

Anti-inflammatory, analgesic and antipyretic effects of the fruit pulp of *Adansonia digitata*

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Received April 28, 1993 - Accepted (revised) December 9, 1993.

SUMMARY. The aqueous extract of *A. digitata* fruit pulp showed a LD_{50} in mice by i.p. route of 8000 mg/kg and induced a marked and long lasting anti-inflammatory and antipyretic effects at 400 and 800 mg/kg per os in rats. The extract showed also a marked analgesic activity in mice at 2 h after administration. Phytochemical screening of the fruit pulp of the plant indicated the presence of sterols and/or triterpenes, saponins, tannins, carbohydrates and glycosides.

Key words: *Adansonia digitata*; anti-inflammatory activity; antipyretic activity; analgesic activity.

The genus *Adansonia* L. (Bombacaceae), commonly known as baobab, comprises eight species, of which *Adansonia digitata* L. is endemic to Africa.¹ Reports have indicated the use of *A. digitata* in folk medicine and as a substitute for eintchona in various systems of medicine.^{2,3} Several reports have dealt with the chemical constituents of the plant, where many discussed the composition and characteristics of the seed oil, as well as other constituents of the fruits including seeds.^{1,4-7} The nutritive value of the seeds⁸ and leaves,⁹ as well as the composition of the leaves of the plant have been investigated.¹⁰ A new flavanonol glycoside was reported in the root bark.¹¹ The root bark oil was isolated, saponified and its fatty acid composition was analyzed by GLC.¹²

This study is a trial to shed some light on the biological activity in rats and mice of the lyophilized aqueous extract of the fruit pulp of the plant, since it is an edible part of the fruit, particularly in Sudan.

EXPERIMENTAL

Plant material. The fruits of *A. digitata* were obtained from Sudan. Their identity was verified by the Staff of the College of Agriculture and Veterinary Medicine, Qassim, Saudi Arabia. Three fruits were opened and the pulp was separated from the seeds to give 110 g of pulp and 250 g of seeds. Extraction of the powdered pulp was carried out with hot distilled water (5 × 1.5 L) and followed by filtration. The combined filtrate was freeze dried for 72 h to give shining buff scales (80 g).

Animals. Balb/c mice and Wistar rats of either sex were obtained from the Laboratory Animal Colonies, Faculty of Medicine, King Saud University. The animals were kept under controlled environmental conditions: day light (10-12 h), temperature (25-28 °C) and humidity (50-55%). The animals were fed on rat-dietary cubes and water *ad libitum*.

Phytochemical screening. The freshly prepared lyophilized aqueous extract was tested for the presence of sterols, triterpenes, saponins, tannins, carbohydrates, flavonoids, alkaloids and cardiac glycosides using standard procedures.¹³

Toxicological and pharmacological investigations

Acute toxicity. The LD_{50} of aqueous extract of *A. digitata* was determined in mice using the procedure described by Behrens and Kerber¹⁴ following i.p. administration.

Anti-inflammatory effect. The anti-inflammatory effect of aqueous extract was studied using a modification of rat paw formalin oedema method as described by Domenjoz *et al.*¹⁵ Twenty rats were divided into 4 groups, 5 rats in each. At the beginning of the experiment the thickness of the left paw was measured in mm. Thereafter, the first group was kept as a non treated control and the second one was orally administered with phenylbutazone (Oxyzone[®], El-Nile Co., Egypt) at the dose of 15 mg/kg. Groups 3 and 4 were orally given the extract in doses of 400 and 800 mg/kg, respectively. The anti-inflammatory effect was determined after measuring the paw's thickness before, 1, 2, 3, 4, 6, 8, 12 and 24 h post-treatment. The mean response (increase in the paw thickness from before inducing inflammation) for each group was calculated.

Analgesic effect. The hot plate method as described by Jacob and Bosvski¹⁶ was used. Twenty mice were divided into 4 groups, each of 5. The first group was left as a non treated control. Group 2 was orally administered acetylsalicylic acid (ASA) (Aspirin[®], Bayer Co., Germany) at the dose of 50 mg/kg active ASA. Groups 3 and 4 were orally given the aqueous extract in doses of 400 and 800 mg/kg, respectively.

Antipyretic effect. Twenty rats were divided into 4 groups, each of 5, and were made hyperthermic by subcutaneous injection of a 12% yeast suspension (1 ml/kg) as described by Teotino *et al.*¹⁷ After 15 h, the temperature of each rat was recorded. The first group was kept as a non treated control, while the second group was orally administered ASA at the dose of 50 mg/kg. Groups 3 and 4 were orally given the aqueous extract in doses of 400 and 800 mg/kg, respectively. The rectal temperature of each rat was recorded hourly for 4 h.

Statistical evaluation. Data obtained were statistically analyzed using the analysis of variance and Dunnett's "t" via SAS program.¹⁸

RESULTS

Analysis of variance for anti-inflammatory, analgesic and antipyretic activity of *A. digitata* (400 and 800 mg/kg) and their reference drugs are given in Table 1.

Phytochemical screening

The chemical test gave positive reactions for sterols, triterpenes, saponins, tannins, carbohydrates and glycosides and was negative for flavonoids, alkaloids and cardiac glycosides.

Acute toxicity test

Preliminary acute toxicity test in mice established the LD₅₀ to be 8000 mg/kg following i.p. administration.

Source of variance	Anti-inflammatory		Analgesic		Antipyretic	
	d.f.	M.S.	d.f.	M.S.	d.f.	M.S.
Treatments	31	6.31**	23	25.20**	19	3.65**
A (Groups)	3	36.85**	3	179.97**	3	7.64**
B (Times)	7	10.70**	5	5.44**	4	9.55**
A B	21	0.49**	15	0.84**	12	0.69**
Error	128	0.07	96	6.04	80	0.10

**Significant at 0.01 level.

Table 1 - Analysis of variance for anti-inflammatory, analgesic and antipyretic activities of *A. digitata* and their standard drug.

Time (h)	Control	Phenylbutazone	<i>Adansonia digitata</i>	
		15 mg/kg	400 mg/kg	800 mg/kg
1	3.79 ± 0.09	2.42 ± 0.09 (1)	3.35 ± 0.06 (0.723)	3.17 ± 0.07 (0.763)
2	5.33 ± 0.13	2.60 ± 0.07 (1)	3.87 ± 0.11 (0.674)	3.76 ± 0.08 (0.691)
3	5.51 ± 0.24	2.78 ± 0.12 (1)	4.57 ± 0.07 (0.608)	4.51 ± 0.07 (0.616)
4	5.72 ± 0.16	3.00 ± 0.13 (1)	5.35 ± 0.07 (0.561)	4.61 ± 0.06 (0.651)
6	5.94 ± 0.13	3.36 ± 0.14 (1)	5.44 ± 0.05 (0.618)	4.77 ± 0.07 (0.704)
8	6.20 ± 0.13	3.90 ± 0.13 (1)	5.52 ± 0.06 (0.707)	4.95 ± 0.09 (0.788)
12	6.34 ± 0.12	4.28 ± 0.15 (1)	5.54 ± 0.09 (0.773)	5.28 ± 0.09 (0.811)
24	6.35 ± 0.12	4.30 ± 0.11 (1)	4.81 ± 0.04 (0.894)	4.75 ± 0.22 (0.905)

n = 5. Critical value of Dunnett's t = 2.377 (A) and 2.649 (B).

Table 2 - Anti-inflammatory effect of the aqueous extract of *Adansonia digitata* in rats (mean of swelling of foot in mm after oral administration).

Anti-inflammatory effect

Results are given in Table 2. The extract at doses of 400 and 800 mg/kg was found to inhibit formalin-induced oedema at different intervals of times. The effect of the two doses of the extract was about 80 to 90% of the effect of phenylbutazone after 12 and 24 h, respectively.

Time (min.)	Control	ASA	<i>Adansonia digitata</i>	
		50 mg/kg	400 mg/kg	800 mg/kg
30	9.6 ± 1.29	15.4 ± 0.51 (1)	12.4 ± 1.08 (0.805)	13.8 ± 1.24 (0.896)
60	10.8 ± 1.07	15.8 ± 0.37 (1)	12.8 ± 1.16 (0.810)	14.0 ± 1.30 (0.886)
90	10.6 ± 1.21	16.4 ± 0.25 (1)	13.6 ± 1.21 (0.829)	15.0 ± 1.05 (0.915)
120	10.2 ± 1.16	16.8 ± 0.37 (1)	13.8 ± 1.02 (0.821)	15.4 ± 1.17 (0.917)
150	10.8 ± 1.28	16.0 ± 0.45 (1)	12.4 ± 1.08 (0.775)	15.4 ± 2.11 (0.964)
180	10.0 ± 1.14	15.4 ± 0.51 (1)	12.0 ± 0.71 (0.779)	14.2 ± 1.69 (0.922)

n = 5. Critical value of Dunnett's t = 2.387 (A) and 2.555 (B).

Table 3 - The analgesic effect of the aqueous extract of *Adansonia digitata* in mice (reaction time after oral administration).

Temperature (°C) after h	Control	ASA	<i>Adansonia digitata</i>	
		50 mg/kg	400 mg/kg	800 mg/kg
Before	39.01 ± 0.17	38.28 ± 0.06	39.22 ± 0.11	39.22 ± 0.10
1	39.00 ± 0.16	37.32 ± 0.11 (1)	37.82 ± 0.23 (0.987)	37.38 ± 0.14 (0.998)
2	38.80 ± 0.19	37.14 ± 0.05 (1)	37.62 ± 0.20 (0.987)	37.44 ± 0.16 (0.992)
4	38.62 ± 0.20	37.06 ± 0.04 (1)	37.42 ± 0.14 (0.992)	37.28 ± 0.10 (0.996)

n = 5. Critical value of Dunnett's $t = 2.394$ (A) and 2.491 (B).

Table 4 - Antipyretic effect of the aqueous extract of *Adansonia digitata* in rats.

Analgesic effect

From Table 3, it is concluded that the extract of the plant has a significant analgesic effect in mice when given in a higher dose (800 mg/kg), while it has a slight analgesic effect at 2 h given in a lower dose (400 mg/kg). ASA at the dose of 50 mg/kg produced a marked analgesic activity.

Antipyretic effect

From Table 4, it is concluded that the aqueous extract of the plant has a significant effect at 1, 2, 3 and 4 h post-treatment, when administered in doses of 400 and 800 mg/kg. ASA induced a marked antipyretic effect at the dose of 50 mg/kg at 1, 2 and 4 h post-treatment.

DISCUSSION

Aqueous extract of the fruit pulp of *A. digitata* produced a marked anti-inflammation activity. It reduced the size of pedal swelling induced by formalin as compared with the control group. The effect was comparable to that induced by standard phenylbutazone (15 mg/kg). This anti-inflammatory effect may be due to the presence of sterols, saponins and triterpenes in the aqueous extract. The extract also produced a marked analgesic activity in mice at the dose of 800 mg/kg. The reaction time (test for pain) was significantly longer than that of the control. In addition, the analgesia produced resembled (90%) that induced by ASA (50 mg/kg). The extract also showed a marked antipyretic activity, as the rectal temperature was significantly decreased as compared with the control values of the hyperthermic rats. The antipyretic activity of this extract resembled that normally induced by standard dose of ASA in hyperthermic rats. Similar findings were reported in folk medicine about the use of this plant as antipyretic and febrifuge.^{2,3}

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