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Effect of Methanol and Aqueous Extracts from *Cinnamomum cassia* (Cinnamon) Bark on Some Microbial Strains

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A B S T R A C T

The emergence and spread of antibiotic resistance, as well as the evolution of new strains of disease causing agents, are of great concern to the global health community. Commonly used medicinal plants of our community could be an excellent source of drugs to fight off this problem. This study is focused on exploring the antimicrobial property of *Cinnamomum cassia* (Cinnamon) bark extracts. Methanol and aqueous extract was used for this study. Extraction was done by cold percolation method. Antimicrobial activity was measured against four microbial strains: *E. coli*, *B. subtilis*, *Enterobacter* and *P. chrysogenum*. Extracts were diluted by serial dilution. Minimum inhibitory concentration (MIC) was measured by using spectrophotometer (OD at 600 nm). Methanol extract had antimicrobial property against *B. subtilis* and *Enterobacter*; while aqueous extract was active against *E. coli*, *B. subtilis* and *P. chrysogenum*. The experiment confirmed the efficacy of *Cinnamon* extracts as natural antimicrobials and suggested the possibility of employing them in drugs for the treatment of infectious diseases caused by the test organisms.

Introduction

Antimicrobial resistance occurs when antibiotics are not effective against microorganisms. Microorganisms that develop antimicrobial resistance are sometimes referred to as "superbugs". As a result, the medicines become ineffective and infections persist in the body, increasing the risk of spread to others (Bashir *et al.*, 2019). New resistance mechanisms are emerging and spreading globally, that results prolonged illness, disability, and death (Sekyere *et al.*, 2018). Because of antimicrobial resistance, immune compromised diseases are spreading faster and also treatment is costly because of

longer stay in hospitals (DeNegre *et al.,* 2019). There is an argent need to find out alternative treatment with lower cost against resistant strains.

Medicinal plants have been known as important resources of natural antimicrobial compounds as an alternative that can potentially be effective in the treatment of these challenging bacterial infections (de Oliveira *et al.,* 2019). Secondary metabolites of plants such as tannins, alkaloids, phenolic compounds, and flavonoids, are very useful source to treat many diseases (Mohotti *et al.,* 2020).

Considering the vast potentiality of plants as sources for natural drug, this study aimed to investigate *in vitro* antimicrobial activity of extracts from *Cinnamomum cassia* (Cinnamon) bark against four microorganisms.

Materials and Methods

Plant materials

Plant dried Sticks were collected randomly from Surat, Gujarat, India. Plant dried sticks were washed in tap water, air dried and then homogenized to fine powder and stored in airtight bottles.

Extraction

Extraction of *Cinnamomum cassia* was done by cold percolation method (Vaghasiya and Chanda 2007; Chander *et al.,* 2016). 10 g of air-dried powder was taken in 100 ml of distilled water and 100 ml methanol in a conical flask. The flask was boiled for 10 min and kept it for 24 h at room temperature in shaking condition. After 24 h, extract solution was taken out in to glass petri plates (put the plates at room temp for air dry and allow it to completely dry). The dry extract was weighed and extractive yield was calculated by following formula.

Extractive yield = (weight of dry extract/ 10 g) X 100

Extract was preserved in refrigerator until use.

Microbial strains

The standard microorganisms were used for antimicrobial study. The bacterial strains were grown in the nutrient broth and maintained on nutrient agar slants at 4^{o} C. The following bacterial strains were used for this study: *Enterobacter aerogenes* ATCC13048, *E. coli* ATCC25922, *B. subtilis* ATCC6633 and *P. chrysogenum* ATCC10108.

Antimicrobial study

Antimicrobial study was determined by broth dilution method. Microbial culture was inoculated in N broth and incubated for 12h at 37^{o}C. Plant extract was dissolved in dimethyl sulphoxide and prepared it in six different concentrations (5, 2.5, 1.25, 0.625, 0.312, 0.156 mg/ml). Dimethyl sulphoxide was used as control. Total seven tubes were prepared for each microbial strains per one plant extract. Tube 1 to 6 was used as test and tube 7 was used as control. 0.9 ml N broth was added in each test tube and 0.1 ml extract was added at increasing concentration in each tube. All tubes were incubated overnight. Microbial growth was observed by using spectrophotometer (OD at 600 nm).

Results and Discussion

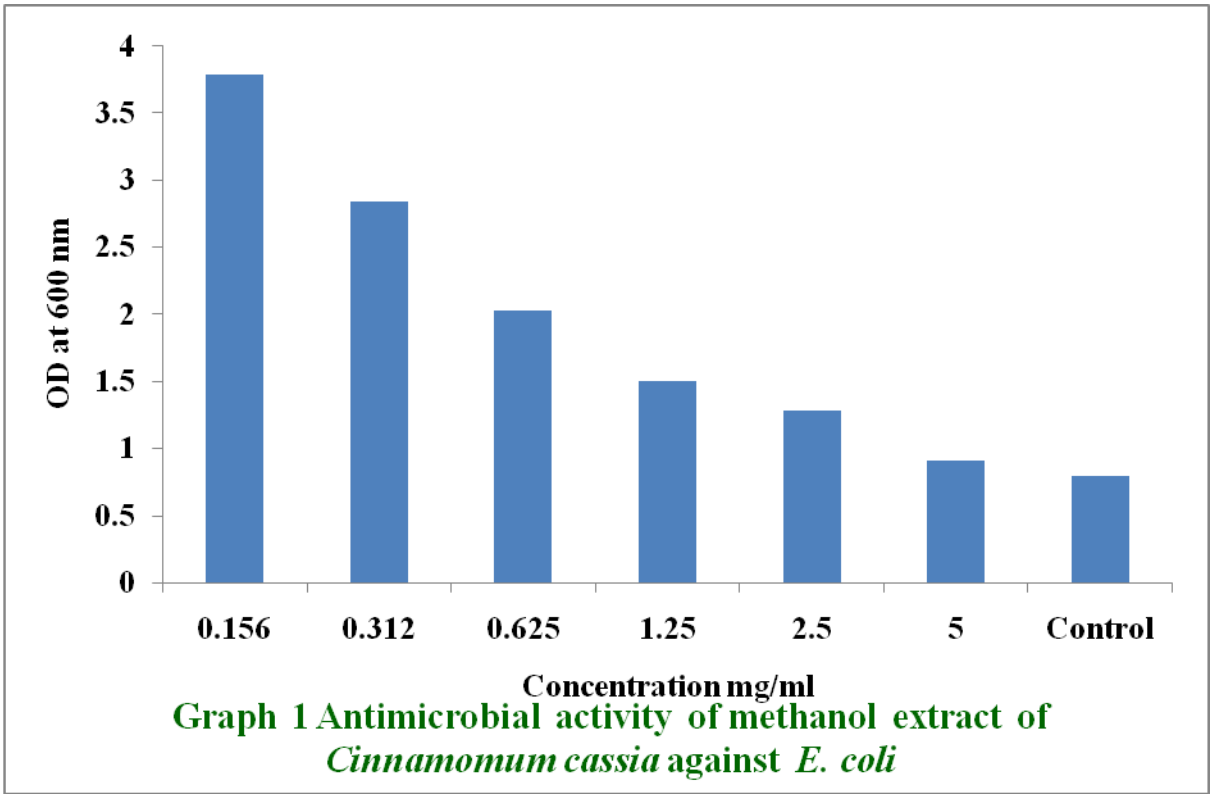
Herbs and spices have been used since ancient times, because of their antimicrobial properties increasing the safety and shelf life of food products by acting against food borne pathogens and spoilage bacteria. *C. cassia* has a broad range of effects on different diseases

like tumour, inflammation, diabetes, bacteria, virus etc (Lee *et al.*, 2018; Wu *et al.*, 2018; Zhang *et al.*, 2019).

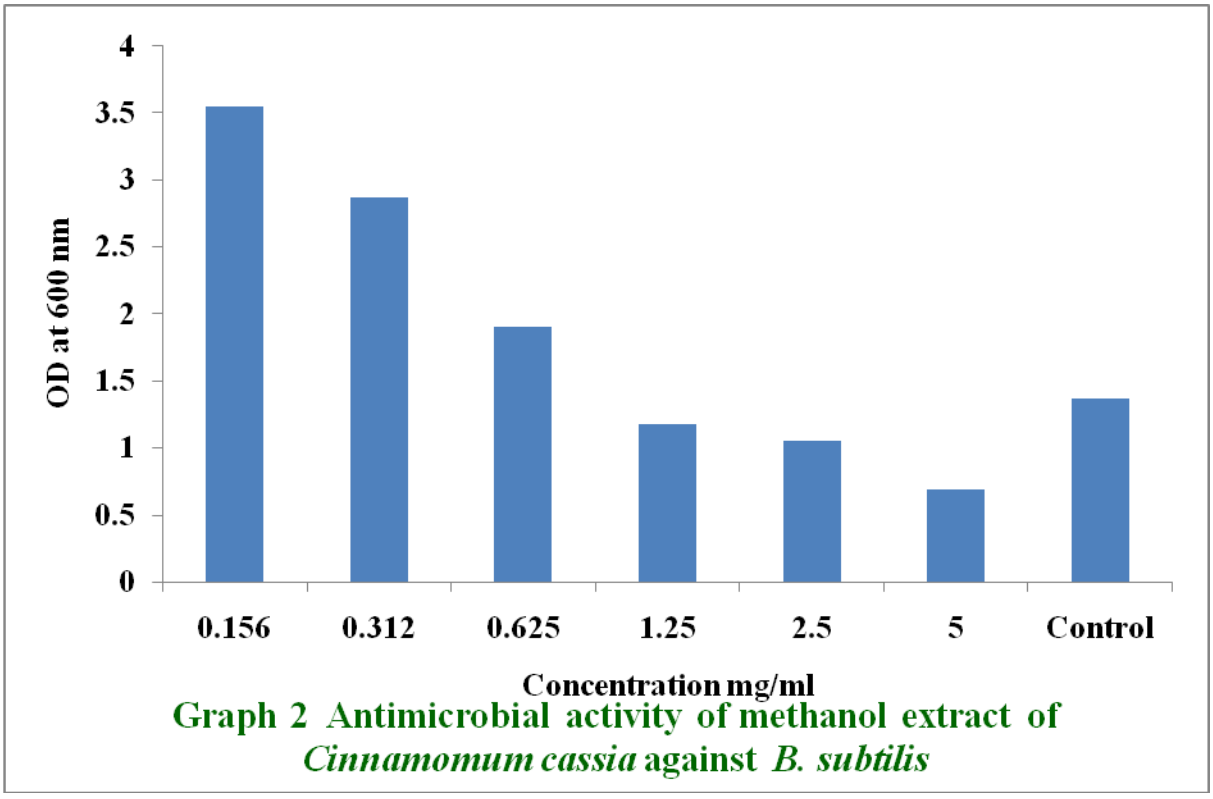
In the present study, Bark of *Cinnamomum cassia* (Cinnamon) was evaluated for its antimicrobial potential against four microorganisms in this study using micro broth dilution assay. Methanol and distilled water was used for extraction of the plant powder. Methanol extract gave the higher extractive yield (5.35g/10g powder) than water extract (2.69g/10g powder). Graphs 1-6 summarize the results obtained from this study. Graph 1 represents antimicrobial study of methanol extract of *Cinnamomum cassia* against *E. coli*. There was no antibacterial activity against *E. coli* while it showed antibacterial activity against *B. subtilis* with MIC value 1.25 mg/ml (Graph 2). Methanol extract also gave antibacterial potential against *Enterobacter* with the MIC value 2.5 mg/ml (Graph 3) but it was inactive against fungal strain *P. chrysogenum* (Graph 4). Aqueous extract of cinnamon was active against *E. coli*, *B. subtilis* and *P. chrysogenum* with the MIC values 5 mg/ml, 0.625 mg/ml and 1.25 mg/ml respectively (Graph 5, 6 and 8), while it was inactive against *Enterobacter* (Graph 7). As compared to methanol extract, water extract was more active against microorganisms especially against fungal strain.

Cinnamon can be suggested as an alternative to synthetic antibiotics, especially for the treatment of antibiotic-resistant bacterial infections. Cinnamon use in food products and cosmetics could be a good strategy to reduce or avoid bacterial degradation and thus to reduce the incidence of infection caused by food and cosmetics. However, there is a lack of clinical trials on the antibacterial effects of cinnamon, and therefore there is a need to be exploring its clinical efficacy (Fig. 1).

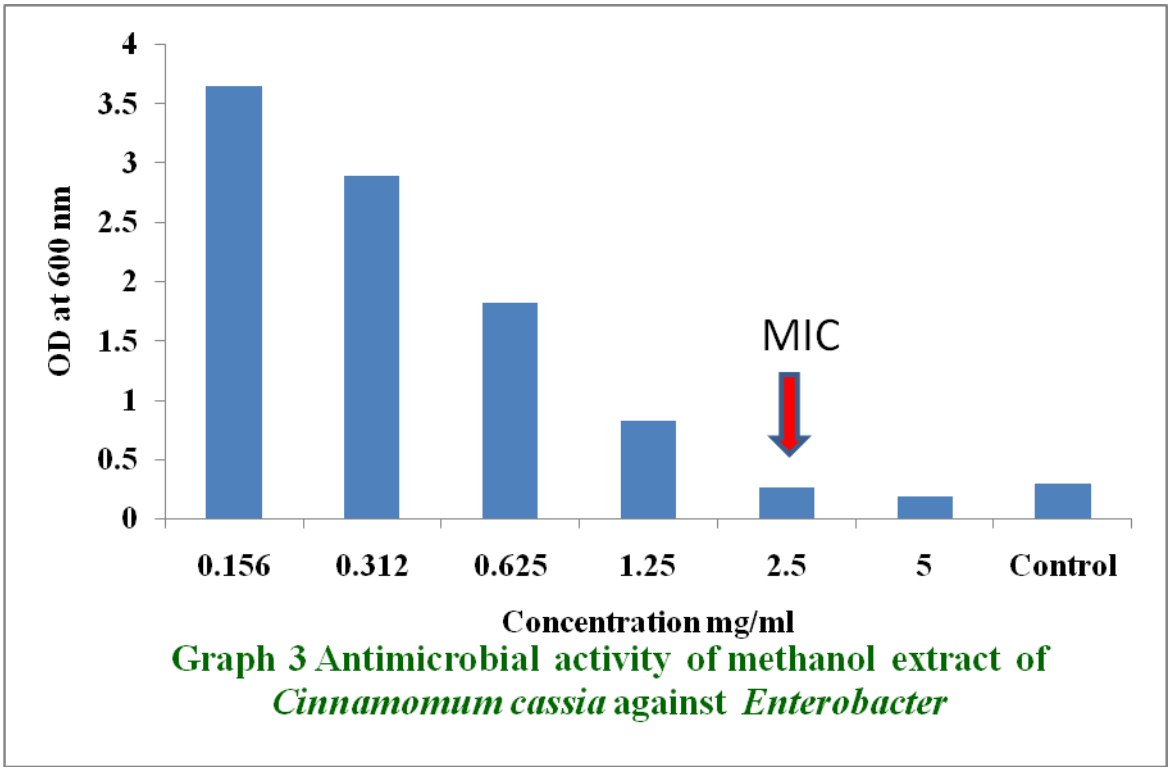
Fig.1



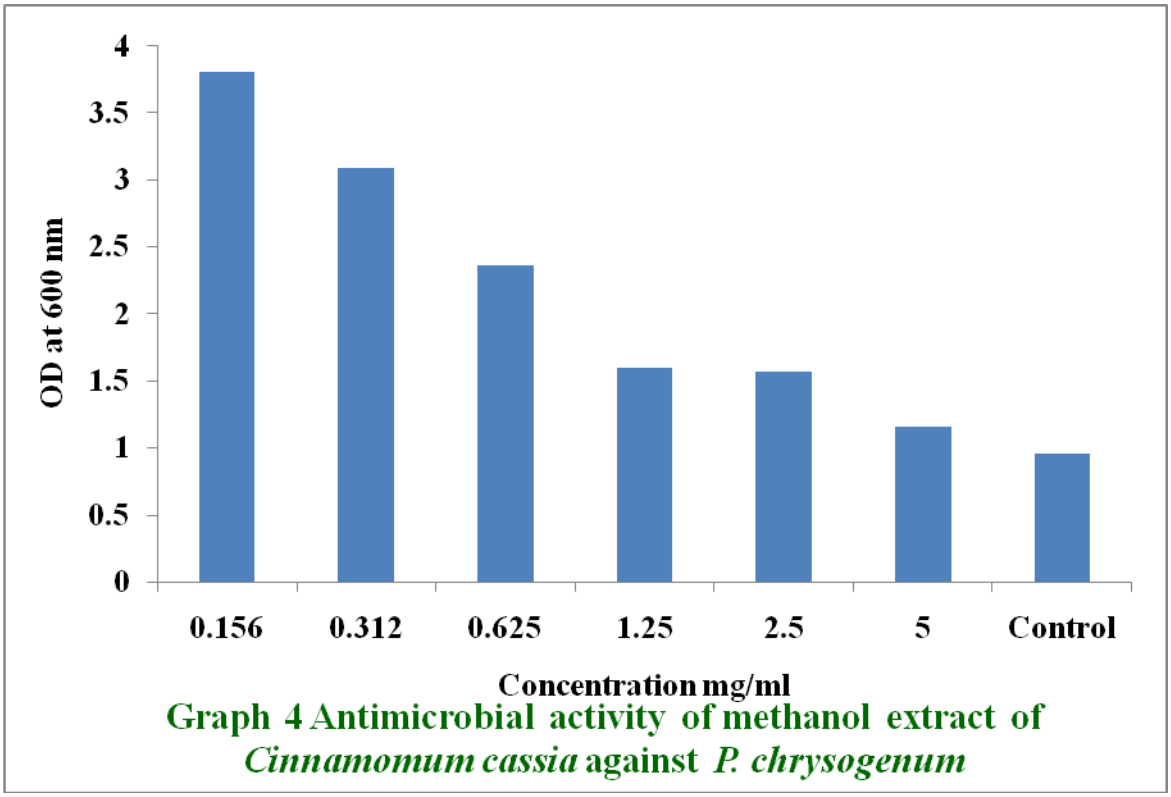
Graph 1 Antimicrobial activity of methanol extract of *Cinnamomum cassia* against *E. coli*



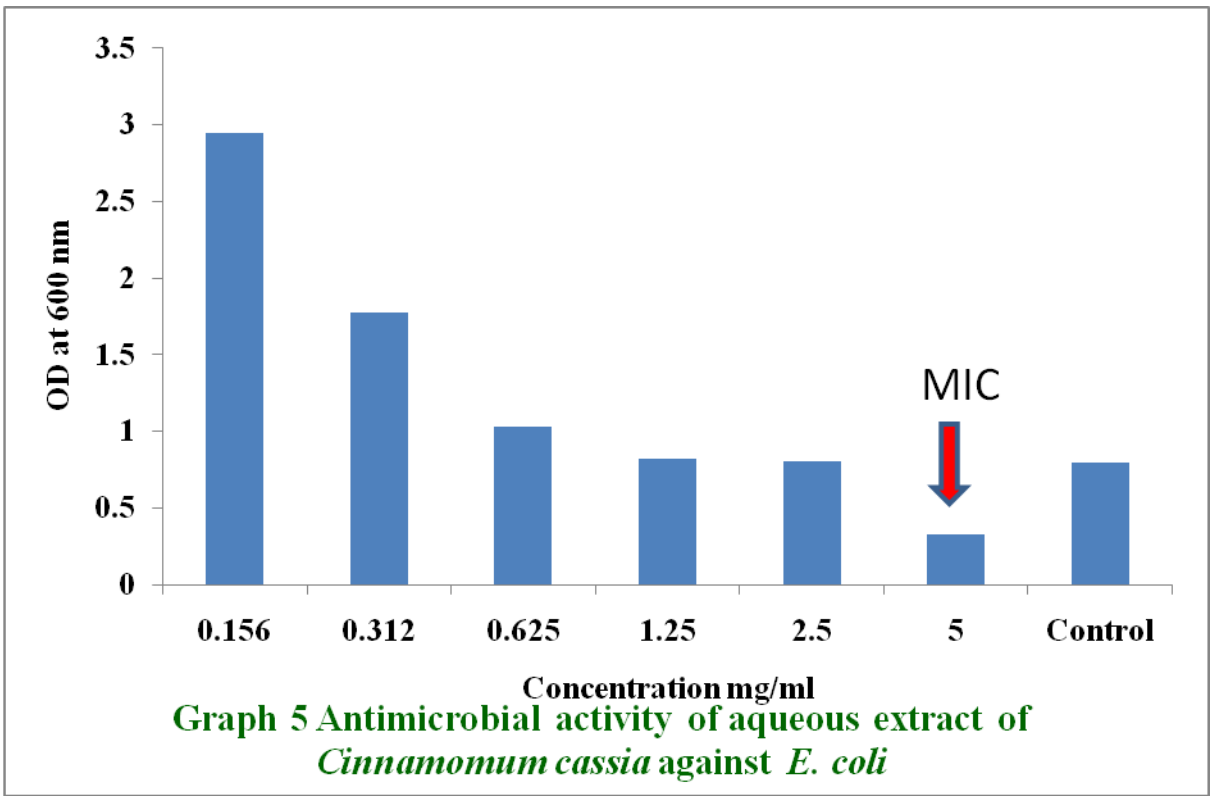
Graph 2 Antimicrobial activity of methanol extract of *Cinnamomum cassia* against *B. subtilis*



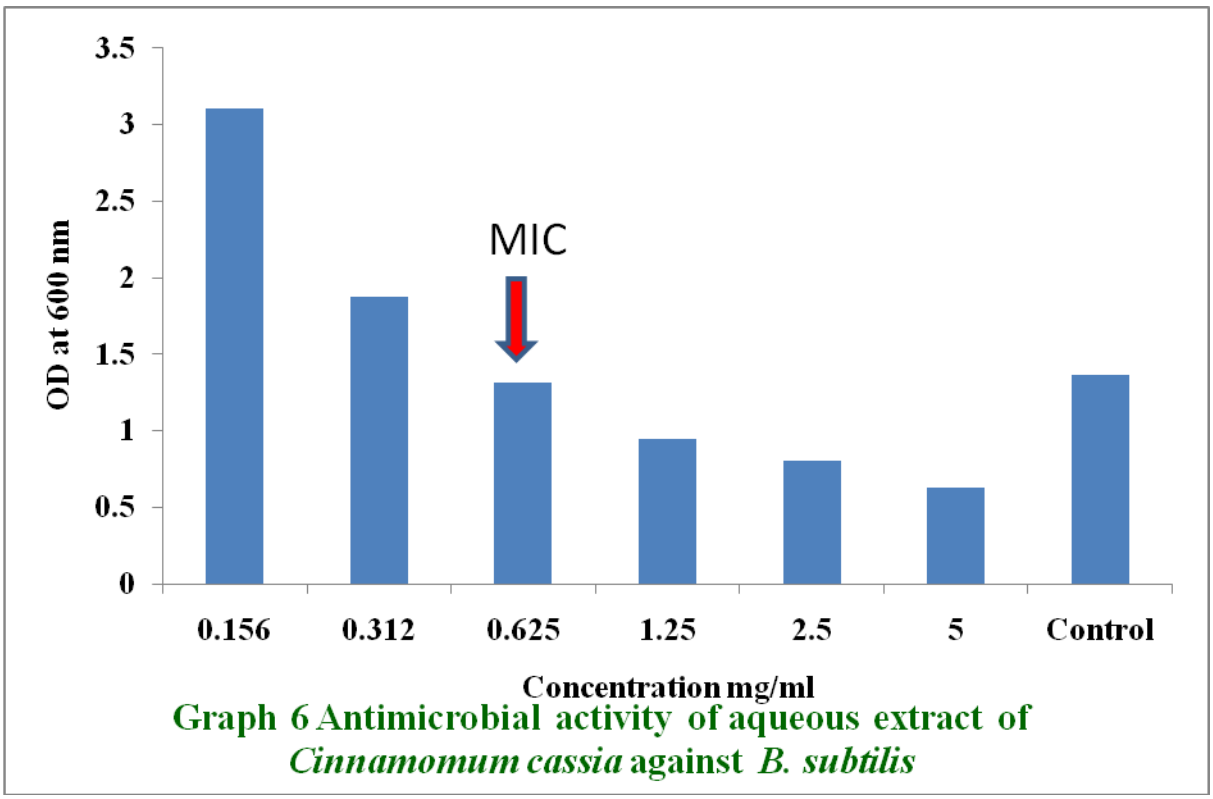
Graph 3 Antimicrobial activity of methanol extract of *Cinnamomum cassia* against *Enterobacter*



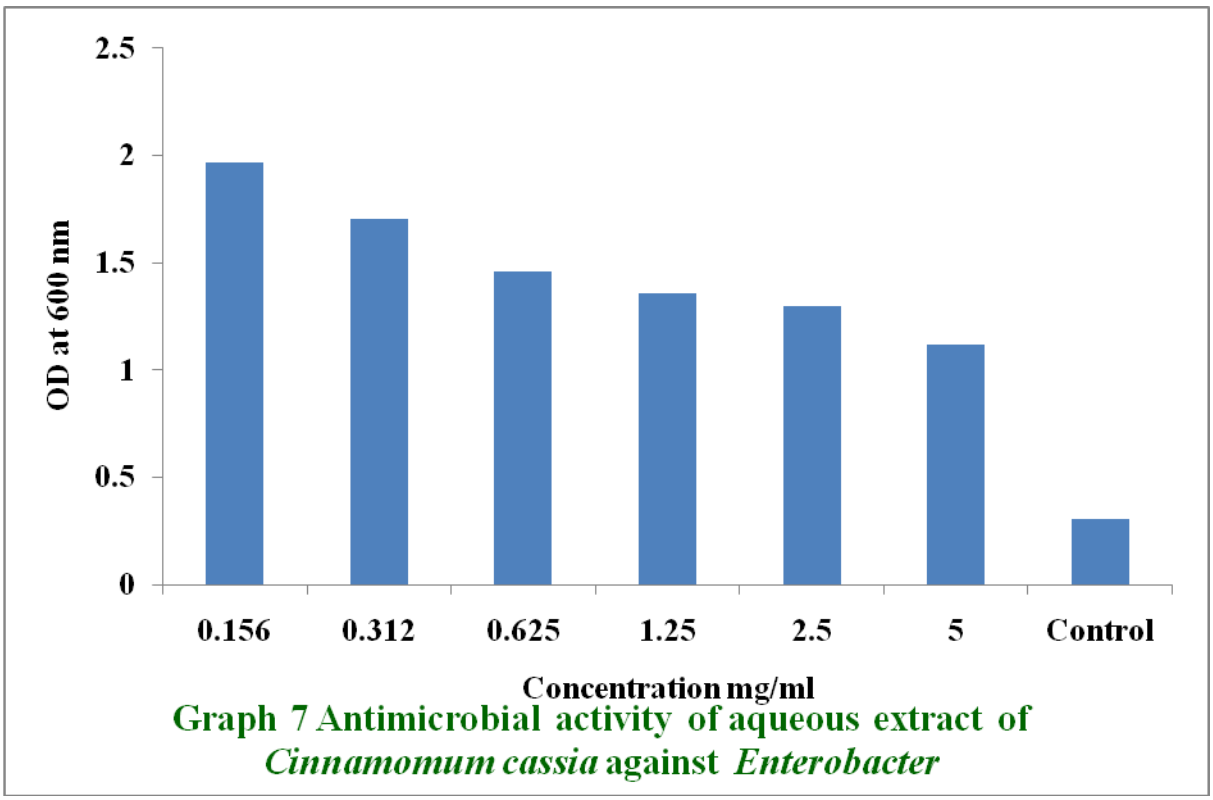
Graph 4 Antimicrobial activity of methanol extract of *Cinnamomum cassia* against *P. chrysogenum*



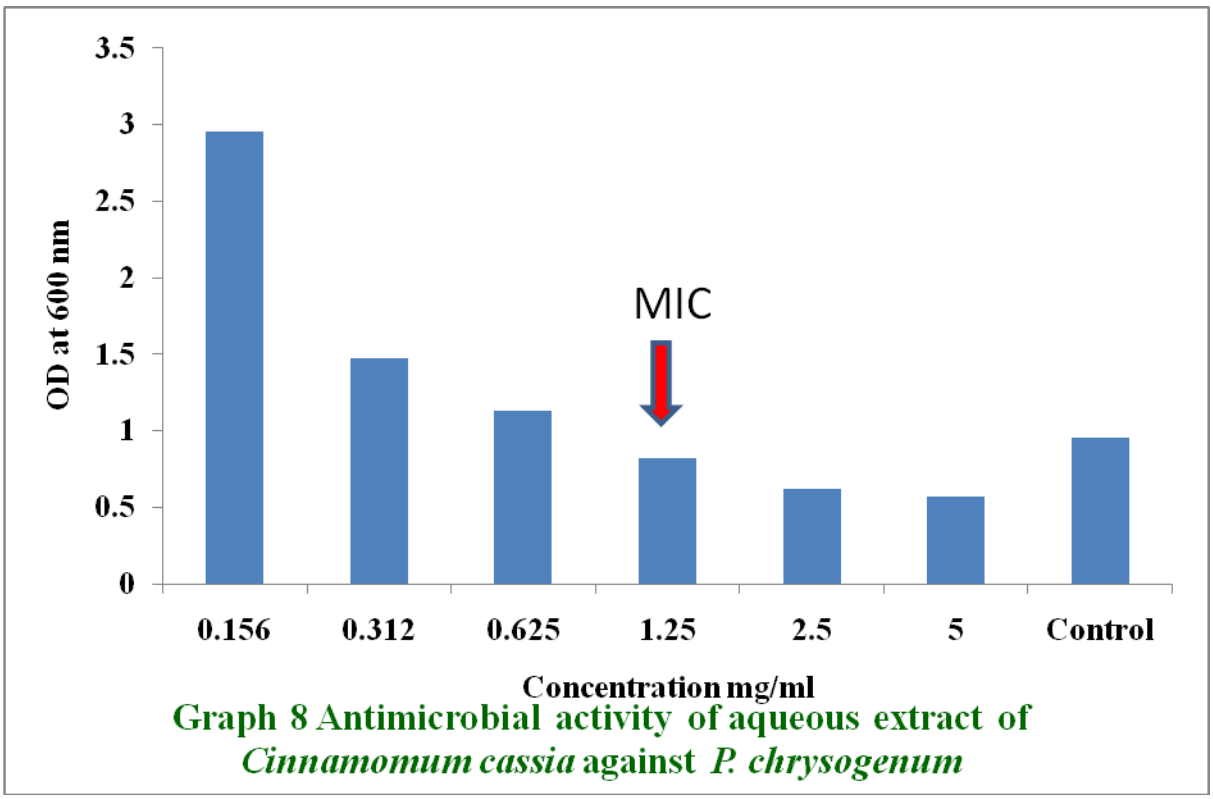
Graph 5 Antimicrobial activity of aqueous extract of *Cinnamomum cassia* against *E. coli*



Graph 6 Antimicrobial activity of aqueous extract of *Cinnamomum cassia* against *B. subtilis*



Graph 7 Antimicrobial activity of aqueous extract of *Cinnamomum cassia* against *Enterobacter*



Graph 8 Antimicrobial activity of aqueous extract of *Cinnamomum cassia* against *P. chrysogenum*

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