



Use of Microwave Drying to Determine Moisture (Dry Matter) in Forage

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INTRODUCTION

Knowing the moisture (dry matter) content of forage at time of harvesting and storage is essential for making and preserving high quality silage and hay as well as accurate formulation of rations. Hay harvested and stored at too high a moisture content will result in spoilage and possible spontaneous combustion. Harvesting hay when it is too dry results in excessive leaf loss and reduced feeding value in addition to the dry matter loss. Harvesting forage for silage at too high or too low a moisture content results in improper fermentation which reduces feeding value.

Squeeze tests are not very accurate for estimating forage moisture content while making hay or silage. Electronic devices are available for rapid moisture determination of forage but these devices are expensive, of varying accuracy, and of questionable value. Oven-type testers are also available but they are too slow for determining the moisture content of forage because under good drying conditions, the moisture level of the forage in the field may have changed substantially before the test is completed.

Below we show how a microwave oven can be used to determine the moisture content in forages in a matter of minutes with an accuracy close to that obtained by accepted research methods.

HOW TO USE THE MICROWAVE OVEN IN MOISTURE DETERMINATION

All that is needed is a small scale, paper plate and a microwave oven. The accuracy of the results are dependent upon the quality of scale used. A \$25 diet scale, measuring in grams, will give reasonably good results although an \$80-100 balance scale weighing to 1/10 of a gram is preferred. This type of balance is available from most farm catalog supply houses.

The moisture determination procedure is as follows:

- 1) Place a preweighed large paper plate (9 inch minimum) on the scale and weigh out exactly 100 grams of the forage prepared as outlined in the following section. A smaller sample can be used but the 100 grams makes for easier calculations.
- 2) Spread the forage evenly on the paper plate.
- 3) Place an 8 oz water glass, three-quarters full of water, in the back corner of the microwave oven; keep water level constant during oven use. This will protect the oven magnetron when sample moisture is low. The setting of adjustable microwave ovens should be 80 to 90 percent of maximum power.

- 4) Samples of wet legumes and/or grasses in the 50 to 70 percent moisture range should be dried initially for eight minutes. Then weigh and record sample weight. Replace in the oven for another minute, remove and weigh. If the weight has not changed more than one gram, use this value. If the change is greater than one gram, continue drying additional one-minute segments until the weight changes less than one gram. For greater accuracy, continue drying until the weight change is less than 0.5 gram per minute.

For forage with a moisture content of 25 to 30 percent, an initial drying time of four minutes should be used. Then weigh the samples following the same procedure as for the wet forage above using one minute drying intervals until the weight change is less than one gram. If greater accuracy is desired, for example in ration formulation, continue the one-minute drying intervals until the weight change is less than 0.5 gram.

- 5) Be careful not to char or burn the sample. If this occurs, it means the oven was set too high, the drying time was too long, or omission of 3/4 glass of water in rear of microwave oven. Discard the charred sample and repeat the test.
- 6) Use the following equation to calculate the moisture content. Keep in mind, since the wet weight and dry weight include the weight of the paper plate (unless scale can be tared to 0 with paper plate on scale), the weight of the paper plate must be subtracted from the wet and dry weight before making the following calculations.

$$\% \text{ moisture} = \frac{\text{wet weight} - \text{dry weight}}{\text{wet weight}} \times 100$$

If you have a scale which permits you to tare the paper plate (adjust the scale to 0 with the paper plate on the scale), the percent moisture can be calculated simply by subtracting the final sample (dry) weight in grams from 100 grams (the original wet weight). The final dry weight is the dry matter content of the sample.

OBTAINING A REPRESENTATIVE SAMPLE

Proper sampling technique is essential if an accurate moisture content is to be obtained. The procedure for obtaining samples of various types of forage are as follows:

Forage in Windrow

Care must be taken to obtain a representative sample from windrows. Avoiding “slug” areas and “very thin” areas, cut a 6 inch section from several locations in the windrow. If the windrow is dry, extreme care must be taken to avoid losing the leaves. Take one-half of the total sample and cut into 1/2 to 1 inch sections for use in the moisture determination.

If the forage in the windrow is to be harvested with a forage chopper, a few hundredweights of forage can be chopped from the windrow of a representative part of the field. A small sample is then collected from various locations in the forage wagon and blended thoroughly for use in the moisture determination.

Hay

The Penn State Forage Sampler (probe) is preferred for sampling hay. Your county agent may have one of these hay probes. This hay probe may be purchased for about \$40 from NASCO, Inc., 901 Janeville Avenue, Fort Atkinson, WI 53538. The probe can be attached to an electric drill or brace. A probe can be made by serrating one end of a 1 inch hollow tube 18 inches long. All hay probes must be kept sharp so that they will cut through, rather than slide past hard stems. Composite sample should be placed in sealed plastic bags until moisture determination is made.

Sampling Conventional Square-Baled Hay Choose at least 12 average looking bales from a lot of hay as best you can to represent the entire lot. Take one core drilling from the end of each of the 12 bales. Place all 12 drillings together in a container (e.g., a clean pail or box), thoroughly mix them for use in the moisture determination. Repeat this procedure for each lot for which moisture content is to be determined. If a bale probe is not available, reach inside each of the dozen bales and carefully remove one handful of material so as not to destroy the leaves. Then with a knife or shears, cut into strips of 2-inch lengths. Mix these samples from all 12 bales for the moisture determination.

Sampling "Big Package" Hay (Large Round Bales or Stacks) For each lot of big package hay, take a sample from two different parts within each of 6-10 bales or stacks. Stacks should be probed from the top, large round bales from the sides (not the ends). Combine and mix the drillings for the moisture determination.

If you do not use a bale probe, sample the large round bales by hand as described for conventional square bales, except that two or three handfuls should be taken from each large package rather than a single handful.

Sampling Loose, Stacked Hay Obtain samples from at least 12 random locations. To make bale probe drillings, stand on the stack and vertically probe where the hay has been compressed between your feet. Without a bale probe, draw the samples as suggested for big package hay.

Silage

Method of sampling for moisture determination will depend upon the type of silo(s) being utilized. In vertical or horizontal silos, collect about 2 gallons of silage by taking handfuls at random from 10 different locations of freshly exposed surface, and mix them in a clean box or pail. The silage unloader may also be used to collect a sample. This is done by passing a container beneath the chute several times (once each minute), collecting 1 or 2 quarts at each pass until a 2-gallon sample is collected. This sample should be thoroughly mixed for the microwave moisture determination.

Samples may also be obtained at time of filling silos by collecting random samples from the forage wagons as they are being emptied into the silo. Whether sampling at the time of filling or unloading a silo, the samples should be placed immediately into plastic bags until the samples are analyzed for moisture content.