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(54) **Title:** MOLLUSCICIDAL COMPOSITIONS

(57) **Abstract:** The invention discloses molluscicidal compositions for controlling snails and slugs, in particular aquatic snails and slugs in fish ponds, paddy fields and similar, by slowly releasing the molluscicide.



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MOLLUSCICIDAL COMPOSITIONS

The invention discloses molluscicidal compositions for controlling snails and slugs, in particular aquatic snails and slugs in fish ponds, paddy fields and similar, by slowly releasing the molluscicide.

BACKGROUND OF THE INVENTION

Aquatic snails and slugs, i.e. snails and slugs which live in the water, are important pests in particular in ponds for the culture of (phytophagous) fish or else in flooded crops (for example paddy fields) . They cause yield losses by depriving the fish of some of their food, or by damaging or destroying the crop plants. Since population densities of a few thousand snails and slugs per m² are not unheard of under practical conditions, it is easy to imagine that they cause considerably damage.

WO 2012/131302 A1 discloses fusion proteins based on peptide toxins as pesticides, in particular a fusion protein comprising: (i) a omega-ACTX-Hv1a protein toxin, or a fragment or variant thereof, linked to (ii) a protein capable of mediating translocation of the fusion protein from the invertebrate gut, preferably snowdrop lectin *Galanthus nivalis* agglutinin GNA.

The current state of the art molluscicidal composition J-LON-5, which is available on the market, rapidly releases the total amount of incorporated active ingredient, which gives rise to fast decomposition by microbials and to washout of the active ingredient from the target area by currents and other environmental influences.

There was a need for compositions which make an active ingredient against snails and slugs in water available for as long time as possible.

The compositions of instant invention in comparison the state of the art molluscicidal composition show a constant slow release of the active ingredient. Thus these new compositions are able to

1. offer crop protection with a single application over the whole relevant growing period;
2. reduce the maximum concentration of active ingredient in the water and thereby minimize environmental impact and loss of active ingredient;

3. reduce the overall amount of active ingredient needed to be applied for crop protection.

The following abbreviations, names and meanings are used, if not stated otherwise:

Ex example

5 iron(III) phosphate FePO_4

iron(III) pyrophosphate $\text{Fe}_4(\text{P}_2\text{O}_7)_3$

MW molecular weight

PAA Polyacrylamide

PVA Polyvinyl alcohol

10 % wt%, if not otherwise stated

$\geq$ / $\Rightarrow$ equal or greater

$\leq$ / $\Leftarrow$ equal or less

The term ingredient and component is used interchangeably, if not otherwise stated.

- 15 Especially in the tables the following meanings are used, if not otherwise stated:

CO compositions

ADD Additive

AI Active Ingredient

BA Bulking Agent

20 DI Disintegrant

FA920 FA 920 SH

FePP Ferric pyrophosphate, iron(III) pyrophosphate, $\text{Fe}_4(\text{P}_2\text{O}_7)_3$

FO4490 FO 4490 SH

LS Limestone

25 Meta Metaldehyde

MC Methyl cellulose;

MgSt Mg-stearate

NA Nicotinamide, Niacinamide

NaBI NaHCO_3

30 Nicl Niclosamide

NiclEt Niclosamide ethanolamine salt

SP Sodium propionate

WA Wetting Agent

W Water

SUMMARY OF THE INVENTION

Subject of the invention is a molluscicidal composition comprising as components

an active ingredient and

5 a disintegrant;

wherein

the active ingredient is selected from the group consisting of metaldehyde, iron(III) phosphate, iron(III) pyrophosphate, saponin, niclosamide, niclosamide ethanolamine salt, methiocarb, a fusion protein FUSP, and mixtures thereof;

10

the disintegrant is selected from the group consisting of acrylamide based polymer, methyl cellulose, waxes based on polyethylene glycol or polypropylene glycol as alcohol component, sodium salt of polymerized alkyl naphthalene sulfonic acid, and mixtures thereof;

15

FSUP comprises: (i) an omega-ACTX-Hv1a protein toxin, or a fragment or variant thereof, linked to (ii) a protein capable of mediating translocation of FUSP from an invertebrate gut.

20 **DETAILED DESCRIPTION OF THE INVENTION**

Molluscicidal composition in the sense of the invention means a composition that harms, preferably kills mollusks. Mollusks in the sense of the invention are preferably snails and slugs.

The active ingredient is a molluscicide, that is a substance active against mollusks, preferably
25 against snails and slugs.

Methiocarb is 3,5-Dimethyl-4-(methylthio)phenyl methylcarbamate with CAS 2032-65-7.

The omega-ACTX-Hv1a protein toxin is known in the art. It is a toxin isolated from the funnel-web spider *Hadronyche versuta*. The terms "omega-ACTX-Hv1a protein toxin",
30 "omega-ACTX-Hv1a toxin", "omega-ACTX-Hv1a protein" and "omega-ACTX-Hv1a" are used interchangeably herein, if not otherwise stated.

The amino acid sequence of omega-ACTX-Hv1a is SEQ ID NO:1:

SPTCIPSGQPCPYNENCCSQSCTFKENENGNTVKRCD SEQ ID NO:1

A modified form of omega-ACTX-Hv1a has a K34 alteration, using the amino acid numbering of SEQ ID NO:1; preferably, the amino acid K34 of omega-ACTX-Hv1a is substituted.

5 By "substituted" it is meant that the Lysine amino acid residue at the position 34 is replaced with another amino acid; preferably the ³⁴Lys is substituted for Glutamine (this is called herein K34Q substitution according to the numbering of SEQ ID NO: 1). The amino acid sequence of the K34Q modified omega-ACTX-Hv1a is SEQ ID NO:2:

10 SPTCIPSGQPCPYNENCCSQSCTFKENENGNTVQRCD SEQ ID NO:2

Preferably, the amino acid K34 of omega-ACTX-Hv1a protein toxin is modified.

Preferably, the omega-ACTX-Hv1a protein toxin has a K34Q substitution.

15

Preferably, the omega-ACTX-Hv1a protein toxin comprises the amino acid sequence of SEQ ID NO:1 or of SEQ ID NO:2;

more preferably, the peptide toxin to be used in FUSP has the amino acid sequence of SEQ ID NO:1 or of SEQ ID NO:2.

20

"Fragment or variant" of omega-ACTX-Hv1a includes that FUSP can comprise an amino acid sequence of omega-ACTX-Hv1a that can vary from the sequence provided in SEQ ID NO:1 or SEQ ID NO:2 with the proviso that the fragment or variant substantially retain the biological activity of the omega-ACTX-Hv1a.

25 "Variants" of a polypeptide include insertions, deletions and substitutions, either conservative or non-conservative. This also includes where the peptide sequence omits several amino acids; preferably less than 5, 4, or 3 amino acids are deleted from the sequence provided

in SEQ ID NO:1 or SEQ ID NO:2. In particular variants of the polypeptide are included where such changes do not substantially alter the omega-ACTX-Hv1a toxin activity. A

30

skilled person knows that the sequence of SEQ ID NO:1 or SEQ ID NO:2 can be altered without the loss of biological activity. In particular, single like for like changes with respect to the physio-chemical properties of the respective amino acid should not disturb the functionality, and moreover small deletions within non-functional regions of the toxin

peptide can also be tolerated and hence are considered "variants" for the purpose of the present invention.

By "conservative substitutions" is intended combinations such as Gly, Ala; Val, Ile, Leu; Asp, Glu; Asn, Gln; Ser, Thr; Lys, Arg; and Phe, Tyr.

- 5 It is particularly preferred if the variant has an amino acid sequence which has at least 75%, yet still more preferably at least 80%, in further preference at least 85%, in still further preference at least 90% and most preferably at least 95% or 97% identity with the amino acid sequence of the omega-ACTX-Hv1a toxin provided herein.

The percent sequence identity between two polypeptides may be determined using suitable
10 computer programs, for example the GAP program of the University of Wisconsin Genetic Computing Group and it will be appreciated that percent identity is calculated in relation to polypeptides whose sequence has been aligned optimally.

There are also naturally occurring homologues to the omega-ACTX-Hv1a peptide toxin which can also be used. Such homologues are considered to be "variants" as defined above.

- 15 *Hadronyche versuta* also produces the toxins omega-hexatoxin-Hv1e, omega-hexatoxin-Hv1c, omega-hexatoxin-Hv1d, and omega-hexatoxin-Hv1b which each have a very high level of sequence identity (only a few amino acid substitutions or deletions). The Sydney funnel-web spider (*Atrax robustus*) produces the peptide toxin omega-hexatoxin-Ar1d which has an identical amino acid sequence to omega-ACTX-Hv1a, and omega-hexatoxin-Ar1h and
20 omegahexatoxin-Ar1f which have a very high level of sequence identity (only a few amino acid substitutions or deletions).

- Further peptide toxins are produced by the Toowoomba funnel-web spider, *Hadronyche infensa* (omega-hexatoxin-Hi1b_10, _8, _5, _2, _1 series; omega-hexatoxin-Hi1d; omega-hexatoxin-Hi1e; omega-hexatoxin-Hi1f) and the Tasmanian funnel-web spider,
25 *Hadronyche venenata* (omega-hexatoxin-Hvn1b_6, _4, _3, _2, _1 series) and the Northern tree-dwelling funnel-web spider *Hadronyche formidabilis* (omega-hexatoxin-Hf1a). The peptide toxins listed above have only a few amino acid substitutions or deletions to the amino acid sequence for the omega-ACTX-Hv1a peptide toxin of SEQ ID NO:1 or SEQ ID NO:2. Therefore each of these peptides toxins are considered to be
30 homologous peptides to the omega-ACTX-Hv1a peptide toxin of SEQ ID NO:1 or SEQ ID NO:2 and hence can be used in FUSP, and are embodiments of the invention.

Further information concerning homologous peptide toxins may be found in the GenBank database. The ArachnoServer database is also very helpful (www.arachnoserver.org) as it includes information regarding a large number of spider toxins, arranged by toxin type

and species. From the information provided in the databases above and by using the well-known BLAST search, the skilled person can readily identify additional peptide toxins that can be used.

5 Preferably, the first and second portions (i) and (ii) of FUSP are linked together by genetic or biochemical means and so, in the first instance, by at least one linking amino acid residue or peptide or, in the second instance, by a covalent or non-covalent bond or bonds or other linking moiety. Where a peptide is used to link said members together the number of amino acid residues in the peptide is variable, and is determined by the distance between
10 the relevant ends of each member necessary to allow FUSP to be in a biologically active conformation. The portions of FUSP may be reversibly linked by means adapted to dissociate and release the toxic agent in situ in an invertebrate gut or circulatory system, for example on being metabolised by an invertebrate animal or may be irreversibly linked, depending on the form of the toxic agent.

15

The second portion of FUSP aids passage of the toxic member through the invertebrate gut, this allowing the protein to move to a site of toxicity in the invertebrate animal. The second portion can be considered as a translocating moiety that is capable of acting as a carrier to translocate the first portion across the gut wall of an invertebrate animal. Thus,
20 FUSP can be used as a pesticide by delivering a toxin to a site of toxicity in an invertebrate pest animal.

The protein capable of mediating translocation of FUSP from the invertebrate gut preferably mediates the translocation of FUSP from the invertebrate gut to the circulatory system of
25 an invertebrate animal, preferably of insects, molluscs and nematodes, more preferably of moluscs.

Suitable proteins capable of mediating translocation of FUSP from the invertebrate gut include plant lectins.

30 Generally any lectin that binds to invertebrate gut can be used.

Preferably, the protein capable of mediating translocation of FUSP from the invertebrate gut is a plant lectin selected from any one or more of the following: snowdrop lectin *Galanthus nivalis* agglutinin (GNA), garlic lectin *Allium sativum*, pea lectin *Pisum sativum* (P-lec),

peanut lectin *Arachis hypogaea*, french bean lectin (PHA, *Phytohaemagglutinin*), or fragments, variants or derivatives thereof.

"Fragment or variant" of the plant lectin includes that the amino acid sequence of the particular lectin protein can differ from that known in the art and that naturally occurring, with the proviso that the fragment or variant substantially retain the biological activity of the lectin, i.e. be capable of mediating translocation of FUSP from the invertebrate gut.

Preferably, the lectin is GNA.

In example for the amino acid sequence of GNA is SEQ ID NO:3:

DNILYSGETLSTGEFLNYGSFVFIMQEDCNLVLYDVKPIWATNTGGLSRSCFLSMQT
DGNLVVYNPSNKPIWASNTGGQNGNYVCILQKDRNVVIYGTDRWATG

Preferably, the GNA comprises the amino acid sequence of SEQ ID NO:3.

Preferably, FUSP further comprises an affinity tag to aid purification.

The use of short amino acid tag sequences to aid the affinity purification of recombinant proteins is well known in the art. Indeed, many commercially available protein expression constructs include nucleic acid sequences encoding such tags. The protein of interest is inserted into the expression construct in such a manner that the affinity tag is linked to said protein. A variety of different affinity tags are known in the art, including chitin binding protein (CBP), maltose binding protein (MBP), glutathione-S-transferase (GST), and the His-tag.

A polyhistidine-tag is an amino acid motif in proteins that consists of at least five histidine (His) residues, often at the N- or C-terminus of the protein. It is also known as hexa histidine-tag, 6xHis-tag, and by the trademarked name His-tag®. They are a well known affinity tag and methods of introducing His-tags to recombinant proteins are known in art, as are routine methods of purifying proteins with His-tags.

Preferably, the affinity tag is a His tag.

In one embodiment, the second portion, which is preferably GNA, is located at the N-terminus of the omega-ACTX-Hv1a protein toxin. Hence such a FUSP has the arrangement: NH₂-(GNA: omega-ACTX-Hv1a)-COOH, such as the peptide with SEQ ID NO: 4:

5 DNILYSGETLSTGEFLNYGSFVFIMQEDCNLVLYDVKPIWATNTGGLSRSCFLSMQT
DGNLVVYNPSNKPIWASNTGGQNGNYVCILQKDRNVVIYGTDRWATGAAASPTCIPS
GQPCPYNENCCSQSCTFKENENGNTVKRCDVDHHHHHH SEQ ID NO:4

10 The peptide of SEQ ID NO:4 has a six amino acid HIS tag placed at the C-terminus. The HIS tag can be used to aid recovery of FUSP when prepared as part of a recombinant protein expression system. However, the presence of the HIS tag is optional and therefore a variant of SEQ ID NO:4 can include that peptide sequence without the HIS tag.

15 In another embodiment, FUSP is NH₂-(GNA: MODIFIED omega-ACTX-Hv1a)-COOH with SEQ ID NO:5:

HHHHHHDNILYSGETLSTGEFLNYGSFVFIMQEDCNLVLYDVKPIWATNTGGLSRSC
FLSMQTDGNLVVYNPSNKPIWASNTGGQNGNYVCILQKDRNVVIYGTDRWATGAAA
SPTCIPSGQPCPYNENCCSQSCTFKENENGNTVQRCD SEQ ID NO:5
20

In this embodiment the HIS tag placed at the N-terminus. Similar to SEQ ID NO:4, the HIS tag is optional and therefore a variant of SEQ ID NO:5 can include that peptide sequence without the HIS tag.

25 Also, SEQ ID NO:5 includes the modified amino acid sequence of omega-ACTX-Hv1a, i.e. having a K34Q substitution as discussed above and as provided in SEQ ID NO:2.

30 The location of omega-ACTX-Hv1a at the N-terminus relative to GNA in FUSP can have a greater pesticide effect, hence this arrangement is a preferred embodiment of the invention.

Therefore a preferred embodiment of the invention is wherein the GNA peptide is located at the C-terminus of the omega-ACTX-Hv1 a protein toxin, such as the FUSP arrangements:

NH₂-(omega-ACTX-Hv1a: GNA)-COOH with SEQ ID NO:6:

ASPTCIPSGQPCPYNENCCSQSCTFKENENGNTVKRCDAAADNILYSGETLSTGEFLNY
 GSFVFIMQEDCNLVLYDVDKPIWATNTGGLSRSCFLSMQTDGNLVVYNPSNKPIWAS
 5 NTGGQNGNYVCILQKDRNVVIYGTDRWATG SEQ ID NO:6

NH₂-(omega-ACTX-Hv1a: GNA: HIS)-COOH with SEQ ID NO:7:

ASPTCIPSGQPCPYNENCCSQSCTFKENENGNTVKRCDAAADNILYSGETLSTGEFLNY
 10 GSFVFIMQEDCNLVLYDVDKPIWATNTGGLSRSCFLSMQTDGNLVVYNPSNKPIWAS
 NTGGQNGNYVCILQKDRNVVIYGTDRWATGVDHHHHHH SEQ ID NO:7

In this embodiment the HIS tag placed at the C-terminus. Similar to SEQ ID NO:4, the HIS
 tag is optional.

15

NH₂-(MODIFIED omega-ACTX-Hv1a: GNA)-COOH with SEQ ID NO:8:

ASPTCIPSGQPCPYNENCCSQSCTFKENENGNTVQRCDAAADNILYSGETLSTGEFLNY
 GSFVFIMQEDCNLVLYDVDKPIWATNTGGLSRSCFLSMQTDGNLVVYNPSNKPIWAS
 20 NTGGQNGNYVCILQKDRNVVIYGTDRWATG SEQ ID NO:8

Also, SEQ ID NO:8 includes the modified amino acid sequence of omega-ACTX-Hv1a, i.e.
 having a K34Q substitution as discussed above and as provided in SEQ ID NO:2.

25 NH₂-(MODIFIED omega-ACTX-Hv1a: GNA: HIS)-COOH with SEQ ID NO:9:

ASPTCIPSGQPCPYNENCCSQSCTFKENENGNTVQRCDAAADNILYSGETLSTGEFLNY
 GSFVFIMQEDCNLVLYDVDKPIWATNTGGLSRSCFLSMQTDGNLVVYNPSNKPIWAS
 NTGGQNGNYVCILQKDRNVVIYGTDRWATGHHHHHH SEQ ID NO:9

30

In this embodiment the HIS tag placed at the C-terminus. FUSP with in SEQ 10 NO:9 is a
 particularly preferred embodiment of the invention

SEQ ID NOs 1 to 9 have been copied from WO 2012/131302 A1, in case of a typo or discrepancy the version of the sequences as published in WO 2012/131302 A1 prevails.

Preferably, FUSP comprises the amino acid sequence of any of SEQ ID NOs 4, 5, 6, 7, 8 or 9.

5

Preferably, the omega-ACTX-Hv1a protein toxin is linked to the N-terminus of the protein capable of mediating translocation of FUSP from the invertebrate gut.

Preferably, FUSP comprises the amino acid sequence of any of SEQ ID NOs 6, 7, 8 or 9.

10

FUSP may be presented as a substantially purified form or preparation. By "purified" is meant that FUSP has been at least partially separated from other components in the presence of which it has been formed, for example other components of a recombinant cell. Methods of purification are known to the skilled person.

15

The form or preparation of FUSP may be substantially pure. By "substantially pure" it is meant that the FUSP is substantially free of other proteins. Thus, any form or preparation of FUSP is included that includes at least 30% of the protein content by weight as FUSP, preferably at least 50%, more preferably at least 70%, still more preferably at least 90% and most preferably at least 95% of the protein content is FUSP, based on the total weight of the form or preparation of FUSP.

20

Thus, FUSP includes compositions comprising the said FUSP and a contaminant wherein the contaminant comprises less than 70% of the composition by weight, preferably less than 50% of the composition, more preferably less than 30% of the composition, still more preferably less than 10% of the composition and most preferably less than 5% of the composition by weight.

25

The invention also includes the substantially pure FUSP when combined with other components ex vivo, said other components not being all of the components found in the cell in which said polypeptides are found.

30

Methods for preparation for FUSP are known.

Preferably, the active ingredient is metaldehyde.

Preferably, the composition has the form of a homogeneous mixture of its components.

The acrylamide based polymer, in the sense of the invention, is selected from the group consisting of polyacrylamide, copolymer of acrylic acid and acrylamide, and mixtures thereof.

- 5 Polyacrylamide can be a non-ionic, a cationic or a anionic polyacrylamide, preferably it is a non-ionic or a cationic polyacrylamide; more preferably it is a non-ionic polyacrylamide.

Preferably, the wax based on polyethylene glycol or polypropylene glycol as alcohol component have as acid component a carboxylic acid; the carboxylic acid is preferably a
10 C₉₋₂₆ fatty acid;

more preferably, the wax based on polyethylene glycol or polypropylene glycol as alcohol component are polyethylene glycol mono stearate or polyethylene glycol mono oleate.

Preferably, the disintegrant is acrylamide based polymer, sodium salt of polymerized alkyl
15 naphthalene sulfonic acid, or a mixture thereof.

Additionally to any other components, the composition can comprise a bulking agent; the bulking agent is selected from the group consisting of phyllosilicate, calcium carbonate, silica, starch, limestone, and mixtures thereof.

20

Phyllosilicates can be clays and clay minerals. Examples are kaolin, bentonite and their components kaolinite and montmorillonite. One type of kaolin is commercially available under the name "bolus alba". The preferred phyllosilicate is kaoline.

- 25 Starch can be used as such or as pregelatinised starch, preferably as pregelatinised starch.

Preferably, the bulking agent is selected from the group consisting of phyllosilicate, calcium carbonate, limestone, and mixtures thereof.

- 30 Preferably, the composition comprises the active ingredient, the disintegrant and the bulking agent; also in combination with the embodiments of these three components.

In one more preferred embodiment the composition comprises the active ingredient metaldehyde, the disintegrant acrylamide based polymer, sodium salt of polymerized

alkyl naphthalene sulfonic acid or a mixture of acrylamide based polymer and sodium salt of polymerized alkyl naphthalene sulfonic acid, and the bulking agent phyllosilicate, calcium carbonate, limestone, or mixtures thereof;

more preferably, the composition comprises the active ingredient metaldehyde, the

5 disintegrant acrylamide based polymer, and the bulking agent phyllosilicate, calcium carbonate or mixtures thereof;

even more preferably, the composition comprises the active ingredient metaldehyde, the disintegrant acrylamide based polymer, and the bulking agent phyllosilicate.

10 Additionally to any other components, the composition can comprise a wetting agent; the wetting agent is water or polyvinyl alcohol, preferably the wetting agent is water.

More preferably, the composition comprises the active ingredient, the disintegrant, the bulking agent and the wetting agent; also in combination with the embodiments of these four
15 components.

In one more preferred embodiment the composition comprises the active ingredient metaldehyde, the disintegrant acrylamide based polymer, sodium salt of polymerized alkyl naphthalene sulfonic acid or a mixture of acrylamide based polymer and sodium salt
20 of polymerized alkyl naphthalene sulfonic acid, the bulking agent phyllosilicate, calcium carbonate, limestone, or mixtures thereof, and the wetting agent.

In one especial embodiment, the composition comprises the active ingredient metaldehyde, the disintegrant acrylamide based polymer, the bulking agent phyllosilicate or calcium
25 carbonate, and the wetting agent water.

In another especial embodiment, the composition comprises the active ingredient metaldehyde, the disintegrant sodium salt of polymerized alkyl naphthalene sulfonic acid, the bulking agent phyllosilicate, limestone, or mixtures thereof, and the wetting agent polyvinyl alcohol.

30

Additionally to any other components, the composition can comprise an additive; the additive is selected from the group consisting of sodium propionate, magnesium stearate, nicotinamide, sodium bicarbonate, and mixtures thereof.

Preferably, the additive is selected from the group consisting of sodium propionate, magnesium stearate, sodium bicarbonate, and mixtures thereof.

In another preferred embodiment, the composition comprises the active ingredient
5 metaldehyde, the disintegrant acrylamide based polymer, and the bulking agent
phyllosilicate, calcium carbonate or mixtures thereof, and the additive sodium propionate,
magnesium stearate or mixtures thereof;

in a more preferably, the composition comprises the active ingredient metaldehyde, the
disintegrant acrylamide based polymer, the bulking agent phyllosilicate, and the additive
10 sodium propionate.

In another more preferred embodiment, the composition comprises the active ingredient
metaldehyde, the disintegrant acrylamide based polymer, and the bulking agent
phyllosilicate, calcium carbonate or mixtures thereof, the additive sodium propionate,
15 magnesium stearate or mixtures thereof, and the wetting agent water;

in a more preferably, the composition comprises the active ingredient metaldehyde, the
disintegrant acrylamide based polymer, the bulking agent phyllosilicate, the additive
sodium propionate, and the wetting agent water.

20 Additionally to any other components, the compositions can comprise known anti mold
agents, such as C₁₋₁₀ alkyl isothiazolinon, 2-butyl-1,2-benzisothiazolin-3-one, phenoxy
ethanol, zinc pyrithion and the like.

Preferably, the C₁₋₁₀ alkyl isothiazolinon is a C₁₋₁₀ alkyl 4-isothiazolin-3-on, more preferably it
is selected from the group consisting of methylisothiazolinon, butylisothiazolinon, and
25 octylisothiazolinon.

Further known anti mold agents are published in the book Microbicides for the Protection of
Materials, edited by W. Paulus, Springer; 2005 edition.

The additive sodium propionate shows also anti mold activity.

30 Preferably, the composition comprises
the active ingredient in an amount of from 7 to 60 wt%, the wt% being based on the total
weight of the composition.

More preferably, the composition, when it comprises metaldehyde, comprises metaldehyde in an amount of from 7 to 55 wt%, the wt% being based on the total weight of the composition.

Embodiments of the possible ranges of the amount of metaldehyde are: 7.5 to 52.5 wt%, 7.5 to 32.5 wt% and 7.5 to 25 wt% of metaldehyde, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises iron(III) phosphate, comprises iron(III) phosphate in an amount of from 5 to 15 wt%, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises metaldehyde and iron(III) phosphate, comprises metaldehyde in an amount of from 10 to 25 wt% and iron(III) phosphate in an amount of from 5 to 15 wt%, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises niclosamide, comprises niclosamide in an amount of from 15 to 30 wt%, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises niclosamide ethanolamine salt, comprises niclosamide ethanolamine salt in an amount of from 15 to 30 wt%, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises iron(III) pyrophosphate, comprises iron(III) pyrophosphate in an amount of from 10 to 30 wt%, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises saponin, comprises saponin in an amount of from 17.5 to 52.5 wt%, the wt% being based on the total weight of the composition.

More preferably, the composition, when it comprises FUSP, comprises FUSP in an amount of from 20 to 30 wt%, the wt% being based on the total weight of the composition.

Preferably, the composition comprises

the disintegrant in an amount of from 5 to 80 wt%, the wt% being based on the total weight of the composition.

Preferably, when a bulking agent is present in the composition, then the composition

5 comprises the bulking agent in an amount of from 1 to 70 wt%, the wt% being based on the total weight of the composition.

Preferably, when an additive agent is present in the composition, then the composition

10 comprises the additive in an amount of from 1 to 15 wt%, the wt% being based on the total weight of the composition.

Preferably, when a wetting agent is present in the composition, then the composition

comprises the wetting agent in an amount of from 0.5 to 75 wt%;

more preferably, when a wetting agent is present in the composition, then the composition

15 comprises the wetting agent in an amount of from 20 to 75 wt% in case the wetting agent is water, or in an amount of from 0.5 to 3 wt% in case the wetting agent is polyvinyl alcohol, the wt% being based on the total weight of the composition.

Preferably, the composition comprises

20 the active ingredient in an amount of from 7.5 to 52.5 wt%,
the disintegrant in an amount of from 0.5 to 20 wt%,
the bulking agent in an amount of from 7.5 to 70 wt%,
the wetting agent in an amount of from 0.5 to 70 wt%;
the wt% being based on the total weight of the composition.

25

More preferably, the composition comprises

the active ingredient in an amount of from 7.5 to 32.5 wt%,
the disintegrant, in case that the disintegrant is acrylamide based polymer, in an amount of
from 5 to 20 wt%, or

30 the disintegrant in case that the disintegrant is sodium salt of polymerized alkyl naphthalene sulfonic acid, in an amount of from 0.5 to 2 wt%,

the bulking agent, in case that the disintegrant is acrylamide based polymer, in an amount of
from 7.5 to 30 wt%, or

the bulking agent, in case that the disintegrant is sodium salt of polymerized alkyl naphthalene sulfonic acid, in an amount of from 25 to 70 wt%,
the wetting agent, in case that the wetting is water, in an amount of from 20 to 75 wt%, or
the wetting agent, in case that the wetting is s polyvinyl alcohol, in an amount of from 0.5 to 3
5 wt%;
the wt% being based on the total weight of the composition,

- In an even more preferred embodiment, the composition comprises
the active ingredient in an amount of from 7.5 to 32.5 wt%,
10 the disintegrant as acrylamide based polymer in an amount of from 5 to 20 wt%,
the bulking agent in an amount of from 7.5 to 30 wt%,
the wetting agent as water, in an amount of from 20 to 75 wt%;
the wt% being based on the total weight of the composition.
- 15 In another even more preferred embodiment, the composition comprises
the active ingredient in an amount of from 7.5 to 32.5 wt%,
the disintegrant as sodium salt of polymerized alkyl naphthalene sulfonic acid in an amount of
from 0.5 to 2 wt%,
the bulking agent in an amount of from 25 to 70 wt%,
20 the wetting agent as polyvinyl alcohol in an amount of from 0.5 to 3 wt%;
the wt% being based on the total weight of the composition.

- In an especially preferred embodiment, the composition comprises
the active ingredient in an amount of from 10 to 30 wt%,
25 the disintegrant as acrylamide based polymer in an amount of from 7 to 17 wt%,
the bulking agent in an amount of from 10 to 30 wt%,
the wetting agent as water, in an amount of from 25 to 55 wt%;
the wt% being based on the total weight of the composition.

- 30 In an especially preferred embodiment, the composition comprises
the active ingredient in an amount of from 10 to 30 wt%,
the disintegrant as acrylamide based polymer in an amount of from 7 to 17 wt%,
the bulking agent in an amount of from 10 to 30 wt%,
the wetting agent as water, in an amount of from 25 to 55 wt%;

the additive, preferably as sodium propionate, in an amount of from 5 to 10 wt%;
the wt% being based on the total weight of the composition.

In an especially preferred embodiment, the composition contains
5 the active ingredient in an amount of from 7.5 to 32.5 wt%,
the disintegrant as acrylamide based polymer in an amount of from 5 to 20 wt%,
the bulking agent in an amount of from 7.5 to 30 wt%,
the wetting agent as water, in an amount of from 20 to 75 wt%;
the wt% being based on the total weight of the composition, and the amount of the
10 components relative to each other is chosen in such a way that the wt% add up to 100%.

In an especially embodiment, the composition contains
the active ingredient in an amount of from 7.5 to 32.5 wt%,
the disintegrant as sodium salt of polymerized alkyl naphthalene sulfonic acid in an amount of
15 from 0.5 to 2 wt%,
the bulking agent in an amount of from 25 to 70 wt%,
the wetting agent as polyvinyl alcohol in an amount of from 0.5 to 3 wt%;
the wt% being based on the total weight of the composition, and the amount of the
components relative to each other is chosen in such a way that the wt% add up to 100%.

20 In an especially preferred embodiment, the composition contains
the active ingredient in an amount of from 10 to 30 wt%,
the disintegrant as acrylamide based polymer in an amount of from 7 to 17 wt%,
the bulking agent in an amount of from 10 to 30 wt%,
25 the wetting agent as water, in an amount of from 25 to 55 wt%;
the additive, preferably as sodium propionate, in an amount of from 5 to 10 wt%;
the wt% being based on the total weight of the composition, and the amount of the
components relative to each other is chosen in such a way that the wt% add up to 100%.

30 Further possible ranges of the amounts of the components in the compositions are shown in
Table 4, preferred ranged are those of the compositions Ka1, Ka2, Ca1, G1A, G1B, G1C
and G1D.

			Table 4							
CO	AI	[g]	BA	[g]	DI	[g]	ADD	[g]	WA	[g]
Ka1	Meta	10 to 49	Kaoline	10 to 26	FA920	6.17 to 12.55	SP	1 to 14	W	26 to 62.5
KaFe1	Meta	12.1 to 23.2	Kaoline	12.1 to 23.2	FA920	7.25 to 15.15	SP	6.1 to 11.6	W	23.2 to 48.5
	FePO ₄	6.1 to 11.6								
Ka2	Meta	10 to 49	Kaoline	10 to 26	FO4490	6.17 to 12.55	SP	5	W	62.5
Ni1	Nicl	23.19	Kaoline	23.19	FA920	7.26	SP	11.5	W	34.78
Ni2	NiclEt	23.19	Kaoline	23.19	FA920	7.26	SP	11.5	W	34.78
Pa1	Meta	10	---		FA920	12.5	SP	5	W	72.5
Pa2	Meta	10	---		FO4490	12.5	SP	5	W	72.5
Ca1	Meta	10 to 49	CaCO ₃	10 to 26	FA920	6.17 to 12.55	SP	1 to 14	W	26 to 62.5
Si1	Meta	10 to 12.9	Silica	10 to 12.9	FA920	12.5 to 16.13	SP	5 to 6.45	W	51.6 to 62.5
St1	Meta	7 to 28	Stygel	1.75	FA920	7 to 17.5	---		W	30 to 54.25
2A	Meta	20	---		MC	78	MgSt	2	---	---
4A	Meta	20	CaCO ₃	20	MC	58	MgSt	2	---	---
8A	Meta	20	CaCO ₃	40	MC	38	MgSt	2	---	---
10A	Meta	20	CaCO ₃	70	MC	8	MgSt	2	---	---
W1A	Meta	50	---	---	Peg400	50	---		---	---
W1B	Meta	50	---	---	Peg50	50	---		---	---
G1A	Meta	30	LS	38	Dar670	1	---		PVA	1
			Kaoline	27						
			Sipernat	1						
G1B	Meta	30	LS	38	Dar670	1	NA	2	PVA	1
			Kaoline	27						
			Sipernat	1						
G1C	Meta	30	LS	38	Dar670	1	NaBI	2	PVA	1
			Kaoline	27						

			Sipernat	1						
G1D	Meta	30	LS	65	Dar670	1	NA	2	PVA	1
			Sipernat	1			NaBI	2		

Preferably, the compositions Ka1, Ka2, Ca1, W1A, W1B, G1A, G1B, G1C and G1D in Table 4 can contain FePP or a combination of Meta and FePP instead of the active ingredient stated in Table 4.

5

Further subject of the invention is a method for preparation of the molluscicidal compositions, the method comprises a premixing of the components to provide a premixture and comprises a shaping of a premixture of the components, with the molluscicidal compositions as defined herein, also with all its embodiment.

10 The shaping is preferably done by pressing or cutting or first pressing and then cutting a premixture of the components into shape.

In case that a wetting agent is part of the composition, the wetting agent can be mixed with the other components in the premixing providing the premixture, or a first premixture is
 15 prepared by mixing the components except for the wetting agent, and then the wetting agent is mixed with the first premixture to provide a second premixture containing the wetting agent, this second premixture then is pressed or cut into shape. If the composition is damp or moist after the shaping then the composition is dried after shaping. This can be especially the case when a wetting agent is part of the composition. The final
 20 compositions are dry.

Preferably, the mixing is done in such a way that any premixture and any composition obtained from the premixture is a homogeneous mixture of the components.

For the mixing any known mixer can be used that is capable of mixing dry substances or that
 25 is capable of mixing pastes or doughs, this especially when a wetting agent is part of the composition. Possible mixers are for example extruders.

For the shaping by pressing or cutting any device can be used that is capable of pressing into shape a powder, a dough or a paste.

Preferably, the device used for mixing and shaping is a device that does both steps
 30 simultaneously or at least consecutively, such as a granulating or pelleting device.

Examples suitable granulating or pelleting devices for both steps, the mixing and the shaping, are the commercially discs and drums as supplied by various manufacturers, such as

Eirich. Good results are achieved using the devices termed Eirich mixer/granulator. Using these, it is possible to make do with small amounts of wetting agent and thus to reduce the time and energy required for drying.

Drying is preferably carried out at a low temperature to avoid decomposition of any components, such as metaldehyde, which is heat-sensitive.

The final compositions are provided after the shaping and optionally the drying in form of cubes, granules, pellets, tablets, and the like.

Therefore another subject of the invention is composition as defined herein in form of cubes, granules, pellets, tablets.

The diameter or the longest dimension of the final compositions is preferably between 1 mm and 15 mm, more preferably 3 mm and 10 mm.

Further subject of the invention is the use of the molluscicidal composition for controlling aquatic snails and slugs, with the molluscicidal compositions as defined herein, also with all its embodiment.

This control is done by application of the compositions to the water surface.

Further subject of the invention is a method for controlling aquatic snails and slugs, wherein the molluscicidal compositions are applied to the water surface, with the molluscicidal compositions as defined herein, also with all its embodiment.

The controlling of aquatic snails and slugs is in particular done in fish ponds or paddy fields.

The compositions act by releasing the active substance while being submerged under the water and lying on the ground. Therefore the components of the compositions are chosen in such a way that the final compositions after shaping show a density of greater than 1 in order to sink after the application to the water surface to the ground.

The rate of application depends, inter alia, on the size of the pest population and is, as a rule, from 0.1 to 10 g /m², preferably 0.1 to 1 g/m² (1 to 100 kg/ha, preferably, 1 to 10 kg/ha) based on the amount of active ingredient.

Examples**Compositions**

Table 1 gives the list of materials.

Table 1				
Name	Product identifier	Specification	Description	Source
Meta	Meta® Metaldehyde 2,4,6,8- Tetramethyl- 1,3,5,7-tetraoxa- cyclooctane	> 98 wt%	-----	Lonza Ltd
FePO₄	Iron (III) phosphate dihydrate FePO ₄ x 2H ₂ O	Fe: 29%	white powder	Sigma- Aldrich Co. LLC
FePP	Fe ₄ (P ₂ O ₇) ₃ ; Diphosphoric acid iron(III) salt; Ferric pyrophosphate; iron(III) pyrophosphate	Iron content: 10.5 to 12.5%	Light Yellow to Very Dark Yellow and Light Green to Very Dark Green and Yellow- Green and Green-Yellow Crystals	Sigma- Aldrich Co. LLC
Sap	Saponin	Sapogenin: 8 to 25%	Extracted from natural resources	Sigma- Aldrich Co. LLC
NicI	Niclosamide	Appearance: Light yellow powder; Niclosamide: ≥ 98.0%; 5-Chlorosalicylic acid: ≤ 0.1%; 2-Chloro-4- nitro aniline: ≤ 0.1%; pH value: 6.0 to 9.0; Moisture: ≤ 0.5%		Nantong Luosen Chemical Co., Ltd.
NicIEt	Niclosamide ethanolamine salt	Appearance: Yellow uniform loose powder; Niclosamide ethanolamine salt: ≥ 98.0%; Moisture:		Nantong Luosen Chemical Co., Ltd.

		<= 1.0%; pH value: 6.0 to 9.0		
Kaoline	Kaoline clay	X-Ray Diffraction Conforms to Structure Loss on Drying: < 2.0 wt% pH: 3.5 - 5.0	Appearance (Color): White to Light Yellow Appearance (Form): Powder	Sigma- Aldrich Co. LLC
CaCO ₃		Appearance (Color): White; Appearance (Form): Powder; Solubility (Turbidity): Clear; Solubility (Color): Colorless; Purity Titration by EDTA: >= 99.0 %		Sigma- Aldrich Co. LLC
Silica	Silica gel, high-purity grade	pore size 60 Angstrom; 220 to 240 mesh 35 to 75 micro meter		Fluka
Stygel	Stygel T		Pregelatinised Starch	Tongaat Hulett, South Africa
LS	Limestone	0.1 to 0.6 mm particle size		FOB Alabaster, Al, US (Southern Clay Brick)
FA920	FA 920 SH; FLOPAM; PAA	Form: powder; MW: high	Non-ionic polyacrylamide	SNF Floerger, France
FO4490	FO 4490 SH; FLOPAM; PAA	Form: powder; MW: very high	Cationic polyacrylamide	SNF Floerger, France
MC	Methyl cellulose; microcrystalline, average particle size 50 micro meter	Loss on drying <= 1.5 %; Residue after ignition <= 0.05 %; Heavy metals (as Pb) <= 10 ppm; pH 5 to 7; Particle size <= 1		Acros Organics (as Thermo Fisher Scientific Inc.)

		% (> 250 micrometer), <= 30 % (> 75 micrometer), >=50 % (> 32 micrometer); Appearance (Color): White Appearance (Form): Crystalline powder Infrared spectrometry: Authentic		
Peg400	Pegosperse 400 DS	Acid Value: 10 Max.; Saponification Value: 115 to 125%; Moisture: 1 Max.; Color, Gardner 1963: 1 Max.; Melting Point: 33°C; Appearance at 25°C: Solid; pH (5%): 5 HLB: 8	polyethylene glycol mono oleate; nonionic and compatible with cationic, amphoteric, anionic, and nonionic surface active agents	Lonza Ltd
Peg50	Pegosperse 50 MS	Acid Value: 5; Saponification Value: 180 to 190%; Moisture: 0.5; Color, Gardner 1963: 2 Max.; Appearance at 25°C: Beads; pH (5%): 5.8; HLB (hydrophilic-lipophilic balance): 2	polyethylene glycol mono stearate; nonionic and compatible with cationic, amphoteric, anionic, and nonionic surface active agents	Lonza Ltd
Dar670	DARVAN® 670	Color, Gardner, 1% Solution: 4 maximum; pH, 1% Solution: 8.0 to 10.5; Total Solids : 92.0% minimum; Moisture Content: 8.0% maximum	Composition: Sodium salts of polymerized alkyl naphthalene sulfonic acids Physical State: Amber powder	Vanderbilt Minerals, LLC
Sipernat	SIPERNAT® 22 LS	Specific surface area (N ₂): 175 m ² /g;	(highly disperse precipitated silica	Evonik Industries AG

		Mean particle size: 3 micro meter; Particle size, d50: 8 micro meter; Tamped density: 70 g/l; Loss on drying: 6%; Loss on ignition: 5%; pH value: 6.2; DBP absorption: 265 g / 100 g; SiO ₂ content: 98%; Na content as Na ₂ O: 1%; Fe content as Fe ₂ O ₃ : 0.03%; Sulfate content as SO ₃ : 0.8%; Sieve residue 45 micro meter Spray: 0.0%		
SP	Sodium propionate $\text{CH}_3\text{CH}_2\text{COONa}$	Appearance (Color): White; Appearance (Form): Powder; Solubility (Color): Colorless to Very Faint Yellow; Solubility (Turbidity): Clear 1 g/ml, H ₂ O; Titration with HClO ₄ : > 99.0%		Sigma- Aldrich Co. LLC
MgSt	Mg-stearate 3.8 to 5.0% Mg	Titration Complexometric 3.8 to 5.0 % (Mg) On dried substance; GC >=40.0 % relative content of stearic acid,	Appearance (Color): White to almost white Appearance (Form): Powder Infrared spectrometry: Authentic	Acros Organics (as Thermo Fisher Scientific Inc.)

		>=90.0 % rel. content of stearic and palmitic acid; Loss on drying <= 6 % (1 g, 105°C); Heavy metals (as Pb) <= 40 ppm, Cd <= 3 ppm, Ni <= 5 ppm, Pb <=10 ppm; Cl <= 1000 ppm; SO ₄ <=1 %		
NA	Nicotinamide; Niacinamide	content >= 98 %; pH: 6.0 to 7.5 (50g/L; 20°C)	White powder; technical quality	Lonza Ltd
NaBI	NaHCO ₃	NH ₄ : <= 5 ppm; Appearance (Color): White; Appearance (Form): Powder; Content: 99.7 to 100.3%; Ca: <= 0.02%; Cl: <= 0.003%; Heavy Metals: <= 5 ppm; Insoluble Matter: <= 0.015%; Fe: <= 0.001%; Mg: <= 0.005%; PO ₄ : <= 0.001%; K: <= 0.005%		Sigma- Aldrich Co. LLC
W	Water		Deionized water	Lonza Ltd
PVA	SELVOL™ E 103; Polyvinyl alcohol	Viscosity (cps): 3.5 – 4.5; Degree of Hydrolysis Mol %: 98.0 - 98.8; Ash wt%: 1.2 Max.; Volatile wt %: 5.0 Max.; pH: 5.0 - 7.0; Methanol wt%: 0.9 Max; VOC wt%: 1.0 Max		Sekisui Chemical Co., Ltd

Preparation of Compositions

If not stated otherwise, the compositions were prepared in the following manner:

The active ingredient, bulking agent, disintegrant, and additive (as was the case and as indicated in table 2) were premixed in the respective quantities to yield a homogenous premixture. The resulting premixture was either directly pressed and/or cut in shape into shape, or optionally the premixture was mixed with a wetting agent to yield a homogenous mixture that was subsequently pressed and/or cut in shape.

Mixing was done in a beaker and shaping was done either with a cake form or by pressing the mixture through a nozzle and then cutting into shape.

Table 2 shows the details of the different compositions.

Table 2										
CO	AI	[g]	BA	[g]	DI	[g]	ADD	[g]	WA	[g]
1	Meta	10	Kaoline	10	FA920	12.5	SP	5	W	62.5
2	Meta	26.23	Kaoline	26.2	FA920	8.2	SP	13.11	W	26.23
3	Meta	20.51	Kaoline	20.5	FA920	12.82	SP	5.13	W	41.03
4	Meta	28.07	Kaoline	28.0	FA920	8.78	SP	7.02	W	28.07
5	Meta	24.62	Kaoline	24.6	FA920	7.69	SP	6.15	W	36.92
6	Meta	18.18	Kaoline	36.3	FA920	5.45	SP	3.64	W	36.36
7	Meta	26.67	Kaoline	26.6	FA920	4.00	SP	2.67	W	40.00
8	Meta	34.09	Kaoline	22.7	FA920	3.41	SP	5.68	W	34.09
9	Meta	34.09	Kaoline	22.7	FO4490	3.41	SP	5.68	W	34.09
10	Meta	44.12	Kaoline	14.7	FA920	4.41	SP	7.35	W	29.41
11	Meta	44.12	Kaoline	14.7	FO4490	4.41	SP	7.35	W	29.41
12	Meta	40.82	Kaoline	20.4	FA920	3.06	SP	5.10	W	30.61
13	Meta	40.82	Kaoline	20.4	FO4490	3.06	SP	5.10	W	30.61
14	Meta	12.90	Kaoline	12.9	FA920	16.13	SP	6.45	W	51.61
15	Meta	12.90	Kaoline	12.9	FO4490	16.13	SP	6.45	W	51.61
16	Meta	19.51	Kaoline	19.5	FA920	12.20	SP	9.76	W	39.02

17	Meta	19.51	Kaoline	19.5	FO4490	12.20	SP	9.76	W	39.02
18	Meta	45.45	Kaoline	22.7	FA920	5.68	SP	5.68	W	34.09
19	Meta	45.45	Kaoline	22.7	FO4490	5.68	SP	5.68	W	34.09
20	Meta	58.82	Kaoline	14.7	FA920	7.35	SP	7.35	W	44.12
21	Meta	58.82	Kaoline	14.7	FO4490	7.35	SP	7.35	W	44.12
22	Meta	42.11	Kaoline	14.0	FA920	8.77	SP	7.02	W	28.07
23	Meta	42.11	Kaoline	14.0	FO4490	8.77	SP	7.02	W	28.07
24	Meta	56.14	-----		FA920	8.77	SP	7.02	W	28.07
25	Meta	56.14	-----		FO4490	8.77	SP	7.02	W	28.07
26	Meta	43.84	Kaoline	10.9	FA920	6.85	SP	5.48	W	32.88
27	Meta	43.84	Kaoline	10.9	FO4490	6.85	SP	5.48	W	32.88
28	Meta	49.38	Kaoline	9.88	FA920	6.17	SP	4.94	W	29.63
29	Meta	49.38	Kaoline	9.88	FO4490	6.17	SP	4.94	W	29.63
30	Meta	12.64	Kaoline	12.6	FA920	15.80	SP	6.32	W	50.57
							NA	2.02		
31	Meta	12.64	Kaoline	12.6	FO4490	15.80	SP	6.32	W	50.57
							NA	2.02		
32	Meta	12.64	Kaoline	12.6	FA920	15.80	SP	6.32	W	50.57
							NaBI	2.02		
33	Meta	12.64	Kaoline	12.6	FO4490	15.80	SP	6.32	W	50.57
							NaBI	2.02		
34	Meta	12.1	Kaoline	12.1	FA920	15.15	SP	11.6	W	48.5
	FePO ₄	6.1								
35	Meta	22.38	Kaoline	22.3	FO4490	10.49	SP	11.19	W	33.56
36	Meta	26.23	Kaoline	26.2	FO4490	8.21	SP	13.11	W	26.23
37	Meta	17.39	Kaoline	17.3	FO4490	10.87	SP	8.70	W	34.78
			CaCO ₃	10.8						
38	Meta	15.53	Kaoline	31.0	FO4490	9.71	SP	7.77	W	31.07
			CaCO ₃	4.85						

39	Meta	16.16	Kaoline CaCO ₃	32.3 5.05	FO4490	10.10	SP	4.04	W	32.32
40	Meta	14.81	Kaoline	14.8	FO4490	18.52	SP	7.41	W	44.44
41	Meta	19.51	Kaoline	19.5	FO4490	12.20	SP	9.76	W	39.02
42	Meta	15.53	Kaoline	15.5	FO4490	14.56	SP	7.77	W	46.60
43	Meta	12.9	Kaoline	12.9	FO4490	16.13	SP	6.45	W	51.61
44	FePP	12.9	Kaoline	12.9	FA920	16.13	SP	6.45	W	51.61
45	Nicl	23.19	Kaoline	23.1	FA920	7.26	SP	11.59	W	34.78
46	NiclEt	23.19	Kaoline	23.1	FA920	7.26	SP	11.59	W	34.78
47	Meta Nicl	11.6 11.6	Kaoline	23.1	FA920	7.26	SP	11.59	W	34.78
48	Meta NiclEt	11.6 11.6	Kaoline	23.1	FA920	7.26	SP	11.59	W	34.78
49	Meta	10	-----		FA920	12.5	SP	5	W	72.5
50	Meta	10	-----		FO4490	12.5	SP	5	W	72.5
51	Meta	10	CaCO ₃	10	FA920	12.5	SP	5	W	62.5
52	Meta	10	Silica	10	FA920	12.5	SP	5	W	62.5
53	Meta	7	Stygel	1.75	FA920	7	-----		W	54.25
54	Meta	28	Stygel	1.75	FA920	17.5	-----		W	30
55	Meta	20	-----		MC	78	MgSt	2	-----	
56	Meta	20	CaCO ₃	20	MC	58	MgSt	2	-----	
57	Meta	20	CaCO ₃	40	MC	38	MgSt	2	-----	
58	Meta	20	CaCO ₃	70	MC	8	MgSt	2	-----	
59	FePP	20	CaCO ₃	20	MC	58	MgSt	2	-----	
60	Sap	20	CaCO ₃	20	MC	58	MgSt	2	-----	
61	Meta Nicl	10 10	CaCO ₃	40	MC	38	MgSt	2	-----	
62	Meta NiclEt	10 10	CaCO ₃	70	MC	8	MgSt	2	-----	
63	Meta	50	-----		Peg400	50	-----		-----	
64	FePP	50	-----		Peg400	50	-----		-----	
65	Sap	50	-----		Peg400	50	-----		-----	
66	Meta Nicl	25 25	-----		Peg400	50	-----		-----	
67	Meta NiclEt	25 25	-----		Peg400	50	-----		-----	

68	Meta	50	-----		Peg50	50	-----		-----	
69	FePP	50	-----		Peg50	50	-----		-----	
70	Sap	50	-----		Peg50	50	-----		-----	
71	Meta	25	-----		Peg50	50	-----		-----	
	Nicl	25								
72	Meta	25	-----		Peg50	50	-----		-----	
	NiclEt	25								
73	Meta	30	LS	38	Dar670	1	-----		PVA	1
			Kaoline	27						
			Sipernat	1						
74	Meta	30	LS	38	Dar670	1	NA	2	PVA	1
			Kaoline	27						
			Sipernat	1						
75	Meta	30	LS	38	Dar670	1	NaBI	2	PVA	1
			Kaoline	27						
			Sipernat	1						
76	Meta	30	LS	65	Dar670	1	NA	2	PVA	1
			Sipernat	1			NaBI	2		
77	Nicl	30	LS	65	Dar670	1	NA	2	PVA	1
			Sipernat	1			NaBI	2		
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	FePP	6.1								

85	Meta	12.1	Kaoline	12.1	FA920	15.15	SP	11.6	W	48.5
	FePP	6.1	CaCO ₃	5.5						

Pool Tests – Study of Diffusion Kinetics

Diffusion rate of the active ingredient in water for the different compositions was determined in a static test setup comprising of a water pool of a defined length and a defined water height.

- 5 The tested compositions was put in place at the center of the pool. Samples were taken at predefined and fixed sample points in a distance of 25, 50, and 75 cm from the center of the pool. Values given in the tables are the average of 4 different samples taken at 2 different sample points, these two different sample points had the same radial distance to the right and to the left of the composition. The amount of sample that was present in each experiment was
- 10 adjusted to the total content of active ingredient in the respective composition to have an equal amount of active ingredient present in each experiment.

The results of the tested compositions with respect to their release of active ingredient are summarized in table 3. The performance of these different compositions was compared to the

15 state of the art Lonza molluscicidal product J-LON-5, which is currently available on the market as snail and slug bait. J-LON-5 contains ca. 95 wt% of corn flour and 5 wt% of Meta as active ingredient.

The commercial product J-LON-5, that was used as comparative example in these release experiments, was also compared to a composition J-LON-5-LAB, that contained the same

20 components as the commercial product J-LON-5, but that was prepared in the same way as the tested compositions of the instant invention. J-LON-5-LAB showed the same release behavior of Meta as J-LON-5.

Table 3				
CO	Time [h]	Meta concentration [mg/L] from sample position at		
		25 cm	50 cm	75 cm
J-LON-5	0	0	0	0
	1	0	0	0
	8	0	0	0.02
	24	1.78	0.43	0.18
	72	2.06	3.68	2.26
	120	5.01	5.45	2.84
	168	7.36	10.28	6.85
	240	13.10	12.27	12.65
	336	20.28	17.84	16.15
14	0	0	0	0

	1	0	0	0
	8	0	0	0
	24	0.05	0.08	0.30
	72	0.56	0.67	0.75
	120	0.85	0.68	0.63
	168	1.95	1.60	1.57
	240	1.82	2.00	2.08
	336	2.12	1.93	1.83
4	0	0	0	0
	1	0.40	0.05	0.01
	8	0.50	0.54	0.73
	24	1.10	1.63	1.09
	72	1.35	1.24	1.65
	120	1.64	1.56	1.45
	168	2.29	1.99	1.84
	240	2.18	2.13	2.03
	336	2.10	1.89	1.83
5	0	0	0	0
	1	0.09	0	0
	8	0.52	0.44	0
	24	0.98	0.77	0.70
	72	1.25	1.32	1.21
	120	2.04	2.16	2.45
	168	1.95	1.75	1.99
	240	2.53	2.97	2.44
	336			
51	0	0	0	0
	1	0.08	0.07	0
	8	0	0.07	0.12
	24	0.19	0.25	0.64
	72	1.39	1.51	1.68
	120	2.49	2.56	2.86
	168	2.86	3.29	3.41
	240	4.17	4.11	4.07
	336			
73	0	0	0	0
	1	0	0	0
	8	0.16	0	0
	24	0.12	0.27	0.20
	72	0.94	0.75	2.11
	120	1.46	1.17	1.17
	168	2.81	1.40	1.24
	240	3.16	2.58	2.43
	336	3.77	3.27	3.28
76	0	0	0	0
	1	0.13	0	0
	8	0.98	0.32	0.32
	24	2.16	1.48	1.42
	72	3.60	3.14	3.23

	120	2.80	2.13	1.92
	168	2.19	2.49	1.96
	240	5.01	4.56	3.91
	336	4.88	4.69	4.26
58	0	0	0	0
	1	0	0	0
	8	0	0	0
	24	0	0	0
	72	0.24	0.28	0.28
	120	0.91	0.94	0.78
	168	1.16	1.17	1.24
	240	1.00	1.26	1.35
	336	1.39	1.41	1.26

Preparation of Compositions with an Extruder

Materials used:

Extruder BTSK 20/40D, Bühler AG, Switzerland

5 Kaoline anhydrous, free flowing, Redi-Dri™, Sigma-Aldrich, 765453

Sodium propionate >= 99.0%: Sigma-Aldrich, P1880

Preparation of a premix:

10 250 g of FA920, 1375 g of Kaoline, 125 g of sodium propionate and 750 g of Meta, all in powder form, were mixed to provide a homogeneous powder.

Extrusion

15 This homogeneous powder was charged continuously with a screw feeder into the extruder while separately from but simultaneously with the homogeneous powder charging water into the extruder at such a rate that the pressure in the extruder could be maintained between 48 and 69 bar. The temperature in the extruder was between 58 to 75 °C.

The product was extruded through a nozzle with a diameter of 2 mm and was cut by rotating baldes into pellets of defined length of 3 to 4 mm.

The pellets were dried under air atmosphere at ambient temperature.

20

Content of Meta in the pellets was about 30 wt%.

Sequence Listing Free Text

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10

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15 Tyr Asn Pro Ser Asn Lys Pro Ile Trp Ala Ser Asn Thr Gly Gly Gln
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20

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20

25

30

25 Glu Asp Cys Asn Leu Val Leu Tyr Asp Val Asp Lys Pro Ile Trp Ala

35

40

45

Thr Asn Thr Gly Gly Leu Ser Arg Ser Cys Phe Leu Ser Met Gln Thr

30

50

55

60

Asp Gly Asn Leu Val Val Tyr Asn Pro Ser Asn Lys Pro Ile Trp Ala

65

70

75

80

35

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25 50 55 60

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30

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100 105 110

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115

120

125

Leu Gln Lys Asp Arg Asn Val Val Ile Tyr Gly Thr Asp Arg Trp Ala

5

130

135

140

Thr Gly His His His His His His

145

150

Claims

1. A molluscicidal composition comprising as components
an active ingredient and

5 a disintegrant;

wherein

the active ingredient is selected from the group consisting of metaldehyde, iron(III) phosphate,
iron(III) pyrophosphate, saponin, niclosamide, niclosamide ethanolamine salt, methiocarb,
a fusion protein FUSP, and mixtures thereof;

10 the disintegrant is acrylamide based polymer;

FUSP comprises: (i) an omega-ACTX-Hv1a protein toxin, or a fragment or variant thereof,
linked to (ii) a protein capable of mediating translocation of FUSP from an invertebrate
15 gut.

2. A molluscicidal composition according to claim 1, wherein
the amino acid K34 of omega-ACTX-Hv1a protein toxin is modified.

20 3. A molluscicidal composition according to claim 1 or 2, wherein
the omega-ACTX-Hv1a protein toxin has a K34Q substitution.

4. A molluscicidal composition according to one or more of claims 1 or 3, wherein
the omega-ACTX-Hv1a protein toxin comprises the amino acid sequence of SEQ ID NO:1 or
25 of SEQ ID NO:2.

5. A molluscicidal composition according to one or more of claims 1 or 4, wherein
the protein capable of mediating translocation of FUSP from the invertebrate gut is a plant
lectin selected from any one or more of the following: snowdrop lectin *Galanthus nivalis*
30 agglutinin (GNA), garlic lectin *Allium sativum*, pea lectin *Pisum sativum* (P-lec), peanut
lectin *Arachis hypogaea*, french bean lectin (PHA, *Phytohaemagglutinin*), or fragments,
variants or derivatives thereof.

6. A molluscicidal composition according to claim 5, wherein

the lectin is GNA.

7. A molluscicidal composition according to claim 5 or 6, wherein the lectin comprises the amino acid sequence of SEQ ID NO:3.

5

8. A molluscicidal composition according to one or more of claims 1 to 7, wherein FUSP further comprises an affinity tag to aid purification.

9. A molluscicidal composition according to claim 8, wherein

10 the affinity tag is a His tag.

10. A molluscicidal composition according to one or more of claims 1 to 9, wherein FUSP comprises the amino acid sequence of any of SEQ ID NOs 4, 5, 6, 7, 8 or 9.

15 11. A molluscicidal composition according to one or more of claims 1 to 10, wherein the omega-ACTX-Hv1a protein toxin is linked to the N-terminus of the protein capable of mediating translocation of FUSP from the invertebrate gut.

20 12. A molluscicidal composition according to one or more of claims 1 to 11, wherein FUSP comprises the amino acid sequence of any of SEQ ID NOs 6, 7, 8 or 9.

13. A molluscicidal composition according to claim 1, wherein the active ingredient is metaldehyde.

25 14. A molluscicidal composition according to one or more of claims 1 to 13, wherein the composition has the form of a homogeneous mixture of its components.

30 15. A molluscicidal composition according to one or more of claims 1 to 14, wherein the acrylamide based polymer is selected from the group consisting of polyacrylamide, copolymer of acrylic acid and acrylamide, and mixtures thereof.

16. A molluscicidal composition according to one or more of claims 1 to 15, wherein the acrylamide based polymer is a non-ionic acrylamide based polymer.

17. A molluscicidal composition according to one or more of claims 1 to 16, wherein the composition comprises a bulking agent;
the bulking agent is selected from the group consisting of phyllosilicate, calcium carbonate, silica, starch, limestone, and mixtures thereof.
- 5
18. A molluscicidal composition according to claim 17, wherein the bulking agent is selected from the group consisting of phyllosilicate.
19. A molluscicidal composition according to one or more of claims 1 to 18, wherein
- 10 the composition comprises a wetting agent;
the wetting agent is water or polyvinyl alcohol.
20. A molluscicidal composition according to one or more of claims 1 to 21, wherein the composition comprises an additive;
- 15 the additive is selected from the group consisting of sodium propionate, magnesium stearate, nicotinamide, sodium bicarbonate, and mixtures thereof.
21. A molluscicidal composition according to one or more of claims 1 to 20, wherein the composition comprises
- 20 the active ingredient in an amount of from 7 to 60 wt%, the wt% being based on the total weight of the composition.
22. A molluscicidal composition according to one or more of claims 1 to 21, wherein the composition have the form of cubes, granules, pellets, tablets.
- 25
23. A method for preparation of the molluscicidal composition as defined in one or more of claims 1 to 22, wherein the method comprises a premixing of the components to provide a premixture and comprises a shaping of a premixture of the components.
- 30 24. Use of the molluscicidal composition as defined in one or more of claims 1 to 22 for controlling aquatic snails and slugs.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/066848

A. CLASSIFICATION OF SUBJECT MATTER INV. A01N25/00 A01N25/10 A01N25/34 A01N35/02 A01N59/26 A01N59/16 A01N43/90 A01N47/22 A01N37/40 A01N63/02 A01N37/46 A01P9/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A01N		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, BIOSIS, CHEM ABS Data, EMBASE, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/319341 A1 (AWADA SALAM M [US] ET AL) 29 December 2011 (2011-12-29) paragraph [0084] paragraph [0097] paragraphs [0017], [0067] paragraph [0010]; claim 5 paragraph [0019] -----	1-24
Y	CN 104 472 511 B (INSTITUTE OF PLANT PROT AND AGRO PRODUCTS SAFETY ANHUI ACADEMY OF AGRI) 8 June 2016 (2016-06-08) abstract page 4, paragraph 25-32; example page 5, paragraph 68 ----- -/-	1-24
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 15 August 2018		Date of mailing of the international search report 19/09/2018
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Galley, Carl

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/066848

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	MARCOS MAYO-PEDROSA ET AL: "Sustained Release Pellets Based on Poly(N-Isopropyl Acrylamide): Matrix and In Situ Photopolymerization-Coated Systems", JOURNAL OF PHARMACEUTICAL SCIENCES, vol. 96, no. 1, 1 January 2007 (2007-01-01), pages 93-105, XP055500083, US ISSN: 0022-3549, DOI: 10.1002/jps.20708 abstract Conclusions; page 103 -----	1-24
A	Michael Cahn: "A Guide to Using Polyacrylamide (PAM) Polymers for Control of Irrigation Run-off on the Central Coast", 19 December 2010 (2010-12-19), pages 1-13, XP055500081, CA (US) Retrieved from the Internet: URL:https://web.archive.org/web/20160804110000/http://cesantabarbara.ucanr.edu/files/75493.pdf [retrieved on 2018-08-15] What is PAM?; page 1 -----	1-24
Y	KR 100 684 229 B1 (CRODA INT PLC) 20 February 2007 (2007-02-20) abstract claims 1, 17 -----	1-24

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2018/066848

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