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Protective Effects of Roots of Terminalia Paniculata and Boswellia Ogadensis Against Inflammation

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Abstract:

Two of India's most common plant species are Boswellia ogadensis and Terminalia paniculata. The anti-inflammatory effects of Terminalia paniculata and Boswellia ogadensis root extracts were studied using methanolic and nHexane methods. At doses of 200, 400, and 600 mg/kg p.o., respectively, of methanolic and n-Hexane root extracts of Terminalia paniculata Brandis and Boswellia ogadensis shown anti-inflammatory efficacy in both acute and chronic settings.

Keywords: Methanol, n-Hexane, acute and chronic inflammatory models.

Introduction

Plants provide an essential role that has allowed animals to exist on this planet. Living things are significant because plants and animals interact and are dependent on one another. Plants with medicinal properties have been around since long before humans did.The herb Terminalia paniculata is a member of the Combretaceae family [1,2]. A species of tree known as Terminalia paniculata is semi-evergreen.The deciduous Boswellia ogadensis tree is a rare and endangered member of the Burseraceae family.[4] The anti-inflammatory effects of n-Hexane and methanolic extracts of Boswellia ogadensis roots and Terminalia paniculata Brandis roots are the primary topics of the present investigation.

Materials and Methods

Collection and Authentification

The roots of Terminalia paniculata Brandis and Boswellia ogadensis most widely found in the India. The plant was collected from Ahemdabad, Gujarat The plant species were authenticated by Taxonomist, Department of Botany, Sabarmati University.

Extraction

After gathering and cleaning the fresh roots, they were left to dry at room temperature for one week before being ground into a powder using a mixer grinder. For 18 hours at 60°C, the Soxhlet apparatus was used to continuously extract 25 gms of the coarse powder with 100 ml of methanol (SD Fine, India). The n-Hexane (SD Fine, India) was used to extract the powder in a sequential fashion. A Whatman no.1 filter paper was used to filter all of the extracts. The next step was

to use a rotary flash evaporator set to 50oC to reduce the volume of the extracts to 30 ml. In a vacuum oven set at 30 to 50˚C, the 30 ml extracts were subsequently concentrated until they reached a consistent weight. Before analysis, the residues that evaporated and maintained a steady weight were kept in a dark place at 4°C. Terminalia paniculata's methanolic residue is known as METP, while its n-hexane residue is known as HETP. The methanolic and n-hexane residues of Boswellia ogadensis were dubbed MEBO and HEBO, respectively, according to previous research [5].

In vivo Anti-Inflammatory Activity [6]

Acute Anti-inflammatory Activity (Formalin-induced Paw Oedema in Rats)

The research utilized female Albino rats that ranged in weight from 180 to 230 grams. The sub-plantar region was injected with formalin (0.1 ml of 1% suspension in 0.9% saline; NICE Chemicals, Edappally) to cause acute inflammation. The paw volume was measured 0, 1, 2, 3, 4, and 5 hours later using a Plethysmometer.

Formalin was given 30 minutes before any of the treatment components. Irritation of the right hind paw developed suddenly. For the second and subsequent dips, a mark was made on the leg at the mallaleous region to help keep the leg at the same level.

After injecting formalin, the first reading was taken at 0 hours. The technique was then repeated at 1, 2, 3, 4, and 5 hours. The actual volume of edema at the moment is determined by subtracting one of the succeeding values from the 0 hour reading. Using the formula, we determined the percentage inhibition by comparing the control group's mean paw volume at various intervals;

Percent inhibition = 100 * (1 – Tt/Tc)

Where, Tt and Tc are the average increase in paw volume of drug treated and control group respectively.

Group-I: Distilled water was supplied and served as control.

Group-II: Animals received a dose of 10 mg/kg of Diclofenac sodium (NICE Chemicals, Manimala Road,,Edappally) i.p. and served as standard

Group-III: Animals received a dose of 200 mg/kg of METP / MEBO p.o.

Group-IV: Animals received a dose of 400 mg/kg of METP / MEBO p.o.

Group-V: Animals received a dose of 600 mg/kg of METP / MEBO p.o.

Group-VI: Animals received a dose of 200 mg/kg of, HETP / HEBO p.o.

Group-VII: Animals received a dose of 400 mg/kg of, HETP / HEBO p.o.

Group-VIII: Animals received a dose of 600 mg/kg of HETP / HEBO p.o.

Chronic Anti-inflammatory Activity (Formalin Induced Paw Oedema)

Each of the six groups consisted of six albino wistar rats ranging in weight from 170 to 230 mg/kg. Prior to the start of the experiment, all of the animals were allowed to drink water at will and fasted for 18 hours. As an oedematogenic agent, 20µl of a recently made 2% suspension of formalin in normal saline was injected subplantarly into the right hind paw of rats across all groups to induce chronic inflammation. The animals were given medication for six days in a row.

In each group, a plethysmometer was used to measure the paw volume both before and six days after the formalin challenge. The calculation involved the increase in paw volume and the percentage of inhibition.

Group-I: Distilled water was supplied and served as control.

Group-II: Animals received a dose of 100 mg/kg of Diclofenac sodium i.p. and served as standard

Group-III: Animals received a dose of 200 mg/kg of METP and MEBO p.o.

Group-IV: Animals received a dose of 400 mg/kg of METP and MEBO p.o. Group-V: Animals received a dose of 600 mg/kg of METP and MEBO p.o. Group-VI: Animals received a dose of 200 mg/kg of, HETP and HEBO p.o. Group-VII: Animals received a dose of 400 mg/kg of, HETP and HEBO p.o. Group-VIII: Animals received a dose of 600 mg/kg of, HETP and HEBO p.o.

Results

Acute Anti-inflammatory Activity (Formalin-induced paw edema in Rats)

All the test compounds (METP, HETP, MEBO and HEBO) were tested with the diclofenac sodium (10 mg/kg) as a standard for the anti-inflammatory activity. Presently diclofenac showed significant 84.38 % inhibition of inflammation at 5th hour (0.20 ± 0.018) when compared with control (1.28 ± 0.042). The test compounds showed maximum percentage of inhibition edema at 5th hour significantly in respective dose levels of 200, 400 and 600mg/kg for the test compounds of METP and HETP as 69.53%, 77.34 %, 82.03% and 62.50%, 71.09%, 76.56% respectively. The values are tabulated in the Table I. The test compounds showed maximum percentage of inhibition of oedema at 5th hour significantly in respective dose levels of 200, 400 and 600mg/kg for the test compounds MEBO and HEBO as 66.41%, 73.44%, 83.59% and 50.78%, 64.84%, 78.91% resp. The values are tabulated in the Table II.

Chronic Anti-inflammatory Activity for Terminalia paniculata Formalin-induced paw Oedema in Rats

Formalin induced paw oedema is one of the most suitable test procedure to screen chronic anti-inflammatory agents. The results obtained as mean increase in paw volume (ml) and % inhibition are represented in Table III and IV. The mean response of standard was 89.73% inhibition of increase in paw thickness after 6 days. In this model at 200, 400 and 600 mg/kg dose levels of METP and HETP extracts showed 37.05%, 54.02%, 75.45%, and 25.45%, 38.84%, 68.30% inhibition of increase in paw thickness after 6 days. The values are tabulated in table no.3. 200, 400 and 600 mg/kg dose levels of MEBO and HEBO extracts showed 43.30%, 67.41%, 81.25%, and 29.46%, 46.88%, 72.32% inhibition of increase in paw thickness after 6 days. The values are tabulated in table no.4. All the results were compared with solvent control and diclofenac sodium reference drug control.

Table I: Effect of METP and HETP on Formalin-induced paw Oedema in Rats (Acute Model)

Groups	Treatment	Paw Oedema Volume (hr)						
		0 hr	1hr	2hr	3hr	4 hr	5 hr	% Inhibition
Group-I	Saline	0.18 ± 0.021	0.78 ± 0.064	1.09 ± 0.037	1.14 ± 0.063	1.19 ± 0.038	1.28 ± 0.042	-
Group-II	Diclofenac sodium (10mg/kg	0.19 ± 0.03	0.34 ± 0.028***	0.57 ± 0.046***	0.32 ± 0.024***	0.23 ± 0.047***	0.20 ± 0.018***	84.38%

	i.p.)	5						
Group-III	METP (200mg/kg p.o.)	0.16 ± 0.025	0.62 ± 0.043**	0.89 ± 0.037**	1.02 ± 0.041***	0.79 ± 0.056***	0.39 ± 0.023***	69.53%
Group-IV	METP (400mg/kg p.o.)	0.17 ± 0.027	0.56 ± 0.040**	0.78 ± 0.054***	0.53 ± 0.028***	0.40 ± 0.037***	0.29 ± 0.021 ***	77.34%
Group-V	METP (600mg/kg p.o.)	0.18 ± 0.039	0.45 ± 0.033***	0.69 ± 0.047***	0.43 ± 0.026***	0.31 ± 0.034***	0.23 ± 0.028***	82.03%
Group-VI	HETP (200mg/kg p.o.)	0.16 ± 0.022	0.70 ± 0.045^{ns}	0.99 ± 0.052^{ns}	1.12± 0.053*	0.94 ± 0.038***	0.48 ± 0.041***	62.50%
Group-VII	HETP (400mg/kg p.o.)	0.17 ± 0.020	0.61 ± 0.038**	0.81 ± 0.043***	0.67 ± 0.029***	0.54 ± 0.032***	0.37 ±0.022***	71.09%
Group-VIII	HETP (600mg/kg p.o.)	0.18 ± 0.034	0.52 ± 0.043***	0.76 ± 0.038***	0.53 ± 0.036***	0.39 ± 0.025***	0.30 ± 0.019***	76.56%

Values are Mean ± SEM (n=6) one way ANOVA followed by Tukey-Karmer's test. Where, *** P<0.001, ** P<0.01, * P<0.05 and ns: Not significant. METP-Methanolic extract of Terminalia paniculata, HETP: n-Hexane extract of Terminalia paniculata

Table II: Effect of MEBO and HEBO on Formalin-induced paw oedema in Rats (Acute Model)

Groups	**Treatment**	**Paw Oedema Volume (hr)**						
		0 hr	**1hr**	**2hr**	**3hr**	**4 hr**	**5 hr**	**% Inhibition**
Group-I	Saline	0.18 ± 0.021	0.78 ± 0.064	1.09 ± 0.037	1.14 ± 0.063	1.19 ± 0.038	1.28 ± 0.042	-
Group-II	Diclofenac sodium (10mg/kg i.p.)	0.19 ± 0.035	0.34 ± 0.028***	0.57 ± 0.046***	0.32 ± 0.024***	0.23 ± 0.047***	0.20 ± 0.018***	84.38%
Group-III	MEBO (200mg/kg p.o.)	0.20 ± 0.032	0.67 ± 0.032*	0.92 ± 0.026*	1.110 ± 0.054**	0.83 ± 0.049***	0.43 ± 0.031***	66.41%

Group-IV	MEBO (400mg/kg p.o.)	0.19 ± 0.047	0.61 ± 0.037**	0.85 ± 0.043**	0.68 ± 0.035***	0.47 ± 0.020***	0.34 ± 0.028***	73.44%
Group-V	MEBO (600mg/kg p.o.)	0.18 ± 0.028	0.53 ± 0.030***	0.72 ± 0.032***	0.47 ± 0.022***	0.29 ± 0.014***	0.21 ± 0.017***	83.59%
Group-VI	HEBO (200mg/kg p.o.)	0.18 ± 0.019	0.73 ± 0.036^{ns}	1.02 ± 0.043^{ns}	1.13 ± 0.046^{ns}	0.98 ± 0.034***	0.63 ± 0.025***	50.78%
Group-VII	HEBO (400mg/kg p.o.)	0.19 ± 0.029	0.68 ± 0.031*	0.84 ± 0.036**	0.73 ± 0.021***	0.59 ± 0.027***	0.45 ±0.018***	64.84%
Group-VIII	HEBO (600mg/kg p.o.)	0.16 ± 0.036	0.59 ± 0.034**	0.78 ± 0.027***	0.60 ± 0.032***	0.41 ± 0.019***	0.27 ± 0.012***	78.91%

Values are Mean ± SEM (n=6) one way ANOVA followed by Tukey-Karmer's test. Where, *** P<0.001, ** P<0.01, * P<0.05 and ns: Not significant. MEBO-Methanolic extract of Boswellia ogadensis, HEBO: n-Hexane extract of Boswellia ogadensis.

Table III: Effect of METP and HETP on Formalin-induced paw Oedema in Rats (Chronic Model)

Groups	Treatment	Initial Paw Volume	Paw Volume After 6 Days	Increase in Paw Volume	% of Inhibition
Group-I	Saline	1.32 ± 0.045	3.56 ± 0.212	2.24 ± 0.143	-
Group-II	Diclofenac sodium (100 mg/kg i.p.)	1.29 ± 0.082	1.52 ± 0.092	0.23 ± 0.065	89.73%
Group-III	METP (200mg/kg p.o.)	1.30 ± 0.063	2.71 ± 0.241	1.41 ± 0.132	37.05%
Group-IV	METP (400mg/kg p.o.)	1.25 ± 0.068	2.28 ± 0.195	1.03 ± 0.178	54.02%
Group-V	METP (600mg/kg p.o.)	1.28 ± 0.047	1.83 ± 0.180	0.55 ± 0.113	75.45%
Group-VI	HETP (200mg/kg p.o.)	1.31 ± 0.050	2.98 ± 0.291	1.67 ± 0.186	25.45%
Group-VII	HETP (400mg/kg p.o.)	1.27 ± 0.039	2.64 ± 0.214	1.37 ± 0.109	38.84%
Group-VIII	HETP (600mg/kg p.o.)	1.26 ± 0.043	1.97 ± 0.173	0.71 ± 0.102	68.30%

Results are expressed on mean + SEM from four observations Paw Volume was measured after 6 days. METP- Methanolic extract of Terminalia paniculata, HETP: n-Hexane extract of Terminalia paniculata

Table IV: Effect of MEBO and HEBO on Formalin-induced paw oedema in Rats (Chronic Model)

Groups	Treatment	Initial Paw Volume	Paw Volume After 6 Days	Increase in Paw Volume	% of Inhibition
Group-I	Saline	1.32 ± 0.045	3.56 ± 0.212	2.24 ± 0.143	-
Group-II	Diclofenac sodium (100 mg/kg i.p.)	1.29 ± 0.082	1.52 ± 0.092	0.23 ± 0.065	89.73%
Group-III	MEBO (200mg/kg p.o.)	1.32 ± 0.043	2.59 ± 0.305	1.27 ± 0.262	43.30%
Group-IV	MEBO (400mg/kg p.o.)	1.28 ± 0.077	2.01 ± 0.215	0.73 ± 0.138	67.41%
Group-V	MEBO (600mg/kg p.o.)	1.26 ± 0.093	1.68 ± 0.146	0.42 ± 0.053	81.25%
Group-VI	HEBO (200mg/kg p.o.)	1.29 ± 0.062	2.87 ± 0.297	1.58 ± 0.235	29.46%
Group-VII	HEBO (400mg/kg p.o.)	1.30 ± 0.048	2.49 ± 0.234	1.19 ± 0.186	46.88%
Group-VIII	HEBO (600mg/kg p.o.)	1.31 ± 0.051	1.93 ± 0.172	0.62 ± 0.121	72.32%

Results are expressed on mean + SEM from four observations Paw Volume was measured after 6 days. MEBO- Methanolic extract of Boswellia ogadensis, HEBO: n-Hexane extract of Boswellia ogadensis.

Discussion

Because it is so similar to human arthritis, the suppression of formalin-induced pedal oedema in rats is a well-known and ideal test technique for screening anti-arthritic and anti-inflammatory drugs. When rats are injected subcutaneously with formalin, it causes localized inflammation and discomfort. There are two phases to formalin's nociceptive effect: the first is a neurogenic component, and the second is a tissue mediated response. To test the efficacy of a substance with potential anti-proliferative effects, formalin-induced arthritis is utilized.[7] During the proliferative phase of inflammation, this experiment was conducted. When compared to the gold standard medication diclofenac sodium, the results with Terminalia paniculata and Boswellia ogadensis of METP, HETP, MEBO, and HEBO (600mg/kg, p.o.) were very similar. This suggests that the medicine is useful in the treatment of formalin-induced arthritis.

One of the best ways to screen for long-term anti-inflammatory drugs is with formalin-induced paw edema. The average response rate was 85.02%, which means that after 6 days, there was no growth in paw thickness. After 6 days, the model demonstrated a significant suppression of the rise in paw thickness at doses of 200, 400, and 600 mg/kg of METP, HETP, MEBO, and HEBO extracts, respectively.

Conclusion

Terminalia paniculata Brandis and Boswellia ogadensis root methanolic and n-Hexane extracts shown anti-

inflammatory efficacy in both acute and chronic models at doses of 200, 400, and 600 mg/kg p.o., respectively.

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