

Opportunities Inputting Lab Values in Ration Software

NIRSC/NFTA/FeedAC
Joint Annual Meeting
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RENAISSANCE NUTRITION, INC.

Nutritional and management consulting serving the East and Midwest Dairy Crescent

2007 talk: Who Will Coordinate/Lead ?

- NIRS Consortium – Go For It !
- NIRSC QC committee recommended analyte definitions and Model lab report tomorrow
- National Forage Testing Association - NFTA
- Feed Analysis Consortium - FeedAC
- USDA Dairy Forage Research Center
- National Research Council

Outline


- Analysis inputs needed
- Differences in methods/calculations
- Results Comparisons among labs
- Consequences of differences
- Recommendations

Needed CPM analyses & references

- DM – Dry Matter , determined by heating below 60 C
- CP – Crude Protein = Kjehldahl N x 6.25
- SP – Soluble protein after 1 hr in borate-phosphate buffer
- NPN– Non Protein Nitrogen (ProtA), SP – tungstic acid precipate (ProtB1)
- ADIN - Acid Detergent Fiber Insoluble Protein (ProtC)
- NDIN - Neutral Detergent Fiber Insoluble Protein; (NDIN – ADIN = ProtB3)
- ADF – Acid Detergent Fiber
- NDF - Neutral Detergent Fiber **without** sodium sulfite, ie. NDR
- peNDF – NDF remaining on a 1.18 mm screen after dry sieving
- Lignin – ADF with 72% Sulfuric Acid; Lignin x 2.4 = unavail. fiber (ChoC)
- Available NDF = (NDF(no sulfite)-NDFCP)-(ligninx2.4) (ChoB3)
- Ash – inorganic residue after combustion of organic matter
- Ether Extract - Fat and compounds extractable by ether
- NFC – Non Fiber Carbohydrate; $NFC = 100 - (CP + Fat + Ash + NDF-NDIP)$
- Silage Acids – acids produced during ensiling (ChoA1)
- Sugar – Cho extracted by water at 39 C Hoover WVU 1997 (ChoA2)
- Starch –Hoover WVU method 1997 = starch, sucrose, fructans (ChoB1)
- Sol Fiber – pectins beta glucans = $NFC - (acids + sugars + starch)$ (ChoB2)

NDF Procedures NRC 2001 pg 250:

- aNDF uses amylase & sodium sulfite
...minimum contamination with starch and protein...and is preferred
- aNDF can't be used CNCPS(CPM), Need NDF-CP measured without sulfite
- “When NDF is measured without the use of sodium sulfite it **probably** should be corrected for protein contamination”
- Adding sulfite to NDF solution reduces CP but does not quantitatively remove all contamination



CPM Carbohydrate Tab – advanced rate inputs

NDF(no SO3) = NDR
or [aNDF + NDR-CP]

Avail NDF (ChoB3) =
[NDR-NDRCP]- UnAvail

Unavail NDF (ChoC) =
Lignin*2.4

“kd rate calculator”
Ex: NDF 45%, Lignin 4%, 3 hr
lag; 45% NDFD24 = 4%/hr
35% NDFD24 = 2.8 %/hr
makes 3 to 5 # Milk

NFC = 100 – [CP + Fat +
Ash + (NDR-NDRCP)]

Soluble Fiber = NFC -
[Sil Acids+Starch+Sugar]

Edit Feed					
Feed Name		Cost	DM	Date	
New C/Sil 28DM 1-6-07		35.00	30.000	00-00-0000	Forage
Protein Carbohydrate Fat MinVit Amino Acids Quick Edit					
Nutrient Fraction	%DM	%NDF	Rates	Intest Digest	
ADF	30.000		%/h	%Escape	
NDF	49.000				
peNDF	45.080	92.000			Z-box, RoTap, PSU box eq.
Lignin	4.900	10.000			
ChoB3 Avail NDF	35.245	71.929	3.800		
ChoC Unavail NDF	11.760	24.000			
Ash	4.000				
Ether Extract	3.188				Gas Release analysis rate adjustment
		%NFC			
NFC	36.308				
ChoA1 Silage Acids	6.172	17.000	0.000		100.000
ChoA2 Sugar	1.452	4.000	300.000		100.000
ChoB1 Starch	28.320	78.000	15.000		80.000
ChoB2 Soluble Fiber	0.364	1.000	15.000		80.000

An Opportunity

- Lab A told customers to add NDR CP to aNDF for value to use in CPM
- Lab B provides NDR results, labeled NDF
- Lab C told customers NOT to add NDR CP to aNDF (labeled NDF) to use in CPM, ... that may overestimate NDF since sulfite does not remove all CP
- What should we use currently
- Will new versions of ration software require a change from labs? Let's talk

Measuring Fiber and Insoluble Protein in Corn Silage in Crucible or Filter Bag

Ferreira and Mertens An Feed Sci Tech 2007 133:3-4 abstract

- aNDF = NDF solution + Sulfite + Amylase
- NDR = NDF solution + Amylase
- NDF = NDF solution + Sulfite

	Crucible	CP	Filter Bag	CP
• aNDF %	43.3	8.6	43.3	9.6
• NDR %	45.6	12.5	44.9	14.2
• NDF %	45.6	8.6	47.3	9.6

- "It is crucial that authors and laboratories accurately describe how they measure NDF and clearly indicate by acronym the method they used"

AGRICULTURAL MATERIALS

Effects of Sodium Sulfite on Recovery and Composition of Detergent Fiber and Lignin

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Sample	Crude protein, %	NDR		Difference
		Without Na ₂ SO ₃	With Na ₂ SO ₃	
Fish meal	53.94	30.44	6.27	24.17
Brewers' grains	30.44	52.32	40.87	11.45
Distillers' grains	25.57	38.56	27.89	10.67
Meat scraps	52.91	30.79	22.18	8.61
Soybean meal	46.15	18.48	12.44	6.04
Alfalfa haylage	17.06	43.57	42.15	1.42
Corn silage	7.65	36.08	34.74	1.34

AGRICULTURAL MATERIALS

Effects of Sodium Sulfite on Recovery and Composition of Detergent Fiber and Lignin

Sample	NDR CPE in aNDF, %-units		
	Without Na ₂ SO ₃	With Na ₂ SO ₄	Difference
Fish meal	10.43	1.29	9.14
Brewers' grains	12.16	4.65	7.51
Distillers' grains	11.01	3.68	7.34
Meat scraps	15.70	8.37	7.33
Soybean meal	3.63	0.48	3.15
Alfalfa haylage	2.53	1.45	1.08
Corn silage	0.72	0.50	0.22

aNDF & NDR-CP Ranges DairyOne Lab

	aNDF	NDR-CP
Legume Silage	39 – 50	2.3 - 4.5
Corn Silage	37 – 49	0.9 – 1.5
Distillers Grains	28 – 38	6.2 – 12.9

2008 n=24 DairyOne	NDR_CP	aNDF	NDR	aNDF + NDR-CP
Hay	4.6	49.3	53.7	53.9
Haylage	2.8	50.4	52.8	53.2

NDR-CP in Corn Silage

- **DairyLand Lab** Nov 05 n = 11
 - NDR-CP = 1.0 %DM
 - aNDF-CP = 0.65 %DM

- **DairyOne Lab** Jan 08 n = 12
 - NDR-CP = 0.7 %DM
 - aNDF = 41.3 %DM; NDR = 41.4 %DM

NDR @ 46 or aNDF @ 43 effects

- peNDF: $.92 \times 46 = 42.3$ or $\times 43 = 39.5$
over/underestimate fiber adequacy/capacity
- Affect on Avail NDF Kd (8.6 lig; 3hr lag; 43 NDFD30)
- NDFD: Digest total then aNDF or NDR?
Or isolate aNDF or NDR then digest?
Flask/crucible or Filter bag? Effect of 1, 2, 4, 6 mm grind size on Kd prediction equation
- RFV and RFQ effect using aNDF vs NDR !?!

What CNCPS/CPM input ?

CPM "True NDF"
= NDR – NDR CP

	aNDF	NDR	NDR CP	aNDF- NDRCP	NDR – NDRCP
Corn Silage	34.7	36.1	0.7	34.0	35.4
Haylage	42.2	43.6	2.5	39.7	41.1
Distillers	27.9	38.6	11.0	16.9	27.6

How did labs compare on Fall 2006 CS

Grand Average of 13 CS samples across Labs												@ Acid=7
	DM	CP	ADF	NDF	Lignin	L/NDF	Ash	Fat	NFC	Sugar	Starch	Sol Fiber
Grand Avg	35.5	8.0	24.5	41.1	3.3	8.1	4.2	3.2	45.2	3.1	32.4	2.7
Lab #1	35.9	8.4	25.6	42.5	3.6	8.5	4.2	3.4	43.0	4.1	30.2	1.7
				hi 9					h 4	hi 10	hi 1	
				mid 4					m 7	mid 3	mid 6	
				lo 0					l 2	lo 0	lo 6	
Lab #2	34.5	7.9	23.5	40.7	3.2	7.9	4.0	3.2	45.7	3.6	35.8	-0.8
				hi 3					hi 4	hi 3	hi 11	
				mid 6					mid 8	mid 10	mid 1	
				lo 4					lo 1	lo 0	lo 1	
Lab #3	35.9	7.7	24.5	40.1	3.1	7.8	4.2	3.0	46.9	1.6	31.3	7.0
				hi 1					hi 8	hi 0	hi 1	
				mid 5					mid 4	mid 0	mid 7	
				lo 7					lo 1	lo 13	lo 5	

NFC = Non Fibrous CHO

NSC = Non Structural CHO (NRC 2001)

- pg 34

$$\text{NFC}\% = 100 - (\text{NDF}\% + \text{CP}\% + \text{Fat}\% + \text{Ash}\%)$$

- pg 14 Eq. (2-4a)

$$\text{tdNFC} = 0.98 (100 - [(\text{NDF} - \text{NDICP}) + \text{CP} + \text{EE} + \text{Ash}]) \times \text{PAF}$$

- NSC = mod. enzyme method of Smith 1981
- NFC - NSC Difference varies considerably ...
caused by pectin and organic acids amounts

NFC calc: Which NDF and NDF(R)-CP ?
Ex:43 or 46; 2.5 or 4.5 - &19,3,8

- NRC 2001 pg 34:
- $\text{NFC, \%} = 100 - (\text{NDF\%} + \text{CP\%} + \text{Fat\%} + \text{Ash\%})$

aNDF or NDR ??

NFC% = 20 or 23

aNDF CP or NDR CP??

- NRC 2001 Eq. (2-4a) pg 14
- $\text{tdNFC} = 0.98 (100 - [(\text{NDF} - \text{NDICP}) + \text{CP} + \text{EE} + \text{Ash}]) \times \text{PAF}$

NFC% = 20.5 or 18.5 or 23.5 or 21.5

Soluble Fiber

- $\text{NFC} - \text{Acids} - \text{Sugar} - \text{Starch} = \text{Sol. fiber}$
- Recent analysis
- $49.3 - 8.93 - 1.7 - 39.5 = -0.83$
- Problem if negative, which value to adjust?

Proposed approach for Discussion

- For NDR-CP determination : use NDR
- For CPM input : use NDR (or aNDF + NDR-CP)
- For NRC ? For Spartan ?
- For NDFD, Kd calculation, RFV, RFQ: use aNDF ?
- For peNDF : use aNDF
- For NFC : use NDR - NDR-CP (or aNDF)
- For Sol Fiber : use NDR - NDR-CP in NFC calculation

Lab Comparison 24hr NDFD Kd rates

Lab #	NDF	Lignin	NDFD24hr	Kd
1	41.4	3.3	49.08	4.61
2	41.2	3.6	37	3.36
3	41.2	3.3	50.6	4.02
4	43.6	2.51		3.07
1	46.0	4.3	48.7	4.88
2	39.3	3	38	3.26
3	38	2.9	54.2	4.38
4	37.8	2.24		3.61
1	40.0	3.2	50.76	4.89
2	37.2	3.1	47	4.57
3	38.1	2.6	54.6	4.23
4	41.2			4.23
1	43.9	4.0	48.08	4.72
2	42.7	3.3	38	3.29
3	37.5	3.1	48.8	3.74
4	38.2			3.40

Lag time reported:
 Lab 1: 3.5 to 4 hr lag
 Lab 2: 4.8 hr lag
 Lab 3: 2.5Hr lag
Lab 4: gas release slow pool

Starch Digestibility

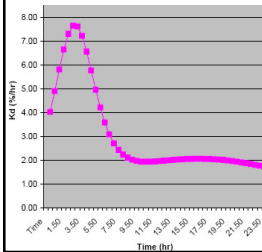
- Degree of Starch Access
- Corn Silage Processing Score
- Processing Adjustment Factor (NRC 2001)
- Enzyme available starch
- 6 hr or 12 hr starch disappearance
- Gas release

Starch Digestibility by DSA (% of Starch)	Reference
> 96.0	Very High
96.0 - 93.0	High
93.0 - 90.0	Medium
< 90.0	Low

Starch Digestibility by DSA (% of DM)

starch passing through the coarse screen	Ranking
Greater than 70%	Optimum
70% to 50%	Average
Less than 50%	Inadequately processed

Starch
- Enzyme Available



Invitro Ruminal Starch Digestibility - 12 hrs (% of starch)
Invitro Intestinal Starch Digestibility (% of starch)

Total Tract Starch Digestibility (Ruminal + Intestinal)

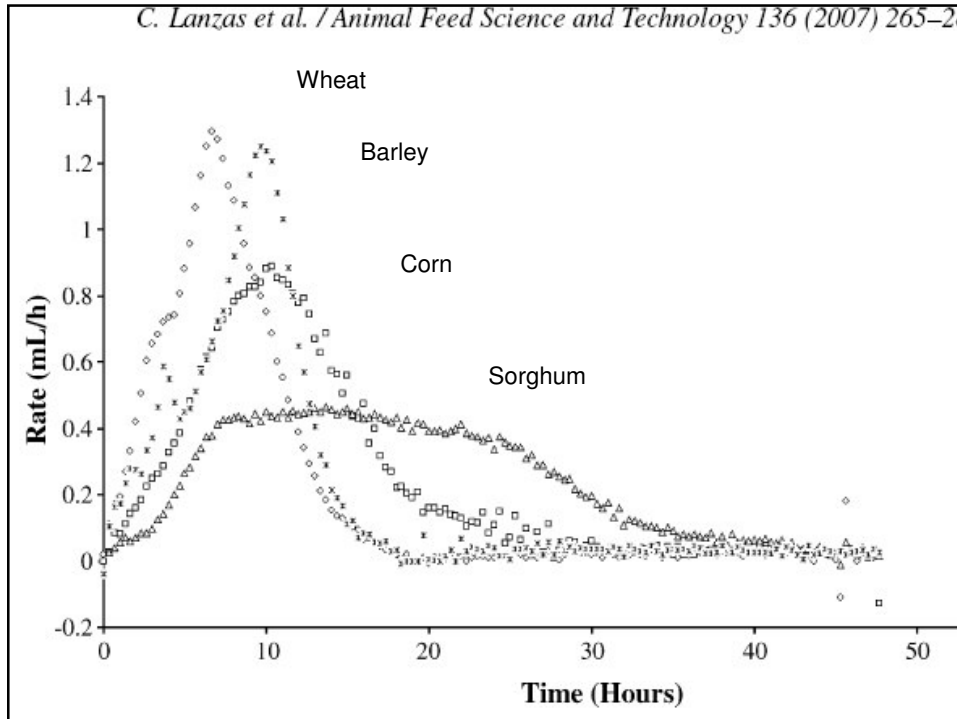
Percent of Total Tract Starch Digested in Rumen
Percent of Total Tract Starch Digested in Intestine

Animal Feed Science and Technology
136 (2007) 265-280

Digestion kinetics of dried cereal grains

C. Lanzas, D.G. Fox, A.N. Pell 2007

- A detailed evaluation of feed values for grains needs to include information on rates of fermentation.
- Rates of gas production have been applied in diet evaluation programs that use digestion rates as feed inputs (Fox et al., 2004; NRC, 2000).



Proteins to Estimate Starch Rate ?

- Pat Hoffman has projects underway and will discuss at this meeting
- Prolamin Zein –
Corn Starch fermentation rates
- Other proteins specific to grain types

Effect of CS Fiber and Starch Rate of Fermentation on CPM predicted Milk

Fiber %/hr	Starch %/hr	ME milk	MP milk	Fiber %/hr	Starch %/hr	ME milk	MP milk
4.7	30	88	88	4.7	10	88	81
3.3	30	87	86	3.3	10	86	79
2.5	30	86	84	2.5	10	85	77

Feed Name		Cost	DM	Date	Concentrate	
CottonseedWhlwLint		190.00	90.100	00-00-0000	Concentrate	
Protein Carbohydrate Fat MinVit Amino Acids Quick Edit Really ?						
Composition				Rates		
		% DM	% EE	Lipolysis	500.000 %/h	
Ether Extract		19.300		Adjust factor	0.000	
Total Fatty Acid		18.914	98.000	LCFA Intestinal Digestibility		
Glycerol		0.386		Rumen Free	Rumen Non-lipolysed	
Pigment		0.000	% TFA	% Intestinal	% Intestinal	
EE and/or triglyceride and/or Fatty Acids *especially PUFA	C12:0	0.000	0.000	95.390	95.390	
	C14:0	0.131	0.690	75.060	48.580	
	C16:0	4.522	23.910	72.480	72.480	
	C16:1	0.104	0.550	64.000	64.000	
	C18:0	0.441	2.330	72.800	72.800	
	:18:1T	0.000	0.000	78.560	0.000	
	:18:1C	2.882	15.240	89.250	66.930	
	C18:2	10.683	56.480	83.000	77.620	
C18:3	0.036	0.190	77.550	77.550		
Other	0.115	0.610	58.170	58.710		

Digest - ibility ?
Hydro - generation rate ?

Estimate and Reduce variability

- White Paper on NIR value compared to wet
- Multi sample testing to minimize variability
- Send 3, pay for 2 ?

Recommendations

- Lab differences can create confusion/frustration and lead to unwarranted “lab hopping” so.....
Provide more info on reports and websites and stay current on procedures & definitions
- Participate in comparative sample programs
 - NFTA, NIRSC, USDFRC, AAFCO, develop lab exchanges
- Ask nutrition groups for definition in the analyses requested, Cooperate with lead organizations to develop uniformity in reports
- Consulting Nutritionists should select one lab, understand how to implement reported results and change labs only with understanding of implications

Recommendations

- Consider Specific Reports for Specific Crops
 - Corn Silage Report
 - Legume/Grass/SmGrain Hay or Silage Report
 - Grain Report; TMR report
- More information/descriptions on reports, include analyte value ranges for your lab
- Examples of all reports by price pkg on web
- Easy access to additional detail on website