Cows agree with Total Tract NDFD

A new (and) better tool for assessing forage quality

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Dept. of Dairy Science
University of Wisconsin-Madison

Balancing rations for carbohydrates (starch and NDF) are critical for health and production in high producing dairy cows.

Milk production is affected by variations in:
- Fiber digestibility => 6-7 lbs of milk
- Starch digestibility => 3-5 lbs of milk

Assessing fiber digestion is not easy

Poor digestion < 40%
Excellent digestion > 50%

A 2-3 unit change in fiber digestibility corresponds to 1 lb change in milk yield.

Fiber digestibility varies in forages

<table>
<thead>
<tr>
<th>Forage Type</th>
<th>Range in % of NDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa hay and silage</td>
<td>25-70</td>
</tr>
<tr>
<td>Corn silage</td>
<td>25-80</td>
</tr>
<tr>
<td>Grass hay and silage</td>
<td>15-80</td>
</tr>
</tbody>
</table>

Two units increase in diet TTNDFD can potentially increase milk yield by 1 lb

The ‘Alphabet Soup’ Forage Fiber Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Rumen Fill</th>
<th>TDN Estimation</th>
<th>Diet Formulation</th>
<th>Herd Diagnostics</th>
<th>Quality Index</th>
<th>Agronomy Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDF</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDFD (30 or 48)</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTNDFD</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>uNDF240</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDF kd</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RFQ</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk/ton</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TTNDFD \( \Rightarrow T_{\text{total}} T_{\text{ract}} \text{NDF} D_{\text{digestibility}} \)

Licensed procedure through the University of WI

>15 years of research, > $500,000 invested in development

A precise laboratory test that accurately predicts how fiber is utilized by high producing dairy cows
Think of forage quality as how far you can travel on a tank of gas:

You can’t calculate how far you can go unless you know:

How much fuel is in the tank (pdNDF)
AND
The miles traveled per gallon (kd)

HOW much milk your forage will make depends on the amount of potentially digestible fiber AND the rate of fiber digestion!

How is TTNDFD determined?

Feed fiber
Potentially digestible NDF
Rate of fiber digestion
Rate of fiber passage

TTNDFD (total tract NDF Digestibility)

How is TTNDFD determined?

Feed and cow factors are combined to measure true fiber digestion

A 2-3 unit change in ration TTNDFD corresponds to 1 pound change in milk yield.

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What do the ‘real experts’ say?

<table>
<thead>
<tr>
<th>Legume/grass feeding trials</th>
<th>Mean 47.3% of NDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(20 trials, 64 observations</td>
<td>Median 47.5% of NDF</td>
</tr>
<tr>
<td>In vivo NDF diet digestibility)</td>
<td>Range 31.1-66.2% of NDF</td>
</tr>
<tr>
<td>St. Dev. 8.1</td>
<td></td>
</tr>
</tbody>
</table>

Cows report that TTNDF digestibility of legume/grasses are higher than TTNDF digestibility of corn silage.

<table>
<thead>
<tr>
<th>Corn Silage/Sorghum feeding trials</th>
<th>Mean 49.2% of NDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(25 trials, 81 observations, In Vivo NDF diet digestibility)</td>
<td>Median 41.1% of NDF</td>
</tr>
<tr>
<td>Range 20.1-58.8% of NDF</td>
<td>St. Dev. 8.8</td>
</tr>
</tbody>
</table>

Validating the TTNDFD model

J. Dairy Sci. 92:3033–3041
doi:10.3168/jds.2009-1136

An alternative method to assess 24-h ruminal in vitro neutral detergent fiber digestibility

J. P. Goosber, B. C. Goss, and D. K. Combs
Department of Dairy Science, University of Wisconsin-Madison, Madison, 53706

Patents

Method for measuring fiber digestibility

US 2009027399 A1

Publication number: US2009027399 A1
Publication date: Dec 3, 2009
Applicant: J. P. Goosber, B. C. Goss, D. K. Combs
Inventors: J. P. Goosber, B. C. Goss, D. K. Combs

Validating the TTNDFD model

J. Dairy Sci. 98:2566-2662
http://dx.doi.org/10.3168/jds.2014-8865

Validation of an approach to predict total-tract fiber digestibility using a standardized in vitro technique for different diets fed to high-producing dairy cows

F. Lopes, K. Ruh, and D. K. Combs
Department of Dairy Science, University of Wisconsin, Madison 53706
Validating the TTNDFD model

In vivo – pool and flux method

- Omasal digesta and rumen fluid collected
- Fecal samples collected
- Rumen contents were evacuated manually at 1300h (4h after feeding) on d 20 and at 0800 h (1 h before feeding) on d 21

Rumen kinetic and pool size

- Rumen pools of iNDF and pdNDF (kg)
- Ruminal passage rates of iNDF and pd NDF (%/h)
- Ruminal digestion rate of pdNDF (%/h)

Can the in vitro TTNDFD test detect a difference in fiber digestibility as ratios of corn silage (36% TTNDFD) and alfalfa (42% TTNDFD) change in the ration?

<table>
<thead>
<tr>
<th>Corn silage:alfalfa ratio</th>
<th>100CS 0AS</th>
<th>67CS 33AS</th>
<th>33CS 67AS</th>
<th>0CS 100AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMI, lb/d</td>
<td>55ab</td>
<td>56a</td>
<td>54b</td>
<td>48c</td>
</tr>
<tr>
<td>4% FCM, l/d</td>
<td>80</td>
<td>78</td>
<td>77</td>
<td>79</td>
</tr>
<tr>
<td>Observed TTNDFD, in vivo</td>
<td>38.3a</td>
<td>40.9ab</td>
<td>39.4ab</td>
<td>43.8a</td>
</tr>
<tr>
<td>Predicted TTNDFD, in vitro*</td>
<td>38 41 41 45</td>
<td>2.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*In vitro TTNDFD analysis of feeds matched the observed (in vivo) NDF digestibility values Lopes et al, 2015

Fiber digestibility TTNDFD vs. in vivo

<table>
<thead>
<tr>
<th>Method</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDF digested in rumen, lb</td>
<td>5.3</td>
</tr>
<tr>
<td>NDF digested in hindgut, lb</td>
<td>0.4</td>
</tr>
<tr>
<td>NDF digested in total tract, lb</td>
<td>5.9 6.4</td>
</tr>
<tr>
<td>Total tract NDF digestibility, % of total NDF</td>
<td>40.6 41.8</td>
</tr>
</tbody>
</table>

Lopes et al, 2015

TTNDFD validation: Comparing lab prediction to results from feeding studies

- Total tract NDF digestibility in vivo studies
  - Seven studies (total of 21 diets) conducted at UW-Madison
- Total tract NDF digestibility in vitro evaluation of diets
  - 21 diets
  - TTNDFD predicted from TMR samples

TTNDFD combines in vitro rate of NDF digestion with iNDF to improve the prediction of in vivo fiber digestion

- Lopes, B. E. Cook, and D. K. Combs
  - Department of Dairy Science, University of Wisconsin-Madison, Madison 53706
  - J. Dairy Sci. TBC:1-13
  - http://dx.doi.org/10.3168/jds.2014-8862
  - © American Dairy Science Association®, TBC.
Stand-alone *in vitro* NDFD30 or iNDF values are poor predictors of in vivo fiber digestion

\[
y = 0.043x + 42.8 \\
R^2 = 0.005
\]

\[
y = -0.864x + 68.3 \\
R^2 = 0.364
\]

**How to use TTNDFD**

- TTNDFD values are consistent across feed types
- Target rations for >42% TTNDFD
- ‘Dynamic kd’ and iNDF are compatible with AMTS and CNPCS ration software
- Co-product feed tables available

**Alforex Introduces Hi-Gest 360**

*Alfalfa with Improved TTNDFD*

<table>
<thead>
<tr>
<th>28 Day Cut System (5 cuts)*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alfalfa Variety</strong></td>
<td><strong>pNDF</strong></td>
</tr>
<tr>
<td>Hi-Gest 360</td>
<td>73.3</td>
</tr>
<tr>
<td>Conventional Check</td>
<td>68.2</td>
</tr>
<tr>
<td>% Difference:</td>
<td>7%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>35 day Cut System (3 cuts)*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alfalfa Variety</strong></td>
<td><strong>pNDF</strong></td>
</tr>
<tr>
<td>Hi-Gest 360</td>
<td>59.1</td>
</tr>
<tr>
<td>Conventional Check</td>
<td>54.8</td>
</tr>
<tr>
<td>% Difference:</td>
<td>8%</td>
</tr>
</tbody>
</table>

Low lignin: higher fiber digestibility
TTNDFD: Tells you how fiber digestibility was improved
TTNDFD: The Take Home Message

1. Fiber digestibility has a big impact on milk yield.
   A 2-3 unit change in ration TTNDFD corresponds to a 1 pound change in milk yield.

2. The TTNDFD test was developed to predict fiber digestibility in high producing dairy cattle
   Can be used across forage types and byproduct feeds
   Can be used in ration balancing and evaluation
   Is a more accurate measure of forage quality than

TTNDFD Guidelines

- Remember 42% TTNDFD
  - Corn silage and haylage average!

- Goal = 48%