude extract of *Leucas inflata* has CNS depressant properties, manifested as antinociception and sedation. The extract has anti-inflammatory and antipyretic actions.

The results of the experiments indicate that plant extract, tested at concentrations of 100mg/ml actively reduced the guinea pig ileum contractions. The extract caused significant and dose-related impairment in the sensorimotor control and ambulatory and total motor activity of treated mice.

These findings are of interest in regard to the medical uses of *Leucas inflata* as an herbal drug for the spasmolytic effect. The presence of relaxation/ antispasmodic activity showed antidiarrheal/ antisecretory activity. It might produce relief of gastrointestinal spasms and improve digestion.

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