

SI Microbiology - Full Discipline Demo

Carbohydrate Fermentation Testing

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Microbiology - Full Discipline Demo
Course	SI Microbiology - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Categorize each statement as true or false.

⚡ The ability to ferment carbohydrates varies in bacteria and is frequently used to differentiate and identify species.	
⚡ Fermentation is indicated by TSI media that turns yellow.	
⚡ Fermentation byproducts increase the pH of unbuffered media.	
⚡ TSI testing is performed using liquid media.	
True	False
1	2

Correct answers:

- 1 Fermentation is indicated by TSI media that turns yellow.

The ability to ferment carbohydrates varies in bacteria and is frequently used to differentiate and identify species.

- 2 Fermentation byproducts increase the pH of unbuffered media.

TSI testing is performed using liquid media.

Match each term with the best description.

⚡ Glucose	A pH indicator used in TSI media	1
⚡ Peptone	Nitrogen source component of TSI media	2
⚡ Lactose	A disaccharide produced by female mammals	3
⚡ Phenol red	A monosaccharide formed by plants and algae through photosynthesis	4
⚡ Fermentation	Anaerobic break down of carbohydrates to produce cellular energy	5

Correct answers:

1 Phenol red 2 Peptone 3 Lactose 4 Glucose 5 Fermentation

Exploration

Byproducts of carbohydrate fermentation include ____.

- ☐ acids
- ☐ alcohols
- ☐ gases
- ☐ All of the above



_____ are the simplest carbohydrates with a general formula of $C_nH_{2n}O_n$.

- ☐ Disaccharides
- ☒ Monosaccharides ✓
- ☐ Acids
- ☐ Peptones

TSI media tubes are inoculated by stabbing a microbe colony into the butt and then streaking the needle across the slant.

- ☒ True ✓
- ☐ False

Aerobic _____ metabolism is demonstrated by media that turns purple-red in the slant portion of the tube.

- ☐ glucose
- ☒ peptone ✓
- ☐ iron
- ☐ sulfur

Exercise 1

Which carbohydrates were present in the TSI media tubes used in this exercise? Describe the characteristics of each in your explanation.

Glucose, sucrose, and lactose were present in the TSI media used in this exercise. Glucose is a monosaccharide produced by plants consisting of six carbon atoms, twelve hydrogen atoms and six oxygen atoms. Sucrose is a disaccharide produced by plants consisting of a glucose and fructose molecule joined together. Lactose is a disaccharide produced by female mammals consisting of a glucose and galactose molecule joined together.

How does the phenol red present in the TSI media permit the observation of both fermentation and aerobic respiration of microbes?

Phenol red is a pH indicator that turns yellow in acidic conditions and purple-red in alkaline conditions. Fermentation of carbohydrates in the TSI media releases byproducts that lower the pH resulting in phenol red turning yellow. Aerobic metabolism of peptones in the TSI media releases byproducts that raise the pH resulting in phenol red turning purple-red.

Did the microbes cultured in this exercise ferment carbohydrates, metabolize peptones, and/or produce hydrogen sulfide? Reference Data Table 1 and Photo 1 in your explanation.

Both *E. coli* and *S. epidermidis* fermented glucose and sucrose/lactose as evidenced by both the butt and slant portions of the media tube turning yellow as referenced in Data Table 1 and Photo 1. Neither microbe metabolized peptones during the 18-24 hour incubation period nor did either produce hydrogen sulfide since the media neither turned purple-red nor black.

Was TSI testing successful in differentiating between *E. coli* and *S. epidermidis*? Reference your results recorded in Data Table 1 and Photo 1 in your explanation.

Yes, TSI testing was successful in differentiating between *E. coli* and *S. epidermidis*. While both microbes fermented glucose and sucrose/lactose, *E. coli* produced gas bubbles in the butt of the media tube whereas *S. epidermidis* did not as recorded in Data Table 1 and Photo 1.

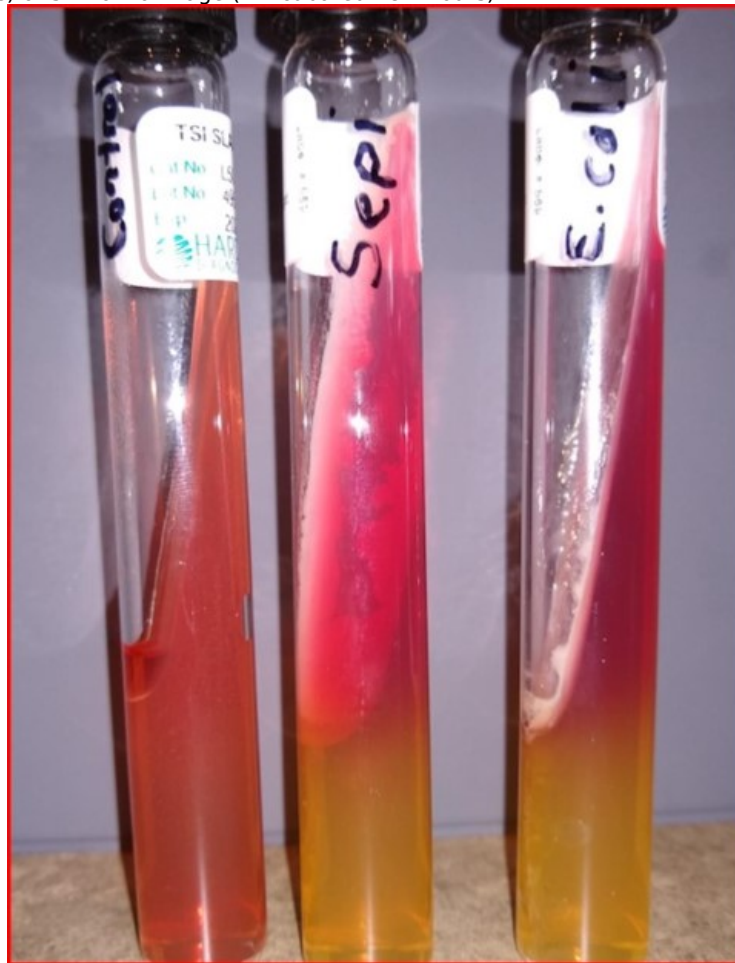
Data Table 1: TSI Test Results
(SAMPLE ANSWER BELOW)

Culture tube	Observations	Symbols	Interpretation
<i>E. coli</i>	Yellow,/yellow with gas bubbles	A/A, G	glucose and lactose and/or sucrose fermentation with gas production
<i>S. epidermidis</i>	Yellow/yellow, no bubbles	A/A	glucose and lactose and/or sucrose fermentation
Control	no change/ no change	NC/NC	No fermentation

Photo 1: TSI Cultures after Incubation

(SAMPLE ANSWER BELOW)

Note to Instructors: example photo of cultures incubated 48+ hours indicating false negative results in aerobic portion of slant. Student results should either appear all yellow (if incubated for shorter periods) or similar to image (if incubated 48+ hours).



Competency Review

_____ is the most abundant monosaccharide and an important energy source for many organisms.

- ☒ Glucose ✓
- ☐ Lactose
- ☐ Sucrose
- ☐ Phenol red

Carbohydrates are composed of carbon, hydrogen, and _____ atoms.

- ☐ chlorine
- ☐ nitrogen
- ☒ oxygen ✓
- ☐ iron

Carbohydrate fermentation produces byproducts that lower the pH of unbuffered media.

- ☒ True ✓
- ☐ False

TSI testing is performed using _____ formulated with glucose, sucrose, lactose, peptone, phenol red, and iron.

- ☒ agar slants ✓
- ☐ agar plates
- ☐ broth tubes
- ☐ diffusion disks

Uninoculated TSI media tubes are typically incubated along with those being tested to serve as controls for color comparisons.

- ☒ True ✓
- ☐ False

Incubated TSI media results are interpreted by ____.

- ☐ color change
- ☐ gas production
- ☐ precipitate formation
- ☒ All of the above

✓

A ____ is used to inoculate TSI media tubes.

- ☐ loop
- ☒ needle
- ☐ swab
- ☐ pipet

✓

Inoculated TSI media tubes should be incubated for at least 48 or more hours before interpreting results.

- ☐ True
- ☒ False

✓

TSI testing results indicate that *E. coli* ____.

- ☐ ferments glucose and lactose/sucrose
- ☐ produces fermentation gases
- ☒ ferments glucose and lactose/sucrose and produces fermentation gases
- ☐ reduces sulfur

✓

Extension Questions

A microbiology student inoculated a TSI media tube by only stabbing the needle into the butt without streaking the needle across the slant. Apply your knowledge of TSI testing to predict how the student's results could be compromised. (SAMPLE ANSWER BELOW)

No microbes would be exposed to aerobic conditions if the student failed to streak the slant portion of the media tube which would prevent the positive results for aerobic peptone metabolism. Failure to streak the slant portion of the tube could potentially prevent positive

results for sucrose/lactose fermentation since there would be no microbes in contact with the slant portion of the agar which should change color in this section when these disaccharides are fermented. Lastly, the student would have no visual confirmation of colony development if the slant surface was not streaked.
