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FACULTY OF SCIENCE AND EDUCATION
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COMPARATIVE STUDY OF THE ANTIFUNGAL ACTIVITY OF *Aloe vera* AND
Zingiber officinale EXTRACTS ON *Trichophyton rubrum*.

RESEARCH REPORT SUBMITTED TO THE BIOLOGY DEPARTMENT FOR PARTIAL
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BY

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DECLARATION

I, Walube Blair, duly declare that the work presented is my original work and has not been submitted for a degree or any other award in any other University or any other institution

Signature.....Date.....

APPROVAL BY THE SUPERVISOR

I hereby confirm that the candidate carried out the work reported in this report under my supervision.

Barugahare Banson, B.Sc., M.Sc., MPHIL

Signature.....Date.....

DEDICATION

This report is dedicated to my father Mr. Katumba Jackson and my mother Mrs. Kagoya Rose for their sacrifice towards my upbringing and all the efforts put in towards the payment of my tuition and all the necessary requirements during my stay at school.

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ABBREVIATIONS AND ACRONYMS

SDA Sabouraud Dextrose Agar

Ms. EXCEL Microsoft excel

H_A Alternative hypothesis

Anova Analysis of variance

H₀ Null hypothesis

KOH Potassium hydroxide

ABSTRACT

Trichophyton rubrum causes the common superficial dermatophyte infection of the feet. It may present in several clinical varieties such as intertriginous, hyperkeratotic, vesiculobullous, ulcerative or a combination of these. It is often referred to as “Athlete’s Foot”.

Tinea pedis may be accompanied by dermatophyte infection of other parts of the body including groin, hands or nails. It is estimated to affect about 15% of the population at large, being more common in closed communities such as army barracks and boarding schools, in warm weather, among those frequently using swimming pools, and when the feet are occluded with nonporous tight fitting shoes.

20 petri dishes seeded with the fungus were treated with *Aloe vera*, *Zingiber officinale* and the mixture of the two using a disc of 9mm in a disc diffusion method on SDA. Each petri dish was divided into four portions that is to say *Aloe vera* portion treatment, *Zingiber officinale* portion treatment, the mixture portion treatment and the control portion.

The petri dishes were placed in the incubator to maintain the temperature of 37°C which is the human body temperature for 48 hours.

The area of inhibition was measured using a divider and a calibrated ruler; the mixture had the highest area of inhibition followed by *Aloe vera* and lastly *Zingiber officinale*.

The antifungal activity of crude extract of the mixture of *Aloe vera* and *Zingiber officinale* had the highest area of inhibition meaning that it was the most effective than that of the individual crude extracts of *Aloe vera* and *Zingiber officinale*.

Key words. Tinea pedis, *Trichophyton rubrum*, *Aloe vera*, *Zingiber officinale*, incubator

CHAPTER 1: INTRODUCTION

1.1: BACKGROUND OF THE STUDY.

Trichophyton rubrum is a dermatophytic fungus in the phylum Ascomycota. It is an exclusively clonal, anthropophilic saprotroph that colonizes the upper layers of the dead skin, and causes athlete's foot, fungal infection of nail, jock itch, and ringworm worldwide. This fungus can live in air, land, water, clothing and even the human body itself and can cause chronic and residual disease due to the body's very mild rejection reaction, on the human body of this fungus concerning the skin of ankles, soles of the feet and the sidelines of the toes.

Tinea pedis is a fungal infection that usually begin between the toes, it is one of the most common superficial fungal infections of the skin in all regions of the world. Mycotic infections of the foot are common in adult males and uncommon in women and children. It is more common in close communities such as army barracks, boarding schools and among those frequenting swimming pools, when the feet are occluded with nonporous shoes. The incidence of this infection is higher in warm humid climates which are known to promote the growth of fungi, but has been found to occur less frequently in areas of the world where shoes are not commonly worn. Most cases of tinea pedis are caused by dermatophyte, fungi that causes superficial infection of the skin and nail by infecting the keratin of the top layer of the epidermis ..

Approximately 15% of the population has a podiatricfungalminfection at a any given time and its estimated that over 70% of the population have suffered at some pont in their livrs from tinea pedis.

Despite the prevalence of the disease, different treatments including topical and oral treatments have been recommended to control dermatophytes. However, recently the use of some natural plant products has been emerged to inhibit the causative organisms. The antimicrobial and antitoxin properties of some plants, herbs, and their components have been documented since the late 19th century. Many of the existing synthetic drugs cause various side effects, hence, drug development plant based compounds could be useful in meeting this demand for newer drugs with minimal side effects.

Aloe vera is a plant, which belongs to the family of Liliaceae and is mostly succulent with a whorl of elongated, pointed leaves. (Strickland, 2004).

The name is derived from the Arabic word 'alloeh' which means 'bitter', referring to the taste of the liquid contained in the leaves.

Aloe is believed to have originated in the Sudan. *Aloe vera* grows in arid climates and is widelydistributed in Africa, India and other arid areas. The species is frequently cited as being used in herbal medicine.*Aloe verais* a perennial, drought resisting, succulent plant. It has stiff green, lance-shaped leaves containing clear gel in a central mucilaginous pulp. Its' thick leaves

contain the water supply for the plant to survive long periods of drought. (Kedarnath, Kaveri, & Patil, 2013).

Aloe vera contains aloins and barbadoins as main chemical constituents. *Aloe vera* has inhibitory effects on *Trichophyton rubrum* which cause tinea pedis because of the presence of anthraquinone as antifungal. (Zeenath Ambareen, 2015)

When a leaf is cut, an orange-yellow sap drips from the open end. When the green skin of a leaf is removed, a clear mucilaginous substance that appears contains fibres, water and the ingredient to retain the water in the leaf. The gel contains 99.3% of water, the remaining 0.7% is made up of solids with carbohydrates constituting for a large components. (Foster, 1999).

Ginger (*Zingiber officinale* Roscoe) has been used as a food spice and herbal medicine. It is widely used throughout the world and adverse effects after ingestion are uncommon. The Food and Drug Administration (FDA) has categorized ginger as a food additive. Moreover, it is natural source showing no toxicity and is considered as 'generally recognized as safe'.

Zingiber officinale is a medicinal plant that has been commonly used in Chinese, Ayurvedic and Tibb-Unani herbal medicines all over the world, since antiquity, for a wide array of unrelated ailments including arthritis, rheumatism, sprains, muscular aches, pains, sore throats, cramps, constipation, indigestion, vomiting, hypertension, dementia, fever, infectious diseases and helminthiasis.

It was reported that *Zingiber officinale* has direct antifungal activity and thus can be used in treatment of fungal infections that's why I choose it to use it in this study.

Zingiber officinale contains monoterpenoids, sesquiterpenoids, phenolic compounds, and its derivatives aldehydes, ketones, alcohols, esters, which provide a broad antimicrobial spectrum against different microorganisms.

Numerous studies have been conducted in different countries to prove such efficiency in number of medicinal plants and most of the studies are restricted with crude extracts. (Reddy & Madhusudhan, 2006).

1.2: Problem Statement.

Trichophyton rubrum is a common superficial fungal skin infection of the feet. It is emerging as an important and a significantly prevalent infection in an increasingly aging population and immune-compromised patients particularly in poor resource countries including Uganda.

Tinea pedis even though it has been ignored by most communities in Uganda, it has been proved to be a general problem though it rarely causes illness, this mycotic infection is contagious, frequently misdiagnosed and often inadequately treated. (Vikas, Kumar, Tilak, Prakash, Nigam, & Gupta, 2011), it is often chronic or recurrent in its course. These infections are most common in urban areas despite the improvement in the health services in such places. This might be due to the unavailability of the medicines in accessible health centers, however, if present, such medicines are tagged a high price which may not be afforded by the low earners in the rural and slum areas. As a result, people tend to forego treating fungal diseases which increase their spread to the general population. Furthermore, antimicrobial drugs are sometimes associated with adverse effects on the humans including hypersensitivity, allergies and immune suppression. And there have been strains of resistance by some dermatophytes unto these drugs. However, with local medicine such as *Aloe vera* and *Zingiber officinale*, the above problems can be solved because such medicine is accessible and cheap. It can be grown at homes and everywhere and used to treat fungal infections due to its antifungal properties.

This will enable individuals diagnosed with tinea pedis to overcome high costs of the antifungals and improvise with the readily cheap available remedies.

1.3: OBJECTIVES.

1.3.1: General Objective.

To compare the antifungal activities of the plant extracts of *Aloe vera* and *Zingiber officinale*

1.3.2: Specific Objectives.

To determine the antifungal effect of *Aloe Vera* extract on *Trichophyton rubrum*.

To determine the antifungal effect of *Zingiber officinale* extract on *Trichophyton rubrum*.

To determine the effectiveness of the combined plant extracts on *Trichophyton rubrum* as compared to single plant extracts.

1.4: Hypothesis

H₀: There is no significant difference between the effectiveness of combined plant extracts of *Aloe vera* and *Zingiber officinale* on compared *Trichophyton rubrum* to the individual plant extracts.

H_A: There is a significant difference between the effectiveness of combined plant extracts of *Aloe vera* and *Zingiber officinale* on compared *Trichophyton rubrum* to the individual plant extracts.

1.5: Significance of the Study.

After carrying out this study, the people who use medicinal plants, for example *Aloe vera* and *Zingiber officinale*, at a larger extent the public will be informed that both *Aloe vera* and *Zingiber officinale* have antifungal properties on athlete's foot. This will provide an alternative and enable them to overcome the side effects and the costs of antifungal drugs.

The treatment of plant extracts in the with the highest area of inhibition will be used to know which of the two is more effective as an antifungal remedy and take it as their first priority, as this will make people under treatment to have a fast and effective remedy to combat athletes' foot before they get tired of the treatment.

People will also get to know that products from these plants can be used as an antifungal and overcome the side effects and the high costs which they incur in buying the antifungal creams such as clotrimazole.

Bibliography

Healthline Media UK Ltd, Brighton, UK. (2004). Retrieved feb fri, 2020, from medicalnewstoday: <http://www.medicalnewstoday>

Adeshina. G.O, J. S. (2011). Antimicrobial activity of fresh juice of *Allium cepa* and *Zingiber officinale* against multidrug resistant bacteria. *International journal of pharmacology and biological science.* , 289-295...

barry, h. (2003). Dermatophyte infection. *American Family Physician*, 67.

Brooks, G., Carroll, K., Butel, J., & Morse, S. (2007). *Medical Microbiology*. San Francisco. : McGraw-Hill Companies,.

Crawford et al. (2001). British medical journal. *Athlete's foot and fungally infected toenails.*, p. 151.

DIVYA, P., & RAJESH, S. (2017). REVIEW ON "ALOE VERA- MEDICINAL PLANT". 3726.

Erdogrul, O. (2002). Antimicrobial activities of some plant extracts used in folk medicine. *Journal of Pharmaceutical biology.*, 269-273.

Foster, S. (1999). Aloe vera: The Succulent With Skin Soothing Cell Protecting Properties. *Herbs for Health magazine.*

Humayun, R., Almas, B., Syed, R., Zia Mohy-Ud-Din, K., Hamad, Y., & Ayesha, T. (2015). Antimicrobial property and phytochemical study of ginger found in local area of Punjab, Pakistan. *International Current Pharmaceutical Journal.*

Ilkit, M., & Durdu, M. (2014). Tinea pedis: The etiology and global epidemiology of common fungal infections. *Crit Rev Microbiol.*

Kedarnath, Kaveri, K., & Patil, V. C. (2013). ANTIMICROBIAL ACTIVITY OF ALOE VERA LEAF EXTRACT. *international journal of applied biology and pharmaceutical technology* , 286.

Lee K, H., Kim, J., Lim, D., & Kim, C. (2000). Anti-leukaemic and anti-mutagenic effects of di(2ethylhexyl)phthalate isolated from Aloe vera Linne. *J Pharm Pharmacol.* 593-598.

Leung, & Albert, Y. (1984). *Chinese Herbal Remedies*. New York.: Universe Books.

Meritxell, A, J. M., & T. (2009). Prevalence of Tinea pedis, tinea unguium of toe nails and tinea capitis in school children from Barcelona. . *Revista Iberoamericana de Micología?*, 228.

- muhammed, a. h., mathew, f., mahnaz, s., & guha, k. (2004). tinea pedis and its complications, *Clinical and Molecular Allergy . Dermatology for the practicing allergists*, 5.
- Neeru, B., Mostafa, W., Mohamed, E., & amanat, a. (2014). GINGER: A FUNCTIONAL HERB. 1.
- Rathod M, D. N. (2015;6). Antifungal activity of two medicinal plants against fungus *Candida albicans*. *Int J Pharma Bio Science* , 701-6.
- Reddy, P. J., & Madhusudhan, P. (2006). Antimicrobial Activity Of Isolates From Piper Longum And Taxus Baccatr. *Pharm.* 236-238.
- Rinaldi, M. (2000). Dermatophytosis: Epidemiological and microbiological update. *Journal of the American Academy of Dermatology*, .
- Shirin, A., & Prakash, J. (2010). *Chemical composition and antioxidant properties of ginger root*.
- Strickland, F. M. (2004). Natural Products As Aids For Protecting The Skin's Immune System Against UV Damage. 24-28.
- Supreet Jain, S. M. (2017). Comparison of Antifungal Effect of Aloe vera Gel and Triphala: An In vitro Study. *Journal of Indian Academy of Oral Medicine & Radiology*, 90.
- Vikas, Kumar, R., Tilak, P., Prakash, C., Nigam, R., & Gupta. (2011). Tinea Pedis– an Update. *Asian Journal of Medical Sciences*, 135.
- Vogler BK, E. .. (1994;9). A systematic review of its clinical effectiveness. *Br J Gen Pract*, 823-8.
- Vuorela. P., L. M. (2004 .). Natural products in the processing of finding new drugs candidates. *Journal of current medical chemistry*, 1375-1389.
- Zeenath Ambareen, S. K. (2015). Antimicrobial Efficacy of Herbal Extracts . *International Journal of Oral Health Dentistry*, 108.
- Zhang, X., Jeza, V., & and Pan, Q. (2008). Salmonella typhi: from a human pathogen to a vaccine vector. *Cellular & molecular immunology*, 91.