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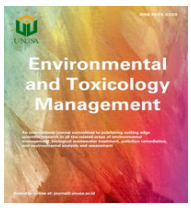

Assessment of microbiological growth on biometric devices

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Abstract

Biometric devices are nowadays common in use for a variety of purposes. The current study aims to assess the bacteria growth on fingerprint scanners and morphological identification of the bacteria. The bacteria growth was determined through the colony forming units followed by morphological identification through hanging drop method and gram staining. The results showed the bacteria growth curve for dilution factor 10^{-6} showed the most accurate growth curve graph and was chosen for morphological identification. From morphological identification, the bacteria was observed for three days and from observation the bacteria's growth moderately. Next, from gram staining method, the bacteria appeared reddish which mean its Gram-negative bacteria. Gram-negative bacteria are among the most significant public health problems in the world due to their high resistance to antibiotics so the recommendation is to change the use of biometric devices to more safe ways to avoid the spread of microorganisms in this pandemic era such as using online attendance system and using staff card. This study has been significant because it can confirm the existing of microorganisms on the surface of biometric devices as well as the types of the microbes by determining the bacteria growth and bacteria identification.

Keyword :
Biometric devices, bacteria, gram staining, morphological identification

1 Introduction

Severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) is a rapidly growing global emergency (Berlit, 2020). COVID-19 may cause hepatitis, intestinal disorders, ketosis, ketoadosis, and blood-brain barrier disruption (Rodriguez-Palacios et al., 2020; Lei et al., 2021; Nikbakht et al., 2020). Futhermore, COVID-19 can cause for mortality in COVID-19 hospitalized patients (Corona et al., 2021; Elezkurtaj et al., 2021). In order to prevent the spread of the virus by reducing the risk of new infections, various preventive measures have been adopted around the world (Janik et al., 2021). There are travel restrictions at the local, national and international levels, physical distancing is encouraged, remote working is allowed, there are strict quarantine policies, as well as restrictions on large gatherings and the banning of large gatherings on a national and international scale (Linka et al., 2020; Oum and Wang 2020; Anzai et al., 2020). However, the usage of fingerprint scanners, where a large number of people place their fingertips, always gives the impression that biometric equipment is laden with a range of bacterias that may play a role in the spread of infections, if not the diseases themselves (Iqbal and Campbell 2021; Okereafor et al., 2020). It is important to note that the skin surface acts as the habitat of a microbial flora, predominantly consisting of gram-positive bacteria (Bhatta et al., 2018; Gerrity et al., 2022).

Serial usage of finger scanners in a particular context may have a greater impact on transmission because latent prints left on the scanner surface by the deposition of finger wetness, perspiration, or oils can dirty the surface (Gomez-Barrero et al., 2022; Do et al., 2020). Unsanitary thumbs may leave living bacteria, fungi, and viruses on the surface of the scanner after use, increasing the likelihood of spreading germs that cause diseases, such as COVID-19, which is mostly disseminated by droplets and contaminated hands or surfaces (Norton et al., 2021; Kusi et al., 2020).

To understand the potential spread of microorganism in biometric device, this study aims to determine the bacteria growth and morphological identification from samples of microorganisms on the fingerprint scanners (FPS) at Dragon, Taman Muhibbah and Kubang Gajah. Bacteria growth can be determined through the colony forming units (CFU) and the growth curve graph will be plotted (Dönmez et al., 2022). The curve can be used to identify different stages of the growth cycle. It also makes it easier to assess cell number and the rate of growth of a specific organism under defined circumstances (Zhang et al., 2021; Kralikova et al., 2022). Contribution of this study is the confirmation of the existing of microorganisms on the surface of biometric devices as well as the types of the microbes by determining the bacteria growth and bacteria identification.

2 Materials and method

2.1 Sample collection

At least one biometric device is put on all access gates of office and laboratory buildings, and two biometric devices are installed to clock entry and exit timings at two locations. The devices are not

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disinfected on a regular basis, and the maintenance department just inspects them for functionality. None of the devices studied were placed within a 50 m radius of animal facilities or livestock farms.

Sampling will be done from 10 fingerprint scanners (FPS) installed at different places to clock in and out times for employees of University Malaysia Perlis. Sample collection's step is start by wearing the gloves and open the cap of the sterilized test tube containing the sterile cotton swab. The cotton swab is removed from the tube and is rub firmly several times across the sampling area, avoiding any touch of swab with other parts of FPS. After swabbing, the cotton swab is insert in the test tube that was label with the location immediately and cap is closed firmly. All the swabs at the same place were collected on the same day and transferred to the laboratory in sterile containers at ambient temperature.

2.2 Sample preparation

The collected swabs were transferred to individual sterile universal bottle containing 20 mL nutrient broth. Nutrient Broth is a medium widely used for the culture of undemanding microorganisms. To prepare nutrient broth, 13 g of nutritious broth powder is dissolved in 1L of distilled water in a clean container then were transferred to universal bottles. After that the Nutrient broth in universal bottles is autoclaved at 121 °C for 15 min. Then swabs in NSS were shake on an orbital shaker for 24 h and then the turbidity is observed.

2.3 Serial dilution

After shaking, the swab was serially diluted until seven dilutions for each sample and bacterial load was determined using spread plate method, for dilution 5, dilution 6, and dilution 7. For one sample, seven dilution blanks is numbered 1 until 7. In each tube, exactly 9 mL of saline solution is poured. The first step is to swirl the original bacterial culture tube. This will ensure that cells are evenly distributed in the tube. Once swirled, exactly 1 mL from original bacterial culture tube is transfer to Tube 1. It should have 10 mL of liquid in Tube 1. Then the Tube 1 is swirled and after swirled, 1 mL from Tube 1 is transfer to Tube 2. This step will be repeated until it make up to dilution 7.

2.4 Spread plate method

After done with the serial dilution, it will continue with the spread plate method. Spread plate method is the method for counting the number of colony-forming bacteria present in a liquid specimen. A fixed amount of inoculum which is 0.1 mL from a sample is placed in the center of an agar plates using a micropipette. Then by using hocky stick the sample was spread eventually on the agar. The step is repeated for sample from each dilution. After that, the plate is inverted and incubated at 37°C for 24-48 h. The count of bacteria was expressed as colony forming-units (CFUs) per mL.

2.5 Streak plate method

For macroscopic observation, streak plate method was used to produce isolated colonies of an organism on an agar plate or known as pure cultures (Kusugal et al., 2021). This is useful to separate organisms in a mixed culture and to study the colony morphology of an organism. First, the inoculating loop was sterilized in the Bunsen burner by putting the loop into the flame until it is red hot and then was allowed it to cool. Second, an isolated colony from the agar plate culture was picked and spread over the first quadrant (approximately 1/4 of the plate) using close parallel streaks .Third, the loop was flamed again and allow it to cool. Fourth, going back to the edge of area 1 that just streaked, then the streaks was extended into the second quarter of the plate (area 2).Then step third and fourth was repeated for the third quarter of the plate (area 3) and the center fourth of the plate (area 4). Lastly, the streaked plate is incubated at 37°C for 24 h. The colonies grown on the plate was examined carefully. All colonies should have the same general appearance to obtain a pure culture. Then after incubated for 24 h the macroscopic observation was done by take a single colony of bacteria from pure culture within the agar using a sterile metal cork borer for 3 d.

2.6 Gram staining method

The gram staining started with the preparation of the smear. A very small sample of a bacterial colony was picked up by using sterilized and cooled loop and was stirred gently stir into the drop of water on the slide to create an emulsion. It is very important to prevent preparing thick, dense smears which contain an excess of the bacterial sample (Monowar et al., 2021; Cherak et al., 2021). A very thick smear can diminishes the amount of light that can pass through, thus making it difficult to visualize the morphology of single cells. Smears typically require only a small amount of bacterial culture. An effective smear appears as a thin whitish layer or film after heat-fixing. Next, Heat fixing kills the bacteria in the smear, firmly adheres the smear to the slide, and allows the sample to more readily take up stains. The smear was allowed to air dry after the smear has air-dried, the slide was hold at one end and pass the entire slide through the flame of a Bunsen burner two to three times with the smear-side up. Then, the smear was ready to be stained. Third, slide with heat fixed smear of bacteria sample from Dragon was placed on staining tray. Smear was gently flooded with crystal violet and was let stand for 1 min. Then, the slide was tilted slightly and rinsed gently with distilled water. After that, the smear was gently flooded with Gram's iodine and let stand for 1 min. The slide was tilted slightly and rinsed gently with distilled water using a wash bottle. The smear will appear as a purple circle on the slide. Then it was decolorized using 95% ethyl alcohol or acetone. The slide was tilted and the alcohol was applied drop by drop for 5 to 10 s until the alcohol runs almost clear. Then it was immediately rinsed with water. Lastly, it was gently flooded with safranin to counter-stain and let stand for 45 s. The slide was tilted slightly and gently rinse with tap water or distilled water using a wash bottle. The slide was blot dry with tissues and finally the smear can be viewed using a light-microscope under oil-immersion.

3 Results and discussion

3.1 Growth curve graph

From all of the growth curve graph that were plotted, the growth curve of dilution factor 10^{-6} for location at FTKA's main office shows the best growth curve (Fig. 1). The graph is separated into four sections, beginning with the lag period, where the growth rate ranges from 0 to 72 h. The CFU/mL during this phase is from 0 to 1.0 x 10^6. The lag phase then transitions to the second phase of growth, which is the exponential phase. The CFU/mL increase rapidly from 1.0 x 10^6 to 8.8 x 10^6 .The increasing of bacteria because of culture media is rich in growth promoting substance, so the growth of bacteria occurs faster (Rafik and Boubaker 2020). Decrease in nutrient concentration will decreases the growth rate (Noh et al., 2018). The exponential phase lasts 72 to 120 h. The stationary phase is the third stage of growth. This phase lasts from 120 to 192 h with CFU/mL is approximately 3.7 x 107 to 3.9 x 10^7. The death phase, which lasts between 192 and 240 h, is the ultimate phase of the growth curve. This bacteria from dilution factor 10^{-6} for location at FTKA's main office was chosen for isolation and then proceed with the morphological identification because show the better growth curve compare to the others.

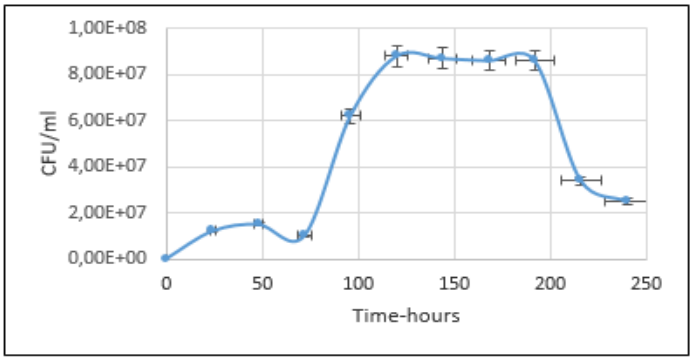

Figure 1 The growth curve of dilution factor 10^{-6} for location at Dragon

3.2 Gram staining result

Bacteria that stain purple with the Gram staining procedure are termed Gram-positive; those that stain pink are said to be Gram-negative (Brochado et al., 2018; Dan et al., 2022). The terms positive and negative have nothing to do with electrical charge, but simply designate two distinct morphological groups of bacteria. From the gram staining method, the results show that the bacteria is appeared reddish which prove that it was Gram-Negative bacteria as shown in Fig. 2. Gram-positive and Gram-negative bacteria stain differently because of fundamental differences in the structure of their cell walls (Rohde, 2019). Gram-negative bacteria have cell walls with thin layers of peptidoglycan (10% of the cell wall) and high lipid (fatty acid) content. This causes them to appear red to pink under a Gram stain. However, the result described that gram negative bacteria were dominant in FPS at FTKA's main office Dragon, Taman Muhibbah and Kubang Gajah.

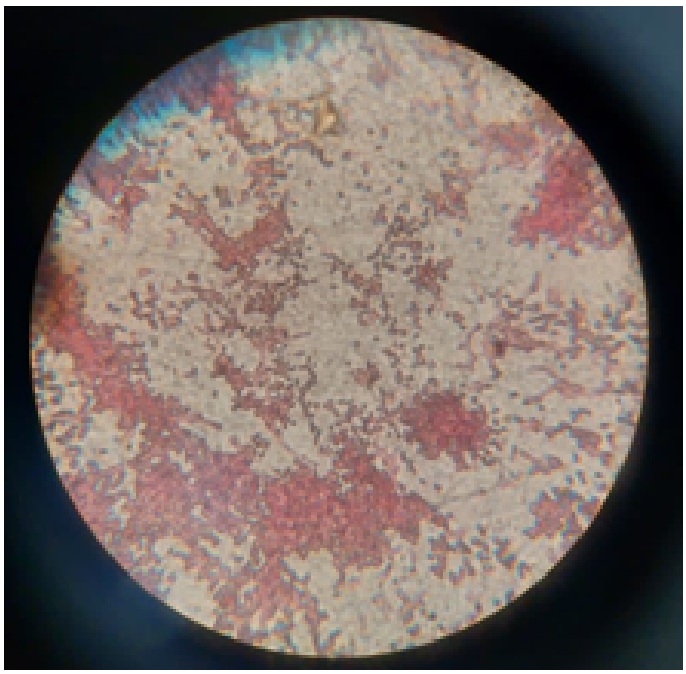

Figure 2 Gram-negative (pink/red) rods using oil immersion objective lens (100x)

4 Conclusion

The objective of the study was to assess the bacteria growth on fingerprint scanners and morphological identification of the bacteria. The result showed that the bacteria growth takes longest time before enter the death phase. From result of morphological identification, the bacteria is white in colour and has strong odor and growth moderately. The bacteria was proven as Gram-negative bacteria through gram staining method. Gram-negative bacteria can cause infections including pneumonia, bloodstream infections, wound or surgical site infections, and meningitis in healthcare settings. Gram-negative bacteria are resistant to multiple drugs and are increasingly resistant to most available antibiotics. From this study, we can learn whether or not microorganisms exist on the surface of biometric devices, as well as the types of the microbes by determining the bacteria growth and bacteria identification. Next, we can propose to the university to change the use of biometric devices to more safe ways to avoid the spread of microorganisms in this pandemic era such as using online attendance system and using staff card .An appropriate recommendation also could be imposed for the continuous usage of biometric systems for entrance and attendance in UniMAP since COVID-19 surface transmission still could occur.

Declaration of competing interest

The authors declare no known competing interests that could have influenced the work reported in this paper.

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