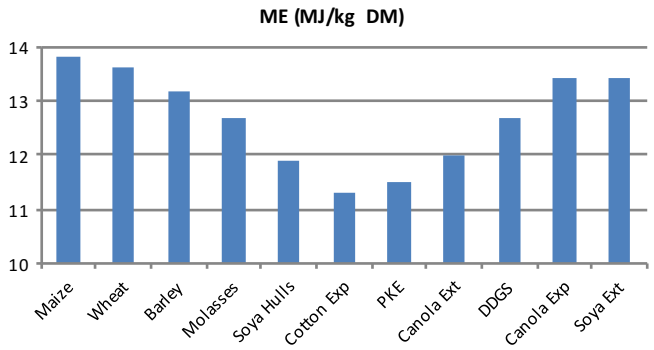
Key Nutritional Principles for Profitable Dairy Farming

Feeding Supplements & Practical Ration Balancing

Dr Julian Waters

Supplement Types - Energy

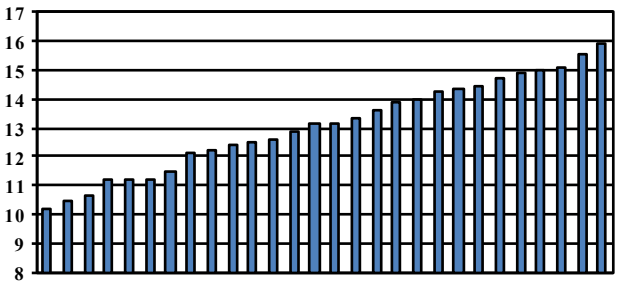


Protected Fats 32-37 MJ

Expeller = Oil Pressed Out, Extracted = Exp + Solvent Extraction

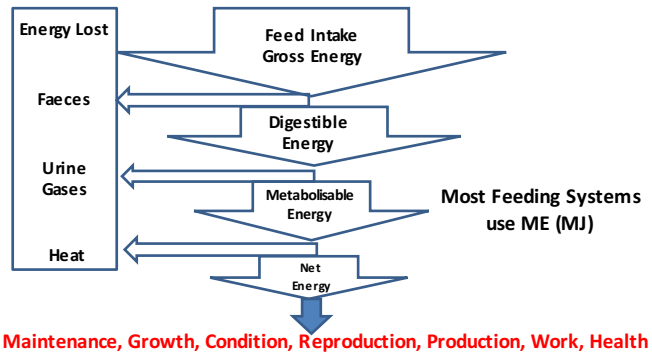
ME Fixed?

28 Wheat Samples (AME MJ/kg DM) NZ data 1997 season



Reliability of Laboratory Results, Company Figures?

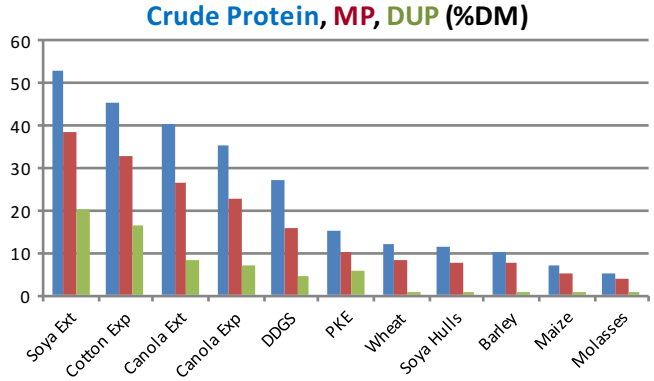
What is Metabolisable Energy?



Maintenance, Growth, Condition, Reproduction, Production, Work, Health

ME Yielding Nutrients = Sugars, Starches, NDF, (Protein), Fats, VFA

Supplement Types - Protein

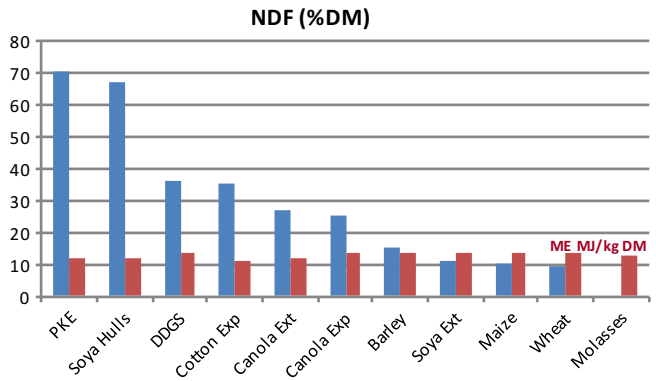


Urea 284% Protein Equivalent (N x 6.25)
Protein (Nutrients) Varies with Source, Crop, Processing

Neutral Detergent Fibre (NDF)

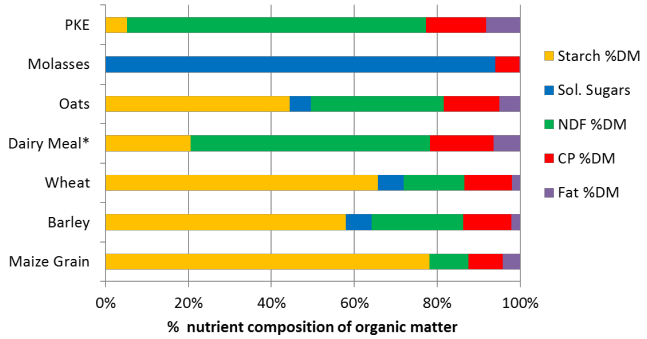
- Measure of Cell Wall (Fibre)
  - Hemicellulose, Cellulose, Lignin
  - Lignin indigestible
    - Reduces degradation & digestion all fibre
    - Degradability
      - Mature (more lignin) < leafy pastures
      - PKE < Soya Hulls (less lignin)

Supplement Types - Fibre



Not long "effective" fibre

Supplements - Nutrients



Kolver 2000, DairyNZ farmfact 1-71 and other industry information *dairy meal have different compositions depending on mix

Why Supplement?

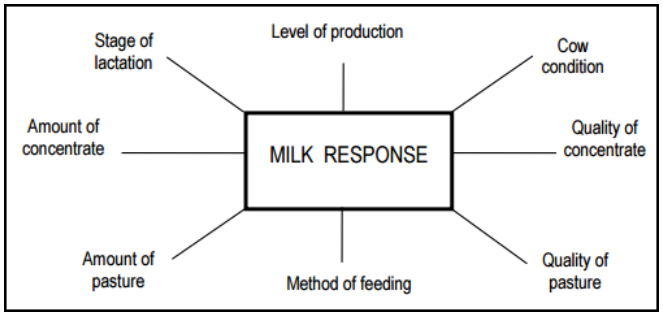
- Fill Feed Gaps
  - Early, Spring, Dry or Cold Periods
- Maintain Production
  - Flatter Lactation Curve (2% Post Peak Decline)
- Increase Production
  - /Cow, /Hectare, Spread Overhead Costs
- Increase Condition
  - Mid to Late Lactation, Dry Period
- Improve Fertility
  - Earlier Oestrus, Better Conception, Hold Pregnancy
- Improve Feed Efficiency
  - Balance Diets
- Improve Pasture Management

Benefits – Short or Long Term?

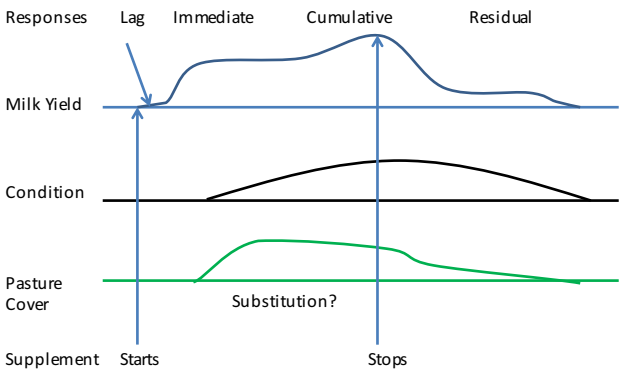
Responses to Supplements

- Immediate, Cumulative, Residual, Marginal
  - Milk Yield/Composition, Condition, Fertility
- Stage of Lactation
  - Yield: Early > Mid > Late Lactation
  - Condition: Early < Mid < Late => Dry
- Factors Affecting
  - Substitution
  - Condition
- Supplements on Milk Composition
  - Fibre, Protected Fat ⬆ % Milk Fat
  - Starch, Sugar ⬆ % Milk Protein
- Wastage

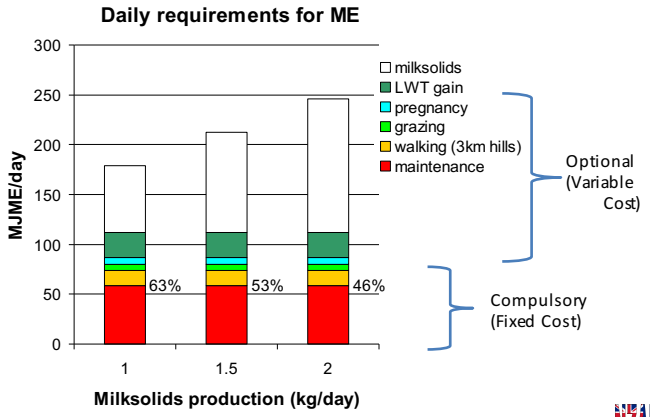
Factors Affecting Responses



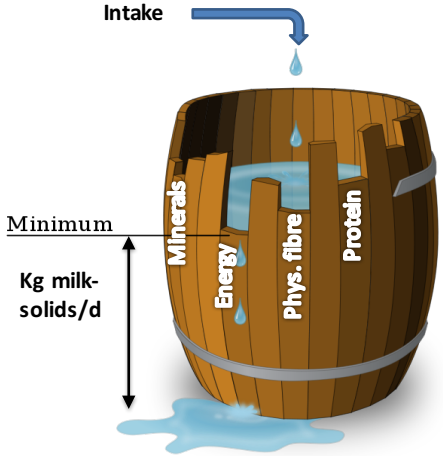
Response Phases



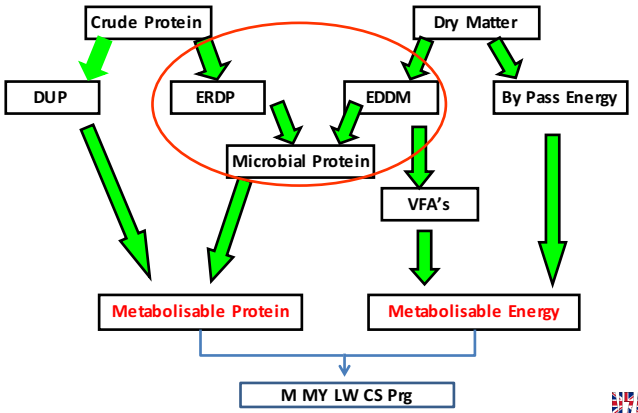
Energy Partition



Limiting Nutrients - Balance?



Metabolisable Protein & Energy - Balance



Milk Urea – Management Tool?

- Milk & Bloods levels similar
- Affected by:
  - Protein intake vs requirement
    - Rumen Degradable Protein
    - High in spring
      - High protein pastures
    - Balance rumen energy & protein
  - Feed intake
  - Time feeding in relation to milking
    - Peaks 3-5 hours after feeding
  - Lower morning, higher in afternoon milk
  - Water intake
    - High MU if dehydrated
  - Breed
    - Jersey < HF
  - Stage of lactation
    - Higher MU early lactation
      - Due to BCS loss
- Useful for balancing diets?
  - Assist in Supplement Choices
  - Consider Trends
  - Target Range 25-35 mg/dl MU
    - <20 High CHO, Low Protein
    - >40 High Protein, Low CHO

MU = 2.14 x MUN (mg/dl)
MUN = 0.47 x MU (mg/dl)

Performance & Nutrient Intake High Producing Holstein Cows Consuming Pasture or Total Mixed Ration

- Trial Design
  - 16 multiparous Holsteins (Penn State)
  - Paired by MY, LW, Days in Milk
  - Then randomly assigned to:
    - Intensively grazed pasture
      - 53% ryegrass, 19% clover, 21% other species
      - 3,080 Pre-, 1,600 kg/ha Post-Graze Cover
    - Full TMR in confinement
  - Grazed previous seasons

(Kolver & Muller (1998) JDS)

Grazing vs. TMR Trial

(Intake kg/d)	Pasture	TMR	P <
DM	19.0	23.4	0.01
ME	221	274	0.02
CP	4.9	4.7	NS
NDF	8.5	7.6	NS
(Intake % LW)			
DM	3.39	3.93	0.01
OM	3.14	3.56	0.02
CP	0.85	0.75	0.02
NDF	1.47	1.21	0.01

Grazing DMI
16.6-21.6 kg/d
2.85-3.76 %LW

(Kolver & Muller (1998) JDS 81:1403-1411)

Grazing vs. TMR Trial

	Pasture	TMR	P <
Milk (kg/d)	29.6	44.1	0.01
MS (kg/d)	1.87	2.74	0.01
Protein : Fat	0.7	0.8	
LW (kg) Start 603kg	562	597	0.01
CS	4.0	5.0	0.01
BHBA (mg/dl)	22.8	18.7	0.02
Glucose (mg/dl)	61.7	63.1	NS
NEFA (meq/l)	684	304	0.01
N Efficiency (g Milk/g N intake)	16.2	27.3	
Predicted Blood Urea (mg/dl)	26	22	

Grazing MY
26-37.6 kg/d

Trial Conclusions

- Pasture vs TMR Cows
  - Lower DMI
  - Lower MY
    - 61% explained by less DMI
      - Rest: Walking, Grazing, Urea Excretion, LW, Milk Composition
    - ME limiting, not MP (25% CP pasture DM)
    - Protein less efficiently used
    - More condition lost
- Production >30 kg/d requires
  - Additional ME (supplements)
  - Sometimes Protein

Ration Balancing
Key Drivers & Priority of Decisions

1. **Energy** (Metabolisable or Net Energy)
   - Source & Form
2. **Protein** (Metabolisable Protein)
   - Degraded, Undegraded & Digested
3. **Rumen Function** (Source 70-80% ME & MP)
   - Fermentation Rates, Effective Fibre
4. **Minerals & Vitamins**
   - Levels, Availability
5. **Other**
   - Rumen or Health Modifiers, Mycotoxin Binders etc.
   - Stress, Challenge, Disease etc.

Ration Balancing – Pasture + PKE

Weight (kg):	500
Fat mobilisation change (kg/d):	-0.70

Milk Yield (kg/d):	30.0
Milk fat (%):	4.8
Milk protein (%):	3.5
Calculated milk solids	2.48

Feeds	*Amount fed (kg as fed/head/d)*	*kg DM/head/d*
Pasture Spring Leafy	134	17.500
Palm Kernel -expelled	3	2.700
		20.2 kg DMI 4.04%LW

Nutrient (Units/d)	*Intake*	*%DM*	*Requirement*	*Shortfall//Excess*
ME (MJ)	232	11.5		
Milk from ME (kg)	30.1			
Protein (%DM)	23.7			
MP -N (g)	3356	16.6	1968	1388
MP -E (g)	2498	12.4	1968	530
Milk from MP (kg)	41.0			
Starch (%DM)	0.1			
Sugar (%DM)	10.4			
NDF (%DM)	39.9			

Response to excess MP – ↑MY by ↑DMI ↑Fat Mobilisation

Eat 134 kg, 13% DM Pasture?

Ration Balancing – What If?

Feeds	*Amount fed (kg as fed/head/d)*	*kg DM/head/d*
Pasture Spring Leafy	134	17.500
Maize	3	2.580

Nutrient (Units/d)	*Intake*	*%DM*	*Requirement*	*Shortfall//Excess*
ME (MJ)	237	11.8	231	6
Milk from ME (kg)	30.9			
Protein (%DM)	23.1			
MP -N (g)	3280	16.3	1960	1320
MP -E (g)	2506	12.5	1960	547
Milk from MP (kg)	41.3			
Starch (%DM)	9.5			
Sugar (%DM)	10.7			
NDF (%DM)	31.8			
NDF from Forage (%DM)	30.5			

Milk quality DSS	Percentage (%)	Output per day (kg)
Milk fat	small reduction	no change
Milk protein	moderate increase	moderate increase
Milk yield change (current - previous) (kg/d)		0.73

Financial	PKE	$270/t
Group Milk yield (kg/d):	30.1	
Milk price ($/kg MS):	4.9	
MOPF ($/d):	11.37	
MOPF (cent/kg):	0.4	

Financial	MAIZE	$470/t
Group Milk yield (kg/d):	30.9	
Milk price ($/kg MS):	5.0	
MOPF ($/d):	11.32	
MOPF (cent/kg):	0.4	

Ration Balancing – What If?

Pasture + PKE

Nutrient (Units/d)	*Intake*	*%DM*	*Requirement*	*Shortfall//Excess*
Calcium (g)	120.0	0.59	127.2	-7.2
Phosphorus (g)	85.8	0.42	79.0	6.8
Magnesium (g)	46.6	0.23	44.8	1.8
Sodium (g)	35.1	0.17	36.3	-1.2
Sulphur (g)	68.3	0.34	46.6	21.6
Cobalt (mg)	2.1		2.2	-0.2
Copper (mg)	213		259	-46
Iodine (mg)	5.5		10.1	-4.6
Manganese (mg)	1908		808	1100
Selenium (mg)	1.1		6.1	-4.9
Zinc (mg)	871		1046	-175

Pasture + Maize

Calcium (g)	110.4	0.55	129.2	-18.9
Phosphorus (g)	75.2	0.37	79.7	-4.5
Magnesium (g)	40.6	0.20	44.0	-3.5
Sodium (g)	35.3	0.18	36.3	-1.0
Sulphur (g)	65.8	0.33	47.0	18.9
Cobalt (mg)	1.8		2.2	-0.4
Copper (mg)	155		244	-89
Iodine (mg)	5.4		10.0	-4.6
Manganese (mg)	1313		803	510
Selenium (mg)	1.1		6.0	-4.9
Zinc (mg)	802		1046	-244

Guideline Nutrient Levels

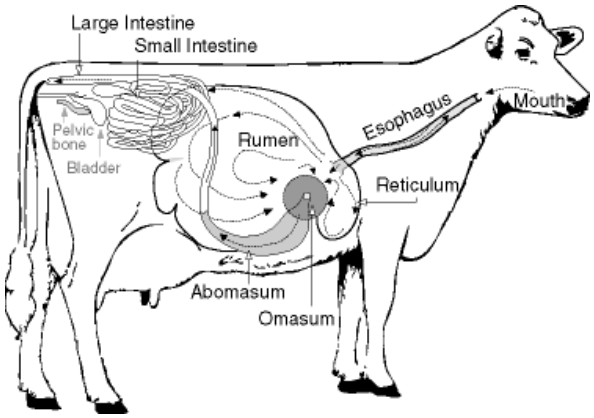
Nutrient (DM Basis)	Early	Mid	Late	Dry	Transition
ME (MJ/kg)	12>	11-11.5	10.5-11	9-10	10-10.5
Protein (%)	16– 18	15-17	15-16	12-13	13-14
NDF (%)	>32	32-37	>35-40	>35	>35
Forage NDF (%)	21	>25	>29	>29	>29
Starch (%)	24-26	23-25	22-25	<20	<20
Sugar (%)	5-10	5-10	5-10	5-10	5-10
Unprotected Fat (%)	<5	<5	<5	<5	<5

Pasture based diets: Transpose Starch & Sugar levels

Planning

- Set Targets (Start with End in Mind)
  - Maintenance, Work, Growth, Production, Reproduction, Condition
- Calculate Requirements
  - Facts & Figures for NZ Dairy Farmers (Dairy NZ)
  - Feed Rationing Program
- Home Grown Feeds
  - Amount & Availability
    - Calculate
  - Nutritional Quality
    - Test
  - Costs
    - Fixed + Variable + Wastage
- Imported (on to farm) Feed Options
  - Availability
  - Quality
  - Nutrient Composition & Specifications
    - ME, Protein, Starch, Sugar, NDF, Minerals
  - Price
    - Purchase + Storage + Handling + Wastage

Value NOT Cost

- **Return on Investment**
  - **Costs of Production**
  - **Margins**
    - **All & Purchased Feeds**

Questions?