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Pesticides Affecting Sexual Characteristics in The Adult Male Guppy *Poecilia reticulata*

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Abstract

Synthetic pesticide compounds have long been identified as affecting primary and secondary sexual characters in different organisms. Even some fungicides like vinclozolin and flutamide have been reported to induce similar changes in the fish. Groups of young adult male guppies were exposed to pesticides dieldrin and aldrin at concentrations between 0.1 and 100 µg/g food, for a period of 50 days. After the exposure period, relevant sexual characteristics of the male reproductive capacity were measured and compared with untreated control fish. The quality and extent of coloration and length of gonopodium were the two characters studied. Both the chemicals affected the fish in a profound manner. The sexual behavior of these fully matured males was affected in a linear fashion with increase in exposure concentration of both the chemicals.

Keywords: Sexual Behaviour, Dieldrin, Aldrin, Sexual Characters, Antiandrogenic Effects.

Introduction

Large scale use of synthetic compounds in agriculture and other industries has long been known to affect the different physiological aspects of non-target organisms. Some of the effects were ultimately lethal, but some are subtle and become apparent only late in the life of the organism. One such deleterious outcome of pesticide exposure is interference with the sexual development at different stages of life cycle. Some physiological and hormonal processes are directly related to the reproductive fitness of the individual and demonstrate population-level effects.

The guppy was chosen as an experimental animal because it is a viviparous fish breeding throughout the year with a short reproductive period. The adult male has a bright orange coloration and performs an elaborate courtship behavior. Its anal fin is differentiated into a copulatory organ (the gonopodium) for transfer of sperm during copulation.

Aim of the Study

This study has attempted to assess the effects of two chemicals on the body coloration, length of gonopodium (copulatory organ), and finally courtship behavior.

Material and Methods

The fish used in this study were healthy, wild guppies (Poecilia reticulata) procured from local water bodies. The fish were maintained in cement tanks which received fully aerated water at a pH of 7.0. Half of the water in the aquaria was renewed weekly. The guppies were fed daily with freeze dried tubifex worms, commercial flake food and live mosquito larvae.

A total of 300 adult males were chosen randomly from the stock tank and divided into 4 experimental groups and 2 control groups. Each group was transferred to a glass aquarium filled with 4L of water. During the experimental period of 50 days, the water was constantly aerated. Daily, feces were removed and clean water was added.

The fish were exposed for 50 days through their food to dieldrin and aldrin. The fish were exposed to the selected chemicals in duplicate sets. Similarly, duplicate set of control groups were also maintained. The selected chemicals were dissolved in acetone to adequate concentrations, mixed thoroughly with the commercial flaked fish food and left for 24 hr in a fume cupboard hood for the evacuation of acetone. This resulted in food containing 1.0, 10.0, and 100.0 µg dieldrin and aldrin per milligram food.

The two control groups received food that was mixed with acetone only. Each group of 20 fish was fed daily with 40 mg fodder to correspond to 0.2, 2, 20, or 200 µg chemical per fish.

Assuming that all fish consumed equal quantity of food, and that average weight of an adult male guppy is 130 mg, the fish at the selected exposure concentration of the two chemicals were dosed with 15, 150, and 1,500 µg chemical/g fish.

After exposure, the male sexual characteristics of importance to guppy reproduction were evaluated. The body coloration and length of gonopodium (copulatory organ) were recorded. The total area of the orange-colored spots was measured in the digital image of the fish and related to the whole body area excluding the fins as the coloration index. The the length of the gonopodium was measured and related to the length of the fish as the gonopodial index.

Results & Conclusion

In the group fed the highest concentration of dieldrin (100 µg/mg), 23% of the fish died during the 30 days of treatment. The corresponding mortalities with the highest concentrations of aldrin (10 µg/mg) was 88%. Because the chemicals were obviously toxic at these application rates, these two groups were excluded from further evaluation of antiandrogenic effects. In contrast, at the 10 and 100 times lower application rates, none of the fish displayed obvious toxic responses such as body darkening or changed swimming activity. Both the chemicals caused pronounced effects on the adult male's body coloration the gonopodial index.

The effects of the selected chemicals also influenced the area and color intensity of the male orange coloration. In the control group, an average 18% of the body surface (coloration index) was covered with orange spots, while this percentage was lower in the treated groups. Statistically, the reduction in coloration index was only significantly different from the control fish in the group treated with dieldrin at 1 µg/mg. Examination even with the naked eye made it obvious that the treatments also caused discoloring of these sexually attractive spots. Measurements of different color components in the digital images demonstrated that this discoloration was caused by a significant brightening of the blue component in all treated groups.

The length of the gonopodium relative to the length of the fish (gonopodial index) was slightly altered by the chemical exposure, as was the size of the fish.

Table 1: Color component changes under exposure to dieldrin and aldrin.

Color	Control	Dieldrin	Aldrin
Red	58.00%	40.00%	42.00%
Green	25.00%	21.00%	18.00%
Blue	17.00%	39.00%	40.00%

Table 2 : Changes in gonopodial index (% of body length) under exposure to dieldrin and aldrin.

Color	Control	Dieldrin	Aldrin
Red	12.00%	9.00%	8.20%

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