# RESEARCH ARTICLES

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## PHYTOCHEMICAL AND PHARMACOLOGICAL STUDIES OF THE FLOWERS OF *MILLINGTONIA HORTENSIS* LINN. F.*

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**Abstract**

Millingtonia hortensis *Linn. f. is an ornamental plant cultivated throughout the country. The dried flowers are not only used for cigarette flavor, but they can also be used as a remedy for asthma. Our attempt to isolate the active constituents was carried out by using pharmacological testing as a tracing tool. Since the methanol extract exhibited bronchodilating effect on isolated rat trachea, this extract was further fractionated into petroleum ether, chloroform, n-butanol and aqueous fractions. Pharmacological studies indicated that the chloroform fraction elicited the most prominent effect. Further separation of the chloroform fraction by short column chromatography enabled hispidulin, the bronchodilating agent, to be isolated. Detection by TLC indicated that hispidulin is one of the compounds present in the smoke of the dried flowers. It is therefore likely that the antiasthmatic activity of the dried flowers of* M. hortensis *Linn. f. is due to hispidulin. Hispidulin is more potent than aminophylline on a molar basis. It was interesting to observe that the aqueous extract of these flowers exhibits a bronchoconstricting action which gradually diminishes upon storage. To assure the safety of patients, attempts to study the toxic effects of the crude extracts and hispidulin have been performed. These studies indicated that hispidulin was less toxic than the crude extract.*

### Introduction

*Millingtonia hortensis* Linn. f., which is cultivated throughout Thailand, is not only known as an ornamental plant but also as a medicinal plant. In Thai traditional medicine, the plant was claimed to possess many activities. Roots can be used for the

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treatment of tuberculosis[1-6] and as an antiasthmatic[1-5]. The flowers are used for the treatment of asthma[1,5-7], sinusitis[4] and as a cholagogue and tonic[3]. The leaves are also used as an asthma remedy[5]. Among the claimed efficacies, smoking dried flowers of *M. hortensis* Linn. f. for the treatment of asthma is widely used. Asthma is one of the major health problems in the Thai population and requires long term treatment. Even though many effective medicines are available in the market, most of them are too expensive for people with low income. Therefore, it is essential to search for new cheaper antiasthmatic drugs from local resources. These two factors prompted us to do phytochemical and pharmacological studies of the flowers of *M. hortensis* Linn. f. which is locally known as "Peep".

Sharma[8] first reported the discovery of scutellarein and scutellarein-5-galactoside from the flowers of *M. hortensis* Linn. f. Subramanian *et al.*[9] investigated the leaves, fruits as well as flowers, and reported the occurrence of hispidulin (6 methoxy-5, 7, 4′-trihydroxy-flavone) in the leaves, acetyl oleanolic acid in the fruits, scutellarein, hispidulin and scrutellarein-5 glucuronide in the flowers. Other than the above compounds, ß-sitosterol was isolated from the heartwood and bark[10,11]. The last phytochemical report indicated the presence of hentriacontane, lapachol, hentriacontanol-1, ß-sitosterol and paulownin in the root of *M. hortensis* Linn. f. Although there have been some reports on phytochemical studies of *M. hortensis* Linnf. f., the only pharmacological study available was a report on the diuretic activity of scutellarein-5 glucuronide[12]. The present study is an attempt to clarify whether the smoke from *M. hortensis* Linn. f. contains any bronchodilator. Our preliminary studies showed that the spots appearing on TLC of the extract from the smoke resembled the methanol extract, and the compound present was rather non-polar so that an attempt was made to isolate the active principles from the methanol extract using pharmacological testing as a tracing tool. Although, during our investigation, Panthong *et al.*[13] reported the bronchodilating effect of the butanol fraction of a water extract of the flowers of *M. hortensis* Linn. f., their approach and findings were different from our experiments. We therefore continued our investigations and were able to isolate hispidulin, one of the bronchodilators, from the chloroform fraction.

**Materials and Methods**

The dried flowers of *M. hortensis* Linn. f. were obtained from Bang-pa-in Palace, Ayudhaya province, Thailand. The specimen was identical with herbarium specimen (BEUSEKOM et al. 3427) deposited at National Herbaria, Forestry Department, Ministry of Agriculture, Thailand.

Mass spectra were obtained on a Varian MAT 112s double-focussing spectrometer. NMR spectra were recorded in DMSO on a Varian XL-300 instrument. IR spectra were recorded with a Nicolet MX-1 FT-IR Interferometer, and absorption bands were recorded in wavenumbers ($cm^{-1}$). UV spectral data were measured with a Uvidec 650 UV/visible spectrophotometer.

*Extraction and Fractionation*

The dried coarsely-powdered flowers of *M. hortensis* Linn. f. (2.743 kg) were exhaustively extracted with methanol by maceration. After concentrating the extract to 1500 ml, a 100 ml portion was evaporated to dryness and 66.3 g of residue was obtained. The remaining methanol extract was successively partitioned with petroleum ether, chloroform and n-butanol, to afford 4 fractions, petroleum ether (51.9 g), chloroform (223.3 g), butanol (229.1 g) and aqueous fraction (270.8 g). Then the methanol extract and its fractions were submitted for pharmacological testing.

*Separation of chloroform fraction*

The dried chloroform fraction (10 g) was submitted to a short column chromatography using silica gel G as an adsorbent and chloroform as eluent. After combining similar fractions and evaporating to dryness, 6 fractions were obtained: $Q_{8-13}$ (0.0863 g), $Q_{14-19}$ (0.0645 g), $Q_{26-35}$ (0.6503 g), $Q_{84-141}$ (0.4017 g), $Q_{142-220}$ (0.3802 g). The remaining extract was separated into 4 bands on a silica column, and these 4 bands were separated and extracted with chloroform-methanol (1:1) to afford 4 fractions, $S_{21}$ (2.4711 g), $S_{22}$ (1.944 g), $S_{23}$ (1.0260 g) and $S_{24}$ (0.4237 g).

*Isolation of Hispidulin*

Fraction $Q_{36-38}$ was concentrated and yellow precipitates were obtained. Recrystallization in methanol yielded hispidulin as a yellow precipitate, m.p. 282-284°C (reported m.p. 282-84° C[9]); $\nu$ max (KBr) 3384, 2932, 1660, 1580, 1492, 1370, 1252, 1179, 1099, 828 $cm^{-1}$; $\lambda$ max (MeOH) 335 (log $\varepsilon$ 3.92), 275 (log $\varepsilon$ 3.82) nm, $\lambda$ max (EtOH) 338 (log $\varepsilon$ 4.37), 277 nm (log $\varepsilon$ 4.30); m/z (% relative intensity) 300 ($M^+$, 100), 299(11), 286(18), 285(99), 283(17), 282(74), 271(12), 258(16), 257(97), 254(19), 167(33), 153(15), 139(38), 119(11), 69(97), 53(13), 43(27), 39(18), 32(22), 28(77), 18(61), 17(14), n.m.r. signals at $\delta$ 3.77 ($OCH_3$), 6.59 (H-8), 6.76 (H-3), 6.87 and 7.01 (H-3, H-5), 7.86 and 8.00 (H-2, H-6). Changes in the ultraviolet spectrum were as follows; in ethanol with sodium ethoxide, 402, 332, 278 nm; in ethanol with sodium acetate, 353,300 nm (shoulder), 277 nm; in ethanol with aluminum chloride, 354, 302, 290, 265 nm; in ethanol with sodium acetate and boric acid, 376,277 nm; in ethanol with sodium hydroxide, 400, 329, 277 nm; in methanol with sodium methoxide, 394, 276 nm; in methanol with sodium hydroxide, 392, 328, 276 nm; in methanol with sodium acetate, 361, 276 nm; in methanol with sodium acetate and boric acid, 338, 276 nm and in methanol with aluminium chloride, 360, 302 nm.

*Preparation of triacetate of hispidulin*

A mixture of hispidulin (0.075 g), sodium acetate (0.05 g) and acetic anhydride (2.5 ml) was refluxed for 6 h, cooled and poured into ice-water. The solid was recrystallized several times from methanol to afford yellowish-brown crystals, n.m.r. signal in $CDCl_3$ at 7.18 and 7.32 (H-3), (H-5) 7.81 and 7.98 (H-2, H-6), 7.22 (H-8), 6.53 (H-3), 3.85 (-$OCH_3$), 2.46, 2.35 and 2.29 (three methyls of acetate), $\lambda$ max (EtOH) 304 (log $\varepsilon$ 4.19), 270(log $\varepsilon$ 4.21) nm.

*Preparation of water extract*

Dried and powdered *M. hortensis* Linn. f. (500 g) was boiled with water (2 l) for 2 h, then the extract was filtered. The marc was repeatedly extracted with two more portions of water. The combined filtrates were freezed-dried and the dried water extract was submitted for toxicological testing.

*Pharmacological testing*

*Tracheal smooth muscle relaxing action :*

*Preparation of isolated rat trachea:* Adult Fisher rats of either sex, weighing 200-250 g were used in all experiments. They were obtained from the Animal Center of the Faculty of Science, Mahidol University, Bangkok. The experimental animals were fed with standard rat chow obtained commercially, and tap water was given *ad libitum.*

Rats were anesthetized with ether and the skin around the neck was cut open. The muscles were dissected out in order to have a clear view of trachea. The full length of trachea before entering the pleural cavity was removed and washed with Kreb's solution. The trachea tube was cut into small pieces about 5 mm in length and then cut open longitudinally. The tracheal sheath was incubated in Kreb's solution aerated with 95% $O_2$, 5% $CO_2$ and kept at a constant temperature of 37°C by a B. Bram Circulator, model 1581850. A preload of 1.0 gm. was applied to the isolated trachea, which were incubated for at least 45 minutes before testing with drugs or chemicals. Unlike guinea-pigs, rats are not sensitive to histamine but they can be obtained regularly and in good health, so that rats were preferred for the present study. The bronchoconstricting tone was therefore induced by a cholinergic agonist instead of histamine, and pilocarpine was selected because it is more convenient to prepare in accurate concentrations than acetylcholine, which is highly hygroscopic.

The constricting tone was induced by $5 \times 10^{-6}$ M pilocarpine throughout this study. Alterations in the tracheal tone were recorded by a Grass Polygraph model 79 D with the aid of force-displacement transducer. The volume of test chemicals added into the 30 ml of bathing solution was kept below 1.0 ml.

*Preparation of test compounds:* All test compounds were freshly prepared in solution prior to the experiments. Dried butanol and aqueous fractions were dissolved in distilled water at a concentration of 500 mg/ml. The water-soluble polyvinyl pyrollidone (PVP) complex of the methanol or the chloroform fractions were formed by using a 1:4 ratio of extract and PVP. The concentration of the water-soluble complex was 300 mg/ml. For controls, 240 mg of PVP was dissolved in 1.0 ml. of distilled water and the same volume as the water soluble complex was added to the test preparation.

Since PVP was costly, an alternative solvent propylene glycol (60 mg/ml) was used to prepare test solutions of hispidulin.

*Toxicological testing*

Mice weighing 25-30 gm of either sex were obtained from the Animal Center of the Faculty of Science, Mahidol University. Acute toxicity of various fractions of methanol extract and water extract were determined. Subacute toxicity (6 weeks) was performed only on the crude chloroform fraction, which possesses tracheal smooth muscle relaxant activity. The test compounds were administered intraperitoneally when crude extracts and fractions were studied, and intravenously when pure compounds were administered.

In addition, to determine the $LD_{50}$ at 48 h with intraperitoneal administration in mice, Hippocratic observations were also conducted at varying time intervals and the behavioral observations were recorded as illustrated in Table 1. The intensity of responses, whether increased or decreased, was arbitrarily scored as follows : 0 = no change; + = slight change; + + = moderate change; + + + = marked change.

**Results and Discussion**

The main purpose of the present studies of the dried flowers of *M. hortensis* Linn. f. was to clarify the folkloric reputation of this medicinal plant as an antiasthmatic drug. To isolate the active compound(s) from the dried powdered *M. hortensis* Linn. f., the specimen was exhaustively extracted with methanol. Pharmacological testing indicated that the methanol extract decreased the force of contraction induced by $5 \times 10^{-6}$M, pilocarpine as illustrated in Fig. 1. An observable response was elicited by adding 0.4 ml of the 300 mg/ml water-soluble complex of PVP and methanol extract.

The crude extract was fractionated into 4 fractions, petroleum ether, chloroform, butanol and aqueous fractions. It is interesting that these fractions exhibited opposite pharmacological activities as follows. The chloroform fraction exhibited the bronchodilating effect (Fig. 2) while the butanol and aqueous fractions exhibited the brochoconstricting action (Fig. 3). Detection by thin-layer chromatography showed similarity between the volatile components obtained from sublimation and from the chloroform fraction. These findings indicated that the Thai herbalist wisely selected smoking for the route of administration for the use of the flowers of *M. hortensis* Linn. f., so that the patient will receive only the bronchodilating action.

The present study will only emphasize the chloroform fraction which possesses bronchodilating action. However, it should be noted that the bronchoconstricting action of the aqueous fraction is not stable and might be mediated via muscarinic receptors because low concentrations of atropine, which effectively inhibit pilocarpine (a muscarinic agonist), could antagonize this bronchoconstricting action as shown in Fig. 4.

Since the water soluble PVP complex of the chloroform fraction produced relaxation of tracheal smooth muscle induced by pilocarpine (Fig. 2), the chloroform fraction was submitted to further fractionation by short column chromatography using silica gel G as an absorbent. After elution by chloroform, 220 fractions were obtained, and similar

**TABLE 1** HIPPOCRATIC OBSERVATION OF THE TEST COMPOUNDS IN EXPERIMENTAL ANIMALS.

| | | |
|---|---|---|
| Date: | Conc. | Animal |
| Substance | Color | Fasted |
| Dose level | Route | Sex |
| Solvent | ml. given | Weight |
| | pH | Time |

| Time | 0 | 5 | 15 | 30 | 45 | 1 | 2 | 3 | 4 | 6 | 24 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Respiration: | | | | | | | | | | | | |
| Rate | | | | | | | | | | | | |
| increase | | | | | | | | | | | | |
| normal | | | | | | | | | | | | |
| decrease | | | | | | | | | | | | |
| Depth | | | | | | | | | | | | |
| increase | | | | | | | | | | | | |
| normal | | | | | | | | | | | | |
| decrease | | | | | | | | | | | | |
| CNS: | | | | | | | | | | | | |
| Motor coordination | | | | | | | | | | | | |
| Ataxia | | | | | | | | | | | | |
| Vertical pole test | | | | | | | | | | | | |
| Inclined screen test | | | | | | | | | | | | |
| Catalepsy | | | | | | | | | | | | |
| Locomotor activity | | | | | | | | | | | | |
| increase | | | | | | | | | | | | |
| normal | | | | | | | | | | | | |
| decrease | | | | | | | | | | | | |
| Tremors | | | | | | | | | | | | |
| Fasciculations | | | | | | | | | | | | |
| Clonic convulsions | | | | | | | | | | | | |
| Tonic convulsions | | | | | | | | | | | | |
| Audiologic response | | | | | | | | | | | | |
| Corneal reflex | | | | | | | | | | | | |
| Touch reaction | | | | | | | | | | | | |
| Righting response | | | | | | | | | | | | |
| Sedation | | | | | | | | | | | | |
| Eyes: | | | | | | | | | | | | |
| Enophthalmas | | | | | | | | | | | | |
| Exophthalmas | | | | | | | | | | | | |
| Palpebral ptosis | | | | | | | | | | | | |
| pulpil size: | | | | | | | | | | | | |
| increase | | | | | | | | | | | | |
| normal | | | | | | | | | | | | |
| decrease | | | | | | | | | | | | |
| Lacrimation | | | | | | | | | | | | |
| increase | | | | | | | | | | | | |
| normal | | | | | | | | | | | | |
| decrease | | | | | | | | | | | | |
| General: | | | | | | | | | | | | |
| Salivation | | | | | | | | | | | | |
| Tail erection | | | | | | | | | | | | |
| Pilamotor erection | | | | | | | | | | | | |
| Urination | | | | | | | | | | | | |
| Diarrhoea | | | | | | | | | | | | |
| Muscle tone | | | | | | | | | | | | |
| Aggressive behavior | | | | | | | | | | | | |
| Miscellaneous | | | | | | | | | | | | |

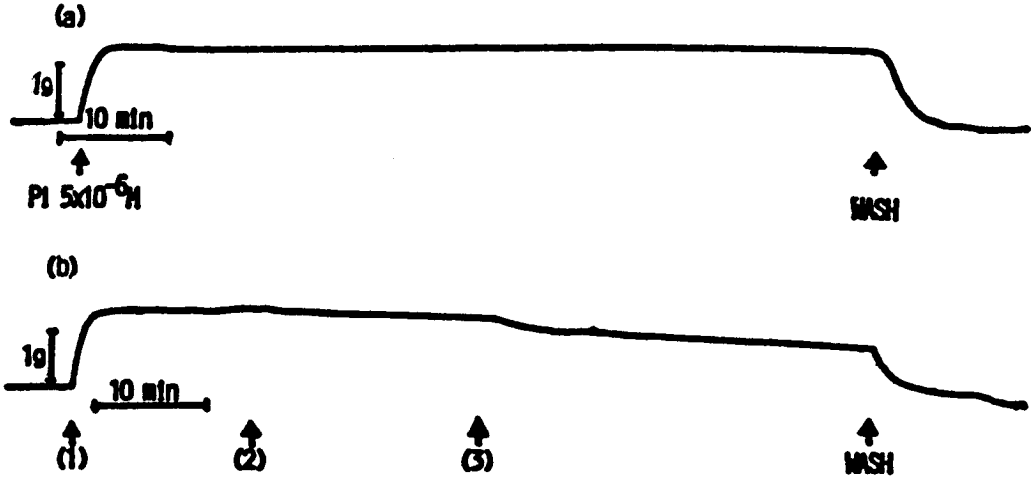


**Fig. 1** Effect of a crude methanol extract of *M. hortensis* flowers on rat tracheal smooth muscle. Pilocarpine ($5 \times 10^{-6}$M), used as a constrictor, was added at position 1. After maximal contraction, 0.4 ml (300 mg/ml) of a water-soluble complex of the methanol extract or the bathing solution were added at positions 2 and 3 respectively. The force of contraction was partially decreased in the experimental (b) compared to the control (a).

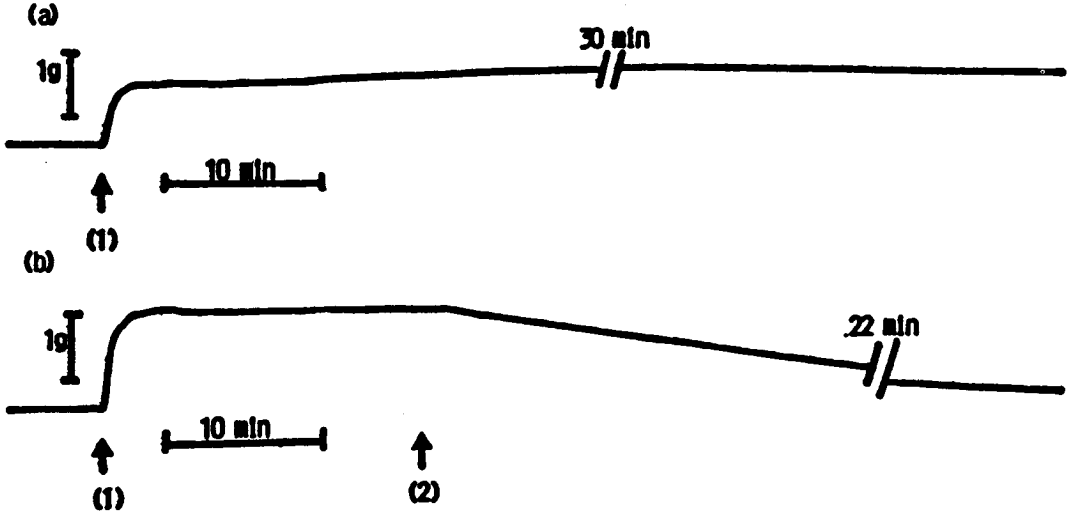


**Fig. 2** Effect of chloroform fraction from *M. hortensis* flowers on the tracheal smooth muscle. Pilocarpine ($5 \times 10^{-6}$M) was added at position 1. After maximal contraction, 0.30 ml (300 mg/ml) of the water-soluble complex of the chloroform fraction or bathing solution was added at position 2. The contraction force was decreased after the addition of the extract (b) as compared to the control (a).

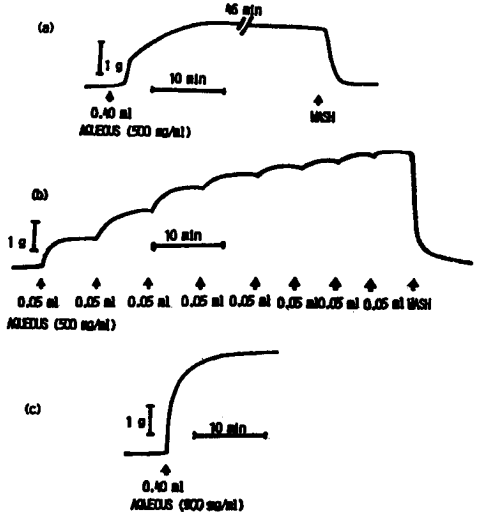


**Fig. 3** The tracheal smooth muscle constricting action of aqueous fraction of *M. hortensis* flowers. (a): Single dose (0.4 ml); (b): separate preparation, 0.05 ml increments added stepwise; (c): single dose of 0.4 ml added again after washing out the drug from preperation (b). Each 0.05 ml of the 500 mg/ml aqueous fraction is equal to 0.83 mg/ml bathing solution.

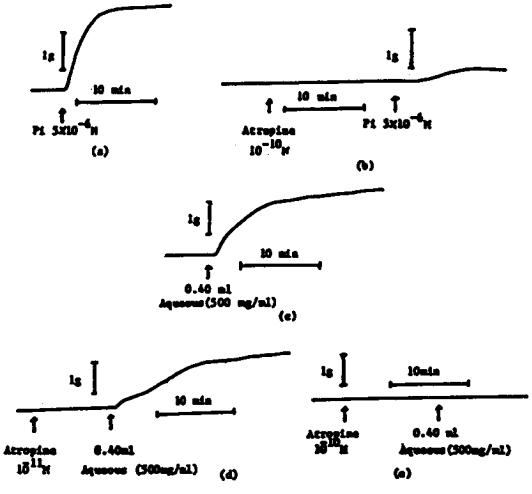


**Fig. 4** The ability of atropine to block the constriction of tracheal smooth muscle induced by the aqueous fraction of *M. hortensis* flowers. (a): Constricting action of pilocarpine ($5 \times 10^{-6}$M); (b): atropine ($10^{-10}$M) given 15 min prior to pilocarpine; (c): 0.4 ml of aqueous fraction (500 mg/ml) produced constriction; (d): atropine ($10^{-11}$M) given prior to addition of aqueous fraction; (e): atropine ($10^{-10}$M) abolishes completely the constricting action of the aqueous fraction.

fractions were combined and submitted for pharmacological testing. All six fractions elicited the bronchodilating effect as illustrated in Fig. 5. Since fraction $Q_{36-83}$ exhibited the most potent activity, further attempts to separate the active compound were carried out on this fraction. After concentrating the $Q_{36-83}$ fraction, yellow precipitates were obtained. The precipitates were recrystallized in chloroform-methanol to afford a pale yellow compound, m.p. 282-284°C, which was later identified as hispidulin. Hispidulin shows bronchodilating action and is more potent compared to aminophylline on an equal weight basis, when tested in the present model, as shown in Fig. 6 .

The extract remaining on the column was separated into 4 fractions according to the observed chromatographic bands. The pharmacological testing of these fractions showed bronchodilating effects.

Detection by thin-layer chromatography showed that all subfractions except $Q_{8-13}$, $S_{23}$, $S_{22}$, $S_{21}$ contained hispidulin. Therefore, bronchodilating activity was not only due to hispidulin but also to other components present in $Q_{8-13}$, $S_{23}$, $S_{22}$, $S_{21}$.

Although hispidulin has been reported as a minor component in the flowers of *M. hortensis* Linn. f. [9], until now no pharmacological studies have been conducted. Flavonoids have been reported to possess several pharmacological activities such as antiallergic, anti-inflammatory and antiviral activity[14]. However, there has been no report in the literature concerning their relaxing effect on the tracheal smooth muscle. Moreover none of the bronchodilating drugs is a flavonoid. It is, therefore, interesting to study the structure-activity relationship of hispidulin. Further studies on the mechanism of the bronchodilating action of hispidulin are being pursued. Moreover, a search will be made for other pharmacological activities which may be responsible for the antiasthmatic reputation of the plant. It is anticipated that the results obtained will shed some light on the pathophysiology of asthma. Furthermore, modification of the chemical structure of hispidulin may create a new class of bronchodilators.

To assure the safety of using the flowers of *M. hortensis* Linn. f. as an asthma remedy, the toxicity of the water extract, the fractions obtained from methanol extract and the isolated compound were tested for acute and subacute toxicity. Preliminary toxicological studies indicated that the butanol and aqueous fractions of the methanol extract and water extract were relatively non-toxic when given, intraperitoneally (Ip), at a dose of 3240 mg/kg, since these fractions and the extract did not cause any death. Higher doses, of these crude extracts were not studied because such doses are higher than the doses recommended by traditional doctors. On the other hand, the chloroform fraction which was the most biologically active fraction, containing hispidulin, has an $LD_{50}$ of 300 mg/kg (Ip, 48 h) by linear regression analysis.

When the chloroform fraction (270, 810 and 1620 mg/kg) were given intraperitoneally to mice and animal behavior was observed for 3 h, the most prominent signs and symptoms were as follows: urination, diarrhoea, jumping, tail erection, rapid and deep respiration. These responses were most often found in mice treated with high doses of the

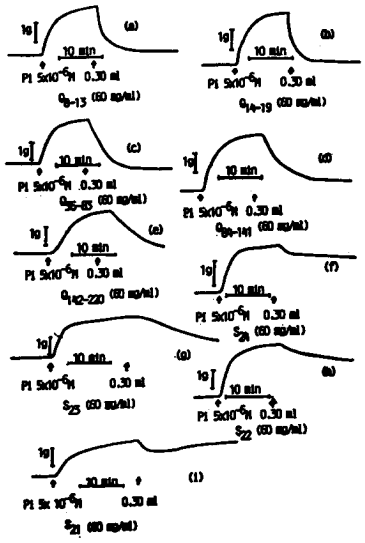

**Fig. 5** The relaxation of tracheal smooth muscle by various fractions obtained from chromatographic separation of the chloroform fraction of *M. hortensis* flowers. Single 0.3 ml doses of various fractions (60 mg/ml) were added into the bathing solution. Examples of the responses of all fractions are illustrated in a, b, c, d, e, f, g, h, and i, using a different tissue preparation for each.

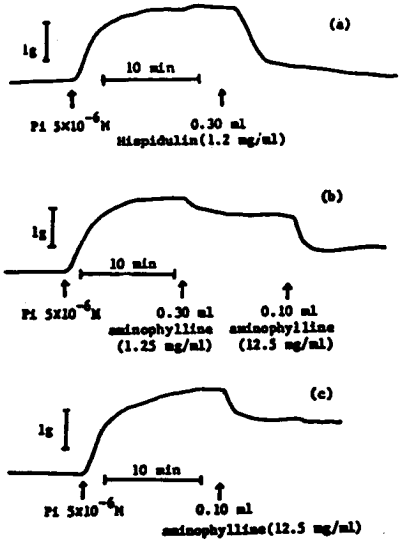


**Fig. 6** Comparison of the rat tracheal smooth muscle relaxation effects of hispidulin and aminophylline. (a): Complete relaxation elicited by $4.0 \times 10^{-5}$M hispidulin; (b) and (c): effects of aminophylline ($9.9 \times 10^{-5}$M). Results were obtained using the same tracheal smooth muscle preparation.

**TABLE 2** NUMBER OF DEATHS FOLLOWING LONG TERM TREATMENT WITH CHLOROFORM FRACTION

| Duration (Days) | Number of deaths (date) | | |
|---|---|---|---|
| | Dose mg/kg , Ip once daily | | |
| | 270 | 810 | 1620 |
| 1-7 | 1 (3) | - | - |
| 8-14 | - | - | 2 (12) |
| 15-23 | - | - | 1 (22) |
| 24-31 | - | 1 (24) | 1 (24), 1 (26), 3 (28) |
| 32-39 | 1 (35) | 1 (34) | - |
| 40-47 | 1 (40) | 2 (44, 47) | - |
| Total | 3 | 4 | 8 |

The numbers in parentheses indicate the days on which death occurred counting from the time of the first administration.

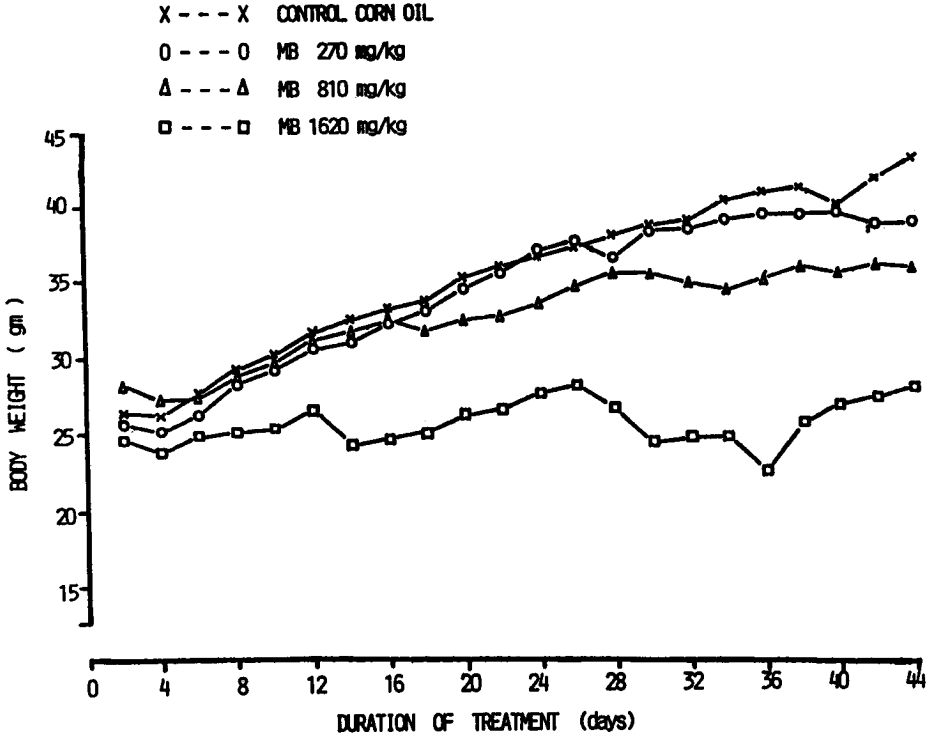


**Fig. 7** Body weight of mice following chronic administration of chloroform extract (MB).

chloroform fraction. Other behavior seemed to be normal.

Hispidulin is found in the chloroform fraction at a concentration of 0.364% W/W, so that doses of 1, 3 and 9 mg/kg are equivalent to about 270, 810 and 2430 mg chloroform fraction/kg respectively. These doses were injected intravenously into separate groups of 10 mice. Preliminary studies suggested that the $LD_{50}$ of hispidulin was approximately 9 mg/kg, which is equivalent to 2430 mg chloroform fraction/kg. These results suggest that the toxicity of the chloroform fraction may be due to other compounds present in the extract. The intraperitoneal route of administration was not studied due to the limited amounts of hispidulin available.

When the chloroform fraction was administered once daily at various doses for 6 weeks, there were 3, 4 and 8 deaths at the doses of 270, 810 and 1620 mg/kg respectively (Table 2). After 45 days of treatment with the chloroform fraction, the remaining mice were sacrificed and gross observations were made of the internal organs. The most prominent abnormality was the presence of hemorrhagic spots in lung tissues and a small amount of bleeding in the pleural cavity.

The body weight of mice treated with the chloroform fraction was followed (Fig. 7). At the doses of 270 and 810 mg/kg, no significant reduction in body weight was observed during the first 3 weeks. After day 21, mice treated with 810 mg/kg of chloroform fraction showed significantly reduced body weight. The higher dose of chloroform fraction (1620 mg/kg) caused a significant reduction in body weight approximately 1 week after the treatment.

In conclusion, our studies showed that there are both bronchodilating and bronchoconstricting agents in the flowers of *M. hortensis* Linn. f. These two groups of active agents were separated by solvent fractionation, and the bronchodilating agents were found in the non-polar fraction, while the bronchoconstricting agents were found in the polar fraction. Hispidulin, one of the active bronchodilators, was isolated. The volatility of hispidulin suggested that hispidulin may be responsible for the claimed efficacy of smoking of the dried flowers of *M. hortensis* Linn. f. as antiasthmatic drug. Since preliminary toxicological studies indicated that the toxicity of intraperitoneal injection of the chloroform fraction was high, intensive toxicological studies of hispidulin should be performed to evaluate its potential for use as a pure compound in asthmatic patients. Further studies on other fractions and their mechanisms of action are being conducted in our laboratory. The results of these studies may lead to the finding of a new class of bronchodilating drugs.

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## บทคัดย่อ


ดอกปีบเป็นสมุนไพรที่รู้จักกันดีว่าสามารถนำมาใช้สูบแก้หืด ในการศึกษาครั้งนี้เป็นการศึกษาหาสารสำคัญที่อยู่ในดอกปีบ การสกัดและแยกสารสำคัญทำโดยใช้วิธีการตรวจฤทธิ์ขยายหลอดลมเป็นแนวทางในการติดตามส่วนที่ออกฤทธิ์ ตลอดจนถึงสารสำคัญ การทดลองพบว่า hispidulin ซึ่งระเหยได้มีฤทธิ์ในการขยายหลอดลม โดยมีฤทธิ์แรงกว่า aminophylline ไม่ว่าจะเปรียบเทียบน้ำหนักเท่ากัน หรือความเข้มข้นเป็น Molar ดังนั้นจึงเป็นไปได้ว่าฤทธิ์รักษาหืดโดยการสูบดอกปีบมาจาก hispidulin ผู้วิจัยยังพบว่า ส่วนสกัดที่เป็นน้ำแสดงฤทธิ์ตรงข้ามคือทำให้หลอดลมหดตัว นอกจากนี้ยังได้ศึกษาความเป็นพิษของสารสกัด และ hispidulin พบว่า hispidulin มีพิษน้อยกว่าสารสกัดเบื้องต้น