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EMBRYOTOXICITY OF MALATHION IN DEVELOPING CHICK

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Abstract: Malathion, an organophosphorous insecticide, was tested for embryotoxic and teratogenic effects in developing chick. Different aquous concentrations of the insecticide (5.0, 10.0, 15.0, 20.0 µg/egg), were injected in yolk sac of he eggs before incubation. Embryo recoveries were made at day 7 and 14 of incubation.

At day 7, morphological, anatomical and morphometric studies revealed concentration dependent adverse effects of the insecticide. The developmental defects were significant reduction in CR length and body weight, hydroencephaly, microcephaly, microphthalmia, anophthalmia, short beak, micromelia, Amelia and ectopia cordis. Developmental anomalies in 14 days embryos included dawarfism, undistinguishable brain parts, microphthalmia, amelia, meningocoele and ectopia cordis.

The present study indicates that Malathion is potentially dangerous to avian development. This indicates that insecticides must be used with utmost care.

Key words: Malathion, insecticide, embryotoxic, teratogenic, avian development.

INTRODUCTION

Pollution is the major problem of modern age. It has increased various hazards, which are severely damaging the living conditions of almost all the organisms. Amongst many other factors causing pollution insecticides contribute a lot. The insecticides of course have increased the agro-production possibilities but environmental and health side effects of their use have rendered differences for living creatures. (Zilberman and Siebert, 1990). Worldwide productions of these insecticides continue to rise with a ten-fold increase in production between 1955 and 1985 (Rosenstock *et al.*, 1991).

Organophosphate are generally amongst the most acutely toxic of all pesticide to vertebrate animals. Using all relevant federal data on food consumption and pesticide residue on food, the environment working group concluded that 9 of 10 American children of age 6 months to 5 years ingest organophosphate insecticide in their food each day (Wiles *et al.*, 1998). Dinham (1993) revealed that there are in total 3 million acute sever cases of pesticides poisonings, of which a large proportion involves organophosphates. Organophosphate applicators had significantly more dizziness, sleepiness, headache and higher neurological symptoms scores than non-applicators (London *et al.*, 1998). Wide range of neuropsychological test, including memory, attention, problem solving and dexterity (Rosenstock *et al.*, 1991). In 1995, in Chine 15,300 pesticide poisoning cases

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were caused, including organophosphates i.e., parathion, methamidophos and diethoate (Shayang and Peipei, 1996).

Organophosphate insecticides exert their acute effect in both insects and mammals by inhibiting acetyl cholinesterase (AChE) in nervous system with subsequent accumulation of toxic level of acetylcholine (ACh), which is neurotransmitter (WHO, 1986).

Malathion is slightly toxic via the oral route, with reported oral LD_{50} values of 1000 mg/kg in the rat, and 400 mg/kg in the mouse (Gallo and Lawryk, 1991; Kidds and James, 1991). It is also slightly toxic via the dermal route, with reported dermal LD_{50} values of greater than 4000 mg/kg in rats (Gallo and Lawryk, 1991; Kidd and James, 1991). Effects of malathion are similar to those observed with other organophosphates, except that larger doses are required to produce them (Gallo and Lawryk, 1991). It has been reported that single doses of malathion may affect immune system response (Gallo and Lawryk, 1991).

Several studies have documented developmental and reproductive effects due to high doses of malathion in test animals (Gallo and Lawryk, 1991). Rats fed high doses of 240 mg/kg/day during pregnancy showed an increased rate of newborn mortality.

Above mentioned studies have indicated that organophosphate insecticides are toxic for non-target organisms and may also be embryotoxic and teratogenic. Thus the present study was planned to evaluate the embryotoxic and teratogenic potential of malathion in developing chicks.

RESULTS AND DISCUSSION

The purpose of present study was to evaluate the developmental toxic effects of an organophosphate insecticide Malathion in chick embryos. The main observations made during the present investigation revealed embryotoxicity and teratogenicity of malathion, injected in chick eggs before incubation.

The developmental defects, including increased embryo lethality, significant ($P<0.001$) reduction in CR length and body weight, hydroencephaly, microcephaly, eye defects, short beak agenesis of beak, twisted spinal cord, micromelia, Amelia and ectopia cordis were found almost in all dose groups (Fog 1 and 2) (Table 1 and 2).

During a study malathion was found to cause DNA abnormalities at all doses rested in human blood cells. Blood samples were drawn from healthy non-smoking men age 23-25. Four different concentrations (0.02, 0.2. 2,20 μg/ml) were added to blood samples. All doses showed chromosome abnormalities. A significant increase was noted for doses 2 and 20 μg/ml (Smith, 1993).

Malathion, Endosulfan, Carbafuran were tested for their toxicity in chicks. The increased level of all the pesticides in feed, with effect from 5^{th} week, showed a certain decrease in feed consumption. Feed conversion efficiency was reduced in Malathion group. When leukocytes response was studied in chick at 4^{th} to 9^{th} weeks of age after

feeding insecticides contaminated feed from the day of hatching absolute heterophilia, eosinophilia, monocytosis and lymphocytopenia were observed (Deshmukh *et al.*, 1991).

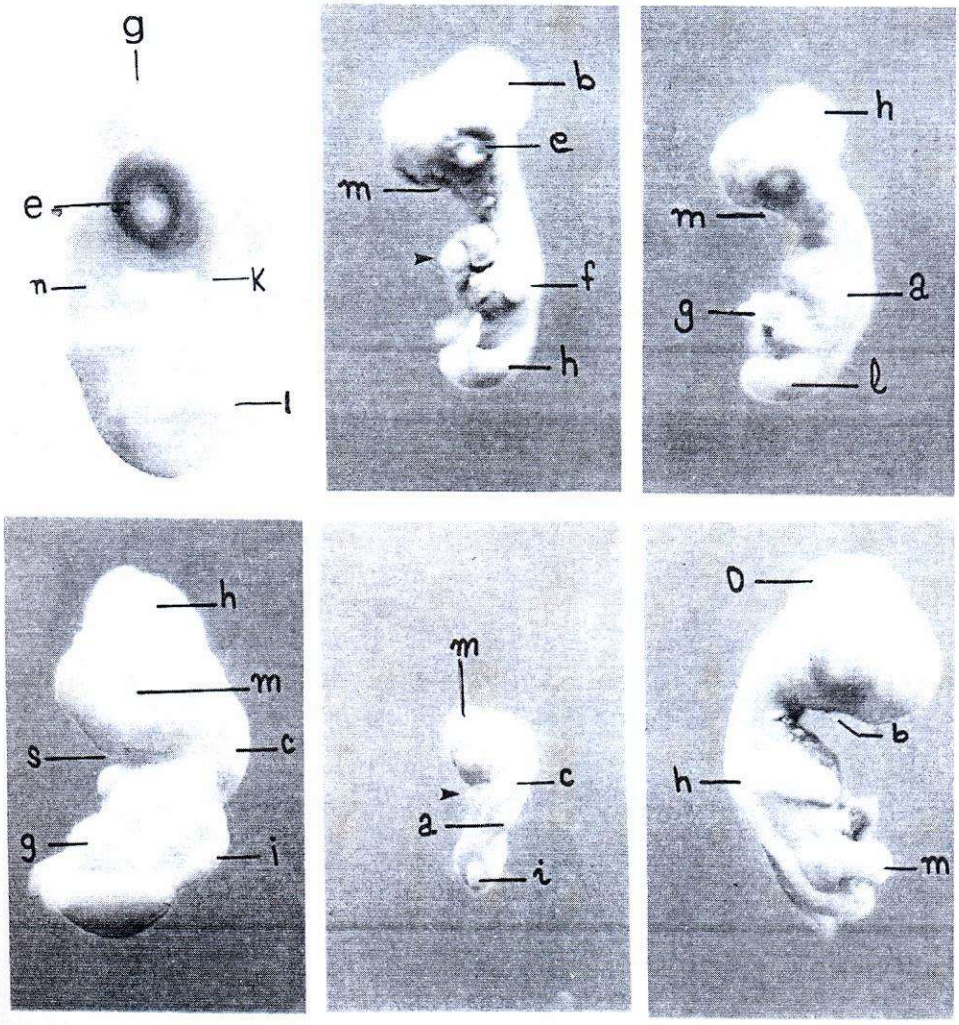

Fig 1: Macrophotographs of 7 days embryos recovered from different dose groups of Malathion. (A) control group embryo, with normal development. (B-F) embryos from 0.025, 0.25, 0.5, 1.0 and 2.0 g/egg dose group, respectively. Note: Developmental anomalies including micromelia (a), mesomelia (i), agenesis of beak (m), gastroschisis (g), hydroencephaly (h), meningomyocod (mn), anophthalmia (mo), microphthalmia (e) and ectopia cordis (arrow head).

In another study by Ooi *et al.* (1991) malathion, mathoxytryptamine and ethoxytrytophol were injected into yolk sac of chick at 4th day of incubation. Abnormalities including twisted vertebral column, abdominal hernia, exteriorizations of heart and viscera, defect of eye, beak and limb were found.

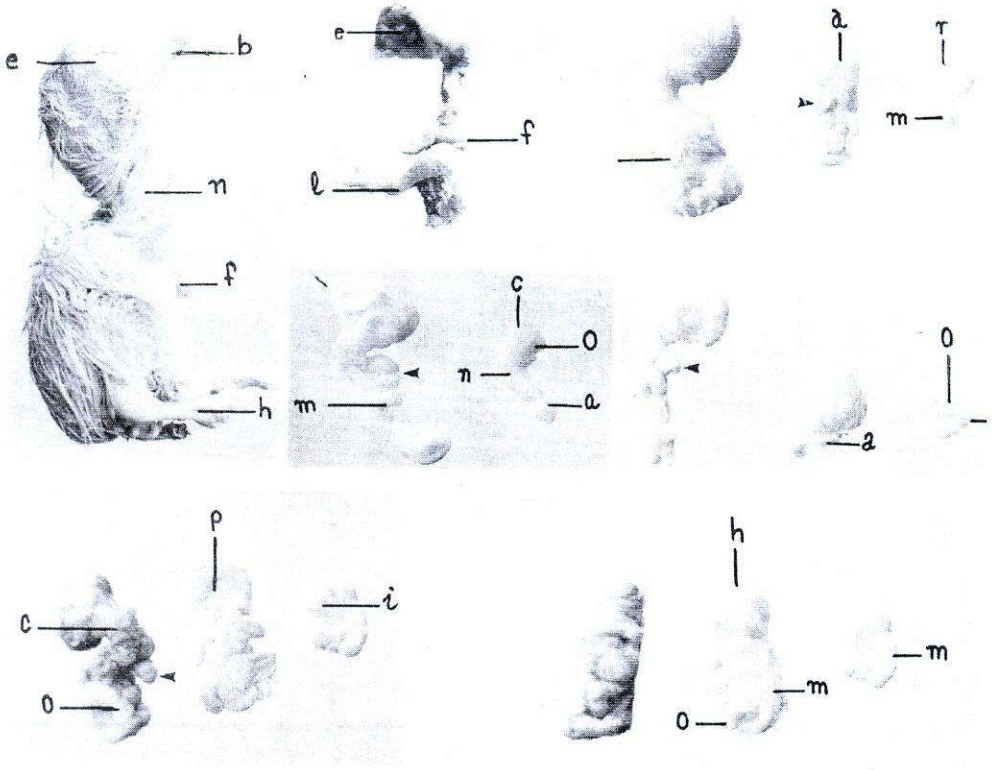

Fig 2: Macrophotographs of chick fetuses recovered, at day 14 of incubation, from different dose groups of malathion. (A) control group fetus (B-C) from 0.025 g/egg dose group; (D-G) from 0.25, 0.5, 1.0 and 2.0 g/egg dose groups, respectively. Note developmental defects including anencephaly (a), microcephaly (c), deformed neck (d) Amelia (m), micromelia (o), anophthalmia (ao), microphthalmia (e) meningomyocoel (mn) and ectopia cordis (arrow head).

Table I: Embryotoxic effects of different concentrations of Malathion in 7-day old chick embryos.

Dose (Mg/egg)	Resorbed (%)	CR Length mm ± S.D	Weight Mg ± S.D	Head	Beak	Eyes	Fore-limb	Hind-limb	Cardiac Position
0.00	0.00	19.35 ± 1.09 n = 20	600 ± 12	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
5.00	600	16.25 ± 2.02** n = 20	320 ± 18***	Microcephaly (50) Hydroencephaly (25)	Agenesis of beak (30.00) Slightly formed (55.00)	Microphthalmia (40.00)	Phocomelia (30.00) Amelia (40.00)	Amelia (10.00)	Ectopia cordis (85)
10.00	60	14.70 ± 4.59** n = 20	310 ± 12***	Microcephaly (65) Hydroencephaly (20)	Slightly formed (15.00) agenesis of beak (50)	Samll (35.00) Microphthalmia (15.00) Monopia (20)	Micromelia (90)	Amelia (50) Micromelia (50)	Ectopia cordis (80)
15.00	70	10.41 ± 0.67*** n = 20	90 ± 2***	Microcephaly (75) Hydroencephaly (20)	Agenesis of Beak (100)	Small (75.14) Very small (42.85)	Phocomelia (20) Micromelia (60) Amelia ((20)	Micromelia (100)	Ectopia cordis (90)
20.00	70.00	10.20 ± 1.80*** n = 20	40 ± 2***	Microcephaly (75) Hydroencephaly (25)	Agenesis of Beak (100)	Anophthalmia (30.0) Microphthalmia (16.66) (70.00)	Micromelia (40.00) Amelia (60.00)	Micromelia (70.00) Amelia (30.00)	Ectopia cordis (90)

Table I **Developmental anomalies induced by different concentrations of Malathion in 14-day chick embryos, injected before incubation.**

Dose (Mg/egg)	Resorbed (%)	CR Length mm ± S.D	Body weight Mg ± S.D	Head	Beak	Eyes	Fore-limb	Hind-limb	Cardiac Position
0.00	0.00	42.75 ± 2.22 n = 20	9.55 ± 0.16	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
5.00	40.00	18.87 ± 1.29*** n = 20	2.79 ± 0.14***	Microcephaly (65) Hydrocephaly (25)	Small Beak (25) agenesis of beak (75)	One eye is small (25) microphthalmia (75)	Short wing (25)	Micromelia (100)	Ectopia cordis (75)
10.00	40.00	18.50 ± 0.91*** n = 20	1.55 ± 1.17***	Microcephaly (75) Hydroencephaly (25)	Agenesis of beak (1000)	Microphthalmia (75)	Micromelia (75) Amelia (25)	Micromelia (100)	Ectopia cordis (80)
15.00	45.00	13.50 ± 0.82*** n = 20	0.81 ± 0.59***	Microcephaly (100)	Small (20) Agenesis of Beak (100)	Microphthalmia (80)	Amelia (40) Micromelia (600)	Micromelia (100)	Ectopia cordis (90)
20.00	60.00	10.75 ± 0.58*** n = 20	0.79 ± 0.38***	Microcephaly (100)	Agenesis of Beak (100)	Microphthalmia (80)	Amelia (40) Micromelia (60)	Micromelia (100)	Ectopia cordis (90)

Malathioni *et al.* (1997) have categorized a whole set of abnormalities encountered in chick embryos following Malathion treatment. Abnormalities such as micromelia, dwarfism, parrot beak and abnormal feathering, short neck, tibiotarsal arthrogryposis and muscular hypoplasia of the legs. Were commonly observed another set of abnormalities designated as type II Many other studies have also shown embryotoxic and teratogenic effects of different organophosphorus insecticides in chick embryos (Greenbeeg and Laham, 1969; Gosh *et al.*, 1998; Asmatullah *et al.*, 2002; Asmatullah *et al.*, 2003).

These results and some earlier studies have indicated that Malathion is toxic to embryonic and fatal tissues and can induce teratogenicity in chick.

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