# ASSESSMENT OF BAIT PREFERENCE OF DIFFERENT FOOD MATERIALS AS A BAIT BY SELECTED RODENT SPECIES (RATTUS RATTUS AND BANDICOTA BENGALENSIS)

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**Abstract -** Rice is world's second most important cereal crop following corn and it is a major crop cultivated in many countries including Sri Lanka. Loss of grains occur through various means including pests. Among them, rodents cause significant damage to a wide range of crops including rice throughout the world. Bandicota bengalensis is the most abundant species in rice fields and Rattus rattus species is the most common type of house rats. Trapping is a common strategy used for scientific studies as well as for controlling them. To achieve a better trap catch it is essential to identify the most preferred baits for rodents. Therefore, in this study thirteen food commodities were evaluated to be used as baits and experiment was laid down in a CRD design with 3 replicates. Fifty rats from each species were introduced into cages and their consumption of different food materials was recorded separately after 24 hours from the rat introduction based on the remaining food mass. Same procedure was repeated again. The results indicated that R. rattus preferred to eat roasted coconut, cooked raw rice, ripened banana, and cooked parboiled rice whereas B. bengalensis preferred to eat short grain paddy rice, cooked raw rice and short grain raw rice. Findings can be used to develop successful rodent baited traps based on the available rodent type in future rodent management practices.

**Keywords -** Baits, Rodent Control, Grain Losses, Bandicota Bengalensis, Rattus Rattus,

## I. INTRODUCTION

Rice (Oryza sativa) is the staple food as well as the highest priority crop in Sri Lanka. Although farmers expect maximum yield potential from rice cultivation, it is limited by biotic and abiotic stresses. Among the biotic stresses pest are the major problem which cause significant yield loss. Therefore, emphasis should be given to minimize pest losses to increase the productivity of rice (Pathak et al., 2018). Rodents are considered as another major group of pests which cause significant damage to a wide range of agricultural crops throughout the world (Brown et al., 2011) under field and storage conditions. In Sri Lanka, Bandicota bengalensis which is known as field rats are most abundant in rice fields whereas Rattus rattus (house rats) normally live in close association with people (Fall, 2011) and highly responsible for post harvest losses. In most of the countries, the damage caused by rodents equals or exceeds those caused by insect pests (Gwinner et al., 1996). Therefore, prompt management practices should be implemented to manage rodents. Although different kinds of rodent management strategies are available, most common and popular method is the application of rodenticides (Makundi, 2005) even in Sri Lanka. But inappropriate and repeated application of rodenticides cause several detrimental effects such as genetic resistance, bait shyness, behavioral avoidance, non-target poisoning and environmental risks. Therefore, development of Ecologically-based Rodent Management System (EBRM) is important to reduced above mentioned effects. Under this scenario, South East Asia and Africa are developing EBRM system considering about population and breeding ecology of target rodent species (Singleton et al., 1999, Brown et al., 2006). EBRM aims to reduce the unwanted consequences of culling methods including rodenticides and it can provide sustainable, safe and efficient rodent management system.

For scientific studies trapping of rodents is essential. In addition to that, trapping is one of the management method of rodents. For a better trap catch, it is important to use effective baits inside the traps which are used to catch rodents. Bait is a kind of food which is used as a prey to catch fish or any other animal. The best bait for a rat trap mainly depends on the rat species that are trying to catch. Different rodent species have different food habits. For instance, R. rattus is herbivorous in nature whereas B. bengalensis is omnivorous. If researchers are dealing with herbivore or omnivore, the strong smells emitting foods such as nuts, fruits, grains, raw and cooked food materials which lure rats into the traps. The main objective of this research was to determine the most preferable bait types of B. bengalesis and R. rattus species. It will provide better insights for future research and development of successful rodent management program.

## II. MATERIALS AND METHODS

### Testing bait preferences of R. rattus (House rats) and B. bengalensis (Field rats)

It was done as two separate experiments for the above selected two rat species. Both studies were conducted at the plant cage in Rice Research and Development Institute, Batalagoda. Thirteen bait types were tested to determine the most preferred hence those could be used to monitor the presence of rodents. Following baits materials were used and tested as the treatments;

long grain parboiled hulled rice (T1), short grain paddy rice (T2), long grain paddy rice (T3), chick pea (T4), ripened banana (T5), roasted coconut (T6), dhal (T7), cooked parboiled rice (T8), cooked raw rice (T9), short grain parboiled hulled rice (T10), short grain raw hulled rice/brown rice (T11), long grain parboiled paddy rice (T12) and long grain raw hulled rice (T13). For the each replicate, 50g of each food mass was used. In first day, the experimental arena was cleaned and protected places for rats were established. Fifty rats from each species were selected for this experiments. Then selected rats were kept in separate place without giving food and water for 24 hours to ensure starvation. Just before rat introduction (rat introduction was done in the evening), the food commodities were measured and placed on plates established in experimental arena. After finishing their starvation, rats were introduced to the experimental arena. Then data were collected in following evening (after 24hours from rat introduction) as first count. Here, remaining food masses were measured separately and data were recorded. After obtaining the data, the experimental arena was cleaned and left it for 24 hours. Then again rats were starved in a separate place as did earlier for 24 hours until next day evening. After complete starvation, again 50g from each food commodity was placed separately on each plate and rats were introduced (during evening). Then data were collected in following evening as second count. During feeding period, no any disturbances were done (unless their behavior can be changed). Same procedure was followed for both species and it was done as two separate experiments. The amount of food eaten (g) by rodents were calculated from above data separately. Data were analyzed following ANOVA using SAS statistical software (SAS Institute, 2002-2008) for each species and means were compared using LSD at $p \leq 0.05$.

## III. RESULTS AND DISCUSSION

### Bait preferences of Rattus rattus (Field rats)

Amount of bait consumed by R. rattus was significantly different for tested food commodities as the baits with the 1st count($F_{12,26}$ =49.39, P<0.0001) and in the 2nd count ($F_{12,26}$ =82.3, P<0.0001). The highest preference of R. rattus was shown for roasted coconut (T6), cooked raw rice (T9), ripened banana (T5) and cooked parboiled rice (T8) without having a significant difference between them (Figure 1.a.). Then the second highest preference was for short grain paddy rice (T2) and long grain paddy rice (T3) without having a significant difference between two of them. The next preference were shown for long grain parboiled hulled rice (T1), long grain parboiled rice (T12) and dhal (T7) having no significant difference among those three. The R. rattus had the low preference on short grain raw rice (T11), short grain parboiled rice (T10) and chick pea (T4) without having a significantly difference among them. Among all food commodities, long grain raw hulled rice (T13) showed the lowest preference for R. rattus. Both first and second count results obtained for the R. rattus showed similar consumption results.

### Bait preferences of Bandicota bengalensis (Field rats)

Amount of bait consumed by B. bengalensis was also significantly different with tested food commodities used as baits in the 1st count($F_{12,26}$ =135.93, P<0.0001) and in the 2nd count ($F_{12,26}$ =210.63, P<0.0001). With respect to the 1st count, the highest preference of B. bengalensis was shown for short grain raw rice (T11) cooked raw rice (T9) and short grain paddy rice (T2) without having a significant difference among them (Figure 2.a.). Then the second most preference were for the treatments: cooked parboiled rice (T8), roasted coconut (T6) and ripened banana (T5) without having a significant difference among those treatments. The next preferable baits were the short grain boiled rice (T10) and long grain paddy rice (T3)with no significant difference between them. Chick pea (T4), long grain parboiled hulled rice (T1), long grain raw hulled rice (T13), long grain parboiled rice (T12) and dhal (T7) showed the lowest preference without having any significant difference among those treatments. In the second count, highest preference was shown for the baits; short grain raw rice (T11) cooked raw rice (T9) and short grain paddy rice (T2) (Figure 2.b.). The second most preferable bait was cooked parboiled rice (T8) for the B. bengalensis. The next preference was shown for both roasted coconut (T6) and ripened banana (T5) without having a significant difference between them. Short grain parboiled rice (T10) and long grain paddy rice (T3) showed a lower preference by the B. bengalensis and they were not significantly different. Among the all the treatments, the lowest preference was shown for chick pea (T4), long grain raw hulled rice (T13), long grain parboiled hulled rice (T1), long grain parboiled rice (T12) and dhal (T7) without having no significant difference among them.

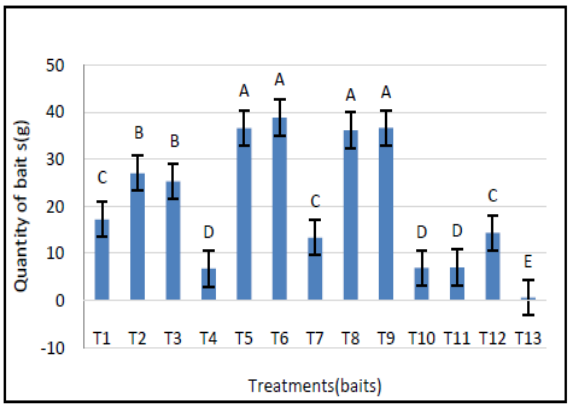


Figure 1.a. Mass of each bait (g) consumed by *Rattus rattus* (mean±SE) for the first count. Means followed by the same letters are not significantly different at *P*=0.05 according to the LSD test following

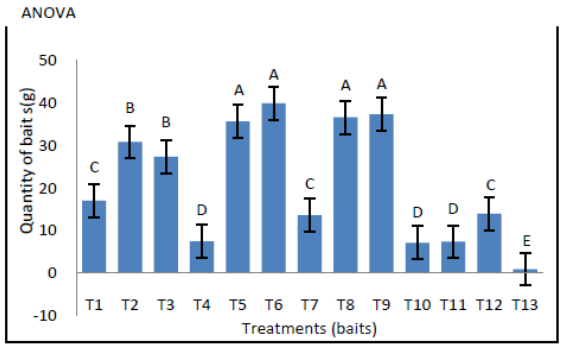


Figure 1.b. Mass of each bait (g) consumed by *Rattus rattus* (mean±SE) for second count. Means. followed by the same letters are not significantly different at *P*=0.05 according to the LSD test following ANOVA.

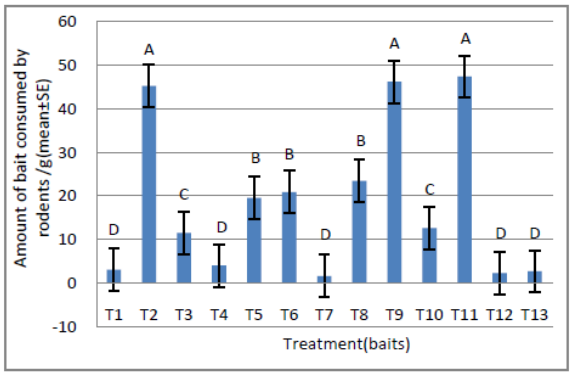


Figure 2.a. Mass of each bait (g) consumed by *Bandicota bengalensis* (mean±SE) for first count. . Means followed by the same letters are not significantly different at *P*=0.05 according to the LSD test following ANOVA.

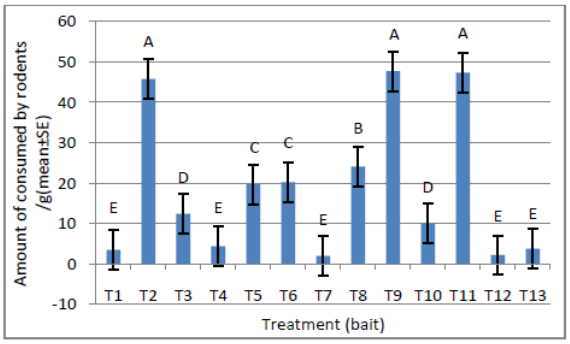


Figure 2.b. Mass of each bait (g) consumed by *Bandicota bengalensis* (mean±SE) for second count.Means followed by the same letters are not significantly different at *P*=0.05 according to the LSD test following ANOVA.

*(Long grain parboiled hulled rice (T1), short grain paddy rice (T2), long grain paddy rice (T3), chick pea (T4), ripened banana (T5), roasted coconut (T6), dhal (T7), cooked parboiled rice (T8), cooked raw rice (T9), short grain parboiled hulled rice (T10), short grain raw hulled rice (T11), long grain parboiled paddy rice (T12), long grain raw hulled rice (T13))*

According to the current study, the mass of food consumed by each rat species were different with the type of food commodity used as the bait. Quality of baits must be suitable for the consumption of rodents (Smythe et al., 1976) because they do not like to feed contaminated foods which are previously infected with rodents. At the same time they do not like to feed dirty, stale or musty baits as their food. Similarly, when baits are stored with some agricultural chemicals they may produce off-smells and may be unfit for rodents because they may repel rodents. For the rat preference, physical characters of grains occupy a major role. Among them, size of bait particles directly affects on their feeding behavior especially it should be suitable for holding by them in their forepaws while eating (Smythe et al., 1976). Spencer, 1953 noted that they prefer to eat foods that can be held in their forepaws. The size of grains and the size of rats have proportionate relationship despite small rats prefer small grains rather larger grains (Smythe et al., 1976). In addition to that, the rodents that have a hoarding reflex the larger bait pieces may be hoarded by them. Similarly, fines and flour-like dusts have least preference which are usually consumed at last. Other than that, presence of outer structures of baits also affect for the preference by rodents because some grain baits may contain different compounds which accept or repel rodents. Their feeding habits can depend on hardness of the bait as well. Obviously, texture might play a role for selecting their foods(Morris et al., 2012). It is reported that soft baits are highly preferred by rodents (Parshad and Jindal, 1991) rather than harder baits like grains. It may be due to easiness of eating and they have to spend less energy when eating. Similarly, taste or olfactory cues could also play a role when selecting their food. But some of those characters were not tested in this study.

According to the findings of Barnett,1975 and Shumake, 1978, familiarity of food flavor also has an impact on rodent preference during their food selection. Similarly, Ahamad and Parshad, 1985 showed that rodents continue to eat the familiar food materials than newly introduced ones.

With respect to the chemical characteristics of baits which are affected on the preference of rodents, sugar content plays a major role. The sugars are highly preferable by rodents and invert sugars such as dextrose, maltose, fructose and levulose are also accepted by them (Smythe et al., 1976). The composition of volatile compounds which can act as attractants for rodents also have greater impact on their feeding behavior. Sometimes food preference may depend on nutrient composition of the food as well. Especially, carbohydrates, protein and lipid composition may affect on their preference (Schloetelburg et al., 2018) . Some studies have revealed that rodent preference is higher on dried fish than grains. It means especial characters of dried fish such as smell and nutrient content may have greater impact on their preference (Mohd-Taib et al., 2021). Other than that, some mechanical treatments also affect on their preference on different foods.

Especially, some grains are treated with different compounds to protect them from various infestations during storage. Some compounds such as fungicides are treated with grains as outer coat to protect them from microbial infections. Fungicides act as strong repellents for rodents (Smythe et al., 1976) thus may lead to least preference for fungicide treated foods. According to the analyzed data B. bengalensis highly prefer to the short grain raw rice, short grain unhulled rice and cooked raw rice. Such preferences are specially associated with their habitats and environmental conditions of habitats. Their least preference were shown for long grain raw hulled rice, long grain boiled hulled rice, chickpea, long grain boiled rice and dhal. Sometimes the preference of B. bengalensis for chickpea and dhal may be reduced due storage treatments, hardness and size. Therefore, it is better to do further investigations in future. The R. rattus have a higher preference on roasted coconut, cooked boiled rice, cooked raw rice and ripen banana that other due to soft nature, pleasant smell and/or some other unidentified physic-chemical characters. Although most of the experiments were done related to baits, such data were not well documented. Nonetheless, characters of baits which have an impact on bait selection of rodents have to be further investigated for the development of successful rodent management programs.

## IV. CONCLUSIONS

According to the results of this experiment it can be concluded that roasted coconut, cooked raw rice, cooked boiled rice and ripened banana can be used as baits to catch R. rattus species whereas short grain unhulled rice, cooked raw rice and short grain raw hulled rice can be used as baits to catch B. bengalensis species. Then above findings can be used for future research and development of successful rodent management programs.

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