The Future of Forage Testing and Markets

Daniel H. Putnam, PhD
Department of Plant Sciences
University of California, Davis
If we don’t change direction soon, we’ll end up where we’re going...
What are some key changes in the Alfalfa Industry that are pertinent to the way we test hay?
Growth in Western Milk Production, 1970-2012

Percent of 1970:
Total Milk: 454%
Cow Numbers: 215%
Production/Cow: 209%

(17.4% of US)
Phenomenal increase in Production/cow

US Production/Cow

\[ y = 2.2329x^2 - 8579x + 8 \times 10^6 \]

\( R^2 = 0.9963 \)

2.9% increase/year since 1970
Alfalfa Production has not kept up.

Growth in Dairy and Alfalfa - California

\[ y = 0.0018x^2 - 7.0958x + 6968.4 \]
\[ R^2 = 0.9976 \]

\[ y = 0.0016x^2 - 6.1573x + 6104.2 \]
\[ R^2 = 0.9348 \]
### Most Hay is Bought/Sold:

<table>
<thead>
<tr>
<th>Results of 381 Responses</th>
<th>Percent Respondents</th>
<th>Percent of Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearly 100% Sold off-farm</td>
<td>51.2%</td>
<td>70.8%</td>
</tr>
<tr>
<td>75% sold, 25% fed on-farm</td>
<td>11.3%</td>
<td>8.2%</td>
</tr>
<tr>
<td>50% sold, 50% fed on-farm</td>
<td>7.3%</td>
<td>2.2%</td>
</tr>
<tr>
<td>25% sold, 75% fed on farm</td>
<td>6.6%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Nearly 100% is fed on my farm</td>
<td>23.6%</td>
<td>17.4%</td>
</tr>
</tbody>
</table>

(Survey, October, 2011)
Less Alfalfa in the Ration

Average Pounds of Alfalfa Hay Fed Per head/per Day to Milk Cows in California, 2003-2013

Year

Source: CDFA Dairy Marketing Branch  *1st quarter 2013  **2nd Quarter 2013
Long Distance Trade

ALFALFA HAY EXPORTS 2001-2012

Volume of Exports (% of 2001)

1999 2001 2003 2005 2007 2009 2011 2013

268% of 2001
12.5% of western alfalfa
New Genetics

Low Lignin Trait—2011-2012 (four locations)

Lower % Lignin

Improved Quality

No difference in RFV, NDF

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Peter Reisen, FGI Int’l data
Changes—

- Phenomenal increase in production/cow
- Long distance sales - hay exports
- Competition of alfalfa with silage in ration
- Genetic innovation (lignin, protein)
- Transition from ‘lowly pasture’ to cash crop

100 years

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What are the implications for Testing?

- Continuing Demand for Rapid Quality Evaluations
- Different Roles for energy, protein, functional fiber for higher producing cows
- More sophisticated analysis of ‘fractions’ of alfalfa
- Challenge to existing systems
Currently: A Fiber-based Marketing system

- RFV Method
  - Essentially 100% related to NDF alone

- TDN Method
  - Exactly 100% related to ADF alone

- In the US we have a **Fiber-Based Marketing System**

- Protein Minimum (exports)
IDEALIZED FIBER-VALUE CURVE

PRICE OR VALUE $/ton

Supreme → Premium → Good → Fair → Utility

Decline?

Area of concern

ADF (%)

55.9 54.5 TDN (%) 52.5 50.5

34 36 NDF (%) 40 44

30

24 26 28 30 32 34 36

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The Challenge:

- Markets have demanded low fiber hays yet, at low feeding levels, alfalfa is being fed as much for its effective fiber as for its energy.
- Current RFV and TDN system will not detect new genetic quality traits, nor reflect intake.
- Our current ‘low fiber only’ RFV and TDN way of marketing miss important, dynamic aspects of quality-usually at a disadvantage to sellers.
What to Test?

Ask the cow

Ask a nutritionist
But don’t ask too many nutritionists
Changing Concepts of Forage Quality Prediction

Subjective Evaluation (color, odor)

Proximate Analysis, Crude Protein

Crude Fiber, Modified Crude Fiber

Detergent Fiber System (CP, ADF/NDF, TDN, RFV)

Summative Equations – Using Rate Related or Digestibility estimates
A consensus approach

- Not all nutritionists agree what’s important.
- However, their opinions make up the sum-total of demand based upon scientific analysis of quality.
- Seek the key analyses which are the highest priority.
What is Quality Hay?

Most Nutritionist would say:

1. Total Digestible Energy (TDN, NEL, Total potential biological energy of forage)
2. Energy per unit time (Intake Potential)
3. Effectively Absorbed Protein (both rumen available and rumen undegradable)
4. Nutritionally Effective Fiber (physical value)
5. Mineral Content (ion balance)
Note: Needs for Testing are Different:

**Markets:**
- Must be Simple
- Within Commodity
- Few Analyses
- Repeatability
- Relation to animal performance
- Between Buyer & Seller

**Ration Balancing:**
- Can be Complex
- Between Commodities
- Many Analyses
- Repeatability
- Must Predict Animal Performance
- Within an economic Unit

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NEL (energy) is 65% of total value of alfalfa

NDF, lignin and ash are most important measurements
- DM, Ash, aNDF, and NDFD, and CP are the key analyses to consider
- Effective fiber (eNDF)
- Indigestible NDF (iNDF) may be of interest, and the future is digestion kinetics
Low NDF hays are still important.
However, need fiber and particle size for good rumen function and health.
NDFD and lignin are helpful.
Survey of Nutritionists:

33 Respondents: Ave. 62,000 animals
9 States, predominately Western – all reported multi-state duties

They said:

- 81% economic value should be based upon lab value, rest upon visual observation
The key analyses for alfalfa were seen to be:

- DM
- NDF or ADF
- CP
- NDFd
- Ash
Alfalfa:

- Is it a good idea to use digestibility data (NDFD or IVDDM) for marketing of alfalfa hay? (choose the answer closest reflects your view)
  - Yes, it helps to differentiate quality (17%)
  - Yes, but labs need to work on standardization (70%)
## Current USDA Hay Quality Guidelines*

<table>
<thead>
<tr>
<th>Category</th>
<th>ADF</th>
<th>NDF</th>
<th>RFV</th>
<th>TDN (90)</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supreme</td>
<td>&lt;27</td>
<td>&lt;34</td>
<td>&gt;180</td>
<td>&gt;55.9</td>
<td>&gt;22</td>
</tr>
<tr>
<td>Premium</td>
<td>27-29</td>
<td>34-36</td>
<td>150-180</td>
<td>54.5-55.9</td>
<td>20-22</td>
</tr>
<tr>
<td>Good</td>
<td>29-32</td>
<td>36-40</td>
<td>125-150</td>
<td>52.5-54.5</td>
<td>18-20</td>
</tr>
<tr>
<td>Fair</td>
<td>32-35</td>
<td>40-44</td>
<td>100-125</td>
<td>50.5-52.5</td>
<td>16-18</td>
</tr>
<tr>
<td>Utility</td>
<td>&gt;35</td>
<td>&gt;44</td>
<td>&lt;100</td>
<td>&lt;50.5</td>
<td>&lt;16</td>
</tr>
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*USDA Market News. Guidelines are based upon Visual Analysis as well as test results.
Revised Core Tests for Alfalfa:

**Core Quality Analysis:**
- DM – Not for quality – but for yield
- NDF - Neutral Detergent Fiber
- CP - Crude Protein
- NDFd – NDF digestibility
- Ash

**Additional Analyses:**
- Lignin – Many nutritionists value lignin
- DCAD – Close up animals

**Calculate:**
- TDN (new national NEL or TDN).
- RFV, RFQ, TDN, Summative Energy Values, NEL, RFV, RFQ, etc. as needed

**Emphasize:** What is actually measured!

**Remember:** Only as good as the sampling procedure
ADF-NDF – too closely related

Relationship of ADF and NDF in Alfalfa (1200 western hays)

\[ y = 1.0921x + 3.1776 \]

\[ R^2 = 0.8695 \]
NDFD – Distinct Information

Relationship of NDF to NDF digestibility

NDFD (% of DM) vs. NDF (% of DM)
NDFD – Independent of RFV/TDN

Relationship between TDN and NDF digestibility
(>1,200 Western States Samples, 2013)

$y = 0.4656x + 16.334$

$R^2 = 0.0949$
NDF Digestibility and ADF Values - Western Hays in Relationship to hay Marketing Categories
What about Intake??

Dry Matter Intake (kg/d)

Time (Day Relative to Calving)
Ash does not contribute energy
For high producing dairy cows

- **NDF** – generally desire lower levels, but not too low
- **CP** – generally higher levels
  - RUP important
- **NDFD** – generally higher levels
- **ASH** – generally lower levels
Challenges to Change:

- Buy in by nutritionists, labs, alfalfa hay groups
- Standardization of in-vitro measurements
- NIRS vs. wet chem.
- Standardization..... But allow innovation with other techniques
  - Particle analysis
  - Gas measurements
  - Protein analysis
# Hay Quality Guidelines

## Range of Hay Quality Analysis for Alfalfa Quality Marketing Groups

<table>
<thead>
<tr>
<th>Category</th>
<th>NDF%</th>
<th>NDFD%</th>
<th>CP</th>
<th>ADF%</th>
<th>RFV</th>
<th>TDN (90%)</th>
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<td>50.5</td>
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Calculated Values:

<table>
<thead>
<tr>
<th>Value</th>
<th>20%</th>
<th>30%</th>
<th>40%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFV</td>
<td>100</td>
<td>75</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>TDN</td>
<td>50.5</td>
<td>52.5</td>
<td>54.5</td>
<td>55.9</td>
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Summary:

- Important to embrace change which is likely to improve lab analysis, and to recognize the changes in the role of alfalfa hay & how its fed.

- Standard hay test
  - DM
  - NDF
  - NDFD
  - CP
  - Ash