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Laboratory and field evaluation of three odorant compounds for improving attraction of the lesser bandicoot rat, *Bandicota bengalensis* (Gray) to 0.0375% coumatetralyl bait

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Abstract

For improving the acceptance of rodenticide bait containing 0.0375% coumatetralyl to control the lesser bandicoot rat, *Bandicota bengalensis*, a predominant pest in rice and wheat cropping in South Asia, three odorant compounds were tested in bi- and multi-choice laboratory feeding tests and under field conditions. The synthetic form of dimethyl sulphoxide (DMSO), carbon disulphide (CS_2) and phenyl acetic acid (PAA), which are considered to be artificial semiochemicals involved in mediating socially induced food choices, were used to amend 0.0375% coumatetralyl baits at the rate of 1.5, 1.0 and 1.0%, respectively. The baits, WSO and RSO, were prepared as mixtures of respectively wheat and rice semolina (particle size 0.000216–0.001 mm^3), sugar and groundnut oil in the ratio 93:5:2. DMSO and CS_2 improved acceptance of WSO bait by approx. 39% and 65%, respectively, and of RSO bait by approx. 39% and 45% in bi-choice feeding tests. However, PAA-amended WSO bait was avoided by *B. bengalensis*. These results were confirmed by analysis of behavioural acts relating to attraction and feeding of baits. Plain RSO baits amended with the odorant compounds were preferred to unamended RSO and traditional wheat bait (cracked wheat/sugar/groundnut oil, 96:2:2), but amended 0.0375% coumatetralyl RSO baits were the least preferred in multi-choice feeding tests, so indicating that the rats discriminated against the poison, even in the most preferred bait base, i.e. the plain RSO. The acceptance of both poison baits, WSO and RSO, was not significantly enhanced in wheat fields but significantly enhanced in rice fields by DMSO. PAA significantly increased bait take of RSO poison bait by rodents in both crops, while CS_2 non-significantly enhanced take of poison in both bait bases in rice crops, although only in WSO poison bait in a wheat field. In mature rice crops, RSO poison bait treated with DMSO or CS_2 was consumed in 2–3 times greater quantities than the alternative wheat bait, thus clearly indicating the usefulness of these odorant chemicals in the control of field rodents.

Keywords: *Bandicota bengalensis*; Semiochemicals; Attractants; Coumatetralyl; Dimethyl sulphoxide; Carbon disulphide; Phenyl acetic acid

1. Introduction

The lesser bandicoot rat, *Bandicota bengalensis,* is a common pest of irrigated agricultural fields throughout South Asia and also commensal in some urban situations (Parshad, 1999). For its control, rodenticide baits prepared by mixing the rodenticide in whole or broken forms of cereal grain with some additives, such as vegetable oil and sugar, are generally used. However, poor bait acceptance by rats adversely affects control success, particularly when alternative food is abundant in the natural habitat. To improve the efficacy of bait material, inclusion of suitable attractants could attract large numbers of rats to rodenticide baits.

For the present investigation, dimethyl sulphoxide (DMSO), carbon disulphide (CS_2) and phenyl acetic acid (PAA) were selected, as these molecules are similar to social odours. PAA, a short-chain fatty acid, is present in the ventral gland of Mongolian gerbil,

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Meriones ungiculatus (Thiessen et al., 1974). In the golden hamster, *Mesocricetus auratus*, vaginal secretions are rich in sulphur compounds, such as dimethyl disulphide, that attract males (Singer et al., 1976). A minute amount (1 ppm) of CS_2 in the breath of *Mus musculus* has been shown to mediate socially induced food choices (Galef et al., 1988). Therefore, the present studies were carried out to assess whether DMSO, CS_2 and PAA could be used to enhance preference (palatability) and ingestion of plain bait bases and rodenticide baits by *B. bengalensis*. Coumatetralyl, an anticoagulant rodenticide was selected because *B. bengalensis* is more susceptible to it than other species (Parshad and Malhi, 1995). The main objective was to establish which was the most preferred and attractive rodenticide bait for reducing bait rejection by rodents, particularly *B. bengalensis*, in the presence of abundant natural food from agricultural crops.

2. Materials and methods

2.1. Rats

The adult rats, *B. bengalensis* Gray (body weight 150–250 g) trapped in the crop fields around Ludhiana (Punjab) were acclimatized in laboratory iron cages (36 cm × 23 cm × 23 cm) individually for 10 days before experimentation. During this period the rats were provided with food consisting of a mixture of broken wheat, 2% sugar, 5% milk powder and 2% groundnut oil (WSMG). Water was provided ad libitum. Groups of six rats with unequal numbers of males and females as trapped in the fields were used in different bi-choice tests.

2.2. Baits

Earlier studies showed that the addition of sugar and vegetable oil improves the acceptance of cereal grains by rats (Kaur and Parshad, 2001a), so that the following bait formulations were used in the present studies:

(a) *Semolina WSO bait*
A semolina (particle size 0.000216–0.001 mm^3) of wheat variety HD 2329, powdered sugar and groundnut oil in ratio 93:5:2 (w/w).

(b) *Semolina RSO bait*
A semolina (particle size as above) of rice variety PR 106, sugar powder and groundnut oil in ratio 93:5:2.

(c) *Common wheat bait*
Cracked wheat, groundnut oil and sugar powder (96:2:2).

(d) *Anticoagulant rodenticide bait*
Coumatetralyl (0.75% tracking powder) manufactured by Bayer India Ltd. was used for preparing poison bait containing 0.0375% active ingredient of the compound.

(e) *Synthetic chemicals*
The following compounds (Laboratory Rasayan s.d. Fine Chemicals Ltd., Boisar 401501, India) were used at different concentrations, for testing their attractant properties: DMSO—0.5%, 1.0% and 1.5%, w/w; CS_2—0.25%, 0.5% and 1.0%, w/w; phenyl acetic acid ($C_6H_5CH_2COOH$, PAA) dissolved in DMSO—0.5% and 1.0%, w/w.

2.3. Testing procedure

2.3.1. Bi-choice laboratory feeding tests

Poison baits were formulated by mixing 0.0375% coumatetralyl into RSO and WSO bait bases. To these baits 1.5% DMSO, 1% CS_2 and 1% PAA were added, having been found earlier to be effective in enhancing acceptance of plain bait by *B. bengalensis* (Kaur and Parshad, 2001b). Because of the volatility of these compounds the freshly prepared baits were offered to rats. Though dissipation of the odour could not be avoided, at any given time the baits were of the same age within different treatment groups. Acceptance of treated coumatetralyl bait by individual rats in preference to untreated alternative bait was determined in a 4-day bi-choice feeding test using six adult rats irrespective of sex, with one rat in a pair of cages joined together for free access to each food. Treated and untreated coumatetralyl baits (20 g) were offered for 4 days to determine preference by recording daily the consumption of each bait after taking into account spillage. The rats were observed for mortality up to 15 days and during this period they were provided with plain WSO mixture and water ad libitum.

2.3.2. Multi-choice laboratory feeding tests monitored through closed circuit television camera (CCTV)

Whether or not the treated baits provided an odour cue to rats for feeding was determined by counting the number of visits to the food source and the time spent at it before (Phase 1, rats exposed to food odours alone for 30 min) and after (Phase 2, rats with access to foods for the same period) removal of a perforated barrier through which the rat could be exposed to the odour without direct access to the food. The experiment was carried out in a rat pen (143 cm × 94 cm × 82 cm) made up of galvanized iron sheet and had four windows, one on each wall of the pen opening into food boxes (each being 22 cm × 15 cm). These windows could be closed by a perforated barrier when desired. The activity of the rats in the pen was monitored through CCTV from the adjoining observation room. The rat pen was designed to offer a large and complex area for the rats to exercise free movement and determine preference of food by