

## Using a Microwave Oven to Determine Moisture Content of Forages

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Knowing the moisture content of forages at the time of harvest and storage is essential for making and preserving high-quality hay and silage. Knowing the moisture content of stored forages is also important for accurate ration formulation.

A squeeze test, which involves squeezing forage into a ball and then guessing the moisture content, is a common method of determination. This method is rapid, but lacks precision. Resistance-type moisture testers estimate moisture as a measure of electrical resistance. These devices provide estimates rapidly, but they usually are expensive (about \$200 to \$300) and vary in accuracy. A portable, electric drying unit also is available and is fairly accurate, but it requires at least 30 minutes before readings can be taken.

Using a microwave oven to determine moisture content is advantageous because it provides accurate results in a minimum amount of time using common equipment. The following procedure describes how to use a microwave oven for moisture determination.

### Obtaining Representative Samples

Proper sampling of forage is essential if an accurate determination of moisture or any nutrient is to be obtained. Sampling procedures vary depending upon the type of forage and whether or not sampling occurs pre-harvest or after the forage has been stored.

### Forage in a Windrow Prior to Baling

With a sharp shears, cut 6-inch sections from several locations in the windrow. If the forage is dry, take extreme care to avoid losing leaves. Cut the sections into pieces about 1 inch long and mix samples in a clean container.

### Forage Prior to Silage Harvest

If forage in the windrow or standing corn or sorghum is to be harvested with a forage chopper, several rounds can be chopped from a representative part of the field. Collect small samples from various locations in the forage wagon, and mix thoroughly in a clean container. As an alternative method, a representative sample of standing forage can also be cut off, run through a chipper, and then a sub-sample of the chopped material used for moisture testing.

### Hay Bales

Use a hay probe to collect samples. For large round bales the probe should be inserted from the rounded side into the center of the bale. Square bales should be probed from the middle of the butt end. More detailed instructions on sampling baled hay can be found on a video "Forage Hay Sampling Method" produced by SDSU Extension and available at: <https://www.youtube.com/watch?v=uQT8w7bHfuA>.

### Silage

In bunker silos, piles, or bagged silage, collect about 2 gallons of silage by taking handfuls at random from about 10 different locations and mix them in a clean container. Silos with unloaders can be sampled by passing the container beneath the chute several times, collecting 1 or 2 quarts at each pass until a 2-gallon sample is collected. Then mix the sample thoroughly in a clean container.

### Procedure for Determining Moisture

The equipment needed for this procedure includes a small scale, paper plate, a glass of water, and a microwave oven. The accuracy of the results depends

on the type of scale used. A dietician's scale measuring in grams will give reasonably good results. These balances are available at many general supply stores and can be purchased economically. Avoid scales that are designed to weigh heavy objects and weigh only to the nearest 1/4 or 1/2 pound. Ideally the scale would weigh to the nearest 1.0 gram for the most accurate results.

The procedure for determination of moisture content with the microwave oven is as follows:

1. Place an 8 ounce glass, three-fourths full of water, in the back corner of the microwave oven. This will protect the oven magnetron when sample moisture is low. The water should be changed as necessary to prevent boiling over.
2. Dry a paper plate on high power for 1 1/2 to 2 minutes. Immediately weigh the dry plate.
3. Weigh about 100 grams of the forage sample and spread evenly on the plate.
4. For dry legume or grass samples (< 35% moisture), dry initially for about two minutes at 50% power. Then weigh and record sample weight. Gently stir the sample and place it in the oven for another 30 to 60 seconds at 50% power. Again remove and weigh the sample. If the weight has not changed more than 2 grams, use this value. If the change is greater than 2 grams, continue drying using additional 30 second intervals at 50% power until the weight change is less than 2 grams.
5. Haylage or silage samples (50 to 75% moisture) require a much longer time for the drying process to be completed. Initially dry samples for about 4 minutes at 50% power. This step may need to be repeated several times. Check the samples frequently and as the sample dries substantially, drying periods can be shortened to 1 minute intervals. The sample is considered dry if the weight change between dryings is less than 2 grams.
6. Be careful not to char the sample. If this occurs, it means that the oven was set too high, the drying

time was too long, or both. Discard the charred sample and repeat the test. Experience will tell you how much drying time your samples require.

**Do not leave samples drying in the microwave unattended.**

7. Use the following equation to calculate the moisture content.

Example calculation:

- (A) Paper plate weight= 10 grams
- (B) Wet sample weight + paper plate = 110 grams
- (C) Dry sample weight + paper plate = 80 grams

$$\begin{aligned} \text{Percent moisture} &= \frac{\text{moisture lost}}{\text{sample weight}} \times 100\% = \frac{B - C}{B - A} \times 100\% \\ &= \frac{110 \text{ grams} - 80 \text{ grams}}{110 \text{ grams} - 10 \text{ grams}} \times 100\% \\ &= \frac{30 \text{ grams}}{100 \text{ grams}} \times 100\% \\ &= 30\% \end{aligned}$$

$$\text{Percent dry matter} = 100\% - 30\% = 70\%$$