



EFFICACY AND PALATABILITY OF PELLETISE RODENTICIDE FORMULATED FROM CASTOR OIL SEED AGAINST RODENTS

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Abstract

Rodents are one of the important pests of public health and agriculture, they are capable of causing crop damage and transmitting diseases to humans. The present rodent control strategy depends primarily on synthetic rodenticides, which are highly toxic non-target species, and are expensive. Naturally produced organic pesticides may be more desirable as they are less harmful specie specific and are economically sustainable. Pelletized rodenticide formulated from castor oil seed (*Ricinus communis L. Euphorbiaceae*) was assessed in a Laboratory experiment for its toxicity and palatability. The study was undertaken to evaluate the optimum concentration of a pelletize rodenticide formulated from castor oil seed on roof rats and to determine a suitable formulation of rat poison from castor oil seed. The roof rats used for this studies were collected from rabbitry, poultry and hostels of Ladoke Akintola University of Technology Ogbomosho, Nigeria. Eighteen (18) roof rats were caught using a cage trap and were divided into three 3 replicates and each replicate had three cages. Each cage had two rats of both sexes. The weight of the roof rats used for this experiment is between 114g to 157g of body weight and are sexually mature. Data were collected on the number of mortality from each treatment during the test period. The result of the treatment groups. higher mortality was recorded on ratio 1:1 of pelletized castor oil seed cake + commercial rat feed and fish meal than on ratio 1: 0.5 pelletized castor oil seed cake + commercial rat feed and fish meal. The most effective pelletize rodenticide studied composed of castor oil seed cake + commercial rat feed and fish meal. It was tested and estimated that ratio 1:1 castor oil seed cake + commercial rat feed and fish meal produce 50% mortality. But in control group, no mortality was recorded. A pelletized rodenticide formulated from castor oil

seed resulted in rat mortality in the test but not in the control group. The liberation of the toxic substance from the poisoned bait might have been delayed by the presence of the plain bait (fish meal) in the choice test. The observation revealed that Castor oil seed cake only + commercial rat feed and fish meal ratio 1:1 formulated into a pellets can serve as an alternative to synthetic rodenticides.

Key words: Castor seed oil, Formulated, Palatability, Pelletized rodenticides, Roof rat,

INTRODUCTION

Rodents cause damage from their burrowing activities which can result in levee failures, flooding of fields, loss of water resources, and the undermining of structures and foundations (Joshi *et al.* 2000, Stuart *et al.* 2008). Approximately 42% of all mammalian species in the world are rodents; this amounts to about 2,277 species rodents (Wilson and Reeder 2005). Introduced rodents pose a serious threat to the native flora and fauna of islands (Wilson and Reeder 2005, Stuart *et al.* 2008, Joshi *et al.* 2000, Moors and Atkinson 1984). Rodents can be very prolific on islands where there are few or no predators, and their omnivorous foraging has led to the endangerment or extinction of numerous island species (Wilson and Reeder 2005, Witmer *et al.* 1998). Many methods exist to reduce rodent populations and/or damage such as Rat proof construction, trap, use of Glue boards, control by cat and dogs etc. (Hyngstrom *et al.* 1994, Buckle and Smith 2015, Witmer and Singleton 2010). Rats are some of the most troublesome and damaging rodents by consume and contaminate food, damage structures and property, and transmit parasites and diseases to other animals and humans. Rats live and thrive under a wide variety of climates and conditions; they are often found in and around homes and other buildings, farms, gardens, and open fields. www.ipm.ucdavis.edu/GENERAL/tools.html

Over recent years the significance of collecting detailed ecological data on the impacts of intruding species has been more widely accepted, it is an essential part of any well-planned eradication project. Likewise, information on eradication techniques, which have developed quickly in the last 30 years but slow to make its way into the usual scientific literature. A few reviews have carefully collected this information (Thomas and Taylor 2002, Courchamp *et al.*, 2003, Howald *et al.*, 2007), still, the encouragement of many rat eradication projects, with all their innovations, almost remain unknown. The majority of rat eradication projects are reports majorly on their methodology and findings, and they are carried out in

temperate zones, notably 1) New Zealand, 2) Australia and 3) North America. its effect on biodiversity was likely completed as much as 3500 years ago, and this has now been out contend emulously in much of its infested range by the rats species (Atkinson 1985, Long 2003). In New Zealand rats are widespread and there is a body of work concerning its effect and methods of control (Campbell and Atkinson 1999, Veitch 2002).

Rodents caused disease outbreaks, some like plague with historical significance, which has been well documented in many countries (Gratz 1994). To reduce the losses incurred from rodent damages to crops, government sponsored rodent control programs are carried out during outbreak seasons. The control strategy includes trapping, habitat alteration, and poisoning using zinc-phosphide and anticoagulant rodenticides (Million 2003).

However, these rodenticides pose a significant threat both to the environment and to public health. Acute poisonings with pesticides including rodenticides account for 300,000 death worldwide (Goel and Aggarwal 2007). Zinc-phosphide releases phosphine gas, which is a nervous system toxicant. Inhalation of phosphine gas removed from inorganic phosphides used as fumigants was responsible for death of a 6 year-old boy and for two adults suffering from severe toxicity (Shadnia *et al*, 2008). Also zinc phosphide is toxic to non-target animals including wildlife (Brown *et al*, 2002). Ingested zinc phosphide was found in carcasses of poisoned rodents and animals eating these carcasses might be at risk of secondary poisoning (Sterner *et al*, 1998).

Botanical pesticides are agricultural pest management agents which are based on plant extracts. In modern times these have been used as alternatives to synthetic chemicals in organic pest management. The practise of using plants and their extracts for pest management in agriculture have a long history among traditional farming peoples throughout the world (Abate et al 2000). This also holds with indigenous farming techniques in Africa, the continent being home to some of the oldest continuing cultures on earth. Their knowledge is however based on another way of reasoning than scientific thinking (Abate et al 2000). Previously, especially during the glory days of the Green Revolution, this knowledge was often scoffed at by those of a scientific predisposition. In recent times people are however beginning to value indigenous and traditional ways as environmentally sound. Although a fascinating field of inquiry, traditional African pest management strategies such as the knowledge of plant pesticides are not well studied (Koksal *et al*, 2009).

Regarding the small scale farmer with limited economic resources, botanical pesticides seem to offer several benefits besides being an environmentally

friendly pest management strategy. Ideally, botanical pesticides are locally available, low-cost, non-toxic or at least less toxic and non-persistent in the environment (Dahlin 2009).

Commercialization of synthetic chemicals is very expensive because of the need for hundreds of documents which are required for the registration process of an active ingredient and a plant protection product. Only economically strong companies have been able to fulfil the demands for information. Botanicals may have an important role as pesticides in the modern world. However, it will take a long time before the potential of new innovations can be realized. While waiting for the business to change, much research work needs to be done to justify the claims of the already known and used plant-based products.

Sustainable agriculture aims at reducing the incidence of pests and diseases to such a degree that they do not seriously damage crops without upsetting nature's balance. One of the aims of sustainable agriculture is to rediscover and develop strategies whose cost and ecological side-effects are minimal. The use of synthetic pesticides has undoubtedly resulted in achievement of green revolution in different countries through increased crop production. However, in recent years there has been considerable pressure on consumers and farmers to reduce or eliminate synthetic pesticides in agriculture. This concern has encouraged researchers to determine a suitable formulation of rat poison from castor oil seed for better alternatives to synthetic pesticides Dubey *et al.*,(2010).

MATERIALS AND METHODS

EXPERIMENTAL SITE

The experiment was carried out in the year 2015 at the Toxicology Laboratory in the Department of Crop and Environmental Protection, Faculty of Agricultural Sciences, Ladok Akintola University of Technology, Ogbomosho (longitude 4°10'1"E and Latitude 8°10'1"N).

Plant Materials and Equipments

1. The smaller castor bean seeds (variety minor) were collected from the botanical garden unit of Ladok Akintola University of Technology Ogbomosho.
2. Muslin cloth used to sieve, Cages and Clay pot used in feeding rat were obtained locally from Ogbomosho,
3. Pelletizing machine with one horse power was purchased at Power tool Ilorin

Feeding: they were fed *ad libitum* and were given fresh water daily from a suspended water feeder. The treatment was administered through feeding method.

They were fed with a pelletized rodenticide formulated from castor seed.

The study was carried out as follow

1. Pelletized cake + feed and fishmeal (1:0.5)
2. Pelletized cake + feed and fishmeal (1:1)
3. Pelletized feed + Zinc phosphide (1: 0.2)
4. Control

Animals and experimental design: The roof rats used for this studies were collected from rabbitry, poultry and hostels of the Ladoke Akintola University of Technology Ogbomosho. Eighteen (18) Roof Rat / black rat (*Rattus rattus*), of both sexes weighing 10-17 ounces and are 13-18 inches total length. The tail is LONGER than combined head and body length and the belly is often white were caught using cage trap baited with rabbitry and poultry feed remnants and maintained on a diet of pelletized commercial rat feed only and water *ad libitum*. After two weeks of acclimatization, those appearing sick and juveniles were excluded. The remaining rats were randomly divided into three three replicates and each replicate had three cages. Each cage had two rats of both sexes, (Note: each metal cage measuring 30cm x25cm contain room and parlour just for easier cleaning, feeding and supply of water). The weight of the roof rats used for this experiment is between 114g to 157g body weight and are sexually mature.

Preparation of a pelletized rodenticide formulated from castor oil seed.

The seed was crushed into coarse meal prior to extraction. The coarse meal of castor seed was then put into the oven to coagulate the protein, this is necessary to permit proper extraction and to free the oil from efficient pressing. Then oven is regulated to 60o C under airtight condition for 25 minute. The heated coarse meal castor seed was poured into a muslin cloth and later placed inside mechanical hydraulic press to remove the oil. The extracted oil was filtered and collected in a settling tank, the remaining materials discharged from the press called cake was mixed thoroughly with commercial rat feed and fish meal served as an attractant into ratio 1:0.5, 1:1 and the third one is Commercial rat feed and fish meal only which served as control.

Each treatment were pelletized as follows:

1. Castor oil seed cake only + commercial rat feed and fish meal ratio 1: 0.5
2. Castor oil seed cake only + commercial rat feed and fish meal ratio 1:1

3. Commercial rat feed and fish meal only (Control)

The size of a pelletized rodenticide formulated from castor oil seed was 4mm and between 1 to 1.5 inch long

All the treatments were replicated three (3) times.

Formulation procedure:

A **pellets** (all the particles are the same weight and shape) is an active ingredient of castor oil seed mixed with excipients (commercial rats feed) and bait (fish meal) which serve as attractive substance. This bait either attracts the pests or is placed where the pests will find it.

Excipients. This serve as an inert substance added to increase the bulk of a pellet for processing. Having an acceptable taste is important for oral formulations,

Starch: serve as binders (or adhesives) are added to formulations to promote cohesiveness within powders.

Chewable pellet are designed to be mechanically disintegrated in the rodents mouth. This pellet is mainly concerning rodent convenience and acceptance. It also offer convenience for rodents and creation of palatable formulations.

Experimental design and management:

Randomized Complete Design (RCD) and Data were taken on the number of mortality per treatment.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) and means were separated with Duncan Multiple Range Test (DMRT) at 5% level of probability using Statistical Analysis Software (SAS) computer software

RESULTS:

At replicate 1, two (2) Mortality was recorded on the first day among the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:1. On the second day, One (1) mortality was recorded on the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:0.5. Then on the third day, another one (1) mortality was recorded on the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:0.5(Table 1). No mortality was recorded among the control treatment which fed with Commercial rat feed and fish meal only. They appeared healthy and were actively moving inside their cages.

At replicate 2, two (2) Mortality were recorded on the second day among the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:1. At the same time one (1) mortality was recorded on the third day and another one (1) mortality on the fourth day on the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:0.5. No mortality was recorded among the control treatment which provided with Commercial rat feed and fish meal only, like the first replicate (Table 1).

At replicate 3, one (1) Mortality was recorded on the second day and another (1) mortality was recorded on the third day on the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:1. But it was observed that rat fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:0.5 abstained for two days from feeding may be they discovered poison bait.

On the third day, it was observed that rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:0.5 were forced to provide on the feed as a result of not an having alternative feed. And, one (1) mortality was recorded on the rats fed with Castor oil seed cake + commercial rat feed and fish meal ratio 1:0.5. No mortality was recorded among the control treatment which provided with Commercial rat feed and fish meal only. Just like the first replicate. Palatable Pelletize feed were intended to encourage consumption.

DISCUSSION:

Over the last decades, the management of pest have purely been with the use of synthetic chemicals. This has proved to be hazardous to man and it environment, although very useful in the control of the pest. In recent times, botanical pesticides is fast replacing the chemicals (synthetic pesticides). Plant have been reported as the significant source of phytochemicals and biologically active natural agents. This is due to the fact that it has been proven not to leave hazardous residue in food for man and his environment.

The use of plants with pesticidal activities have been a practice among local farmers in Africa and in the rest of the world. In time past, the traditional methods of managing pest were not acceptable to the academic, not until recently, that value is now given to the conventional ways of controlling pest. This has now inform the research into various plants with pesticidal attributes (Abate *et al.*, 2000).

However, documented evidence of the chemical composition of all kinds chemicals should be made reduce the health risk to man, but that may not be applicable to botanical pesticides although botanicals may cause allergic in people who are very sensitive and reactive. Botanicals consist of hundreds of

components as a mixture and impacts of the mixtures must be studied in depth. The registration and documentation of synthetic chemicals are costly. This is because of many paper work required by the body in-charge of the registration. At the final process, the financial involvement is usually enormous -: as such only very few solvent companies can get the commercial right of synthetic pesticides. However, due to the high cost of commercialization of synthetic chemical, research on botanicals is still in process, while waiting for the business to change, much research work needs to be done to justify the claims of the already known and used plant-based products.

Remind that rats are particularly shy animals and nervous of strange objects that appear in their territories. Therefore it is better to use attractive bait or existing materials that will deliver an excellent results in controlling rats.

It was deduced from the observations that fish meal is a more attractive bait for castor oil seed cake + commercial rat feed. In formulating powdered castor oil seed as rodenticide, fish meal served as good bait. Therefore, the observation revealed that castor oil seed cake baited with fish meal is highly effective in controlling rats.

Again, the result of a pelletized rodenticide formulated from castor oil seed on roof rats where higher mortality was recorded on ratio 1:1 of pelletized castor oil seed cake + commercial rat feed and fish meal than on ratio 1: 0.5 pelletized castor oil seed cake + commercial rat feed and fish meal. The most effective pelletize rodenticide studied was composed of ratio 1:1 castor oil seed cake + commercial rat feed and fish meal compared with ratio 1:0.5pelletise castor oil seed cake + commercial rat feed and fish meal.

Reports on adverse effects of chemical pesticides and environmental risks resulting from their thoughtless application have replace the interest approaching botanical pesticides as an ecochemical stand-in pest management (Isman 2006). In the environment of agricultural pest management, biopesticides are well in organic food production and may play a greater role in production and keeping of food in the developing countries. The focus of modern society towards 'green consumerism' desiring fewer artificial ingredients in food can favour plant-based products which are 'widely considered as safe' in ecofriendly management of plant pests as botanical pesticides.

Biopesticide will play an essential role in the time ahead for pest control both industrialized and developing countries. Biodiversity-rich countries should rapidly bioprospect their locally used flora to document pesticidal plants to examine future cases of biopiracy and establish their supreme right on the bio pesticides developed from plants (Dubey *et al.*, 2010).

Due to cost and environmental toxicity of current rodent management approaches, an integrated pest management approach incorporating natural pesticides should be considered as an alternative to the exclusive use of pesticides as pest management tools. As eradication provides permanent solutions and for invasive species and its merely always desirable when it can be achieved (Parkes and Panetta 2009).

Based on the result of this laboratory experiment, a pelletized rodenticide formulated from castor oil seed fed to rats can be a substitute or effectively used as rodenticide instead of synthetic rodenticides currently being used in control rats. Castor oil seed has been generally used and approved as an agricultural crop in subtropical and tropical locations. The oil from the seed has been used in the production of many products like paint, varnishes and is used as the protective coating for plastics. It is also used for biodiesel. A multipurpose castor oil plant has now been found to have rodenticidal property which is now formulated as an effective rodenticide. It was deduced from the observations that a pelletized rodenticide containing castor oil seed cake in concoction or mixed with commercial rat feed + fish meal can suppress or conquer rodent population.

CONCLUSION

The significance of this present finding is that the majority focus on synthetic rodenticide for control of rats. But increase in demand of this multipurpose agricultural crop will help the local farmers to cultivate this castor bean plant and will reduce unemployment in the society. With this new finding the interest of the community and local farmers will be stimulated in using natural plants and extract for vertebrate pest control.

There is a need to encourage the use of a pelletized rodenticide derived from castor seed in controlling rats by household and the farmers because of its relative advantages.

- No technicalities in the application.
- No effect on the ecosystem.

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Picture of a Palatable Pelletize Rodenticide formulated from Castor oil seed





Table 1: Number of mortality of the roof rat fed with a pelletized rodenticide formulated from castor oil seed are presented in the table.

Days after treatment

Treatment	Replicate 1 (% mortality)				Replicate 2 (% mortality)				Replicate 3 (% mortality)			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Pelletise cake+ feed + fish meal (1:0.5)	0	1	0	1	0	0	1	1	0	0	0	1
Pelletise cake + feed + fish meal(1:1)	2	0	0	0	0	2	0	0	0	1	1	0
Control	0	0	0	0	0	0	0	0	0	0	0	0