Friend or Foe: The Importance of Identifying Bacteria with Biochemical Tests

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Introduction

Bacteria play a major role in our lives, whether that is helpful or harmful. In fact, anywhere from 10-100 trillion microorganisms live symbiotically with any given person's own cells (3). However, any bacteria that are not normally found in the body are cause for concern. Some strains are pathogens and can be antibiotic-resistant (2). Therefore, it is important to be able to correctly identify these bacterial species for diagnoses and prescriptions. Additionally, specific pathogenic bacterial strains can be found in food, water, and other industrial products. Determining the species and origin is crucial for efficiently containing an outbreak. Finally, correctly identifying and isolating bacteria can positively impact human health. According to a journal article by Franz et. al, "Some *Enterococcus faecium* and *Enterococcus faecalis* strains are used as probiotics and are ingested in high numbers, generally in the form of pharmaceutical preparations" (2). Therefore, it is also important to be able to accurately identify probiotic bacteria in order to isolate and utilize their benefits.

Bacteria can be identified using both selective and differential methods. A selective media only allows specific types of bacteria to grow on it, while differential media will produce differing results, like varying color, to differentiate between species. For example, selective media may only contain lactose, so only lactose fermenters will grow, whereas differential media may contain multiple types of sugars, but have a specific color associated with lactose fermentation (1). Selective and differential media often work synonymously to narrow down the bacterial species. Another test commonly used in identifying bacteria is a Gram stain. Bacteria that are Gram-positive have a simpler cell wall compared to Gram-negative bacteria, and Gram-negative bacteria tend to be more pathogenic (1). In this report, bacteria were identified by using

various selective and differential methods. By logically using both selective and differential media as well as a Gram staining procedure, correctly identifying bacterial species is possible.

Methods & Materials

In order to complete this procedure, two previously inoculated unknown bacterial samples were obtained. Their respective numbers were #10 and #31. First, a Gram stain was performed to determine whether they were Gram-positive or negative. Next, the Gram-positive sample was inoculated on a Sheep's Blood Agar (SBA) plate, and the Gram-negative sample was grown on an Eosin-Methylene Blue (EMB) plate. The results were compared with a standard results table to determine the proceeding tests. Using the Gram-positive sample from the SBA plate, catalase and bile-esculin tests were performed. The Gram-negative sample isolated from the EMB plate was inoculated on a Triple Sugar Iodine (TSI) slant and was tested for urease. The results of each of these tests were then compared with the expected results table in order to identify the species (Table 1).

Results

Sample #10 was Gram-negative, while Sample #31 was Gram-positive. The streak for sample #31 displayed gamma hemolysis while the stab displayed beta hemolysis on the SBA plate (Image 1), its catalase test was negative, and it was negative for growth in bile but positive for esculin production (Image 3, Table 1). Sample #10 had translucent to pink growth on the EMB plate (Image 2), and it was positive for urease (Table 2). For its TSI slant, the slant was red (positive for glucose), the butt was yellow (positive for lactose/sucrose), there were no cracks in the media (negative for gas production), and it was positive for sulfur reduction, determined by a black color (Image 4, Table 2).

Discussion

The objective of this report was to identify bacterial species using a series of biochemical tests, and this proved to be successful. The hypothesis that logically using biochemical tests would aid in the identification of species was supported. According to the results, the unknown sample #31 is most likely *Enterococcus faecalis* because the results of the unknown tests were almost identical to the results for *E. faecalis* (Table 1). While the unknown #31 seemed to be negative for growth in bile, it produced a high amount of esculin, which means unobserved bacterial growth was likely (Image 3). On the contrary, the unknown sample #10's results align directly with the results for *Proteus vulgaris* (Table 2). Therefore, it can be concluded that the unknown bacterium #10 was likely *P. vulgaris*.

Using selective and differential biochemical tests for bacterial identification is important, especially as that pertains to human health. As *E. faecalis* can be probiotic, other bacterial species and strains can be pathogenic (2). And, the human microbiome is very complex, and can even be different from person to person (3). Therefore, determining the origin of bacterial growth is crucial in areas from the food industry to the medical field. Bacteria can be helpful or harmful, and biochemical tests can help humans determine whether bacteria are friend or foe.

Tables

Table 1

	Results	
Test	Unknown #31	*Enterococcus faecalis*
SBA	gamma/beta (streak/stab)	gamma/beta (streak/stab)
Catalase	-	-
Bile-Esculin	-/+	+/+

Results for *E. faecalis* are reported from standard results.

Table 2

	Results	
Test	Unknown #10	*Proteus vulgaris*
EMB	translucent	pink/translucent
TSI glucose	yellow +	yellow
TSI lactose/sucrose	red +	orange/red
TSI gas production	-	+/-
TSI sulfur reduction	++	+++
Urease	+	+

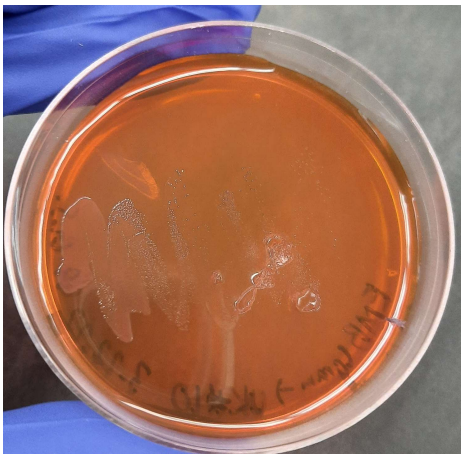
Results for *P. vulgaris* are reported from standard results.

Images

Image 1

SBA Plate: Unknown #31

Image 2

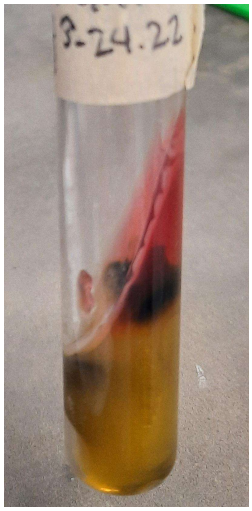


EMB Plate: Unknown #10

Image 3

Bile-Esculin Test: Unknown #31

Image 4



TSI Slant: Unknown #10