



DETERMINING MOISTURE CONTENT OF ALFALFA Using A Microwave Oven

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A knowledge of the moisture content (mc) of alfalfa can assist a farmer in performing such operations as cutting, raking, mowing, ensiling and storing. When alfalfa is cut, it is about 80% mc. Then it can be dried in swaths to 40 to 50% mc, and raked into windrows for further drying down to 15 to 20% mc, at which level it can be baled. For safe storage, alfalfa must be dried to a moisture level of 20% or less, measured on a wet basis (wb).

Properly ensiled forages provide excellent feed; but, the greatest single factor leading to poor preservation is the moisture level at which the forage goes into the silo. A horizontal or bunker silo requires a hay crop of 60 to 72% mc. A sealed concrete silo requires hay of 40 to 50% mc.; a Harvestore silo, 40 to 45% mc; and an upright, open-top silo requires hay of 50 to 70% mc.

Measuring Techniques

A crude technique of estimating the moisture level is squeezing the alfalfa and making a guess using past experience, but this could easily induce errors and result in excess leaf loss (over-dried) or spoilage (under-dried). A more accurate method is drying the alfalfa in an oven at 103°C for about 25 hours; but this is expensive and time-consuming. Moreover, on a hot day, the moisture content of the alfalfa in the field could be substantially lower at the end of half-an-hour drying period than the sample was initially. A microwave oven, however, can be used to estimate moisture levels of alfalfa in just a few minutes.



Figure 1. A microwave oven used to estimate moisture levels of alfalfa hay samples

Microwave Measurement Procedure

1. For ease of calculation, weigh out 50g or 100g (depending on the size of the microwave oven) of freshly cut alfalfa. (The alfalfa may be chopped into lengths of 3 to 5 cm (1 to 2 in) for more convenient handling.)
2. Put the alfalfa sample into an oven-proof or heat-resistant glass or ceramic dish large enough to allow the sample to be spread into a thin layer to promote even drying, but not so large as to restrict heat circulation in the oven (Figure 1).
3. Place the dish of alfalfa into the microwave oven and heat for about 6 minutes, remove from oven and reweigh. If the alfalfa does not seem to be completely dry, replace in the oven and heat for another 2 minutes. Reweigh. If in doubt, dry for another 2 minutes and reweigh. If any charring has occurred, use the previous weight for calculating the moisture content. Be sure to mix the sample and rotate the dish each time it is replaced in the oven.

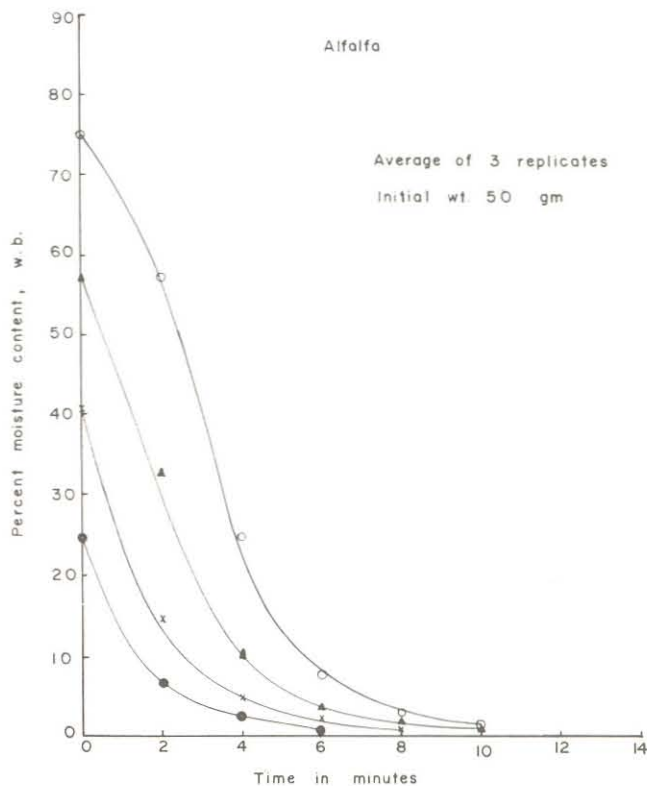


Figure 2. Drying curves for alfalfa

Calculation of Moisture Content

If the sample is weighed before and after heating in a microwave oven, and, if it is assumed that the heating would remove all of the moisture, then

$$\% \text{ mc} = \frac{W_1 - W_2}{W_1} \times 100$$

where, W_1 = weight of sample before heating
 W_2 = weight of sample after heating

Example Assume an alfalfa sample weighing **100g** before heating and **25g** after heating.
 $\% \text{ mc of initial sample} = \frac{100 - 25}{100} \times 100 = 75\%$

Figure 2 gives an indication of the drying rate of alfalfa samples of various initial moisture contents heated in a microwave oven and reweighed every 2 minutes. Needless to say, the percent mc after 6 minutes of continuous drying will be slightly lower than the figure indicated in Figure 2; however, the greatest moisture loss in either case occurs during the first 6 minutes.

For comparative purposes, Table 1 shows that the average initial mc of alfalfa as determined by three different techniques was quite close; hence, it is feasible as well as convenient to determine the moisture content

of alfalfa using a microwave oven before harvesting or storing the crop.

Table 1. Average initial moisture content of alfalfa as determined by different techniques

Material	Experiment number	Conventional drying	Step-wise* drying in microwave oven	Continuous** drying in microwave oven
Alfalfa (50 gm sample)	1	—	24.5	26.0
	2	43.8	41.1	42.8
	3	56.3	56.1	55.9
	4	76.8	74.5	74.1

* *Step-wise drying indicates drying in two minute steps. Sample was mixed at the end of each step. Total period of drying: eight or ten minutes.*

** *Total period of drying: eight to ten minutes.*

The results given in Table 1 were obtained by using a microwave oven with output power of 700 watts and frequency of 2450 MHz. Its cavity (inside) dimensions were 40 x 24 x 42 cm. Output power of different microwave ovens would differ and hence slight variation in the result is expected. The farmer can easily establish the drying period with a little experience.