References

GILLESPIE, J.S. & McGRATH, J.C. (1975). The effects of lysergic acid diethylamide on the response to field stimulation of the rat vas deferens and the rat and cat anococcygeus muscles. *Br. J. Pharmac.*, **54**, 481–488.

NASH, C.W., GILLESPIE, J.S. & ROBERTSON, E.N. (1974). Noradrenaline uptake properties of the anococcygeus muscle of the rat. *Canad. J. Physiol. Pharmacol.*, **52**, 430–440.

Monoamine oxidation in tissues of the developing chick

B.A. CALLINGHAM & C.J. FOWLER

Department of Pharmacology, University of Cambridge, Hills Road, Cambridge CB2 2QD

Monoamine oxidase (MAO) activity in several animal tissues is related to growth (see Gripois, 1975). For example, in the rat heart, its specific activity increases with age due to a slowing of the rate of degradation of the enzyme (Callingham & Della Corte, 1972). Changes in the thyroid status modify this relationship by changing the rate of synthesis (Lyles & Callingham, 1974). The domestic fowl, which, at hatching is an independent but immature animal, has been used in this present study.

The hearts and livers of male chicks were homogenized in 1 mM potassium phosphate buffer, pH 7.4. MAO activity was assayed radiochemically using [^{3}H]-tyramine and [^{14}C]-benzylamine, and expressed as nmol substrate consumed (mg protein)$^{-1}$ h^{-1}. MAO specific activities were determined in the hearts and livers of groups of 4 chicks, at 6, 21, and 40 days after hatching. In both organs there was an increase in enzyme activity with age using either substrate.

Chicks were made hypothyroid by the addition of 0.2% (w/w) of 2-thiouracil in the feed, beginning the day after hatching. At 40 days after hatching, the treated chicks were about 70% of the control weight, and their hearts 60%. In the liver there were significant increases in MAO specific activity, 2.4 and 2.1 times control for tyramine and benzylamine respectively. In the heart there was a significant decrease in activity towards benzylamine (56% of control) but no significant change in tyramine oxidizing activity.

Chicks were made hyperthyroid by daily injections of (–)-thyroxine (1 mg/kg, s.c.) for 11 days, beginning on the second day after hatching, and killed 24 h after the last injection. At this time, the hyperthyroid birds had an increased temperature, a body weight 80% of that of the controls, but no change in heart weight. In the heart there were significant increases in MAO specific activity to 1.4 and 1.5 times control for tyramine and benzylamine respectively. No significant changes in activity were seen in the liver.

Experiments using clorgyline showed that tyramine oxidation in the heart was brought about by MAO-A and -B together with a clorgyline-resistant enzyme. Benzylamine oxidation in the heart was brought about wholly by this clorgyline-resistant enzyme, which was, however, inhibited by semicarbazide. In the liver, MAO-A and -B were responsible for all the tyramine oxidation, but MAO-B and the clorgyline-resistant enzyme oxidized benzylamine.

These results indicate that the enzymes responsible for the oxidation of tyramine and benzylamine in chick heart and liver can be resolved into MAO-A and -B (Johnston, 1968) and a clorgyline-resistant enzyme (Lyles & Callingham, 1975) that does not appear to be flavine-dependent. The activities of these enzymes are influenced by the development and thyroid status of the bird.

Supported by a grant from The British Heart Foundation. C.J.F. is a Medical Research Council Scholar. We thank May & Baker Ltd., for a gift of clorgyline (M & B 9302).

References

CALLINGHAM, B.A. & DELLA CORTE, L. (1972). The influence of growth and of adrenalectomy upon some rat heart enzymes. *Br. J. Pharmac.*, **46**, 530–531P.

GRIPOIS, D. (1975). Review: developmental characteristics of monoamine oxidase. *Comp. Biochem. Physiol.*, **51C**, 143–151.

JOHNSTON, J.P. (1968). Some observations upon a new inhibitor of monoamine oxidase in brain tissue. *Biochem. Pharmac.*, **17**, 1285–1297.

LYLES, G.A. & CALLINGHAM, B.A. (1974). The effects of thyroid hormones on monoamine oxidase activity in the rat heart. *J. Pharm. Pharmac.*, **26**, 921–930.

LYLES, G.A. & CALLINGHAM, B.A. (1975). Evidence for a clorgyline-resistant monoamine metabolizing activity in the rat heart. *J. Pharm. Pharmac.*, **27**, 682–691.