

# Laboratory Evaluation of Repellent Properties Against Birds of the Synthetic Pyrethroid Decamethrin

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**ABSTRACT** Both technical grade and commercially formulated decamethrin administered in feed has a generally repellent action upon quail, with strong individual variations. The excipient used in the commercial preparation has a similar effect on its own, probably due to its odor. Repellency diminishes after repeated exposure and even becomes reversed in the case of the purified pyrethroid, which attracts intoxicated quail.

(*Key words:* decamethrin, Japanese quail, pesticide, contamination)

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## INTRODUCTION

Among the new synthetic pyrethroids now marketed internationally, decamethrin, NRDC 161, (S)- $\beta$ -cyano-3-phenoxybenzyl-cis-(1R, 3R)-2,2-dimethyl-3-(2,2-dibromovinyl) cyclopropane carboxylate, is of particular interest due to its wide range of application and relatively high stability (Elliott *et al.*, 1974). This pyrethroid ester has insecticidal properties similar to those of organochlorides, especially DDT, but has the advantage of being less persistent and less teratogenic, particularly in mammals (Aldridge *et al.*, 1978; Barnes and Verschoyle, 1974; Kavlock *et al.*, 1978).

Lutz-Ostertag and Lutz (1974) have reported teratogenicity of natural pyrethrum upon the genital tract of birds. It has also been recently shown that decamethrin, especially in its commercial form, although not highly toxic, does cause partial sterility in early quail embryos after contamination of eggs according to various procedures (David, 1981).

Blow (1978) has reported that a similar synthetic pyrethroid, permethrin, has a repellent action on insects. The present work set out to see whether such an effect was observable for decamethrin against birds.

## MATERIALS AND METHODS

Three products were tested; purified technical decamethrin (8L 1212), a commercial decamethrin formulation containing 25 g of active substance per liter of excipient, and the matrix alone (samples donated by Roussel-

Uclaf Procida, Paris). To avoid any base-catalysed stereoconversions, preparations were slightly acidified with .001% acetic acid.

Laboratory-raised quail were used (Géromoise breed of *Coturnix coturnix japonica*). For 25 days after hatching, the chicks were fed exclusively with a commercial-type aliment made up essentially of cereals, powdered meat extracts, fats, minerals, and antibiotics. At the end of this time, the young quail were ringed and caged, two females and one male per cage, and submitted to the following experimental conditions.

Adjacent pairs of cages were equipped with a common feeding trough hung along the outside. A tray containing 100 g of contaminated ration was placed in the middle of the trough in front of each cage, and a third tray holding 100 g of clean feed was placed between them, i.e., opposite the dividing grill between the two cages. The control tray was thus somewhat less accessible than the two treated ones.

The pesticide was suspended (technical decamethrin) or dissolved (commercial product) in water and then dispersed onto the surface of the feed at a dose of 10 mg of active substance per 100 g of aliment; i.e., 100 ppm. The excipient alone was applied at the same concentration.

The daily intake of contaminated and control ration was monitored throughout the duration of the experiment (75 days), and the behavior of the quail toward the various choices of aliment offered them was observed qualitatively. Every morning uneaten feed was discarded and replaced with fresh batches.

## RESULTS

*Feed Contaminated with Technical Grade Decamethrin (D).* The aqueous suspension of purified pesticide is odorless. Even at low concentrations it causes a sensation of heating and itching when in contact with the skin. The quail reacted variously to the product. Some, after tasting it for the first time, showed an aversion. Others were less selective and ate either ration indifferently.

Among the resistant quail, some continued to avoid the treated feed, whereas others began to show progressively stronger attraction to the pesticide. This behavior was particularly apparent among quail fed only with aliment contaminated with technical decamethrin. By week 3 they became impatient whenever the experimenter came near, and rushed to drink the aqueous suspension directly from the pipette. Two or three minutes later they recovered consciousness and then behaved normally, eating either the treated or the clean ration indifferently.

The daily intake of decamethrin-contaminated feed ranged from 2.7 g to 25 g, depending on the individual and the state of advancement of the experiment. Average amounts of clean and treated aliment ingested were 23.3 g and 6.2 g, respectively, giving a total daily intake of all feed of 29.5 g per bird (Table 1).

At the end of the experiment, the adult quail weighed on average 210 g; 205 g for the males and 215 g for the females. Control birds

of the same age weighed on average 200 g.

*Feed Contaminated with Commercial Decamethrin (DE).* The quail showed an aversion to the odor of the commercial preparation. As for D product, the birds reacted variously. Some ingested small but regular amounts of aliment throughout the duration of the experiment, while others took progressively greater interest in the treated ration, which they eventually preferred to the control.

Intake of clean feed rose slightly during the experiment.

The final average weight of adult quail was 209 g (194 g for males, 223 g for females). This result was close to that for the preceeding series D, and was again greater than for controls (Table 1).

*Feed Contaminated with Excipient Alone (E).* The characteristic odor of the commercial formulation is due to the excipient. The reaction of the quail to the matrix alone was the same as that observed with the commercial product DE. The average daily intake of treated feed was 8.5 g, i.e., less by half that of the commercial preparation. The first batch of quail ingested 12 g per day until the death of one of the females. The rate then fell to 3 g per day. The second set ingested contaminated ration regularly throughout the experiment. The total average amount of aliment eaten was close to that for the D series and slightly lower than that for the DE series (29.2 g) (Table 1).

The rate of intake of clean feed was somewhat higher than that for the DE quail.

TABLE 1. Average amounts of ingested feed. Quail fed partly with untreated aliment and partly with feed contaminated with technical grade decamethrin (D), commercial decamethrin (DE), or excipient (E). Average final weights of quail. Control quail ate on average 28.9 g/day of untreated feed and weighed 200 g at the end of the experiment

	D: Technical decamethrin	DE: Commercial decamethrin	E Excipient alone
Mean intake of treated feed in g/day/quail (SE)	6.2 Cage G: 8.7 (1.3) Cage H: 3.6 (.9)	14.6 Cage L: 21.1 (2.1) Cage M: 8.1 (1.3)	8.5 Cage I: 9.3 (1.1) Cage K: 7.7 (1.0)
Mean intake of control feed	23.3 (1.1)	17.2 (.7)	20.7 (.5)
Total mean intake of all feed	29.5	31.8	29.2
Mean final weight of quail (in g)	210 205 (male) 215 (female)	209 194 (male) 223 (female)	215 213 (male) 217 (female)

The average final weight of the adults in this lot was somewhat heavier than in controls; 215 g, i.e., 213 g for males and 217 g for females (Table 1).

#### DISCUSSION

At the start of the experiment, most quail showed aversion to the technical decamethrin, the commercial preparation, and the excipient. Some, however, ate the clean or the contaminated feed indifferently.

The odor given off by the matrix of the commercial product is repellent to quail. They recoiled as far as possible from the feeding trough until the smell wore off.

Large individual variations in behavior were apparent. Certain birds ate either feed indifferently at the start, but most became gradually accustomed to the contaminated ration while still preferring the control.

It is noteworthy that decamethrin, especially in purified form, produced a state of dependency in some quail. After a period of adaptation lasting about 15 days they showed marked symptoms of addiction, becoming highly restless when deprived of pesticide and then fighting to drink it directly from the pipette, heedless of its irritant properties. Abundant salivation and tremors followed, which, according to Aldridge *et al.* (1978) are suggestive of an action of the pyrethroid on the brain by modification of acetylcholine and cyclic nucleotide levels.

The pesticide also stimulated the appetite of

the quail, which gained weight relative to the controls fed exclusively with untreated aliment.

On dissection, the birds appeared morphologically normal but their organs, especially heart, liver, digestive and urogenital tracts, were in most cases enveloped in fat. More thorough histophysiological examination and chromatographic measurement of residual decamethrin levels in the various tissues of contaminated quail are being undertaken.

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