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Authors' Contribution

AY and JIO conceived and designed the study. JIO and DIA did literature review. All the authors were involved in the writeup, and statistical analysis; JIO revised the paper.

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Isolation and Identification of Fungi from Female Hair Wigs in Benue State University Makurdi, Nigeria

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Numerous medical conditions and hormones can cause hair loss, which can manifest as full or partial baldness, leaving people self-conscious about their look. This study was carried out to isolate and identify fungi from female hair wigs among Benue State University Students. A total of 50 sample of female hair wigs were randomly collected and processed for fungi using culture medium (Potato Dextrose Agar) and identified based on morphological characteristics and microscopy. A total of 3 fungal pathogens which all belong to the genus *Aspergillus* were observed; *Aspergillus niger*, *Aspergillus fumigatus* and *Aspergillus ochraceus* were identified. *A. niger* was observed to have the highest incidence of 9 (56.25 %), this was followed by *A. ochraceus* which had an incidence of 4 (25.0 %) and the least incidence was observed with the *A. fumigatus* 3 (18.75 %) respectively. The human hair wig was observed to have the highest incidence of fungi 9 (36.0 %) than synthetic wig 7 (28.0 %). This study documented fungal species such as *A. niger*, *A. fumigatus* and *A. ochraceus* to be contaminant of human Hair wig of female students within Benue State University due to its exposure to surfaces and heat generated from the body. Further research is necessary to understand the fungi that may contribute to the development of dandruff and how it interacts with other microorganisms in the hair and scalp.

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INTRODUCTION

Many diseases and hormones can cause hair loss, which can result in complete or partial baldness and cause people to feel self-conscious about their appearance. Consequently, there is now a huge demand for hair implants. The term "wig" refers to hair extensions made from synthetic fibre, futura, human hair, animal hair, or a mix of these materials (Clavaud *et al.*, 2013; Dike Ijere *et al.*, 2022). A wig is a synthetic or natural hair covering that covers all or most of the head and is used by women in particular to make one look more fashionable, lovely, or appealing. Wigs can be worn for religious purposes or as a less invasive and costly alternative to medical treatments for hair restoration. Some individuals use wigs to cover up their baldness (Wallenfels and Sasson, 2000). In the early 1990s, jute fibres were used to make hair-like materials for theatrical wigs. However, as styles evolved, alternative raw materials were available, such as animal hair, human hair, synthetic fibre, futura, virgin hair, or a combination of these materials (Choi *et al.*, 2020; Wallenfels and Sasson, 2000; Yang *et al.*, 2017).

The keratinized fibrous tissue that emerges from follicles outside the epidermis is the human hair shaft. In addition to serving as a sensory organ, hair is essential for defense, control of body temperature, environmental protection, and attractiveness. An estimated one million germs live on each square centimeter of human skin (Grice *et al.*, 2008; Kerk *et al.*, 2018; Liao *et al.*, 2023). Microbes that are easily transferred to hair wigs are responsible for a number of common scalp commensal microflora and scalp disorders, such as folliculitis types, fungal diseases, dandruff, and folliculitis decalvans. As a result, the hair plays a crucial role in the pathogenesis and predisposition of disease (Bahashwan and Alshehri, 2024; Clavaud *et al.*, 2013; Kerk *et al.*, 2018).

Hair shaft surfaces, on the other hand, continue to be hydrophobic and dry. Approaching the upper hair follicle, the skin flora is readily removed and transferred to surfaces and hair wigs upon contact, where it may remain for an

extended period of time (Brooke *et al.*, 2009; Tokunaga *et al.*, 2019). Dermatophytes are important for human health because they include pathogenic fungi that may attack keratinised tissues including skin, hair, and nails in humans and animals, causing dermatophytosis. These fungi are classified into three genera: *Microsporum*, *Trichophyton*, and *Epidermophyton* (Atta *et al.*, 2019; Deng *et al.*, 2023; Moskaluk and VandeWoude, 2022). The aim of this study is to carry out the isolation and identification of fungi from female hair wigs among Benue State University Students.

MATERIALS AND METHODS

Sample collection

A total of 50 sample of female hair wigs were randomly collected from female students at Benue State University campus, first camp, Makurdi. Hands were cleansed using alcohol - base hand sanitizer and powder free disposal gloves were worn per sample to prevent cross contamination before collecting each sample. Individual's female hair wigs were randomly swabbed using sterile swab sticks. Swabs were moistened with 10ml of distilled water added to the swab case and excess were removed by pressing the swab sticks against the inner side of the tube. Samples were collected from the hair wig in a tri-directional manner: up/down, left/right and diagonally, recapped and properly labeled with an identification code. Samples were immediately transported to Microbiology Laboratory of the Department of Biological Science, Benue State University, Makurdi for further analysis.

Inoculation of swabs from Hair Wigs

Swab samples were inoculated on already prepared Potato Dextrose Agar for fungi growth by spreading and plates were incubated at room temperature for 7 to 12 days. According to manufacturer's instructions, Potato Dextrose Agar (Himedia, MH118-500g) was prepared and autoclaved for 15 min at 121°C and dispensed in to 20-25 ml portions into sterile 15 x 100 mm petri dishes and allowed to set as described

previously (Alghamdi *et al.*, 2018; Echevarría, 2022).

Identification of fungi isolates

After the incubation period, fungi species were identified based on colony morphology and purified to obtain pure colonies for the identification purposes. Each representative colony was identified by wet mount using lactophenol cotton blue under a light microscope using x 40 objectives lens. Fungi isolates were all identified on the basis of their morphological characteristics as described previously (Abdullah *et al.*, 2016; Aernan *et al.*, 2023; Alghamdi *et al.*, 2018; Echevarría and Iqbal, 2021; Esmail *et al.*, 2020).

Statistical analysis

Percentage occurrence of each fungi was calculated, SPSS (Statistical Package for the Social Sciences) Package of 2010 software was

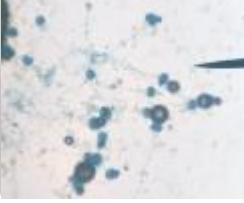
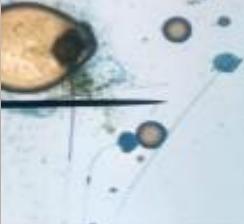
used for Chi-square to determine the relationship between isolates and Female hair wig. P-value of less than 0.05 ($P<0.05$) was obtained and considered statistically significant.

RESULTS

Fungal pathogens isolated from Hair Wigs

In this study, the hair wigs of the female students of Benue State University, Makurdi were investigated for the presence of fungal pathogens. Table 1 showed the fungal pathogens isolated from the hair wigs used by the female students of Benue State University and their morphological characteristics. A total of 3 fungal pathogens which all belong to the genus *Aspergillus* were observed; *Aspergillus niger*, *A. fumigatus* and *A. ochraceus* respectively.

Table 1. Fungal pathogens isolated from the Hair Wigs used by Female Students of Benue State University, Makurdi and their Morphological characteristics.

Fungal isolates	Colonial characteristics	Morphological characteristics	Macroscopic view	Microscopic view
<i>Aspergillus niger</i>	Brown to black	Conidiophores arise from a foot cell and chain		
<i>Aspergillus fumigatus</i>	White to green	Echinulated conidia produce in chains from phialides		
<i>Aspergillus ochraceus</i>	Purple to grey	Non-dense flaky sporulated colonies		

Incidence of the fungi isolated from the hair wigs

Table 2 showed the incidence of the fungi isolated from the hair wigs of the female students of Benue State University, Makurdi. *A. niger* was observed to have the highest incidence of 9 (56.25 %), this was followed by *A. ochraceus* which had an incidence of 4 (25.0 %) and the least incidence was observed with the *A. fumigatus* 3(18.75 %) respectively. The incidence was highly significant with respect to the fungal species ($\chi^2 = 23.660$; df=2; p=0.000).

Table 2. Incidence of Fungi Isolated from the Hair Wigs of the Female Students of Benue State University, Makurdi.

Fungal Isolates	Incidence (%)
<i>Aspergillus niger</i>	9 (56.25)
<i>Aspergillus fumigatus</i>	3 (18.75)
<i>Aspergillus ochraceus</i>	4 (25.00)
Total	16 (100)

$\chi^2 = 23.660$; df=2; p=0.000

Table 3. Prevalence of Fungi associated with the Wigs of Female Students of Benue State University, Makurdi based on Wig type.

Wig Type	No examined	No of fungi Isolated	Prevalence (%)
Synthetic Wig	25	7	28.00
Human Hair	25	9	36.00
Total	50	16	32.00

$\chi^2 = 0.368$; df=1; P=0.544

DISCUSSION

Fungal assessment of human female hair wig among Benue state university students, makurdi was documented in this study. A total of 3 fungal pathogens which all belong to the genus *Aspergillus* were observed; *Aspergillus niger*, *A. fumigatus* and *A. ochraceus* respectively were identified. Our results coincides with previous study (Alghamdi *et al.*, 2018) that determined the prevalence of keratinophilic fungi and bacteria from hair samples of females. The documented fungi were *Aspergillus niger*, *Aspergillus flavus*, *Penicillium* spp, *Alternaria alternata*, *Chrysosporium keratinophilum*, *Cladosporium cladosporioides* and *Trichosporon mucoides*. The slight difference in the fugal isolates may be due to difference in type, sample location and

the method of sampling procedure in which both research were carried out.

In this research, it was also documented that; *A. niger* was observed to have the highest incidence followed by *A. ochraceus* and the least incidence was shown by the *A. fumigatus* respectively. This research displays the most common isolate in terms of both frequency and percentage of occurrence. Some strains of *Aspergillus niger* have been discovered to be harmful to people. It is linked to the formation of oxalate crystals in clinical specimens and can result in lung illness and deadly invasive aspergillosis in immunocompromised people (Ashraf and Iqbal, 2021; Atchade *et al.*, 2017).

This study also recorded *Aspergillus ochraceus* to be the second most abundant on female hair

wig. It is a filamentous fungus in nature and has characteristic biseriate conidiophores which can easily spread in the air and can contaminant any surface available of which human hair wig mya not be exclusive. *A. ochraceus* is known to produce citrinin and ochratoxin A, two of the most prevalent mycotoxins that contaminate food. The dihydroisocoumarin mullein is also produced by it (Chepchirchir *et al.*, 2009; Iqbal *et al.*, 2021).

The current study provided us with new information on the presence of fungus on human hair wigs. Fungal infections of the skin and scalp are a very prevalent concern in many clinical and epidemiological investigations, particularly in tropical and subtropical parts of the world where fungi thrive in warm, humid climates (Iqbal and Ashraf, 2023). These illnesses, which are spread from person to person by directly infecting skin scales or hairs (hair follicles), have grown to be serious health issues that impact children, adolescents, and adults. Humans can also contract them via direct contact with contaminated soils and diseased animals (Alghamdi *et al.*, 2018; Echevarría, 2019a; Echevarría, 2019b; Iqbal *et al.*, 2019). Fungal pollution of the surrounding air has an impact on human health and requires awareness, education, and hygienic practices to prevent sickness (Echevarría and Iqbal, 2021). The ecological significance of keratinolytic activity in fungi is significant, and it appears that little is known about how keratinophilic fungi affect human health. Understanding the prevalence and spread of human and animal mycosis etiological agents, as well as other potentially harmful fungus, on healthy hairs is crucial for comprehending the epidemiological cycle of these fungi, independent of ecological perspectives. Since there is a chance that humans might become infected by fungus in these settings, precautions should be made to avoid the spread of harmful fungi.

CONCLUSION

This study documented fungal species such as *Aspergillus niger*, *A. fumigatus* and *A. ochraceus* to be contaminant of human Hair

wig of female students within Benue State University due to its exposure to surfaces and heat generated from the body. Regardless of these contaminants, wearing a wig has several benefits since it completely alters your look and protects your natural hair from harm, especially heat, hairstyles, coloring, and hairdos. Health authorities should intensify their health education programs, which should cover body cleanliness and hair maintenance in addition to the prevention and treatment of major illnesses caused by ignorance. Further investigation of fungal that play potential causative role in the progression of dandruff and its interactions with other members of the hair scalp microbial community is recommended.

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CONFLICT OF INTEREST

Authors hereby declare that they have no conflict of interest.

REFERENCES

Abdullah, Q., Mahmoud, A., Al-harethi, A., 2016. Isolation and identification of fungal post-harvest rot of some fruits in Yemen. PSM Microbiol., 1(1): 36-44.

Aernan, P.T., Odo, J.I., Aondofa, T.J., Anietie, D.J., Iqbal, M.N., 2023. Investigation of Bacteria and Fungi Associated with Onion (*Allium cepa*) Bulbs Rot Purchased from Markets in Makurdi, Central Nigeria. Int. J. Nanotechnol. Allied Sci., 7(2): 14-23.

Alghamdi, S.A., Alotaibi, H.A., Al-Subai, M.Z., Alwakeel, S.S., 2018. Isolation and identification of microbial and fungal flora from female hair samples in Riyadh Saudi

Arabia. Int. J. Environ. Agric. Biotechnol., 3(1): 2456-1878.

Ashraf, A., Iqbal, M.N., 2021. Fungi in the Sands of Egyptian Pyramids is a Concern for Public Health. PSM Biol. Res., 6(1): 19-21.

Atchade, E., Jean-Baptiste, S., Houzé, S., Chabut, C., Massias, L., Castier, Y., Brugiére, O., Mal, H., Montravers, P., 2017. Fatal invasive aspergillosis caused by *Aspergillus niger* after bilateral lung transplantation. Med. Mycol. Case Rep., 17: 4-7.

Atta, M.M., Ahmed, A.J., Al-Shwilly, H.A., Baker, H.Q., Talib, D.Y., 2019. Microbiological contamination of scalp hair in female students in college of education. Plant Arch., (09725210), 19(2).

Bahashwan, E., Alshehri, M., 2024. Insights into alopecia areata: a systematic review of prevalence, pathogenesis, and psychological consequences. Open Dermatol. J., 18(1).

Brooke, J.S., Annand, J.W., Hammer, A., Dembkowski, K., Shulman, S.T., 2009. Investigation of bacterial pathogens on 70 frequently used environmental surfaces in a large urban US university. J. Environ. Health., 71(6): 17-23.

Chepchirchir, A., Bii, C., Ndinya-Achola, J., 2009. Dermatophyte infections in primary school children in Kibera slums of Nairobi. East Afr. Med. J., 86(2).

Choi, H.-J., Gong, D.J., Youn, C., Yeo, S.Y., 2020. Preparation of Flammability Artificial Hair based on Super Engineering Plastic. Textile Coloration and Finishing, 32(2): 103-110.

Clavaud, C., Jourdain, R., Bar-Hen, A., Tichit, M., Bouchier, C., Pouradier, F., El Rawadi, C., Guillot, J., Ménard-Szczebara, F., Breton, L., 2013. Dandruff is associated with disequilibrium in the proportion of the major bacterial and fungal populations colonizing the scalp. PloS One., 8(3): e58203.

Deng, R., Wang, X., Li, R., 2023. Dermatophyte infection: from fungal pathogenicity to host immune responses. Front. Immunol., 14: 1285887.

Dike Ijere, N., Okereke, J., Ezeji, E., 2022. Potential Hazards Associated With Wearing of Synthetic Hairs (Wigs, Weavons, Hair Extensions/Attachements) in Nigeria. J. Environ. Sci. Public Health., 6(4): 299-313.

Echevarría, L., 2019a. Molecular identification of filamentous fungi diversity in North Coast beaches sands of Puerto Rico. Int. J. Mol. Microbiol., 2(3): 51-61.

Echevarría, L., 2019b. Preliminary study to identify filamentous fungi in sands of three beaches of the Caribbean. PSM Microbiol., 4(1): 1-6.

Echevarría, L., 2022. Inventory of filamentous fungi and yeasts found in the sea water and sand of the beach of pier in Arecibo Puerto Rico. PSM Microbiol., 7(1): 4-11.

Echevarría, L., Iqbal, M.N., 2021. Identification of Fungi and Yeasts from the Sands of the Pyramids of Giza, in Cairo, Egypt. PSM Biol. Res., 6(1): 13-18.

Esmail, A., Al-Warafi, E., Hassan, S., Hatem, S., Badr, A., Alzuhiri, I., Talab, O., Ghaleb, R., Al-Khayat, A., 2020. Evaluation of Banknote Contamination with Bacteria and Fungi among Falafel Vendors in Ibb City-Yemen. PSM Microbiol., 5(4): 112-119.

Grice, E.A., Kong, H.H., Renaud, G., Young, A.C., Bouffard, G.G., Blakesley, R.W., Wolfsberg, T.G., Turner, M.L., Segre, J.A., 2008. A diversity profile of the human skin microbiota. Gen. Res., 18(7): 1043-1050.

Iqbal, M.N., Ashraf, A., 2023. Fungi in Water Wells in Dairy Farms and Potential Public Health Hazards Associated with Dairy Products. PSM Microbiol., 8(1): 24-26.

Iqbal, M.N., Ashraf, A., Iqbal, A., 2019. Filamentous Fungi in Beach Sands: Potential Pathogens for Infectious

Diseases. *Int. J. Mol. Microbiol.*, 2(3): 63-65.

Iqbal, M.N., Iqbal, I., Muhammad, A., Shahzad, M.I., 2021. A Review of Mycotoxins Produced by Fruit Spoilage Fungi: Mycotoxins from Fruit Spoilage Fungi. *PSM Biol. Res.*, 6(2): 46-49.

Kerk, S.K., Lai, H.Y., Sze, S.K., Ng, K.W., Schmidtchen, A., Adav, S.S., 2018. Bacteria display differential growth and adhesion characteristics on human hair shafts. *Front. Microbiol.*, 9: 2145.

Liao, B., Cui, Y., Yu, S., He, J., Yang, X., Zou, S., Li, S., Zhao, P., Xu, H., Long, M., 2023. Histological characteristics of hair follicles at different hair cycle and in vitro modeling of hair follicle-associated cells of yak (*Bos grunniens*). *Front. Vet. Sci.*, 10: 1277586.

Moskaluk, A.E., VandeWoude, S., 2022. Current Topics in Dermatophyte Classification and Clinical Diagnosis. *Pathogens.*, 11(9).

Tokunaga, S., Tanamachi, H., Ishikawa, K., 2019. Degradation of Hair Surface: Importance of 18-MEA and Epicuticle. *Cosmet.*, 6(2): 31.

Wallenfels, R., Sasson, J.M., 2000. The Ancient Near East: an encyclopedia for students. Scribner.

Yang, L., Guo, J., Zhang, S., Gong, Y., 2017. Preparation and characterization of novel super-artificial hair fiber based on biomass materials. *Int. J. Biol. Macromol.*, 99: 166-172.