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Introduction and Sources of Molluscicides

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Abstract

The term "molluscicide" refers to any drug used to control or eradicate soft-bodied invertebrates, such slugs and snails. These chemicals are commonly employed in agriculture, horticulture, and public health programs to manage mollusc populations that can cause damage to crops, transmit diseases, or infest water bodies. Molluscicides can be categorized into chemical and non-chemical methods. Chemical molluscicides include metaldehyde, iron phosphate, copper sulphate, and synthetic molluscicides like carbamates. In most slug pellets intended for crop protection, the active component is metaldehyde. For those that supply drinking water, this poses a problem. Therefore, it's critical to comprehend this compound's origins, transportation, and environmental destiny. Monitoring and analytical methods for finding metaldehyde in environmental matrices are some of the topics covered in this critical study. Along with possible watershed management plans and activities helpful for reducing the environmental impact of this molluscicide, novel methods for removing metaldehyde from drinking water are given.

Keywords: Molluscicides; Mollusc; Metaldehydes; Carbamates Molluscicides; Iron Phosphates; Copper Based Molluscicides; Biological Agents Molluscicides

Introduction

Molluscicides are compounds or substances used to manage or eliminate molluscs, especially those that are deemed pests in aquaculture or agriculture. These compounds are intended to target molluscs, such as slugs and snails that could harm other cultivated plants or crops. Molluscicides are substances that kill molluscs directly or discourage them from eating on plants. They might be in the form of baits, sprays, or granules [1,2]. Top of FormIt appears that your question may have a small spelling error. If you intended to say “mollusc,” then they are a broad category of animals that are invertebrate and are members of the phylum Mollusca. Molluscs comprise animals including squid, clams, snails, and slugs. They are distinguished by their soft bodies, which are typically covered in a hard shell, and by the fact that they frequently have a powerful foot for walking. Molluscs are found in a wide range of habitats, such as freshwater, marine, and terrestrial ones, and they are crucial components of the ecosystems in which they live. The main purpose of molluscicides is to control certain mollusc species that endanger public health, gardens, or crops. Molluscicides, for instance, are frequently used in agriculture to manage slugs and snails that harm crops and result in financial losses. Molluscicide use may have an impact on the environment. Beneficial insects, birds, and mammals are among the non-target creatures that chemical molluscicides may endanger. Furthermore, improper use of some molluscicides can contaminate soil and water bodies, creating ecological imbalances. Biological control agents, cultural customs, or physical obstacles are examples of non-chemical techniques. Molluscicides can be used as sprays, powders, granules, pellets, baits, or granules. The target mollusc species, the surrounding conditions, and the required level of effectiveness all influence the application method selection [1]. Governmental organizations frequently control the use of molluscicides because of the possible harm they may cause to the environment and public health. In order to reduce negative impacts on people, animals, and the environment, regulations may include limitations on application rates, application techniques, and safety measures. Many human ailments, including diarrhoea, bloody stools, urogenital infections, and neurological abnormalities, are brought on by molluscs. Synthetic molluscicides are frequently used to control molluscs, such as slugs, motts, and snails. These pesticides are expensive to import, cause toxicity issues in non-targeted creatures, and harm the environment. Plant molluscicides have acquired importance due to their strong action, reduced resistance, and greater biodegradable rate. These factors reduce risks (death of fish, birds, and other wildlife) and enhance mollusc resistance. An attempt has been made to illustrate the natural regulation of molluscs through the use of plant extracts and secondary metabolites in this review Figures 1-3.

Figure 1: Mollusca [3].

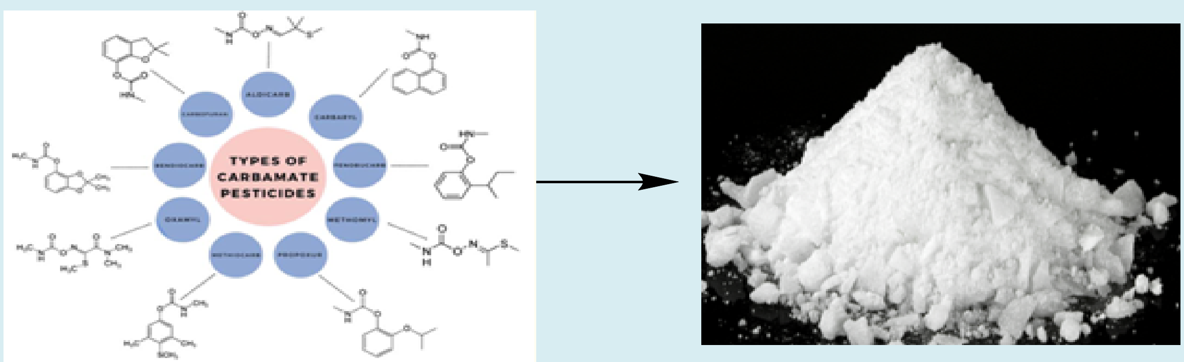

Figure 2: Carbamates molluscicides [4].

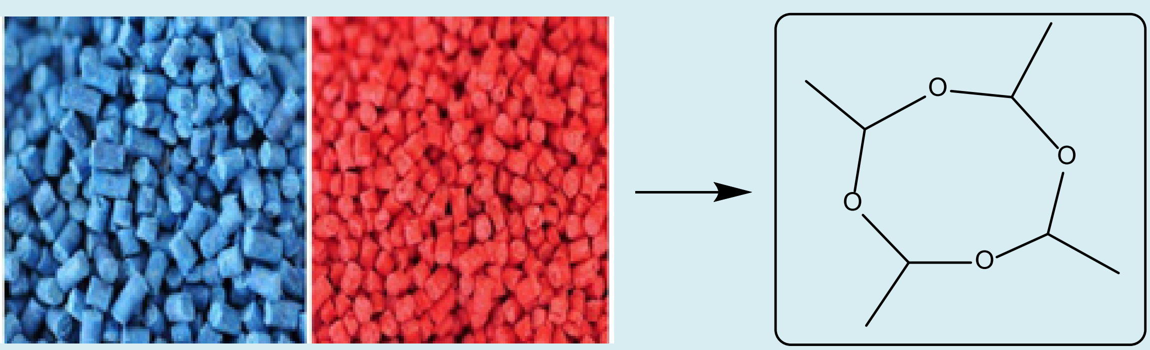

Figure 3: Metaldehyde Molluscicides [5].

Mollusca

Appearing in the phylum Mollusca, molluscs are a varied collection of invertebrate organisms. Among them are well-known animals like clams, snails, octopuses, and squid that can be found in freshwater, marine, and terrestrial environments. Key traits of molluscs include the following Table 1:

Types	Example	Image	References
Soft body	1.Arionhortensis (garden slug)		UK C (2014) Arion hortensis (A. Ferussac (1819) [6,7]
Muscular body	1. CornuAspersum (garden snail)		Çelik MY, Duman MB, Sarıipek M, Gören GU & Karayücel S (2018) [8].
Bilateral Symmetry	2. Metaldehyde		Castle GD, Mills GA Gravell, A Jones, L., Townsend I, Cameron DG, Fones, GR (2017) [9].
Mantle	1. Achatinafulica (giant African land snail)		Raut SK & Barker G.M (2002) [10].
Radula	1. Helix Aspersa		Iglesias J & Castillejo J (1999) [11].

Table 1: Traits of Molluscs.

Soft Body: The soft bodies of Mollusca are usually covered in a hard calcium carbonate shell that serves as protection. But not every mollusc possesses a shell; some, like octopuses, have none at all or a shell that is greatly reduced.

Muscular Foot: The majority of molluscs move by using a muscular tissue called a foot. Distinct groups of molluscs can have very distinct foot shapes and functions. For instance, the foot of clams is used for burrowing into the substrate, but the foot of snails is utilized for crawling.

Mantle: In species that have one, molluscs have a thin layer of tissue called the mantle that secretes the shell. In addition, the mantle is responsible for excretion and gas exchange.

Radula: A radula is a specialized feeding device found on many molluscs. It resembles a ribbon and is covered in small teeth. The radula's form and use can change based on the mollusc's diet. It is employed for scraping or chopping food.

Bilateral Symmetry: The ability to divide a mollusc's body into two identical halves along a single plane is known as bilateral symmetry.

Well-Developed Neural System: With a simple brain and a variety of sensory organs, molluscs often have a well-developed neural system. Certain animals, like octopuses, have extremely sophisticated nerve systems that allow for highly developed behaviours and intelligence. With over 100,000 species identified, molluscs range in size from microscopic snails to enormous squids. They contribute to the cycling of nutrients, provide food for other creatures, and even serve as markers of the health of the environment, among other vital ecological activities in a variety of ecosystems. Furthermore, a large number of molluscs have economic significance due to their use as human food sources as well as in the manufacturing of jewellery (certain molluscs may generate pearls) and pharmaceuticals.

Molluscicide Types

Molluscicides come in a variety of forms and are applied in diverse contexts to manage mollusc pests. Typical varieties include some of the following:

Metaldehyde: This substance is frequently utilized in bait mixtures to keep slugs and snails under control in fields and gardens. Molluscs find metaldehyde baits attractive, but when they eat it, it can be hazardous to them.

Iron Phosphate: As an alternative to metaldehyde, molluscicides based on iron phosphate are thought to be less hazardous to the environment and non-target creatures. They function by interfering with slugs' and snails' digestion processes.

Carbamate Molluscicides: In agriculture, carbamate chemicals like methiocarb are employed to manage mollusc pests. They cause paralysis and death in molluscs by blocking the acetylcholinesterase enzyme.

Copper-based Molluscicides: In aquatic environments, copper compounds, like copper sulphate, are used as molluscicides to control snails and other molluscs that could harm aquatic vegetation or spread disease to fish.

Biological Control Agents: To regulate mollusc populations, a few naturally occurring predators or parasites can be employed as biological control agents. For instance, several nematode species and predatory beetle species consume molluscs such as snails and slugs.

These are only a few varieties of molluscicides that are available; each has a unique mode of action and situational applicability. Molluscicides should be used sensibly and in accordance with label directions to reduce damage to non-target creatures and the environment.

Mostly Used Chemical Molluscicides:

Carbamates Molluscicides: A common class of compounds used as insecticides and pesticides is carbamates. On the other side, molluscicides are compounds that are used to kill or control molluscs, such as slugs and snails. Thus, compounds belonging to the carbamate class that are especially employed to manage mollusc populations are referred to as carbamate molluscicides. The way these molluscicides operate is by messing with the target molluscs' nervous system, which eventually results in their demise. Different formulations, including pellets, powders, and liquids, can be used for different purposes, contingent on the product and application technique. It's crucial to remember that, even though carbamate molluscicides can be successful in managing mollusc populations, care should be taken while applying them to reduce the possibility of injury to the environment and non-target species. Additionally, to guarantee their efficacy and reduce any negative effects, appropriate application methods and respect to safety regulations are essential [12].

Metaldehyde: Molluscicides are compounds used to manage slugs and snails in gardens, fields, and other outdoor habitats. One frequent active ingredient in these substances is metaldehyde. Molluscicides based on metaldehyde are commonly prepared as pellets or granules, which are dispersed among plants or in locations where slugs and snails are causing harm.

The following is essential knowledge regarding metaldehyde molluscicides:

Mechanism of Action: Slugs and snails are killed by dehydration brought on by metaldehyde. It interferes with their capacity to make slime, which is necessary for locomotion and defence, when consumed. Slugs and snails get dehydrated and finally die if they don't have enough slime.

Application: Plants that are vulnerable to harm from snails and slugs are usually treated with metaldehyde molluscicides. Slugs and snails must overcome a barrier formed by evenly distributed pellets or granules containing metaldehyde on the soil's surface in order to get to the plants. It's critical to adhere to the application rates and safety precautions recommended by the manufacturer.

Effectiveness: When applied properly, metaldehyde works well against slugs and snails. Rainfall, for example, might have an impact on how effective it is since too much moisture can make the pellets degrade more quickly, decreasing their efficiency. It might need to be reapplied on a regular basis, particularly after a lot of rain.

Safety Concerns: Although metaldehyde is a common molluscicide, there are safety issues with its application. If consumed in significant amounts, metaldehyde is poisonous to beneficial insects, wildlife, and pets. Specifically, dogs are prone to metaldehyde poisoning, which can be fatal if not addressed right away. Products containing metaldehyde must be kept out of the reach of children and pets, stored safely, and applied in accordance with label directions in order to reduce risks.

Regulation: To guarantee their safe and responsible usage, the use of molluscicides based on metaldehyde is regulated in several nations. Regulatory bodies frequently set standards for product labelling, application rates, and safety measures in order to safeguard the environment, the health of people, and animals.

Alternatives: There is growing interest in non-toxic alternatives to metaldehyde for controlling slugs and snails because of worries about the chemical's toxicity and its effects on non-target animals. Biological controls (introducing natural predators, for example), cultural practices (using mulch or raised beds to minimize moisture), and additional chemical choices (molluscicides based on iron phosphate, which are thought to be less hazardous to non-target animals) are some examples of these alternatives.

Overall, slug and snail populations can be managed in gardens and agricultural settings with the use of metaldehyde-based molluscicides. However, in order to reduce hazards to the environment and non-target organisms, it's crucial to use these products responsibly and look into alternative approaches whenever feasible [13].

Molluscicides Effects on Crops

A discussion on molluscicides in relation to crops or agriculture. It's possible, though, that you are referring to another name or a chemical that comes from mollusc fish. Should the term "molluscicides" pertain to a particular material or combination, the way it affects crops would be determined by its molecular makeup and method of action. It is hard to give a thorough response in the absence of more context or details regarding what "molluscicides" actually are it is hard to give a thorough response in the absence of more context or details regarding what "molluscicides" actually are. All substances given to crops, however, can generally have different effects based on criteria including concentration, application method, time, and the particular crop being treated. I would be pleased to provide a more thorough response if you could elaborate on what "molluscicides" is and how they might affect crops. Molluscicides are compounds that are used to manage or eradicate molluscs, which can be agricultural pests and include slugs and snails. Although they can be useful in controlling these pests, they might potentially have unforeseen consequences for the environment and crops:

Non-Target Organisms: Molluscicides have the ability to harm organisms outside their intended mollusc target. If consumed or if they come into contact with the chemical residue, they could damage beneficial insects, soil organisms, small mammals, and birds.

Soil Health: A few molluscicides have a long half-life in the soil, which may have an effect on microbial activity and soil health. The development of crops and the cycling of nutrients may be affected by this.

Residue in Crops: Crops, especially those planted near to the ground, may occasionally absorb molluscicide residues. This may cause the plant's edible portions to become contaminated, which could be harmful to people's health if consumed.

Resistance: Overuse or indiscriminate application of molluscicides can cause target mollusc populations to become resistant, which reduces their effectiveness over time and necessitates the use of larger doses or alternative chemicals.

Ecological Impact: Because mollusc has a variety of ecological responsibilities, using molluscicides to reduce or eliminate them can have a negative impact on ecosystems. They might take part in the cycle of nutrients or act as prey for other creatures.

Water Contamination: Runoff from molluscicide-treated farms may contaminate neighbouring bodies of water, harming aquatic life and perhaps resulting in ecological unbalance.

Regulatory Concerns: The use of molluscicides may be governed by laws and limits in many nations because of the possible effects they may have on the environment and human health.

Metaldehyde Effect

When it comes to abiotic breakdown processes like hydrolysis and photolysis, metaldehyde is typically stable and highly mobile in soil. With a half-life of around two months, metaldehyde chiefly disappears from soils through aerobic biodegradation. Metaldehyde's half-life is significantly longer (>200 days) in anaerobic environments. There won't be much volatilization from soil or water surface as a result of its low vapor pressure and Henry's Law constant. Further evidence that volatilization losses from soil surfaces will be negligible comes from a laboratory volatility research. The principal byproduct of metaldehyde breakdown is acetaldehyde. After being easily oxidized to acetic acid and eventually to carbon dioxide and water, acetaldehyde is a relatively short-lived metabolite in the environment [14-21].

Carbamates Effect: Here are some benefits and drawbacks of carbamates.
Pest Control: Insects, weeds, and fungus are among the pests that carbamates effectively suppress, protecting crops and boosting agricultural output.
Selective Toxicity: When handled correctly, many carbamates are safer for both people and animals since they are not as harmful to mammals as some other pesticides are.

Drawbacks

Water Contamination: Carbamates have the ability to seep into the soil, contaminating surface water bodies through runoff or groundwater, endangering aquatic ecosystems and supplies of drinking water.
Residual Effects: Long-term exposure concerns for organisms can result from the long-term persistence of some carbamates in the environment.
Resistance Development: Using carbamates indiscriminately or over extended periods of time might cause target pests to become resistant, which eventually reduces their effectiveness.
Health Risks: Although carbamates may not offer as much of a hazard to animals as some other pesticides do, handling or exposure to them without appropriate protective gear can still be harmful to human health.
Impact on Pollinator: Since many plant species depend on bees and other pollinators for their reproduction, many carbamates may be toxic to these organisms.

Environmental Management

Several actions may be performed to lessen the harmful effects of carbamates, including:
Integrated Pest Management (IPM): Incorporating alternative control techniques like biological control, crop rotation, and habitat management can help minimize the need for chemical pesticides, including carbamates, by encouraging the adoption of IPM practices.
Regulation and Monitoring: Tight control and oversight over the use of carbamates can reduce environmental damage and guarantee their safe usage.
Educational Programs: Risqué to human health and the environment can be reduced by teaching farmers and pesticide applicators how to handle, apply, and dispose of carbamates properly.
Alternative Methods: It is possible to lessen dependency on carbamates and other chemical pesticides by promoting study into and acceptance of alternative, less hazardous pest management techniques.

Therefore, even though carbamates can be useful tools in agriculture, it is important to carefully control their usage to reduce any adverse effects on the environment. In conclusion, molluscicides can be a useful tool for controlling mollusc pests in agriculture, but their application needs to be well thought out in order to reduce any potential harm to crops, the environment, or public health. For sustainable pest control, integrated pest management solutions that combine several techniques such as cultural practices, biological controls, and sparing chemical use are frequently advised [14].

Natural Sources of Molluscicides: Molluscicides are compounds that are used to manage or eradicate molluscs, including slugs and snails, which can be disease-carrying organisms or agricultural pests. Although synthetic molluscicides are readily available, natural sources can also function as molluscicides. Here are a few instances:
Plant Extracts:
Neem (Azadirachta indica): Studies have demonstrated the molluscicide effects of neem extracts. Molluscs are poisonous to a variety of chemicals found in neem tree extracts.
Tobacco (Nicotiana spp.): Molluscs are among the many creatures that are harmful to nicotine, a component of tobacco. It is possible to employ tobacco extracts as molluscicides.
Chrysanthemum (Chrysanthemum spp.): Pyrethrins, which are naturally occurring pesticides with potential molluscicide effects, are present in some kinds of chrysanthemum.

Sources from Microbes:
Bacillus thuringiensis (bt): Although Bt is most famous for its ability to kill insects, some strains of the plant have also been shown to be effective against slugs and snails.
Pseudomonas aeruginosa: Molluscs are poisoned by certain strains of this bacterium.

Metal-based Substances:
Iron phosphate: this is a synthetic molluscicide made from natural sources, however it is generated synthetically. Iron phosphate is used in organic gardening and is thought to be environmentally benign.

Natural Minerals:
Copper: Used occasionally as molluscicides, copper compounds and salts are harmful to molluscs. For instance, natural sources can provide copper sulphate.
Lime: Also referred to as calcium hydroxide, lime is a molluscicide. It works by rupturing the molluscs ‘ mucous membranes, which results in dehydration and death.

Herbs and Plants:
Garlic (Allium sativum): Research has indicated that the garlic extracts have an effect on certain kinds of snails and slugs.
Ginger (Zingiber officinale): Certain preparations of

ginger have been reported to have some molluscicide-like properties.

Additional Resources: Predatory Species: Adding molluscs' natural predators can also act as a biological control mechanism. Ducks and several fish species consume slugs and snails as food. It's crucial to remember that, even while these natural sources can be useful molluscicides, their effectiveness may differ based on a number of variables, including the type of mollusc, concentration, and application technique. Furthermore, precautions should be made to guarantee that their use does not negatively impact the environment or non-target creatures [15]Top of Form.

Conclusion

Humans can die from schistosome and other infections linked to molluscs. Artificial substances such as metal and polyquaternary ammonium compounds, aromatic hydrocarbons, and their salts, such as niclosamide, have very sluggish rates of biodegradation, which makes them hazardous to the environment and having limited applications. Moreover, due of their illegal use, molluscs may get resistant to them. Plants can naturally regulate molluscs through secondary metabolites like as alkaloids, saponins, cardiac glycosides, and essential oils/terpenes. Because they are readily available, inexpensive, environmentally acceptable, quickly biodegrade, and perhaps most importantly because there is a lower likelihood that the molluscs will develop resistance. These appear to be the most effective strategies for managing the overabundance of molluscs. While there are no known health hazards associated with typical ambient concentrations of metaldehyde based on existing toxicity data, water corporations are becoming increasingly concerned about the use of metaldehyde-contaminated surface water to create drinkable supplies. The physical-chemical characteristics of this substance make it impossible for standard drinking water treatment methods to remove, which makes the problem especially challenging to solve.

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