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ORIGINAL ARTICLE **OPEN ACCESS**

Isolation, Characterization of Compounds from Bark of Cinnamon And Its Anti-Microbial Activity a against Covid 19 *In Silico* Analysis

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ABSTRACT

Metal Nanoparticles (NPs) have been widely used for various applications in biomedical sciences, including in drug delivery, and as therapeutic agents, but limited owing to their toxicity towards the healthy tissue. This warrants an alternative method, which can achieve the desired activity with much reduced or no toxicity. Being a eco-friendly C. varum is besides non-toxic as compared to chemical bsased NPs. NTA is oxidized by the silver ions adsorbed on the silver oxide surface can be a good catalyst. Extract and analyse phytochemical from cinnamaldehyde. Synthesize AgNPs by Cinnamon extract. Characterize the reduction of Silver nanoparticle and analyse the performance of antibacterial activity and then analyse antioxidant property of silver nanoparticle, Finally check the performance of molecular docking of phytochemicals against Covid 19.A variety of preparation techniques have been reported for the synthesis of silver NPs; notable examples include, laser ablation, gamma irradiation, electron irradiation, chemical reduction, photochemical methods, microwave processing, and biological synthetic methods. Gas chromatogram of cinnamom extract shows presence of 15 different compounds. AgNPS were synthesized eco-friendly method using cinnamon as reductant and nictonicacidhydrazide as stabilizer. Changes on white to brown colour indicates formation of silver nanoparticle confirmed by UV absorption around 350 nm. The FTIR study was carried out to recognize the possible biomolecules responsible for proficient stabilization of silver nanoparticles shows identical vibration of Nicotinic acid and cinnamom extract. The aqueous silver ions when exposed to leaf broth were reduced and resulted in the green synthesis of rod shape silver nanoparticles ranges from 50 nm to 100 nm.

Key words: *Cinnamon, cinnamaldehyde, silver nanoparticle, molecular docking of phytochemicals against Covid 19.*

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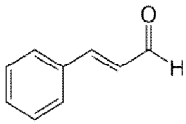
INTRODUCTION

Cinnamon spice is obtained from the inner bark of several trees within the genus, which itself is comprised of approximately 250 plant species [1]. The most common species are C. cassia (Chinese cinnamon, commonly referred to as Cassia) and C. verum (also called C. zeylanicum, commonly referred to as true cinnamon). These two species contain a varying percentage of cinnamaldehyde with up to 85.3% and 90.5% reported, respectively. trans-Cinnamaldehyde has been identified as the component that gives rise to much of the reported antimicrobial properties of this spice [2]. Isolated cinnamaldehyde has been shown to effectively inhibit the growth of an array of microorganisms such as bacteria, moulds, and yeasts, as well as having been reported to inhibit toxin production by micro-organisms[3].

Structure of Cinnamaldehyde:



Cinnamon bark has been utilized since thousands of years as a spice, flavouring agent and food seasoning it is also used in traditional medicine for treatment of diabetes, tumors, diarrhea, fever, common cold, toothache, nausea, chill, flatulence, amenorrhea, headache, cough, cardiovascular diseases, eye inflammation, bad breath, rheumatism, dyspnea, leukorrhea, frigidity, vaginitis, impotency and neuralgia [4], and many more. Botanically, cinnamon is a tropical tree, the inner bark is mostly used as a spice, it belongs to family Lauraceae, comprises about 250 species, four of them are of commercial importance and traded worldwide, which are Ceylon cinnamon (Cinnamomum verum or Cinnamomum zeylanicum) from India and Sir Lanka, Chinese cinnamon (Cinnamomum cassia or Cinnamomum

aromaticum), Indonesian cinnamon (Cinnamomum burmannii) and Vietnamese cinnamon (Cinnamomumloureiroi) [5].

Flavorant: There is numerous applications of cinnamaldehyde that is beneficial to human. The most obvious application for cinnamaldehyde is as a flavouring agent in chewing gum, ice cream, candy, and beverages. It is used at the levels ranging from 9 to 4900 parts per million (ppm) or less than 0.5% [6]. It is also used in some natural and also in perfumes, sweet or fruity scents. So, almond, apricot, butterscotch, and other natural aromas may partially employ the compound for their pleasant smells [7]. Then, cinnamaldehyde sometimes used as a food adulterant; powdered beechnut husk aromatized with cinnamaldehyde can be marketed as powdered cinnamon[8].The cinnamaldehyde flavouring present does not possess any risk to the health of the consumer[9].

Anticancer Recent research reports documented the anticancer activity of cinnamaldehyde/cinnamic aldehyde was observed in cell culture and animal models of the disease. Proliferation, invasion, and tumour growth were inhibited in a murine A375 model (rats and mice) of human melanoma (skin cancer), though only at high doses of cinnamaldehyde [10]. The result reveals the propenal group and as well as the functional group in the 2'-position of cinnamaldehyde structure possesses anti-cancer activity.

Cinnamaldehyde in food industry: Cinnamaldehyde are essentially utilized as food enhancing and a therapeutic herb. Over the span of studies intended to find its most extreme microbial lethality under food transforming conditions, a gas chromatographic-mass spectrophotometric system was created for the extraction and examination of essential oil components, for example, cinnamaldehyde from commercial cinnamon containing foods (a few brands of cinnamon breads, oats, treats, puddings, and fruits juices). The cinnamaldehyde substance went as additive in squeezed orange in apple cinnamon cereals and for cinnamon swirl bread. [11].

Covid 19 Drug Target:

Coronaviruses (CoV) (family: Coronaviridae) are enveloped viruses containing non-segmented, positive-stranded genomic RNA. These viruses are pleomorphic particles ranging from 80–220 nm in diameter. The genome size of coronaviruses ranges from 26–32 kilobases. It has better genome sequence vis-à-vis to the SARS-CoV compared to MERS-CoV, but the amino acid sequence is different from the other coronavirus, especially in the region of 1ab polyprotein and S-protein or surface glycoprotein[12].

The causative pathogen was identified as a beta coronavirus with high sequence homology to bat corona viruses (CoVs) using angiotensin-converting enzyme 2 (ACE2) receptors the dominant mechanism of cell entry [13].

The Viral RNA Synthesis and Replication

Non-structural proteins (Nsps), functional proteins, participate in viral replication and infection of the host by inducing transcription and translation of viral RNA. These proteins are getting the current and future attention as drug targets for COVID-19 treatment.

RNA-Dependent RNA Polymerase (RdRp)

RdRp also known as Nsp12 is a conserved protein in COVID-19 which is an essential enzyme for RNA transcription and replication of this virus. The RdRp domain of polymerase is located at the C-terminus, and has a conserved Ser-Asp-Asp motif·Drugs like favipiravir, ribavirin, penciclovir, silybin, galidesivir, itraconazole, novobiocin, chenodeoxycholic acid, cortisone, idarubicin, pancuronium bromide, diastral etexilate 6'-fluorinated-aristeromycin analogues, acyclovir, and fleximer analogues exhibited RdRp inhibition [14].

Papain-Like Protease (PLpro)

Despite the lack of clinical evidence, disulfiram has been revealed to inhibit MERS and SARS papain-like protease in cell cultures. On the other hand, clinical trials have been initiated to test ritonavir and lopinavir in patients infected with COVID-19 [15] remdesivir.

MATERIALS AND METHODS

Chemicals

Materials used for the preparation of SNPs colloid were silver nitrate (AR) from Merck Ltd., Mumbai, India, sodium hydroxide (AR) of analytical grade form SD Fine-Chem.Ltd., Nictonic acid hydrazide (Avira, Mumbai)

Instrumentation

For kinetic measurement and absorption spectra, a LAB UV Next Gen UV–visible double beam spectrophotometer equipped with an A-100 constant-temperature sipper system was used. A Thermo Scientific Nicole 6700 Fourier transform infrared (FTIR) spectrometer was used for the study of the functional group linked with the prepared SNPs

Synthesis and Kinetics of Silver Nanoparticles

Freshly prepared thermally equilibrated solutions at 25 ± 0.1 °C for 1/2 h in a thermostat were used throughout the present study. A glass-stoppered two-necked flask was used to carry out the reaction, which was fitted with a condenser to eliminate the chances of evaporation. The SNPs colloid was obtained by the reduction of $AgNO_3$ by injecting 10mL of Cinnamon extract in the presence of already pre-equilibrated and 10 mg Nicotinic acid hydrazide and NaOH solution (to maintain the alkaline pH) at 25 ± 0.1 °C in the required amount into the two-necked flask.

Ultraviolet-Visible Absorbance Spectroscopy

The bio reduction of silver ions (Ag^+) into silver nanoparticles (Ag^0), nicotinic acid hydrazide and cinnamon extract was monitored in aqueous solution by a UV-Vis spectrophotometer (Lambda 35® PerkinElmer, USA) at regular interval in wavelength ranges between 200 and 1,000 nm.

FTIR Spectroscopy

FTIR spectroscopy analysis of AgNPs was conducted to confirm the promising role of a mixture of phytoconstituents of the plant extracts and Nicotinic acid hydrazide on the surface alternation and stabilization of biosynthesized AgNPs. The ATR-FTIR was performed using Bruker alpha spectrophotometer with a resolution of 4 cm^{-1}. The samples were scanned in the spectral ranges of 4,000–500 cm^{-1} by an average of 25 scans per sample and the result obtained was analyzed through SPS software.

Metal Chelating Activity

Antioxidant activity of extract was performed by metal chelating activity. Cinnamon extract, Nicotinic Acid and AgNP were tested at 100 µL contain 25, 50,75 and 100 µg/mL was mixed with 50 µL of 2 mm, ferrous chloride, and the reaction was started by adding 0.2 ml of 5 mm ferrozine. Then, absorbance was recorded at 562 nm after 10 min in a dark room. Distilled water, instead of extract, was used for the control. Metal chelating activity was calculated by: EDTA is used as standard

Inhibition (%) = (1 − A562(test)/A562(control)) × 100

Antibacterial activity

The antibacterial activity of ethanol extract of cinnamon and nicotinic acid examined by disc diffusion method against *Escherichia coli, S.aureus* and *Candida albicans*. Disc were loaded with 50 µg of compound and placed over the agar surface previously inoculated with test pathogen. the zone of inhibition against tested pathogens were recorded after 24 h incubation at 37° C. tetracyclin used as positive control.

Molecular docking:

Compounds from extract matched with PubChem and smiles are retrieved and its ADME were tested on SWISS DOCK. Preparation of protease of COVID19 (PDB 7AEH) structure was conducted by downloading the receptor macromolecule from the Protein Data Bank from http://www.rcsb.org/pdb formatted from .pdb website to .pdb. Cavity must be determined to find the residues in the receptor. The cavity determination was performed using the offline Auto dock software that was downloaded from https://www.cgl.ucsf.edu/chimera/ Receptor macromolecules were separated from solvents and ligands or nonstandard residues. The separation of macromolecules from unnecessary molecules was done using the Discovery Studio 4.0 program. The result of the separation was saved in .pdb format. The design of the ligand structure of the derived compound is downloaded from the PubChem site (http://pubchem.ncbi.nlm.nih.gov./). The docking file preparation was conducted by using Autodock Tools that was optimized by setting the number of action torsion and converting the format to .pdbqt. While the receptor preparation was being conducted by adding hydrogen polar, the grid box was set to know the position of the binding site and the format was changed to. pdbqt. This file was saved in a single folder in the C: drive on the computer. Molecular Docking Process was conducted using AutodockVina. Ligands and receptor that were already in drive C: copied and converted in the form of notepad were saved with a conf.txt name, AutodockVina was executed with command prompt program. Molecular docking analysis was done by looking at the free energy value of binding docking results, viewed at the output in log.txt format.

RESULT AND DISCUSSION

Synthesis and characterization of silver nanoparticle

We adopted a simple procedure to synthesize silver nanoparticles from cinnamon bark extract. For the green synthesis of silver nanoparticles by *C. zeylanicum* plant extracts were carried by 5 ml of extract was added to 1000 ml of 5mM AgNO3 solution (plate 1). On mixing the plant extract of *C. zeylanicum* with silver nitrate solution (1mM), the colour of the reaction mixture started changing to yellowish within 1hr and to dark brown after 8 h. further it was noted that addition of Nicotinic acid hydrazide 100µg/mL to the reaction vessel reduction process was observed with in 30 min. The formation of silver nanoparticles was monitored with colour change and UV-Vis spectrum. The colour of the reaction mixture started changing to brown within 45 min. The most characteristic part of silver solution is a narrow plasmon

absorption band observable in the 250 – 350 nm regions. The distinct visible peak was observed at 405nm which is an indication of reduction of silver. This indicates that by UV method, silver gets reduced in a faster way than the conventional method. The morphology of NP reveals rod shaped AgNP 50- 100 nm This band may be due to intermolecular charge transfer transition involving the whole electronic system of the compound with a considerable charge transfer character originating mainly from the pointing towards the carbonyl group of the above mixture .

The Ultraviolet spectra analysis of cinnamon extract, nicotinicacidhydrazide and silver nanoparticle has been investigated by UV-Visible spectral analysis and the spectrum are shown in figs 1,2,3. The experimentally absorption maxima value of cinnamon extract and nicotinic acid hydrazide has been found to be 279 and 209, 261nm respectively. The silver nanoparticle is prepared by using cinnamon extract and nicotinic acid hydrazide mixture. The silver nanoparticle absorption maxima is 256 and 304 nm which is different from the cinnamon extract and nicotinic acid hydrazide maximum absorption value

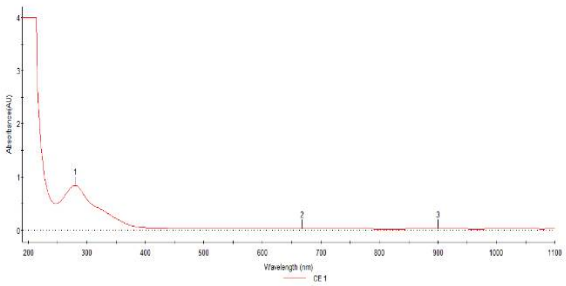


Figure 1. UV spectrum of extract of Cinnamon EXTRACT

Name	No.	Peak(nm)	Peak(AU)	No.	Valley(nm)	Valley(AU)
CE	1	279.85	0.8403			
	2	668.25	0.0308			
	3	899.90	0.0286			

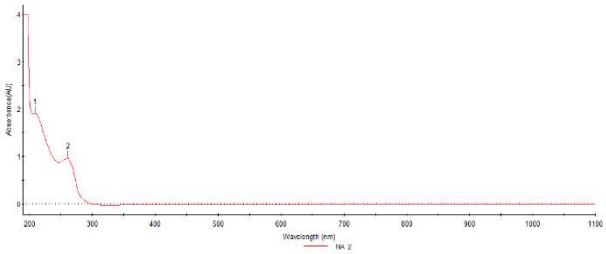


Figure 2. UV spectrum of NA

No.	Peak(nm)	Peak(AU)
1	209.45	1.9038
2	261.30	0.9649

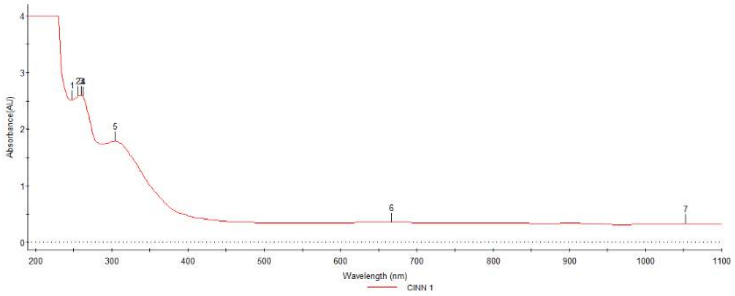


Figure 3. UV spectrum of Silver NP

Name	No.	Peak(nm)	Peak(AU)	No.	Valley(nm)	Valley(AU)

CINN	1	247.70	2.5215
	2	256.35	2.6101
	3	260.05	2.5996
	4	262.50	2.6013
	5	304.65	1.7959
	6	667.00	0.3597
	7	1,051.75	0.3311

FTIR Characterization

Figure4 represent the correlation of capping agents stretching on silver nanoparticle shows some similar vibration of cinnamon extract. FTIR vibration of cinnamon extract (fig 5) recorded at 3416, 2994, 2925,2854, 1769, 1758 1246 1098, and 1053 cm^{-1} . Nicotinic hydrazide is an inhibitor of peroxidase enzyme. It forms solid metal complexes having strong biological activity shows vibration around 3435,2985,2090,1634,1451,1349,1066,1076 and 1045 cm^{-1}(fig 6).FTIR data of silver nanoparticle shows major vibration peaks recorded as 3380,2975,2899,2926,2256,1925,1650,1451,1407,1382 and 1049 cm^{-1}(fig 7). Vibration The OH and N–H stretching vibrations generally give rise to bands at 3600-3300 and 3500–3200 cm^{-1} respectively. In the present case, the bands observed at 3416 and 3435 cm^{-1} assigned as phenolic OH stretching vibrations of cinnamon and NH stretching vibrations of nicotinicacidhydrazide respectively which is decreases at 3380 cm^{-1} for cinnamon mediated silver nano particle. The cinnamon mediated silver nano particle have two CH stretching frequency is at 2975, 2926 cm^{-1}. This is differ from the cinnamon extract (2994, 2925 cm^{-1}) and nicotinicacidhydrazide (2985 cm^{-1}). The Carbonyl group (C=O) stretching frequency of extract is observed at 1769 cm^{-1} and the mediated silver nanoparticle is observed at 1650 cm^{-1}. From the above values clearly reveals that the extract will reduce the size of silver into silver nanoparticle. The obtained data of plant extract is correlate with the bioactive constituent present in bark extract of Cinnamomum reported by Maruthamuthuand Kumaresan

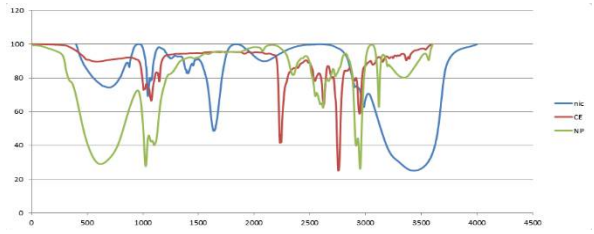


Figure 4 FTIR data of AgNP and capping agents

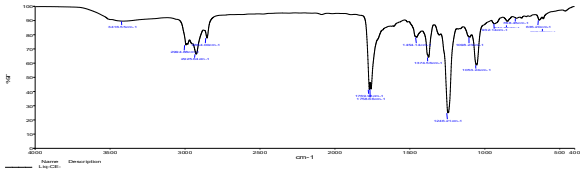


Figure 5.FTIR spectrum of extract of Cinnamon

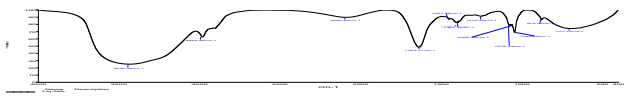


Figure 6. FTIR of nicotinic acidhydrazide

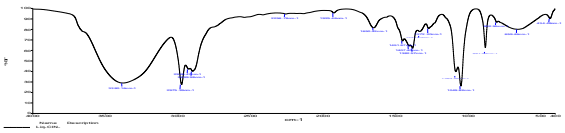


Figure 7 FTIR spectrum of Cinnamaldehyde mediated Silver NP

GCMS analysis

Gas chromatogram of cinnamom extract shows presence of 15 different compounds (fig 8) and the detected compounds are enlisted on table 1. Out of 15, 72.15% Cinnamyl acetate, 12.13% Cyclohexasiloxane, dodecamethyl-4.09% Coumarin, 3.55% Coumarone were predominantly found .the

retention time begins at6.45 min identified compound is phosphorous acid, triphenyl ester and end with 39min with 2-((trimethylsilyl)ethynyl)heptamethyltrisilane. ethanone, 2-(4-chlorophenyl)-1-cyclohexyl-2-(1-piperidinyl)-, 1,3-diphenyl-1-((trimethylsilyl)oxy)-1(e)-heptene and 4-tert-Octylphenol, TMS derivative were found in trace amount. The ADME pharmacological activity of Cinnamylacetate, coumarin, Coumarone were given in table 2 denotes that these compounds are low molecular weight, readily soluble and don't have any violation. These compounds were selected for docking with COVID 19 target

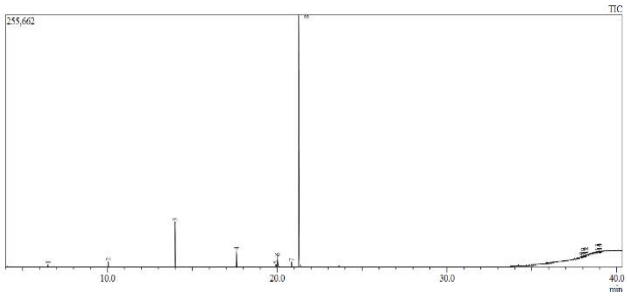


Fig 8 GCMS analysis

Table 1. NIST matched detected compound

	Retention time	Area %	Name
1	6.495	0.32	PHOSPHOROUS ACID, TRIPHENYL ESTER
2	10.047	1.19	BENZOIC ACID, 2,6-BIS(TRIMETHYLSILOXY)-, TRIMETHYLSILYL ESTER
3	13.983	12.13	Cyclohexasiloxane, dodecamethyl-
4	17.604	72.15	Cinnamyl acetate
5	19.917	1.11	Fluro[2,3-c]pyridine, 2,3-dihydro-2,7-dimethyl-
6	20.025	3.55	Coumarone
7	20.849	4.09	Coumarin
8	21.27	1.31	1,2,3-PROPANETRICARBOXYLIC ACID, 2-HYDROXY-, TRIETHYL ESTER
9	37.94	0.68	ETHANONE, 2-(4-CHLOROPHENYL)-1-CYCLOHEXYL-2-(1-PIPERIDINYL)-
10	38.025	0.3	ETHANONE, 2-(4-CHLOROPHENYL)-1-CYCLOHEXYL-2-(1-PIPERIDINYL)-
11	38.139	0.48	ETHANONE, 2-(4-CHLOROPHENYL)-1-CYCLOHEXYL-2-(1-PIPERIDINYL)-
12	38.19	0.91	ETHANONE, 2-(4-CHLOROPHENYL)-1-CYCLOHEXYL-2-(1-PIPERIDINYL)-
13	38.86	0.35	1,3-DIPHENYL-1-((TRIMETHYLSILYL)OXY)-1(E)-HEPTENE
14	38.971	0.52	4-tert-Octylphenol, TMS derivative
15	39	0.93	2-((TRIMETHYLSILYL)ETHYNYL)HEPTAMETHYLTRISILANE

Antioxidant activity

The significant antioxidant potential of AgNPs was evaluated by metal chelating(plate 2) radical scavenging assay having IC50 77µg/mL among AgNP, 81 µg/mL for nicotinic acid and 309 µg/mL for cinnamon extract (table3). The EDTA was used as a standard. the antioxidant activity of synthesized nanoparticles using metal chelating assay and observed the antioxidant potentials of photosynthesize nanoparticles recorded as 26,42,58,70%. Metal chelating potential of cinnamon were 32,42,52,68% and nicotinic acid shows 14,16,29,45 % They suggested that phytochemical mediated silver NPs can be used as a potential free radical scavenge.

TABLE 2.ADME and pharmacological property of identified compound

Con	Nicotinic acid	Cinnamon	AgNP
25	14	32	26
50	16	42	42
75	29	52	58
100	45	68	70
Ic50	81	309	77

Table 3.percentage of Antioxidant activity of AgNP

Compound name	Molecular weight	H acceptor	H-donar	Log p	Log s	GI abortion	BBB permeant	Lipinski	Pain
Cinnamyl Acetate	176.21g/mol	2	0	2.17	-2.43	High	Yes	Yes 0 violation	0 alert
coumarin	146.14g/mol	2	0	1.75	-2.29	High	Yes	Yes 0 violation	0 alert
Coumarone	118.13g/mol	1	0	1.90	-2.99	High	Yes	Yes 0 violation	0 alert

Antibacterial effect

Antimicrobial potential of nicotinicacidhydrazide(NAH)and cinnamon extract against *candida albicans* and E.coli was evaluated by disc diffusion method(plate 3) and it was noted that NAH have had moderate antimicrobial activity (16 mm) against both pathogens and Cinnamon extract showed less significant activity(12 mm). The antifungal activity of AgNP was significant antibacterial activity against 3 test pathogens and showed 20 mm zone of inhibition (plate 4) against *C.albicans, E.coli and S.aureus*. Condensation of nicotinic acid hydrazide with plant extract exhibited potent antibacterial reported previously by many reported researchers

***In silico* antiviral activity**

The pandemic that started in Wuhan (China) in 2019 has caused a large number of deaths, and infected people around the world due to the absence of effective therapy against coronavirus 2 of the severe acute respiratory syndrome (SARS-CoV-2).Viral

maturation requires the activity of the main viral protease (MPR), so its inhibition stops the progress of the disease. To evaluate possible inhibitors, a computational model of the SARS-CoV-2 enzyme Mpr was constructed in complex with 3 selected compounds. Ligand 1 Coumarin (PLATE 5) shows interaction with MPR and molecular docking of the models show a moderate affinity for the enzyme (score -4.2/ GLU). Coumarone formed hydrogen bond with THR and ASN and the docking score -4.7 much better than coumarin. Third compound Cinnamyl Acetate interacted with SER and ASN of MPR formed hydrogen bond with docking score -4.5 to -5 shows highest affinity(plate 7).In addition to the high affinity of these compounds for SARS-CoV-2 Mpro, low toxicity is expected considering the Lipinski, rules. Therefore, this novel study provides candidate inhibitors that would allow experimental studies which can lead to the development of new treatments for SARS-CoV-2.

Plate 6 Interaction of Coumarone With Covid 19 Main Protease

Amino acid	H distance A◦	Score
THR(92)	2.131A◦	-4.7
ASN(135)	2.059A◦	-4.2

Plate7: Interaction of cinnamyl acetate ith covid19 main protease

Amino acid	H distance A◦	Score
SER(114)	2.129A◦	-4.5
ASN(135)	2.086A◦	-5.0

CONCLUSION

A variety of preparation techniques have been reported for the synthesis of silver NPs; notable examples include, laser ablation, gamma irradiation, electron irradiation, chemical reduction, photochemical methods, microwave processing, and biological synthetic methods. Gas chromatogram of cinnamom extract shows presence of 15 different compounds. AgNPS were synthesized eco-friendly method using cinnamon as reductant and nictonicacidhydrazide as stabilizer. Changes on white to brown colour indicates formation of silver nanoparticle confirmed by UV absorption around 350nm.The FTIR study was carried out to recognize the possible biomolecules responsible for proficient stabilization of silver nanoparticles shows identical vibration of Nicotinic acid and cinnamom extract. . the aqueous silver ions when exposed to leaf broth were reduced and resulted in the green synthesis of rod shape silver nanoparticles ranges from 50 nm to 100 nm. Metal chelating property of nicotinic acid, cinnamon extract and AgNP found to be concentration depended and more significant at AgNP WITH LEAST ic50 77µGAgNPs were tested fort heir antibiotic sensitivity pattern against E.coli and C. albicans by the Kirby–Bauer disk diffusion method and found to be effective on AgNP, moderately by Nicotinic acid hydrazide

and less significant on extract. Further the *in silico* docking of phytochemical Cinnamyl acetate ,coumarine and coumarone have ability to bind and interfere the main protease of covid 19 suggest that the application of AgNP as vital role in anti-viral therapy. The DATA anticipate that the insights obtained in the present study may prove valuable for researching and developing novel anti-COVID-19 therapeutic Nano silver agents in the future.

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CONFLICT OF INTEREST:
The authors declare that they have no conflict of interest.

REFERENCES

1. Singh,G,Maurya,S., de Lampasona,M.P. and Catalan (2007). A comparison of chemical, antioxidant and antimicrobial studies of cinnamon leaf and bark volatile oils, oleoresins and their constituents. Food and Chemical Toxicology.45(9):1650–1661.
2. Shreaz,S.,Wani,W.A., Behbehani,J.M., Raja,V., Irshad ,M., Karched ,M., Ali,I.,Siddiqi,W.A.,and Hun, L.T. (2016).Cinnamaldehyde and its derivatives, a novel class of antifungal agents.Fitoterapia.112: 116–131.
3. Visvalingam,J., Hernandez-Doria,J.D., and Holley,R.A. (2013) Examination of the genome wide transcriptional response of Escherichia coli O157:H7 to Cinnamaldehyde exposure. Appl. Environ. Microbiol.79 :942–950.
4. Gill,A.O., and Holley,R.A.(2006) Disruption of Escherichia coli, Listeria monocytogenes and Lactobacillus sakei cellular membranes by plant oil aromatics.Int. J. Food Microbiol.108 : 1–9.
5. Hajimonfarednejad,M.,Ostovar,M.,Raee,M.J., Mayer,M.H., Hashempur,J.G., and Heydari,M. (2019) Cinnamon: A systematic review of adverse events. Clinical Nutrition. 38: 594-602.
6. Ribeiro-Santos, R., Andrade, M., Madella,D., Martinazzo, A.P., Moura, L.A.G., Melo, N.R. and Sanches-Silva A 2017. Revisiting an ancient spice with medicinal purposes: Cinnamon.Trends in Food Science and Technology. 62: 154-169.
7. Gutiérrez, L., Escudero, A., Batlle, R. and Nerín, .C (2009) Effect of mixed antimicrobial agents and flavors in active packaging films. Journal of Agricultural and Food Chemistry.57(18): 8564–8571.
8. Friedman, M., Kozukue,N. and Harden, L.A.(2000) Cinnamaldehyde content in foods determined by gas chromatography-mass spectrometry. J. Agric Food Chem.48: 5702–5709.
9. Chang,S.T., Chen, P.F. and Chang ,S.C. (2001) Antibacterial activity of leaf essential oils and their constituents from Cinnamomumosmophloeum.J. of Ethnopharmacology. 77(1):123-127.
10. Burt, S.(2004) Essential oils: their antibacterial properties and potential applications in foods--a review. Int. J. Food Microbiol. 94: 223–253.
11. Gomes,C.,Moreira,R.G. and Castell-Perez,E. (2011) Poly (DL-lactideco-glycolide) (PLGA) nanoparticles with entrapped trans cinnamaldehyde and eugenol for antimicrobial delivery applications. Food Sci. 76: 16–24.
12. Filoche,S.K., Soma,K. and Sissons,C.H. (2005) Antimicrobial effects of essential oils in combination with chlorhexidinedigluconate. Oral Microbiology and Immunology.20(4): 221–225.
13. Arabi,Y.M., Alothman,A., and Balkhy, H.H. (2018). Treatment of Middle East Respiratory Syndrome with a combination of lopinavir-ritonavir and interferon-beta1b (MIRACLE trial): study protocol for a randomized controlled trial. Trials.19(1):81.
14. Gallagher,T.M., Buchmeier and Coronavirus,M.J. (2001). **S**pike proteins in viral entry and pathogenesis. Virology.279 (2): 371– 374.
15. Chang,C.K., Sue, S.C., Yu, T.H., Hsieh,C.M, Tsai,C.K., Chiang,Y.C., Lee,S.J., Hsiao,H.H., Wu, W.J., Chang, W.L., Lin,C.H. and Huang,T.H.(2006). Modular organization of SARS coronavirus nucleocapsid protein. J. Biomed. Sci. *13* (1): 59– 72.

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