Journal of Ethnopharmacology 175 (2015) 528–548

Contents lists available at ScienceDirect

Journal of Ethnopharmacology

journal homepage: www.elsevier.com/locate/jep

Review

A review of the relaxant effect of various medicinal plants on tracheal smooth muscle, their possible mechanism(s) and potency

Farzaneh Shakeri, Mohammad Hossein Boskabady *

Neurogenic Inflammation Research Centre and Department of Physiology, School of Medicine, Mashhad University of Medical Sciences, Mashhad 9177948564, Iran

ARTICLE INFO

Article history:
Received 14 July 2015
Received in revised form
4 October 2015
Accepted 6 October 2015
Available online 8 October 2015

Keywords:
Medicinal plants
Relaxant effects
Smooth muscle
Trachea
Possible mechanisms
Toxicological effects

Chemical compounds studied in this article:
Carvacrol (PubChem CID: 10364)
dithymoquinone or nigellone (PubChem CID: 398941)
safranal (PubChem CID: 61041)
thymoquinone (PubChem CID: 10281)
thymol (PubChem CID: 6989g)
umbelliprenin (PubChem CID: 1781413)
p-cymene (PubChem CID: 7463)
cuminaldehyde (PubChem CID: 326)
trans-anethole (PubChem CID: 637563)
alpha-pinene (PubChem CID: 6654)
β-pinene (PubChem CID: 14896)
saponins (PubChem CID: 11007422)
apigenin (PubChem CID: 5280443)
alpha-phellandrene (PubChem CID: 7460)
crocetin (PubChem CID: 5281232)

ABSTRACT

Ethnopharmacological relevance: The therapeutic effects of the medicinal plants described in the current review on obstructive pulmonary diseases have found mention in ancient Iranian medical texts and in traditional folk medicine. These effects are attributed to their bronchodilatory activity, which relaxes the smooth muscles of the airway. Therefore, in the present review, the relaxant effects of various extracts, fractions and constituents of medicinal plants on tracheal smooth muscle are reviewed in light of their therapeutic effects on obstructive pulmonary diseases.

Materials and methods: The online literature was searched using Medline, PubMed, ScienceDirect, Scopus, Google Scholar, Web of Science and SID (for articles written in Persian). Moreover, local books on ethnopharmacology from 1918 to 2014 were searched with keywords such as tracheal smooth muscle, airway smooth muscle, relaxant effect, bronchodilatory effect and related mechanisms to identify studies on the relaxant effects of medicinal plants on tracheal smooth muscle and the possible mechanism(s) of these effects.

Results: All studied plants showed significant relaxant effects on tracheal smooth muscle, which were similar or superior to the effect of theophylline at the used concentrations. According to the results, most of these plants also showed an inhibitory effect on muscarinic and histamine (H_1) receptors, whereas some plants showed more pronounced stimulatory effects on the beta-adrenergic receptor. Some of the studied plants also showed inhibitory effects on calcium and potassium channels.

Conclusion: The present article reviewed the relaxant effects of several medicinal plants on tracheal smooth muscle, which were comparable or superior to the effect of theophylline at the studied concentration. The possible mechanisms of the relaxant effects of the studied medicinal plants and a comparison of these effects were also reviewed. This review presents the fractions and constituents of plants with potent relaxant effects on tracheal smooth muscle, which can be used to treat obstructive pulmonary disease.

Contents

* Corresponding author. Fax: 98 511 8828564.
E-mail addresses: boskabadymh@mums.ac.ir, mhboskabady@hotmail.com (M.H. Boskabady).

http://dx.doi.org/10.1016/j.jep.2015.10.017
0378-8741/

1. Introduction

Herbal medicine has been traditionally used to treat different ailments (Holm and Herbst, 2001), with a large population relying on herbal medicine for primary medical care in some parts of the world (Ismail, 2010). Several drugs are derived either directly or indirectly from plants or from molecules of plant origin. Several medicinal plants and some pharmacologically active substances from medicinal plants exert relaxant effects on tracheal smooth muscles, that is, bronchodilatory effects.

Bronchodilators are used to treat airway obstructive disorders, as they relieve the airway obstruction by relaxing airway smooth muscles. In this review, the relaxant effects of medicinal plants on tracheal smooth muscles and their possible mechanism(s) as well as their comparative potencies are reviewed.

2. Method

The online literature was searched using Medline, PubMed, ScienceDirect, Scopus, Google Scholar, Web of Science and SID (for articles written in Persian), as well as local books on ethnopharmacology published up to 20 December 2014, to identify studies on the relaxant effects of medicinal plants on tracheal smooth muscles and their possible mechanism(s). The following keywords were used for the search: tracheal smooth muscle, airway smooth muscle, relaxant effect, bronchodilatory effect, calcium channel-blocking effect, potassium channel-opening effect, muscarinic receptor inhibitory effect, histamine (H_1) receptor inhibitory effect, stimulatory effect on β_2-adrenoceptors and methylxanthine activity. All of these keywords were searched for each plant and its constituents. All published studies in English or Persian language were included in the review. The literature search was conducted by both authors independently, with no inconsistencies between the two authors. The review included the following steps: (1) the possible mechanism(s) for the relaxant effects of medicinal plants were also reviewed using the available literature. (2) The relaxant effects of extracts, some fractions and some constituents for all studied medicinal plants were reviewed. (3) The possible toxic effects of studied medicinal plants were presented. (4) The maximum relaxation effect (effect of most potent concentration) of each extract, fraction and constituent of each plant was calculated at a concentration of 1 mg/ml. This was then compared for different plants, as well as for various extracts, fractions and constituents within each plant, to find those with the most potent relaxant effect for possible future clinical studies.

3. Possible mechanisms of the relaxant effects of medicinal plants on tracheal smooth muscles

Several possible mechanisms have been suggested for the relaxant effects of medicinal plants on tracheal smooth muscles, which are reviewed in this section.

3.1. Calcium channel-blocking effect

The relaxant effect on smooth muscles can be attributed to calcium channel blocking (Miyahara et al., 1993). The extract of *Nigella sativa* L. *(N. sativa)* inhibited contractions induced by carbachol, KCl and histamine. These results indicated that *N. sativa* has a non-specific bronchodilatory action that is possibly mediated