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Effect of Crude Extracts from *Leonotis nepetaefolia* (Labiatae) on Rat and Guinea-pig Smooth Muscle and Rat Cardiac Muscle

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Abstract—The actions of hydroalcoholic and tea extracts of stems of *Leonotis nepetaefolia* on agonist-induced and electrically-evoked contractions have been analysed in-vitro in rat uterus and left atrium and in guinea-pig ileum and trachea. The tea extract (500–2000 μg mL^{-1}) caused parallel and graded rightward shifts of concentration-response curves to bradykinin and $BaCl_2$ in the rat isolated uterus, but antagonized responses to prostaglandin $F_{2\alpha}$ in a typically non-competitive manner. The hydroalcoholic extract also caused rightward displacements of the curves to bradykinin, acetylcholine (ACh), angiotensin II, oxytocin and $BaCl_2$ and reduced their maximal contractile effects. Both extracts (30–3000 μg mL^{-1}) relaxed uterine preparations precontracted with KCl (80 mM), the hydroalcoholic extract being about 2-fold more potent than the tea extract. The relaxant response to the former was unaffected by propranolol (1 μM) or forskolin (10 nM), but was potentiated 2-fold by 3-isobutyl-1-methylxanthine (10 μM). In the guinea-pig ileum the hydroalcoholic extract shifted the ACh- and bradykinin-induced contractile curves to the right and markedly inhibited their maximal effects, whereas the tea extract caused a typical non-competitive antagonism of ACh-induced contractile responses. In field-stimulated ileal strips, both extracts (3–3000 μg mL^{-1}) caused contractions and inhibited twitch responses. Guinea-pig tracheal rings precontracted with carbachol (0·3 μM) were relaxed only by concentrations of either extract in excess of 1000 μg mL^{-1}, an action that was unaffected by propranolol (0·1 μM) or by indomethacin (1 μM). Prior incubation of tracheal rings with the hydroalcoholic extract (1000 μg mL^{-1}), which failed to affect responses to ACh, significantly potentiated the relaxations induced by isoprenaline or theophylline (3-fold) of preparations contracted with carbachol. Finally, the hydroalcoholic extract (0·1–1000 μg mL^{-1}) caused a graded long-lasting inotropic effect in the rat electrically-stimulated left atrium. Altogether, these findings provide some experimental support for the reputed folk medicinal anti-asthmatic and anti-diarrhoeal properties of this plant. It is suggested that the pharmacological effects of the extracts of *L. nepetaefolia* may result from potentiation of the cAMP system.

Leonotis nepetaefolia, one of the 41 species of Labiatae (Trease & Evans 1978), is generally known in Brazil as "Cordão de Frade", but has at least another 40 different popular names in other countries (Morton 1981). It is used to treat bronchial asthma, diarrhoea, fever, influenza and malaria, and as an analgesic (Roigy Mesa 1945; Asenjo et al 1948; Cruz 1965; Morton 1975, 1981). Phytochemical analysis has revealed that *L. nepetaefolia* contains, amongst many constituents, labdanic acid (Baghy et al 1965), the diterpene methoxynepetefolin (Machand 1973), the terpenic alcohols nepetefolinol and leonotinine (Purushothanan et al 1976) and a coumarin, characterized as 4,6,7-trimethoxy-5-methylchromen-2-one (Purushothanan et al 1976). However, to the best of our knowledge, no pharmacological studies have yet been carried out with extracts or constituents of this species.

In the present study we have investigated the pharmacological actions of the crude hydroalcoholic extract and the tea extracts obtained from *Leonotis nepetaefolia* to determine the plants' purported anti-asthmatic and anti-diarrhoeal properties. Current anti-asthmatic therapy is based mainly on the use of drugs which act either via stimulation of β_2-adrenoceptors, such as terbutaline and salbutamol, or by inhibition of smooth muscle phosphodiesterase, such as theophylline. The bronchodilator effects of both types of drugs are the result of increased cAMP levels in smooth muscle cells, determined either by stimulation of adenylate cyclase or by reduction in cAMP catabolism. Raised intracellular cAMP levels in cardiac muscle result in increased inotropism (Tsien 1977; Weiss & Hait 1977; Seamon & Daly 1986). Considering that the extracts of *L. nepetaefolia* could potentially exhibit a profile of activity similar to that of β-adrenoceptor agonists and/or phosphodiesterase inhibitors, the present study examines their effects on tracheal, ileal and uterine smooth muscle, as well as on cardiac muscle.

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Materials and Methods

Drugs

The following drugs were used: acetylcholine iodide, propranolol hydrochloride, bradykinin, prostaglandin $F_{2\alpha}$, oestradiol benzoate, 3-isobutyl-1-methylxanthine, histamine chloride, carbachol hydrochloride, theophylline hydrochloride, isoprenaline hydrochloride (all from Sigma, USA), oxytocin (Syntocinon, Sandoz, Brazil), angiotensin II (synthesized at Department of Biophysics, Escola Paulista de Medicina, São Paulo, Brazil) and forskolin (Calbiochem, USA). All reagents used were of analytical grade (Merck) and solutions and drugs were prepared daily in distilled and deionized water.

Extract preparation

Botanical material was collected and classified by Dr Lads-

lau A. Skorupa (Department of Botany, Cenargem, Brasilia, DF, Brazil).

In view of the popular medicinal uses of *L. nepetaefolia* in the form of decoction or hydroalcoholic extraction, two extracts were prepared and tested. The crude hydroalcoholic extract (HE) of *L. nepetaefolia* was prepared as previously described (Calixto et al 1985). Leaves and stems were minced and extracted with 50% ethanol-water in the proportion 1 : 1 (w/v), stirred mechanically at room temperature (22°C) for 15 days, filtered, desiccated and resuspended in 0·9% (w/v) NaCl solution (saline) to the desired concentration. To prepare the tea extract (TE), the material was minced and boiled at 100°C in distilled water (1 : 1 w/v) for 2 min, filtered, concentrated in-vacuo and resuspended in saline. The yields were 11·9% and 11·0% for HE and TE, respectively.

Pharmacological analysis

Rat uterus. Preparations were obtained from female Wistar rats, 200–250 g, pretreated 24 h earlier with oestradiol benzoate (0·5 mg kg^{-1}, s.c.). Strips 15–20 mm long were suspended in 5 mL of aerated De Jalon solution (composition (mM): NaCl 154; KCl 5·6; $CaCl_2$ 0·3; $MgCl_2$ 1·4; $NaHCO_3$ 1·7 and glucose 5·5) maintained at 30°C. Isotonic contractions were recorded by means of a light lever (6-fold amplification) inscribing on a kymograph under 1 g of load. After an equilibration period of 30–40 min, complete concentration-response curves to acetylcholine (ACh), bradykinin, prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$), angiotensin II, oxytocin and barium chloride ($BaCl_2$) were obtained at 30 min intervals (Van Rossum 1963). Concentration-response curves to $PGF_{2\alpha}$ and angiotensin II were constructed by exposure to single increasing concentrations of either agonist for 1 min, followed by washout, at 10 min intervals. Once the curves became reproducible, the preparations were exposed to increasing concentrations of HE or TE from *L. nepetaefolia* (500–2000 $\mu g\ mL^{-1}$) for 20 min, and new curves to agonists constructed in their presence. The maximal contraction obtained to a given agonist in the second concentration-response curve (before exposure to an extract) was taken as the 100% response and all contractions calculated as functions of this value. Only one agonist was tested on each strip.

In other experiments preparations were contracted with KCl (80 mM, prepared by equimolar replacement of NaCl by KCl in the medium). After stabilization of the contractile response, complete inhibitory concentration-response curves to the extracts (1–3000 $\mu g\ mL^{-1}$) were obtained in the absence or in the presence of propranolol (1 μM), forskolin (10 nM) or 3-isobutyl-1-methyl-xanthine (IBMX, 10 μM), incubated 20 min beforehand. The IC50 or EC50 values for the extracts or drugs, i.e. the concentrations causing half maximal inhibition or contraction, respectively, were determined. To correct for spontaneous desensitization during the course of the experiments, separate analogous experiments were performed in tissues using only the vehicle used to dilute the extracts.

Guinea-pig ileum. Strips of ileum 3 to 4 cm long were obtained from guinea-pigs, 300–500 g, and set up for the recording of isotonic or isometric contractions in a 5 mL organ bath containing gassed (95% O_2-5% CO_2) Krebs-Henseleit solution (mM: NaCl 113; KCl 4·7; $CaCl_2$ 2·5; $NaHCO_3$ 25; $MgSO_4$ 1·1; KH_2PO_4 and glucose 11) at 37°C, under 1 g of resting tension as previously described (Calixto et al 1984). After an equilibration period of 30–40 min, cumulative concentration-response curves either for ACh or bradykinin were constructed first in the absence and 30 min later in the presence of *L. nepetaefolia* extracts (500–2000 $\mu g\ mL^{-1}$) as described for the rat uterus.

In other experiments, the ileal strips were submitted to electrical field stimulation at 0·1 Hz with 1 ms rectangular pulses of supramaximal strength delivered transmurally via platinum electrodes. Once electrically-evoked twitches became stable, cumulative concentration-response curves to the extracts (10–3000 $\mu g\ mL^{-1}$) were constructed and the mean IC50 or EC50 values were calculated.

Guinea-pig trachea. Tracheal rings 3–4 mm wide were obtained from guinea-pigs, 300–500 g, of either sex. The preparations were mounted in warm (37°C) gassed (95% O_2-5% CO_2) Krebs-Henseleit solution under 1 g of tension for recording of isometric contractions. After equilibration for at least 60 min the preparations were contracted by addition of carbachol (0·2 μM). Once the response plateaued (which usually took about 15 min), cumulative inhibitory concentration-response curves were obtained for isoprenaline or theophylline either in the absence or in the presence of the HE or the TE of *L. nepetaefolia*, incubated 20 min beforehand.

In other experiments, cumulative concentration-response curves for the HE and the TE were obtained in preparations without previous tonus. A final set of preparations was used to assess the influence of TE or HE on responsiveness to ACh or histamine. In these experiments, the extract (500–2000 $\mu g\ mL^{-1}$), was added to the bath 20 min before obtaining a cumulative concentration-response curve to one of the agonists.

Rat left atrium. Left atria were excised from female Wistar rats, 200–250 g, and set up in gassed (95% O_2-5% CO_2) Krebs-Henseleit solution at 37°C and submitted to a resting tension of 1 g. Following 60 min equilibration, the preparations were paced by electrical stimulation with 5 ms rectangular pulses of twice the threshold strength delivered at 2–3 Hz. Once the isometric twitches became stable, a single cumulative concentration-response curve to the HE, the TE (0·1–1000 $\mu g\ mL^{-1}$) or the vehicle was obtained and the EC50 values determined.

Statistical analysis

Results are expressed as the means ± s.e.m. except for IC50 and EC50 values which are presented as the geometric means accompanied by their 95% confidence limits. Data were analysed, where appropriate, by Student's *t*-test for unpaired samples. Differences below the 0·05 probability level ($P < 0·05$) were considered to be statistically significant.

Results

Rat uterus

The cumulative administration of the *L. nepetaefolia* HE or TE alone (100–2000 $\mu g\ mL^{-1}$) did not affect the tonus of the

preparations (results not shown). However, when tissues were preincubated with the extracts (500–2000 μg mL^{-1}) for 20 min before agonist additions, different effects were observed depending on the agonist. Thus, TE caused concentration-dependent displacements to the right of the bradykinin and $BaCl_2$ concentration-response curves, but caused a typical non-competitive antagonism of $PGF_{2\alpha}$-induced contractions (results not shown). In a similar but more potent manner, the HE also caused rightward displacements (i.e. increased the EC50 values) of the concentration-response curves to bradykinin, ACh, angiotensin II, oxytocin and $BaCl_2$, allied to significant inhibition of the maximal responses to these agonists (Fig. 1A–F). The HE was especially potent in inhibiting responses to angiotensin II and $PGF_{2\alpha}$.

When tested in preparations precontracted by KCl (80 mM), both extracts (100–3000 μg mL^{-1}) caused concentration-dependent relaxations. The HE was about 2-fold more potent than the TE in producing this effect (Fig. 2A, Table 1). Previous incubation of the preparation with propranolol (1 μM) significantly enhanced the potency and the maximal relaxant action of both extracts (Fig. 2B, Table 1). Pretreatment of the tissues with isobutyl-3-methylxanthine (10 μM), but not with forskolin (10 nM), also slightly potentiated (about 2-fold) the relaxant effect of HE (Fig. 2C, Table 1). All the effects caused by both extracts were reversed by intermittent washings of the preparation with physiological solution over a 30–60 min period.

Guinea-pig ileum

When added to the guinea-pig isolated ileum, the HE (500–2000 μg mL^{-1}) caused concentration-dependent displacements to the right of the ACh and bradykinin concentration-response curves accompanied by marked inhibition of the maximal responses to these agonists (Fig. 3A, C). In contrast, the TE caused a typical non-competitive antagonism of ACh-induced contractile responses without increasing the EC50 to the agonist (Fig. 3B).

In field stimulated preparations, both HE (10–3000 μg mL^{-1}) and TE (3–3000 μg mL^{-1}) caused concentration-dependent muscle contractions associated with an inhibition of twitch responses. The extracts were equipotent in inhibiting twitch responses, whereas the TE caused greater contractions than did the HE (Fig. 4A, B).

Guinea-pig trachea

Both the TE and the HE from *L. nepetaefolia* (up to 3000 μg mL^{-1}) caused discrete graded contractions of guinea-pig tracheal rings amounting, at the highest concentration treated, to about 25% of the response to 0·2 μM carbachol (results not shown). However, when added cumulatively to rings precontracted with carbachol (0·2 μM), both extracts failed to alter tone up to 1000 μg mL^{-1}, but induced significant relaxations at 3000 μg mL^{-1} ($-74{\cdot}5 \pm 12{\cdot}0\%$ for HE and $-27{\cdot}1 \pm 12{\cdot}5\%$ for TE). The relaxations caused by the high concentrations of either extract were not influenced significantly by incubation with propranolol (0·1 μM) or with

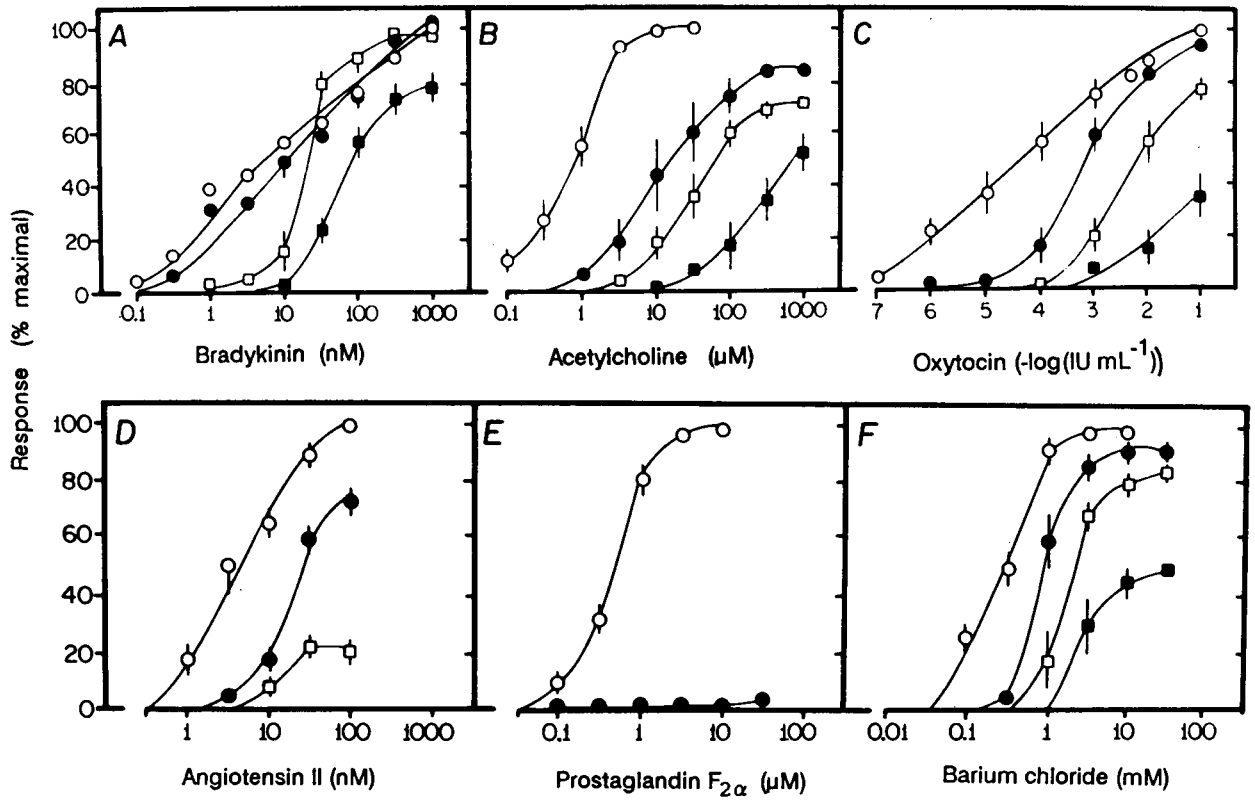

FIG. 1. Mean concentration-response curves for bradykinin (A), acetylcholine (B), oxytocin (C), angiotensin II (D), prostaglandin $F_{2\alpha}$ (E) and $BaCl_2$ (F) in the rat isolated uterus in the absence (○) or in the presence of the hydroalcoholic extract of *Leonotis nepetaefolia* 500 (●) 1000 (□) or 2000 (■) μg mL^{-1}. Each point represents the mean of 4 to 6 experiments and the vertical lines the s.e.m.

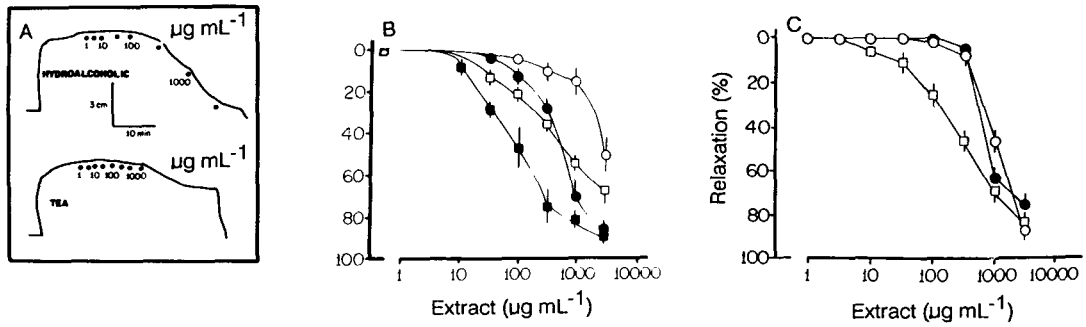

FIG. 2. Relaxant effects of the hydroalcoholic and the tea extracts of *Leonotis nepetaefolia* on the rat isolated uterus precontracted with KCl (80 mM). (A) Typical isotonic traces showing the relaxant effects of cumulative additions of either extract. (B) Mean relaxant concentration-response curves for the tea (○) or the hydroalcoholic extract (□) in the absence (open symbols) or in the presence of propranolol (1 μM) (closed symbols). (C) Mean concentration-response curves for the relaxant effects of the hydroalcoholic extract obtained in the absence (○) or in the presence of either forskolin (● 10 nM) or 3-isobutyl-1-methylxanthine (□ 10 nM). In panels B and C each point represents the mean of 4 to 7 experiments and the vertical lines the s.e.m.

Table 1. Inhibitory potencies (IC50) and maximal relaxant effects of the crude hydroalcoholic and tea extracts from *Leonotis nepetaefolia* on contraction of the rat isolated uterus induced by KCl (80 mM). Experiments were conducted either in the absence or in the presence of propranolol (1 μM), forskolin (10 nM) or isobutyl-3-methylxanthine (IBMX, 10 μM).

Extract	Condition	IC50 (μg mL^{-1} × 100)[a]	% maximal response[b]
Tea	Alone	ca. 9·0	51·3 ± 11·4
	+Propranolol	2·2 (1·3–3·8)*	66·2 ± 7·2
Hydroalcoholic	Alone	4·2 (2·6–6·9)	92·7 ± 1·2
	+Propranolol	0·7 (0·2–2·2)*	88·8 ± 2·3
	+Forskolin	6·1 (5·4–7·0)	85·4 ± 8·6
	+IBMX	2·5 (1·6–6·3)	75·2 ± 6·0

Each value is the mean of 4 to 7 experiments. [a]Geometric means accompanied by their 95% confidence limits. [b]% inhibition (mean ± s.e.m.) caused by 3000 μg mL^{-1} of extract. * Significantly different from extract alone ($P < 0.05$).

indomethacin (1 μM, results not shown). In a separate set of preparations, concentration-response curves to ACh or histamine were found to be slightly but significantly depressed by prior incubation with the HE for 20 min, at concentrations in excess of 1000 μg mL^{-1} (results not shown).

Tracheal rings incubated with the HE (1000 μg mL^{-1} a concentration which as stated above, did not affect carbachol-induced contraction) for 20 min and contracted with carbachol (0·2 μM) displayed a pronounced (10-fold) increase in sensitivity to the relaxant effects of isoprenaline (Fig. 5A) and to a lesser extent (3-fold) of theophylline (Fig. 6A). A higher concentration of the HE (2000 μg mL^{-1}) failed to cause any further leftward shift of the concentration-response curves to either dilator agonists, but rather reduced the magnitude of their maximal relaxant responses. This latter observation may have been, at least in part, due to a significant relaxant effect of the HE itself on carbachol-induced contractions, thus limiting the extent of the dilator responses to isoprenaline or theophylline. Similar experiments conducted with rings incubated with the TE and precontracted with carbachol (0·2 μM) revealed that this extract (up to 2000 μg mL^{-1}) did not cause significant potentiation of relaxations induced by isoprenaline (Fig. 5B) or by theophylline (Fig. 6B).

Rat left atrium

Cumulative additions of the HE of *L. nepetaefolia* (0·1–1000 μg mL^{-1}) to the rat isolated left atrium produced concentration-dependent long-lasting positive inotropic effects which were resistant to successive washouts of the tissue (Fig. 7A,

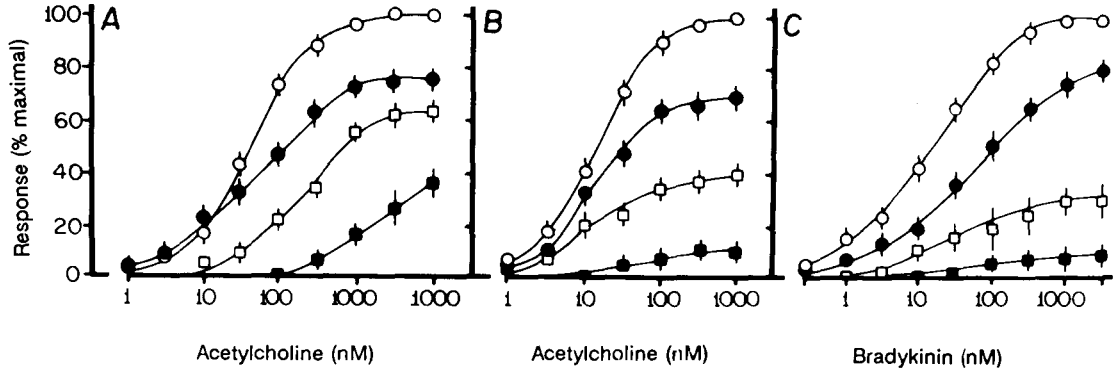

FIG. 3. Mean concentration-response curves for acetylcholine and bradykinin in the guinea-pig isolated ileum in the absence (○) or in the presence of increasing concentrations of hydroalcoholic (A and C) or tea (B) extracts of *Leonotis nepetaefolia:* 500 (●); 1000 (□) and 2000 (■) μg mL^{-1}. Each point represents the mean of 5 to 7 experiments and the vertical lines the s.e.m.

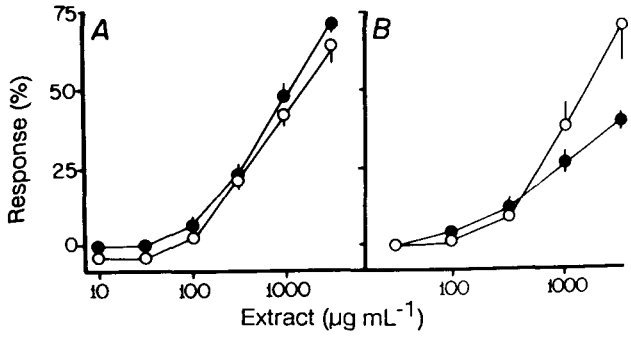

FIG. 4. Mean concentration-response curves for the tea (○) and the hydroalcoholic extract (●) from *Leonotis nepetaefolia* on field-stimulation-induced twitch responses (A) and tonus (B) of guinea-pig isolated ileum. Each point represents the mean of 5 experiments and the vertical lines the s.e.m.

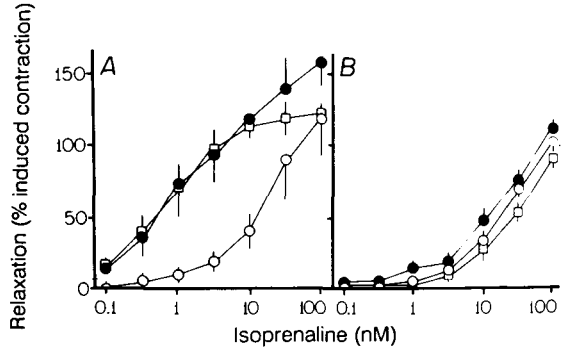

FIG. 5. Mean inhibitory concentration-response curves for isoprenaline in the isolated ring of guinea-pig trachea pre-contracted with carbachol (0·2 μM) in the absence (○) or in the presence of hydroalcoholic (A) or tea extract (B) from *Leonotis nepetaefolia:* 1000 (●) and 2000 μg mL^{-1} (□). Each point represents the mean of 4 to 5 experiments and the vertical lines the s.e.m.

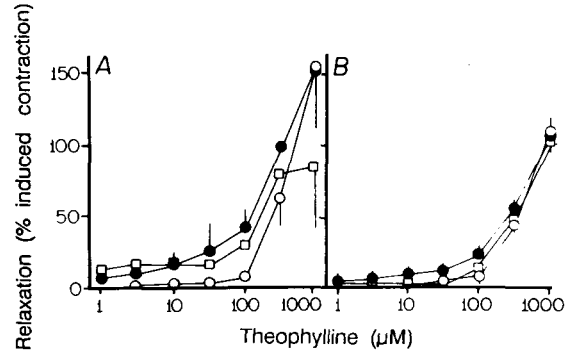

FIG. 6. Mean inhibitory concentration-response curves for theophylline in the isolated ring of guinea-pig trachea pre-contracted with carbachol (0·2 μM) in the absence (○) or in the presence of crude hydroalcoholic (A) or tea (B) extract of *Leonotis nepetaefolia:* 1·0 (●) and 2 mg mL^{-1} (□). Each point represents the mean of 4 to 5 experiments and the vertical lines the s.e.m.

B). Although HE caused this effect in all preparations studied, the substantial variation in sensitivity to this effect may account for the diphasic appearance of the mean concentration-response curve shown in Fig. 7B. The TE caused a much smaller inotropic effect than the HE (results not shown).

Discussion

The current results demonstrate that *L. nepetaefolia* extracts exhibit interesting pharmacological profiles characterized by reversible concentration-dependent relaxant effects on agonist-induced contractions of several non-vascular smooth muscles, as well as a marked positive inotropic action of the HE on the isolated left atrium. Collectively, they provide some experimental support for the medicinal use of extracts of this plant for treatment of bronchial asthma and diarrhoea.

Although the HE and to a lesser extent the TE both inhibited agonist-induced contractions of the rat uterus, the characteristics of their actions depended on the agonist used. Thus, both extracts caused mainly rightward shifts in the concentration-response curves to some agonists (bradykinin and $BaCl_2$ with the TE; bradykinin, ACh, oxytocin and $BaCl_2$ with the HE), allied to only small changes in maximal responses, whereas the curves to others were markedly flattened in a typically non-competitive fashion ($PGF_{2\alpha}$ with both extracts and angiotensin II with the HE). Inhibitory effects of both extracts were also observed in the guinea-pig ileum against bradykinin- and ACh-induced contractions and responses to electric field-stimulation. Thus, rather than blockade of specific receptors for any of the agonists tested, the active substances of the extract may have triggered an inhibitory mechanism or blocked a common excitation-contraction transducing mechanism in the smooth muscle cell leading to varying degrees of antagonism towards different agonists. Alternatively, the extracts may have inactivated, metabolized and/or sequestered certain agonists. Though this latter possibility cannot be entirely ruled out at this stage, the fact that the HE shifted the concentration-response curve to bradykinin to the right in the rat uterus but flattened that obtained in the guinea-pig ileum argues against such a mode of action.

It is well known that activation of β_2-adrenoceptors can markedly reduce smooth muscle contractility via stimulation of adenylate cyclase and formation of cAMP (Weiss & Hait 1977; Seamon & Daly 1986). However, the relaxant effects of both extracts on uterine strips pre-contracted with KCl seemed unrelated to stimulation of β-adrenoceptors as they were potentiated, rather than inhibited, by addition of the β-adrenoceptor blocker propranolol. The findings that relaxations caused by either extract were also enhanced by prior incubation with the phosphodiesterase inhibitor IBMX, strongly suggests that the active principle(s) present in these extracts act to amplify second messenger transducing mechanisms mediated by cAMP. This action could involve activation of adenylate cyclase and/or inhibition of phosphodiesterase, both of which would lead to increased intracellular cAMP levels.

The results obtained in guinea-pig tracheal rings also strengthen this view. Thus, at a high concentration, the HE and to a lesser extent the TE caused significant relaxations of tracheal rings pre-contracted with carbachol, which were not dependent on the release of cyclo-oxygenase-derived arachidonic acid metabolites or on activation of β_2-adrenoceptors, since they were unaffected by indomethacin or by propranolol. In addition, the HE from *L. nepetaefolia*, but not the TE, caused significant sensitization of tracheal rings to the

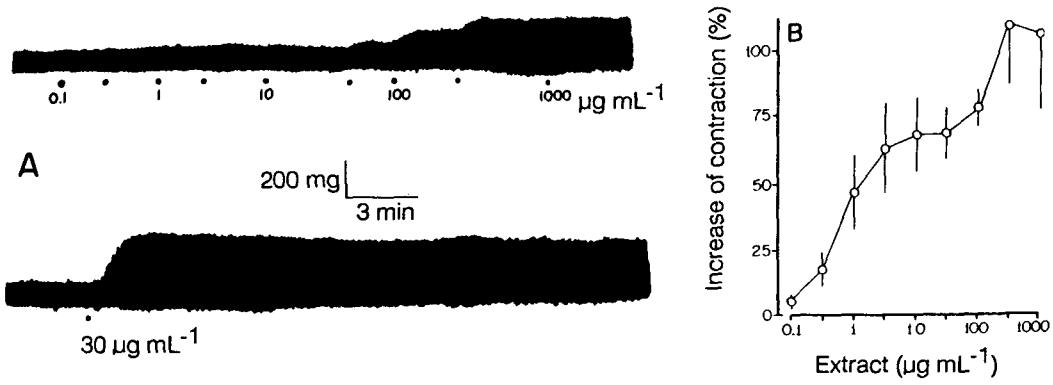

FIG. 7. Effect of hydroalcoholic extract of *Leonotis nepetaefoli* on inotropism of the rat isolated electrically-driven left atrium. (A) Typical records showing the positive inotropic effect of hydroalcoholic extract. (B) Mean concentration-response curve where each point represents the mean of 9 experiments and the vertical lines the s.e.m.

relaxant effects of isoprenaline and theophylline at a concentration which did not, affect contractions induced by ACh.

In contrast to the effects in smooth muscle, activation of adenylate cyclase or increased cAMP accumulation in cardiac muscle leads to enhanced inotropism (Tsien 1977; Weiss & Hait 1977; Kupfermann 1980; Seamon & Daly 1986). Thus, the findings that HE caused a marked concentration-dependent inotropic effect in the electrically-stimulated isolated left atrium also points towards an action of the active principle(s) of *L. nepetaefolia* on cAMP accumulation. Very similar results have been described for forskolin, a diterpene isolated from *Coleus forskohlii*, another species of Labiatea. This compound is a potent and reversible direct activator of adenylate cyclase which acts independently of membrane receptors and guanine nucleotides to increase cAMP levels (for review see Seamon & Daly (1986)). Thus, it is possible that the active principle present in the extracts from *L. nepetaefolia*, presumably of terpenoid nature, exhibits a forskolin-like profile of activity.

The HE was found to be more active than the TE in virtually all of the experiments. The reason for this is still unclear, but could involve at least two possibilities: 1) the greater efficiency of the former procedure in extracting the more polar compounds of the plant over a longer period of time (15 days) as opposed to the 2 min of decoction employed to prepare the TE; 2) the compound(s) responsible for the biological activity of the extracts is thermolabile and is, thus, susceptible to denaturation upon decoction. This issue should be resolved once the active principle(s) is isolated and characterized.

In conclusion, the present results indicate that the HE and to a lesser extent the TE from *L. nepetaefolia* exhibit potent and reversible relaxant actions on smooth muscle and positive inotropic activity on cardiac muscle, presumably by increasing cAMP levels through activation of adenylate cyclase and/or by inhibition of phosphodiesterase. They also provide some experimental support for the popular use of this plant as a folk medicine for the treatment of bronchial asthma and diarrhoea.

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