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Evaluation of the Relaxant Activity of some United Arab Emirates Plants on Intestinal Smooth Muscle

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Abstract

Although medicinal plants are used as antispasmodic agents in folk medicine there have been no scientific studies of the phytochemical composition and usefulness of these plants for such treatment. Extracts of 23 plants used in the traditional medicine of the United Arab Emirates were tested for their effects on intestinal smooth muscle activity.

Most of the plants tested caused stimulation followed by inhibition of the motility of the rabbit jejunum and guinea-pig ileum. The inhibitory effect of plants that had EC50 values < 1 mg was confirmed in-vivo using the gastrointestinal transit time test. These plants were phytochemically screened for their secondary constituents. The effect of *Rhazya stricta* was investigated, particularly in relation to acetylcholine effect.

The results indicated the potential of some of the plants, especially *Rhazya stricta*, as a source of antispasmodic agents.

Plants have been widely used since ancient times as antispasmodic agents in traditional folk medicine. Relatively few of these plants have, however, been scientifically studied and their usefulness verified (e.g. Fintelmann 1991; Molina et al 1991; Abdalla et al 1993). As far as we are aware, there are no scientific studies of the phytochemical composition and usefulness of these plants as antispasmodic agents.

In the course of systematic studies on United Arab Emirates (UAE) medicinal plants with antispasmodic action, we have screened 23 plants commonly used in UAE traditional medicine for treatment of various ailments such as stomach pain, intestinal colic and helminthiasis (El Ghonemi 1993), the activity of which might include the relaxation of smooth muscle.

There is often poor correlation between the results of studies conducted in-vitro and in-vivo on the same organ or system. In this work we have, therefore, compared the intestinal smooth muscle relaxant activity (ISMRA) of the plant extracts on isolated guinea-pig ileum and rabbit jejunum (in-vitro studies) as well as the effect of the more potent of the above extracts on the gastrointestinal (GI) transit time of mice (in-vivo studies). In addition, we have phytochemically screened the latter plants for their secondary constituents.

Materials and Methods

Materials

Drugs used were acetylcholine chloride (Sigma, MO, USA), atropine sulphate (Sigma), charcoal (Riedel-de Haën, Germany), and morphine sulphate (Sigma). All other chemicals were of analytical reagent grade. Solutions of drugs and plant extracts were freshly prepared in normal saline and added to the organ bath in a volume less than 0·5 mL. Drug concentrations refer to the base.

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Animals

Locally bred male albino mice of the TO strain, 20–30 g, male guinea-pigs, 450–600 g and male white New Zealand rabbits (1·5–2 kg) were used in this study. They were housed under standard conditions of temperature (22 ± 2°C) and relative humidity (50–60%) and had free access to water and pelleted diet (mice) or pelleted diet and green Alfalfa (rabbits and guinea-pigs) except where mentioned.

Plant materials

The plants used are listed in Table 1. They were collected from various parts of the UAE between February and April 1993. The plants were authenticated by a taxonomist at the Herbarium of the Desert and Marine Environment Research Centre, UAE University, where voucher specimens were deposited.

Plant extracts

Preparation of water extract. Coarsely powdered plant material (20·0 g) was macerated with distilled water (100 mL) and left to stand for 12 h with occasional shaking. The aqueous extract was filtered and the volume of the filtrate was adjusted to 100 mL with distilled water. The concentration of the solution was expressed as a percentage of the powdered plant material. The above preparation is similar to that used in traditional medicine.

Preparation of the lyophilized extract. Coarsely powdered plant material (150 g) was macerated with distilled water (250 mL) and left to stand for 12 h with occasional shaking. The aqueous extract was filtered and the filtrate freeze-dried (Christ-B1-16).

Preparation of the alcoholic extract. Coarsely powdered plant material (200 g) was defatted with hexane for 12 h in a Soxhlet extraction apparatus and the residue exhaustively extracted with ethanol (95%). The alcoholic extract was filtered and the filtrate evaporated under vacuum.

Table 1. The Latin and family names of some United Arab Emirates plants and the type of response induced by their extracts on rabbit isolated jejunum.

	Latin name	Family name	Part used*	Response†
1	*Albizzia lebbeck* (L.) Benth.	*Leguminoceae*	L	S-I
2	*Arnebia hispidissima* Lehm	*Boraginaceae*	AP	S-I
3	*Calligonum comosum* Herit	*Polygonaceae*	AP	S-I, PR
4	*Capparis cartilaginea* Decne	*Capparaceae*	L	C-I
5	*Caralluma arabica* Brown	*Asclepiadaceae*	AP	S-I
6	*Chrozophora oblongifolia* Del	*Orobanchaceae*	L	S-I
7	*Cistanche tubulosa* Schenk	*Euphorbiaceae*	AP	I, NS
8	*Cleome brachycarpa* Vahl	*Capparaceae*	L	S-I, PR
9	*Cynomorium coccineum* Linn	*Cycomoriaceae*	AP	S-I, NS
10	*Fagonia indica* Burm	*Zygophyllaceae*	L	S-I, PR
11	*Haplophyllum tuberculatum* Forssk	*Rutaceae*	L	S-I, NS
12	*Heliotropium kotschyi* Bge	*Boraginaceae*	L	I
13	*Iphiona aucheri* Boiss	*Compositae*	L	I, NS
14	*Leptadenia pyrotechnica* Forssk	*Asclepiadaceae*	AP	C-I, PR
15	*Nigella sativum* Linn	*Ranunculaceae*	S	S-I, PR
16	*Physorrhynchus chamaerapistrum* Boiss	*Cruciferae*	AP	S-I
17	*Pulicaria glutinosa* Jaub & Spach	*Compositae*	L	S-I
18	*Reseda aucheri* Boiss	*Resedaceae*	L	S-I
19	*Rhazya stricta* Decne	*Apocynaceae*	L	S-I
20	*Salsola baryosma* Schutt	*Chenopodiaceae*	AP	NS
21	*Trichodesma africana* (L.) Lehm	*Boraginaceae*	L	S-I
22	*Zygophyllum mandevelli* Schweinf	*Zygophyllaceae*	AP	S-I
23	*Zygophyllum qatarense* Hadidi	*Zygophyllaceae*	L	I, NS

* L = leaves; AP = aerial parts; S = seeds.
† S-I = initial stimulation (potentiation) followed by inhibition; C-I = initial contraction followed by inhibition; PR = partial recovery; NS = non-specific changes (disturbance in frequency and magnitude); I = inhibition without initial stimulation.

Fractionation of the alcoholic extract. The alcoholic extract obtained as described above was further fractionated into chloroform, butanol and aqueous fractions. The extract (10 g) was suspended in distilled water (300 mL) and extracted successively with chloroform (3 × 50 mL) and butanol (4 × 50 mL). The chloroform and butanol extracts and the remaining aqueous fraction phase were evaporated under vacuum.

Rabbit jejunum

The method followed was that described by Edinburgh University Staff (1970). Rabbits were stunned and decapitated. The abdomen was opened and the jejunal part of the small intestine removed and placed in Tyrode's solution of composition (mM): NaCl 137, KCl 2·7, $CaCl_2$ 1·36, NaH_2PO_4 0·32, $MgCl_2$ 0·49, $NaHCO_3$ 25 and glucose 11·7. The intestinal contents were gently flushed with Tyrode's solution and the adhering mesenteric attachments removed. The tissues were mounted on a thermostatically controlled 10-mL jacketed organ bath by hooking one end of the tissue to the organ holder and the other end to the isometric transducer (Lectromed UF 1). The Tyrode's solution was maintained at 37°C; through it was bubbled a gas mixture of 95% O_2 and 5% CO_2. The tissues were kept under 1 g tension and left to equilibrate for 30 min. The spontaneous rhythmic contractions were recorded on a chart recorder (Lectromed Multitrace-2).

The inhibitory effect of the plant extracts were calculated from their control (pre-treatment) responses. The concentration which produced a 50% inhibitory response was calculated as the IC50 value and the maximum inhibition produced by the extract was taken as the I_{max} value.

Guinea-pig ileum

This method followed was that described by Edinburgh University Staff (1970). Guinea-pigs were stunned and decapitated. The abdomen was opened to remove the terminal part of the ileum and the latter was placed in Krebs solution of composition (mM L^{-1}): NaCl 94·8, KCl 4·7, $CaCl_2$ 1·9, $MgSO_4$ 1·2, KH_2PO_4 1·2, $NaHCO_3$ 25 and glucose 11·7. The isolation and mounting procedures were as described above.

In one set of experiments, the acetylcholine dose-response curves were constructed in the presence and absence of different concentrations of the plant extracts as antagonists. In another set the response to a single sub-maximum dose of acetylcholine was measured before and 15 min after exposure of the isolated tissue to different concentrations of the plant extracts. The percentage inhibition produced by the plant extracts were calculated.

ISMRA assessment criteria

The rabbit jejunum preparation was used as a primary screening test because it exhibits spontaneous activity which would demonstrate stimulatory action, inhibitory action or no effect of the plant extract in question.

Plant extracts which showed no effect after being tested on three different rabbit jejunal tissues were deemed ineffective and were not tested further. Those which showed inhibitory activity were tested further on 6–8 different jejunal tissues for each concentration.

Each active plant extract was added in increasing amounts until a concentration which caused maximum inhibition was reached (I_{max}). From the dose-reponse curve obtained, the concentration of the plant extract that caused 50% of the maximum inhibition (IC50) was calculated. The IC50 value was taken as the measure of ISMRA activity.

Plant extracts with IC50 < 1 mg were tested in-vivo for their gastrointestinal transit time.

Gastrointestinal transit time

The charcoal meal method was used. Mice were starved of food but not water for 16 h and were then treated orally with plant

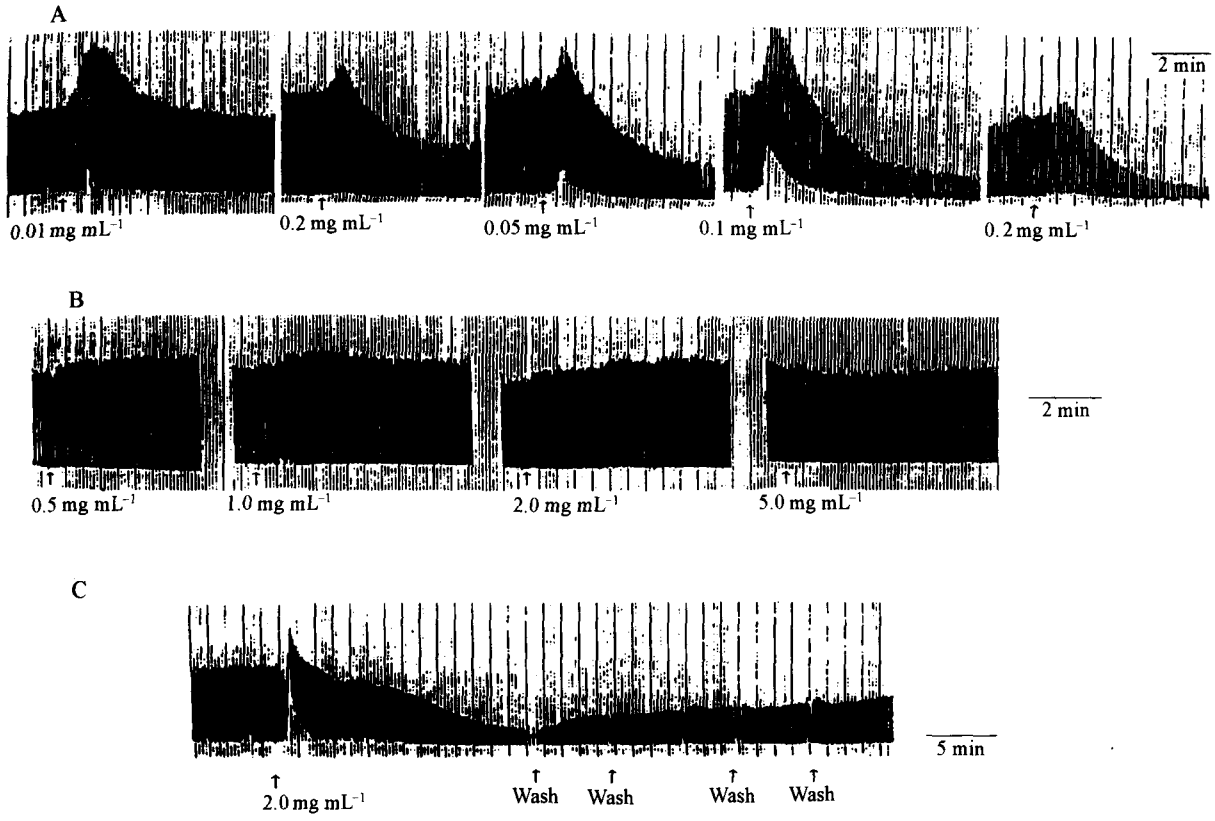

FIG. 1. Representative traces showing the effect of increasing doses of aqueous extracts of *R. stricta* (A), *C. comosum* (B) and *F. indica* (C) on spontaneous contractions of the isolated rabbit jejunum. The extract from *R. stricta* initially stimulated then inhibited the preparation. *C. comosum* had no effect, whereas *F. indica* stimulated then inhibited the contractions, the latter being practically irreversible.

extract or vehicle, or injected subcutaneously with morphine (5 mg kg^{-1}). After 45 min, the animals were dosed orally with charcoal suspension (10% charcoal in 5% gum acacia) at a dose of 0·25 mL/mouse. Thirty minutes later, the mice were killed by cervical dislocation. The abdomen was opened and the intestines were removed from the pyloric junction to the caecal end. The farthest distance travelled by the charcoal meal was measured, as was the total length of the intestine. Gastrointestinal transit was expressed as the percentage of the distance travelled by the charcoal relative to the total length of the small intestine.

Phytochemical screening

The plant material was defatted with hexane and the residue was extracted with ethanol. The ethanolic extract was tested for free and glycosidic bound anthraquinones, alkaloids, flavonoids and tannins. The defatted material was tested for sterols and/or terpenes, cardiac glycosides and saponins (Tanira et al 1994).

Statistical analysis

Values reported are means ± s.e.m. (n = 6–10). The significance of differences between means was assessed using unpaired Student's *t*-test. *P* values less than 0·05 were considered significant.

Results

Rabbit jejunum

The effects of the tested plant extracts on the rabbit jejunum (in-vitro) are summarized in Table 1. Most of the extracts caused immediate, short-lived stimulation followed by a gradual dose-dependent inhibition of the rabbit jejunal motility. A typical response of these plants (represented by *R. stricta*) is shown in Fig. 1A. Although the extracts of *C. tubulosa*, *H. tuberculatum*, *I. aucheri* and *Z. qatarense* produced non-specific changes in the frequency and magnitude of the spontaneous contraction of the tissue, their overall response could be categorized as inhibitory. A trace exemplifying this response is given in Fig 1B.

For each plant extract, IC50 and I_{max} values were calculated from the respective dose-response curve. A summary of these data is shown in Table 2.

Although most of the responses were completely reversed by washing the tissue preparation with perfusing solution, the inhibition caused by *C. comosum*, *C. brachycarpa*, *F. indica*, *L. pyrotechnica* and *N. sativum* could be only partially reversed. The partial irreversibility of the response to *F. indica* is apparent from Fig. 1C.

Guinea-pig ileum

Acetylcholine ($1 \times 10^{-1} - 5 \times 10^{-5}$ M) induced contraction of guinea-pig ileum in a dose-dependent manner. Fig. 2A depicts the dose-reponse relationship of acetylcholine with and without addition of various concentrations (0·01, 0·05, 0·1 mg mL^{-1}) of lyophilized *R. stricta* extract. At a concentration of 0·01 mg mL^{-1} the extract shifted the dose-reponse curve of acetylcholine to the left indicating a synergistic effect with a reduction in acetylcholine EC50 value from $2{\cdot}7 \times 10^{-9}$ to $2{\cdot}1 \times 10^{-10}$ M. At 0·1 mg mL^{-1}, however, the lyophilized extract of *R. stricta* shifted the curve to the right in a parallel

Table 2. The effects of some United Arab Emirates plant extracts on spontaneous contractions of rabbit isolated jejunum.

Extract	Solvent	n	I_{max}* (%)	IC50†(mg mL^{-1})
1 *Rhazya stricta*	Water	8	92·4 ± 2·0	0·09
2 *Heliotropium kotschyi*	Water	6	74·2 ± 5·2	0·13
3 *Rhazya stricta*	Butanol	8	97·7 ± 1·9	0·14
4 *Albizzia lebbeck*	Water	7	94·7 ± 2·1	0·32
5 *Fagonia indica*	Butanol	7	94·8 ± 3·6	0·62
6 *Fagonia indica*	Water	8	80·4 ± 6·2	0·85
7 *Reseda aucheri*	Butanol	8	83·8 ± 2·6	0·91
8 *Arnebia hispidissima*	Water	4	72·3 ± 8·1	0·93
9 *Reseda aucheri*	Water	6	92·3 ± 2·7	0·97
10 *Zygophyllum qatarense*	Water	6	94·4 ± 5·6	1·26
11 *Iphiona aucheri*	Water	7	77·0 ± 4·6	1·64
12 *Chrozophora oblongifolia*	Water	6	92·0 ± 1·6	1·76
13 *Zygophyllum mandevelli*	Water	7	80·8 ± 9·5	1·97
14 *Salsola baryosma*	Water	3	41·7 ± 8·4	2·11
15 *Pulicaria glutinosa*	Water	7	86·5 ± 4·4	2·28
16 *Leptadenia pyrotechnica*	Water	3	42.8 ± 2·8	2·31
17 *Haplophyllum tuberculatum*	Water	6	94·7 ± 1·9	2·38
18 *Cleome brachycarpa*	Water	4	83·5 ± 6·7	2·41
19 *Nigella sativum*	Water	6	82·1 ± 2·8	2·64
20 *Caralluma arabica*	Water	4	67·0 ± 5·2	3·03
21 *Physorrhynchus chamaerapistrum*	Water	3	69·7 ± 3·0	3·15
22 *Capparis cartilaginea*	Water	3	57·0 ± 4·6	3·46
23 *Calligonum comosum*	Water	6	100	3·60
24 *Cistanche tubulosa*	Water	4	56·8 ± 12·4	3·64
25 *Trichodesma africana*	Water	4	60·9 ± 8·3	12.53
26 *Cynomorium coccineum*	Water	3	28·3 ± 8·3	–

* The percentage maximum inhibition (mean ± s.e.m.).
† The extract concentration required to produce 50% maximum inhibition.

manner, giving an EC50 value of $8·6 \times 10^{-7}$ M. At a concentration of 0·05 mg mL^{-1} *R. stricta* gave a mixed response. At its lower concentrations it potentiated the action of acetylcholine whereas at higher concentrations it antagonized acetylcholine-induced contraction. The maximum acetylcholine-induced contraction was reduced by about 20% in the presence of lyophilized extract of *R. stricta* at all concentrations.

As shown in Fig. 2B, *R. stricta* (butanol fraction) shifted the acetylcholine dose-reponse curve to the right. The acetylcholine EC50 value of $1·0 \times 10^{-8}$ M in the control was changed to $9·7 \times 10^{-9}$, $1·3 \times 10^{-5}$ and $1·1 \times 10^{-6}$ M after addition of *R. stricta* (butanol fraction) to the bath at 0·01, 0·05, and 0·1 mg mL^{-1}, respectively.

Increasing concentrations of atropine (0·001–0·1 μg mL^{-1}) produced a rightward shift of the acetylcholine dose-reponse curve in a dose-dependent manner (Fig. 3). The EC50 value of $1·5 \times 10^{-8}$ M in the control was changed to $1·3 \times 10^{-7}$ M (0·001 μg mL^{-1}), $2·63 \times 10^{-6}$ M (0·01 μg mL^{-1}), and $2·07 \times 10^{-5}$ M (0·1 μg mL^{-1}).

The I_{max} and IC50 values of *R. stricta* and *F. indica* (aqueous and butanol fractions, respectively) against a sub-maximum dose of acetylcholine (1×10^{-5} M) are shown in Table 3. *F. indica* (lyophilized extract) at concentrations of 0·05 and 0·1 mg mL^{-1}, did not affect acetylcholine contractions. The butanol fraction (0·05 and 0·1 mg mL^{-1}), however, caused a moderate rightward shift of the acetylcholine dose-reponse curve. At a lower concentration (0·01 mg mL^{-1}) *F. indica* extract increased the maximum contraction induced by acetylcholine by about 125%.

Gastrointestinal transit time

Table 4 summarizes the effect of various treatments on gastrointestinal transit time. *A. lebbeck*, *A. hispidissima*, *F. indica*, *H. kotschyi*, *R. aucheri* and *R. stricta* caused a delay in gastro-

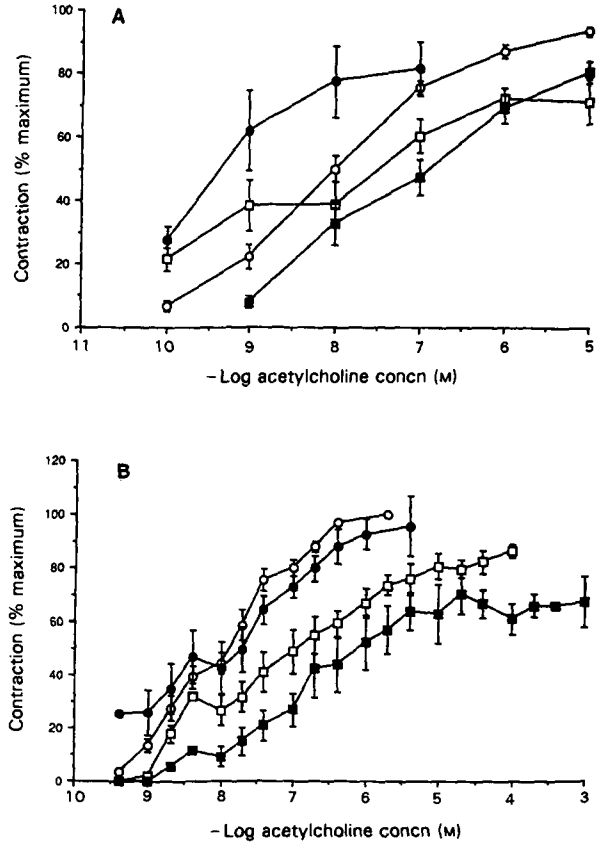

FIG. 2. Dose-reponse curves for acetylcholine alone (O) or in the presence of lyophilized water extracts (A) or butanol extract (B) of *R. stricta* at concentrations of 0·01 mg mL^{-1} (●), 0·05 mg mL^{-1} (□) and 0·1 mg mL^{-1} (■). Each point and vertical bar represent mean ± s.e.m. (n = 6).

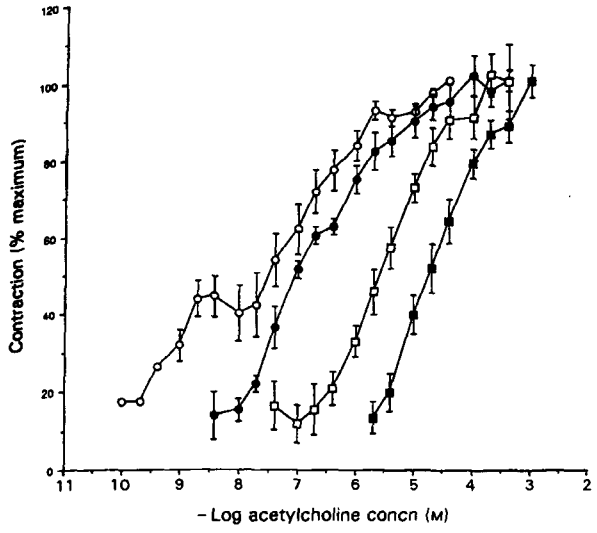

FIG. 3. Concentration-response curve for isolated guinea-pig ileum in the absence (O) and presence of atropine sulphate at concentrations of 0·001 μg mL^{-1} (●), 0·01 μg mL^{-1} (□) and 0·1 μg mL^{-1} (■). Each point and vertical bar represent mean ± s.e.m. (n = 6).

intestinal transit time that varied between 25 and 50%. Morphine (5 mg kg^{-1}) delayed the transit by about 76% in comparison with the control. The efficacy was highest for *R. stricta* (butanol fraction), followed by *F. indica* (aqueous extract), *R. aucheri*, *A. hispidissima*, *H. kotschyi*, *A. lebbeck* and lowest for *R. stricta* (aqueous traction). *R. stricta* aqueous fraction showed only a slight reduction in gastrointestinal transit (15%) when given at a dose of 2 g kg^{-1}. When the dose was doubled inhibition increased to more than 30%.

Phytochemical analysis

The phytochemical analysis of secondary constituents of plant extracts with EC50 < 1 mg mL^{-1} (n = 6) is shown in Table 5.

Table 3. The effect of extracts of certain United Arab Emirates plants on acetylcholine-induced contractions of the guinea-pig ileum.

	Rhazya stricta (lyophilized)	*Rhazya stricta* (butanol)	*Fagonia indica* (aqueous)
IC50	0·87 ± 0·14	0·45 ± 0·03*	1·14 ± 0·11†
I_{max}	84·1 ± 0·9	99·2 ± 0·8**	89·6 ± 7·1‡

Values in the table are mean ± s.e.m. (n = 4–6). *$P < 0·05$; **$P < 0·01$ compared with lyophilized *R. stricta*; †$P < 0·01$, ‡$P < 0·001$ compared with *R. stricta* (butanol).

All the tested plants showed the presence of saponins, flavonoids, tannins and terpenes and/or sterols. *R. stricta* contained appreciable amounts of alkaloids whereas *A. lebbeck* and *F. indica* contained none. All the plant extracts screened were devoid of anthraquinones and cardiac glycosides.

Discussion

Most of the plant extracts tested showed an inhibitory action on the spontaneous contractions of rabbit jejunal tissue, indicating antispasmodic activity. Six extracts with an IC50 value < 1 mg on rabbit jejunum preparation were selected to be tested using the gastrointestinal transit time method to confirm their in-vivo ISMRA. The basis of this selection was that compounds with appreciable therapeutic potential would induce their effect with an IC50 < 1 mg if they were to be taken in reasonable amounts of their crude plant material.

A. lebbeck, *A. hispidissima*, *H. kotschyi*, *R. stricta*, *F. indica* and *R. aucheri* caused a significant delay in gastrointestinal transit. The effects of these plant extracts were, however, significantly less than that produced by morphine (5 mg kg^{-1}). The effects on gastrointestinal transit confirmed the inhibitory action of these plant extracts on rabbit jejunal tissue and suggest the potential of the last three as antispasmodic agents.

Table 4. Effect of extracts of certain United Arab Emirates plants and morphine on gastrointestinal transit time in mice. Each value in the table is the mean ± s.e.m. (number of observations are in parenthesis). The plant extracts were given to mice orally and morphine subcutaneously 45 min before administration of charcoal suspension. Thirty minutes later the animals were killed and gastrointestinal transit measured.

Extract	Gastrointestinal transit time (%)		
	0·5 g kg^{-1}	1·0 g kg^{-1}	2·0 g kg^{-1}
Control (saline) (1 mL kg^{-1})		66·64 ± 1·97 (12)	
Morphine (5 mg kg^{-1})		16·23 ± 1·26*** (6)	
Albizzia lebbeck (alcohol)	NA	52·7 ± 6·7*** (6)	49·8 ± 6·1** (6)
Arnebia hispidissima (alcohol)	57·6 ± 5·4* (6)	44·9 ± 5·9*** (6)	40·2 ± 3·8*** (6)
Fagonia indica (aqueous)	63·98 ± 1·69 (6)	NA	34·2 ± 2·2*** (6)
Heliotropium kotschyi (alcohol)	59·9 ± 4·2 (6)	47·3 ± 5·3*** (6)	NA
Reseda aucheri (alcohol)	59·1 ± 5·4 (6)	55·9 ± 6·6 (6)	36·3 ± 4·1*** (6)
Rhazya stricta (aqueous)	NA	64·4 ± 5·2 (6)	55·9 ± 3·2 (6)
Rhazya stricta (butanol)	NA	44·4 ± 3·72*** (6)	33·7 ± 4·2*** (6)

*$P < 0·05$, **$P < 0·01$, ***$P < 0·001$ compared with control. NA = not attempted.

Table 5. Phytochemical analysis of some United Arab Emirates plant species with antispasmodic action.

Species	Part	Terpenes or sterols	Alkaloids	Saponins	Compound Anthraquinones	Flavonoids	Cardiac glycosides	Tannins
Albizzia lebbeck	Leaf	+ +	−	+ + +	−	+	−	+
Arnebia hispidissima	Aerial	+	+	+ +	−	+	−	+
Reseda aucheri	Leaf	+ +	+	+	−	+ +	−	+
Rhazya stricta	Leaf	+ +	+ + +	+	−	+ +	−	+
Fagonia indica	Aerial	+ + +	−	+ +	−	+ +	−	+ +
Haplophyllum tuberculatum	Aerial	+	+ +	+	−	+ +	−	+ +

+ + + appreciable amount, + + moderate amount, + trace amount, − complete absence.

Some plant extracts (*C. tubulosa*, *H. tuberculatum*, *I. aucheri* and *Z. qatarense*) did not produce a consistent response indicating that they might not be therapeutically useful. Some other extracts caused irreversible inhibitory action. This irreversibility (noticeably with *F. indica*) is indicative of a long duration of action. *F. indica* is well reputed among folk medicine practitioners in the UAE as a potent long-acting agent when used to treat intestinal colic. The irreversibility of its action in this work supports this reputation.

The dose-reponse curve of acetylcholine on guinea-pig ileum was assessed in the presence and absence of a commonly used plant extract with a high ISMRA, i.e. that from *R. stricta*. The results obtained demonstrate the presence of more than one active component in terms of intestinal smooth muscle activity in the lyophilized extract of *R. stricta*. The presence of a synergistic component which might be acting in an acetylcholine-like fashion is suggested. It appears that the action of this component dominates the effect of the extract at low concentration. This was indicated by the transient stimulatory phase noticed on rabbit jejunal tissue (Fig. 1B) and was further supported by the observation that 0·05 mg mL^{-1} of the lyophilized extract of *R. stricta* shifted the acetylcholine dose-reponse curve to the left. Another component with an antagonistic action which appears to dominate the effect of the extract at a higher concentration (0·1 mg mL^{-1}) was also observed. This antagonistic component might have caused a shift of the dose-response curve to the right (Fig. 2A).

It is apparent that the antagonistic component of *R. stricta* extract did not alter the acetylcholine-induced maximum contraction. This observation might imply its competitive nature, and thus it could be postulated that the ISMRA of *R. stricta* extract is a result, at least in part, of the interaction of this component with the cholinergic receptor site of the intestinal smooth muscle in an atropine-like fashion.

The chemical constituents of most of the plants studied in this report are not fully known (El Ghonemi 1993). For a few plants, however, (e.g. *R. stricta*), there are several reports on the phytochemical constituents. *R. stricta* has been shown to contain alkaloids with a β-carboline component (Bashir et al 1994) and two flavonoids (Bashir unpublished data).

In conclusion, the results presented in this report indicate the potential of some UAE plants as antispasmodic agents. Of significant potential is *R. stricta*. The in-vitro effect of this plant on rabbit jejunum and guinea-pig ileum tissues coupled with its potent action on gastrointestinal transit time strongly confirm its folk medicinal use as an antispasmodic agent. Assessment of its safety should, however, be established before its recommendation for therapeutic use. Some preliminary results have recently been published (Ali et al 1995).

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