

# Comparative prevalence of microbial infestation of artificial fingernails and natural fingernails from consented volunteers in Ibadan metropolis in South west Nigeria.

Olufemi, Lionel Okunye<sup>1\*</sup>, Idowu Philip Adegboyega<sup>2</sup>, Okanlawon Babatunde Meshach,<sup>3</sup>  
Ovuakporaye Mark Akpotu<sup>4</sup>, Ojieabu, Winifred, Aitalegbe<sup>5</sup>

<sup>1</sup>Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Olabisi Onabanjo University, Ogun State, Nigeria.

<sup>2</sup>Department of Pharmaceutical Microbiology, Faculty of Pharmacy, University of Ibadan, Ibadan Nigeria.

<sup>3</sup>Department of Medical Laboratory Science, College of Health Sciences, Ladoke Akintola University of Technology, Ogbomosho, Osun State, Nigeria

<sup>4</sup>Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Olabisi Onabanjo University, Ogun State, Nigeria.

<sup>5</sup>Department of Clinical Pharmacy and Biopharmacy, Faculty of Pharmacy, Olabisi Onabanjo University, Ogun State, Nigeria.

## ARTICLE INFO

### Article history:

Received 14 May 2021  
Revised 18 July 2021  
Accepted 9 Aug 2021  
Online 30 Sept 2021  
Published -

### Keywords:

Microbial infestation,  
fingernails,  
microbial infestation.

### \* Corresponding Author:

femoetic@yahoo.com  
<https://orcid.org/0000-0001-6444-563X>  
+2349066611198

## ABSTRACT

**Background:** The ability of many bacteria and fungi associated with artificial fingernails and natural fingernails to produce toxin(s) as well as exhibit other pathogenic potential is of public health concern. Superimposition of artificial fingernails over the natural fingernails has become a vogue in the fashion world particularly amongst women with little or no regards to a probable health implication. This study was carried out to compare the prevalence of microflora on artificial fingernails and natural fingernails from consented volunteers.

**Methods:** A cross-sectional survey of selected volunteers was randomly sampled and examined. Questionnaires were served to the respondents to sample their knowledge, attitude and practices on their choice nails. Aseptically scraped powdery crust from fingernail plate and associated fingernail underneath crust were obtained from 40 volunteers wearing artificial nails and 40 volunteers wearing natural nails. The samples were plated on different culture media for possible isolation of bacteria and fungi.

**Results:** Individual samples harbored different bacteria and fungi in varying densities with the percentages of the bacteria flora and fungi higher in those wearing artificial fingernails. The percentages of isolates obtained from artificial fingernails compared with natural fingernails were in ratios of; coagulase negative *staphylococci* (100:87.5), *Staphylococcus aureus* (95:80), *Pseudomonas* species (60:37.5) while *Trichophyton rubrum*, *Trichophyton mentagrophyte* were in ratio of 12.5:2.5 and 7.5: 5 percent respectively. *Candida albicans* was recorded to be of highest percent (15) amongst the isolates of fungi from artificial fingernails.

**Conclusion:** Therefore, artificial fingernails could contribute to transmission of pathogens when kept unattended to, hence an increased awareness in proper hand washing and sanitizing must be exercised when such nail enhancement i.e. artificial nails are worn to forestall this pathogen transmission.

## 1. Introduction

Artificial fingernails are hard, flat translucent covering positioned on the tip of a human finger, they are useful for scratching and fine manipulation. Natural fingernails start in the nail root, hidden under the cuticle. When cells at the root of the nail grow, the new nail cells push out the old nail

cells which then flatten and harden. The newly formed nail then slides along the nail bed, the flat surface under one's nails<sup>1</sup>

Nail consists of four epidermal components: the matrix, proximal nailfold, nailbed, and hyponychium. The matrix is close to the bony phalanx. The horny product of the matrix is the nail plate, which migrates distally over the

nailbed. The distal portion of the matrix, the lunula, is visible as a white, crescent-shaped structure. The proximal nailfold is a modified extension of the epidermis of the dorsum of the finger, which forms a fold over the matrix; its horny product is the cuticle. The nailbed is an epidermal structure that begins at the distal margin of the lunula and terminates in the hyponychium, which is the extension of the volar epidermis under the nail plate. It ends adjacent to the nailbed. The condition of human fingernail is a real indicator of one's lifestyle and diet. Good nutrition will show up in pink, smooth nails. Genetics and age play a part in the appearances of human nails and one may find that ridges begin to appear when one is approaching his 40s<sup>2</sup>

Artificial nails are extension placed over natural fingernails as a fashion accessory which mimics the appearance of real fingernails as closely as possible and are composed of acrylic polymers which are made by reacting acrylic monomers. Artificial nails facilitate colonization of bacteria on the hands and makes hand washing less effective and the use of gloves seemingly impossible. Artificial nail can be useful to those that have trouble growing their nails which must be maintained regularly at a salon to avoid disintegration<sup>3</sup>.

Bacteria, precisely *Pseudomonas aeruginosa* has been isolated in culture of specimen from the paronychia (inflammatory lesion around the margin of a nail). Whether there is true invasion of the nail plate by bacteria or just diffusion of the pigment into the nail plate is not certain. Black paronychia is associated with *Proteus species*. *Staphylococci spp* and *streptococci spp* may be found as secondary invaders. Artificial fingernails were more likely to harbor bacterial pathogens and yeasts, than native nails due to the extended surface area<sup>4</sup>

This study was therefore carried out to compare the prevalence of microbial infestation of artificial fingernails and natural fingernails from selected volunteers in Ibadan metropolis.

## 2. Method

**2.1 Study design:** A descriptive research design was adopted to obtain information from consented volunteers with natural nails and artificial nails to unravel their rationale for wearing their choice nails, based on a designed questionnaire (Table 1)

**2.2 Collection of Samples:** The scrapped nail samples from the consented volunteers were aseptically collected into specimen bottle and transferred to the laboratory for microbiological examination. Ethical approval was obtained from the ministry of health before the study was carried out on informed volunteers.

## 2.3 Microbiological evaluation

0.5g of the scrapped nailbed underneath samples were suspended in 5mL of sterile peptone water and Saboraud dextrose broth, and sub-cultured on differential, selective and enriched culture media namely MacConkey agar medium, mannitol salt agar medium and sheep blood agar base medium for the isolation of bacteria, and thereafter, biochemical confirmatory tests that include, Gram staining, coagulase test, oxidase test and fermentation of sugars were carried out on the bacterial isolates. Saboraud dextrose agar fortified with 0.05mg of chloramphenicol and 0.2mg of cyclohexidime was used for the isolation of fungi. The plate cultures were incubated aerobically at 36°C for 24 hours and 28-30°C for 72 hours for five days for the isolation of bacteria and fungi respectively. The culture growths were biochemically differentiated using urea broth, by which varied isolates of fungi were confirmed<sup>5</sup>. Microscopic identification of bacteria was done by Gram staining the bacterial isolates and that of mould isolates was performed by placing pieces of a colony from SDA to clean microscopic slide and staining with lactophenol -in -cotton blue. After placing a coverslip, each preparation was observed microscopically<sup>6</sup> Ethical approval reference AD 13/497/4275 was obtained from the department of planning research and statistic division, Oyo State Ministry of Health.

## Statistical analysis

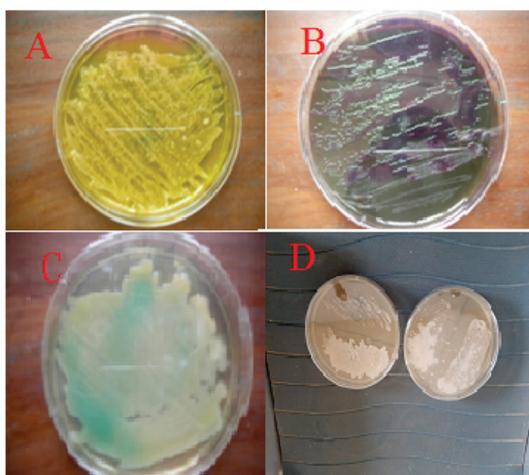
Microsoft<sup>®</sup> Excel was used to collate the data while descriptive statistics were used to summarize the data as shown in the Table 1 and Figure 2.

## 3. Results

Variations percentages in response to the reasons for choosing or not choosing to wear artificial and natural fingernails among the volunteers as shown in Table 1 appears to be an attempt to flow with social trend, intention to beautify oneself and any other justifiable reasons as adjudged to be right by the wearers.

**Table 1: Knowledge, attitudes and practices of sampled volunteers/respondents**

Questions	Responses			
	n(%)	Yes	No	Uncertain
Do you know that fingernails can be infested with microbes?	50	45	5	
Do you have a habit of washing your fingers before touching any objects (biological, non-biological samples)?	62	18	20	
Do you have a habit of washing your fingers after touching any objects (biological, non-biological samples)?	57	20	23	
Do you normally rub antimicrobial ointment on your hands (fingernails inclusive)?	10	75	15	
Do you normally do your fingernails in specific manicure salon/studios?	12	88	0	
Do you normally do your fingernails by the roadside pedicurist or hawkers?	30	70	0	
Do you have a customized style you are used to?	10	86	4	
Do you normally do your nail for a party or festive reason?	22	78	2	
Do you normally do your fingernails to mask infection?	0	97	3	
Do you normally do your fingernails to appeal to opposite sex?	35	50	15	
Do you normally do your fingernails to enhance your beauty and uniqueness?	60	10	30	
Do you normally explore you itchy body parts with your fingernails?	72	20	8	
Do you normally wear hand gloves when performing your duty?	0	96	4	
Do you normally explore your nose with your fingernails?	45	48	7	
Do your extended manicured fingernails serve as deterrents to your duty?	10	87	3	
Is there any secrets with your preference for artificial fingernails?	6	90	4	
Are you more comfortable with artificial nails compared to natural nails?	42	50	8	



Figures 1 are selected culture plates that showed the growth of the isolates of bacteria; (A) *Staphylococcus aureus*, (B) *Streptococcus* spp, (C) *Pseudomonas aeruginosa* and (D) fungi obtained from the scraped fingernail samples

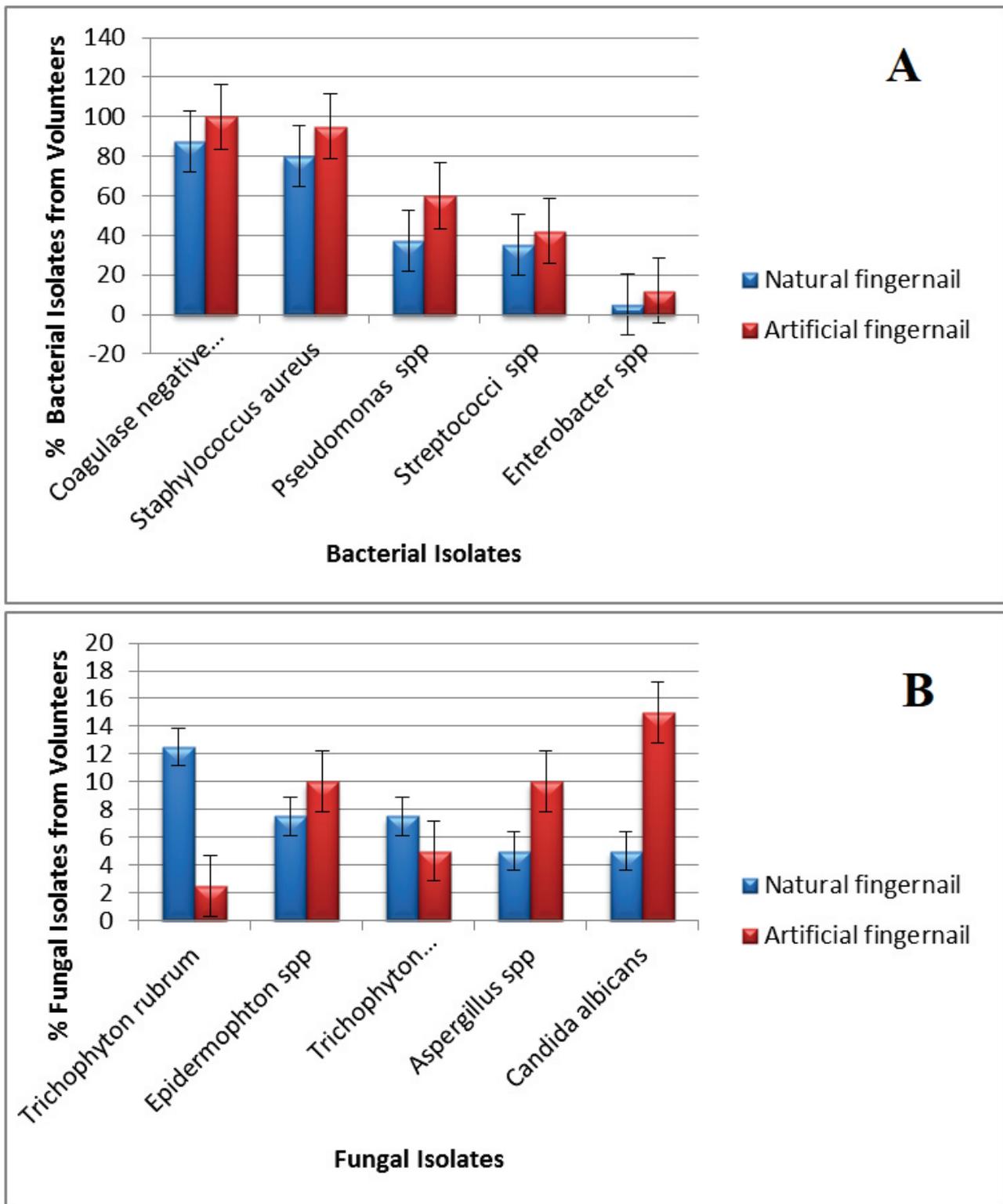


Figure 2 Percentage of (A) bacterial isolates from consented volunteers (B) of fungal isolates from consented volunteers

#### 4. Discussion

Eighty (80) consented volunteers were sampled; the common denominator was that those with artificial nails and natural nails were all identified with bacteria and fungi in varying percentage. The percentage ratios of coagulase negative *staphylococci* (87.5:100) obtained were comparatively higher in both natural fingernails and artificial fingernails, which could be due to ease of contact of these isolates as a result of their presence in both biological and non-biological contact surfaces the volunteers may have been exposed. *Staphylococcus aureus* were also found to be relatively higher in both artificial and natural fingernails (80:95) percent which could be due to possibility of volunteers exploring their body parts with their fingers, thereby carrying up resident or nomadic microflora. This agrees with the study of Pottinger *et.al.*,<sup>5</sup> on bacterial carriage by artificial versus natural nails. It could also be due to the level of hand hygiene practice and health status of the volunteers<sup>5</sup>.

*Pseudomonas aeruginosa*, were found in ratio (37.5:60) percent which could probably be due to immune status and task being performed by the individual volunteers, which is similar with the study of Bae *et.al.*,<sup>6</sup> on green nail syndrome treated with application of tobramycin eye drop<sup>6</sup>. *Streptococcus* species isolated from natural fingernail compared to artificial fingernail were in ratio of (35:42) % showing proximity in abundance. The presence of streptococci in the individuals studied, could also be attributed to health status, the environment and the daily chores which determines the types and the density of the microbes contacted. *Enterobacter spp* isolated from the subjects were relatively low in quantity (5:12) percent. This could be attributed to prevailing activity or circumstances surrounding the volunteers, their awareness of hand hygiene practices, health status, the choice of hand cleansing agent or otherwise on bacteria carriage by artificial versus natural nails<sup>7</sup>.

The remarkable high number of bacterial load from artificial nail wearers in comparison with natural nail volunteers could be attributed to the additional nail fix that provides an extensive surface area for microbes to port, the composition of nail fix, contact with their manicurist, their salon or nail studio environment and what those individuals were using their fingers to explore. *Candida albicans* was isolated in ratio of 15 to 5% in artificial nail to natural nails which were recorded to be the highest amongst the fungi studied. This could be attributed to distributive availability of these isolates in specific anatomical loci of human body as a result of pH shift, prevailing immune status and risk factors associated with underlying infection. *Aspergillus* species were also isolated in ratio (5:10) % from among the individuals in both studied group. This could also be

attributed to immune status and environmental related activities of the subjects. *Trichophyton rubrum*, *Trichophyton mentagrophytes* and *Epidermophyton* were isolated in lower percentage from consented individuals and are indicative of health risks, this corroborates the findings of Baran<sup>8</sup> on nail beauty therapy; an attractive enhancement or potential hazards.

The variations in the percentages of the isolates in this study could be due to flexibility of survival of these organisms relative to the immune status of every individual examined, the awareness of on health and the hygiene practices of each volunteer, the types of decontaminating soap or ointments that are used to decimate or eliminate the proliferation of these organisms. Artificial fingernails may interfere with hand cleansing agent because of their composition.<sup>9</sup> In view of the absence of policies restricting the use of artificial nails, those who do wear them should be informed about the tendency of artificial nails to harbor pathogenic microbes and the importance of regular hand washing with water, antimicrobial soap and ointments to reduce the transmission and evolution of resistant microbes. Several previous studies, including this, have found that wearing artificial fingernails had more pathogens than those from native nails. This agrees with the findings of Rich (2005) on nail cosmetics; the benefit and pitfalls<sup>10</sup>. Artificial nails could harbor more pathogenic organisms than natural nails and it is more difficult to maintain hygienically than natural nails

#### 5. Conclusion

The varying percentage of microbial carriage load, the possibility of the isolates of bacteria and fungi obtained to become pathogenic and feasibility of transmission of infectious disease when kept unattended to, could be detrimental to human health. Hence an increased awareness in proper hand washing and sanitizing must be exercised when such nail enhancement i.e. artificial nails are worn to forestall this pathogen transmission.

#### References

1. Nickey HJ. (2005). 10 years younger - Channel 4 makeover series p.105-107 published 2005 by Channel 4 Books, a division of Transworld publisher ISBN 1-905-02603-X, Germany.
2. McGinley KJ, Larson EL and Leyden JJ.(1988). Composition and density of microflora in the subungual space of the hand. *Journal of clinical microbiology*, 26(5), 950 - 953. <https://doi.org/10.1128/JCM.26.5.950->

3. Hedderwick SA, McNeil SA, Lyons MJ, and Kauffman CA.(2000). Pathogenic organisms associated with artificial fingernails worn by healthcare workers. *Infection control and hospital epidemiology*, 21(8), 505–509. <https://doi.org/10.1086/501794>
4. Moolenaar RL, Crutcher JM., San Joaquin VH, Sewell, LV., Hutwagner, LC, Carson, LA, Robison DA., Smithee LM. and Jarvis WR. (2000). A prolonged outbreak of *Pseudomonas aeruginosa* in a neonatal intensive care unit: did staff fingernails play a role in disease transmission?. *Infection control and hospital epidemiology*, 21(2), 80–85. <https://doi.org/10.1086/501739>
5. Pottinger J., Burns S, and Manske C. (1989). Bacterial carriage by artificial versus natural nails. *American journal of infection control*, 17(6): 340–344. [https://doi.org/10.1016/0196-6553\(89\)90003-5](https://doi.org/10.1016/0196-6553(89)90003-5)
6. Bae Y, Lee GM, Sim JH, Lee S., Lee SY, Park YL (2014). Green nail syndrome treated with application of tobramycin eye drop. *Ann Dermatol*. 26(4):514–516.
7. Brook I. (1993) Paronychia A mixed infection. *Microbiology and management*. *J Hand Surg Br*. 18(3):358–359
8. Baran R. (2002) Nail beauty therapy: an attractive enhancement or a potential hazard? *J Cosmetic Dermatol*. 1(1):24–29.
9. Shelly A. McNeil, Catherine L. Foster, Sara A. Hedderwick and Carol AK (2001). Effect of Hand Cleansing with Antimicrobial Soap or Alcohol-Based Gel on microbial Colonization of Artificial Fingernails Worn by Health Care Workers *Clinical Infectious Diseases*. (32): 3 <https://doi.org/10.1086/318488>
10. Rich P. (2005) Nail cosmetics: the benefits and pitfalls. In: RK Scher, CR Daniel, A Tosti, B Elewski, P Fleckman, and P Rich, eds *Nails: diagnosis, therapy, and surgery*. China: Elsevier Saunders pp 221–227
11. Atwater AR., Reeder M (2019). Trends in nail services may cause dermatitis: not your mother's nail polish. *Cutis*. 103(6):315–317.
12. Centers for Disease Control and Prevention. Nail technicians' health and workplace exposure control [Internet]. 2018 [cited 2019 July 1]. Available from: <https://www.cdc.gov/niosh/topics/manicure/default.html>.
13. Baran R, Schoon D (2004). Nail beauty. *J Cosmetic Dermatol* 3(3): 167–170.
14. Bryson PH, Sirdesai SJ (2010). Chapter 27: colored nail cosmetics and hardeners. In: ZD Draelos, ed. *Cosmetic dermatology products and procedures*, 1st ed. Hoboken, NJ: Wiley-Blackwell, p. 206–213.
15. Schoon D (2010). Chapter 28: cosmetic prostheses as artificial nail enhancements. In: ZD Draelos, ed. *Cosmetic dermatology products and procedures*, 1st ed. Hoboken, NJ: Wiley-Blackwell, p. 215–221.