Characteristics of *Staphylococcus aureus* Bacteria in Student Skin Samples at Biology Department, Jabal Ghafur University

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ABSTRACT

Staphylococcus aureus is a group of normal flora on the surface of the body and can cause infections under certain conditions. This research aims to identify the characteristics of *Staphylococcus aureus* from skin swabs taken from the students at the Biology Department, Jabal Ghafur University. This constitutes preliminary research aiming to determine the characteristics of Staphylococcus aureus and its sensitivity to natural ingredients that can act as antibacterial agents. This research is classified as descriptive research using Carter's method. The isolation of *Staphylococcus aureus* bacteria was carried out by wiping the entire skin of the hands with sterile cotton. Samples were cultured on selective media on Mannitol Salt Agar (MSA), followed by the identification of bacteria by Gram staining, catalase, and coagulase tests. The test results showed that the growth of bacterial colonies on the MSA medium, which was golden yellow, indicates its ability toferment glucose and mannitol in the medium. The Gram staining results were purple, denoting Gram-positive bacteria. Cocciform morphology, positive catalase test, positive coagulase test. Therefore, it is concluded that the characteristics of *Staphylococcus aureus* bacteria include spherical, Gram-positive, Catalase-positive, and Coagulase-positive.

Keywords: *Staphylococcus aureus, Isolation, Characterization, Skin*

1. INTRODUCTION

Some bacteria usually colonize a person's skin several days after birth. The skin acts as the main barrier that protects the body against infection. However, an imbalance in homeostasis between the skin flora and theimmune system, as well as poor hygiene, can lead to disease. One of the normal flora that colonizes human skin is *Staphylococcus aureus*. Although *Staphylococcus aureus* acts as a normal flora, it also quickly causes inflammation when the skin is damaged or there are open wounds. Indicators of this bacterial infection are red, swollen, painful skin and pus forming around the wound. Wounds and open sores on the skin accelerate the penetration of *Staphylococcus aureus* into the tissue and cause skin infections. Infectious diseases are ranked among the deadliest diseases in the world. Apart from the skin, *Staphylococcus aureus* also causes respiratory infections [1], bacteremia, infective endocarditis, gastroenteritis, meningitis [2], and urinary tract infections [3].

Skin is known to come into contact with *Staphylococcus aureus* easily. The process of contamination and spread of bacteria starts with daily activities without people realizing it because the environment in which they live is cosmopolitan. Various activities, such as gardening, washing, touching objects, and so on, are sources of the spread of bacteria [4]. Research by Holderman et al. [5] showed that*Staphylococcus epidermidis* and *Bacillus subtilis* bacteria were detected from escalator supports in a mall in Manado City, Indonesia. The same bacteria were alsodetected on cell phones and were dominated by*Staphylococcus aureus* [6], food sold in markets [7], [8].

The Biology Department of Jabal Ghafur University, located at Gle Gapui, Indrajaya District, Pidie Regency, Aceh Province, Indonesia, has a strong ancestral cultural heritage in the use of biodiversity. Most of the biology department's students are from this region. This area has quite extensive land and is full of bushes. Glee Gapui residents use this area for their livelihood; local people process, sell, and take firewood from the surrounding land. This activity allows

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infection with various bacteria, including *Staphylococcus aureus*.

This research is a preliminary study to determine the characteristics of Staphylococcus aureus bacteria identified in the Glee Gapui Community, Indrajaya District, Pidie Regency, Aceh, Indonesia, as well as its sensitivity to natural ingredients that can act as antibacterials. Knowing the characteristics of bacteria isvery important to prevent infection and reduce the number of infectious patients. This research aims to identify the characteristics of *Staphylococcus aureus* from skin swabs taken from the students at the Biology Department at Jabal Ghafur University.

2. RESEARCH METHODS

2.1 Location

The research was conducted in the Lab of Microbiologyat FMIPA Syiah Kuala University Banda Aceh from July to August 2023. Research begins with bacterial isolation, followed by characterization.

2.2 Tools and Materials

Staphylococcus aureus clinical isolate, mannitol agar (MSA) medium, coagulase, plasma, NaCl fis, 3% hydrogen peroxide (H_2O_2), distilled water, crystal violet, lugol, and safranin. The tools used are micropipettes, incubators, water baths, magnetic stirrers, laminar flow, microscopes, and autoclaves.

2.3 Sample Collection

Seventeen students from the Biology Department in the Glee Gapui, Indrajaya District, provided skin samples for this research. 10% of the total number of students were randomly selected to create the sample, which consisted of two students.

2.4 Bacterial Isolation

Staphylococcus sp. isolates came from swabs of healthyskin samples from Biology department students at Jabal Ghafur University from Glee Gapui, Indrajaya District, Pidie Regency. *Staphylococcus sp*. isolates were isolated into MSA [9], [10] and stored for 24 hours at 37 oC (Figure 1). Positive for *Staphylococcus sp.* if the colony is yellow.

2.5 Characterization of Staphylococcus Aureus

Culture characterization was carried out through physiological (Gram stain) and biochemical (catalase, coagulase) tests according to the 2015 National Standards Agency standards.

Gram staining is carried out to identify Gram characteristics and bacterial morphology. Staining begins with the preparation and attachment of the bacterial surface to glassware, the absorption of crystal violet, the washing and cultivation of Lugol, and the decolourization and cultivation of safranin. Finally, the carefully washed and dried preparation is ready for examination under a microscope [11].

Catalase test to differentiate *Staphylococcus sp*. and *Streptococcus sp.* The $H_2O_{2(l)}$ was homogenized with one inoculum of mannitol agar (MSA) in a glass vessel [10]. Catalase+ is characterized by the appearance of gas foam (O_2) produced by the genus *Staphylococcus* [12].

The coagulase test is useful for determining whether *Staphylococcus sp*. is positive or not. The coagulase test that was tried was a tube method equipped with nutritional broth and 1 ml of plasma. The tube method coagulase test uses two test tubes labelled "test" and "positive control". One colony of test bacteria is added to the “test” tube, and one colony of *Staphylococcus aureus* is added to the positive control. Leave it for 4 hours at the beginning to get the results. If it does not show a + sign, continue for 24 hours. Coagulase + is characterized by the presence of gel-like lumps at the bottom of the tube, and coagulase is characterized by the absence of lumps [11].

2.6 Data Analysis

Data from laboratory analysis were analyzed descriptively for each stage carried out. The results are tabulated in tables and figures and equated with the identification standards of Bergey's Manual of Systematic Bacteriology.

3. RESULT AND DISCUSSION

Based on the isolation and identification of two healthy skin samples (S1 and S2 samples), the results are presented in Table 1.

Table 1. Colony Morphology on Mannitol Salt Agar (MSA) Media

Sample	Shape	Colour	Surface	Periphery	Elevation	Colony Aspect	Fermentation
S1	Small Round	Yellow	Fine	Flate	Convex	Shiny	+
S2	Small Round	Yellow	Fine	Flate	Convex	Shiny	+

+ = Fermenting Mannitol Salt Agar (MSA)

Table 1 concludes that all bacterial colonies that grew in the MSA medium showed positive results in the fermentation of the medium. The visible morphology of the colony is small and round, with flat edges and convex tubercles, shiny and yellowish (Figure 1). The research of Prasetyo and Kusumaningrum [13] showed that *Staphylococcus aureus* has the characteristics of round-shaped colonies on solid media that are aggregated, smooth, appear shiny, and yellow. However, this must be confirmed by physiological tests (Gram stain), catalase, and coagulase tests.

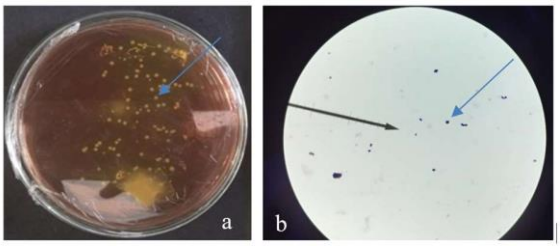

Figure 1. Growth of *Staphylococcus sp.* on MSA media (a) and Gram staining results (arrow shows *Staphylococcus sp*.) (b)

Figure 1a shows the colour transformation of the medium from red to yellow due to the fermentation of mannitol by *Staphylococcus aureus* in the mannitol salt agar (MSA) medium [14]. Pathogenic *Staphylococcus aureus* is able to ferment sugar and mannitol in an MSA medium [10] and produces acid and a yellow colour [9]. Salt Agar (MSA) media is a differentially selective medium against *Staphylococcus sp.* MSA medium contains 7.5% NaCl salts, making it selective. In general, bacteria cannot grow at 7.5% salinity, except for *Staphylococcus sp.* [7].

Detection results showed that the isolate was cocci-shaped and purple (Figure 1b), the catalase test was +, and the coagulase test was + in both samples tested (Table 2). The resulting purple colourindicates that the isolate belongs to the Gram+ group. The purple colour is caused by bacteria that maintain the purple crystal colour on the Gram stain. Gram+ bacteria have a thicker peptidoglycan layer when compared to Gram-(8). In Gram+ bacteria, the crystal violet dye is completely absorbed by the peptidoglycan layer, so it does not wash off easily [15]. Ibrahim [16] emphasized that Staphylococcus aureus is classified as a gram-positive bacteria with colony-life characteristics.

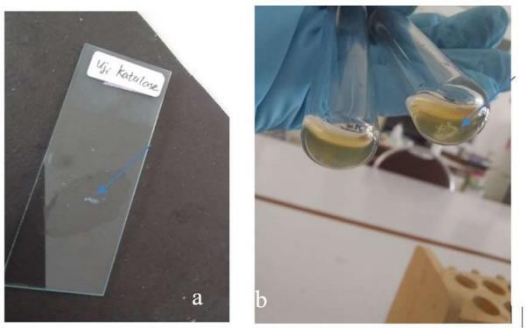

Figure 2. (a) The catalase test results are characterized by the presence of foam, and (b) the coagulase test results show the presence of lumps.

The results of the coagulase test on the isolates tested showed a + result, which was characterized by the presence of gel-like lumps (Figure 2b). The coagulase enzyme is an extracellular protein produced by *Staphylococcus aureus* and can thicken plasma [14].

Plasma coagulation occurs when it reacts with the coagulase enzyme to form esterase and clotting activity and activates prothrombin to form fibrin and plasma [17]. Plasma coagulability is a virulence factor in the pathogenesis of *S. aureus* [18].

Table 2. Identification of *Staphylococcus aureus* on Gram Staining and Biochemical Tests

Sample	Gram Staining	Catalase Test	Coagulase Test
S1	Coccus shape, purple colour	+	+
S2	Coccus shape, purple colour	+	+

+ Catalase Test : The presence of gas bubbles
+ Coagulase Test : The presence of gel-like lumps

4. CONCLUSION

This findings of this study conclude that isolates from two samples of skin swabs from Biology department Students at Glee Gapui community, Indrajaya District, Pidie Regency, can ferment mannitol and sugar, cocci, Gram+,catalase, and coagulase+ tests. The isolate was positive for *S. aureus.*

AUTHORS' CONTRIBUTIONS

Authors 1 and 3 contributed to the data analysis and finalization of the article, and Author 2 contributed to the

data collection.

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