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SHORT COMMUNICATION



Mentha arvensis essential oil suppressed airway changes induced by histamine and ovalbumin in experimental animals

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ABSTRACT

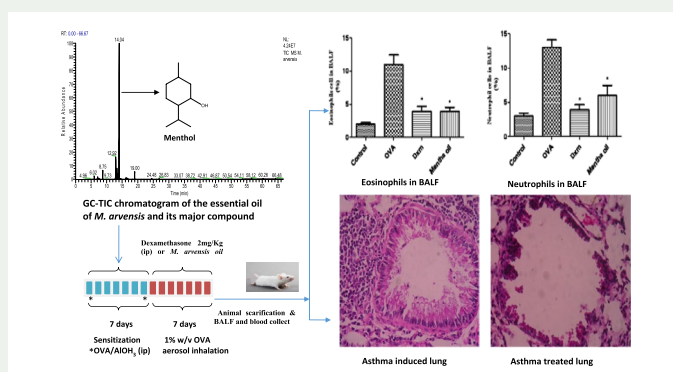
The present investigation aimed to evaluate the activity of the essential oil of *Mentha arvensis* L. on exogenously induced bronchoconstriction in experimental animals. The anti-asthmatic effect of *M. arvensis* essential oil (MAEO) was studied using histamine aerosol-induced bronchoconstriction in guinea pigs and ovalbumin (OVA) sensitised albino mice. Treatment with *M. arvensis* oil significantly ($p < 0.001$) increased the time of preconvulsive dyspnoea in histamine-induced guinea pigs. Oral treatment of MAEO significantly ($p < 0.001$) decreased absolute eosinophil count, serum level of IgE and the number of eosinophils, neutrophils in BALF. Histopathological examination of lungs showed that essential oil rescinded bronchial asthma. The present investigation provides evidence that MAEO relaxes bronchial smooth muscles and suppressed immunological response to OVA.

ARTICLE HISTORY

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KEYWORDS

Mentha arvensis L.; immunosuppression; bronchorelaxation; essential oil composition; GC-MS



1. Introduction

Bronchial asthma, a common chronic inflammatory airway disease affects as many as 334 million people of all ages worldwide. It is a substantial health care burden and affects quality of life, due to its physical, psychological and social effects (GAN 2014). Currently available

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treatments for asthma such as beta-2 agonist, anticholinergics, methylxanthines, mast cell stabilizers, leukotriene antagonist, glucocorticoids, IgE antibody like omalizumab etc. on long term basis, are associated with several adverse effects like muscle tremors, restlessness, hyperglycaemia, tachycardia, flushing, convulsions, mood changes, adrenal crisis etc. (Katzung et al. 2009). Essential oils of plants have been traditionally used for respiratory tract infections, and are used nowadays for cold (Inouye et al. 2001).

In *Ayurvedic* medicine *M. arvensis* is advocated for the treatment of asthma, nasal catarrh, bronchitis, cough, liver and spleen disease (Kapoor 1990). Moreover, the essential oil constituents viz., l-menthol, menthone and 1,8-cineole (chewing gum constituents) exhibited anti-allergic effects (Arakawa & Osawa 2000). Marked variation (30.0–93.7%) of menthol content and other chemical constituents in the essential oil of *M. arvensis* from different region has been reported (Pino et al. 1996; Alankar 2009; Joshi 2014a). The aim of present study was to evaluate the anti-asthmatic activity of commercially available essential oil of MAEO using *in vivo* models.

2. Results and discussion

2.1. Analysis of the essential oil

The identified compounds are listed in Table S1. The major constituent of the MAEO was menthol (72.6%). The other minor constituents were menthone (8.5%), limonene (3.3%) and menthyl acetate (2.4%).

2.2. Effect of MAEO on histamine-induced bronchoconstriction in guinea pigs

The MAEO significantly ($p < 0.001$) and dose dependently increased the latency of preconvulsive time (PCT) in histamine-challenged animals with the values of $37.77 \pm 3.52\%$ and $63.00 \pm 0.73\%$ at the dose of 200 and 400 $\mu\text{L}/\text{kg}$, respectively. The increase of PCT at a dose of 400 $\mu\text{L}/\text{kg}$ was comparable to that of dexamethasone (Table S2).

2.3. Effect of the MAEO on OVA-sensitised mice

2.3.1. Absolute eosinophil count in blood and serum IgE level in OVA-sensitised mice

MAEO treated group at the dose of 200 $\mu\text{L}/\text{kg}$ body weight significantly ($p < 0.001$) decreased inflammatory cells in blood (Figure 1A). On the day 15, after final OVA sensitisation, significantly increased serum level of IgE was observed in untreated mice. The treatment with MAEO significantly ($p < 0.001$) decreased the level of serum IgE at the dose of 200 $\mu\text{L}/\text{kg}$ (Figure 1B).

2.3.2. Inflammatory cells from BALF

In animals, sensitised with OVA and treated with MAEO (200 $\mu\text{L}/\text{kg}$), the inflammatory cells were significantly ($p < 0.001$) decreased as compared to that of untreated group (Figure 1C, D).

2.4. Histopathological changes in lung tissues

Lung sections of mice exposed to OVA stained with haematoxylin and eosin showed significant inflammatory changes in peribronchial and perivascular areas, increased bronchial

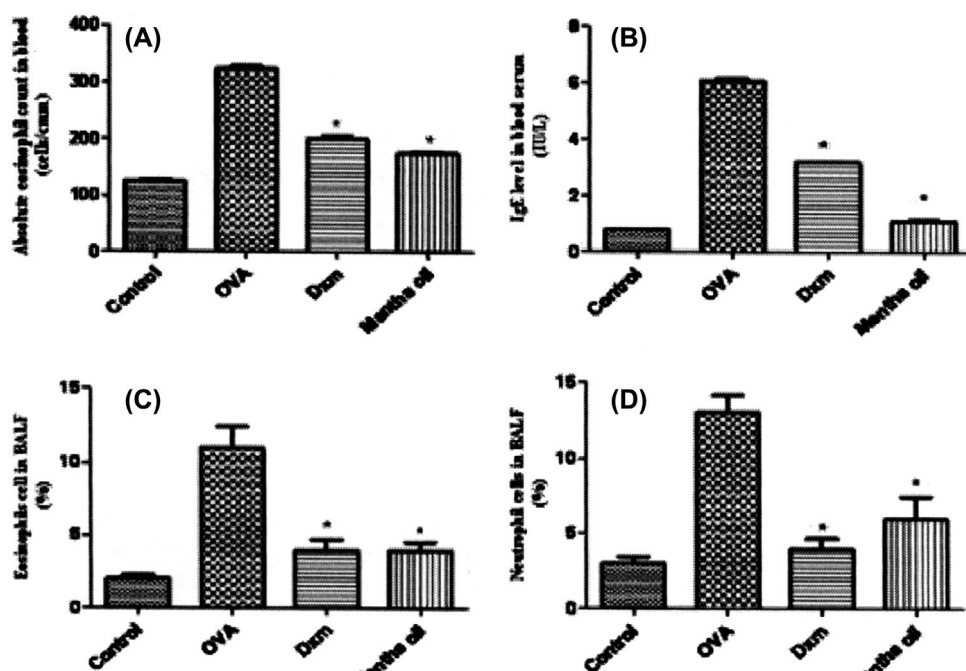


Figure 1. Effect of MAEO on: (A) blood eosinophils count in mice; (B) serum IgE in mice; (C) BALF eosinophils in mice; (D) BALF neutrophils in mice. Values are expressed as mean $\pm$ standard error of the mean, where $n = 6$ in each group, * $p < 0.001$ compared with ovalbumin treated group.

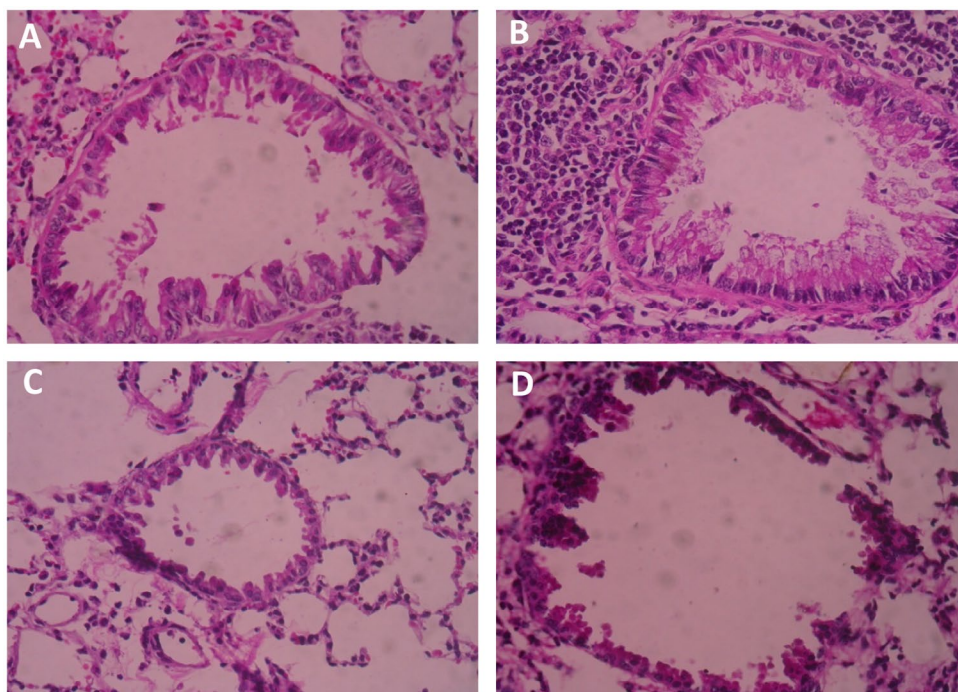


Figure 2. Microphotography of mice lung section stained with haematoxylin-eosin (40 $\times$). Normal control (A); Ovalbumin treated (B); Dexamethasone treated (C); MAEO (200 μ L/kg) treated (D).

muscles thickening and epithelial hyperplasia (Figure 2B). The histological changes induced by OVA were markedly suppressed by treatment with MAEO (200 μ L/kg) (Figure 2D) and was almost comparable to normal (Figure 2A) as well as dexamethasone (Figure 2C) treated groups.

Asthma is an allergic respiratory disease commonly characterised by increased airway reactivity to different spasmogens. Bronchial asthma is triggered by the release of inflammatory mediators like histamine, acetylcholine, leukotrienes, prostaglandins, or specific exposure to allergens, leading to acute bronchoconstriction (Nelson 2003). Bronchodilator effect of MAEO was evident by significantly increased latency for PCT in guinea pigs. Eosinophil suppressant effect of MAEO suggests its anti-allergic activity and its efficacy in ameliorating allergen-induced asthma. IgE is invariably associated with the pathogenesis of asthma and its inhibition by MAEO indicates its efficacy in asthma and other allergic condition (Platts-Mills 2001). Moreover, eosinophil granule derived basic proteins have been implicated with asthma (Bloemen et al. 2007). Suppression of neutrophils in BALF and inflammatory changes in lung tissue indicate anti-inflammatory activity of MAEO. Thus, anti-allergic, anti-inflammatory, immunosuppressant and bronchodilator activity of MAEO together appear to contribute for its efficacy in bronchial asthma. The major compounds of MAEO were menthol, menthone and 1,8-cineole, but which of its constituents is/are responsible for anti-allergic activity need to be explored.

In conclusion, the essential oil used in the present study contains more than 70% menthol and oxygenated monoterpenes along with other chemicals. It is difficult to predict the contribution of chemicals other than menthol for the observed anti-asthmatic effect of MAEO. The present investigation provides evidence that MAEO relaxes bronchial smooth muscles and suppresses immunological response to OVA. The traditional use of MAEO for bronchial asthma could be attributed to its bronchodilator and immunosuppressant properties as observed in present study.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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