



INCIDENCE AND COMPARATIVE EFFECTS OF HYDRAULIC OIL AND TOPICAL ANTIFUNGAL CREAMS ON *Tinea pedis* AND ECZEMA

Adenugba, I.T, Akpainyang, N.U, Uko, E,A, Jones, A.M & Esu, Edidiong Michael
Department Of Science Technology
School of Applied Science, Akwa Ibom State Polytechnic, Ikot Osurua

ABSTRACT

This study was aimed at the enumeration of the incidence rate of *Tinea pedis* and Eczema among the students, the isolation and identification of the fungal pathogens and the comparative the effects of the potency of hydraulic oil and antifungal creams against the fungal isolates. The hydraulic oil used here included Bx oil, Al oil and Ad oil while the antifungal creams were Tr creams, Gd cream and Sk cream. A total of twenty one (21) students with either *Tinea pedis* or eczema volunteered for this analysis. The significant different ($p < 0.05$) was seen as the result showed that, of the eleven (11) female students five (5) (45.5%) had *Tinea pedis* while 6 (54.5%) had eczema and of the 10 male students 8 (80.0%) had *Tinea pedis* while 2 (20.0%) had eczema. Among the isolates identified included *Trichophyton sp*, *Microsporium sp* and *Aspergillus sp*. Susceptibility result showed that the Bx oil sample was quite effective on all the fungal isolates while resistance was seen on the Ad and Al oil samples for all the isolates, the susceptibility of the antifungal creams on the isolates showed that all the isolates were sensitive to Tr and Sk cream while moderate sensitivity was seen for Gd cream. This analysis therefore shows that antifungal creams have a higher level of susceptibility on fungal isolates compared to hydraulic oil and so medical prescription of antifungal creams should be adhered to by patients for the prevention and treatment of *Tinea pedis* and Eczema.

Key Words: Incidence, Comparative effects, hydraulic oil and topical creams.

INTRODUCTION

Dermatophytic infection of the skin can manifest in different anatomical regions of the body and have been accordingly named. Thus, *Tinea capitis* affects the scalp, *tinea barbae* the face, *Tinea unguum* the nails, *Tinea manuum* the hands, and *Tinea cruris* the groin area. *Tinea pedis*, also known as athlete's foot, is a chronic fungal infection of the feet and is the focus of this review. *Tinea pedis* is estimated to be the second most common skin disease in the United States, behind acne (Weinstein and Berman, 2002) and up to 15% of the population may manifest the disease (Bell-Syer *et al.*, 2002).

Tinea pedis presents as pruritic, erythematous, inflamed regions on the feet that may be located on the sole or lateral aspects of the foot and sometimes between the toes. Three genera of fungi may cause *Tinea pedis*, *Trichophyton*, *Epidermophyton* and *Microsporum*. Other, non-dermatophyte, fungi like *Malassezia furfur*, *Corynebacterium minutissimum*, and *Candida* species may also cause *Tinea pedis*. These fungi may be spread from soil, animals or humans as well as through contact with fomites.

Dermatitis, also known as Eczema, is a group of diseases that results in inflammation of the skin (Nedorost, 2012). Dermatitis is a group of skin conditions that includes atopic dermatitis, allergic contact dermatitis, irritant contact dermatitis and stasis dermatitis (Nedorost, 2012). Allergic contact dermatitis occurs upon exposure to an allergen, causing a hypersensitivity reaction in the skin. Treatment of atopic dermatitis is typically with moisturizers and steroid creams (McAleer *et al.*, 2012).

Hydraulic oil consists of oils and additives designed to transmit power while acting as a lubricant and coolant. The oil is effective in a wide range of temperature and reduces wear, rust and corrosion in equipment used in industries like agriculture, mining and construction. According to the study conducted by Placek (2006) who reported antimicrobial properties of hydraulic oil exposure on micro-organisms such as bacteria and fungi. The study indicated the antifungal effects of hydraulic oil on skin infections by dermatophytes to include ringworm, eczema, skin rashes and pimple etc when applied on the affected parts. The antimicrobial properties of hydraulic oil was attributed to the chemical composition such as butanol, ester, polyalkylene, glycols, silicones, alylated aromatic hydrocarbon, polyalphaopons, corrosive inhibitor and anti-erosion additives etc. studies earlier conducted prove the antimicrobial properties of these chemical when tested against hospital mediated skin infection (Placek 2006).

AIM OF THE STUDY

The aim of this study is to investigate the potency of hydraulic oil against skin infection such as dermatitis and *Tinea pedis* and the objectives of the study are to:



- To evaluate the incidence rate of these infection among the student population.
- To isolate and characterized dermatophyte and *Tinea pedis* using micro biological methods
- Assess the effects of hydraulic oil on eczema and *Tinea pedis*
- Assess the effects of antifungal creams on eczema and *Tinea pedis*

MATERIALS AND METHODS

Sample Collection

A sterile swap sticks were used to aseptically collect the samples from about 21 (eleven female and ten male) different volunteer, after the subjects were well informed of the purpose of the project analysis. Samples were aseptically transported to Microbiology Laboratory for fungal investigation within an hour of collection and culturing on appropriate fungi media. To compare the effect on and treatment of *Tinea pedis* and eczema, hydraulic oils (Bx hydraulic oil, Ad hydraulic oil and Al hydraulic oil) and antifungal creams (Tr Antifungal cream, Gd antifungal creams and sk antifungal cream) were used.

Sterilization of Materials

All glass wares used in this research work were thoroughly washed, drained and sterilized in a hot air oven at 160°C for 1 hour. Plastic containers were properly sterilized with alcohol and thoroughly rinsed with distilled water. The media used in this research product were proposed according to the manufacturer's instructions and were sterilized using the autoclave at 121°C (15psi) for 15 minutes. Inoculation loops were sterilized using ethanol and cotton wool.

Cultivation of Fungi

About 15-20ml of sabouraud dextrose agar (SDA) medium was held at the temperature between 45°C, antibiotic was added to the medium before being poured aseptically into the Petridish, swirled to mix and allowed to solidify. The samples which were collected using sterile swap stick was streak on the medium. The inoculated plates were properly wrapped, labeled and was later incubated invertedly for 3-5 days at room temperature.

Isolation and Purification of Isolates

The emerging visible discrete fungal colonies from the incubated plates were sub culture onto freshly prepared SDA using a stabbing method and was allowed to grow within 3-5 days. Pure colonies of the organisms were maintained for further analysis.

Morphological and Microscopical Analysis

The emerging visible discrete fungal colonies from the incubated plates were viewed using a microscope. The isolate were presumptively identified according to pigmentation presentation on SDA.

Carbohydrate Fermentation Test

This test showed the ability of fungi to ferments carbohydrate (sugars) to obtained product like alcohol, acid, gas or other organic molecules.

Antifungal Sensitivity Test

Sterile sabouraud dextrose agar (SDA) plates were prepared with antibiotics and allowed to solidify. These plates were seeded uniformly to cover the entire surface with each of the tested organisms. A pair of sterilized forceps was used to transfer hydraulic oil impregnated disc onto each of the plate and incubated at room temperature for 4 days. This process was repeated for antifungal oil including Bx oil, Ad Oil and Al Oil. Observation of zones of inhibition (clearance) around the disc on each cultured plate was measured with meter rule in millimeter (mm). All results were read and interpreted based on the guideline of Clinical and Laboratory Standards, NCCLS (2000) classified as either sensitive (S), or resistance (R) based on the interpretation of zone of inhibition.

Statistical Analysis

Data were subjected to analysis of variance (ANOVA) and T-test was used for comparison of means. Statistical significance was accepted at $p < 0.05$.

RESULT AND DISCUSSION

Results

The comparative effect of hydraulic oils and topical antifungal creams on *Tinea pedis* and eczema obtained from students in Akwa Ibom State Polytechnic was



studied using standard analytical procedures. From the analysis carried out the following results are presented on tables.

Table 4.1 shows the gender distribution of infected students with *Tinea pedis* and eczema in Akwa Ibom State Polytechnic, from the table 21 samples were collected from which 10 sample were male and 11 samples were from female.

Table 4.2 reveals the percentage frequency of *Tinea pedis* and eczema in Akwa Ibom State Polytechnic from the table 80% of *Tinea pedis* and 20% of eczema where from the male while 45.5% *Tinea pedis* and 54.5% eczema from female.

Table 4.3 reveals the morphological, microscopical and biochemical characteristic of the fungal genera isolated from *Tinea pedis* and eczema from the following fungal genera, isolates obtained were *Microsporium sp.*, *Trichophyton sp.*, *Epidermophyton sp.*, *Trichoderm sp.*, and *Aspergillus sp.* The fungi isolates were presumptively identified according to their cultural characteristic on SDA.

Table 4.4 shows the hydraulic oils susceptibility profile of fungal isolates obtained from *Tinea pedis* and eczema. From the table three brands of hydraulic oil were used which included Bx hydraulic oil, Ad hydraulic oil and Al hydraulic oil.

Table 4.5 reveals the antifungal cream susceptibility pattern of the fungal isolate obtained from *Tinea pedis* and eczema. Absolutely, three brands of antifungal cream were used for this study. The antifungal cream were Gd antifungal cream, Tr antifungal creams and Sk antifungal cream as presented on table 4.5.

Table 4.1: Population of students in Akwa Ibom State Polytechnic used for the isolation of *Tinea pedis* and eczema

Sex	<i>Tinea pedis</i>	Eczema	Total
Male students	8	2	10
Female students	5	6	11
Total	13	8	21

Table 4.2: The percentage frequency occurrence of *Tinea pedis* and eczema in Akwa Ibom State Polytechnic

Sex	Infection	Percentage occurrence	Total
Male students (10)	<i>Tinea pedis</i>	8	80.00%
	Eczema	2	20.00%
Female students (11)	<i>Tinea pedis</i>	5	45.5%
	Eczema	6	54.5%



Table 4.3: The morphological, microscopic and biochemical characteristics of the fungal genera isolated from student of Akwa Ibom State Polytechnic

Isolates	Colony pigmentation	Appearance	Reverse side	Natural of hyphae	Vegetative and reproduction structure	Nature of conidial	Vesicle head	Germ tube test	Sugar fermentation				Probably Most organisms
									Maltose	Lactose	Gulose	Manitol	
1 (Ta)	White	Cottony and flat	Yellow	Hyaline Septate hyphae	Thick hyphae single or in group. Small chains of barrel shape, anthroconidia from both hyphae and macroconidia are similar in size conidiospore with clavate	Some cylindrical and ellipsoidal	Smooth and ellipsoidal	+	A G	AG	AG	A G	<i>Trichophyton sp</i>
2 (Ta & Ez)	Milky colony	Moist and floppy	Yellow to brown	Septate hyphae	Conidiospore are highly branched some formed in distmetetocortic rings with lateral branched that are raised	Ovoid and cylindrical	Globes	+	A G	AG	AG	A G	<i>Trichoderma sp</i>
3 (Ta)	Milky colony	Mucoid and (clavole) Club shape	Yellow	Hyaline Septate (multi-septate)	Short conidiospore abundant, smoothwalled macroconidia and much-septate hyphae well developed pseudo mycelium	Radiate conidia	Globes vesicle head	-	A G	AG	AG	A G	<i>Epidermophyton sp</i>
4 (Ta & Ez)	Milky	Cottony and flat	Orange	Hyaline Septate hyphae	Macroconidia Are Hyaline Multi-Septate Fusiform (Variable In Form). Short conidiophores with thin	Macroconidi a cylindrical to ellipsoidal	Radia and cylindrical	+	A G	AG	AG	A G	<i>Microsporium sp</i>

Incidence And Comparative Effects Of Hydraulic Oil And Topical Antifungal Creams On
Tinea Pedis And Eczema

5 (Ez)	Greenish	Cottony	Orange	Non-Septate	walled. Long conidiahpores and high branched with a well developed mycelium	Globes	Globes	-	A G	AG	AG	A G	<i>Aspergillus sp</i>
--------	----------	---------	--------	-------------	--	--------	--------	---	--------	----	----	--------	-----------------------

Keys: += Positive, -= Negative, Ta= *Tenia pedis*, Ez= Eczema, A = Acid production, G = Gas production, AG:Acid and Gas



Table 4.4: Susceptibility pattern of hydraulic oils on isolates from *Tinea pedis* and *Eczema*

Hydraulic sample	<i>Epidermophyton sp</i>	<i>Microsporium sp</i>	<i>Trichophyton sp</i>	<i>Trichoderma sp</i>	<i>Aspergillus sp</i>
Bx sample	28.5mm(S)	6.5mm(R)	15.5mm(I)	9.5mm(I)	12.5mm(I)
Ad sample	6mm(R)	6mm(R)	10mm(I)	6mm(R)	16mm(R)
Al sample	5mm(R)	5mm(R)	8mm(R)	5mm(R)	5mm(R)

Keys

Bx = Bendix oil

Ad = Allhad oil

Al = Allied oil

S = Sensitive

I = Intermediate

R = Resistance

According to NCCLS (2000)

≥ 18mm sensitive (susceptible)

17-10mm (intermediate)

≤ 9mm (Resistance)

Table 4.5: Susceptibility pattern of antifungal creams on isolates from *Tenia pedis* and *Eczema*

Anti-fungal sample	<i>Epidermophyton sp</i>	<i>Microsporium sp</i>	<i>Trichophyton sp</i>	<i>Trichoderma sp</i>	<i>Aspergillus sp</i>
Tr	25mm(S)	21mm(S)	17.5mm(S)	19mm(S)	18mm(S)
Cd	11.5mm(I)	11.5mm(I)	11mm(I)	18mm(S)	17.5mm(I)
Sk	19mm(S)	18mm(S)	20mm(S)	20mm(S)	18mm(S)

Keys

- Tr = Tribat cream
G-D = G-derm cream
Sk = Skineal
S = Sensitive
I = Intermediate
R = Resistance

According to NCCLS (2000)

- ≥ 18mm sensitive (susceptible)
17-10mm (intermediate)
≤ 9mm (Resistance)

DISCUSSION OF RESULTS

The comparative effect of hydraulic oil and topical antifungal creams on *Tinea pedis* and eczema isolated from students in Akwa Ibom State Polytechnic was studied. *Tinea pedis* is a common skin infection of the feet caused by fungus, sign and symptoms often includes itching, scaling, cracking and redness (Bell-syer *et al.*, 2012). Eczema is a group of disease that results in inflammation of the skin, the disease are characterized by itching, red skin and a rash. In rare cases the skin may blister (Bell-syer *et al.*, 2012). Out of the 21 samples analyzed from *Tinea pedis* and eczema, 10 of the samples were obtained from male students while 11 samples were obtained from female as presented on table 4.1. The result obtained shows that female student of Akwa Ibom State Polytechnic had the highest percentage frequency of eczema of (54.5%) while the male student had the higher percentage frequency of *Tinea pedis* of 80%. The finding is in agreement with the work of Hainer (2003), who reported high occurrence of dermatitis in women the high frequency occurrence in women may be as a result of cream reaction and other environmental factors. The fungal genera isolated from these research works are *Trichophyton sp.* *Trichoderma sp.* *Epidermophyton sp.* *Microsporium sp* and *Aspergillus sp* the result obtained therefore agrees with the work of Kaushik *et al.*, (2015). Who reported that athletes foot is caused by a number of different fungi including species of *Trichophyton*, *Epidermophyton*, *Microsporium sp* and other non-dermatophyte fungi like *Malassezia sp* and *Candida sp*. The aforementioned organisms are together responsible for the vast majority of cases of *Tinea pedis* throughout the world. Fungal infection are not usually serious in otherwise fit, healthy adults, but they can be embarrassing and



distressing. Very ill and immune compromised patients are at the risk of serious fungal infection, especially, if they had multiple courses of antibiotics and have undergone invasive procedures (Alberti *et al.*, 2001). A recent study showed that *Trichophyton sp.* accounted for over 76% of all dermatophyte infections, including *Tinea pedis* (Weinstein and Berman, 2002). The presence of *Aspergillus sp.* and *Trichoderma sp.* are associated with fungal infection, exposure of the infection site to moisture like bathtub, covered shoes, wet rugs etc, poor sanitation and other environmental factors encourage the spread of the infection. The result obtained reveals that three hydraulic oil samples were used which are Bx hydraulic oil, Al-hydraulic oil and Ad hydraulic oil, and Bx hydraulic oil was seen with the highest susceptibility pattern. While Ad hydraulic oil and Al hydraulic oil showed low effect on the isolates as presented on table 4.4. Hydraulic oils consists of oil and additive designed to transmit power while acting as a lubricant and coolant. The oil is effective in a wide range of temperatures and reduces wear, rust and corrosion in equipment used in industries. The primary function of hydraulic oil is to convey power according to Placek (2006). Moreover, the three antifungal creams used here included Tr antifungal cream, G-d antifungal cream and sk antifungal cream. From the result obtained it is reveals that *Epidermophyton*, *Microsporium*, *Aspergillus* and *Trichoderma* were all sensitive to Tr antifungal cream with zones of inhibition ranging from 18mm -19mm. G-Derm sample was effective on *Trichoderma sp.* (19mm) and intermediate to *Epidermophyton sp.* (11.5mm), *Microsporium* (11.5mm), *Trichophyton sp.* (11mm) and *Aspergillus sp.* (11.5mm), while *Epidermophyton sp.* (20mm), *Trichoderma sp.* (20mm) and *Aspergillus sp.* (18mm) were seen to be sensitive to Sk antifungal cream. This finding is in agreement with the work of other researches like Markova(2002), Gould and Brooker (2012), Gould and Brooker (2008) who reported that superficial *mycoses* are treated mainly with topical antifungal agents. Topical treatment such as cream, spray, liquids and powder are used for the treatment of *Tinea pedis* and Eczema infections. There are growing concerns that some fungi are becoming resistant to antifungal drugs, complicating treatment especially for patient with severe infections (Tortorano *et al.*, 2000).

Dermatophytic infections of the feet are very common, they affect the spaces between the toes (inter-digital infection) or the plantar surface (soles). Inter-digital infection usually give rise to areas of macerated skin, while plantar infection usually look dry Scaly and flaky. In many cases infection arises

through the interaction of several species of fungus of low grade pathogenicity or the interaction of fungi with bacteria (Gould and Brooker, 2012). The result obtained shows that antifungal creams have a higher level of susceptibility pattern than the hydraulic oils. Hydraulic oils were not designed primarily for the treatment of superficial *mycosis* rather antifungal creams were primarily and mainly designed for the prevention and treatment of superficial *mycosis*.

CONCLUSION

From this research it can be concluded that *Trichophyton sp*, *Trichoderma sp*, *Epidermaphyton sp*, *Microsporium sp* and *Aspergillus sp* causes dermatitis and dermatophyte and other complication in both immune compromised and healthy individuals. The infection rate of *Tinea pedis* and Eczema as obtained from this study shows that the female group are more open to Eczema while the male group are more exposed to *Tinea pedis*. It shows that antifungal creams were more effective compared to the moderate effect of hydraulic oils. Therefore both can be considered appropriate for empirical treatment of *Tinea pedis* and Eczema depending on one's skin type.

RECOMMENDATIONS

Based on the analysis the following recommendations are made:

- This study recommends that routine mycological analysis and antifungal susceptibility tests of antifungal creams, should be carried out so as to help in the administration of drugs for the treatment of superficial *mycosis*.
- There should be public education/enlightenment program on the importance of proper personal hygiene and environmental sanitation habits so as to reduce the transmission rate of dermatophyte and other skin infection.
- Periodic monitoring of antifungal cream, is highly recommended due to high rate adulteration in the society.
- Finally, individuals should visit a dermatologist if severe cases or changes occur during treatment.

REFERENCES

Alberti, C., Bovawine, A. and Ribaud, P. (2001). Relationship between environment fungal contamination and the incidence of invasive



- Aspergillosis in Haematology patients. *Journal of Hospital Infection*, **48** (3): 198-206.
- Bell-Syer, S. E., Khan, S. M. and Torgerson, D. J. (2012). Oral treatments for fungal infections of the skin of the foot. *The Cochrane Database of Systematic Reviews*, **10**: 35-84.
- Gould, D. and Brooker, C. (2008). *Infection Prevention and Control. Applied Microbiological for Healthcare*, (2nd ed), Polgrave Macmillan, London. pp. 23-25.
- Kaushik, N., Pujalte, G. G. and Reese, S. T. (2015). Superficial fungal Infections. Primary care. *Clinic in office practice* **42**(4): 501-516.
- Maskova, T. (2002). What is the most effective treatment for *Tinea pedis* (Athlete's foot). *Journal of Family Practice*, **51**: 21-23.
- McAleer, M. A., Flohr, C. and Irvine, A. D. (2012). Management of difficult and severe Eczema in childhood. *BMJ*, **345**: 4770-4773.
- National Committee for Clinical Laboratory Standards, (NCCLS) (2000). Performance standard for antimicrobial susceptibility testing. Ninth Informal Suppl., National Committee for Clinic Laboratory Standard Wyne Pa., pp. 45-49.
- Nedorost, S. T. (2012). *Generalized Dermatitis in Clinical Practice*, Springer Science and Business Media, pp, 1-3.
- Placek, D. (2006). *Synthetics, Mineral Oils and Bio-based Lubricants*, Rudnick, I., (ed.), CRC Press, p. 519.
- Tortorano, A. M., Kibbler, C. and Pernan, J, (2006). Candidaemia in Europe: Epidemiology and Resistance, *Internal Journal of Antimicrobial Agents*, **27**(5): 389-366.
- Weinstein, A. and Berman, B. (2002). Topical Treatment of Common Superficial *Tinea* Infections. *Am Fam Physician*, **65**:2095-2102.