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Teratogenicity of the Fungicides Captan and Folpet in the Chick Embryo[1]

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The teratogenic effects of the fungicides captan and folpet have been reported for several vertebrate embryos (MARLIAC 1964; MARLIAC et al. 1965; MITCHELL 1975; VERRETT et al. 1969). In a study of the synthesis of DNA, RNA and protein in the developing chick treated with these fungicides our observations on anomalous development confirm and extend these earlier reports.

MATERIALS AND METHODS

Fertile White Leghorn chicken eggs were incubated at 38°C and 80% relative humidity for periods ranging from 4 to 20 days. The eggs were injected with 1, 6, 12 or 18 ppm captan just prior to incubation (day 0) in one study. A later study involved injecting eggs with 12 ppm captan or folpet after incubation for 4 days.

Fungicides were injected in a total volume of 0.05 ml to 0.10 ml using dimethylsulfoxide (DMSO) as the solvent. VERRETT et al. (1969) have shown these levels of solvent to cause background mortality averages of 15% with a range of 0 to 25%. These values are of the same magnitude as saline injected controls.

The fungicides used were a gift of the Chevron Chemical Company and were supplied as highly purified samples (captan, 98.6% and folpet, 99.94%). Control injections of chick saline were also performed for each study. All injections were made using the procedure of McLAUGHLIN et al. 1963.

RESULTS

The incidence of abnormalities observed grossly and microscopically in embryos from day 5 through day 20 is compiled in Table I. The spectrum of abnormalities was as follows: eventration of the viscera, micro-

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TABLE 1.

Incidence of Abnormalities in Chicken Embryos

	number of viable eggs	Abnormalities[1]						
		eventration of viscera	eye	skull	wing	leg	spine	beak
Untreated controls	646	0	0	0	0	0	1	0
1 ppm Captan (day 0)	37	2	4	2	0	1	3	4
12 ppm Captan (day 4)	78	2	7	7	3	9	17	6
12 ppm Folpet (day 4)	106	2	1	0	1	2	9	3

($P < .001$)

1. Individual embryos may exhibit multiple abnormalities.

TABLE 2.

MORTALITY OF CHICKEN EMBRYOS

	Number Dead/ Total Embryos	Concentration ppm (mg/kg) in egg	Time of Injection	Percent Mortality
Untreated Samples[1]	128/774	---	---	17
Captan	83/120	1	day 0	69
Captan	27/37	6	day 0	73
Captan	42/50	12	day 0	84
Captan	47/54	18	day 0	87
Captan	116/194	12	day 4	60
Folpet	76/182	12	day 4	42

($P < 0.001$)

1. DMSO controls.

phthalmia, wing micromelia, leg hemimelia, deformed toes, asymmetrical development of the spine, lordosis of the spine, contortion of the neck (wryneck), absence or reduction of upper beak, cross-beak associated with microphthalmia, and various degrees of failure of normal skull development.

It was observed that spinal abnormalities constituted the greatest percentage of abnormalities with both captan (29%) and folpet (50%). Leg abnormalities occurred in 14% of the total after captan treatment and 11% after folpet. Of interest is the observation that 13% of the total captan induced abnormalities involved failure of normal skull development while none of this type was noted after folpet treatment. However, microphthalmia and abnormal beak development occurred in approximately equal numbers of embryos treated with each fungicide (14% with captan, 16% with folpet). Wing and visceral malformations occurred in less than 10% of the total abnormalities. It should be noted that since there was a high mortality of the treated embryos during early development (Table 2) the teratogenic effects observed from day 5 to day 20 were fewer than the actual number possible. Of the control embryos only one showed a detectable abnormality and less than 1% died throughout the incubation period.

DISCUSSION

These data confirm the results previously reported by MARLIAC (1964, 1965) and VERRETT et al. (1969) and their co-workers for the chick and are comparable to those noted by MITCHELL (1975) in the snapping turtle. We emphasize that there seems to be no correlation between dose level and the observed teratogenic effects.

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