

Name _____

Date _____ Hour _____

DDG Nutrient Testing Student Worksheet

Grade Level: Middle School

Background information

In the United States, commercial production of fuel ethanol involves breaking down the starch present in corn into simple sugars, also called “glucose”. These sugars are then fed to yeast, which begins the process of fermentation. The main product is used as ethanol – it is primarily found as a fuel additive in the gasoline used in our vehicles. Some of the other products include animal feed, corn oil, and carbon dioxide. The remaining nutrients include proteins, fats, minerals, and vitamins that are essential in use in feed for livestock. Our focus is on the nutrient availability of the products before fermentation occurs and after.

We will be using three indicators to test for nutrient availability – Benedict’s Solution, Lugol’s Solution, and Biuret Reagent. Benedict’s Solution will detect the presence of glucose, and it will provide an orange to red precipitate (form a solid) after heating. The Lugol’s Solution (Iodine) will turn black when starch is present. The Biuret Reagent will turn purple when protein is present. This process will allow us to see where the nutrients are available at different times of production of corn products, like ethanol.

Pre-lab Check Questions: Answer the following questions with your partners before beginning the lab.

1. What is fermentation?

2. What role does the yeast play in the fermentation process?

Investigation Question

Which of these, corn slurry (before fermentation) or corn mash (after fermentation), will provide the highest nutritional value to livestock after fermentation has occurred?

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Materials

Corn Mash (4 ml per group)

5 pipettes per station

Test tube rack

Parafilm

Lugol's Solution (Iodine)

Hot plate or water bath

Water (for hot water bath)

Sharpie (for labeling test tubes)

Corn Slurry (4 ml per group)

6 test tubes per station

Test tube holder (for use with hot bath)

Benedict's Solution

Biuret Reagent Solution

Beaker (600 ml) (for water bath)

Tape (for labeling test tubes)

Procedure for Lab

Carbohydrate Indicator Test (Glucose)

1. Label a test tube for corn slurry glucose test, and another test tube for corn mash glucose test.
2. Add 2 ml of corn slurry to a test tube, then add 2 ml of Benedict's Solution.
3. Cover with Parafilm and mix.
4. Place test tube in a boiling water bath for 2 minutes. (Caution: Use a test tube holder as the test tube will be hot to touch).
5. Record color change in the table.
6. Repeat steps 2 - 5 in a new test tube with the fermented corn mash.

Complex carbohydrate Indicator Test (Starch)

1. Label a test tube for corn slurry starch test, and another test tube for corn mash starch test.
2. Add 1 ml of corn slurry in a test tube and add 1 drop of the Lugol's solution.
3. Cover with Parafilm and mix.
4. Do not heat solution.
5. Record color change in the table.
6. Repeat steps 2 - 5 in a new test tube with the fermented corn mash.

Protein Indicator Test (Do not heat; heating will cause the proteins to breakdown which will give a negative test.)

1. Label a test tube for corn slurry protein test, and another test tube for corn mash protein test.
2. Add 1 ml of corn slurry and add 2 ml of Biuret Reagent to a test tube.
3. Cover with Parafilm and gently mix.
4. Wait 30 seconds for a color change.
5. Record color change in the table.
6. Repeat steps 2 - 5 in a new test tube with the fermented corn mash.

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Sample	Carbohydrate Indicator Test (Glucose)	Complex Carbohydrate Indicator Test (Starch)	Protein Indicator Test
Corn Slurry			
Fermented Corn Mash			

Lab Analysis

1. Were your predictions correct?
2. What do the results tell you about what happened during the fermentation process?

Reflection and Conclusion

1. Our livestock are in need of protein. Based on our observations, which solution would best be used for our livestock?
2. Based on our test results, which types of macromolecules are primarily seen after the fermentation process?

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Take it further!

Protein is vital for the health and upkeep of livestock. Do some research to compare the different benefits between using distillers grains (wet (WDG) or dried (DDG)) to other corn based feeds in the daily diet of livestock. Look for the topics below during your research. Write a two-paragraph summary or your findings.

- Cost of feed
- Availability of feed
- Nutrient supply

Science and Agriculture Careers

These are a few of the careers that would apply to this type of laboratory specialty. Do a little research and write a short summary on one that would interest you. You may even find one not on the list.

- Agricultural Inspector
- Agricultural Specialist
- Chemist
- Food Specialist
- Soil and Plant Scientist
