ANIMAL SCIENCE (MS)

# Fermentation in ruminants

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| **Focus question** | How might we maximize digestion in cows by using energy concentrate byproduct materials in the total mixed ration? |
| **Vocabulary** | Enticer, total mixed ration (TMR), total digestible nutrients (TDN) |

Ruminants can convert feeds unsuitable and unpalatable for humans into milk and meat, and thereby play a key role in food security. Up to 30 percent of a U.S. dairy cow's diet is made up of human inedible "by-product feedstuffs," according to a joint study published by researchers at Kansas State, Texas A&M and Michigan State University (**frontiersin.org/articles/10.3389/fsufs.2019.00114/full**). To offset increases in feed prices, farmers can potentially improve animal performance or feed efficiency by using these feed by-product enticers. While byproducts allow farmers flexibility in putting together diets, they still have to be aware of the basics of ruminant nutrition and put together diets that do not "violate" the rumen. The purpose of this procedure is to investigate which food byproducts can help maintain fermentation rate to increase efficiency of feed for maximized milk production.

## Materials

- Small plastic bottles or flat-bottomed tubes
- Animal feed sample
- Distilled water
- 9-in. balloons
- By-product feedstuffs (Skittles, chocolate, citrus pulp, stale donuts, and/or other bakery products)
- Yeast
- Cellulase
- Measuring tape
- Water bath
- Thermometer
- Timer

## Procedure

1. To an appropriately labeled small plastic bottle/tube, add the following samples using an electronic balance: 1 g of animal feed sample, 3 g of hay, and 1 g of selected feed by-product and replace the lid.
2. Then add the following (digestive enzymes) samples to the labeled tube or bottle: 1 g of cellulase and 2 g of yeast.
3. Using a graduated cylinder, add 20 mL of warm water (39 °C) to the mixture in the bottle/tube, cap, and shake for 30 seconds to incorporate all ingredients.
4. Then remove the plastic cap and place a 9 inch balloon over the top of the bottle. Place the bottle into a water bath set at 39 °C.
5. Once the bottle is placed in the water bath, set a timer for 5 minutes and record the diameter of the balloon, then shake the bottle and replace it back into the water bath. Repeat every 5 minutes for a total of 30 minutes, recording the diameter of the balloon in a data table for each time segment.

6. Repeat steps 1–5 for each trial.
7. Finally, create a graph of the diameter of the balloon over time to examine the fermentation rate of the feed by-product.

### Table 1: Carbon dioxide production of by-product in feed sample over 30 min

| Trials | 5 minutes | 10 minutes | 15 minutes | 20 minutes | 25 minutes | 30 minutes |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| Average | | | | | | |

## Reflection

1. Which by-product created the most energy? Explain your reasoning based on evidence from your experiment or the class data.

2. Which by-product would be best for providing the most energy over the longest period of time? Explain your reasoning based on evidence from your experiment or the class data.

3. When choosing an energy concentrate, which of the substances would be the best for a dairy cow? Explain your reasoning based on evidence from your experiment or the class data.

## Rubric for self-assessment

| Skill | Yes | No | Unsure |
|---|---|---|---|
| I created a model of a mini fermenter. | | | |
| I collected data to determine the best by-product and wrote a CER supported by my data. | | | |
| I explained how the reaction within the model happened. | | | |