ANTIBACTERIAL SCREENING OF LEAF AND FLOWER EXTRACTS FROM SOME FLOWERING PLANTS

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TABLE OF CONTENTS

TITLE	PAGE
TITLE PAGE	i
TABLE OF CONTENTS	ii
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	iv
ABSTRACT	v
INTRODUCTION	1
A. Background of Study	1
B. Statement of Problem and Hypothesis	2
C. Objectives of Study	3
D. Significance of Study	3
E. Scope and Limitations	4
F. Definition of Terms	4
REVIEW OF RELATED LITERATURE	6
RESEARCH DESIGN AND METHODOLOGY	14
A. Research Design	14
B. Methodology	14
RESULTS AND DISCUSSIONS	17
SUMMARY	25
CONCLUSION	25
RECOMMENDATIONS	26
LITERATURE CITED	
APPENDICES	

T6

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List of Tables

TABLES

TABLES	PAGE
1. Diameter zone of inhibition (mm) of leaf extracts on *B. subtilis* after 24 hours	18
2. Diameter zone of inhibition (mm) of flower extracts on *B. subtilis* after 24 hours	19
3. Diameter zone of inhibition (mm) of leaf extracts on *S. aureus* after 24 hours	21
4. Diameter zone of inhibition (mm) of flower extracts on *S. aureus* after 24 hours	23

Abstract of the study

The antibacterial potential of the leaf and flower extracts of anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) were tested against *B. subtilis* and *S. aureus* using disc diffusion method.

The diameter zone of inhibition after incubation was measured. The Tukey Test was used to see if the antibacterial potential of the extracts vary significantly. The result showed tetracycline as having the highest diameter zone of inhibition against *B. subtilis* and *S. aureus*.

The means of the diameter zone of inhibition of leaf extracts against *B. subtilis* decreased in the order: tetracycline > French rose > birds of paradise > anthurium > chrysanthemum > bougainvillea > sunflower = distilled water.

The means of the diameter zone of inhibition of the flower extracts against *B. subtilis* decreased in the order: tetracycline > French rose > birds of paradise > anthurium > sunflower. bougainvillea > chrysanthemum = distilled water.

The means of the diameter zone of inhibition of the leaf extracts against *S. aureus* decreased in the order: tetracycline > French rose > birds of paradise > anthurium > chrysanthemum > bougainvillea > sunflower = distilled water.

The means of the diameter zone of inhibition of flower extracts against *S. aureus* decreased in the order: tetracycline > birds of paradise > French rose > anthurium > sunflower = chrysanthemum = bougainvillea = distilled water.

ANTIBACTERIAL SCREENING OF LEAF AND FLOWER EXTRACTS FROM SOME FLOWERING PLANTS

Chapter I

Introduction to the study

A. Background of the study

Microbes are organisms that cannot be seen by the naked eye, However present almost everywhere. These organisms include certain bacteria, viruses, algae, fungi, and protozoan. The existence of these organisms was first demonstrated and proven in the 1600's when Robert Hooke of England built the first compound microscope and Anton Van Leeuwenhook of Holland constructed powerful lenses. Using both the compound microscope and the lenses, the existence of microbes was finally verified (Grolier's International Encyclopedia 1991). Later, as succeeding scientists further studied these microorganisms, they have discovered some of these pathogens as the main cause of several unexplainable diseases. Since these disease-causing microbes are found almost anywhere, everybody is susceptible to be in contact with them. In an attempt to lower the risk of infection and contamination, scientists provided the public with numerous precautionary tools. This concern later led to the development of sanitizers.

During the past years, several researchers had been studying plant properties and their capability to serve as effective antibacterial agents. The discovery of plants with such ability proved to be essential due to the public need for protection from these minute hazards to health. Though several species of plants have been clinically proven to posses antibacterial properties, numerous plants are still left untouched. This became the basis of the researchers to further continue what has been laid before them: testing more plant samples for their antibacterial potential.

The Philippines is gifted with A vast array of plants thus inspiring the researchers to take advantage of the abundant flora of this country. Since flowering plants are found almost anywhere in the locality, the researchers decided to make use of them instead. Once proven, these plants won't be grown only to be appreciated for their flowers, but to be utilized as an alternative to the expensive commercial sanitizers and antibacterial agents currently sold in the market.

In this study, the researchers tested the antibacterial properties of the leaf and flower extracts of some flowering plants namely: anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) were tested against *B. subtilis* and *S. aureus.*

B. Statement of the problem and hypotheses

This study aimed to determine the feasibility of the leaf and flower extracts of some flowering plants to kill *B. subtilis* and *S. aureus* and answer the following questions:

1. Did the leaf and flower extracts of the flowering plants posses antibacterial properties against *B. subtilis* and *S. aureus?*
2. Was there a significant difference on the antibacterial potential of the various leaf and flower extracts of the flowering plants and the positive control tetracycline on *B. subtilis* and *S. aureus?*

C. Objective of the study

This study was conducted with the following objectives:

1. To determine the antibacterial potential of the leaf and flower extracts of the flowering plants: anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) against *B. subtilis* and *S. aureus*
2. To compare the antibacterial potential of the leaf and flower extracts of anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) against *B. subtilis* and *S. aureus*.

D. Significance of the study

This study aimed to determine the feasibility of the leaf and flower extracts of anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) in destroying and preventing the further growth of *B. subtilis* and *S. aureus*. It also determined is a significant difference exists between the antibacterial potential of the leaf and flowering extracts of these flowering plants and to the positive control tetracycline against these bacteria.

Because the study determined if the leaf and flower extracts of anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C.

morifolium), and French rose (*R. gallica*) contain antibacterial potential against *B. subtilis* and *S. aureus,* the findings of this study can further be utilized to develop natural replacements for commercially sold antibacterial agents. The leaf or flower extracts which are to be proven effective can be used as substitute antiseptics, antibacterial agents, or wound remedy.

E. Scope and limitations

This study is limited to testing the antibacterial potential of only six plants namely: anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*). Aside from this, the study only made use of two test organisms, *B. subtilis* and *S. aureus.* The scope of the measurement of the diameter of the zone of inhibition after 24 hours of extract application is only expressed to the nearest tenth of a millimeter.

F. Definition of terms

Some terms in this study were given their conceptual and operational meanings definitions:

Feasible--capable of being used successfully (Webster Illustrated Contemporary Dictionary, 1987).

In this study, this term refers to the successful usage of the leaf extracts as feasible antibacterial agents.

Antibacterial agent--any substance having power to destroy or weaken microbes (Webster Illustrated Contemporary Dictionary, 1987).

In this study, this term refers to the eight leaf extracts applied to each type of bacteria.

Bacteria-- a group of one-celled microscopic organisms that encompasses the smallest, simplest, and perhaps first form of cell life that evolved. (Grolier's International Encyclopedia, 1991).

In this study, this term refers to the two types of test organism namely *B. subtilis* and *S. aureus*.

Tetracycline—an antibiotic which has been safely used to treat skin disorders for over 30 years, it is most commonly used to treat acne, but some other skin disorders such as rosacea and perioral dermatitis also respond to tetracycline (The Skin Site, 1997).

In this study, this refers to the substance used as positive control from which the effects of the leaf and flower extracts were compared for any significance.

Chapter 2

Review of Related Literature

A. Antibacterial Agent

An antibacterial agent is any of the large variety of chemical compounds and physical agents that are used to destroy microorganisms to prevent their development (Encyclopedia Britannica, 1993).

B. Bacteria

Bacteria is the common name for a vast group of one-celled microscopic organisms that encompasses the smallest, simplest. And perhaps first form of cell life that evolved. They constitute one of the two divisions in the kingdom Monera. They are unicellular and furnish both the raw material and the chemical machinery for their own reproduction. A century ago in the United States and even today in the less developed countries, at least 25% of the children died of bacterial infections before reaching puberty. In the United States and other Western countries, this figure is now below 5% as the result of improved sanitation, hygiene, nutrition, and medical care (Grolier's International Encyclopedia, 1991).

C. Herbal Medicine

Herbal medicine is the oldest and most widely used form of medicine in the world today. Yet medicinal herbs that formerly were held in esteem now are commonly dismissed as placebos. This article reviews the state of plant-derived drug research and discusses the efficacy and safety of herbal medicines within the context of the contemporary political and regulatory framework. The article also explores the relationship between medicinal plant use and temporally changing disease patterns. (Alternative Therapies in Health and Medicine. 1996; 2(4): 36-41) Throughout history medical practitioners have used as remedies plants and other materials taken from nature. Although some of the therapeutic properties attributed to plants have proven to be erroneous, medicinal plant therapy is based on the empirical findings of hundreds and thousands of years. For example, ancient Egyptians used the fruits and leaves of the bishop's weed (Ammi majus) to treat vitiligo, a skin condition characterized by a loss of pigment. More recently, a drug (§-methoxypsoralen) has been produced from this plant to treat psoriasis and other skin disorders, as well as T-cell lymphoma.[1] Claims made in the 18th century that pokeroot (Phytolacca decandra) is effective against cancer have been discounted, though this plant has been shown to kill cancer in mice. The scientific literature is replete with studies indicating the antiviral, antimicrobial, anti-inflammatory, antifungal, antibiotic, and anticarcinogenic activity of specific plants. For the most part, however, these findings are not followed up, due to the lengthy and expensive procedures involved in testing and developing a drug for regulatory approval. In fact, research investment in plant-derived drugs by pharmaceutical companies has been dwindling for much of the 20th century, and by the end of the 1970s had virtually ground to a halt. One reason is that after a 20-year, multimillion-dollar plant screening effort by researchers for the National Cancer Institute, not a single agent of general use in the treatment of human cancer was identified.[2] It should be noted, however, that the screening program used a mouse leukemia cancer as the only screen, whereas cancer comprises some 200 disease types. Japan, France, China, and many other countries are actively studying and developing plant-derived medicines, while the US is lagging behind. (Alternative therapies in health and medicine.htm)

D. French Rose

The Apothecary's Rose, known to botanists as *Rosa gallica officinalis*, is one of the most celebrated of all ancient roses. In the Renaissance art of the 15th and 16th centuries, it was one of the two most often painted roses — *Rosa alba* being the other. As such, its red color (really a deep pink) represented the blood of Christian martyrs. In fact, the petals of this rose were dried and rolled into beads; then strung into what became the rosary and from which the rosary received its name. The Apothecary's Rose dates back much further in history than the Renaissance, however. Believed to have come from ancient Persia, not much is known about the rose prior to the 7th century when Islam swept through the area and zealots destroyed much of the texts of that time. The rose came to Europe via noble knights returning from the Crusades. One story says that the rose was returned to King Louis VII after the Second Crusade in Syria. The rose made its way to King Henry II. Henry had married Queen Eleanor of Aquitaine, but had done so probably out of need to solidify the kingdom. As it sometimes happens, Henry had a mistress named Jane Clifford, later renamed The Fair Rosamond. Queen Eleanor got wind of this affair, concocted a poison to give her husband's mistress, and disguised the deadly potion with the oil of the Apothecary's Rose and *R. alba*. Chiefly grown in monasteries by monks eager to capitalize on the rose's medicinal values, by the end of the 13th century it was also grown for its perfume and dried for potpourri. By the 16th century, dried petals from the Apothecary's Rose were steeped in wine as a cure for hangovers – although this idea was not new; coming from the Early Romans who used roses for the same purpose almost 1200 years before. (The Apothecary's Rose.htm, 1999) Druggists dispensed remedies containing the Apothecary's Rose that reportedly aided indigestion, sore throats, skin rashes and eye maladies. Women believed that the petals would eliminate wrinkles and preserve their youth if rubbed on the skin. It was proven, late in the 19th century, that roses contained essential oils, potassium and iron. (R_Gallica Officinalis.htm, 1998)

E. Sunflower

Some scholars say that the origin of this plant is in South West of U.S.A. and the North of Mexico. Others put the origin in Mexico, Peru and U.S.A., between Minnesota and the Gulf of Mexico. Some say that there were old forms in West Canada.

The taxonomical classification for cultivated sunflower is Family Compositae, Subfamily Tubulifloras, Tribe Heliantheas, Genus Helianthus, and Species Annuus. H. Annus comes from the cross between two savage forms: H. lenticularis and H. debilis. The cultivar "macrocarpus" is considered like the form from which all the cultivated forms come. Indians used sunflower for both uses: Direct Food and to get oil. In the XIXth century it was wide cultivated in Central and South Russia, for direct food and to get oil. In 1883 it appears the first important factory of oil in this country.

F. Birds of Paradise

This group consists of four, tender perennials originally from South Africa. The most commonly grown is S. reginae, commonly known as the Bird-of-Paradise, Crane Flower or Crane Lily. This plant forms clumps of long-stalked leaves up to 3 feet long. The evergreen, bluish- or gray-green leaves have an oblong shape and leathery texture. (botany-sterilitza.htm) The beautiful flowers are produced atop long stalks, mainly in the spring The bird-of-paradise flower (*Strelitzia reginae*), or crane flower as it is sometimes known, is native to the southern and eastern parts of the Cape Province and northern Natal in South Africa, where it grows wild on river banks and in scrub clearings in coastal areas. It was first introduced into Britain in 1773 by Sir Joseph Banks, then the unofficial director of the Royal Gardens at Kew. He named the exotic-looking plant *Strelitzia* in honor of Queen Charlotte, wife of George III and Duchess of Mecklenburg-Strelitz, who lived at Kew for many years. (Royal Botanic Gardens, Kew Education.htm)

G. Bougainvillea

In 1768 when Admiral Louis de Bougainvillea began his long journey to the Pacific Ocean and discovered the vine that now bears his name, it was a botanical highlight of the voyage. Through the ensuing years, this Brazilian beauty has assumed its rightful place as one of the most popular, spectacular and beautiful tropical plants. *B. glabra* are among the most beautiful of flowering vines. These tropical members of the Nyctaginaceae (Four-O'Clock) family, are very vigorous, evergreen, woody vines with spines.
They grow readily from cuttings 4"-6" long, and in 4-6 weeks will develop good root systems when given bottom heat and mist. outer 1"-

2" of the root ball, and repot in the same size container. Bougainvillea need very bright light (2,500 fc) and do well under high shade or in full sun. These vines typically lose some leaves for a short time during the winter, but when light conditions are low, leaf loss may occur at any time. Under high light conditions, the colorful bracts will adorn the plant almost constantly and will persist for weeks. Plant in the ground in San Antonio is not recommended because of the winter damage, which will result, and the fact that our soils are too rich and we receive too much rain. In the ground, the plant will stay vegetative and bloom little. (Bougainvillea.htm,1997)

H. Chrysanthemum

These hardy plants are natives of China, Japan, northern Africa, and southern Europe. They belong to the Daisy family, Compositae. Their flowers come in every color except blue. Their blooms come in a huge variety of shapes and sizes. Some are spherical in shape and have incurved petals at the center. The yellow flowers are rather sparse and the leaves are elongated, oval and toothed. They are leathery when dried and can be used as bookmarks. Fresh young Costmary leaves can be used in salads and to add a balsam flavor to beer, soups, and bread. . Fresh young Costmary leaves can be used in salads and to add a balsam flavor to beer, soups, and bread. (Botany-chrysanthemum.htm)

I. Anthurium

These plants are found in South America. They are grown for their brightly colored flower spathes and/ or their ornamental leaves. A. andreanum (flamingo flower/ tail flower) produces orange-red spathes with red-tipped yellow spadix that grow at irregular intervals. The large, heart-shaped, dark green leaves are produced on long stalks. In cool climates, anthuriums need to be grown as house or greenhouse plants. Potting should be done early in the year, as soon as new roots begin to develop from rootstock. The 6 to 7 inch pots should be filled half way with crooks. A suitable soil mixture for these plants is three orchid peat, one part leaf mild and one part sphagnum moss, with a scattering of coarse sand, crushed charcoal and broken brick. Each year, the rootstock elongates and produces roots at higher level; the plants eventually become raised high above the rims of the pots. Seeds may also be sown as soon as they have ripened, in shallow earthenware pans filled with chopped sphagnum moss, charcoal, and sand. The seeds are scattered in the moss particles and the pan is covered with a piece of glass and placed in propagating case. (www.Botany.com)

J. Tetracycline

Tetracycline is an antibiotic, which has been safely used to treat skin disorders for over 30 years. It is most commonly used to treat acne, but some other skin disorders, such as rosacea and perioral dermatitis, also respond to tetracycline. Since tetracycline does not cure, but only suppresses these skin disorders, it may be necessary to continue taking it for months or even years. There is a bacteria that normally lives on the skin called *Propionibacterium acnes*. This bacteria feed on the sebum produced by the skin's oil glands. Sometimes, this bacteria multiplies and causes inflammation and acne. Tetracycline reduces the number of these bacteria. Out of innumerable women using oral contraceptives who have taken tetracycline, a few have become pregnant. It is debatable as to whether the failure of the contraceptive is due to the tetracycline or the established 1.0% failure rate of the pill. Tetracycline makes you more sensitive to sunlight. In other words, it's easier to get a sunburn while taking medication, so you should use a sunscreen of SPF 15 or higher. Ten percent of female patients will develop a yeast infection while taking antibiotics. The onset of genital itching and vaginal discharge suggests the beginning of a yeast infection. Tetracycline should be discontinued if you become pregnant because it is incorporated into the baby's bones and teeth. Tetracycline often causes temporary nausea and abdominal cramps. Tetracycline should be taken with water on an empty stomach, either 1 hour before meals or 2 hours after meals. You should not take it with milk or dairy products because this will decrease absorption of the medicine. (The skin site, 199)

K. Summary

The forgoing literature stating certain characters of the eight flowering plants and the tested medical uses and application of some is enough to support the possibility of the leaf and flower extracts of these to destroy *B. subtilis* and *S. aureus*. The chemical components of some plants and their unique properties are probable indicators of their antibacterial capability.

Chapter 3

Research Design and Methodology

A. Collection of specimen

A certain quantity of the leaves and flower petals of anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) were gathered from within the vicinity of Jaro, Iloilo City. The leaves and petals were then brought to the Philippine Science High School WVC Science Research laboratory where they were washed with tap water and rinsed with distilled water.

B. Preparation of Culture Media

B.1 Sterilization of Equipment

All equipment used, like the petri dishes and beakers, were thoroughly washed with soap and tap water and air-dried. After which, these equipment were sterilized using the pressure cooker at a temperature of 121^0 C and 15 psi pressure.

B.2 Cooking of Agar

A solution of 3.5 grams Nutrient Agar to 125 ml distilled water was prepared. The solution was then stored in a sterilized Erlenmeyer flask, which was then covered tightly by a rubber stopper to avoid contamination.

B.3 Sterilization of Agar

The flasks containing the agar was sterilized using a pressure cooker set at a temperature of 121^{0}C and at a pressure of 15 psi. The sterilized agar was dispensed into several petri dishes. These petri dishes were then left on a cool place to allow the agar to harden.

C. Inoculation

A small amount of each bacterium was transferred into a single plate with hardened agar using a loop wire. To avoid contamination, the loop wire was placed over direct flame where it was heated until redness. The loop was then dipped into the tube containing the bacteria. Using the loop, the bacteria were then streaked on the agar of the petri dish. This plate was then incubated for 24 hours at a temperature of 37^{0}C to allow reproduction.

D. Preparation of Inoculum for Assay Plates

D.1 Preparation of the Assay Plates

The remaining petri dishes were streaked with *B. subtilis* and *S. aureus* coming from the former petri dish that served as a culture medium. After doing so, the petri dishes were placed in an incubator at 37^{0}C for 24 hours.

D.2 Sterilization and Preparation of Whattman Paper Discs

The punched Whattman paper discs were placed in foil paper and was sterilize in the pressure cooker at a temperature of 121^{0}C and at a pressure of 15 psi. Twelve sterilized Whattman paper discs were immersed in each extract and were left for three minutes.

E. Antibacterial Testing

Six Whattman paper discs containing the leaf extracts and another six containing the flower extract of the same flowering plant were placed in a petri dish for each bacterium. A single plate for each bacterium was treated with six discs treated with the positive control tetracycline, and the negative control distilled water. The paper discs were placed at a conventional distance from each other. All petri dishes were incubated at 37^{0}C for a period of 24 hours.

F. Measuring Zone of Inhibition

After the incubation period of 24 hours, the effect of the extracts on each bacterium was determined. Using a 12-inch ruler, the diameter zone of inhibition created by the discs was measured. The largest area for each plate, including the area of the filter paper, was measured as the zone of inhibition and was expressed to the nearest tenth of a millimeter. The results were analyzed using statistical tool to arrive at certain conclusions.

G. Statistical Analysis

One- Way analysis of variance and Tukey test were utilized to test the hypotheses that there is no significant difference on the antibacterial property of the different plant extracts on *B. subtilis* and *S. aureus*.

Chapter 4

Results and Discussions

This study was conducted to determine the antibacterial potential of six flowering plants namely anthurium (*A. andraeanium*), sunflower (*H. annus*), birds of paradise (*S. reginae*), bougainvillea (*B. glabra*), chrysanthemum (*C. morifolium*), and French rose (*R. gallica*) on *B. subtilis* and *S. aureus*.

Table 1 shows the zone of inhibition in millimeters of the leaf extracts on *B. subtilis* after 24-hour treatment.

Result of Table 1 show that almost all leaf extracts posses antibacterial potential against *B. subtilis*. By comparing the means, Table 1 shows the antibacterial potential of the leaf decreased in the order:

Tetracycline > French rose > birds of paradise > anthurium > chrysanthemum > bougainvillea > sunflower = distilled water.

Tukey test was used to further compare the antibacterial property of each treatment to each other. At a significant level of 0.05, the mean difference of each treatment was first compared to birds of paradise leaf extracts. Tukey test showed that only French rose and tetracycline have a significant difference in their effect on the diameter zone of inhibition of *B. subtilis*.

Bougainvillea, anthurium, chrysanthemum, and sunflower leaf extracts, and distilled water did not show any significant difference on their effect on the diameter zone of inhibition of *B. subtilis* after 24 hours treatment. On the other hand, these extracts varied significantly to the effect of French rise leaf extracts and tetracycline to the test organism, while tetracycline and French rose did not vary significantly at all.

Table 1. Diameter zone of inhibition (mm) of leaf extracts on *B. subtilis* after 24 hours. Values of the same letter (superscript) do not differ significantly (Tukey test $p<0.05$).

Treatment	Diameter Zone of Inhibition						Mean ± Sd.
	Trials						
	1	2	3	4	5	6	Means
Birds of Paradise	8.5	9.5	6.2	6.2	7	6	7.23 ± 1.4469 [a]
Bougainvillea	7.5	5.5	5.5	5.5	6.5	7	6.08 ± 0.880 [a]
French Rose	13	9	8.5	10	8.5	9.5	9.75 ± 1.696 [b]
Anthurium	7.5	6	8.5	6	9.5	5.5	7.16 ± 1.602 [a]
Chrysanthemum	7.5	6.5	8	6	5.5	5.5	6.5 ± 1.049 [a]
Sunflower	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± 0 [a]
Distilled water	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± 0 [a]
Tetracycline	13	12.5	10.5	8.2	14	9	11.2 ± 2.328 [b]

Table 2 shows the diameter zone of inhibition in millimeters of flower extracts on *B. subtilis* after 24 hours.

Results of table 2 show hat flower extracts posses antibacterial potential against *B. subtilis*. The antibacterial potential of the flower extracts on *B. subtilis* decreased in the order: Tetracycline > French rose > birds of paradise > anthurium > sunflower. bougainvillea > chrysanthemum = distilled water.

Using Tukey test, the mean difference of the treatments were utilized to determine if a significant difference exists between the antibacterial potential of each treatment from one another.

Tukey test showed that all flower extracts and distilled water did not vary significantly on their effect on the diameter zone of inhibition of *B. subtilis*. The only significant difference exists between the antibacterial potential of tetracycline and the rest of the treatment.

Table 2. Diameter zone of inhibition (mm) of leaf extracts on *B. subtilis after 24 hours.* Values of the same letter (superscript) do no differ significantly (Tukey test p<0.05).

Treatment	Diameter Zone of Inhibition						Mean ± Sd.
	Trials						
	1	2	3	4	5	6	Means
Birds of Paradise	7.2	6	5.5	6.5	7.2	6.5	6.45 ± 0.739 [a]
Bougainvillea	6.5	5.5	5.5	5.5	5.5	5.5	5.67 ± 0.204 [a]
French Rose	5.5	6.5	6	10	6.5	7	6.92 ± 1.594 [a]

Anthurium	5.5	6	6.5	9.5	5.5	9.5	7.08 ± 1.908 ^{a}
Chrysanthemum	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 ^{a}
Sunflower	6.5	6	6	7	6.2	5.5	6.2 ± 0.510 ^{a}
Distilled water	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 ^{a}
Tetracycline	13	12.5	10.5	8.2	14	9	11.2 ± 2.328 ^{b}

Table 3 shows the effect on the diameter zone of inhibition of the leaf extracts on *S. aureus* in millimeters after 24 hours.

Result of table 3 show that the almost all leaf extracts posses antibacterial potential against *S. aureus*. By comparing the means of the six replicates, the antibacterial potential of the leaf extracts on *S. aureus* decreased in the order:

Tetracycline > French rose > birds of paradise > anthurium > chrysanthemum > bougainvillea > sunflower = distilled water.

Tukey test showed all leaf extracts except French rose did not vary significantly on their antibacterial potential on *S. aureus* compared to that of distilled water. On the other hand, French rose varied significantly from the rest except if compared to tetracycline.

Table 3. Diameter zone of inhibition (mm) of leaf extracts on *S. aureus* after 24 hours. Values of the same letter (superscript) do not differ significantly (Tukey test p<0.05)

Treatment	Diameter Zone of Inhibition						Mean ± Sd.
	Trials						
	1	2	3	4	5	6	Means
Birds of Paradise	11	8	7.2	6.5	6	5.5	7.37 ± .987 [a]
Bougainvillea	6.5	5.5	5.5	6	5.5	5.5	5.75 ± .418 [a]
French Rose	12	10.5	9.5	10	13	11.5	11.08 ± 1.320 [b]
Anthurium	6	6	7	7.5	8	9	7.25 ± 1.173 [a]

Chrysanthemum	7	6	5.5	6	5.5	5.5	5.92 ± .585 [a]
Sunflower	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 [a]
Distilled water	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 [a]
Tetracycline	13.5	12.5	14	11	13	10	12.33 ± 2.723 [b]

Table 4 shows the diameter zone of inhibition in millimeters of the flower extracts on *S. aureus* after 24 hours.

Results of table 4 show that almost all flower extracts posses antibacterial potential against *S. aureus*. It decreased in the order:

Tetracycline > birds of paradise > French rose > anthurium > sunflower = chrysanthemum = bougainvillea = distilled water.

At a significant level of 0.05, Tukey test show that all flower extracts did not show significant difference in their antibacterial potential compared to distilled water. It only follows that the extracts pose significant difference with tetracycline.

Table 4. Diameter zone of inhibition (mm) of flower extracts on *S. aureus* after 24 hours. Values of the same letter (superscript) do not differ significantly (Tukey test $p<0.05$)

Treatment	Diameter Zone of Inhibition						Mean ± Sd.
	Trials						
	1	2	3	4	5	6	Means
Birds of Paradise	7	7.5	6.5	7	7	6.2	6.87 ± .455 [a]
Bougainvillea	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 [a]
French Rose	10	6.5	6	5.5	6	5.5	6.58 ± 1.715 [a]
Anthurium	5.5	5.5	5.5	6	8	7	6.25 ± 1.037 [a]
Chrysanthemum	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 [a]

Sunflower	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 [a]
Distilled water	5.5	5.5	5.5	5.5	5.5	5.5	5.5 ± .000 [a]
Tetracycline	13.5	12.5	14	11	13	10	12.33 ± 1.538 [b]

Discussion

In table 1 and table 2, we notice that all leaf extracts except French rose show significant difference with tetracycline. This means that the ability of French rose leaf extracts to destroy and prevent further growth of *B. subtilis* and *S. aureus* is closely similar to the ability of the commercially bought tetracycline. Druggists dispensed remedies containing the Apothecary's Rose or French rose, reportedly aided indigestion, sore throats, skin rashes and eye maladies. Women believed that the petals would eliminate wrinkles and preserve their youth if rubbed on the skin. It was proven, late in the 19th century, that French roses contained essential oils, potassium and iron (R_Gallica Officinalis.htm, 1998), which may have caused the high antibacterial potential of French rose leaves.

Chapter 5

Summary, Conclusion, and Recommendations

A. Summary

The researchers were able to procure leaf and flower extracts by blending flower petals and leaves with distilled water in a ratio of 1 gram: 2 ml distilled water. These crude extracts were then strained to remove stranded particles. Six replicates were made for each extract to test the antibacterial potential of these extracts against *B. subtilis* and *S. aureus* using disc diffusion method. Tetracycline was used as the positive control and distilled water as the negative control. After 24 hours of incubation, the diameter zone of inhibition was measured to the nearest tenth of a millimeter. One- Way Analysis of Variance and Tukey Test were used to determine if a significant difference exists in the antibacterial effect of the leaf and flower extracts on the test organisms.

B. Conclusion

After 24 hours, results showed that almost all treatments except distilled water, exhibited antibacterial potential against *B. subtilis* and *S. aureus.*

Antibacterial potential of leaf extracts on the diameter zone of inhibition of *B. subtilis* decreased in the order: tetracycline > French rose > birds of paradise > anthurium > chrysanthemum > bougainvillea > sunflower = distilled water.

Antibacterial potential of the flower extracts on the diameter zone of inhibition of *B. subtilis* decreased in the order: tetracycline > French rose > birds of paradise > anthurium > sunflower > bougainvillea > chrysanthemum = distilled water.

Antibacterial potential of the leaf extracts on the diameter zone of inhibition of *S. aureus* decreased in the order: tetracycline > French rose > birds of paradise > anthurium > chrysanthemum > bougainvillea > sunflower = distilled water.

Antibacterial potential of the flower extracts on the diameter zone of inhibition of *S. aureus* decreased in the order: tetracycline > birds of paradise > French rose > anthurium > sunflower = chrysanthemum = bougainvillea = distilled water.

C. Recommendation

This study tested the antibacterial potential of the leaf and flower extracts of six flowering plants against two test organisms. For future studies, the researchers recommend the testing of other plants and other bacteria as test organisms. The researchers also recommend testing the antibacterial potential of plant extracts using different concentrations.

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www.Botany.com

Diameter Zone of Inhibition of *B. subtilis* after 24 hours tr

Report

zone of inhibition

birds of paradise	Mean	7.2333
	N	6
	Std. Deviation	1.4459
bougainvillea	Mean	6.2500
	N	6
	Std. Deviation	.8803
french rose	Mean	9.7500
	N	6
	Std. Deviation	1.6956
anthurium	Mean	7.1667
	N	6
	Std. Deviation	1.6021
chrysanthemum	Mean	6.5000
	N	6
	Std. Deviation	1.0488
sunflower	Mean	5.5000
	N	6
	Std. Deviation	.0000
distilled water	Mean	5.5000
	N	6
	Std. Deviation	.0000
tetracycline	Mean	11.2000
	N	6
	Std. Deviation	2.3281
Total	Mean	7.3875
	N	48
	Std. Deviation	2.3067

Oneway

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
zone of inhibition	Between Groups	176.376	7	25.197	13.595	.000
	Within Groups	74.137	40	1.853		
	Total	250.513	47			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
birds of paradise	bougainvillea	.9833	.786	.911	-1.5291	3.4958
	french rose	-2.5167*	.786	.049	-5.0291	-4.2E-03
	anthurium	6.667E-02	.786	1.000	-2.4458	2.5791
	chrysanthemum	.7333	.786	.981	-1.7791	3.2458
	sunflower	1.7333	.786	.370	-.7791	4.2458
	distilled water	1.7333	.786	.370	-.7791	4.2458
	tetracycline	-3.9667*	.786	.000	-6.4791	-1.4542
bougainvillea	birds of paradise	-.9833	.786	.911	-3.4958	1.5291
	french rose	-3.5000*	.786	.002	-6.0125	-.9875
	anthurium	-.9167	.786	.937	-3.4291	1.5958
	chrysanthemum	-.2500	.786	1.000	-2.7625	2.2625
	sunflower	.7500	.786	.978	-1.7625	3.2625
	distilled water	.7500	.786	.978	-1.7625	3.2625
	tetracycline	-4.9500*	.786	.000	-7.4625	-2.4375
french rose	birds of paradise	2.5167*	.786	.049	4.19E-03	5.0291
	bougainvillea	3.5000*	.786	.002	.9875	6.0125
	anthurium	2.5833*	.786	.040	7.09E-02	5.0958
	chrysanthemum	3.2500*	.786	.004	.7375	5.7625
	sunflower	4.2500*	.786	.000	1.7375	6.7625
	distilled water	4.2500*	.786	.000	1.7375	6.7625
	tetracycline	-1.4500	.786	.595	-3.9625	1.0625

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
anthurium	birds of paradise	-6.67E-02	.786	1.000	-2.5791	2.4458
	bougainvillea	.9167	.786	.937	-1.5958	3.4291
	french rose	-2.5833*	.786	.040	-5.0958	-7.1E-02
	chrysanthemum	.6667	.786	.989	-1.8458	3.1791
	sunflower	1.6667	.786	.420	-.8458	4.1791
	distilled water	1.6667	.786	.420	-.8458	4.1791
	tetracycline	-4.0333*	.786	.000	-6.5458	-1.5209
chrysanthemum	birds of paradise	-.7333	.786	.981	-3.2458	1.7791
	bougainvillea	.2500	.786	1.000	-2.2625	2.7625
	french rose	-3.2500*	.786	.004	-5.7625	-.7375
	anthurium	-.6667	.786	.989	-3.1791	1.8458
	sunflower	1.0000	.786	.904	-1.5125	3.5125
	distilled water	1.0000	.786	.904	-1.5125	3.5125
	tetracycline	-4.7000*	.786	.000	-7.2125	-2.1875
sunflower	birds of paradise	-1.7333	.786	.370	-4.2458	.7791
	bougainvillea	-.7500	.786	.978	-3.2625	1.7625
	french rose	-4.2500*	.786	.000	-6.7625	-1.7375
	anthurium	-1.6667	.786	.420	-4.1791	.8458
	chrysanthemum	-1.0000	.786	.904	-3.5125	1.5125
	distilled water	.0000	.786	1.000	-2.5125	2.5125
	tetracycline	-5.7000*	.786	.000	-8.2125	-3.1875
distilled water	birds of paradise	-1.7333	.786	.370	-4.2458	.7791
	bougainvillea	-.7500	.786	.978	-3.2625	1.7625
	french rose	-4.2500*	.786	.000	-6.7625	-1.7375
	anthurium	-1.6667	.786	.420	-4.1791	.8458
	chrysanthemum	-1.0000	.786	.904	-3.5125	1.5125
	sunflower	.0000	.786	1.000	-2.5125	2.5125
	tetracycline	-5.7000*	.786	.000	-8.2125	-3.1875

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
tetracycline	birds of paradise	3.9667*	.786	.000	1.4542	6.4791
	bougainvillea	4.9500*	.786	.000	2.4375	7.4625
	french rose	1.4500	.786	.595	-1.0625	3.9625
	anthurium	4.0333*	.786	.000	1.5209	6.5458
	chrysanthemum	4.7000*	.786	.000	2.1875	7.2125
	sunflower	5.7000*	.786	.000	3.1875	8.2125
	distilled water	5.7000*	.786	.000	3.1875	8.2125

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

zone of inhibition

Tukey HSD[a]

treatment	N	Subset for alpha = .05: 1	2
sunflower	6	5.5000	
distilled water	6	5.5000	
bougainvillea	6	6.2500	
chrysanthemum	6	6.5000	
anthurium	6	7.1667	
birds of paradise	6	7.2333	
french rose	6		9.7500
tetracycline	6		11.2000
Sig.		.370	.595

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.000

Diameter Zone of Inhibition of *B. subtilis* after 24 hours

Report

zone of inhibition

birds of paradise	Mean	6.4833
	N	6
	Std. Deviation	.6676
bougainvillea	Mean	5.6667
	N	6
	Std. Deviation	.4082
french rose	Mean	6.9167
	N	6
	Std. Deviation	1.5943
anthurium	Mean	7.0833
	N	6
	Std. Deviation	1.9083
chrysanthemum	Mean	5.5000
	N	6
	Std. Deviation	.0000
sunflower	Mean	6.2000
	N	6
	Std. Deviation	.5099
distilled water	Mean	5.5000
	N	6
	Std. Deviation	.0000
tetracycline	Mean	11.2000
	N	6
	Std. Deviation	2.3281
Total	Mean	6.8187
	N	48
	Std. Deviation	2.1129

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
zone of inhibition	Between Groups	147.455	7	21.065	13.508	.000
	Within Groups	62.378	40	1.559		
	Total	209.833	47			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
birds of paradise	bougainvillea	.8167	.721	.945	-1.4880	3.1213
	french rose	-.4333	.721	.999	-2.7380	1.8713
	anthurium	-.6000	.721	.990	-2.9046	1.7046
	chrysanthemum	.9833	.721	.868	-1.3213	3.2880
	sunflower	.2833	.721	1.000	-2.0213	2.5880
	distilled water	.9833	.721	.868	-1.3213	3.2880
	tetracycline	-4.7167*	.721	.000	-7.0213	-2.4120
bougainvillea	birds of paradise	-.8167	.721	.945	-3.1213	1.4880
	french rose	-1.2500	.721	.666	-3.5546	1.0546
	anthurium	-1.4167	.721	.517	-3.7213	.8880
	chrysanthemum	.1667	.721	1.000	-2.1380	2.4713
	sunflower	-.5333	.721	.995	-2.8380	1.7713
	distilled water	.1667	.721	1.000	-2.1380	2.4713
	tetracycline	-5.5333*	.721	.000	-7.8380	-3.2287
french rose	birds of paradise	.4333	.721	.999	-1.8713	2.7380
	bougainvillea	1.2500	.721	.666	-1.0546	3.5546
	anthurium	-.1667	.721	1.000	-2.4713	2.1380
	chrysanthemum	1.4167	.721	.517	-.8880	3.7213
	sunflower	.7167	.721	.973	-1.5880	3.0213
	distilled water	1.4167	.721	.517	-.8880	3.7213
	tetracycline	-4.2833*	.721	.000	-6.5880	-1.9787

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
anthurium	birds of paradise	.6000	.721	.990	-1.7046	2.9046
	bougainvillea	1.4167	.721	.517	-.8880	3.7213
	french rose	.1667	.721	1.000	-2.1380	2.4713
	chrysanthemum	1.5833	.721	.376	-.7213	3.8880
	sunflower	.8833	.721	.919	-1.4213	3.1880
	distilled water	1.5833	.721	.376	-.7213	3.8880
	tetracycline	-4.1167*	.721	.000	-6.4213	-1.8120
chrysanthemum	birds of paradise	-.9833	.721	.868	-3.2880	1.3213
	bougainvillea	-.1667	.721	1.000	-2.4713	2.1380
	french rose	-1.4167	.721	.517	-3.7213	.8880
	anthurium	-1.5833	.721	.376	-3.8880	.7213
	sunflower	-.7000	.721	.976	-3.0046	1.6046
	distilled water	.0000	.721	1.000	-2.3046	2.3046
	tetracycline	-5.7000*	.721	.000	-8.0046	-3.3954
sunflower	birds of paradise	-.2833	.721	1.000	-2.5880	2.0213
	bougainvillea	.5333	.721	.995	-1.7713	2.8380
	french rose	-.7167	.721	.973	-3.0213	1.5880
	anthurium	-.8833	.721	.919	-3.1880	1.4213
	chrysanthemum	.7000	.721	.976	-1.6046	3.0046
	distilled water	.7000	.721	.976	-1.6046	3.0046
	tetracycline	-5.0000*	.721	.000	-7.3046	-2.6954
distilled water	birds of paradise	-.9833	.721	.868	-3.2880	1.3213
	bougainvillea	-.1667	.721	1.000	-2.4713	2.1380
	french rose	-1.4167	.721	.517	-3.7213	.8880
	anthurium	-1.5833	.721	.376	-3.8880	.7213
	chrysanthemum	.0000	.721	1.000	-2.3046	2.3046
	sunflower	-.7000	.721	.976	-3.0046	1.6046
	tetracycline	-5.7000*	.721	.000	-8.0046	-3.3954

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
tetracycline	birds of paradise	4.7167*	.721	.000	2.4120	7.0213
	bougainvillea	5.5333*	.721	.000	3.2287	7.8380
	french rose	4.2833*	.721	.000	1.9787	6.5880
	anthurium	4.1167*	.721	.000	1.8120	6.4213
	chrysanthemum	5.7000*	.721	.000	3.3954	8.0046
	sunflower	5.0000*	.721	.000	2.6954	7.3046
	distilled water	5.7000*	.721	.000	3.3954	8.0046

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

zone of inhibition

Tukey HSD[a]

treatment	N	Subset for alpha = .05: 1	2
chrysanthemum	6	5.5000	
distilled water	6	5.5000	
bougainvillea	6	5.6667	
sunflower	6	6.2000	
birds of paradise	6	6.4833	
french rose	6	6.9167	
anthurium	6	7.0833	
tetracycline	6		11.2000
Sig.		.376	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.000

Diameter Zone of Inhibition of *S. aureus* after 24 hours

Report

zone of inhibition

birds of paradise	Mean	7.0333
	N	6
	Std. Deviation	2.0265
bougainvillea	Mean	5.7500
	N	6
	Std. Deviation	.4183
french rose	Mean	11.0833
	N	6
	Std. Deviation	1.3197
anthurium	Mean	7.2500
	N	6
	Std. Deviation	1.1726
chrysanthemum	Mean	5.9167
	N	6
	Std. Deviation	.5845
sunflower	Mean	5.5000
	N	6
	Std. Deviation	.0000
distilled water	Mean	5.5000
	N	6
	Std. Deviation	.0000
tetracycline	Mean	12.3333
	N	6
	Std. Deviation	1.5384
Total	Mean	7.5458
	N	48
	Std. Deviation	2.7318

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
zone of inhibition	Between Groups	300.206	7	42.887	33.947	.000
	Within Groups	50.533	40	1.263		
	Total	350.739	47			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: zone of inhibition
Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
birds of paradise	bougainvillea	1.2833	.649	.509	-.7910	3.3577
	french rose	-4.0500*	.649	.000	-6.1243	-1.9757
	anthurium	-.2167	.649	1.000	-2.2910	1.8577
	chrysanthemum	1.1167	.649	.674	-.9577	3.1910
	sunflower	1.5333	.649	.287	-.5410	3.6077
	distilled water	1.5333	.649	.287	-.5410	3.6077
	tetracycline	-5.3000*	.649	.000	-7.3743	-3.2257
bougainvillea	birds of paradise	-1.2833	.649	.509	-3.3577	.7910
	french rose	-5.3333*	.649	.000	-7.4077	-3.2590
	anthurium	-1.5000	.649	.313	-3.5743	.5743
	chrysanthemum	-.1667	.649	1.000	-2.2410	1.9077
	sunflower	.2500	.649	1.000	-1.8243	2.3243
	distilled water	.2500	.649	1.000	-1.8243	2.3243
	tetracycline	-6.5833*	.649	.000	-8.6577	-4.5090
french rose	birds of paradise	4.0500*	.649	.000	1.9757	6.1243
	bougainvillea	5.3333*	.649	.000	3.2590	7.4077
	anthurium	3.8333*	.649	.000	1.7590	5.9077
	chrysanthemum	5.1667*	.649	.000	3.0923	7.2410
	sunflower	5.5833*	.649	.000	3.5090	7.6577
	distilled water	5.5833*	.649	.000	3.5090	7.6577
	tetracycline	-1.2500	.649	.542	-3.3243	.8243

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
anthurium	birds of paradise	.2167	.649	1.000	-1.8577	2.2910
	bougainvillea	1.5000	.649	.313	-.5743	3.5743
	french rose	-3.8333*	.649	.000	-5.9077	-1.7590
	chrysanthemum	1.3333	.649	.460	-.7410	3.4077
	sunflower	1.7500	.649	.153	-.3243	3.8243
	distilled water	1.7500	.649	.153	-.3243	3.8243
	tetracycline	-5.0833*	.649	.000	-7.1577	-3.0090
chrysanthemum	birds of paradise	-1.1167	.649	.674	-3.1910	.9577
	bougainvillea	.1667	.649	1.000	-1.9077	2.2410
	french rose	-5.1667*	.649	.000	-7.2410	-3.0923
	anthurium	-1.3333	.649	.460	-3.4077	.7410
	sunflower	.4167	.649	.998	-1.6577	2.4910
	distilled water	.4167	.649	.998	-1.6577	2.4910
	tetracycline	-6.4167*	.649	.000	-8.4910	-4.3423
sunflower	birds of paradise	-1.5333	.649	.287	-3.6077	.5410
	bougainvillea	-.2500	.649	1.000	-2.3243	1.8243
	french rose	-5.5833*	.649	.000	-7.6577	-3.5090
	anthurium	-1.7500	.649	.153	-3.8243	.3243
	chrysanthemum	-.4167	.649	.998	-2.4910	1.6577
	distilled water	.0000	.649	1.000	-2.0743	2.0743
	tetracycline	-6.8333*	.649	.000	-8.9077	-4.7590
distilled water	birds of paradise	-1.5333	.649	.287	-3.6077	.5410
	bougainvillea	-.2500	.649	1.000	-2.3243	1.8243
	french rose	-5.5833*	.649	.000	-7.6577	-3.5090
	anthurium	-1.7500	.649	.153	-3.8243	.3243
	chrysanthemum	-.4167	.649	.998	-2.4910	1.6577
	sunflower	.0000	.649	1.000	-2.0743	2.0743
	tetracycline	-6.8333*	.649	.000	-8.9077	-4.7590

Multiple Comparisons

Dependent Variable: zone of inhibition
Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
tetracycline	birds of paradise	5.3000*	.649	.000	3.2257	7.3743
	bougainvillea	6.5833*	.649	.000	4.5090	8.6577
	french rose	1.2500	.649	.542	-.8243	3.3243
	anthurium	5.0833*	.649	.000	3.0090	7.1577
	chrysanthemum	6.4167*	.649	.000	4.3423	8.4910
	sunflower	6.8333*	.649	.000	4.7590	8.9077
	distilled water	6.8333*	.649	.000	4.7590	8.9077

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

zone of inhibition

Tukey HSD[a]

treatment	N	Subset for alpha = .05	
		1	2
sunflower	6	5.5000	
distilled water	6	5.5000	
bougainvillea	6	5.7500	
chrysanthemum	6	5.9167	
birds of paradise	6	7.0333	
anthurium	6	7.2500	
french rose	6		11.0833
tetracycline	6		12.3333
Sig.		.153	.542

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.000

Diameter Zone of Inhibition of *S. aureus* after 24 hours

Report

zone of inhibition

birds of paradiss	Mean	6.8667
	N	6
	Std. Deviation	.4546
bougainvillea	Mean	5.4167
	N	6
	Std. Deviation	.2041
french rose	Mean	6.5833
	N	6
	Std. Deviation	1.7151
anthurium	Mean	6.2500
	N	6
	Std. Deviation	1.0368
chrysanthemum	Mean	5.5000
	N	6
	Std. Deviation	.0000
sunflower	Mean	5.5000
	N	6
	Std. Deviation	.0000
distilled water	Mean	5.5000
	N	6
	Std. Deviation	.0000
tetracycline	Mean	12.3333
	N	6
	Std. Deviation	1.5384
Total	Mean	6.7438
	N	48
	Std. Deviation	2.3553

T6

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
zone of inhibition	Between Groups	227.580	7	32.511	39.220	.000
	Within Groups	33.158	40	.829		
	Total	260.738	47			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
birds of paradise	bougainvillea	1.4500	.526	.135	-.2303	3.1303
	french rose	.2833	.526	.999	-1.3970	1.9636
	anthurium	.6167	.526	.935	-1.0636	2.2970
	chrysanthemum	1.3667	.526	.186	-.3136	3.0470
	sunflower	1.3667	.526	.186	-.3136	3.0470
	distilled water	1.3667	.526	.186	-.3136	3.0470
	tetracycline	-5.4667*	.526	.000	-7.1470	-3.7864
bougainvillea	birds of paradise	-1.4500	.526	.135	-3.1303	.2303
	french rose	-1.1667	.526	.362	-2.8470	.5136
	anthurium	-.8333	.526	.756	-2.5136	.8470
	chrysanthemum	-8.33E-02	.526	1.000	-1.7636	1.5970
	sunflower	-8.33E-02	.526	1.000	-1.7636	1.5970
	distilled water	-8.33E-02	.526	1.000	-1.7636	1.5970
	tetracycline	-6.9167*	.526	.000	-8.5970	-5.2364
french rose	birds of paradise	-.2833	.526	.999	-1.9636	1.3970
	bougainvillea	1.1667	.526	.362	-.5136	2.8470
	anthurium	.3333	.526	.998	-1.3470	2.0136
	chrysanthemum	1.0833	.526	.456	-.5970	2.7636
	sunflower	1.0833	.526	.456	-.5970	2.7636
	distilled water	1.0833	.526	.456	-.5970	2.7636
	tetracycline	-5.7500*	.526	.000	-7.4303	-4.0697

Multiple Comparisons

Dependent Variable: zone of inhibition
Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
anthurium	birds of paradise	-.6167	.526	.935	-2.2970	1.0636
	bougainvillea	.8333	.526	.756	-.8470	2.5136
	french rose	-.3333	.526	.998	-2.0136	1.3470
	chrysanthemum	.7500	.526	.839	-.9303	2.4303
	sunflower	.7500	.526	.839	-.9303	2.4303
	distilled water	.7500	.526	.839	-.9303	2.4303
	tetracycline	-6.0833*	.526	.000	-7.7636	-4.4030
chrysanthemum	birds of paradise	-1.3667	.526	.186	-3.0470	.3136
	bougainvillea	8.333E-02	.526	1.000	-1.5970	1.7636
	french rose	-1.0833	.526	.456	-2.7636	.5970
	anthurium	-.7500	.526	.839	-2.4303	.9303
	sunflower	.0000	.526	1.000	-1.6803	1.6803
	distilled water	.0000	.526	1.000	-1.6803	1.6803
	tetracycline	-6.8333*	.526	.000	-8.5136	-5.1530
sunflower	birds of paradise	-1.3667	.526	.186	-3.0470	.3136
	bougainvillea	8.333E-02	.526	1.000	-1.5970	1.7636
	french rose	-1.0833	.526	.456	-2.7636	.5970
	anthurium	-.7500	.526	.839	-2.4303	.9303
	chrysanthemum	.0000	.526	1.000	-1.6803	1.6803
	distilled water	.0000	.526	1.000	-1.6803	1.6803
	tetracycline	-6.8333*	.526	.000	-8.5136	-5.1530
distilled water	birds of paradise	-1.3667	.526	.186	-3.0470	.3136
	bougainvillea	8.333E-02	.526	1.000	-1.5970	1.7636
	french rose	-1.0833	.526	.456	-2.7636	.5970
	anthurium	-.7500	.526	.839	-2.4303	.9303
	chrysanthemum	.0000	.526	1.000	-1.6803	1.6803
	sunflower	.0000	.526	1.000	-1.6803	1.6803
	tetracycline	-6.8333*	.526	.000	-8.5136	-5.1530

Multiple Comparisons

Dependent Variable: zone of inhibition

Tukey HSD

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
tetracycline	birds of paradise	5.4667*	.526	.000	3.7864	7.1470
	bougainvillea	6.9167*	.526	.000	5.2364	8.5970
	french rose	5.7500*	.526	.000	4.0697	7.4303
	anthurium	6.0833*	.526	.000	4.4030	7.7636
	chrysanthemum	6.8333*	.526	.000	5.1530	8.5136
	sunflower	6.8333*	.526	.000	5.1530	8.5136
	distilled water	6.8333*	.526	.000	5.1530	8.5136

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

zone of Inhibition

Tukey HSD[a]

treatment	N	Subset for alpha = .05 1	2
bougainvillea	6	5.4167	
chrysanthemum	6	5.5000	
sunflower	6	5.5000	
distilled water	6	5.5000	
anthurium	6	6.2500	
french rose	6	6.5833	
birds of paradise	6	6.8667	
tetracycline	6		12.3333
Sig.		.135	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 6.000