



# Evaluating forage quality by visual appraisal, pH, and dry matter content

**Jud Heinrichs and Virginia Ishler**



Department of Dairy and Animal Science  
The Pennsylvania State University  
324 Henning Building  
University Park, PA 16802  
(814) 865-5491 • FAX (814) 865-7442  
[www.das.psu.edu/teamdairy/](http://www.das.psu.edu/teamdairy/)

---

**Topics Include:**

Activity 1: Visual appraisal of feeds  
Activity 2: pH determination of forages  
Activity 3: Determining forage dry matters

# ACTIVITY 1 - VISUAL APPRAISAL OF FEEDS

---

The first step in evaluating forage and feed quality is to examine them visually for certain criteria. In this exercise several samples of haylage, corn silage, high moisture grain, and dry hay should be available for appraisal. It would be ideal if the samples came from various storage structures (i.e. bunker, upright, bag). Answer the following questions pertaining to the appropriate samples.

## Haylages

---

1. What stage of maturity were these haycrop forages harvested? Consider the leafiness or steminess of the samples. Is the sample mostly grass or alfalfa? Do you think the moisture content is appropriate for the type of storage structure? Is there any evidence of mold?

Haylage 1	Haylage 2
Haylage 3	Haylage 4

2. Do you consider the length of cut to be too fine, just right, or too coarse for ensuring proper fermentation? For good rumen health?

Haylage 1	Haylage 2
Haylage 3	Haylage 4

3. How would you describe the odor of these forages? Strong acid? High ammonia? Vinegar? Alcohol?

Haylage 1	Haylage 2
Haylage 3	Haylage 4

### Corn silages

1. Examine the amount of grain present in the silage. Does there appear to be a lot, not much, or typical amounts of grain in the silage? Is the grain present hard or soft? Do you think the moisture content is appropriate for the type of storage structure? Is there evidence of any mold?

Corn silage 1	Corn silage 2
Corn silage 3	Corn silage 4

2. Do you consider the length of cut to be too fine, just right, or too coarse for ensuring proper fermentation? For good rumen health?

Corn silage 1	Corn silage 2
Corn silage 3	Corn silage 4

3. How would you describe the odor of these forages? Strong acid? High ammonia? Vinegar? Alcohol?

Corn silage 1	Corn silage 2
Corn silage 3	Corn silage 4

### High moisture shelled corn

1. Evaluate the dry matter, odor, and particle size of the two samples.

High moisture corn 1

High moisture corn 2

### Dry hay

1. Evaluate the following hay samples for stage of maturity, leafiness, color, and moldiness.

Hay 1

Hay 2

**Table 1. Suggested dry matter levels for ensiling high moisture ingredients.**

		Range (%)
<b>Grains</b>		
Shelled corn:		
	Kernel dry matter	70-75
	Whole-ear dry matter	65-70
Ear corn:		
	Kernel dry matter	65-75
	Whole-ear dry matter	60-70
Small grains		65-75
<b>Forages</b>		
Haycrop silage:		
	Oxygen-limiting	45-60
	Conventional tower silos	35-40
	Horizontal silos	30-35
	Balage	40-60
Corn silage:		
	Oxygen-limiting	40-45
	Conventional tower silos	32-37
	Horizontal silos	30-35

**Table 2. Recommended forage particle sizes using the Penn State Separator.<sup>1</sup>**

Screen	Particle Size (inches)	Corn Silage	Haylage	TMR
Upper Sieve	> 0.75	3 to 8%	10 to 20%	2 to 8%
Middle Sieve	0.31 to 0.75	45 to 65%	45 to 75%	30 to 50%
Lower Sieve	0.07 to 0.31	30 to 40%	20 to 30%	30 to 50%
Bottom Pan	< 0.07	< 5%	< 5%	≤ 20%

<sup>1</sup> Portion remaining on the screen

**Table 3. Troubleshooting common silage problems.**

<u>Visual problem</u>	<u>Possible cause</u>
Caramelized dark brown kernels.	Generally kernels are a dark brown color caused by entrapment of oxygen during filling or air leaks in the silo. This indicates a high heat of fermentation.
Dark colored haylage with a cooked or tobacco smell.	Excessive heat damage favored by high dry matter content, oxygen not eliminated, too long a chop, or poor compaction.
Moldy silage	Molds grow in the presence of oxygen and crops. Favored by slow filling, slow feed out, too long a chop, poor distribution and packing, and air infiltration in the structure.
Rancid odor	Generally caused by clostridial fermentation with the production of butyric acid. Favored by low dry matter content, and low plant sugar content.
Vinegar odor	Fermentation dominated by bacteria, which ferments sugars to acetic acid. Favored by low dry matter content, and low soluble plant sugar content.
Alcohol odor	Fermentation dominated by yeast, which ferments sugars to alcohol. Favored by slow feed out, air penetration, and limited plant sugar content.

Source: Adapted from the Pioneer Forage Manual: A Nutritional Guide.

## ACTIVITY 2 - pH DETERMINATION OF FORAGES

---

Determining forage pH can reveal some aspects related to the type of fermentation that has taken place and the forage quality. It can also give clues to what may have gone wrong during the ensiling process if the pH is too high. Listed below are the ideal ranges for pH of various crops at different dry matter contents.

Expected range in pH for ensiled crops	
<u>Crop</u>	<u>pH range</u>
Corn silage	
25% DM	3.5 - 3.9
30% DM	3.8 - 4.1
35% DM	3.9 - 4.3
Legume silage	
<30% DM	4.6 - 5.5
30-35% DM	4.6 - 5.1
>35% DM	4.6 - 5.2
Grass silage	
<30% DM	4.3 - 4.8
30-35% DM	4.3 - 4.7
>35% DM	4.4 - 5.0

Determine the pH on the following forages:

Haylage 1 - pH \_\_\_\_\_

Haylage 3 - pH \_\_\_\_\_

Haylage 2 - pH \_\_\_\_\_

Haylage 4 - pH \_\_\_\_\_

Corn silage 1 - pH \_\_\_\_\_

Corn silage 3 - pH \_\_\_\_\_

Corn silage 2 - pH \_\_\_\_\_

Corn silage 4 - pH \_\_\_\_\_

Have any of the above forages undergone an undesirable fermentation?

## ACTIVITY 3 - DETERMINING FORAGE DRY MATTERS

Ensiling forages at the proper dry matter content is important for a proper fermentation to occur. The ideal forage dry matter content is highly dependent on the type of storage structure being used. Monitoring dry matter is not only important prior to ensiling but also when the forage is being fed out. The following exercise will focus on how to use a microwave oven to dry forage samples.

Guidelines for using a microwave oven in determining dry matter contents. Some steps to ensure accuracy when using a microwave include:

1. Use the full power setting.
2. Limit the size of the sample to less than 50 grams.
3. Short time intervals when drying help prevent samples from burning.
4. Keep sample spread out as thinly as possible to promote uniform heating.
5. Samples do not have to be cooled before weighing.
6. Puncture grain kernels in corn silage and high moisture grains to ensure a more complete drying.
7. Do not place a glass of water in the microwave with the sample. It will end up adding moisture back to the sample from it boiling and steaming.

Listed below are some suggested guidelines for drying times. Times will vary depending on sample size.

Corn silages	<40% DM	Haycrop forages	<40% DM	>40% DM
Initial drying time	1:30 minutes	Initial drying time	1:00 minutes	0:50 seconds
Second drying time	0:45 seconds	Second drying time	0:35 seconds	0:40 seconds
Third drying time	0:35 seconds	Third drying time	0:25 seconds	0:25 seconds
Fourth drying time	0:30 seconds*	Fourth drying time	0:15 seconds*	0:15 seconds*

\*After each drying time, feel sample for moisture content; the sample should get more brittle with each subsequent drying time. After the fourth drying time, weigh sample on scale and record weight. Place sample in microwave for another 10 to 20 seconds, weigh sample again. Continue this process until the sample weight does not change.

Recording forage dry matter values:

Forage: \_\_\_\_\_ Initial weight: \_\_\_\_\_

Final weight: \_\_\_\_\_

(Dry matter % = Final weight ÷ Initial weight x 100) Dry matter % \_\_\_\_\_

-----

Forage: \_\_\_\_\_ Initial weight: \_\_\_\_\_

Final weight: \_\_\_\_\_

(Dry matter % = Final weight ÷ Initial weight x 100) Dry matter % \_\_\_\_\_

-----

Forage: \_\_\_\_\_ Initial weight: \_\_\_\_\_

Final weight: \_\_\_\_\_

(Dry matter % = Final weight ÷ Initial weight x 100) Dry matter % \_\_\_\_\_

-----

Forage: \_\_\_\_\_ Initial weight: \_\_\_\_\_

Final weight: \_\_\_\_\_

(Dry matter % = Final weight ÷ Initial weight x 100) Dry matter % \_\_\_\_\_

-----

Forage: \_\_\_\_\_ Initial weight: \_\_\_\_\_

Final weight: \_\_\_\_\_

(Dry matter % = Final weight ÷ Initial weight x 100) Dry matter % \_\_\_\_\_

-----

Forage: \_\_\_\_\_ Initial weight: \_\_\_\_\_

Final weight: \_\_\_\_\_

(Dry matter % = Final weight ÷ Initial weight x 100) Dry matter % \_\_\_\_\_

The second part of this exercise will illustrate the significance of how dry matter changes in forage can affect the pounds of forage dry matter intake.

A herd in southeastern Pennsylvania was feeding a one group total mixed ration consisting of haylage as the only forage source and a complete grain mix as the concentrate source. The ration developed was a 50:50 forage to concentrate ratio on a dry matter basis. For the average cow, the program called for 50 pounds of haylage and 26 pounds of grain mix as-fed. This herd was part of a field trial where forage dry matters were determined on a weekly basis. Assume this producer did not account for dry matter changes in the haylage over the following three weeks and continued to use the formula of 50 pounds of haylage as-fed during weeks 2 through 4. Compare the differences in haylage dry matter intake.

**Week 1**

50 lbs. X     .46     % haylage DM as a decimal =            haylage DM lbs.

**Week 2**

50 lbs. X     .39     % haylage DM as a decimal =            haylage DM lbs.

**Week 3**

50 lbs. X     .33     % haylage DM as a decimal =            haylage DM lbs.

**Week 4**

50 lbs. X     .36     % haylage DM as a decimal =            haylage DM lbs.

1. What type of problems would you expect to see happen in animal performance with these changes in forage dry matter intake?
  
  
  
  
  
  
  
  
  
  
2. If the recommendation of the ration program were for cows to consume 23 pounds of haylage dry matter, how much haylage would need to be fed on a wet basis during weeks 2 through 4 to meet the required forage dry matter intake?

---

This publication is available in alternative media on request.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. The Pennsylvania State University does not discriminate against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Direct all inquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 201 Willard Building, University Park, PA 16802-2801; tel. (814) 863-4700/V, TDD (814) 865-1150/TTY.

Where trade names appear, no discrimination is intended, and no endorsement by Penn State's College of Agricultural Sciences is implied.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.