

Effectiveness of the Domestic Cat (*Felis silvestris catus*) Urine Extracts Odour against Commensal Rodents

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†This study is dedicated to J.J. Magadula who passed away before this study was
completed.

Abstract: The aim of this study was to investigate the effects of an extract of cat urine odour as a repellent of commensal rodents in houses. Cat urine was drawn and stored frozen in universal bottles at -20°C until use. The stored cat urine was then thawed and mixed with maize starch to form a thick dough and then granulated and dried at room temperature before being packed in a hermetically closed jar. Initially, rodent foot marks on tracking soot coat tiles were used to estimate the rat population before the cat urine extracts application. Twenty households with high and low rodent activities were selected purposively in the study area. Ten houses were treated with the urine extracts and ten others were kept untreated (control). Both treated and untreated houses were categorized at two levels (i.e. low and high rodent activities) as determined by the tracking tile foot prints. One tracking tile was placed in each of the selected houses and rodent foot marks were counted. Collected data were subjected to analysis of variance and the results showed a significant difference in rodent activities which however, depended on the sex of the cat that donated the urine base. Female cat urine extract repelled significantly more commensal rodents as compared to male cat urine extract. The repellent effect was observed from day 1 to 4; but not beyond. Our findings suggest that cat urine odour has the potential to repel commensal rodent pest species; with female cat urine being more effective than male cat urine.

Key words: Commensal rodents, domestic properties, rodenticides, crop losses, odours, repellants, cat urine extract

INTRODUCTION

Rodents pose a significant threat to crop losses both in field and in storage leading to serious food damage (Mdangi *et al.*, 2013; Mulungu *et al.*, 2003). In Tanzania, damage to stored grains is largely attributed to *Rattus rattus*. Mdangi *et al.* (2013) reported that 35% of stored maize grains are caused by rodent pest species. Currently, reducing the size of commensal rodent pest populations in houses relies on lethal control methods, including the use of rodenticides (Mulungu *et al.*, 2010; Makundi *et al.*, 1999). These methods, however, provide only a short-term solution because the rodent colonies soon recover and the problems posed by the rodent persist. Similarly, these methods are often uneconomical, hazardous to human health and the environment hence socially unacceptable (Makundi *et al.*, 1999). There are increasing demands for effective, non-lethal rodent control approaches to be developed (Burger, 2005; Berton *et al.*, 1998). An idealized non-lethal management system would produce a significant decrease in rodent pest activity within a house and, in the longer-term, reduce the damage by rodents of stored grains (Leypold *et al.*, 2002). Chemical repellent signals have been reported to reduce rodent pest activities (Mulungu *et al.*, 2016), which is an avoidance response in rodent pests and hence restricts the growth of rodent populations (Leypold *et al.*, 2002). The aim of this study was to investigate the effectiveness of cat urine odour as a repellent of commensal rodents.

Since cats and rodent are natural enemies, the scent of a cat can easily drive away rodent from houses and hence the hypothesis of our study is to test if the cat urine odour has a significant rodent repellent effect. Cat urine contains a chemical compound, which rodents have evolved to react to. When rodents smell such a compound, their bodies produce a stress hormone called corticosterone, and flee from the cat. In addition, the compound can even trigger hormonal reactions that can keep female rodent from reproducing at all, or cause them to have smaller litters than usual (Leypold *et al.*, 2002). That kind of reaction is, however, not unique to rodents. Indeed, many prey species won't reproduce, or will hold off on giving birth, if they know there's a predator nearby (Stowers *et al.*, 2002).

MATERIALS AND METHODS

Study location

The current study was conducted in Mikese village (37°53'60" E; 6°46'S) located in Morogoro Rural District in Tanzania some 30 kilometers east of the Morogoro Municipality, along the Morogoro - Dar es Salaam highway. The annual rainfall ranges from 700 to 1000 mm. The short rainy season starts in mid-October and ends in December while the long rains start in

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February and ends in mid-May. The dry season extends from June to October. The annual average maximum and minimum temperatures are 26°C and 21°C, respectively. Soils are acidic lithosols and ferralitic latosols with deeper deposits of ferruginous sandy clay. Mikese villagers depend mostly on rain-fed agriculture and maize is the main crop. Other crops cultivated include beans, soybeans and horticultural crops. The area experienced rodent pests problem and they cause high crop losses and health hazards through bites (Plate 1).

Cat urine extract

In this activity, we evaluated cat urine extract (concentrate) produced by the Institute of Traditional Medicine at Muhimbili University of Health and Allied Science in houses, in order to determine the effectiveness of the product against commensal rodents. Cat urine from the cat was drawn and stored frozen in universal bottles at -20°C until use. The stored cat urine was thawed and mixed with maize starch to form thick dough and then granulated and dried at room temperature before being packed in a hermetically closed jar (Plate 2). The cat urine samples from female and male cats were packed separately (Plate 2).

Commensal rodent activities

The repellent effect of cat urine odours against commensal rodents was studied in 24 households. Cat urine extracts from female and male cat were tested separately against rodents.

Selection of households

Twenty households were selected purposively and adaptively within Mikese village for this study. Ten households were treated with cat urine (five with female concentrated cat urine and five with male concentrated cat urine). The remaining ten households were controls (without cat urine) at two levels (i.e. low and high rodent activity as determined by treatment of tiles coated by soot and followed by recording foot tracks of rodents on the tiles). Track tiles are often favoured over trapping as being less time-consuming, less expensive and having reduced risks associated with animal contact, while still providing a reliable estimate of the population (Drennan *et al.*, 1998). The percentage of track plates visited, therefore, may be used to provide an index of abundance (Drennan *et al.*, 1998); however, track tiles are more frequently used simply to determine the presence of a species in an area or habitat type.

Implementations of treatments

Ten households were treated, each with one packet of cat urine extract. Of these, five were treated with female urine and the remaining five with male urine extract. Ten household which were not treated with cat urine were used as controls (Plates 3a & 3b). *Assessment of rodent activities and data collection*

Tracking tiles were placed one in each house (whether treated with cat urine or not) in order to track commensal rodent foot marks. All square draft with rodents' foot mark was counted on daily basis and converts into percentages (Plate 5).

Data Analysis

Collected data were subjected to analysis of variance (ANOVA) using SAS (1997) programme. The mean separation was done using least significant mean (LSMeans) test to determine variables with significant differences between treatments by sex and days. In addition, comparison was made between houses with high commensal rodent population, which were treated versus those with low infestation which were not treated as well as among houses with low commensal rodent infestations, which were treated versus those with high infestation, which were not treated. These analyses aimed at investigating the effect of cat urine in those two scenarios on rodent movement and recolonization.

RESULTS

Table 1 shows the ANOVA results (percentages) of rodent activity in houses from day 1 to day 3 but not day 4 of exposure. The results show that there was a significant difference on rodent activity depending on the sex of the cat that the urine was drawn from. Also, cat urine has a significant repellent effect in houses treated from day 1 and 2; but not beyond. No significant difference was observed on interactions between sex and treated houses.

Differences between the repellent effect of male and female cat urine extracts was observed in the current study (Figure 1). Female cat urine extract repels more of commensal rodents as compared to male cat urine extract. The feline's urine has more ammonia than any other carnivore's urine and it is the ammonia that gives the cat urine its characteristics smell.

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Data collected were also analyzed for houses with high commensal rodent infestations which were treated with cat urine extract as compared to those with low infestation, which were not treated. The results show that rodent activity in treated houses decreased from 60 to 43% from day 1 to day 3 while in untreated houses with low rodent activity, the rodent activity increases (Figure 2). However, when comparing with untreated houses with high rodent activity against treated houses with low population, the results show that there is a decrease of rodent activity in treated houses while in untreated houses rodent activity remain constant (Figure 3).

Table 1: ANOVA Table for percentage rodent activities over the period of study

Source of Variation	Df	Days				
		0	1	2	3	4
Replication	4	1869.7	2203	1946.8	2384.0	2712.2
Sex	1	963.1*	2082.6*	1079.6*	2899.5*	60.2
Treatment	1	10449.3*	10636.7**	6018.4*	2082.2	4258.2
Sex*Treatment	1	100.8	40.8	300.8	2612.7	1649.8
Error	12	1443.3	1131.8	1273.4	1227.7	1568.5
Total	19					

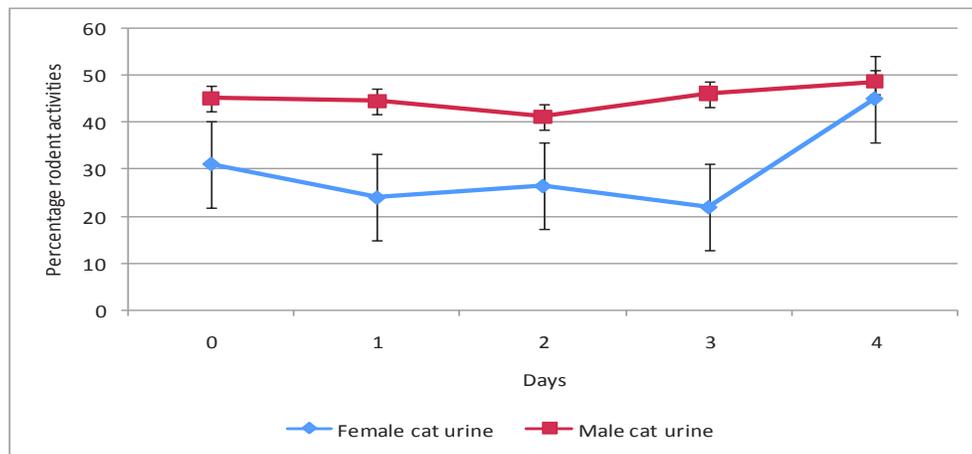


Figure 1: Percentage rodent activities (±SD) based on tracking tiles in houses treated with female or male cat urine

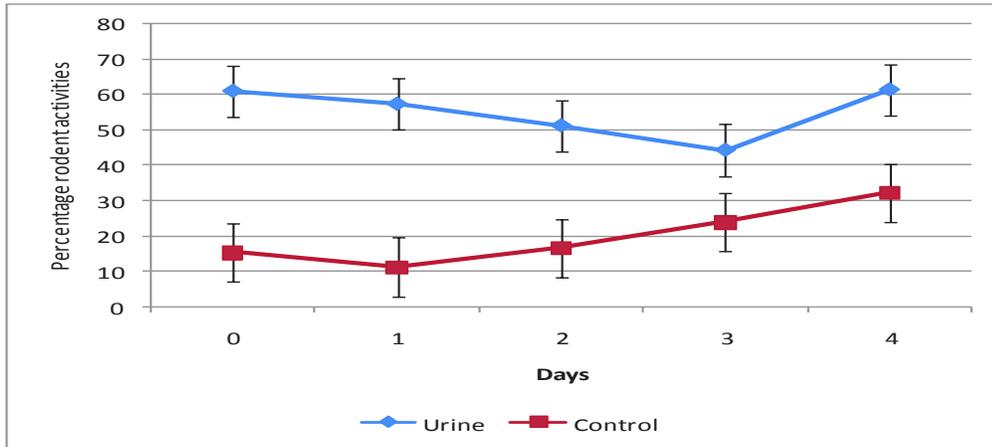


Figure 2: Percentage rodent activities (\pm SD) on tracking tiles in houses with high rodent activity treated with cat urine extract against houses with low rodent activity as a control

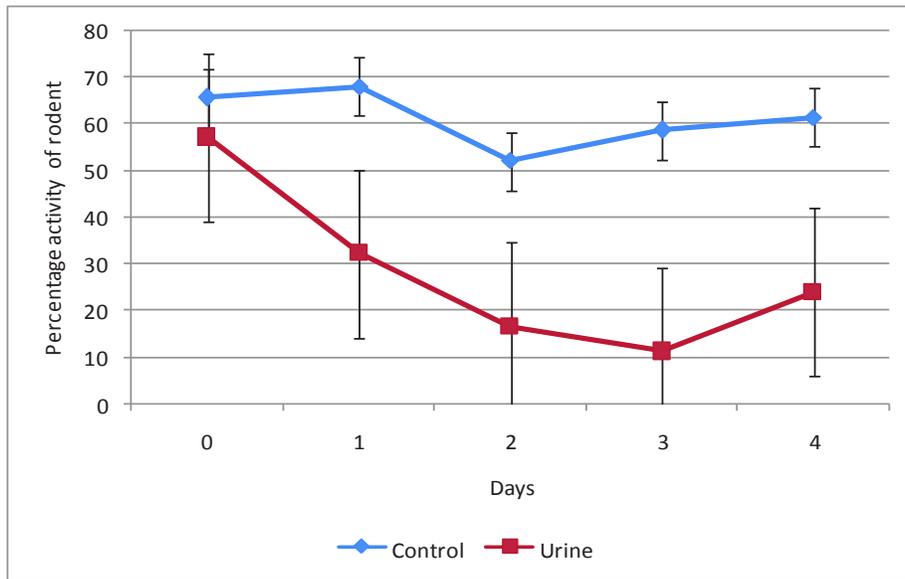


Figure 3: Percentage rodent activities (\pm SD) on tracking tiles in houses with low rodent activity treated with cat urine extract against houses with high rodent activity as a control.

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Plate 1: A farmer bitten at night by rodents in a study area (Mikese village)





Plate 2: Cat urine extract used both female and male cat urine

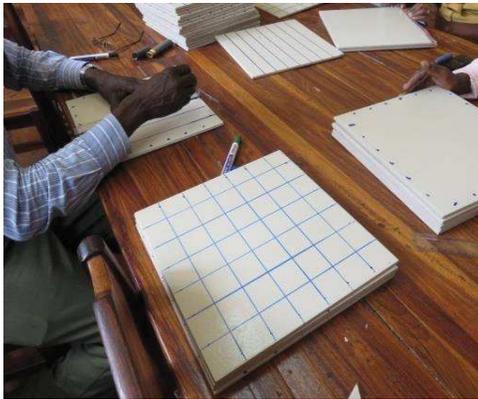


Plate 4a: Research Assistant making 49 square rooms in tiles



Plate 4b: Researchers putting soot on tiles

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Plate 5: Tile with rodent foot marks from one control house (without cat urine)

DISCUSSION

Predator-prey relationships provide classic information for the study of innate animal behaviour. It has been observed in the current study that odours from cat urine elicit innate reactions in commensal rodents, including stereotyped avoidance behaviours and stimulation of the hypothalamic-pituitary-adrenal axis that coordinates sympathetic stress responses (Apfelbach *et al.*, 2005). Therefore, it seems that commensal rodent detected cat urine odour through common metabolites derived from shared metabolic pathways (Berton *et al.*, 1998). In fact, cat urine odour makes the rat think there is a predator in the area and flee. This trend was observed also in the current study where there was an increase of rodent activities in houses where cat urine extract was not placed possibly because the rodents were moving from treated to non-treated houses (Zhang and Zhang, 2014) especially when the population in those houses are low (Shilova and Tchabovsky, 2009).

It has also been reported that after control of territorial and group-living species demonstrated an increase in mobility behaviour and a decrease in interspecific aggression (Shilova and Tchabovsky, 2009; Gurney and Nisbet, 1978). From the current study it implies that, the rate of migration of untreated houses, especially in houses with low population was high due to redistribution of migrants from treated houses. In fact, the high population in untreated houses with low density was mainly due to recruitment of immigrants. However, in untreated houses with high population the rate of population recruitment was low due to the fact that population was at saturation so no migrants were coming in a rodent community (Davis, 1953). Pearl (1927) suggests that population growth followed a logistic curve. This curve was explained by Strecker (1955), the population tends to multiply according to a growth curve which rises slowly at first and then picks up momentum until it shoots upward almost vertically and then it would begin to stabilize at some asymptotic level. However, this movement is at small-scale by individual rodents and their movements build up slowly over study time in response with low population in untreated houses.

Unsurprisingly, the increase of rodent activity in day 4 in the treated houses indicates that cat odour initially causes rodents to panic or flee, but at a later time the effectiveness of cat urine extract becomes less concentrated due to the fact that the compound is volatile. Similar observation has been reported that when cats (*Felis chaus nilotica*) are released to control rodents in grain storages the number of rodents increases after six to seven month's treatment (Desoky *et al.*, 2014). Therefore, the presence of the smell of the cat urine odour may deter the rodents for a while. It has also been reported that rats are highly intelligent and even if there is cat smell in the area they may soon realize that there isn't one there. Therefore, the odours will fade with time and will need replenishment. Therefore, behavioural migration mechanisms to control rodent using cat urine should be considered when developing ecologically - based rodent management strategies.

CONCLUSION

Our findings show how a cat urine odour detected in the environment can trigger an elaborate danger-associated behavioural response in commensal rodents. Using rodent repellent in handling rodent problem might be considered to be scientifically sound, more humane and convenient as compared to using rodenticides and rodent traps. Nevertheless, the findings from this study are inconclusive and more investigations are needed to evaluate its effectiveness in also in the field.

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