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HR EXCELLENCE IN RESEARCH

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MODULATION OF THE TOTAL ANTIOXIDANT STATUS IN BEES

PATENT: WO 2022/018009 A1 / 2022.01.27;
MD 4905 / 2024.10.31

AUTHORS: Aurelian GULEA, Ion TODERAȘ, Olga GARBUZ,
Victor ȚAPCOV, Vasilii GRAUR, Sebastien FLOQUET,
Arcadie FUIOR, Diana CEBOTARI

APPLICATION FIELDS: Agriculture

AIM: Chemical synthesis, characterization of new synthetic stimulator of the total antioxidant status of the bee's hemolymph and bee larval hemolymph that may find application in apiculture.

SOLUTION: New cobalt coordination compound with thiocarbazide ligand have been obtained using the directed synthesis method.




The IC₅₀ (mg/mL) values of hemolymph towards ABTS cation radicals

Compound	bee's hemolymph	bee larval hemolymph
Control	13.56	9.95
Vitamin C (prototype)	13.14	6.31
Claimed substance	2.48	1.26


ADVANTAGES: The invention pertains to chemistry and apiculture, specifically to a biologically active cobalt coordination compound which stimulates the total antioxidant status of the hemolymph of *Apis mellifera* bees and their larvae to enhance their resistance to diseases. Addition of this substance at the first feeding after wintering enhances the total antioxidant status of the bee's hemolymph and bee larval hemolymph by 5.4-7.9 times in comparison to control, and up to 5.3 times in comparison with prototype.

IMPLEMENTATION STAGE: At the laboratory level.

ACKNOWLEDGMENTS: This research was supported by the institutional project #010602



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NEW INHIBITORS OF THE PROLIFERATION OF FUNGI OF THE SPECIES *Candida albicans*

PATENT: MD 4886 / 2024.09.30
request for patent MD a 2024 0021 / 2024.06.17

AUTHORS: Aurelian GULEA, Ianina GRAUR, Vasilii GRAUR,
Irina USATAIA, Victor ȚAPCOV, Carolina LOZAN-TÎRȘU

APPLICATION FIELDS: Medicine – pharmacy – cosmetics

AIM: Chemical synthesis, characterization of new synthetic antifungal agents that may find application in medicine.

SOLUTION: New synthetic compounds of the thiocarbamide derivatives have been obtained using the directed synthesis methods.



Antifungal activity of the claimed compounds compared to the prototype (μg/mL)

Compound	<i>Candida albicans</i> ATCC 10231	
	MIC	MFC
Prototype	0.70	0.70
Claimed substance 1	0.008	0.031
Claimed substance 2	0.004	0.008

MIC – minimum inhibitory concentration
MFC – minimum fungicidal concentration

ADVANTAGES: The described compounds possess fungistatic and fungicidal activity within the limits of concentrations 0.004-0.031 μg/mL against fungi of the species *Candida albicans*, which exceeds 23-175 times the activity of the prototype. The present inventions expand the arsenal of fungal inhibitors of the *Candida albicans* species with high antifungal activity.

IMPLEMENTATION STAGE: At the laboratory level.

ACKNOWLEDGMENTS: This research was supported by the institutional project #010602



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Mechanical properties of materials „Iulia Boiarskaia”
Section: Glassware and thermal treatment of materials
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LOW-TEMPERATURE SINTERING OF $\text{In}_2\text{O}_3\text{:Sn}$ CERAMICS

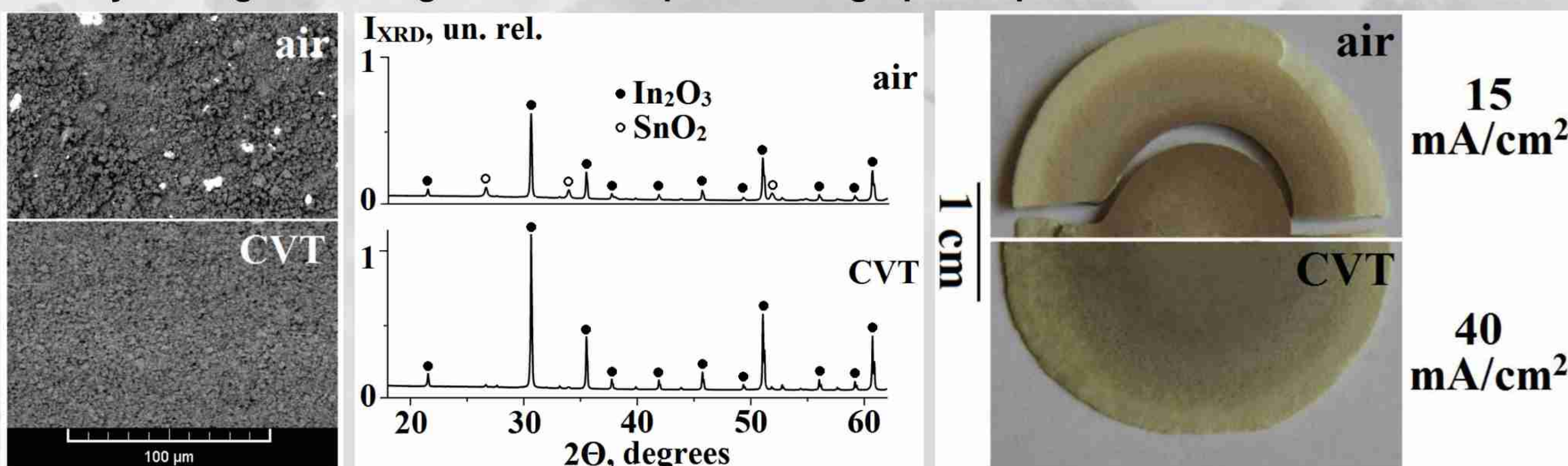
PATENT: MD s 2024 0068
AUTHORS: Gleb Colibaba, Dumitru Rusnac

APPLICATION FIELDS: Optoelectronics

AIM: The elaboration of cost-effective technology for low temperature sintering of uniform and highly conductive $\text{In}_2\text{O}_3\text{:Sn}$ (ITO) ceramics using **chemical vapour transport (CVT)** reactions

SOLUTION:

ITO ceramics are sintered in quasi closed quartz ampoules using $\text{In}_2\text{O}_3 + \text{SnO}_2 + \text{InOCl}$ mixed powders. $2\text{InOCl} + 1/2\text{O}_2 \rightarrow \text{In}_2\text{O}_3 + \text{Cl}_2$: **Cl_2** acts as a **CVT agent**, increasing the vapor pressure by **6 orders** of magnitude (mainly In and Sn halides), enhancing the mass transport between sintered particles, contributing to the higher uniformity, density, conductivity and thermal stability of magnetron targets that can operate at high-power plasma



SnO_2 inclusions, XRD spectra, overheating and cracking of sputtered ITO ceramics sintered at 800 °C in air and using Cl_2 as a transport agent

ADVANTAGES:

- ❖ Decrease of sintering temperature from 1500 to **800 °C**
- ❖ 99% of the initial diameter
- ❖ Relatively high density of 4.7 g/cm³
- ❖ Absence of material loss and interaction with a crucible (low sintering temperature)
- ❖ No need to use expensive nanopowders
- ❖ Complete dissolution of SnO_2 dopant micropowders with particle size up to 50 mkm
- ❖ Low resistivity down to **$3 \times 10^{-2} \Omega\text{-cm}$** (the decrease of resistivity by **100 times**)
- ❖ High thermal stability of targets (increase of current density from 15 to **40 mA/cm²**)
- ❖ Higher structural quality of ITO thin films deposited at the high magnetron power

IMPLEMENTATION STAGE: Pilot

ACKNOWLEDGMENTS: This work was supported by the Ministry of Education, Culture and Research of Moldova under the projects No. 25.80013.5007.10RE (Strategic Vision for the Development of Scalable Thin-Film Technologies in Niche Photovoltaic Markets and 011201 (Functional 2D and 3D oxychalcogenic materials, metals, and polymers with advanced magnetic, photoelectric, optical, and bioactive properties for applications in spintronics, optoelectronics, and biomedicine)



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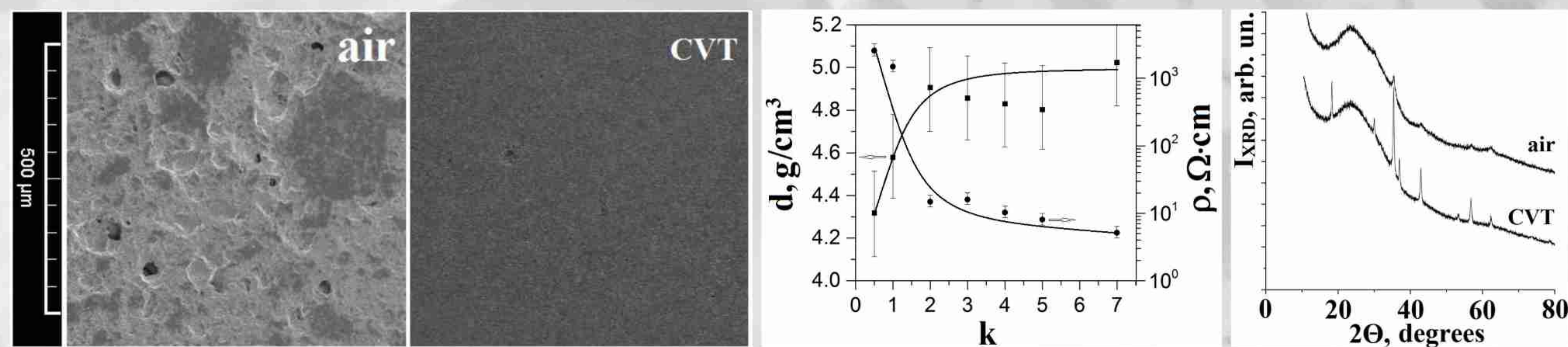
PRODUCING CONDUCTIVE CERAMIC TARGETS AND THIN FILMS OF $\text{Fe}_2\text{O}_3\text{:(ZnO)}_k$ ALLOYS AT LOW TEMPERATURES

PATENT: MD s 2024 0072
AUTHORS: Gleb Colibaba, Dumitru Rusnac, Vladimir Fedorov,
Anatolie Sidorenko (Technical University of Moldova), Olga Shikimaka

APPLICATION FIELDS: Optoelectronics

AIM: The elaboration of cost-effective technology for low temperature sintering of uniform and conductive $\text{Fe}_2\text{O}_3\text{:(ZnO)}_k$ ceramic magnetron targets using **chemical vapour transport (CVT)** reactions. The deposition of $\text{Fe}_2\text{O}_3\text{:(ZnO)}_k$ thin films with improved structural quality and controllable electrical properties

SOLUTION: $\text{Fe}_2\text{O}_3\text{:(ZnO)}_k$ ceramics are sintered in quartz ampoules using **HCl + H₂** as a **CVT agent**. **HCl** increases the vapor pressure by **8 orders** of magnitude (mainly halides), improving the mass transport between sintered particles, contributing to a higher uniformity, density and hardness of ceramics. **H₂** increases concentration of intrinsic donor defects (Zn/Fe excess), contributing to higher conductivity and thermal stability of high-power magnetron targets. High power magnetron deposition leads to a higher structural quality and conductivity of thin films



SEM images of $\text{Fe}_2\text{O}_3\text{:ZnO}$ samples obtained by sintering in air and using CVT

The density and resistivity of CVT $\text{Fe}_2\text{O}_3\text{:(ZnO)}_k$ alloys


The XRD spectra of $\text{Fe}_2\text{O}_3\text{:ZnO}$ thin films

ADVANTAGES:

- ❖ Decrease of sintering temperature from 1500 to **1050 °C**
- ❖ 99% of the initial diameter
- ❖ High density up to 4.5 g/cm³ (90 % relative density)
- ❖ Absence of material loss and interaction with a crucible (low sintering temperature)
- ❖ No need to use expensive nanopowders
- ❖ Complete dissolution of components
- ❖ Relatively low resistivity down to 5 $\Omega\text{-cm}$ (**decrease by 3–5 orders** of magnitude)
- ❖ High thermal stability (**no target cracking**, increase of current density from 15 to 40 mA/cm²)
- ❖ Higher structural quality of thin films deposited at the high magnetron power
- ❖ Obtaining **conductive thin films** with controllable chemical activity and optical properties


IMPLEMENTATION STAGE: Pilot

ACKNOWLEDGMENTS: This work was supported by the Ministry of Education, Culture and Research of Moldova under the projects No. 25.80013.5007.10RE (Strategic Vision for the Development of Scalable Thin-Film Technologies in Niche Photovoltaic Markets), 011201 and 020201



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HR EXCELLENCE IN RESEARCH

UV-C Sterilizing Device

BREVET: MD s 2024 0049

AUTHORS: MUNTEANU Ion, ȚURCAN Marina

APPLICATION FIELDS: Medicine – Food – Health – Hygiene.

AIM: The invention refers to the decontamination and annihilation of pathogens, frequently present on objects with irregular surfaces (for example: laboratory instruments, dental, surgical instruments and equipment, measuring devices, various devices), as a result of the action of ultraviolet radiation type C applied, which can be applied in the disinfection of various objects with irregular surfaces within medical, secondary and higher education institutions, the food industry, public health, etc...

SOLUTION: The particularity of the proposed device is the introduction of a set of quartz rods of different diameters that play an essential role of radiation diffusion to increase the decontamination rate of shaded areas of bodies with uneven surfaces.


The main idea of the proposed device are the increase in the radiation dose in the shaded areas of objects with irregular surfaces where direct radiation does not reach, and as a result of the physical effects obtained such as the reflection/refraction of UV-C radiation due to the quartz rods inserted inside the decontamination chamber, the dispersion of these radiations takes place to the entire surface of bodies with irregular shapes, as a result of which the pathogens are subjected to these high doses of radiation and effectively inactivated. At the same time, around these quartz rods the so-called evanescence zone appears which is a very effective area for decontamination of pathogens that are found at the contact between the object and the rod.

So, a bactericidal device is proposed, simple in construction, but which allows the disinfection of the surfaces of various irregular objects much more effectively compared to other devices, and due to the appearance of a microwave oven, it is very convenient to use.

ADVANTAGES: The advantages of this device are the significant reduction in the exposure time under the action of UV-C radiation of various objects with irregular surfaces by increasing the efficiency of the disinfection rate due to the dispersion of radiation in the decontamination chamber.


IMPLEMENTATION STAGE: : At the laboratory level.

ACKNOWLEDGMENTS: This research was supported by the *research project*: Subprogram code 011206, Cifrul 24.80012.5007.26SE.



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HR EXCELLENCE IN RESEARCH

THE USE OF 2-(TERT-BUTYL)-6-CHLORO-3-(1H-1,2,4-TRIAZOL-1-YL)-2H-CHROMEN-2-OL AS AN IMMUNOSTIMULATORY AND ANTIFUNGAL AGENT AGAINST *FUSARIUM* SPP. IN THE TREATMENT OF TOMATO SEEDS.

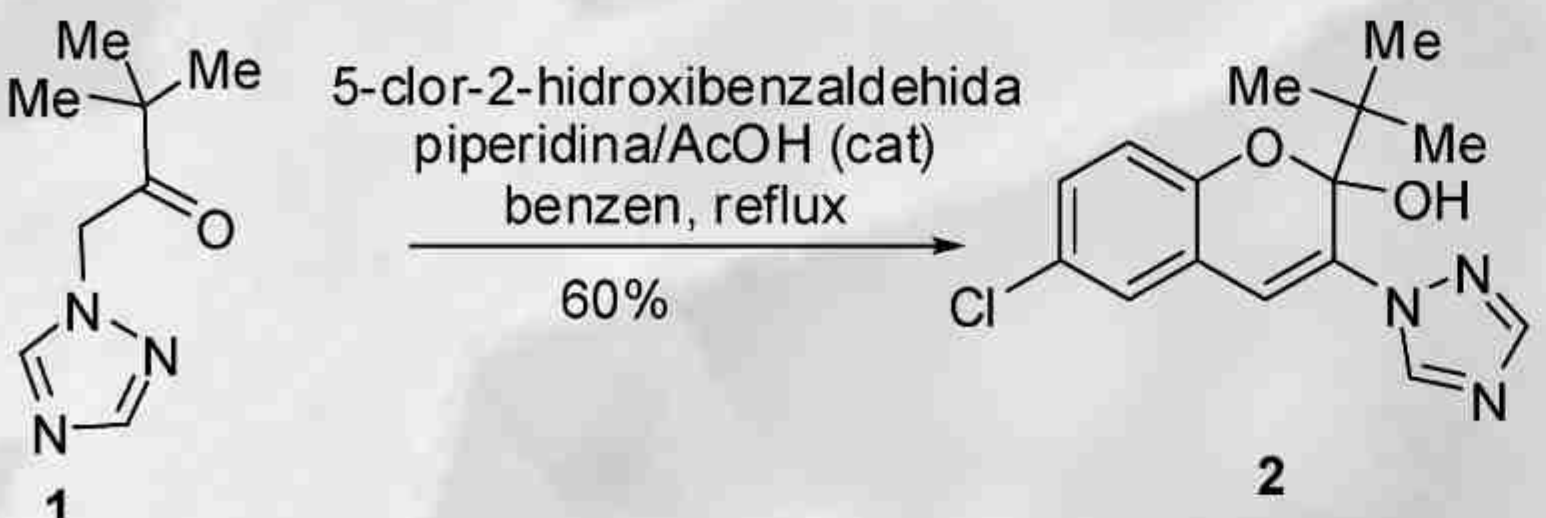
PATENT: Nr 7502 from 05.05.2025

AUTHORS: CEABANOVA M.; GRAJDIERU C.; SUCMAN N.; POGREBNOI V.; COJOCARI S.; MITINA I.; MITIN V.; POGREBNOI S.; MACAEV F.

APPLICATION FIELDS: chemistry and plant protection

AIM: to develop a novel seed treatment agent based on 2-(tert-butyl)-6-chloro-3-(1H-1,2,4-triazol-1-yl)-2H-chromen-2-ol, exhibiting both antifungal and immunostimulatory activity against *Fusarium* spp. in tomato plants

SOLUTION: The proposed solution consists in treating tomato seeds with a 0.01% solution of 2-(tert-butyl)-6-chloro-3-(1H-1,2,4-triazol-1-yl)-2H-chromen-2-ol, which exhibits both antifungal and immunostimulatory activity against *Fusarium* spp. The compound can be applied in aqueous solution or in a preparative form based on chitosan, the latter providing a synergistic effect and significantly enhancing antifungal efficiency and plant growth stimulation.



Methodology: Tomato seeds were treated for 8 hours with solutions of the active compound at concentrations of 0.01% and 0.1%, as well as with preparative formulations containing chitosan. After treatment, seeds were germinated under two conditions: aseptically on sterilized filter paper for visual assessment of root and stem growth, or planted in soil naturally infected with *Fusarium* spp., confirmed by molecular tests. Each treatment included 20 seeds with three replicates. After a 14-day growth period under controlled conditions (16 h light/8 h dark, 24°C, 5000 lm/m² illumination, 60–65% humidity), root and stem lengths were measured.

Fungal colonization was assessed by extracting total DNA from homogenized plant tissues, followed by qPCR amplification using *Fusarium*-specific β -tubulin primers (fcbt2/fcbt3). The accumulation of pathogen DNA in plant tissues was calculated using the ΔCq parameter, which reflects the difference between the maximum amplification cycle and the observed cycle for each sample. Statistical analyses included the Student's t-test for mean comparisons and the Shapiro-Wilk test for normality. qPCR amplification efficiency was evaluated based on the standard curve slope, ensuring reliable quantification of the pathogen.

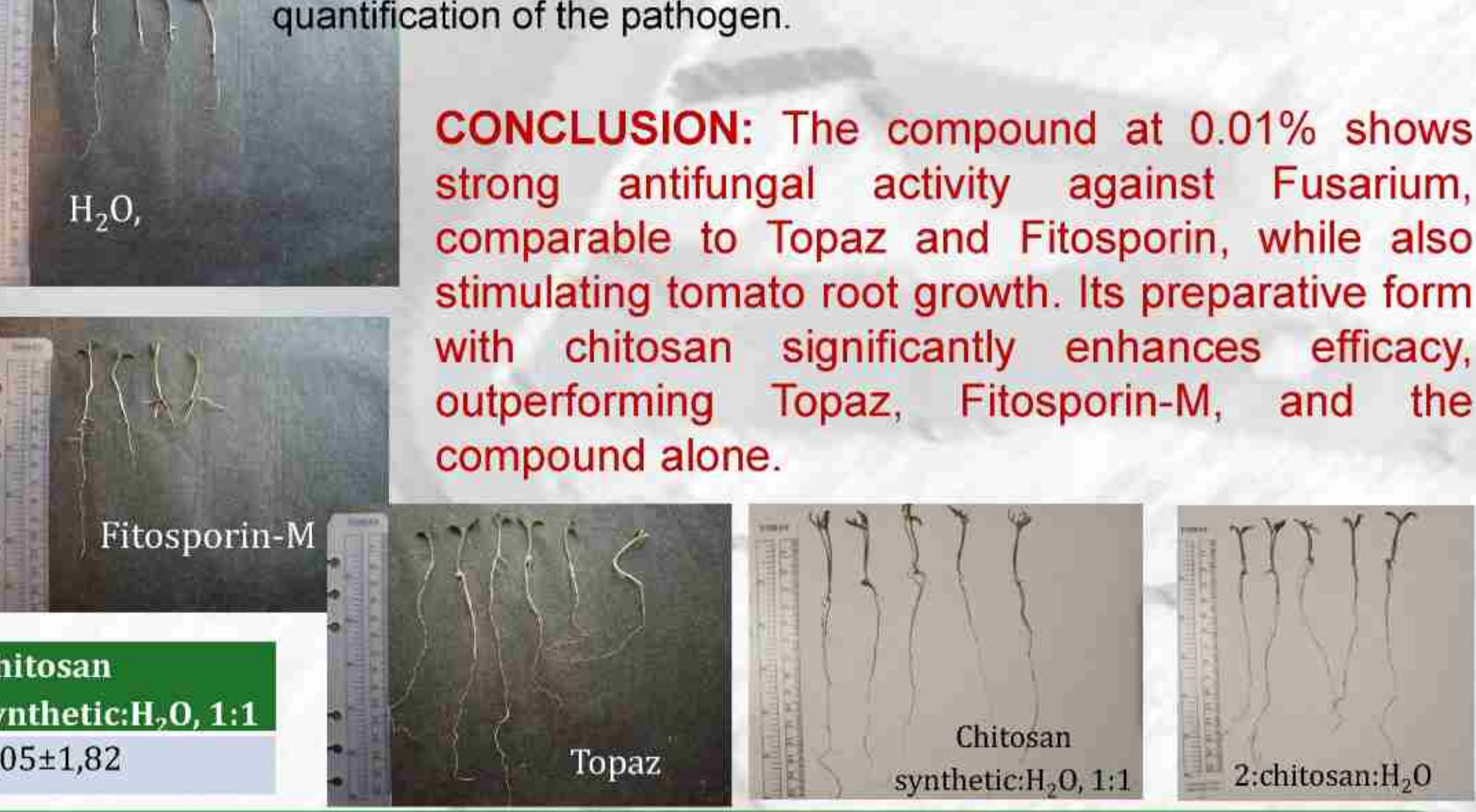
Seria	H ₂ O	2, 0,1%	2, 0,01%	2:chitosan:H ₂ O	Chitosan synthetic	Chitosan synthetic+H ₂ O, 1:1
Stem, mm	31,06±6,43	18,11±7,94	37,4±7,81	21,39±5,84	39,31±14,38	51,88±6,04
Root, mm	43,29±15,26	22,22±8,58	46,0±15,04	39,54±10,98	46,63±17,16	65,75±15,12
Root/stem	1,43±0,54	2,08±2,62	1,26±0,43	1,88±0,45	1,25±0,36	1,30±0,43

Table 2. Effect of seed treatment with the tested compositions on the growth of vegetative organs and the spread of *Fusarium* spp. fungi in the tissues of tomato plants grown in infected soil

	Root, mm	Stem, mm	Root/Stem, mm/mm
H ₂ O	24,83±29,61	18,33±12,48	1,55±1,45
Fitosporin-M	24,75±24,75	21,50±7,50	1,23±0,98
Topaz	88,44±56,41	17,11±6,23	5,45±4,47
2, 0,1%	n/a	n/a	n/a
2, 0,01%	124,80±58,76	18,50±3,69	6,66±2,98
2:chitosan:H ₂ O	148,20±81,88	20,60±3,65	7,70±5,64
Chitosan synthetic	137,14±72,80	20,29±4,42	6,54±2,51
Chitosan synthetic+H ₂ O, 1:1	115,64±59,27	23,36±8,28	4,72±1,09

Table 3. Effect of tomato seed treatment with the tested compositions on the accumulation of *Fusarium* spp. DNA in plant tissues

	H ₂ O	Fitosporin-M	Topaz	2, 0,1%	2, 0,01%	2:chitosan:H ₂ O	Chitosan synthetic	Chitosan synthetic+H ₂ O, 1:1
ΔCq	9,59±0,21	2,44±0,55	1,40±0,30	n/a	2,21±1,47	1,02±0,81	4,39±0,42	3,05±1,82



CONCLUSION: The compound at 0.01% shows strong antifungal activity against *Fusarium*, comparable to Topaz and Fitosporin, while also stimulating tomato root growth. Its preparative form with chitosan significantly enhances efficacy, outperforming Topaz, Fitosporin-M, and the compound alone.

ADVANTAGES: Accessibility and ease of synthesis of the claimed compound. Pronounced fungitoxic activity against *Fusarium* spp. at low concentration (0.01%). Dual action: fungicidal effect combined with immunostimulatory properties. Synergistic enhancement of activity when formulated with chitosan, surpassing commercial standards (Topaz, Fitosporin-M) and the individual components. Potential to reduce chemical load in agriculture while increasing plant resistance and productivity.

IMPLEMENTATION STAGE: laboratory stage

ACKNOWLEDGMENTS: This research was carried out within the framework of the project 24.80012.5007.13TC "Development of formulations against tomato phytopathogens based on indigenous natural substances and their derivatives".



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NEW COPPER(II) COMPOUNDS AS INHIBITORS OF CANCER CELLS
PROLIFERATION

Patent request 20240031 from 2024.10.16

AUTHORS: Aurelian Gulea, Victor Țapcov, Olga Garbuz,
Roman Rusnac, Aliona Pîntea

APPLICATION FIELDS: Medicine and Pharmaceutics

AIM: The present invention consists in obtaining new coordination compounds that possess properties of inhibiting the proliferation of cancer cells.

SOLUTION: Synthesis and structural characterization of {N-[(2-methoxyphenyl)-2-(pyridin-2-yl-methylidene)hydrazine-1-carbothioamido]]copper(II) nitrates (*compound I*) and {N-[(4-methoxyphenyl)-2-(pyridin-2-yl-methylidene)hydrazine-1-carbothioamido]]copper(II) (*compound II*) as proliferation inhibitors of a) cell lines: BxPC-3 – pancreatic cancer, RD – human muscle rhabdomyosarcoma, HeLa – cervical cancer, HL-60 – human myeloid leukemia, LNCaP – human prostate carcinoma cancer, MCF-7 – breast carcinoma cancer, HepG-2 – human liver hepatocellular carcinoma cancer, K-562 – human bone marrow chronic myeloid leukemia cell line.

The IC₅₀ (μM) values of anticancer activity of compounds I and II

Compound	Cell lines							
	BxPc-3	RD	HeLa	HL-60	LNCaP	MCF-7	HepG-2	K-562
Cisplatin	0,5	0,15	0,1	0,08	0,8	0,3	0,2	0,3
I	0,1	0,1	0,8	0,03	0,8	0,1	0,4	0,5
II	0,1	1,2	1,1	0,03	0,3	0,6	0,6	0,03

*Average results of three experiments, SEM < ±3%.

ADVANTAGES: The invention consists of the establishment of anticancer activity of compounds I and II, which exceeds the cisplatin activity by 17-2.7 times and exceeds the analogous characteristics of the structural analogue by 30-1.1 times.

IMPLEMENTATION STAGE: Design, prototype

ACKNOWLEDGMENTS: This research was supported by the institutional project #010602




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