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Original Article

The Antibacterial, Antioxidant Properties and Natural Compound Screening Method of *Cinnamomum zeylanicum* Bark was Investigated through FTIR Testing

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Abstract:
Both in vivo and in vitro studies have demonstrated that phytochemical components of photobiotic have potent antibacterial effects against Gram-positive and Gram-negative bacteria. There was a lack of data on cinnamon powder's minimum inhibitory concentration (MIC) and in vitro antibacterial effectiveness against different microorganisms. Thus, the purpose of this research was to compare the in vitro antibacterial activity and MIC of cinnamon powder extracts with that of conventional antibacterial medications against a range of microorganisms. The standards of CTX-Cefotaxime and GN-Gentamicin, as well as the methanolic crude extract and ethanol fraction of *Cinnamomum zeylanicum* bark extracts, have antibacterial activities that were measured at 21.08±0.33, 16.89±0.31, 34.00±0.32, and 29.60±0.31 respectively for *Bacillus subtilis*, and recorded 13.89±0.29, 17.00± 0.32, 24.81±0.25, and 26.90±0.27 respectively for *Enterococcus faecalis*, while recorded 09.11±0.15, 19.75±0.32, 20.00±0.21 and 17.45±0.19 respectively for *Streptococcus pyogenes*, in the same time antibacterial activity recorded 15.00±0.30, 08.68±0.14, 27.90±0.29 and 26.04±0.29 respectively for *Staphylococcus epidermidis* and recorded 15.90±0.30, 14.06±0.29, 29.95±0.31 and 32.17±0.33 respectively for Staphylococcus aureus. FT-IR peak values of solid analysis of *Cinnamomum zeylanicum* Bark. Peak (Wave cm-[1], Intensity, Corr. Intensity, Base (H), Area, Bond, Type of Vibration, and Functional group assignment recorded 667.37, 70.282, 2.383, 667.01, 2.226 and Alkenes; 690.52, 71.720, 0.518, 713.66, 3.769, and Alkenes; 788.89, 77.439, 2.341, 821.68, 4.707, Alkenes; 999.13, 66.259, 1.402, 1006.84, 12.823, and Alkenes; 1029.99, 63.849, 0.209, 1031.92, 4.297, and alkyl halides; 1226.73, 82.894, 0.214, 1228.66, 2.659, and alkyl halides; 1417.68, 85.533, 0.939, 1427.32, 2.347, and alkyl halides; 1454.33, 85.135, 1.371, 1483.26, 2.052, and alkyl halides; 1516.05, 85.999, 0.843, 1521.84, 1.943, and Aromatic; 1539.20, 85.109, 1.482, 1571.99, 2.655, and Aromatic; 1645.28, 78.585, 0.511, 1647.21, 5.122, Amide; 2854.65, 85.991, 4.453, 2868.15, 2.326, and Alkane. The anti-oxidant properties of *Cinnamomum zeylanicum* were studied in methanol, ethanol extract, and standards, specifically looking at its ability to scavenge superoxide and nitric oxide radicals recorded 23.79±1.92, 19.84±1.75, and Quercetin (standard) 41.00±3.07 respectively of Superoxide radical scavenging. 43.90±3.08, 31.00±2.95, and Curcumin (standard) 65.00±4.97 respectively of Nitric oxide radical scavenging.

Keywords: Natural Compound, *Cinnamomum zeylanicum* Bark, Antioxidant, FTIR

Introduction:

The use of phyto biotics or PFAs are beneficial since they have medicinal benefits and are a safe alternative to antibiotics as growth promoters. Such products come from plants, including essential oils, herbs and oleoresins [1-3]. They are mixed with feed or water provided to commercial animals so that their performance grows, including the results produced and the quality of merchandise produced through animals. A spice means a dried portion of a plant or herb used in little amounts to add flavor, color or to preserve foods. Many of the main ingredients in spices contain significant amounts of flavonoids, carotenoids, terpenoids, and minerals, and they help with health in many ways like as antioxidants, antibacterial drugs, anti-inflammations, fighting cancer, stimulating digestion and lowering fever [4, 5]. Cinnamon (*Cinnamomum zeylanicum*) is a very old spice and belongs to the lauraceous family as well as the Cinnamomum genus. Its name in English is cinnamon, in Hindi it's dalchini, in Gujarat it's known as taj and in Sanskrit it is sometimes called tweak. The parts of cinnamon tree, like leaves and bark, are different in their chemical compounds. For example, leaves mainly contain 70-95% eugenol and 1-5% cinnamaldehyde while bark has 5-10% eugenol and 65-80% cinnamaldehyde. At present, people taking various drugs for different illnesses are being threatened by multidrug-resistant microbial infections. Too much use of antibiotics, lack of education, and a small amount of research on new drugs in the field could cause multidrug-resistant bacteria to affect people. Antimicrobial drug resistance rising and being spread to more places has created a new threat for the global Infectious Diseases Control Programme. A total of 122 compounds were recorded; 80% of them had the same or similar uses (for traditional medicine). It was also noticed that only 94 of the plants used for medicinal purposes had these compounds. Various traditional medicine practices throughout the world use a variety of secondary plant metabolites, e.g. tannins, terpenoids, alkaloids, flavonoids, phenols, and quinones, obtained from medicinal plants to manage various diseases and infections [10, 11]. For ages, both the Egyptians and the Chinese have turned to cinnamon (*Cinnamomum zeylanicum*) as a flavoring spice and a traditional medicine. Around 250 kinds of cinnamon species have been found all around the world. Spice plants are added to food for their taste and also have advantages in medicine, controlling diseases, and as an antioxidant. Cinnamon helps food stay fresh for a longer time. Cinnamon has been shown to fight inflammation, as well as control fungi, bugs, and cancers [12, 13]. According to a study, cinnamaldehyde is antimicrobial since its terpenoids and phenylpropanoids easily penetrate a cell's membrane, reach its internal parts, and negatively affect microorganism enzymes [14, 15]. The goal of this study was to check the antibacterial abilities of cinnamon bark extract in the fight against bacterial infections and contribute to the development of innovative drugs against resistant infections.

Materials and Methods:

Processing of Plant Materials and Extract Preparation

Powdered *Cinnamon zeylanicum* bark was purchased in Babylon's Hilla market, ground using a mechanical grinder, and stored in sealed containers. Making extracts thereafter required the usage of dried cinnamon powder. It was common practice to use ethanol as a solvent in Soxhlet extractions to obtain cinnamon bark powder. Following that, the mixture was subjected to reduced pressure in a rotary evaporator to concentrate it. After placing the extract in a rotary evaporator and setting the temperature to 40°C, the solvent was separated. For future experiments, the designated ethanolic extract was stored in a sterile screw-capped glass bottle at 4°C with the appropriate labelling. We rinsed the cinnamon barks with clean water and let them dry in the sun for two days. There you have it. Grinding the barks into a fine powder was the next step; after 30 minutes in an oven set to 40 °C, they were sufficiently dried. Ten grammes of

cinnamon powder and fifty millilitres of alcohol were mixed in a 250 millilitre Erlenmeyer flask and stirred. Placing the sealed flask on a shaker and leaving it at room temperature for 48 hours obtained the desired results. Following completion of incubation, the extract was spun in a centrifuge at 3,500 RPM for 20 minutes and filtered with Whitman filter paper No. 1. A semi-solid substance was created in the oven at 40 °C using the filtrate. The next step was to dry it at 45 °C in a crucible. Before we used the extract, we put it in the freezer at -20 ºC.

Antimicrobial Sensitivity Determination via Disc Diffusion Assay

To create a 10% dimethyl-sulfoxide (DMSO) solution, 90 ml of distilled water was put in a measuring cylinder, followed by 10 ml of DMSO dissolved into it. In order to ready the diffusion solution, 0.5 ml of tween 80 was blended in 99.5 ml of 10% DMSO.

Method for conducting disc diffusion test

The presence of antibacterial activity was checked in cinnamon powder methanolic and ethanolic extracts by carrying out the disc diffusion method. It was cultured in a medium broth at 37°C for 18 h and in 10 ml of Mueller-Hinton Agar. It was decided to test the suspension under a 0.5 McFarland turbidity standard, which is the same as about 1.5×108 CFU/ml in sterile saline solution. A sterile cotton swab was used to put a five hundred microliter sample of the suspensions on the agar plates of both control types and test types (standard and Gentamicin agar, respectively). The liquid was filtered through a 0.45 µm membrane to make it sterile. Using sterile aseptic conditions, 50 µl from the cinnamon powder-ethanolic and aqueous-extracts were distributed on the empty sterilized discs (6 mm) and these were carefully set on the agar. Sterile, moisted discs were set on the seeded plates to act as control in the experiment. The tests were run using standard doses of CTX-Cefotaxime (standard) and GN-Gentamicin (standard), as control measures. Each Petri plate was tightly wrapped with parafilm to stop its samples from drying out. The plates were kept at room temperature for 30 minutes so that the extracts could be diffused, after which they were kept at 37°C for 18 h. The day following incubation, the distance of the zone inhibition was measured with the aid of vernier caliper. Every concentration of the cinnamon extracts was tested against all the bacteria three times.

Antioxidant [Scavenging radicals of superoxide and nitric oxide]

Scavenging of superoxide radicals

This process used to be measured through an approach of removing NBTs, and this method is from a published source. If superoxide radicals are there, the system reduces NBT to the purple formazan while the PMS is together with NADH. Oxygen radicals are mainly produced in the body by O2. Into each well of the Graded Assignment Page 4, 1 ml of reaction mixture was added. It contained sample solutions of varying concentrations, 20 mM phosphate buffer at pH 7.4, sodium NADH, NBT, and PMS. After 5 minutes of incubation at room temperature, the formed formazan was measured at 562 nm and then compared to the suitable blank. In every instance, each test was repeated six different times. The experiments in the present study were conducted by using quercetin as a positive control.

Radical scavenging for nitric oxide

When added to water, SNP produces nitric oxide. At regular blood levels, it encounters oxygen and changes into nitrites ions. Such compounds are identified by carrying out the Griess Illosvoy method. The last volume (3 ml) of the reaction mixture had phosphate buffered saline, a pH of 7.4, different amounts of test solution (from 0 to 70 µg/ml), and 10 mM of SNP. After 150 minutes of incubation, 0. 5 ml of the mixture was taken and to this, 1 ml of sulfanilamide (0. 33% in 20% glacial acetic acid) was added; the mixture was left to stand for 5 minutes. After putting one milliliter of napthylethylenediamine dihydrochloride (NED) (0. 1% w/v) in the mixture, it was incubated at 25°C for 30 minutes. The amount of pink chromophore, which develops

when diazotized sulphanilamide provides NED, was measured at 540 nm after comparing it with the blank. They all take place six times each time the test is performed. There was a set standard of curcumin.

Statistical Analysis of Data

The information was analyzed using statistical programs made by IBM in New York, NY, USA, and Tukey HSD test was used in testing mean values at 95% or 99% confidence interval. For this study, statistical significance was decided as any p-value less than 0.05.

Results and Discussion:

FTIR showed useful results for studying surface-bound bioorganic compounds, but Raman worked better for spotting and describing changes in carbon and nitrogen groups. FT-IR peak values of solid analysis of *Cinnamomum zeylanicum* Bark. Peak (Wave number cm^{-1}, Intensity, Corr. Intensity, Base (H), Area, Bond, Type of Vibration, and Functional group assignment recorded 667.37, 70.282, 2.383, 667.01, 2.226 and Alkenes; 690.52, 71.720, 0.518, 713.66, 3.769, and Alkenes; 788.89, 77.439, 2.341, 821.68, 4.707, Alkenes; 999.13, 66.259, 1.402, 1006.84, 12.823, and Alkenes; 1029.99, 63.849, 0.209, 1031.92, 4.297, and alkyl halides; 1226.73, 82.894, 0.214, 1228.66, 2.659, and alkyl halides; 1417.68, 85.533, 0.939, 1427.32, 2.347, and alkyl halides; 1454.33, 85.135, 1.371, 1483.26, 2.052, and alkyl halides; 1516.05, 85.999, 0.843, 1521.84, 1.943, and Aromatic; 1539.20, 85.109, 1.482, 1571.99, 2.655, and Aromatic; 1645.28, 78.585, 0.511, 1647.21, 5.122, Amide; 2854.65, 85.991, 4.453, 2868.15, 2.326, and Alkane. To find out how nanoparticles are built and what the bonds are, Raman and FTIR spectroscopy are useful. They both allow finding out the vibrational modes that can reveal which groups and which phase is near the NPs. Unlike FTIR, Raman spectroscopy discovers small shifts in molecules that are polarized, while FTIR reveals a lot about the types of bonds and groupings in molecules that carry a permanent dipole. Even so, Raman spectroscopy can result in fluorescence or damage to sensitive biological samples when the high–energy laser is used [16-18]. In comparison, FTIR works with longer wavelengths that are believed to cause slightly less harm to the samples. By having this feature, researchers can repeat each step several times without losing the sample's integrity. This is due to the fact that FTIR uses direct absorption while Raman takes only subtle rearrangements of charges [19, 20]. So, to get samples with similar peaks, you often need to use longer acquisition or increase the amounts of your samples. This method finds uses across a wide variety of fields, including materials science, biology and environmental research. Analyzing mixtures without needing to prepare large samples is the reason why mass spectrometry is essential in exploring nanoparticles and their impact on biological systems. They help to understand what chemicals each type of nanoparticle contains and how useful they could be for science tasks like identifying drugs, controlling their delivery, checking their impacts on the environment and biology, and monitoring their properties and processes [21-24] In the study of nanoparticles, FTIR spectroscopy is important since it gives detailed information about the chemistry at the molecular level of nanomaterials. Analysis of green synthesized NPs using FTIR is due to important aspects connected to their production, stabilization, and usage. FTIR analysis allows for detecting the presence of specific functional groups, so their participation in metal ion reduction and in the production of metal oxide NPs often becomes clear [25, 26]. characteristic peaks shown in the FTIR spectrum confirm that the nanoparticles have formed successfully by exposing the presence of biomolecules involved in their manufacture. Besides, by using FTIR, the change in particle stability due to synthesized nanoparticle and capping agent interactions can be analyzed and understood [26, 27]. Having this knowledge is necessary for maintaining that NPs keep their desired qualities and be useful for things like delivering drugs and cleaning polluted places [28-31].

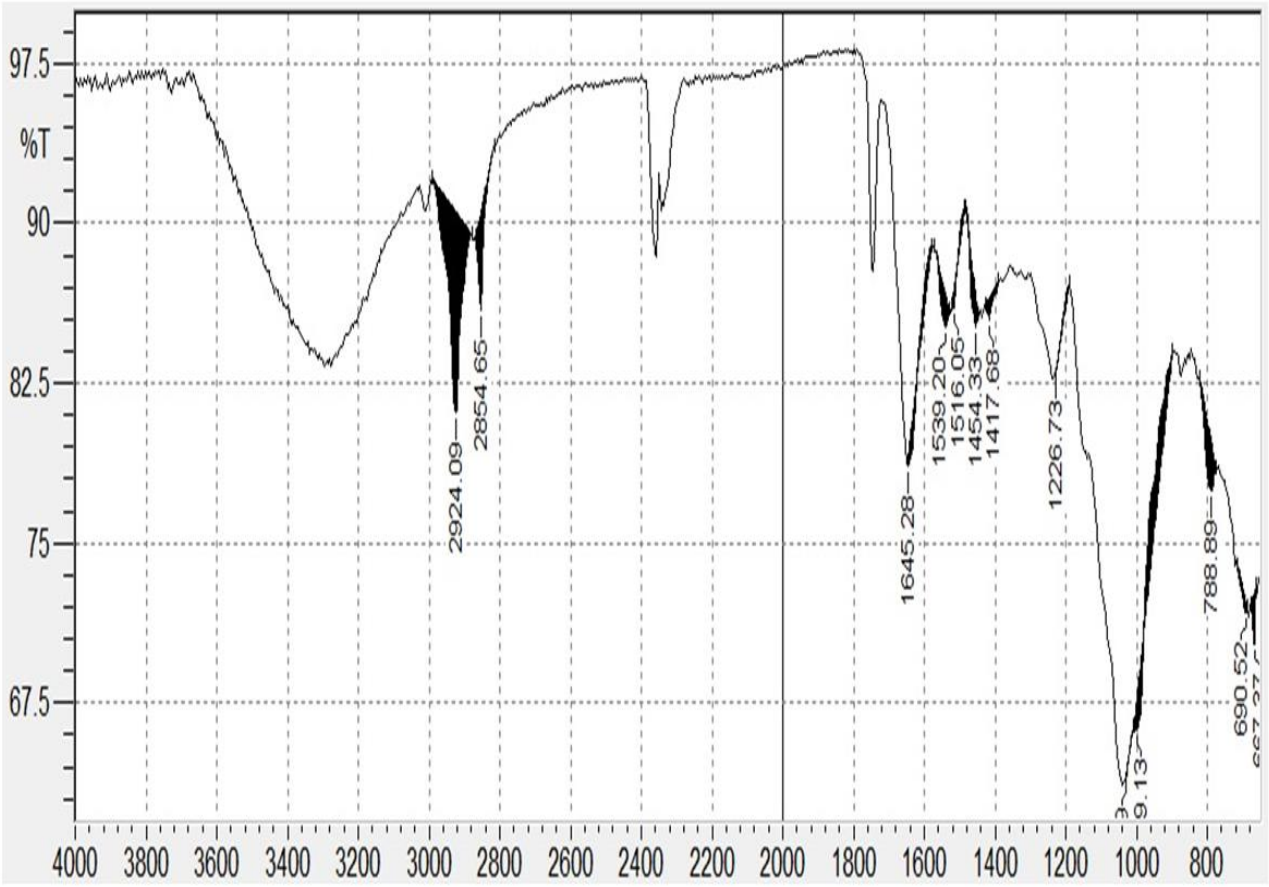

Figure 1. Fourier-transform infrared spectroscopic profile solid analysis of *Cinnamomum zeylanicum* Bark

Table 1. FT-IR peak values of solid analysis of *Cinnamomum zeylanicum* Bark.

No.	Peak (Wave number cm-1)	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area	Type of Intensity	Bond	Type of Vibration	Functional group assignment	Group frequency
1.	667.37	70.282	2.383	667.01	661.58	2.226	0.080	Strong	=C–H	Bending	Alkenes	650-1000
2.	690.52	71.720	0.518	713.66	686.66	3.769	0.059	Strong	=C–H	Bending	Alkenes	650-1000
3.	788.89	77.439	2.341	821.68	775.38	4.707	0.357	Strong	=C–H	Bending	Alkenes	650-1000
4.	999.13	66.259	1.402	1006.84	898.83	12.823	0.220	Strong	=C–H	Bending	Alkenes	650-1000
5.	1029.99	63.849	0.209	1031.92	1008.77	4.297	0.003	Strong	C-F	Stretch	alkyl halides	1000-1400
6.	1226.73	82.894	0.214	1228.66	1190.08	2.659	0.001	Strong	C-F	Stretch	alkyl halides	1000-1400
7.	1417.68	85.533	0.939	1427.32	1390.68	2.347	0.088	Strong	C-F	Stretch	alkyl halides	1000-1400
8.	1454.33	85.135	1.371	1483.26	1448.54	2.052	0.147	Strong	C-F	Stretch	alkyl halides	1000-1400
9.	1516.05	85.999	0.843	1521.84	1485.19	1.943	0.041	Medium	C=C	Stretch	Aromatic	1400-1600
10.	1539.20	85.109	1.482	1571.99	1529.55	2.655	0.167	Medium	C=C	Stretch	Aromatic	1400-1600
11.	1645.28	78.585	0.511	1647.21	1579.70	5.122	0.113	Bending	N-H	Stretch	Amide	1550-1640
12.	2854.65	85.991	4.453	2868.15	2816.07	2.326	0.326	Strong	C-H	Stretch	Alkane	2850-3000
13.	2924.09	81.181	9.343	2989.66	2879.72	6.487	1.847	Strong	C-H	Stretch	Alkane	2850-3000

Efficacy of *Cinnamomum zeylanicum* bark extracts (ethanol fraction), CTX-Cefotaxime (standard), and GN-Gentamicin (standard) as antibacterial agents against five different pathogenic microorganisms recorded 21.08±0.33, 16.89±0.31, 34.00±0.32, and 29.60±0.31 respectively for *Bacillus subtilis*, and recorded 13.89±0.29, 17.00± 0.32, 24.81±0.25, and 26.90±0.27 respectively for *Enterococcus faecalis*, while recorded 09.11±0.15, 19.75±0.32, 20.00±0.21 and 17.45±0.19 respectively for *Streptococcus pyogenes*, in the same time antibacterial activity recorded 15.00±0.30, 08.68±0.14, 27.90±0.29 and 26.04±0.29 respectively for *Staphylococcus epidermidis* and recorded 15.90±0.30, 14.06±0.29, 29.95±0.31 and 32.17±0.33 respectively for *Staphylococcus aureus*. Changes in the levels of ATP, pH, and membrane potential were examined to study vanillic acid's ability to fight off CREH in cells. When vanillic acid of concentration 500 µg/mL (65%) was added to the culture, the capability to form biofilms and the virulence of S. marcescens ATCC 14756 and MG1 were obviously reduced. Including vanillin, ethyl vanillin, or vanillic acid during the preparation and storage of food could stop the growth of Cronobacter spp. and also disrupt the cell membrane of CREH in food samples. Different types of Artemisia were proven to create metabolites that fight against bacteria. The research found a significant amount of chlorogenic acid in tall species of the Asteraceae genus from the ethanolic extract [32, 33]. These findings indicate that chlorogenic acid links to the cell membrane, makes holes in it, reduces the cell's energy, and expels macromolecules from the inside, which eventually causes the cell to die.

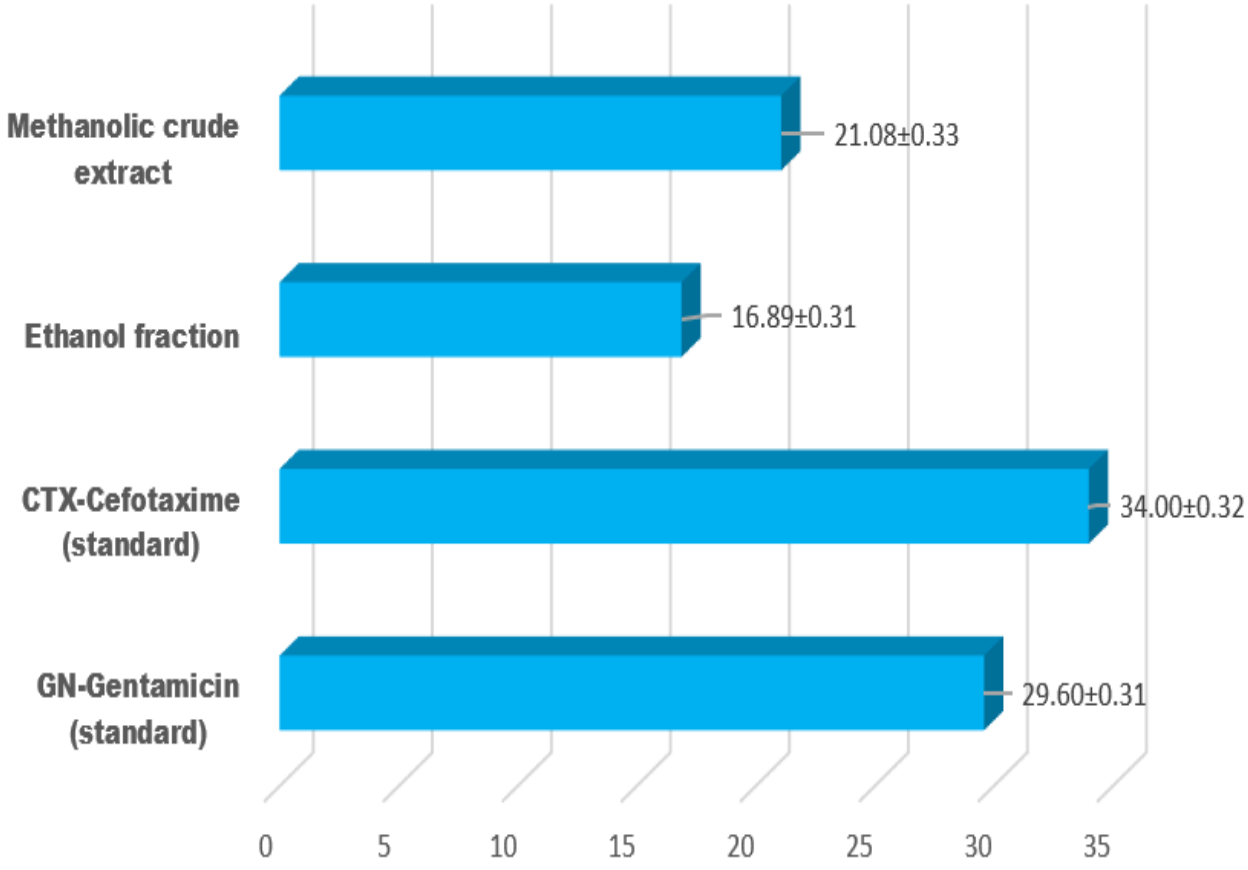

Figure 2. Antibacterial Properties of Methanolic crude extract, Ethanol fraction of *Cinnamomum zeylanicum* bark extracts, CTX-Cefotaxime (standard) and GN-Gentamicin (standard) against *Bacillus subtilis*

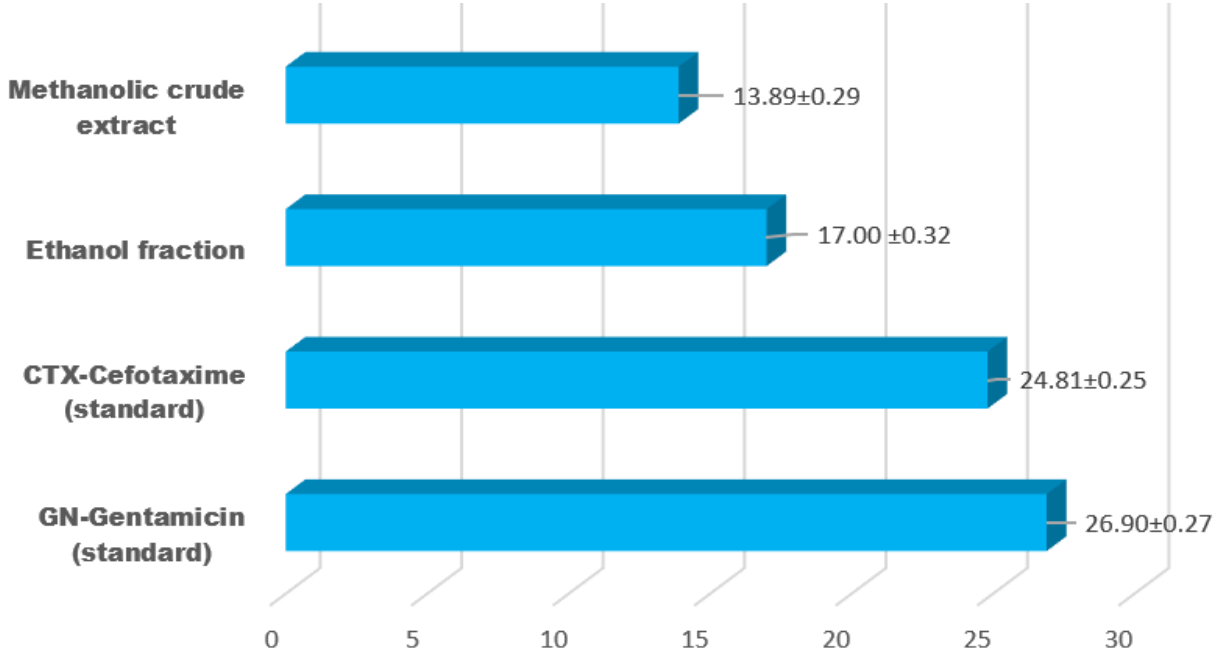

Figure 3. Antibacterial Properties of Methanolic crude extract, Ethanol fraction of *Cinnamomum zeylanicum* bark extracts, CTX-Cefotaxime (standard) and GN-Gentamicin (standard) against *Enterococcus faecalis*

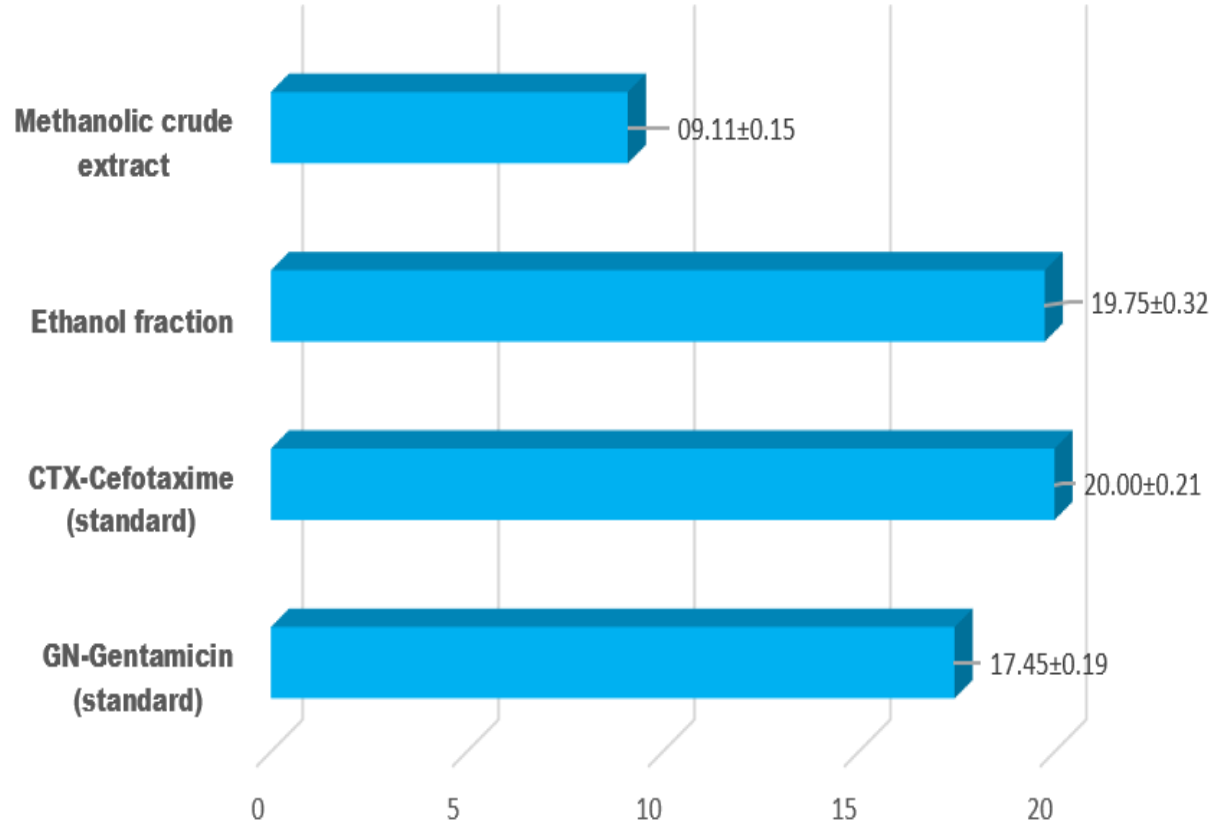

Figure 4. Antibacterial Properties of Methanolic crude extract, Ethanol fraction of *Cinnamomum zeylanicum* bark extracts, CTX-Cefotaxime (standard) and GN-Gentamicin (standard) against *Streptococcus pyogenes*

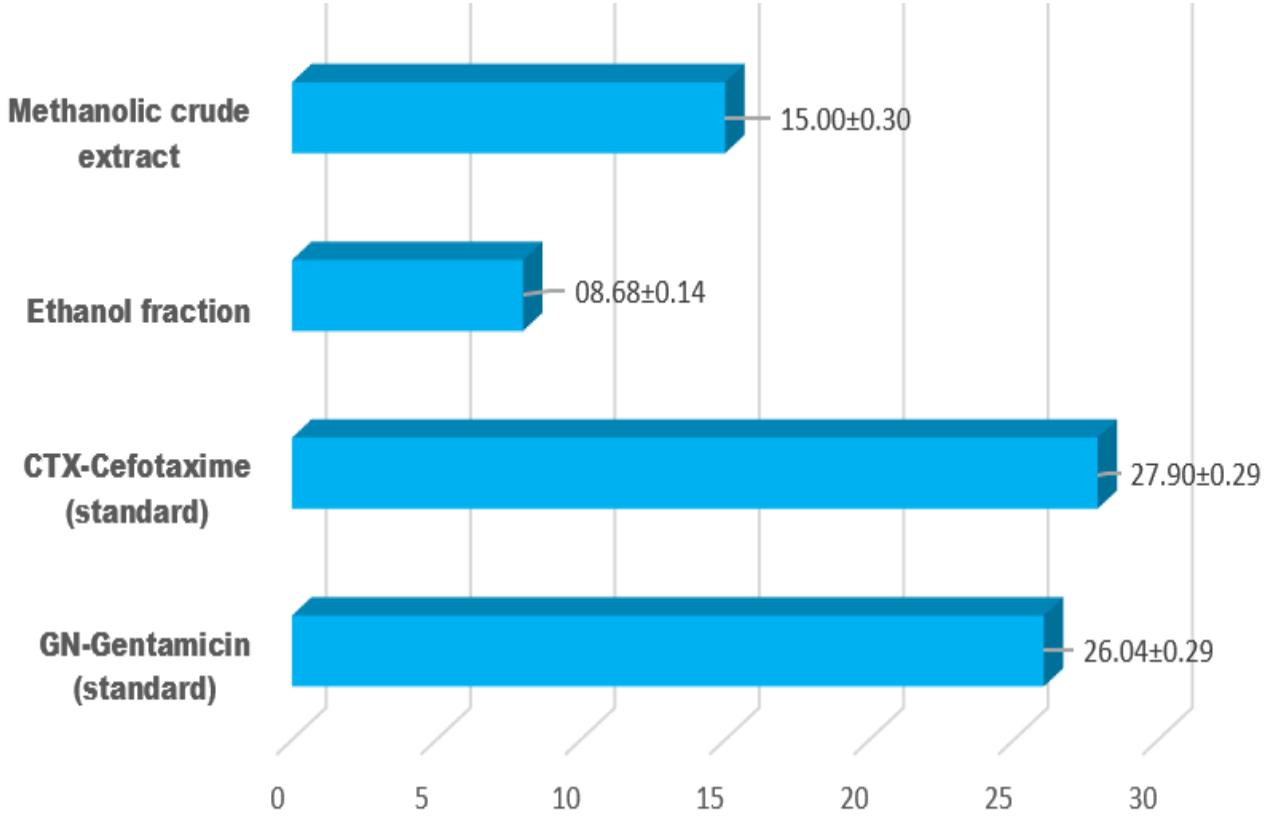

Figure 5. Antibacterial Properties of Methanolic crude extract, Ethanol fraction of *Cinnamomum zeylanicum* bark extracts, CTX-Cefotaxime (standard) and GN-Gentamicin (standard) against *Staphylococcus epidermidis*

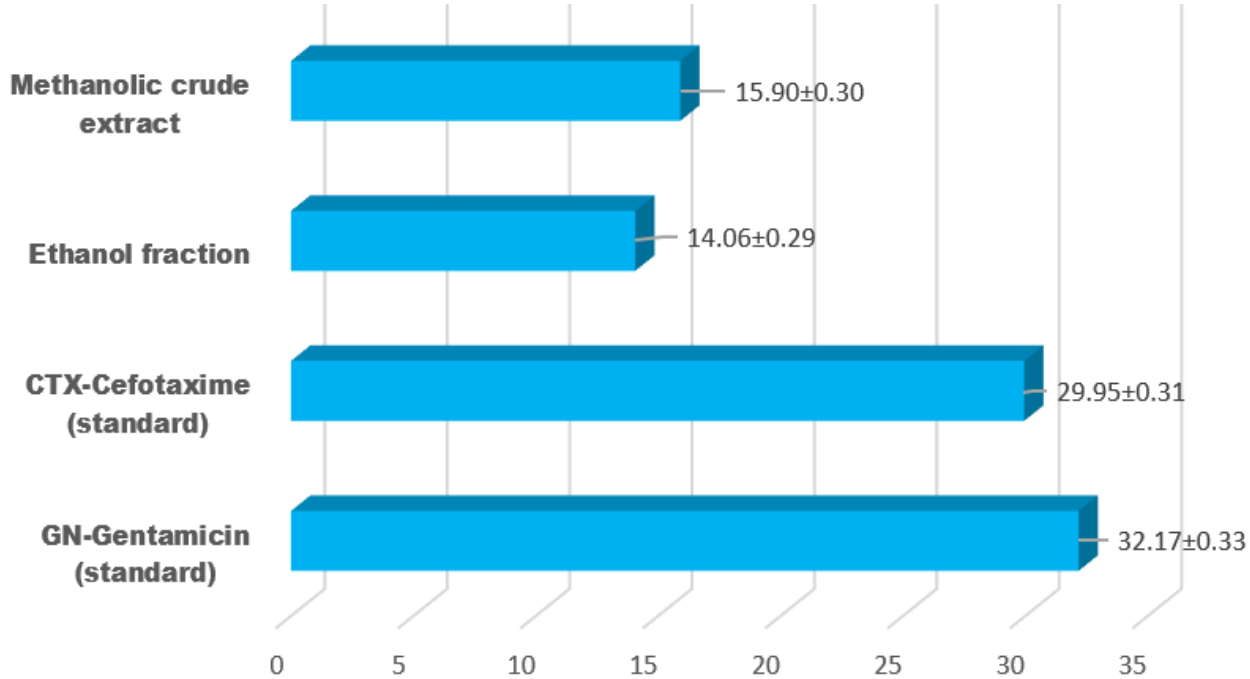

Figure 6. Antibacterial Properties of Methanolic crude extract, Ethanol fraction of *Cinnamomum zeylanicum* bark extracts, CTX-Cefotaxime (standard) and GN-Gentamicin (standard) against *Staphylococcus aureus*

Activity of *Cinnamomum zeylanicum* as an antioxidant (superoxide and nitric oxide radical scavenger) in methanol, ethanol extract, and industry standards recorded 23.79±1.92, 19.84±1.75, and Quercetin (standard) 41.00±3.07 respectively of Superoxide radical scavenging. 43.90±3.08, 31.00±2.95, and Curcumin (standard) 65.00±4.97 respectively of Nitric oxide radical scavenging. Antioxidants prevent the oxidation process by preventing free radicals from doing damage. It is easy for them to react with free radicals through oxidation, and the reaction may happen in one stage or requires more steps. Antioxidants are able to engage with reactive molecules by transferring electrons alone, exchanging hydrogen atoms, or binding with metals called "transitional metals" [34, 35]. Besides, the presence of antioxidants is found as enzymes as well as non-reactive types in the extracellular and intracellular areas. Health is affected by how well balanced free radicals and antioxidants defenses are in the body. Exposure to free radicals often causes oxidative stress and this links to diseases such as cancer, weak bones, diabetes and heart problems. ROS lead to oxidative stress and damages various molecules in the cells, which may eventually become long-lasting and serious [35, 36]. Polyphenols, vitamins, flavonoids and carotenoids are antioxidant compounds that are already known to be rich in many spices, fruits and vegetables. In addition, food that contains lots of antioxidants is good for both preventing and managing the diseases linked to oxidative stress. There is a high amount of phenolic compounds in *Cinnamomum zeylanicum*. The way these compounds operate is linked to their structure (reactive benzene rings), which allows them to remove radicals inside the human body. The main phenolic compounds present in *Cinnamomum zeylanicum* essential oils are cinnamaldehyde, eugenol, carvacrol, cinnamic acetate and thymol. Analysis of phenolic compounds in *Cinnamomum zeylanicum* showed that it may be effective in reducing hyperlipidemia, either by reducing cholesterol and/or by stopping the damaging of fats [37-40]. Out of all the parts used medicinally from the *Cinnamomum zeylanicum* tree, the bark was the part with the most antioxidant activity. It appears that the antioxidant potential of essential oils goes above that of leaves, bark and other plant parts. Peroxynitrite (ONOO-) can react with different types of biomolecules since it breaks down into two highly reactive radicals called NO2• and OH•. When excess oxygen goes out of balance, these radicals may damage your blood vessels, skin, heart, lungs, kidney, and brain. It has been proven that eugenol, an ingredient of Cinnamon's active oils, can prevent damage caused by peroxynitrite in tests carried out in vitro. But, the amount of eugenol in the active oils depends on the type of Cinnamon used, and C. zeylanicum has the highest. As a result, spice rich in eugenol from Cinnamon oil is identified as an ingredient able to interfere with the actions of radicals NO2• and OH•. Studies have been carried out to find out the antioxidant activity of Cinnamomum zeylanicum using various tree parts in different types of tests, including those done in the body and outside it [41, 42]. Many researches have indicated that total antioxidant capacity plays a role in cutting down blood lipid peroxide, better liver antioxidant protection, lower male infertility, and decreasing the risk of inflammatory diseases. A group at North Sulawesi University in Indonesia carried out a study with Swiss Albinot mice. They found that using Cinnamon at 0.25% and Cardamom at 0.5% orally by drinking 100 ml per mouse a day while facing azoxymethane induced colon ic carcinogenesis could control its growth by decreasing lipid peroxidation and boosting Glutathione S transferase in the liver and colon. Antioxidants give extra benefits like preventing food spoilage among items that contain lots of fats and oils. Currently, many companies in the food sector are focused on preserving their products from becoming more toxic and safer for people's health. For this reason, antioxidants found in plants [43-45] and especially in C. zeylanicum interest manufacturers and consumers. It has been shown that antioxidant compounds from nature can be very good for health. They are also used in place of the artificial antioxidants, for instance butylated hydroxytoluene (BHT) and butylated

hydroxy anisole (BHA). Research confirms that including *C. zeylanicum* in food helps to raise antioxidant enzymes and eliminate the ROS, while at the same time lowering malondialdehyde levels when an organism is often subject to stress [46, 47]. *Cinnamomum zeylanicum* compounds seem to be strong, as research reveals that irradiation – a popular way to preserve foods today – does not change the antioxidant activity in extracts from the plant. Therefore, it is suitable to keep foods fresh. Also, *Cinnamomum zeylanicum* is given a nutraceutical label by the pharmaceutical industry. The fragrance of these oils also lets them be used in different products like foods, perfumes and drugs.

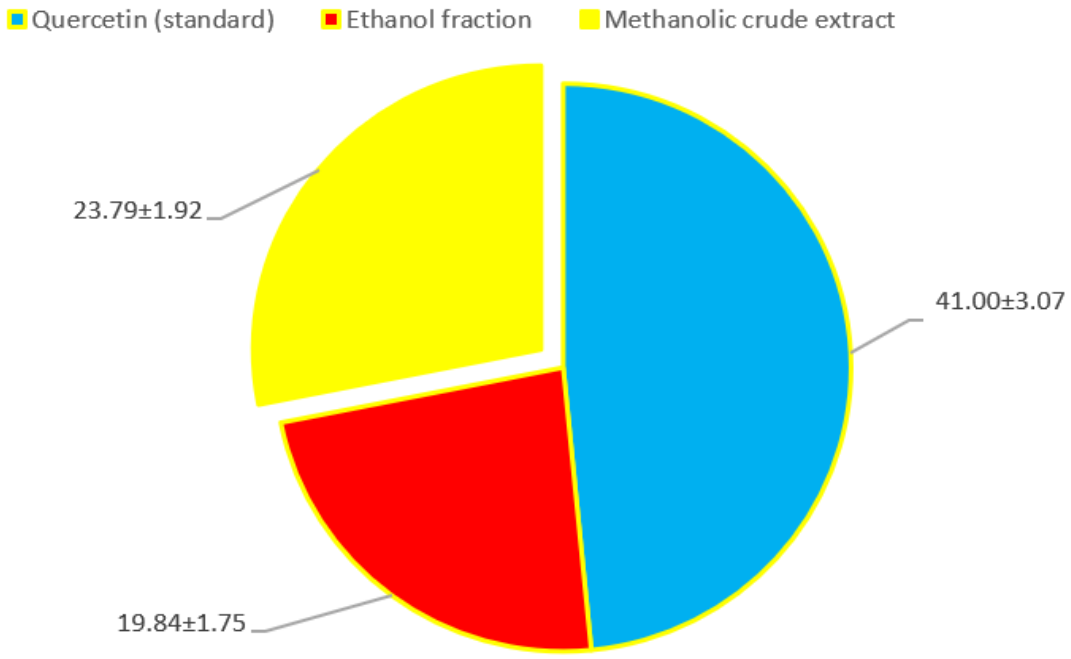

Figure 7. Antioxidant [Superoxide radical scavenging] activity of *Cinnamomum zeylanicum* L. and Quercetin (standard)

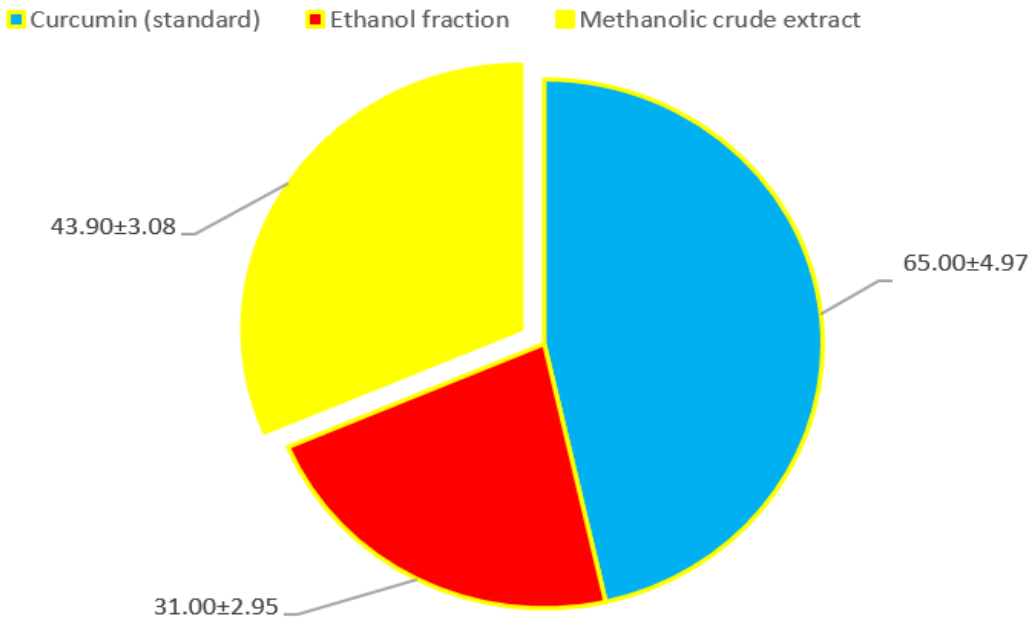

Figure 8. Antioxidant [Nitric oxide radical scavenging] activity of *Cinnamomum zeylanicum* L. and Curcumin (standard)

Antioxidant compounds are found in several parts of *Cinnamomum zeylanicum* like its leaves, buds, flowers, fruits, bark, root bark and oils. It also contains numerous volatile compounds, which mainly work as antioxidants. The main compounds found in *C. zeylanicum* are cinnamyl acetate, eugenol, trans-cinnamaldehyde (the main scent of Cinnamon), cinnacassiol, camphene, catechins, cineol, coumarin and gamma-terpinene, alpha-terpineol, alpha-thujene, E-nerolidol, pinene, proanth Also, cinnamyl compounds, hydrolyzed phenol, tannins, phenylpropanoids and terpenoids are the main sources of compounds produced by the plants. It is reported that C. zeylanicum includes linalool, benzyl benzoate, and eugenyl acetate as its key antioxidants. Cinnamon powder alcoholic extract showed antibacterial activity against *Escherichia coli* with a zone of inhibition of 11mm in the test, yet Pseudomonas aeruginosa remained unaffected. Staphylococcus aureus did not survive in the presence of ethanolic extract from cinnamon powder, but *Pseudomonas aeruginosa* came out unharmed [48, 49]. There was strong antibacterial effect when ethanolic cinnamon extract was tested against *Bacillus cereus*, while aqueous extract of cinnamon did not show activity against *B. cereus* or the other groups (*S. aureus*, *E. coli*, and *P. aeruginosa*). Ethanolic extract of cinnamon was able to inhibit the growth of *Staphylococcus aureus* and *Escherichia coli* by 14 mm and 11 mm, respectively. All in all, it was found that at different concentrations, cinnamon oil prevented the growth of Streptococcus agalactiae, Escherichia coli, *Staphylococcus aureus*, *Listeria Monocytogenes*, and *Pseudomonas aeruginosa*, as shown by different zones of inhibition. Many ways have been found for these phytochemicals to carry out their health functions. Chemicals may stop microorganisms from growing, change some metabolic functions, or regulate signal communication and genes. When phytochemicals work, they collapse bacterial cell walls and membranes, so their contents escape, the proton force is disturbed, influx and efflux pumps fail, and then the cell undergoes cytosis. Antioxidants stop tissue damage by reducing the level of free radicals or by getting rid of them or helping them breakdown [50, 51]. Both butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) are often used in cooking to help preserve the freshness of completely cooked food products. At the same time, they can threaten the health of people. That is why people call for natural antioxidants over synthetic ones in the food industry to ensure food safety. Many experts recommend that we rely on plants and vegetables, because they are rich in antioxidants that help fight oxidative problems in meat and meat products. Antioxidants from fruits and plants are produced by the important process of extraction. A number of extraction factors, for example, solvent selection, its strength, temperature used, and how long the extraction is done, have an impact on the results. Most of the time, solvent extraction is chosen to remove natural oxidants from plants. On the other hand, the amount extracted usually depends on the solvent, the temperature used, the time spent, and what the sample is made of. Which solvent is chosen and the chemical nature of the sample are the greatest factors to consider in the process of extraction [52-54]. Lipid peroxidation takes place when PUFAs in phospholipids react with oxygen, and this reaction makes lipid hydroperoxides (ROOH). Sometimes, a free radical reactive group first removes a hydrogen atom from PUFA, then the process continues with more free radicals being produced. The feature of *Cinnamomum cassia* bark is the existence of seven aromatic compounds: lyoniresinol 3α-O-β-D-glucopyranoside, D glucopyranoside, (±)-syringaresmol, and four other derivatives.

Conclusion:

Black pepper fruit is considered very important in the global spice industry. It can be affected easily by changes in the weather. Besides being used in recipes, the fruit is helpful in medicine and biology, since it is loaded with bioactive compounds. Black pepper contains piperine, oleoresins, and essential oil, and it helps in the functioning of the gastrointestinal system. In addition, it reduces inflammation. Black pepper is

known for having antibacterial effects. There is no question that black pepper's cooperation with minerals and drugs enhances their absorption in the body. All things considered, black pepper can be seen as a nutraceutical product by health-care consultants. More studies are required to check if the policy affects the selected goods in the proper way, and the results from such studies will make the issue more detailed. It is feasible that the application of new therapy for difficult infections involving extracts of *Cinnamomum zeylanicum* should be given more attention. We are also running in vitro studies to find out about the antimicrobial activity of additional organisms apart from those we studied already.

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