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SYNERGISTIC ACTION OF INSECTOACARICIDE COMPOSITIONS BASED ON BITTER ALMOND SEEDS

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Abstract:
The article presents data on the physicochemical properties of a complex composition in the form of powder and suspension in various concentrations based on bitter almond seeds. For the powder and suspension, the particle sizes, electrical conductivity of the solution, surface tension, and biological activity were determined. The complex composition contains seeds of bitter almonds, extracts of bitter wormwood, onion, garlic, laundry soap, kaolin adsorbent and cornflour. A complex composition based on bitter almond seeds is effective against Argas persicus mites
under the studied conditions. The studies were carried out on ticks Argas persicus at various stages of ontogeny, collected from birds and farm animals. The death of ticks at different concentrations was studied. Starting at a concentration of 0.5%, the death of mites is observed. From 1.0 to 2.5% concentration, the death of ticks ranges from 32±0.4% to 56±0.3%. More effective concentrations turned out to be 5-10%, where the death of mites reaches 84 ± 0.2%. The composition based on plant extracts is an environmentally friendly, safe insectoacaricide.

Keywords: Bitter almond seeds, bitter wormwood extracts, onion and garlic extracts, bentonite, cornflour, insectoacaricides.

1. INTRODUCTION

Complex compositions based on extracts of medicinal and plant raw materials are of great practical interest in the search for new insectoacaricidal agents. Ethanol extracts of the terrestrial part of *Haplophyllum pperform*at a concentration of 1% proved to be effective against pear sucker (*Psylla pyri*) [1]. The review provides information on 95 plants, water or ethanol extracts that are of practical interest for agriculture as insecticides and insectoacaricides [2]. Extracts of garlic bua lbs, tobacco extract, extract of fruits and seeds of apple, lilac flowers and others turned out to be useful insecticides against pests of tea, rice and vegetables [3]. Crude methanolic extracts of *Artemisia herba-alba* and *Punica granatuare*be are effective against adult motility and egg hatching of *Haemonchus contortus.* This indicates the effectiveness of bitter wormwood extracts as an anthelmintic [4,5]. A review of data on the expediency of using plants and their extracts against mites is given [6,7]. Essential oils and their derivatives were isolated from the rhizomes of Alpinia galanga cultivated in India against the nymphs *Haemaphysalis longicornis.* The essential oil derivative at a concentration of 50 mg/ml completely suppressed the hatching of *Haemaphysalis longicornis* eggs.
The chemical composition of the essential oils of *Thymus mongolicus*, *Cinnamomum Verum* and *Origanum vulgare* were analyzed and their potential application for the control of the tick vector *Haemaphysalis longicornis* was evaluated. The phenols thymol and carvacrol (phenol monoterpenoids) were shown to make up 34.66% and 75.72% of the essential oils of *Thymus mongolicus* and *Origanum vulgare*, respectively, while transcinnamicc aldehyde (49.42%) was the main component of *CinnamomumVerumm.* Essential oils showed significant acaricide activity in the studied concentrations [9]. Essential oils of *Artemisia absinthium L.* and *Tanacetum vulgare L.* were extracted by three methods and tested against the spider mite *Tetranychus urticae Koch.* It has been shown that beta-thujone is the main component of the essential oil, which will affect the acaricidal activity of the oil [10]. Garlic *(Allium sativum L.)* is widely used in folk medicine in China and Iran. The effectiveness of *Allium sativum L.* is associated with organosulfur compounds in the composition of garlic (allylcin, diallyl disulfide, S-allyl cysteine, diallyl trisulfide, etc. Therefore, *Allium sativum L.* is a potential natural agent that exhibits the effect of an insecticide [11]. Ethyl acetate extract of *Achyranthes Aspera L* leaves, acetone extract of leaves and chloroform extract of *Anisomeles malabarica,* methanol extract of Gloriosa superba

flowers and methanol extract of *Ricinus communis* leaves are recommended as ecologically safe insectoacracids [12]. Alcoholic extracts of *Datura metal fruit* and the whole plant *Argemone mexicana* showed a 50% tick mortality rate. Based on phytochemical studies, an acaricidal effect was found that is associated with the presence of alkaloids and glucosides in the fruits of *Datura metal*, terpenoids, flavonoids, phenols, and alkaloids in extracts of the whole plant *Argemone mexicana* [13]. Ethanol extract of walnut Juglans regia 10% concentration causes 100% death of *Rhipicephalus microplus* tick larvae [14].

The acaricidal activity of 18 Mediterranean plants was studied against the spider mite *Tetranychus urticae Koch*. Extracts of *Ruta chalepensis L.* showed 65% activity, *Astragalus Acrocephalus Boiss* - 55% and *Urtica pilulifera L.* – 51aboutto adults. High efficiency (65%) was achieved when *Phlomis syriaca* extract was used on adults. [fifteen]. The extract of the *Costus speciosus* plant has acaricidal and ovicidal activity against the two-budded spider mite *Tetranuchus urticae Koch* in vitro. The extract showed 79.67±4.01% egg mortality [16]. The effectiveness of plant extracts for mites has been noted in several publications [17-19]. Because of their bitter taste, cyanogenic glucosides are effective plant protection components because they release toxic hydrogen cyanide. Because of their bitter taste, cyanogenic glucosides are effective plant protection components because they release toxic hydrogen cyanide. At the same time, some insects feed on cyanogenic plants and the content of cyanogenic glucosides is strictly regulated in their life cycle, and also plays an important role in environmental protection [20]. Due to the presence of amygdalin in the composition of bitter almonds and their extracts, the prospects for obtaining insectoacaricides are of practical interest [21].

This work aims to develop a multicomponent composition based on synergistic insectoacaricides by using bitter almond seeds.

2. MATERIALS AND METHODS

The object of the study was the seeds of bitter almonds (*Amygdalus communis L. varieties Amara D.C.*), dry extracts of bitter wormwood (*Artemesia absinthium L.*), and onion (*Allium cepa L.*), garlic *(Allium sativum L.*). The seed powder was obtained from the seeds of bitter almonds harvested in the Bostanlyk district of the Tashkent region of the Republic of Uzbekistan (collection in 2017). After removing the shell from the seeds by cold pressing, the oil was pressed on the Akita jp unit. The residue was dried at 40°C to constant weight and ground in a blender. The average particle size of the powder was determined based on sieve analysis.

To determine the content of amygdalin in the extracts, HPLC-mass spectrometry was used. Separation was carried out on an HPLC Agilent Technologies-1260 (USA) on a reverse-phase column 2.1 × 150 mm (3.5 µ) Eclipse XDB (Agilent Technologies, USA). Mass spectra of substances were obtained by ESI mass spectrometry (electrospray) using a 6420 Triple Quad LC/MS mass spectrometer (Agilent Technologies, USA). The mass spectra of the samples were recorded with positive ionization. The following parameters of the mass spectrometer were chosen: scanning range - 30-1100 m/z, dryer gas flow rate - 4 l/min, gas temperature - 350 °C, gas pressure at the atomizer needle - 20 psi, evaporator temperature - 350 °C, the voltage on the coronary needles is 4 microamperes, the voltage on the capillary is 4500 V.

Dry extract of bitter wormwood (Artemisia Absinthium L.) was obtained by percolation using 70% ethanol at a ratio of 1:10. The extraction was repeated three times. The solution was evaporated from the filtrate and a dry extract was obtained. Dry extract powder of bitter taste and dark brown colour.

Alcoholic extracts of onion and garlic were obtained by percolation using 90% ethanol at a ratio of raw material and extractant 1:10. Used food cornflour without pre-treatment.

Natural adsorbent bentonite (Navbakhor deposit, Navaino region) white-grey powder. Swells when wet in water. To remove minerals and salts, they were first washed in hot water, then with a 10% hydrochloric acid solution. Then the solid phase was separated from the liquid by centrifugation. The solid sample was dried and ground in colloid mills. The solid sample was passed through a sieve with a size of 0.1 mm and dried at 413 K to constant weight.

Determination of the insectoacaricidal action of a complex composition

To obtain 100 g of insectoacaricidal composition [22], 12 g of bitter almond fruit powder, 1.5 g of onion alcoholic extract, 1.5 g of garlic alcoholic extract, 1.5 g of bitter wormwood alcoholic extract, 5 g of cornflour, and laundry soap are weighed 3 g and bentonite 75.5 g. The mixture is well stirred, crushed to a colloidal size and dried to constant weight. Packed in bags made of cloth, paper or polyethene To assess the insecticidal effect, the composition was dissolved at a concentration of 0.5 to 10%, which allows reducing the concentration of mites. The studies were carried out on ticks - *Argas persicus* at various stages of ontogeny, collected from birds and farm animals. Each type of *A. persicus* mites, 50 pcs., werwasaced on filter paper in glass cups. The experiments were carried out in 5 repetitions (relative humidity in the laboratory 81% and temperature 26°C).

3. THE RESULTS OBTAINED AND THEIR DISCUSSION

After removal of the amniotic membrane, oil and degreasing, the bitter almond powder was obtained. The sample was dried at 40°C to constant weight. The powder is a white mass with a sliodourodor. The average particle size of bitter almond powder was found to be 1.23 ± 0.05 mm. The powder obtained from bitter almond seeds was subjected to chromatographic analysis. On fig. 1 shows GLC chromatography of a standard sample of amygdalin. The retention time of the standard amygdalin sample is 9.56 minutes. As the data show, after removing the oil, the crushed powder contains 3.24% amygdalin in its composition [23] with a retention time of 8.879 min (Fig. 2).

To obtain an insectoacaricidal composition, a dry extract of wormwood was used in the form of a powder, brown in colour, and bitter in taste, with a luteolin content of 5.596 mg/g. The content of luteolin in the dry extract was determined by GLC (Fig. 3) using the luteolin standard, the exposure time of which appeared at 5.5 min.

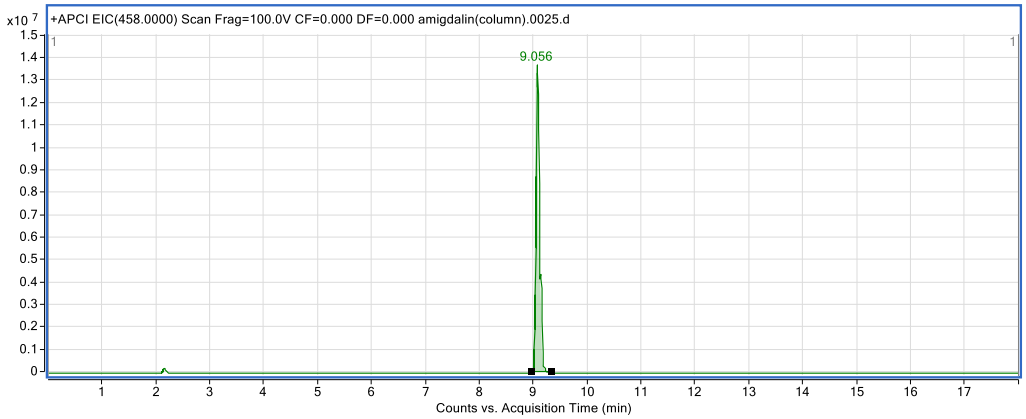

Fig.1. The chromate-mass spectrum of a standard sample of amygdalin (100% content of amygdalin).

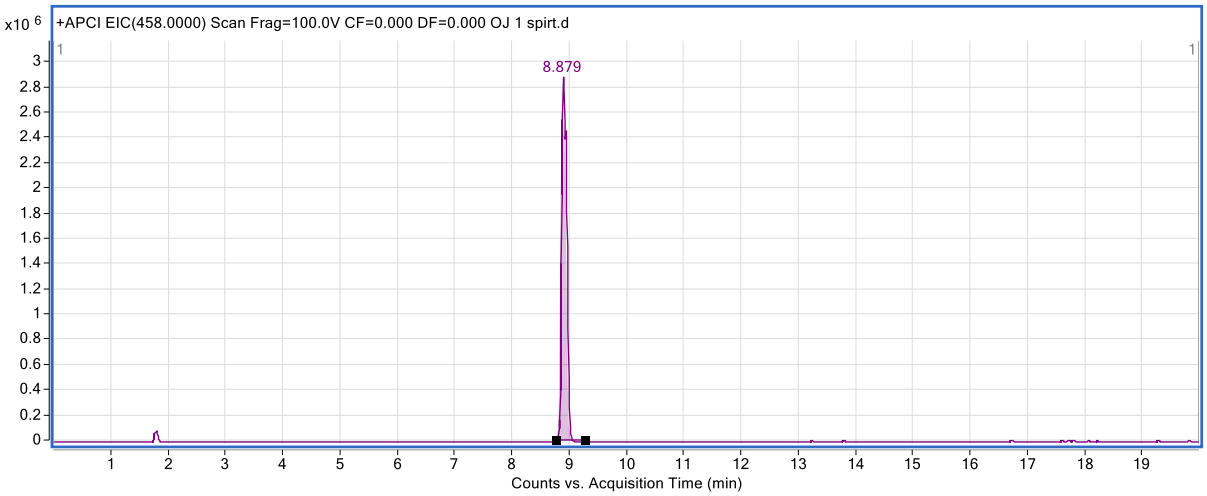

Fig. 2. The chromatography-mass spectrum of bitter almond powder (amygdalin content 3.24%).

Cornmeal and bentonite are sensitive to cleaning the surface of the skin. Fat-free fruits of bitter almonds contain a large amount of amygdalin glycoside during hydrolysis, which contains benzaldehyde and cyanic acids, which give the composition an insectoacaricidal effect. A certain contribution to the detection of the insectoacaricidal effect has an impact on the presence of bitter polynya extract, which includes luteolin and alkaloids. Sulfur-containing organic compounds of dry onion extract and extract also affect enhancing the effect of the composition.

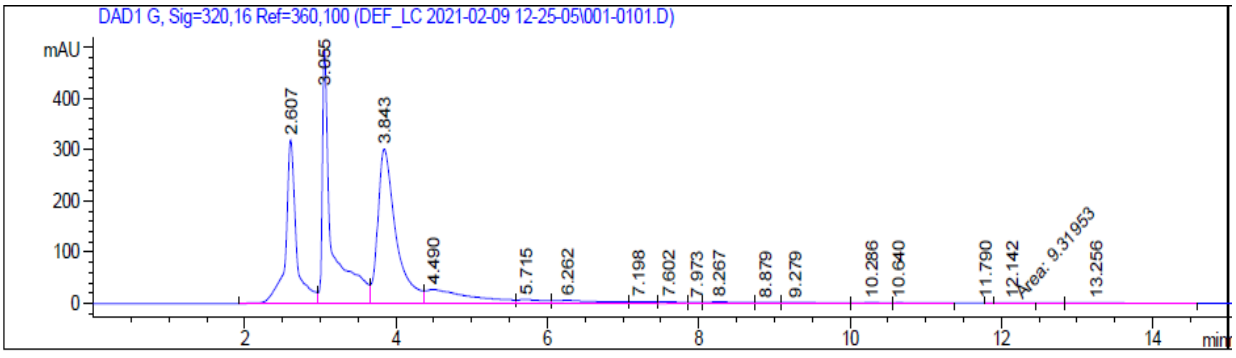

Fig.3. GLC chromatography of a dry extract of bitter wormwood was obtained by percolation from 70% alcohol (UV detection at 320 nm).

Cornmeal and bentonite have adsorbing properties and help clean the surface of animal hair. Fat-free fruits of bitter almonds contain in their composition amygdalin glycoside, upon hydrolysis of which benzaldehyde and cyanic acid are formed, which give the composition an insectoacaricidal effect. A certain contribution to the appearance of the

insectoacaricidal effect is influenced by the presence of bitter wormwood extract in the composition, which contains luteolin and alkaloids.
Sulfur-containing organic compounds of dry extract of onion and garlic also affect enhancing the effect of the composition.

The insecticide-acaricidal composition based on bitter almond seeds is a yellow-grey powder of a peculiar odour, that easily forms a colloidal solution in the form of a gel. Table 1 shows the powder size distribution of a complex intectoacaricidal composition. In the composition of the powder, the proportion of particles with a size of 1-2 mm is 2.23%, particles with a size of 1.0 and 0.5 mm are 14.37%, and the proportion of particles 0.50 to 0.25 mm is 28.82%. Particles with a size of 0.10 to 0.05 mm were found in the composition, accounting for 31.16%. The share of particles of the smallest size less than 0.05 mm is equal to 15.3%.

In the preparation of the insectoacaricidal composition, adsorption technology was used. To do this, liquid extracts of bitter wormwood, onions, and garlic are introduced into the composition of bentoniand the, laundry soap, with constant stirring, the solvent is removed until a dry mass is formed at room temperature. Then crushed seeds of bitter and almonds, and cornstarch are introduced into the composition of bentonite and mixed well. The insecticidal composition is dried to a constant weight. The insecticidal composition is applied against mites in the form of a pow or the form of a suspension is applied to the skin of animals or birds.

1-table. Particle size distribution of an insecticide-acaricidal composition based on bitter almond seeds.

Granule size in mm	Yield mass fraction of powder fractions, %
- 2 + 1	2,23
- 1 + 0,5	14,37
- 0,5 + 0,25	28,82
- 0,25 + 0,1	31,16
- 0,1 + 0,05	8,12
- 0,05	15,3
Initial mass	100

Some physicochemical parameters of a 1% suspension of the insectoacaricidal composition are presented in Table 2. The dispersed system in the form of a suspension has a turbidity of 105.8 cm-1 and the particle size of the dispersed phase is 74.78 nm (determined by the turbidimetric method). At 20°C the suspension has a viscosity of 0.024. The electrical conductivity of the suspension is 1240 ohm-1*cm-1. The pH of the solution determined by the potentiometric method is 5.764. The surface tension of a 1% suspension is 0.047 N/m.

2-table. Basic physicochemical constants of 1% solution of insectoacaricidal composition.

Main characteristics	turbidity dispersed systems т, NTU	The particle size of the dispersed phase, nm	Поверхностное натяжение, N/m	Electrical conductivity, $Om^{-1}\cdot cm^{-1}$	The pH of water extract
Mean	105.8	74,78	0,047	1240	5.764

The insectoacaricidal composition based on the seeds of bitter almonds, due to the presence of extracts of wormwood, onion and garlic, has an insectoacaricidal effect. Amygdalin is the composition that undergoes hydrolysis with the formation of cyanic acid and benzaldehyde.

The insecticidal activity of the composition based on bitter almond seeds was studied at a suspension concentration of 0.5 to 10% (table 3). The studies were carried out on ticks Argas persicus at various stages of ontogeny, collected from birds and farm animals. The death of ticks at different concentrations was studied. Starting at a concentration of 0.5%, the death of mites is observed. From 1.0 to 2.5% concentration, the death of ticks ranges from 32±0.4% to 56±0.3%. More effective concentrations turned out to be 5-10%, where the death of ticks reaches 84±0.2%. Thus, the insectoacaricidal composition exhibits pronounced insectoacaricidal properties.

Инсектоакарицидная активность композиции на основе семян горького миндаля изучали при концентрации суспензии от 0,5 до 10% (таблица 3).

Table 3. Influence of concentration of insectoacaricidal composition on the death of mites *Argas persicus.*

N of experiments	Type of mites Argas persicus (spec.)	The concentration of insectoacaricide in suspension, %	Doom ticks in %
контроль	50	Дис. вода	0
1	50	0,5	20±0,5
2	50	1,0	32±0,4
3	50	2,0	45±0,5
4	50	2,5	56±0,3
5	50	5,0	80±0,5
6	50	7,5	82±0,4
7	50	10,0	84±0,2

Исследования проведены на клещах *Argas persicus* в различных стадиях онтогенеза, собранных от птиц и сельскохозяйственных животных. Изучена гибель клещей при разных концентрациях. Начиная концентрации 0,5 % наблюдается гибель клещей. От 1,0 и до 2,5% концентрации гибель клещей составляет от 32±0,4 % до 56±0,3%. Более эффективными концентрациями оказались 5-10%, где гибель клещей доходит до 84±0,2 %. Таким образом, инсектоакарицидная композиция проявляет явно выраженные инсектоакарицидные свойства. Under similar conditions, the well-known insectoacaricide alpha-cypermethrin at a dilution of 1ml/100 exhibits weaker insectoacaricidal properties. If we take into account the harmlessness, environmental safety of the composition, then the advantages of the proposed compositions are revealed.

A comparative study of the activity of suspensions of the insecticidal composition at a concentration of 1.0 to 5% of the concentration of alpha-cypermethrin against A. persicus mites is shown in table 4.

Таблица 4. Сравнительное изучение акарицидных свойств инсектоакарицидной композиции против клещей *A.persicus*.

Tested drugs	The effectiveness of the drug (death of ticks A.persicus,%)			
	1 day	2 day	3 day	4 day
1% suspension	10±1	10±1	15±1	20±2
2,5% suspension	25±2	25±2	30±3	40±4
5% suspension	30±3	50±4	60±5	75±5
Alpha- cypermethrin*	20±1	30±2	40±3	65±4
Distilled water	0	0	0	0

*1 ml/100 ml

Suspension at a concentration of 1 to 5% concentration has an insecticidal effect. If, at a concentration of up to 2.5% concentration, the effectiveness of the insectoacaricidal composition approaches alpha-cypermethrin, then at 5% concentration, the composition is more effective than alpha-cypermethrin. The main active ingredient of the insectoacaricidal composition is amygdalin, the hydrolysis of which produces benzaldehyde and cyanic acid. The composition contains bitter wormwood, which is why flavonoids, alkaloids and artemisinin are present. The introduction of garlic and onion extracts into the composition of the insectoacaricide, due to the presence of sulfur compounds, causes an insectoacaricidal effect. Thus, the inspectoacaridine composition from the presence in its composition of a complex of biologically active substances, especially the components of bitter almonds, bitter wormwood, and sulfur compounds, exhibits inspectoacaricidal properties.

4. CONCLUSIONS

An insecticidal composition based on crushed seeds of bitter almonds, dry extracts of bitter wormwood, onions and garlic, bentonite, soap and cornflour in the form of powder or 5-10% suspension can be recommended as a harmless, environmentally friendly insecticidal acaricide against Argas persicus mites.

5. DISCLOSURE STATEMENT

The authors have no conflicts of interest.

6. AUTHORS' CONTRIBUTIONS

All authors participated in the writing, editing and quantification of the constituent components of the proposed compositions.

7. FINANCING

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