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FORMULA TO BUILD A BETTER "RAT TRAP" RODENTICIDE

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In the time that the Pesticides Division of Agriculture Canada has been evaluating rodenticides, it has become apparent that the formulated product's efficacy is dependent on the character of the inert ingredients as well as on the actual active toxicant. The type of food, its level of manufacture, the adhesive-binder, the attractants and preservatives can each affect the efficiency of the active ingredient. Currently, very serious problems have arisen because of the anticoagulant resistence and bait shyness that rodents have developed towards existing products.

For rodenticides, then, each active chemical and each so-called inert ingredient should be evaluated and standards established to ensure that the formulated products will provide good rodent control. Standards for inert ingredients would certainly benefit both the users and the industry by providing a better-built rat formulation.

The primary concern when evaluating the effectiveness of any rodenticide is whether enough toxicant will be consumed by the animal to provide a lethal dose. Some actives are more toxic than others, which influences the amount of bait that must be consumed for control, but does not necessarily mean the bait with the most toxic active is most effective.

Particle size and shape, taste, odor, attractants, impurities, diluents, stickers, mode of action, use site, characteristics of the rodent, and method of manufacture - these are all factors that can influence the efficacy of a rodenticide formulation. Accordingly, each factor will be discussed separately.

Particle Size: Each species has a preferred food size range and the general acceptability of the bait is determined by whether or not the bait falls within the range of the target species. Particle size is directly related to the available surface area of the food bait and the degree of absorption or adsorption possible.

Large particles may be hoarded, while minute pieces may be ignored. Uniformly-sized particles ensure even distribution of the toxicant.

Particle Shape: Particle shape influences whether or not an individual species will choose to eat a bait. Neophobia (fear of new objects) can cause a rodent to reject unfamiliar objects or shapes.

Taste: The product must be palatable enough to compete with alternate food sources, which are ever present in the animal's environment.

Any taste that can be related to a negative experience (such as illness) can induce bait shyness. A bland active will be overruled by an inert ingredient that produces an unacceptable taste.

Odor: Odor acts as a motivating device; it stimulates a rodent to search and locate the source of the odor. Strength of odor can determine whether the product acts as an attractant or as a repellent. Odor identifi-

cation can be a learned response. If the formulation is palatable, the rodent associates its gustatory experience with the odor of the item.

Addition of an odor attractant to a bait can have one of the following effects:

1. The bait attracts the animal, but provides no further stimulation to consume the formulation.

2. The bait attracts the animal and the odor stimulates it to try the bait, but the attractant has no influence on the palatability of the bait.

3. The bait attracts the animal and the attractant gives a positive or negative taste to the formulation. Where there is a possibility of spoiling the palatability of the bait, an odor attractant used on the outside of a bait carton provides a better stimuli to the investigating rodent than mixing the attractant into the bait.

Impurities: Impurities in the toxicant can affect the toxicity of the product and influence the taste and acceptance of the bait formulation. They can affect the learned response to the taste and smell of the formulation. Impurities in the inert ingredients can have similar effects and can also influence the mode of action of the toxicant, the shelf life and use life of the product.

Diluents: Diluents must be bland or they must improve the palatability of the formulation. Diluents can be added to a product to aid in the acceptance of the bait where the toxicant has an unacceptable taste in the field formulation and the diluent can actually mask the unacceptable taste. However, this is not usually a realistic proposition.

Stickers: Stickers (or binders) are needed to hold the toxicant to the food bait. Stickers are important because they can affect the taste and odor of the bait. They can also alter the time of intoxication (symptoms produced by the active) and/or alter the storage or field life of the formulation. Physical properties of the sticker must also be considered. For example, a highly volatile sticker could cause loss of the toxicant, or an inappropriate sticker could reduce the acceptability of the bait by increasing tackiness and rancidity.

Mode of Action: The mode of action can influence the acceptance of the bait by the target species. If the action is immediate but not fatal, the animal will usually stop eating upon expression of symptoms, which lessens the chances for control. Encapsulation or specific additives can eliminate quick expression of intoxication thus increasing the chances of further consumption and improving the probability of control.

Anticoagulants kill by reducing prothrombin levels in the rodent's blood. Usually five feedings are needed to kill the animal, so it is very important for the bait to be acceptable and attractive for a considerable length of time.

A bait intended for such long-term exposures requires a more refined grain (i.e., degermed and hulls and husk removed) to reduce the possibility of rancidity. Low volatility binders are also recommended.

Placement of Bait: Whether the bait is to be used indoors or outdoors will influence the need for bait preservatives (specifically, paraffin type baits).

The temperature, humidity, sunlight and wind exposure of the use site must be considered when judging the suitability of a product. Inert ingredients should be selected to enhance, or at least not undermine, the product's efficiency in the specific placement site. Similarly, any extended storage will preclude the use of short-life inert ingredients.

Rodent Characteristics: Age, sex and species of the rodent all have a bearing on the acceptability and efficacy of the product. Males are more selective in choosing anticoagulant baits, while females require less toxicant per unit body weight for a lethal dose. Males have a greater chance of exposure to bait because they are more curious and maintain a larger territory than females. Norway rats are usually more sensitive to toxicants than Roof rats. In addition, local populations can show specific dislikes for certain types of bait, making control impossible with such formulations in the area. (For example, paraffin baits are rejected by rats in Hawaii.) Any or all of these factors can influence bait requirements.

Method of Manufacture: Present manufacturing and storage methods can reduce the availability of the active ingredient by 90% from the time the formulation is mixed until the bait is set out. A complete review of current methods, coupled with an understanding of inert adhesive binders, bait size, shape and impurities could solve this problem and lead to a better built rodenticide.

The benefits of more effective control will more than compensate for any increased time it takes to choose and formulate a better built "rat trap" formulation.