CURRENT STUDIES IN COMPARATIVE EDUCATION, SCIENCE AND TECHNOLOGY, VOLUME 2, NUMBER 2, 2015, PP. 303-311

Mycoflora of Different Wastewater from Some Hair Dressing Saloons in Port Harcourt in Nigeria

BELINDA NGOZI ONWUSAH, ISOBOYE MICHAEL AMAFINA & OMOKARO OBIRE
Rivers State University of Science and Technology, Nigeria

ABSTRACT The mycoflora of different wastewater samples from hair dressing salons in different locations of Port Harcourt was evaluated using standard microbiological techniques. The samples were analyzed for total fungal count and fungi diversity. The wastewater samples without conditioning crème relaxer had the highest population of fungi counts when compared with the samples with conditioning crème relaxers. The total fungal count in samples from Location A ranged from 3.0×10^2 to 4.0×10^2 spore forming unit per ml (sfu ml^{-1}) with a mean value of 3.3×10^2 sfu ml^{-1}, count in samples from Location B ranged from 3.0×10^6 to 9.0×10^6 sfu ml^{-1} with a mean value of 5.33×10^6 sfu ml^{-1} while count in samples from Location C ranged from 3.0×10^2 to 6.0×10^2 sfu ml^{-1} with a mean value of 4.0×10^2 sfu ml^{-1}. The fungi isolated and their incidences (%) in all the samples studied were The fungi isolated and their incidences (%) in all the samples studied were *Alternaria* sp (2.29%), *Aspergillus* sp (19.31%), *Fusarium solani* (14.8%), *Mucor plumbeus* (5.68%), *Penicillium crysogenum* (22.7%), *Rhizopus oligosporus* (17.0%), *Rhodotorula mucilaginosa* (5.68%) and *Saccharomyces cerevisiae* (12.5%),. The fungi that recorded the highest incidence in Locations A, B, and C were *Saccharomyces cerevisiae* (39.13%), *Penicillium crysogenum* (31.25%), and *Rhodotorula mucilaginosa* (29.41%) respectively. Generally, *Saccharomyces cerevisiae* was isolated from the wastewater samples with conditioning crème relaxer while *Mucor plumbeus* was not. Statistical analyses using ANOVA on both the counts and frequency of occurrence of fungi showed that there was a significant difference at $p=0.05$ between the various samples from the different locations. The presence of these fungi in the wastewater samples is attributed to contamination from the environment e.g. *Alternaria* sp found mostly in dusty room and in air, from the hair of individuals, combs, brushes etc used in the processing of the hair, and from the hands of hair dressers. Some species of these fungal genera are potential pathogens which can cause infections when they come in contact with the skin, scalp or the hair through the use of contaminated combs,

brushes, towels etc. Public enlightenment and awareness campaigns on the importance of using personal salon kits are advocated. The use of personal salon kits, towels, combs and hair brushes and proper disposal of salon wastewater should therefore be encouraged as to prevent mycotic infections from hair dressing salons.

Keywords: Hair dressing salon, wastewater, fungi, *Alternaria*, infection

Introduction

The hair is a filamentous biomaterial that grows from follicles found in the dermis (Sherrow, 2006; Krause and Foitzik, 2006). A salon is a facility which offers beauty services and could be a barbering salon or a hair dressing salon. A hair dressing salon is a place for cosmetic or medicinal preparation for dressing the hair. The hair dressing salon offers a wide range of services from hair styling and skin treatments to tanning, manicures and make-up application. In providing these services, wastewaters are generated. Among the organic substances present in wastewater from hair dressing salons are carbohydrates (starch), fats, soaps, dyes, shampoos and synthetic organic chemicals. In many cases, this wastewater is discharged without treatment and it can have a negative impact on the environment (Bowers *et al*., 2002). The constituents of some of these wastewaters can cause plant toxicity problem which results in impaired growth, reduce yield, change in morphology and even death of plants growing on soils exposed to such wastewater. The harmful effects of wastewater effluents could be delayed for several years. It adversely affects groundwater quality when nutrients leach down the soil (Mahmood and Magbool, 2006). Long-term reductions in dissolved oxygen concentrations can result in changes in species composition (Welch, 1992; Environmental Canada, 1997). Wastewater carries disease causing fungi, bacteria, viruses and other pathogens. Many microbial pathogens in wastewaters can cause chronic disease with costly long-term effects such as degenerative heart disease and stomach ulcer. Microbial pollutants can also serve as indicators of water quality. The density and diversity of these pollutants can vary depending on the intensity and prevalence of infection (Paillard *et al*., 2005).

In Nigeria, hair dressing salons discharge their liquid wastes into surrounding soil environment and/or other types of subsurface disposal systems. The continuous trend towards the formulation of new beauty tips and manufacture of novel hair products to satisfy the demands of the growing populace could lead to some serious pollution and health problems. If this wastewater from salons is channeled to discharge into rivers or lakes, it can be harmful

in various ways. It can for example be a source of infection promoting the spread of waterborne disease (Obire, 2002). If these wastewaters are discharged into the soil environment, it can cause accumulation of recalcitrant chemicals in the soil, destabilization of the ecological balance (death of some soil microbes) and negative effect on human health. There has been paucity of information on the effect of wastewater from hair dressing salon on soil microorganisms although hair dressing salons constitutes a high percentage of small scale industries (John *et al*., 2009).

The aims and objectives of this research are to determine the population of fungi in different wastewater samples and identify the types of fungi associated with different wastewater samples from selected hair dressing salons. To encourage individuals that patronize hair dressing salons to be conscious of potential pathogenic microorganisms associated with salon environment and guide themselves from being infected. To reawaken concerned government agencies and other stakeholders of the danger associated with discharge of untreated wastewater from hair dressing salons.

Materials and Method

Description of the Study Area and Collection of Wastewater Samples

The study areas and locations of the hair dressing salons were Mile 4 Diobu Area, Azikiwe Diobu Area and Campus Shopping Complex. The Mile 4 Diobu Area location was a hair dressing salon at Ada-George Road by Agip in Rumueme. This salon is chosen because a lot of persons living around this area patronize this salon and also the categories of persons that patronize this area are more of the middle class and wealthy individuals. The Azikiwe Diobu Area Location was a hair dressing saloon at the back gate of the University Campus. A hair dressing saloon at Campus back gate. The classes of individuals that patronize this hair dressing salon are more of students, few traders and workers. While the Campus Shopping Complex Location was a hair dressing saloon located in RSUST campus**.** The classes of people that patronize this salon are students, lecturers and traders. The study areas were referred to as Location A, Location B, and Location C respectively.

Wastewater samples were collected from the pool of wastewater in each of the salons. The cap of the sterile sample bottle was removed and the bottle was dipped into the pool of wastewater facing upward. The samples from locations A and C contained conditioning crème relaxer while the sample from location B contained no conditioning crème relaxer. After collection of the wastewater samples, the bottle was capped, labeled appropriately, put in an ice box and immediately transported to the laboratory for analysis. Samples were collected at weekly interval for a period of three (3) weeks.

Isolation and Enumeration of Fungi

One milliliter (1ml) of each of the water samples was pipetted with 1ml pipette and added into nine milliliter (9ml) of normal saline and diluted serially in 10 fold dilution up to 10^{-5} for sample A and C and 10^{-7} for sample B. These dilutions were chosen after preliminary studies of the cultivation. An aliquot (0.1ml) of 10^{-1} and 10^{-2} dilutions of samples A and C and the 10^{-6} and 10^{-7} of sample B were inoculated onto separate freshly prepared Sabouraud Dextrose Agar (SDA) plates for the isolation of fungi. The spread plate method was done using a sterile bent glass rod spreader to spread the sample evenly on the SDA plates. The cultured plates were incubated at 37°C for 5 to 7 days. Spores that developed on the plates were counted and the average of replicate cultures was recorded as spore forming unit per milliliter (sfu ml^{-1}) of wastewater.

Microscopic Examination and Identification of Isolated Fungi

Macroscopic examination of fungal growth was by observing the colony morphology-diameter, colour (pigmentation), texture and surface appearance. Microscopic examination was done by wet mount method and observing sexual and asexual reproductive structures. The prepared slides with teased fungi were observed under low and high power objective, and observation recorded as the cultural characteristics, sporangia, conidia, arthrospores, and vegetative mycelium, septate and non-septate hyphae according to Barnett and Hunter (1972).

Results

The result of the total fungal counts in spore forming units/ml (sfu/ml) of the different wastewater samples from hair dressing salon of the different locations showed that, the wastewater samples without conditioning crème relaxer had the highest population of fungi counts when compared with the samples with conditioning crème relaxers. The total fungal count in samples from Location A ranged from 3.0×10^2 to 4.0×10^2 spore forming unit per ml (sfu ml^{-1}) with a mean value of 3.3×10^2 sfu ml^{-1}, count in samples from Location B ranged from 3.0×10^6 to 9.0×10^6 sfu ml^{-1} with a mean value of 5.33×10^6 sfu ml^{-1} while count in samples from Location C ranged from 3.0×10^2 to 6.0×10^2 sfu ml^{-1} with a mean value of 4.0×10^2 sfu ml^{-1}. The incidence (%) of fungi isolates from the wastewater samples of three hair dressing salons is shown in Figure 1.

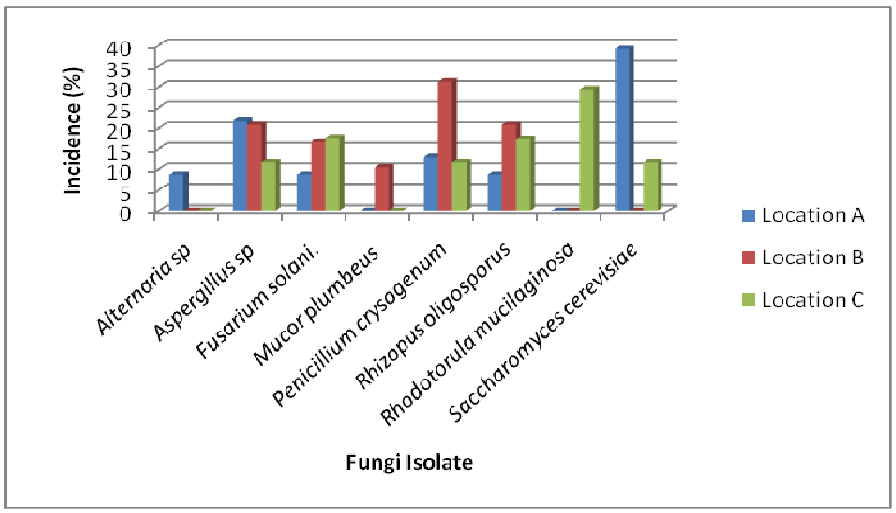

Fig. 1: Incidence (%) of fungi isolates from the wastewater samples of the hair dressing salons

Generally, the fungi isolated and their incidences (%) in all the samples studied were *Alternaria* sp (2.29%), *Aspergillus* sp (19.31%), *Fusarium solani* (14.8%), *Mucor plumbeus* (5.68%), *Penicillium crysogenum* (22.7%), *Rhizopus oligosporus* (17.0%), *Rhodotorula mucilaginosa* (5.68%) and *Saccharomyces cerevisiae* (12.5%),. The fungi that recorded the highest incidence in Locations A, B, and C were *Saccharomyces cerevisiae* (39.13%), *Penicillium crysogenum* (31.25%), and *Rhodotorula mucilaginosa* (29.41%) respectively.

Discussion

This study has revealed the total count of fungi isolated from wastewater from three different hair dressing salons. Sample A and C contained conditioning Crème Relaxer while sample B was without conditioning Crème Relaxer. Sample B without conditioning relaxer had the highest number of fungi counts because of the absence of some chemical contained in the hair conditioning Crème Relaxers. This study has also revealed the types of fungi associated with hair dressing salon water. Of the eight (8) fungal genera isolated *Penicillium crysogenum, Aspergillus* sp, *Fusarium solani*, and *Rhizopus oligosporus* occurred in all the samples, *Alternaria* sp occurred in sample A alone, S*accharomyces cerevisiae* occurred in samples A and C, while *Rhodotorula mucilaginosa* occurred only in sample C.

This study showed that among the variety (diversity) of fungi isolates, *Penicillium crysogenum* had the highest frequency of occurrence while *Al-*

ternaria sp had the lowest. There was significant difference between the number of fungi in samples with hair conditioning Crème Relaxer and sample without hair conditioning Crème Relaxer. The low counts in samples with relaxer are attributed to the various chemicals used in processing the hair. These chemicals includes conditioning Crème Relaxer, Shampoos, hair conditioners, hair creams, gels and hair sprays, ingredients of which are mostly hydrocarbon-based chemical including alcohols.The conditioning Crème Relaxer, shampoos and hair sprays containing alcohols must have been responsible for the reduction in the number of fungi and bacteria after processing (Obire *et al.,* 2010). This also accounts for the variety of fungi isolated from the wastewater with hair conditioning Crème relaxer that do not contain most of those chemical especially conditioning Crème relaxer.

The fungi that were able to utilize hair conditioners, hair crème, gels and hair sprays which are hydrocarbon based chemicals as nutrients were able to proliferate on the processed hair of females and hence the expression of a greater variety of fungi. The utilization of hydrocarbons for growth by both bacteria and fungi has been reported and documented by several investigators (Ahearn and Meyers, 1976, Bartha and Atlas, 1977, Davis and Westlake, 1976; Obire, 1988, Obire *et al.*, 2009). This study revealed that potential pathogenic microorganisms which can create a lot of health problems to humans are associated with wastewater from hair salons.

Groups of fungi that invade the superficial layer of the epidemis and degrade the keratinized tissues of skin, hair and nails in living animals include man, causing ringworm are called Dermatophytes and belong to the class of fungi known as Hyphomycetes were also isolated from these samples to which fungal genera of *Aspergillus sp.* and *Fusarium solani* also belong. *Aspergillus sp.* and *Fusarium solani* including species of *Mucor plumbeus* isolated in this study can cause opportunistic mycosis. Certain strains of *Fusarium solani* have been associated with skin lesions. Their infections are usually or always secondary to trauma or debilitation of the host (Singleton and Sainsbury 2001, Obire *et al.,* 2010). *Aspergillus* sp and *Fusarium solani* have also been associated with *Onycomycosis* (mycosis of the finger-or-toe-nails). *Penicillium crysogenum* cause *penicilliosis* disease in human, *Mucor plumbeus* causes Necrosis and thrombosis, *Rhizopus mucilaginosa* causes Rhinocerebral mucormycosis, Alternaria are the causative agents of Phaeophphomycosis. Cases of onychomycosis, ulcerated cutaneous infections and keratitis as well as virceral infections and Osteomyelitis due to *Alternaria* have been reported.

Conclusion

This study has revealed that a variety of fungi is associated with hair dressing salon, which can have negative effect on human and even to population

of soil microbes. Fungi isolated during this study are capable of causing infectious diseases in humans example include; dandruff, ringworm, onychomycosis, and skin infections etc. These pathogens can be transferred from one individual to another, through skins to skin contact, use of contaminated hair brushes, combs, towels etc and even from finger nails of the hair dressers as most of them hardly wear hand gloves and keeps long finger nails believing that these promote better scrubbing of the scalp. These practices also result in some injury to the scalp and will promote the spread of fungi from their fingers and from one person's hair to another. The use of hair conditioning crème relaxer, hair shampoos should be encouraged as it brings about reduction in microbial population on the hair and even in wastewater from salons. Most chemicals contained in these hair conditioners, shampoos, sprays, hair creams can be hazardous to soil microbes, receiving water bodies as most salon in Port Harcourt either dispose their wastewater by direct discharge onto the soil or connect to the drainages which is channeled to rivers. From the findings of the present study; Individuals are encouraged to use their personal salon kit, towels, combs and hair brushes; Individuals are encouraged to wash their hair as often as possible as this will reduce the occurrence of pathogenic microbes; Hair dressers in salon should endeavour to keep short finger nails and wear hand gloves before processing hair of their clients; Hair product industries should strive to produce products that are not considered hazardous; Because of the dangers associated with improper disposal of salon wastewater, site with proper treatment and disposal system should be created by the government agency for commercial hair dressers to operate so as to have the wastewater from such small scale industries treated and properly disposed.

Correspondence
Omokaro Obire
Department of Applied and Environmental Biology
University of Science and Technology
P.M.B 5080, Port Harcourt, Nigeria
E-mail: omokaro515@yahoo.com

References

Ahearn, D. G. and Meyers, S. P. (1976). Fungal degradation of oil in the Marine environment. In: Gareth Jones (ed). Recent advances in aquatic mycology, pp. 127-130.

Bartha, R. and Atlas, R. M. (1977). The microbiology of aquatic oil spills. Advance applied microbiology. 22: 25-266.

Bowers, F., Cole, K. and Hoffman, J. (2002). Characterizing Beauty salon wastewater for the purpose of regulating onsite disposal systems. New Jersey Department of Environmental protection. New Jersey. 5pp.

Davis, J. B. and Westlake, D.W.S (1979). Crude Oil Utilization by Fungi. *Canadian Journal of Microbiology* 25: 146-156.

Environmental Canada (1997). Review of the impacts of municipal wastewater effluents on Canadian waters and human health. Ecosystem Science Directorate, Environmental Conservation Service, Environmental Canada. 25pp.

John, O. U. M., Ndom, H. N. and Akortha, E. E. (2009). Effect of Untreated Wastewater from Hair Dressing Salon on Agricultural Soil. *Nigerian Journal of Microbiology* 23 (1); 1956-1964.

Krause, K. and Foitzik, K. (2006). "Biology of Hair follicle: The Basics". Seminars in Cutaneous Medicine and Surgery 25:2. Dio:10. 1016/j. sder.2006.01.002.

Mahmood, S. and Maqbool, A. (2006). Impacts of Wastewater irrigation on water quality and on the health of local community in Faisalabed. *Pakistan Journal of Water Resources.* 10(2) 19-22.

Obire, O. (1998). Studies on the biodegradation potentials of some microorganism isolated from water systems of two petroleum producing areas in Nigeria. *Nigerian Journal of Botany*. 1: 81-90.

Obire, O. and Aguda, M. (2002). Bacteria Community of Leachate from a waste dump and an adjacent stream in Nigeria. *Journal of Applied Science and Environmental Management* 6 (2):71-75.

Obire, O., Davis, I. and Putheti, R.R. (2009). Biological hazards in vended

crude oil and ammonia used as medication. *Journal of Pharmacy Research* 2. (3): 320-326.

Obire, O., and Putheti, R.R. (2009). Fungi in bioremediation of oil polluted environments. Year of Energy 2009. Sigma xi, the scientific research society. http//www.energy/sigmaxi.org; http//www.energy.sigma. org/?page id=245.

Obire, O., Putheti, R.R. and Amachree, O. (2010). Incidence of dermatophytes and non-dermatophytes fungi in natural and processed human scalp hair. *International Journal of Chemical and Analytical Science* 1 (3): 161-164.

Paillard, D., Dubois, V., Thiebaut, R., Nathier, F., Hogland, E., Caumette, P. and Quentine, C. (2005). Occurrence of *Listeria spp*. In effluents of French urban wastewater treatment plants. *Applied Environmental Microbiology* 71 (11): 7562-7566.

Petts, J. (1994). *Environmental Impact Assessment for Waste Treatment and Disposal*. Wiley 512 pp.

Singleton, P. and Sainsbury, D. (2001). Dictionary of Microbiology and Molecular biology, 3rd Edition. John Wiley and Sons Ltd. New York, 2001; 895p.

Welche, E. B. (1992. *Ecological Effects of Wastewater*. Applied Limnology and Pollutant Effects, 2nd Edition. Chapman and Hall, New York. 45pp.

Sherrow, V.(2006). Encyclopedia of Hair: A Cultural History. 88 Post Road West, weatport, CT: Greenwood Press. P. iv. ISBN 0-313-331 45- 6.