

Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation Design Proposal)

(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: SDBC147

Project Title: Investigation Design Proposal on the Antimicrobial Properties of Oranges

Project Type: Investigation Design Proposal

To our best knowledge and after thorough literature research, as of 27/06/2022, there are no* similar works. If there are, the reference links are as below:

N.A.

The enhancement our project has made for the existing related products or research are summarized below:

N.A.

I. Background

Antibiotics are used commonly in modern medicine, such as preventing infections after surgeries, treating infections, and even sore throats. Due to the unrestricted use of antibiotics, bacterial resistance is becoming an increasingly pressing issue. From previous research, various plants, including oranges, have been proven to have antimicrobial effects. This project focuses on determining whether orange peel extracts can be used as an alternative to antibiotics.

II. Objective(s)

This project aims to propose an investigation design to compare the antimicrobial effects of orange peel extracts with antibiotics.

III. Hypothesis

The antimicrobial properties of orange peels make refined extracts of the orange peels a viable alternative to antibiotics in the face of the antibiotic resistance problem.

IV. Methodology

Materials to be used: orange peels, distilled water, methanol, conical percolator, bacteria culture (*Bacillus subtilis*, *Staphylococcus aureus*, and *Escherichia coli* on agar plates), pipette, filter paper, and antibiotics, caliper.

To make the orange peel extracts, oranges are peeled to obtain orange peels, which are then rinsed with distilled water and air-dried for one week. Air-drying should take place at temperatures below 30°C with good air circulation and no direct sunlight. Methanol is used as a solvent for extracting desired compounds from orange peels. The extraction method used is percolation, which can be used to extract thermolabile and volatile substances.

A semi-quantitative comparison between the antimicrobial effects of orange peel extract and standard antibiotics is achieved by the disk diffusion method. Prepare bacteria culture of *Bacillus subtilis*, *Staphylococcus aureus* and *Escherichia coli* on agar plates. Place two filter paper disks saturated with orange peel extracts and antibiotics respectively onto each agar plate and incubate overnight. Measure and compare the diameters of the zones of inhibition with a caliper. Repeat the experiment to get average values.

Zones of inhibition of orange peel extracts and antibiotics on agar plates with different bacteria are measured. It is measured using a caliper. Repeat trials and calculate the average. A larger zone of inhibition shows a stronger antimicrobial effect.

V. Expected Results and Impact of research

Orange peel extracts are expected to display a certain level of antimicrobial activity. Compared to antibiotics, the antimicrobial effects (measured by the diameter of zones of inhibition) of orange peel extracts may be weaker than antibiotics. The extracts are considered to be an effective alternative to antibiotics if the diameter of zones of inhibition is greater than half of that of antibiotics. Previous research showed that orange peel extracts should demonstrate antibacterial effects on both gram-positive and negative bacteria.

The antimicrobial activity of orange peels is attributed to several compounds, including tannins and saponins. Tannins are phenolic molecules that form irreversible complexes with proline-rich proteins, resulting in the inhibition of cellular protein synthesis, and Saponins are naturally occurring compounds that can form stable, soaplike foams in aqueous solutions. Both compounds are abundant in orange peels, making them suitable as antimicrobial agents.

This project has several limitations. Only several species of bacteria were included in the experiment proposal. The antimicrobial effects may vary across different species, which suggests that orange peel extracts may be less effective on some species not investigated. The antifungal and antiviral effects of the extracts are also not included in this project. Previous research has shown that the antifungal effect of the extracts is significantly weaker than the antibacterial effect. The effect of the extracts on viruses is not known.

If orange peel extracts are proven to be a viable alternative to antibiotics, they may be able to relieve antibiotic resistance. The extracts may be further modified and purified with advanced technology to produce more concentrated extracts. An increase in the concentration of the extracts may enhance its antimicrobial effects. Orange peels may be used to produce concentrated extracts, which can be used in the replacement of antibiotics. Reducing the use of antibiotics may relieve the selective pressure for the development and transmission of antibiotic-resistance genes. The extracts may reduce the development of antibiotic resistance. The vital problem of antibiotic resistance may be mitigated.

The problem of orange peel waste may also be alleviated. Orange peels are disposed of as waste nowadays, contributing to the problem of insufficient space at landfills. Orange peels can be collected to produce extracts and the number of orange peels disposed of at landfills may be reduced, making them an effective, accessible, and cheap alternative to antibiotics.

VI. Conclusion

Orange peel extracts have been proven more effective than that other parts of the fruit, as a large number of phenolic compounds and other antibacterial compounds are present. It is also effective in inhibiting the growth of bacteria (more effective on gram-positive than gram-negative bacteria) but is less effective than antibiotics. Despite the possibility of a correlation existing between antibiotic resistance and antimicrobial resistance, the orange peel extract may still be used in the replacement of antibiotics at higher concentrations.

*** Our project is developed based on our school's previous project and the enhancement is as below:**

N.A.