
**ISSN Print:** 2664-6536
**ISSN Online:** 2664-6544
**Impact Factor:** RJIF **5.4**
IJBB 2024; 6(1): 51-56
www.biosciencejournal.net
Received: 23-01-2024
Accepted: 28-02-2024

**Ahmed Abdurrahman Mohammed**
Kirkuk Education Directorate, Ministry of Education, Kirkuk, Iraq

**Corresponding Author:**
**Ahmed Abdurrahman Mohammed**
Kirkuk Education Directorate, Ministry of Education, Kirkuk, Iraq

# Isolation and diagnosis of bacteria from under long nails (natural and artificial) in young females

**Ahmed Abdurrahman Mohammed**

**DOI:** https://dx.doi.org/10.33545/26646536.2024.v6.i1a.66

**Abstract**
The current study examined the bacteriological content of fingernails among a group of young females collected from Kirkuk University between December 1, 2023, and February 1, 2024. The participants included individuals with both natural and artificial long nails, aged between 18 and 25 years. A total of 110 swab samples were taken from beneath the long nails of the participants using sterile swabs. The results revealed that 86 samples contained various types of bacteria, while fungi were excluded from the analysis as the study focused exclusively on bacterial content beneath long nails. Additionally, 24 samples showed no bacterial presence.
Following colony isolation, the organisms were identified based on Biochemical tests are crucial for identifying and characterizing microorganisms. The indole test determines an organism's ability to produce indole from tryptophan. The citrate test assesses an organism's ability to use citrate as its sole carbon source. The nitrate reduction test checks if an organism can reduce nitrate to nitrite or further to nitrogen gas. Lastly, the urease test detects the presence of the enzyme urease, indicating an organism's ability to hydrolyze urea. These tests help in identifying and classifying bacteria based on their metabolic capabilities. The predominant bacteria found in the samples were *E. coli*, comprising 35 isolates (40.6%), followed by *Staphylococcus epidermidis* with 18 isolates (20.9%). *Propionibacterium acnes* exhibited the lowest occurrence, with only one isolate in this study. Subsequent sensitivity tests were conducted to assess the resistance of isolated bacteria to the antibiotic used. The results indicated resistance among isolates to ampicillin, methenamine, and clindamycin. However, most isolates showed sensitivity to levofloxacin and amikacin.This suggests a potential dissemination of disease-causing microbes beneath fingernails, underscoring the significance of nail hygiene practices.

**Keywords:** Microbes, female nails, hygiene, handwashing

## Introduction
Recently, the trend of long nails among women has emerged. Some of these nails are natural and grown organically, while others are achieved by adding artificial nails that are glued onto the existing nails. They remain in place for extended periods, leading to the accumulation of dirt and various types of microscopic organisms underneath, making them difficult to clean or causing fear of breakage or damage during the cleaning process.
Since the late 1980s, scientists have focused on the area between nails and fingers to identify the microorganisms that reside there [1, 2]. They have found that women who wear artificial nails have a higher variety of bacteria on their fingertips compared to those who do not wear artificial nails, whether before or after handwashing [3]. There have also been warnings regarding manicure procedures, However, some women tend to ignore them. It is crucial to pay attention to these warnings to maintain healthy nails, as improperly sterilized nail cutting tools can cause serious complications." Ranging from skin inflammation to other body infections, including infections caused by bacteria such as *Escherichia* species, *Staphylococcus* species, and *Pseudomonas* species [4, 5].
Any sudden damage to artificial nails resulting from impact Lifting the natural nail at the base can create an opening for dirt and bacteria to enter [6]. while bacteria and fungi may also thrive in the space between nails and potentially spread to the natural nail. reattached nail is not properly cleaned [7]. Hand contamination with feces is a significant pathway for people to be exposed to disease-causing microorganisms, facilitating the transmission of diseases from feces to the mouth. This highlights that nails can serve as a means of transferring pathogens to food [8]. Many infections stem from poor hand and nail hygiene, a result of widespread

unhealthy habits. Research indicates that approximately 80% of diseases can be attributed to inadequate home and personal hygiene practices [9].

The discovery that nails can transfer pathogens to food [10]. and the increased use of nail treatments by some young women, such as nail cosmetics and acrylics, are health concerns as the growth of bacteria inside the nails can lead to unhealthy, thin, and fragile nails [11]. The spread of infections and infectious diseases thrives within the environments of schools and universities. The transmission of bacterial intestinal infections through hands can have significant consequences for students, as stated in reference [12].

This study aims to isolate and identify different types of bacteria found under nails, which cause various diseases in other parts of the body.

## Methods

The current study focused on the microbiological analysis of young female nails. This study was conducted from December 1, 2023, to February 1, 2024, on a group of students from Kirkuk University who have both long and short nails (natural and artificial), ranging in age from 18 to 25 years old. Some of them exhibited symptoms of various diseases, including skin inflammations, nail bed infections, gynecological infections, or diarrhea, while others did not show any symptomatic conditions.

A total of 110 swab samples were taken from under the long nails of these girls using sterile swab sticks prepared for this purpose. They were then cultured on bacterial growth media such as B. agar, N.agar, and MacConkey agar. The cultures were then incubated in an incubator for 24 hours. Subsequently, the isolated colonies growing on the culture media were diagnosed using precise scientific methods for isolating microorganisms that ferment lactose, indicated by the production of acid gas in Durham tubes. Streaking positive acid gas fermentation tubes onto selective media was done for the isolation of pure bacterial colonies, which were subsequently analyzed for their biochemical and morphological [13, 14].

## Results

The results of this study showed that out of 110 swab samples taken from under the long nails, 86 samples (78.1%) contained different types of bacteria and fungi. Fungi were disregarded in our study as we focused solely on bacterial content under long nails. Additionally, 24 samples (21.9%) were bacteria-free, as illustrated in Table 1. The types of bacteria isolated in this study are detailed in Table 2.

**Table 1:** Numbers and percentages of positive and negative samples for bacteriological culture

| Positive | | Negative | | Total | |
|---|---|---|---|---|---|
| **No.** | **%** | **No.** | **%** | **No.** | **%** |
| 86 | 78.1 | 24 | 21.9 | 110 | 100 |

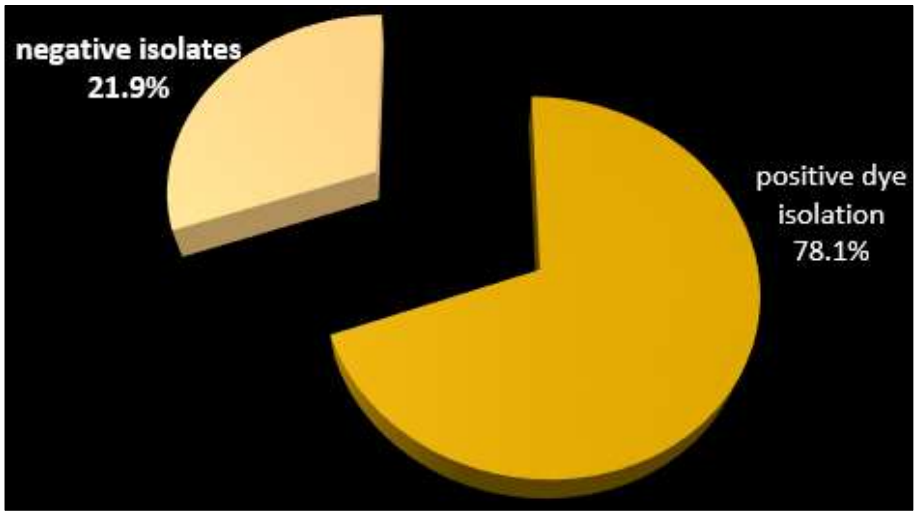


**Fig 1:** Percentage of positive and negative samples

**Table 2:** Showing the number and types of bacterial isolates obtained from under the nails

| Bacteria | No. |
|---|---|
| *E. coli* | 35 |
| *Staphylococcus epidermidis* | 18 |
| *Staphylococcus aureus* | 15 |
| *Protus* | 9 |
| *Pseudomonas aeruginosa* | 6 |
| *Gardnerella vaginalis* | 2 |
| *Propionibacterium acnes* | 1 |

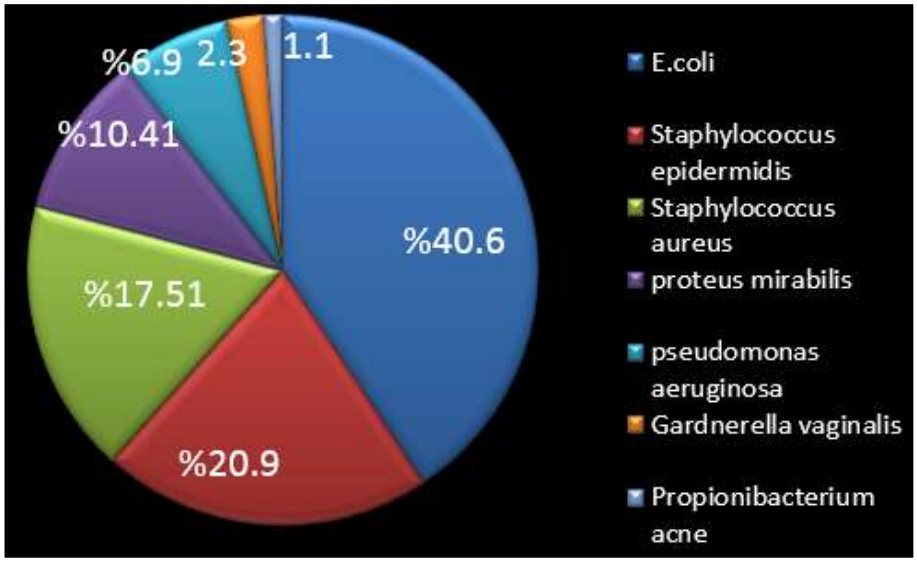


**Fig 2:** Percentage distribution of bacterial isolates obtained from under the nails

The highest percentage of bacteria found in the samples was the bacterial type *E. coli*, with a count of (35) isolates, followed by the type *Staphylococcus epidermidis* with (18) isolates. The lowest number of isolates was for the bacteria Propionibacterium acnes, with only one isolate out of a total of (86) isolated bacterial isolates.

On the other hand, this study revealed that the swabs taken from under the nails contained multiple types of bacteria in each sample, as shown in Table (3). The highest percentage of mixed bacteria from the swabs was *Staphylococcus epidermidis + E. coli*, accounting for (34%) of the total isolates. Although these bacteria are part of the natural flora in the human gut, they have the ability to cause infection after leaving their natural site. Factors that contribute to their infection include their possession of some virulence factors, and a significant proportion of hospital-acquired infections occur due to cross-contamination and the transfer of microorganisms through negligence in personal hygiene conditions in handwashing and the non-use of disinfectants, especially as it contributes significantly to their spread and contamination. This was followed by *Staphylococcus aureus + E. coli + Gardnerella vaginalis*, accounting for (22%) of the isolates. The lowest percentage of bacterial mixtures was *Staphylococcus aureus + Propionibacterium acnes*, accounting for (5.8%). These results were consistent with many studies, including [14, 15].

Subsequently, sensitivity tests were performed to assess the isolated bacteria's resistance to the administered antibiotics, including Clindamycin, penicillin, Oxacillin, Amikacin, Erythromycin, and levofloxacin. He isolates demonstrated resistance to ampicillin, methenamine, amikacin, and clindamycin, with the majority exhibiting sensitivity to levofloxacin and amikacin. *Staphylococcus aureus* and *Pseudomonas aeruginosa* isolates exhibited the greatest antibiotic resistance, suggesting their capacity to induce nail-related illnesses. This study emphasized the importance of nail hygiene, as it is evidence that the lengthening of nails, whether natural or artificial, provides a favorable environment for the growth and multiplication of bacteria and fungi underneath them. This can be a source of food contamination when touched or a source of other skin infections when scratched or when skin scratches occur. Therefore, continuous attention should be paid to cleaning and sterilizing them [16].

**Table 3:** Shows the mixed bacterial isolates isolated from under the nails

| Bacteria | No. | % |
|---|---|---|
| *Staphylococcus epidermidis + E. coli* | 34 | 39.5 |
| *Staphylococcus aureus + E. coli + Gardnerella vaginalis* | 22 | 25.5 |
| *Staphylococcus epidermidis + E. coli + proteus* | 14 | 16.3 |
| *Proetus + Pseudomonas aeruginosa* | 8 | 9.4 |
| *Staphylococcus aureus + E. coli + Pseudomonas aeruginosa* | 5 | 5.8 |
| *Staphylococcus aureus + Propionibacterium acnes* | 3 | 3.5 |
| Total | 86 | %100 |

**Table 4:** Sensitivity of Staphylococcus aureus bacteria to the antibiotics used

| No. | CFM | CL | CD | OX | AM | P | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|
| 1. | R | R | S | R | R | S | R | R | S |
| 2. | R | R | R | R | S | R | R | R | I |
| 3. | S | R | I | R | S | S | R | R | I |
| 4. | R | S | S | S | R | S | R | S | S |
| 5. | I | R | S | S | S | S | R | S | R |
| 6. | R | S | R | R | R | S | R | S | R |
| 7. | R | R | S | R | S | S | R | S | R |
| 8. | S | R | R | S | R | S | S | S | R |
| 9. | S | S | I | R | S | S | R | S | S |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10. | S | R | S | S | R | S | S | R | S |
| 11. | S | I | R | R | S | S | R | S | S |
| 12. | S | I | S | R | R | S | R | S | R |
| 13. | S | I | R | R | S | S | I | R | S |
| 14. | S | R | S | R | R | R | R | R | S |
| 15. | R | S | S | S | S | S | S | R | S |

**Table 5:** Susceptibility of Proteus mirabilis bacteria to the antibiotics used

| No. | CFM | CL | CD | OX | AM | P | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|
| 1. | R | R | S | R | R | R | R | S | R |
| 2. | R | S | R | R | S | S | I | R | S |
| 3. | S | R | S | R | R | R | R | R | S |
| 4. | R | S | I | S | S | S | S | R | S |
| 5. | R | S | I | R | S | R | R | R | R |
| 6. | S | S | S | S | R | R | R | R | S |
| 7. | R | R | S | R | S | R | R | R | R |
| 8. | S | R | R | S | R | S | S | R | R |
| 9. | R | S | I | R | S | R | R | S | S |

**Table 6:** Sensitivity of Staphylococcus epidermidis bacteria to the antibiotics used

| No. | CFM | CL | CD | OX | AM | P | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|
| 1. | S | R | S | R | R | S | R | S | S |
| 2. | S | R | R | R | S | R | R | S | I |
| 3. | S | R | I | R | S | R | R | S | I |
| 4. | S | S | S | S | R | S | R | S | S |
| 5. | S | R | S | S | S | R | R | S | R |
| 6. | S | S | R | R | R | R | R | S | R |
| 7. | S | R | S | R | S | R | R | S | R |
| 8. | S | R | R | S | R | S | S | S | R |
| 9. | S | S | I | R | S | I | R | S | S |
| 10. | S | R | S | S | R | I | S | S | S |
| 11. | R | S | R | R | S | I | R | S | S |
| 12. | R | R | S | R | R | S | R | S | R |
| 13. | R | S | R | R | S | S | I | R | S |
| 14. | S | R | S | R | R | R | R | R | S |
| 15. | R | S | S | S | S | S | S | R | S |
| 16. | R | S | S | R | S | R | R | R | R |
| 17. | S | S | S | S | R | R | R | R | S |
| 18. | R | R | R | R | S | S | R | R | S |

**Table 7:** Susceptibility of Pseudomonas aeruginosa bacteria to the antibiotics used

| No. | CFM | CL | CD | OX | AM | P | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|
| 1. | R | S | S | S | S | S | S | R | S |
| 2. | R | R | S | R | S | R | R | R | R |
| 3. | S | R | S | S | R | R | R | R | S |
| 4. | R | R | R | R | R | S | R | R | S |
| 5. | R | S | S | S | R | S | S | R | S |
| 6. | R | S | R | R | R | R | R | S | R |

**Table 8:** Sensitivity of Propionibacterium acne bacteria to the antibiotics used

| No. | CFM | CL | CD | OX | AM | P | IPM | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | R | R | S | R | R | S | S | R | S | S |

**Table 9:** Sensitivity of *Gardnerella vaginalis* bacteria to the antibiotics used

| No. | CFM | CL | CD | DO | OX | AM | P | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | S | R | S | R | R | R | S | R | S | S |
| 2. | S | R | R | S | R | S | S | R | R | I |

**Table 10:** Sensitivity of Escherichia coli bacteria to the antibiotics used

| No. | CFM | CL | CD | OX | AM | P | ME | LEV | E |
|---|---|---|---|---|---|---|---|---|---|
| 1. | R | R | S | R | R | S | R | S | S |
| 2. | R | R | R | R | S | R | R | R | I |
| 3. | S | R | I | R | S | R | I | R | I |
| 4. | R | S | S | S | R | S | I | S | S |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5. | I | R | S | S | S | R | I | S | R |
| 6. | R | S | R | R | R | R | R | S | R |
| 7. | R | R | S | R | S | R | R | R | R |
| 8. | S | R | R | S | R | S | S | R | R |
| 9. | R | S | I | R | S | S | R | S | S |
| 10. | R | R | S | S | R | S | S | R | S |
| 11. | S | S | R | S | S | S | R | S | S |
| 12. | S | R | S | S | R | S | R | S | R |
| 13. | S | S | R | S | S | S | I | R | S |
| 14. | S | R | S | S | R | S | R | R | S |
| 15. | S | S | S | S | S | S | S | R | S |
| 16. | S | S | S | S | S | R | R | R | R |
| 17. | S | S | S | S | I | R | R | R | S |
| 18. | S | R | R | R | S | S | R | R | S |
| 19. | S | S | R | S | R | R | S | R | R |
| 20. | S | R | S | R | R | R | S | R | R |
| 21. | S | S | R | R | S | R | S | R | S |
| 22. | S | R | R | R | R | R | S | S | R |
| 23. | S | S | R | S | S | S | R | S | S |
| 24. | S | R | R | R | R | S | R | S | R |
| 25. | S | S | S | S | S | R | S | S | R |
| 26. | S | R | R | S | R | S | R | S | R |
| 27. | S | S | S | R | S | S | S | S | R |
| 28. | S | R | R | R | R | S | S | S | R |
| 29. | S | R | R | R | R | S | S | S | R |
| 30. | S | R | R | S | R | S | S | R | R |
| 31. | S | S | I | R | S | S | R | S | S |
| 32. | S | R | S | S | R | S | S | R | S |
| 33. | S | S | R | R | S | S | R | S | S |
| 34. | S | R | S | R | R | S | R | S | R |
| 35. | S | S | R | R | S | S | I | R | S |

Resistant S- Sensitive I-Intermediate

## Conclusion

The prevalence of long nails, both natural and artificial, among women has become increasingly popular in recent times. However, these long nails present challenges in maintaining proper hygiene, leading to the accumulation of dirt and various microorganisms underneath them. Scientific studies have demonstrated that individuals with artificial nails harbor a greater diversity of bacteria on their fingertips compared to those without artificial nails. Neglecting warnings regarding manicure procedures can result in serious complications, including infections caused by bacteria such as Escherichia species, Staphylococcus species, and Pseudomonas species.

Damage to artificial nails can create openings for bacteria and fungi to enter, potentially leading to infections. The spread of pathogens from nails to food and the increased use of nail treatments raise significant health concerns. Research indicates that inadequate hand and nail hygiene contribute to approximately 80% of diseases. Therefore, maintaining proper nail hygiene is essential to prevent infections and maintain overall health.

A recent study focused on the microbiological analysis of young females' nails revealed high bacterial presence under long nails. The study identified various bacterial species, with Escherichia coli being the most prevalent, followed by Staphylococcus epidermidis and Staphylococcus aureus. Mixed bacterial isolates were also common, emphasizing the importance of regular cleaning and sterilization to prevent infections.

Antibiotic sensitivity tests showed resistance among Staphylococcus aureus and Pseudomonas aeruginosa isolates, indicating their potential to induce nail-related illnesses. These findings underscore the necessity of maintaining nail hygiene, as prolonged nails provide a conducive environment for bacterial growth and can serve as a source of infection transmission.

Recommendations for maintaining nail hygiene include regular brushing and scrubbing with alcohol gel or liquid soap, wearing medical gloves when handling potentially infectious materials, and avoiding excessively long nails. Conducting further studies to isolate and diagnose anaerobic bacteria and other microbial pathogens can provide valuable insights into preventing nail-related infections. Overall, prioritizing nail hygiene is crucial for preventing the spread of infections and ensuring overall well-being.

## Recommendations

1. Brushing the nails with a brush and scrubbing with alcohol gel or liquid soap is a crucial step to eliminate microorganisms and remove them from under the nails.
2. Conducting a specific study to isolate and diagnose anaerobic bacteria and other microbial pathogens such as fungi would be beneficial.
3. When there's a chance of coming into contact with blood, saliva, or any potentially infectious materials, it's important to wear medical gloves and regularly sanitize hands with specialized sanitizers.
4. Avoid letting nails grow excessively long and trim them regularly to maintain cleanliness, as long nails can accumulate and harbor bacteria and germs underneath them.

## References

1. Aneja K. Experiments in microbiology, plant pathology, tissue culture and microbial biotechnology.

5th ed. New Delhi: New Age International Publishers; c2017. p. 240-268.
2. Aneja K. Laboratory manual of microbiology and biotechnology. 2nd ed. New Delhi: New Age International Publishers; c2018. p. 242-270.
3. Hedderwick S, Shelly M, Micheal L, Carol K. Pathogenic organisms associated with artificial fingernails worn by healthcare workers. J Infect Control Hosp. Epidemiol. 2007;21:505-509.
4. McKenzie JE, Priest P, Audas R, Poore MR, Brunton CR, Reeves LM, *et al*. Hand sanitisers for reducing illness absences in primary school children in New Zealand. Trials. 2010;11:7.
5. Risan MH. Isolation and Identification of Bacteria from under Fingernails. Int. J Curr. Microbiol. App Sci. 2017;6(8):3584-3590.
6. Pittet D. Improving compliance with hand hygiene in hospitals. Infect Control Hosp. Epidemiol. 2000;21:381-386.
7. Hunter J, Savin J, Dahl M. Clinical dermatology. Malden, Mass: Blackwell Sciences; c2002. p. 173.
8. Kumar A, Chordia N. Role of microbes in human health. Appl. Microbiol: Open Access. 2017;3(2):2471-9315.
9. Larson E. Hygiene of skin: When is clean too clean? J Emerg Infect Dis. 2001;7(2):12-17.
10. Mengist A, Aschale Y, Reta A. Bacterial and parasitic assessment from fingernail in Debremarkos, northwest Ethiopia. Can J Infect Dis. Med. Microbiol.; c2018. p. 27.
11. Kanafani ZA, Kourany WM, Fowler VG, *et al*. Clinical characteristics and outcomes of diabetic patients. Eur. J Clin. Microbiol. Infect Dis. 2009;15:1477-1482.
12. Tambekar DH, Shirsat SD, Bhadange DG. Drinking Water Quality Deterioration in Households of Students with High Illness Absenteeism. J Health Allied Sci. 2011;10(2):1-4.
13. Tambekar DH, Shirsat SD. Hand washing: a cornerstone to prevent the transmission of diarrhoeal infection. Asian J Med. Sci. 2009;1(3):100-103.
14. Trick WE, Verno MO, Hayes RO. Impact of Ring Wearing on Hand Contamination and Comparison of Hand Hygiene Agents in a Hospital. 2003;36:1383-1390.
15. Tuupo MP. Acrylic Nail and Native Nail Bacteria. J. 2006 May;1:57-64.
16. Wachukwu CK, Abbey SD, Ollor AO, Obilor NL. Public Health Implication of Artificial Finger Nails Used by Health Workers and Food Handlers in Port Harcourt, Nigeria. J Appl. Sci. 2007;7:3580-3583.