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Poultry egg components as cereal bait additives for enhancing rodenticide based control success and trap index of house rat, *Rattus rattus*

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PEER REVIEW

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Comments

Present research is a very good study evaluating the potential of poultry egg albumin and egg shell (both crushed and powder form) in enhancing the acceptance of cereal bait by house rat. The acceptance was assessed based on bi-choice and no-choice experiments in laboratory cages and food scale consumption monitor. Authors have also tested the efficacy of these components after mixing in zinc phosphide bait, an acute rodenticide in poultry farms. Egg albumin has been found to have potential in increasing acceptance of cereal based bait.
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ABSTRACT

Objective: To compare the acceptance and efficacy of cereal bait containing different concentrations of poultry egg components in laboratory and poultry farms to control house rat, *Rattus rattus* (*R. rattus*).

Methods: Acceptance of cereal bait containing different concentrations (2%, 5% and 10%) of poultry egg components such as egg shell powder (ESP), egg albumin (EA) and crushed egg shell as bait additives were studied after exposing them to different groups of rats in bi-choice with bait without additive. Behaviour of rats towards cereal bait containing 2% concentration of different egg components was recorded in no-choice conditions through Food Scale Consumption Monitor. In poultry farm predominantly infested with *R. rattus*, acceptance and efficacy of 2% zinc phosphide bait containing 2% EA and ESP was evaluated. Trap success of single rat traps containing chapatti pieces smeared with 2% EA and 2% ESP was also evaluated in poultry farm.

Results: In bi-choice tests, significantly ($P<0.05$) higher preference was observed for baits containing 2% and 5% ESP and all the three concentrations of EA compared to plain bait by female rats and that of baits containing 5% and 10% EA by male rats. In no-choice test, non-significantly higher consumption, number of bouts made and time spent towards bait containing 2% EA was found by rats of both sexes. In poultry farm, acceptance and efficacy of 2% zinc phosphide bait containing 2% EA and ESP was significantly ($P<0.05$) more than 2% zinc phosphide bait without additive. No significant difference was, however, found in trap success of single rat traps containing chapatti pieces smeared with 2% concentration of EA and ESP placed in the poultry farm.

Conclusions: Present data support the use of 2% egg albumin and egg shell powder in cereal bait to enhance acceptance and efficacy of 2% zinc phosphide bait against *R. rattus*. This may further help in checking the spread of rodent borne diseases to animals and humans.

KEYWORDS

Rattus rattus, Egg albumin, Egg shell, Bait enhancers, Rodenticide bait, Trapping

1. Introduction

Rodents have been identified as the most important mammalian pests at the global level. Damages caused by them lead to huge amount of crop losses and food shortages. Storage losses to rodents in India alone are 25%-30% costing at least $5 billion annually[1]. The house rat, *Rattus rattus* (Linn.) (*R. rattus*) is one of the most common commensal rodent pest worldwide. It often damages, contaminates and spoils packed food and non-food materials in transit and storage besides being involved in spreading several diseases of public health importance[2]. It is the

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predominant pest species infesting poultry farms in India and posing a serious threat to poultry operations by feeding on poultry feed, contaminating it with their excrements, damaging eggs, attacking and killing chicks, causing structural damages to buildings, doors, windows, feed containers and transmitting several diseases[3]. The species acts as a wild reservoir horizontally transmitting infectious organisms to other rodent species and arthropod vectors living closer to anthropized environments, thus leading to inevitable exchange of pathogens between rodents, animals and humans[4]. Hence it is very important to control this species.

Rodenticide baiting is the most widely used method to control rodents throughout the world. Among rodenticides, acute poisons are more preferred and frequently applied, as people are anxious to see a rapid kill and get rid of damages caused by them[5]. However, rodent control with acute rodenticide baits has often been found ineffective in reducing rodent densities due to several factors. Poor poison bait acceptance, sub-lethal dosing and subsequent conditioned aversion, dietary preferences and neophobia can reduce the efficacy of rodenticide baiting[6]. Bait-shyness induced through conditioned taste aversion, can last more than a year, even when the rodenticides have been removed from the baits. Once shy, the rats prefer to remain hungry than eating an apprehensive food.

Use of poison baits is still the most reliable strategy for controlling field as well as commensal rodents, however, baiting techniques should be modified according to the psychological characteristics of the target species. Several researchers have noted the need for an additive that could be added to rodenticide baits for increasing their acceptance and efficacy[7-9]. Different workers have suggested the efficacy of different bait additives against different rodent species[10-14]. Since *R. rattus* is the predominant rodent pest species found in poultry farms and feeds on poultry eggs, the bait containing egg components may be more acceptable to it. Present study was hence conducted to compare the acceptance of bait containing different concentrations of poultry egg components by *R. rattus* in laboratory and to study their potential in increasing rodenticide based control success and trap index in poultry farms.

2. Materials and methods

2.1. Collection and maintenance of animals

Adult *R. rattus* of both sexes were trapped using single and multi rat catch traps from poultry farms in and around Ludhiana, India and kept individually in laboratory cages (each of size, 36 cm×23 cm×23 cm) for acclimatization (10-15 d) before experimentation. Food and water were provided *ad libitum*. Food consisted of preferred cereal based bait containing loose mixture of cracked wheat, powdered sugar and groundnut oil (WSO bait) at a ratio of 96:2:2. Rats were used and maintained as per the guidelines of Institutional Animal Ethics Committee.

2.2. Bi-choice experiments

During experimentation, mature and healthy rats of both sexes were weighed and divided into four groups (I to IV) of 10 rats each (five of each sex). In the first experiment, rats of Groups I, II and III were exposed to WSO bait containing 2%, 5% and 10% egg shell powder (ESP) as additive, respectively in bi-choice with WSO bait without additive for 5 d. There was no significant difference in average body weight of rats in treated and untreated groups. Bait was kept in bowls and water was provided *ad libitum*. The position of bowls was changed daily to avoid any difference in consumption due to side preference. In the second experiment, rats of Groups I, II and III were exposed to WSO bait containing 2%, 5% and 10% poultry egg albumin (EA) as additive, respectively, whereas in the experiment third, similar sets of rats were exposed to WSO bait containing 2%, 5% and 10% crushed egg shells (CES) as bait additive, respectively. Rats of Group IV kept as untreated control were fed on WSO bait without additive in all the experiments. Before and after the treatment, all the rats were fed on WSO bait only.

Bait consumption was recorded after every 24 h and every time bait was replaced to the original 30 g. Before weighing, the bait of all the treated and untreated rats was cleared of fecal pellets and dried if needed. Mean daily consumption of food (g/100 g body weight) was calculated separately for each group of rats during pre-treatment, treatment and post-treatment periods. The percent acceptance of WSO bait with additive over WSO bait without additive during treatment period was determined as per the formula given below:

$$\text{Percent acceptance} = \frac{\text{Consumption of WSO bait with additive during treatment}}{\text{Total bait consumed during treatment}} \times 100$$

2.3. No-choice experiments

Four rats of each sex were exposed to WSO baits containing 2% concentration of ESP, EA and CES in no-choice test under Food Scale Consumption Monitor (FSCM) (Columbus Instruments, USA). Each rat was kept in a cage provided with a feeding bowl and a feeding sensor below. Each rat was exposed to a particular type of bait formulation for 4 d. Rats were kept without food overnight prior to experimentation. Behaviour of rats in the form of consumption of bait (g/kg body weight), number of bouts made and time spent (second) was recorded for 2 h a day by means of the software of FSCM loaded in the computer.

2.4. Poison baiting experiment

Three blocks (I, II and III) of poultry farm, with each block further consisting of four replicated sheds were selected at village Ghutani Kalan, District Ludhiana (India). One block (IV) consisting of four sheds selected at the Campus,