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Aldrin Epoxidase in Liver and Small Intestine of Rat and Japanese Quail

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Epoxidation of aldrin to dieldrin is a typical mixed-function oxidase reaction. During the past few years, studies have been carried out on this reaction in plants (YU et al. 1971), insects (KRIEGER and WILKINSON 1969), various invertebrates (KHAN et al. 1975), rat (WONG and TERRIERE 1965, GILLETT et al. 1966, GHIASUDDIN and MENZER 1976), rabbit (NAKATSUGAWA et al. 1965), pig (LEWIS et al. 1967) and birds (GILLETT and ARSCOTT 1969, RUNNELS and KHAN 1973).

In vertebrates, most of the data in drug metabolism involve the use of homogenates or microsomal fractions of liver, the main site of detoxifying activity. Other organs, however, have metabolic ability, and amongst them, the digestive tract (HARTIALA 1973).

In rat, the drug metabolizing activity of the digestive tract is difficult to study : the activity is usually low (WATTENBERG et al. 1962, LAKE et al. 1973) and stable microsomal fractions were not available until recently (STOHS et al. 1976). Most of the reports involve benzpyrene or biphenyl hydroxylation, but information about aldrin epoxidation is lacking. In birds BARTLET and KIRINYA (1976) have detected high aminopyrine demethylase activity in intestinal slices of chick.

MATERIALS AND METHODS

Wistar rats (2-months old) and Japanese quails (6-months old) are reared in standard laboratory conditions. Rats are killed by a blow on the head and quails by decapitation. Liver and other organs are immediately removed, weighed and rinsed in NaCl 9.0 ‰ at 0°C. The chilled organs are homogenized in KCl 1.15 % with a Potter homogenizer to make a 20-25 % homogenate. After centrifugation (10, 800 g x 10 min), the supernatant is used as enzyme source and referred thereafter as "enzyme".

The procedures of incubation and dosage are essentially as described by KRIEGER and WILKINSON (1969) with minor modifications :

Phosphate buffer pH 7.4	5×10^{-2} M (final concentration)
NADP (Boehringer)	5×10^{-4} M "
G6P (Boehringer)	5×10^{-3} M "
$MgCl_2$	5×10^{-3} M "
Aldrin (Shell) in 50 µl methoxyethanol	5×10^{-5} M "
Enzyme	0.5 ml

Total volume : 2.55 ml in Erlenmeyer flask (25.0 ml).

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After 15 min incubation at 40°C in a shaking incubator, the reaction is stopped by 2.5 ml acetone and dieldrin extracted with 2 x 4.0 ml petroleum ether. The extracts completed to a volume of 10.0 ml are analyzed by gas chromatography.

RESULTS AND DISCUSSION

The metabolism of aldrin in the digestive tract of rat and quail gives dieldrin, confirmed by retention times on two different columns. No attempt has been made to identify other possible metabolites of aldrin and/or dieldrin.

The activity is mainly located in the liver and small intestine, and, to a smaller extent, in colon and coecum (Table 1).

TABLE 1

Aldrin epoxidase activity in the digestive tract of rats and quails (mean of 2 animals).

		♂		♀	
		pmole/ g x min	pmole/whole organ x min	pmole/ g x min	pmole/whole organ x min
Rat	Stomach	350	640	54	94
	Liver	65,000	798,000	13,500	124,000
	Pancreas	15	21	<10	-
	Duodenum	1,400	2,000	550	700
	Colon+coecum	610	2,110	150	500
	Spleen	330	2,460	48	26
Quail	Crop	52	58	50	76
	Liver	3,100	22,900	8,800	48,200
	Pancreas	99	66	<10	-
	Duodenum	4,800	10,000	6,700	20,800
	Colon+coecum	160	350	580	4,500
	Spleen	1,300	480	140	52

In small intestine of both rats and quails, the activity decreases from the proximal to the distal end, as described by WATTENBERG (1972) for benzpyrene hydroxylase (fig. 1). The most striking feature is the high specific activity of the duodenum of quail, as compared to rat (Table 2).

These data are still emphasized when we consider the whole detoxifying ability of each organ (Table 3, data calculated from fig. 1).

These results suggest that intestinal microsomal system can be a major route of xenobiotic metabolism in quail. Further work is undertaken to have a more detailed survey of the causes and toxicological implications of such findings.

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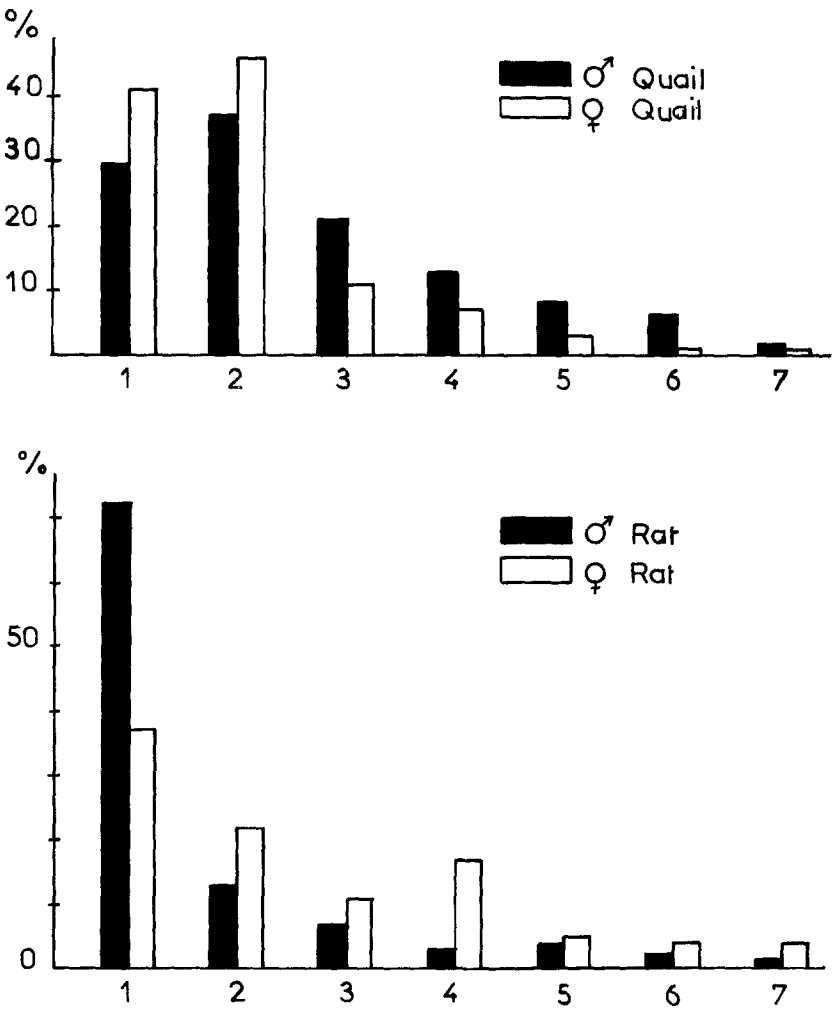

Fig. 1 : Aldrin epoxidase in small intestine of rat and quail (small intestine is divided into 7 fragments of equal length ; fragment 1 is the duodenum).

TABLE 2

Aldrin epoxidase activity (pmole/g x min) in liver and duodenum of rat and quail (mean of 3 animals).

		Liver	Duodenum
Rat	♂	41,900	2,270
	♀	6,930	330
Quail	♂	6,540	6,790
	♀	2,360	6,950

TABLE 3

Relative detoxifying ability of liver and small intestine in rat and quail.

		Liver	small intestine
Rat	♂	1000	8
	♀	1000	15
Quail	♂	1000	1600
	♀	1000	1800

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