Chemical Defence Establishment,
Porton Down,
Salisbury, Wiltshire, U.K.

T. D. INCH
R. W. BRIMBLECOMBE

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REFERENCES

BARLOW, R. B. (1971). *J. Pharm. Pharmac.*, **23**, 90–97.
BEBINGTON, A. & BRIMBLECOMBE, R. W. (1965). *Advances in Drug Research*, **2**, 143–172.
BRIMBLECOMBE, R. W., GREEN, D. M., INCH, T. D. & THOMPSON, P. M. J. (1971). *Ibid.*, **23**, 745–757.
BRIMBLECOMBE, R. W. & INCH, T. D. (1970). *Ibid.*, **22**, 881–888.
BRIMBLECOMBE, R. W., INCH, T. D., WETHERELL, J. & WILLIAMS, N. (1971). *Ibid.*, **23**, 649–661.
COOPER, D. B., INCH, T. D. & SELLERS, D. J. (1971). *Tetrahedron Lett.*, 2329–2332.
DUFFIN, W. M. & GREEN, A. F. (1955). *Br. J. Pharmac. Chemother.*, **10**, 383–386.
INCH, T. D. (1971). *Progr. Brain Res.* In the press.
INCH, T. D., LEY, R. V., RICH, P. (1968). *J. chem. Soc. C*, 1693–1699.

Acetylcholine-like action of atropine on the ciliary epithelium of the frog oesophagus during the warmer months

Atropine is known to show muscarinic actions in some experimental conditions (Burn, 1956 b & c; Hazard, Savini & Renier-Cornec, 1959; Teitel, 1961; Ashford, Penn & Ross, 1962; Goodman & Gilman, 1970). We now report another example seen in the ciliary epithelium of the oesophagus of *Rana tigrina*, the common Indian frog (60–300 g), after pithing (Burn, 1952). Experiments were made at room temperature between May 1970 and April 1971, with black seeds of *Amaranthus gangeticus* (average weight 0·95 mg/seed) instead of white poppy seeds (average weight 0·29 mg/seed). Drugs dissolved in 0·2 ml amphibian Ringer were gently measured from a syringe onto the tissue surface and readings of the time for the seed to travel 2 cm were taken over a 3–10 min period. Drugs were washed off by gently irrigating the surface with amphibian Ringer. Atropine sulphate from three sources (T. & H. Smith, U.K.; Boehringer, Germany; Indian Health Institute & Laboratory, India) was used. For control experiments carbachol (1 μg) and acetylcholine bromide (1–300 μg) were used. Hyoscine hydrobromide (0·5–3·0 μg) and eserine sulphate (1 μg) were used in some experiments.

The normal time required by the seed to travel 2 cm was about 47 s (range 11–81 s) in the summer and about 117 s (range 80–165 s) in the winter. Throughout the year, in the doses exceeding 0·1 mg, atropine usually inhibited the ciliary movement thus increasing the seed travelling time. However, smaller doses of atropine generally stimulated the cilia during the summer and inhibited during the winter (Table 1). These effects could be repeatedly elicited on the individual tissues. Hyoscine in May and June stimulated the cilia (20–68% reduction in the control seed travelling time). Throughout the year, acetylcholine, carbachol and eserine consistently stimulated the cilia (54–83% reduction in the control seed travelling time). When their individual stimulant doses were mixed together and placed onto the tissues, atropine and carbachol did not manifest clear additive or antagonistic effect.

Briefly keeping the tissues warm (90°F) in winter or cool (55°F) in summer did not alter their respective responses (Table 1) to the smaller doses of atropine.

Table 1. *Effect of atropine on ciliary movement of the frog oesophagus epithelium.*

Months, season (range of room temperature °F)	Total no. of frogs	Doses of atropine applied on the tissue surface: 0·1–30·0 μg — No. of tissues showing stimulation (range of % decrease in seed travelling time)	0·1–30·0 μg — No. of tissues showing inhibition (range of % increase in seed travelling time)	0·1–30·0 mg — No. of tissues showing inhibition (range of % increase in seed travelling time)
May-June, summer (86–102)	10*	10 (12–62%)	—	4 (7–55%)
July-October, monsoon rains (86–96)	16	15 (5–53%)	—	16 (11–68%)
December-February, winter (65–75)	8*	—	7 (6–58%)	5 (3–71%)
April, spring (92–97)	4	2 (2–21%)	2 (11–55%)	4 (5–55%)

* Higher dose of atropine was not tried in some frogs.

The *Rana tigrina* cilia, in the warmer months, respond to atropine like those of *Mytilus edulis* gill plates (Burn, 1956b). Burn, who suggested a cholinergic mechanism for the ciliary movement (1956a), has also commented upon acetylcholine-like action of atropine in some experimental conditions (1956c).

Department of Pharmacology,
All-India Institute of Medical Sciences,
New Delhi-16,
India.

M. H. AKHTER
N. K. BHIDE

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REFERENCES

ASHFORD, A., PENN, G. B. & ROSS, W. J. (1962). *Nature, Lond.*, **193**, 1082–1083.

BURN, J. H. (1952). *Practical Pharmacology*, p. 62–65. Oxford: Blackwell.

BURN, J. H. (1956). *Functions of Autonomic Transmitters*, (a) p. 78, (b) p. 84 & (c) p. 96. Baltimore: The Williams & Wilkins Company.

GOODMAN, L. S. & GILMAN, A. (1970). *The Pharmacological Basis of Therapeutics*, 4th edn, p. 527. London: Collier-Macmillan.

HAZARD, R., SAVINI, E. & RENIER-CORNEC. A. (1959). *Archs int. Pharmacodyn. Thér.*, **120**, 369–373.

TEITEL, A. (1961). *Nature, Lond.*, **190**, 814–815.