Macromolecules in animal feed

Focus questions	What are the differences in the macromolecules content of different animal foods? How do the amounts differ for different animals?
Vocabulary	Monosaccharide, starch, protein, lipid

Animal foods are developed by animal nutritionists to meet the requirements of specific animals. Most animals, just like humans, need carbohydrates, lipids and protein. However, the stage of life and the activity of the animals will determine how much of each is required. Animal feed companies spend more than $1 billion each year to advertise over 2,000 separate brands. As consumers, we see mainly dog and cat food commercials, but there are many different kinds of pet foods. Livestock feed is also a large market.

Chickens, pork, cattle, dairy, fish and goats all require feed to grow and produce eggs, milk and meat. Corn is the largest ingredient of animal feed, while other coarse grains, soy and wheat, also contribute significant amounts to animal feed.

Materials

- Various animal foods (i.e., fish, turtle, cat, dog, rabbit, cattle, chicken, pig/hog, goat, etc.)
- Benedict's solution (or glucose strips)
- Sudan III
- Iodine
- Protein strips or Biuret solution
- Coffee grinder
- Balance
- Distilled water
- Mortar and pestle
- Filter paper
- Funnel
- Small beaker
- Test tube
- Test tube holder
- Hot plate
- Cell well plate
- Beaker with water for water bath
- Vortex (optional)

Procedure

Macromolecule testing

1. Weigh out 5g of sample using an electronic balance. Place sample into a mortar.
2. Add 20 mL of distilled water to the food sample in the mortar. Grind sample with a pestle into a slurry.
3. Filter slurry using filter paper and funnel. Collect liquid food sample into a small graduated cylinder or beaker.
4. Use the filtrate to complete the Carbohydrate Indicator Tests and the Protein Indicator Test.

Monosaccharide indicator standard test (glucose)

1. Add 2 mL of food sample solution with 2 mL of Benedict's solution in a test tube.
2. Use Vortex to give sample a quick mix (or cover with parafilm and invert test tube). Record sample color in data chart.
3. Place test tube containing food sample and Benedict's solution in a boiling water bath and heat for 2 minutes. Record sample color in data chart.
4. The glucose present in the solution reacts with the copper sulfate in the Benedict's reagent creating copper oxide, which results in an orange to red-brick precipitate. The intensity of the color depends on the concentration of glucose present in the sample.
5. Rate the precipitate color change and record sample data in the chart.
   0: no color change/negative, 1: weak/positive, 2: strong/positive, 3: very strong/positive
6. Alternatively, add 1 mL of the whole milk sample to a test tube with the matching label.
7. Dip the test glucose test strip into the dairy samples for 1–5 seconds.
8. Wait 5 minutes and compare the color of the test strip to the color chart.
9. Record sample color in data chart.
10. Repeat this process with the remaining samples.

Complex carbohydrate indicator standard test (starch)

1. Add 1 mL of food sample solution with 1 drop of Lugol's iodine solution in a test tube or cell well plate.
2. Use a vortex to give the sample a quick mix (or cover with parafilm and invert test tube). Do not heat!
3. A bluish-black color indicates a positive test for starch.
4. Rate the precipitate color change and record sample data in the chart.
   0: no color change/negative, 1: weak/positive, 2: strong/positive, 3: very strong/positive
5. Keep the sample to observe until day 3 of the lab.

Protein indicator standard test

1. Add 1 mL of food sample solution in a test tube or cell well plate. Dip a protein test strip into the filtrate to compare to the color chart on the bottle.

Lipid indicator test

1. Label the test tubes or cell well plates with sample names.
2. Add 1 mL of sample to corresponding labeled tubes or wells.
3. Record the color of each sample.
4. Add 1 drop of Sudan III to each sample. A bright red color indicates the presence of lipids.

Reflection

1. Create a data table that compares the relative amounts of sugar, starch, lipid, and protein in each crop.

2. Record your research information about digestion and metabolism for the animal which the food was developed.

3. Develop a model (could be a physical model using blocks, a flow diagram or animation/video) to show how one of the nutrients is broken down through cellular respiration to create energy for the animal.

Rubric for self-assessment

Skill	Yes	No	Unsure
I completed tests for macromolecules in an animal food.			
I developed a model to show how sugars, starches, lipids or proteins are broken down by animal digestion.			
I can explain how energy is gained by an animal through the process of cellular respiration.			