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Rating and Ranking Feedstuffs by Economic Value

What are feeds used for?

- Animals do not require feeds!
- Feeds are *packages* of nutrients.
- The value of a feed is the sum of the values of the nutrients that it contains.

What are the nutrients of economic value?

It depends…

- On the buyer…
- On the class of animals
- On the objective
  - Tactical vs. Strategic

Our Approach…

- Moderately sophisticated buyer
- Lactating dairy cows
- Strategic

- Also assumes that feeds are free of unacceptable properties/compounds
  - Molds
  - Weeds

What nutrients?

- Set 1:
  - NE_L
  - RDP
  - dRUP
  - eNDF
  - neNDF

→

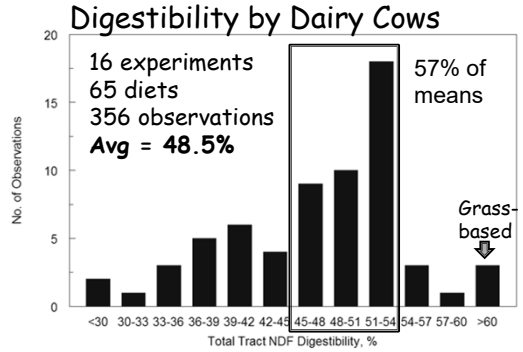
- Set 2:
  - NE_L
  - MP
  - eNDF
  - neNDF

What is TDN?

Why not use ivNDFd?

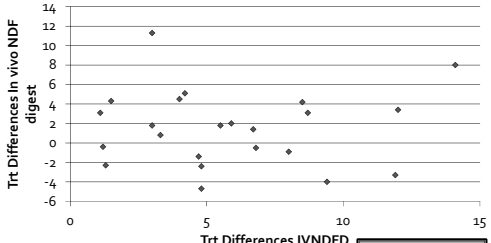
Sum of:	dProtein	High, well estimated by ADICP
	dNDF	VARIABLE Surface ratio of lignin to NDF
	dFat (x 2.25)	High, 100% for fatty acids
	dNFC	High, 98% at maintenance

Total Tract In Vivo NDF Digestibility by Dairy Cows



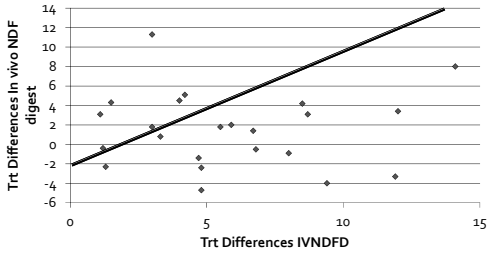
Trt Differences: IVNDF of ingredient vs TMR In vivo

Avg=1.5



Avg=5.8

Trt Differences: IVNDF of ingredient vs TMR In vivo



ivNDFd

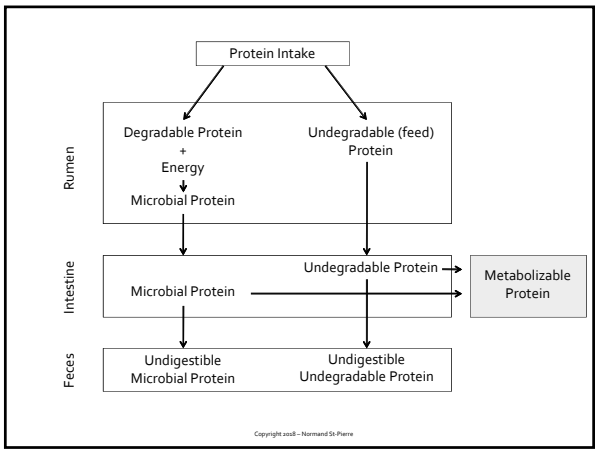
- Overestimates differences.
- Magnitude of the difference in ivNDFd is NOT related to the magnitude of the difference in true (in vivo) NDF digestibility.
- BUT, the ranking within experiment was often OK
  - ivNDFd might have potential, but NOT as a direct replacement.

What is NE_L

- A linear transformation of TDN
- But NOT with a zero intercept
  - 5% TDN = 0.00 Mcal/kg NE_L
- TDN overestimates the energy of forages relative to concentrates.

What is MP?

- Metabolizable protein



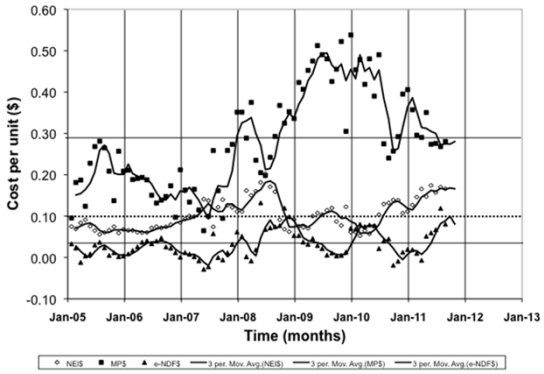
Aufmerksamkeit!

- Forages are all relatively low in undegradable protein.
- Degradable protein has NO value unless there is sufficient ruminal energy to grow microbes.
- *CRUDE PROTEIN* (by itself) is not a ***Meaningful*** measure of economic value!

Market prices of nutrients

- Use all feeds sold in a given market
  - NOT just corn and soybean meal
- Use their nutritional composition
- Solve simultaneously (hedonic pricing)

- Sesame™ software
  - Free at: https://dairy.osu.edu/node/23
- Progressive Dairyman



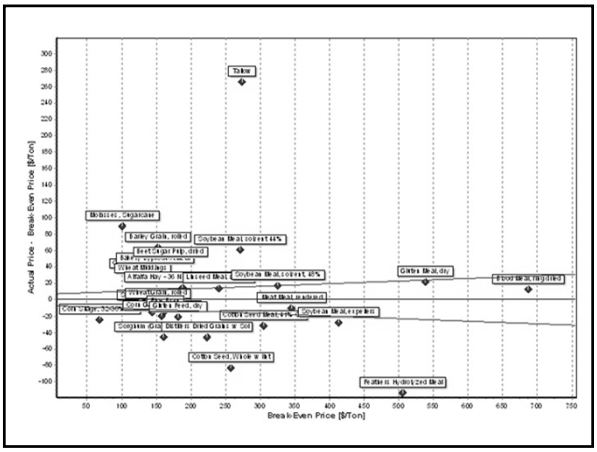
January 2012 to December 2014

Nutrients	Average	S.D.	Min	Max
NE_L (¢/Mcal)	15.2	2.1	11.1	17.4
MP (¢/lb)	31.1	4.8	26.8	40.6
eNDF (¢/lb)	4.7	4.0	0.0	11.9
neNDF (¢/lb)	-8.5	2.8	-12.4	-5.1

2012-2014 vs Jan. 2018

Nutrients	Average
NE_L (¢/Mcal)	15.2
MP (¢/lb)	31.1
eNDF (¢/lb)	4.7
neNDF (¢/lb)	-8.5

Nutrients	Average
NE_L (¢/Mcal)	3.8
MP (¢/lb)	52.4
eNDF (¢/lb)	11.1
neNDF (¢/lb)	- 1.9



Calibration set

Name	Actual [/T]	Predicted [/T]	Lower limit	Upper limit	Corrected	75.0% CI	75.0% CI	Weight
Alfalfa Hay - 36 NDF 22 CP 1	203.000	187.854	162.433	213.276	221.627	196.205	247.048	1.000
Bakery Byproduct Meal	185.000	147.064	132.095	162.034	-	-	-	1.000
Barley Grain, rolled	216.000	152.007	139.750	164.265	-	-	-	0.500
Beet Sugar Pulp, dried	215.000	169.263	156.310	182.217	-	-	-	1.000
Blood Meal, ring dried	700.000	687.051	658.315	715.788	-	-	-	1.000
Corn Grain, ground, dry	138.000	157.304	143.366	171.241	-	-	-	1.000
Corn Silage, 32-38% DM	43.500	68.013	59.030	76.996	68.013	59.030	76.996	1.000
Cotton Seed Hulls	157.000	124.863	90.387	159.338	-	-	-	0.500
Cotton Seed Meal, 41% CP	273.000	304.472	293.455	315.490	-	-	-	1.000
Cotton Seed, Whole w lint	174.000	257.359	217.132	297.587	-	-	-	0.250
Distillers Dried Grains w Sol	177.000	222.882	207.709	238.055	-	-	-	1.000
Feathers Hydrolyzed Meal	392.000	505.711	486.930	524.492	-	-	-	0.125
Fish Menhaden Meal, mech.	1495.000	519.004	499.882	538.126	-	-	-	0.003
Gluten Feed, dry	160.000	180.817	170.169	191.464	-	-	-	1.000
Gluten Meal, dry	560.000	538.373	519.045	557.700	-	-	-	1.000
Hominy	129.000	144.323	132.896	155.751	-	-	-	1.000
Linseed Meal, solvent	254.000	239.599	227.688	251.511	-	-	-	1.000
Meat Meal, rendered	335.000	345.444	330.342	360.546	-	-	-	1.000
Molasses, Sugarcane	190.000	100.009	87.179	112.839	-	-	-	0.250
Rice Bran	148.000	162.166	148.813	175.520	-	-	-	1.000
Sorghum (Grain), Grain, rolle	115.000	160.202	148.291	172.113	-	-	-	1.000
Soybean Hulls	122.000	129.014	105.021	153.007	-	-	-	1.000
Soybean Meal, expellers	395.000	413.309	400.021	426.597	-	-	-	1.000
Soybean Meal, solvent 44%	332.000	270.773	260.371	281.176	-	-	-	0.500
Soybean Meal, solvent, 48%	342.000	325.131	313.551	336.712	-	-	-	1.000
Tallow	540.000	273.641	222.902	324.379	-	-	-	0.025
Wheat Grain, rolled	147.000	151.727	138.336	165.118	-	-	-	1.000
Wheat Middlings	156.000	130.097	115.066	145.127	-	-	-	1.000

Appraisal set

Name	Actual [/T]	Predicted [/T]	Pred.-Act.	75.0% CI	75.0% CI	Corrected
Alfalfa Hay - 32 NDF 24 CP 1	0.000	187.352	187.352	164.346	210.359	238.011
Alfalfa Hay - 40 NDF 20 CP 1	0.000	183.209	183.209	155.697	210.721	200.095
Alfalfa Hay - 44 NDF 18 CP 1	0.000	181.075	181.075	151.078	211.071	181.075
Alfalfa Hay - 48 NDF 16 CP 1	0.000	178.035	178.035	145.454	210.616	161.149

Alfalfa - Entries

Nutrients	Units	Low	Reference	High
Dry matter	%	88	88	88
Crude protein	%	16	20	24
NDICP	%	2.5	2.5	2.5
ADICP	%	1.5	1.5	1.5
Ether Extracts	%	2.0	2.0	2.0
NDF	%	44	40	36
ADF	%	34	30	26
Lignin	%	8.8	7.0	5.4
Ash	%	10	10	10
RUP	% CP	25	25	25
RUPd	% RUP	70	70	70
NDFe	% NDF	92	92	92

Alfalfa – Calculated Values

Nutrients	Units	Low	Reference	High
TDN from NFC	%	29.9	29.9	29.9
TDN from NDF	%	15.8	15.4	14.8
TDN from CP	%	14.3	18.3	22.3
TDN from EE	%	2.3	2.3	2.3
TDN at 3X	%	50.7	54.0	57.1
NE_L at 3X	Mcal/cwt	51.5	57.6	63.5
MP at 3X	%	7.02	7.99	8.95

$ Value – Reference Alfalfa - 2018

	Comp.	DM %	Mcal or Lbs/ton	Unit Prices ¢/unit	Value $/ton
NE_L (Mcal)	57.6	88	1014.2	3.8	38.54
MP (%)	7.99	88	140.7	52.4	73.73
eNDF (%)	36.8	88	647.7	11.1	71.89
neNDF %)	3.2	88	56.3	- 1.9	- 1.07
TOTAL					**183.09**

57.6 x 88 x 0.2 = 1014.2

1014.2 x 3.8 ÷ 100 = 38.54

$ Value – Reference Alfalfa – 2012-2014

	Comp.	DM %	Mcal or Lbs/ton	Unit Prices ¢/unit	Value $/ton
NE_L (Mcal)	57.6	88	1014.2	15.2	154.15
MP (%)	7.99	88	140.7	31.1	43.76
eNDF (%)	36.8	88	647.7	4.7	30.44
neNDF %)	3.2	88	56.3	-8.5	-4.79
TOTAL					223.56

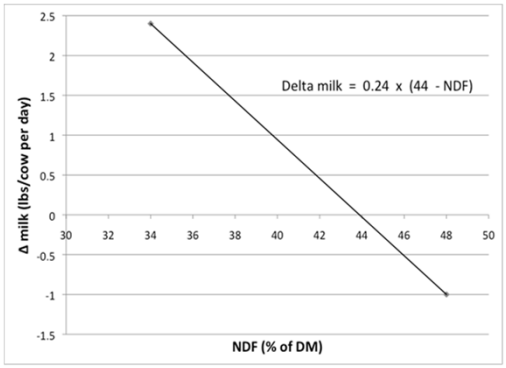
$ Value – Reference Alfalfa – 2012-2014 vs 2018

	Value $/ton
NE_L (Mcal)	154.15
MP (%)	43.76
eNDF (%)	30.44
neNDF %)	-4.79
TOTAL	**223.56**

	Value $/ton
NE_L (Mcal)	38.54
MP (%)	73.73
eNDF (%)	71.89
neNDF %)	- 1.07
TOTAL	**183.09**

Not quite done…

- Two TMRs with same nutrient concentrations
  - TMR A – High quality alfalfa
  - TMR B – Low quality alfalfa
- Cow fed TMR A produce a bit more milk because the forage is "less filling".



Quality adjustments
$/ton of hay per 1% deviation from reference[1]

Forage	+/- $1/cwt	$10/cwt	Milk Price $15/cwt	$20/cwt
Alfalfa	0.24	2.40	3.60	4.80
Grass	0.26	2.64	3.96	5.28

[1] References are:
Alfalfa: 44% NDF
Grass: 53% NDF

Examples

- Alfalfa at 39% NDF, milk at $20/cwt
- 44 - 39 = 5 units of deviation
- 5 units x $4.80/unit = + $24/ton

- Alfalfa at 35% NDF, milk at $18/cwt
- 44 - 35 = 9 units of deviation
- $18/cwt x $0.24/unit = $4.32/unit dev.
- 9 units x $4.32/unit = + $38.88/ton

Correction factor

- Depends on % NDF
  - Less than 44% (alfalfa) → ↑ value of forage
  - More than 44% (alfalfa) → ↓ value of forage
- Depends on milk price
  - Milk price high → Large adjustment
  - Milk price low → Small adjustment

Marginal change in value

Entries	Alfalfa SD units	Grass SD units	Change in value ($/ton) Alfalfa	Grass
Dry matter	1.4	1.1	3.83	2.41
Crude protein	2.6	3.1	5.52	5.81
NDICP	0.9	1.3	1.15	1.48
ADICP	0.4	0.5	-2.11	-2.57
Ether extracts	0.5	0.7	2.36	3.31
NDF	6.3	6.2	-31.09	-31.59
Lignin	0.9	1.1	-4.00	-5.91
Ash	1.2	1.5	-4.41	-5.50
RUP	3.0	3.0	2.30	1.28
RUPd	5.0	5.0	1.37	1.00
NDFe	1.0	1.0	0.93	1.40

Summary

- Economic value of a feeds are driven by their nutritional contents.
- Economically important nutrients are:
  - NE_L, RDP, RUP, eNDF, neNDF
  - NE, MP, eNDF, neNDF
- Values of nutrients vary a LOT across time and location.

Summary

- Forage values must be corrected for quality effect on milk production
  - Correction is dependent on NDF and milk price

Summary

- Economically important chemical assays:
  - Dry matter
  - Crude protein
  - Neutral detergent fiber ⇐
  - Lignin
  - Ash