

# A feed industry view & the role of specific supplements



Robert Bennett (Adisseo),  
Ainhoa Perojo, Anthony Mercier, Angela Schroeder (Kemin)

*Nitra, Slovakia,  
May 11, 2011*

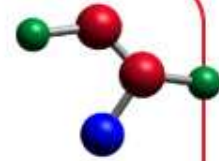


***Innovative and practical management approaches to reduce nitrogen excretion by ruminants***



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## Presentation outline

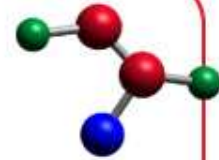
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1. The feed industry – a quick overview
2. AA nutrition – Current practice
  - A seminal trial: Ohio State University
  - AA impact on MP efficiency
    - the « Rulquin Equation », follow-up to the « Rulquin Ratios »
  - Illustrations
  - Field validation
3. Economics and Putting this into practice

### Conclusion



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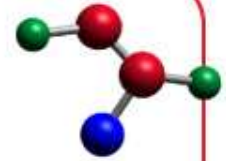
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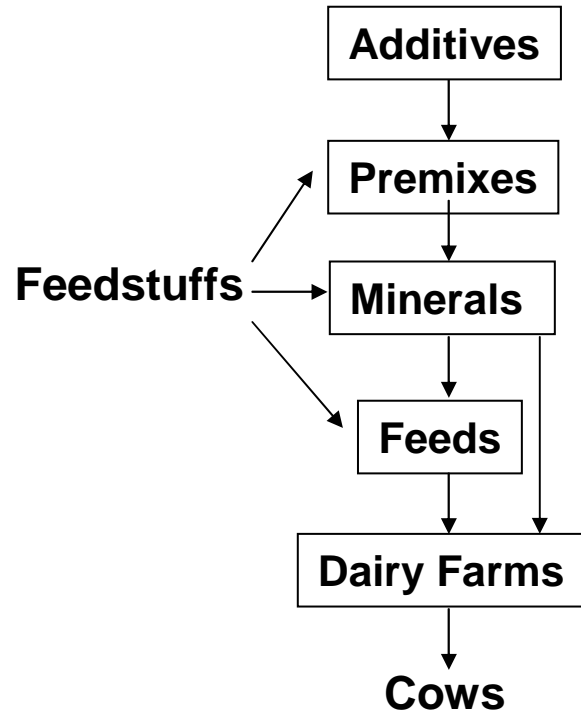
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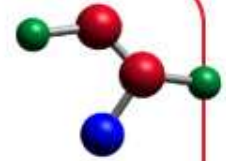


## Traditional

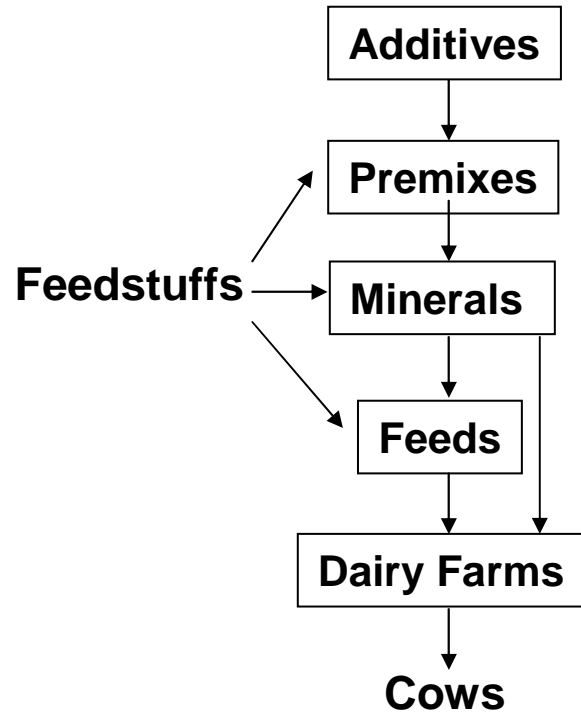




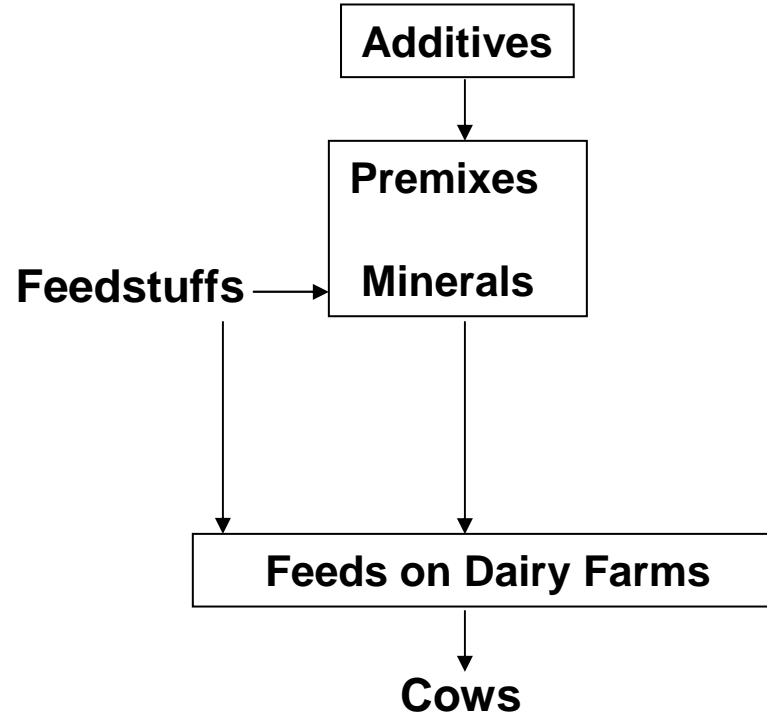
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### Traditional

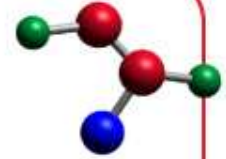


### Large Farms

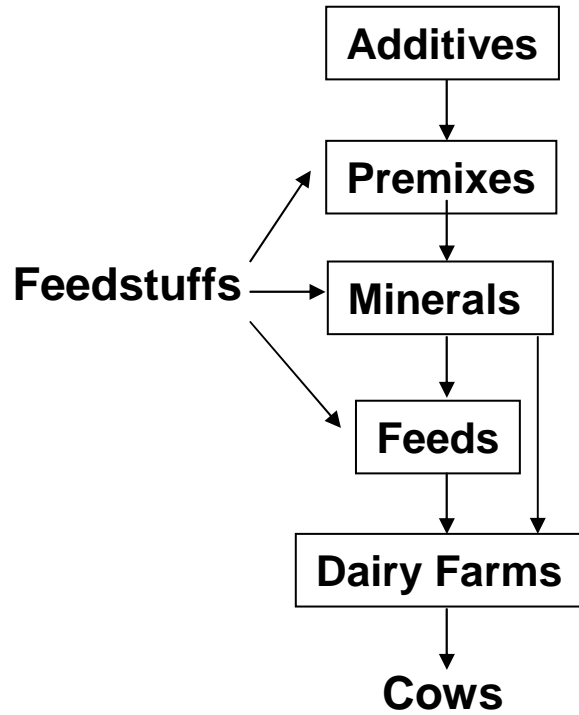




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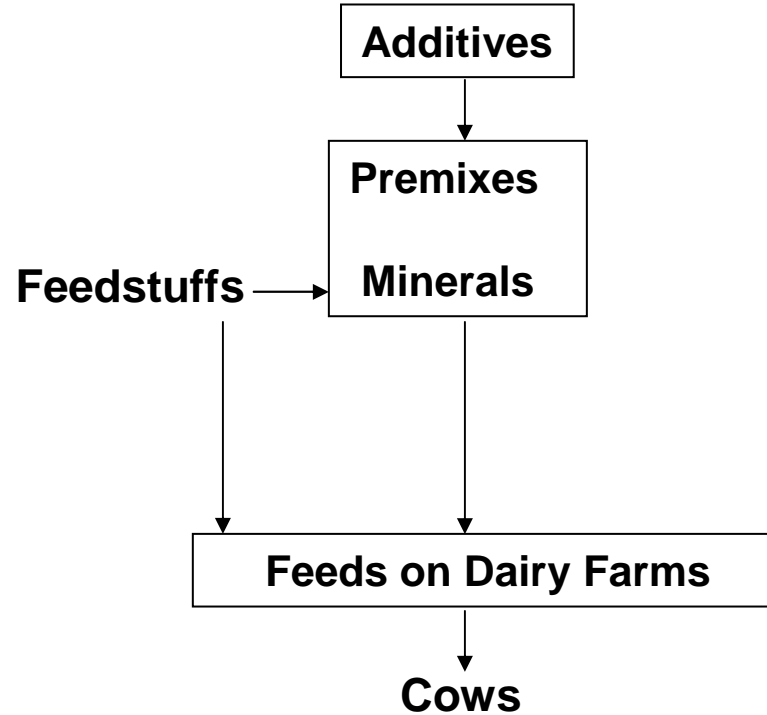


### Traditional



US 30%  
EU 80%

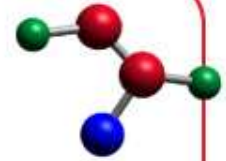
### Large Farms



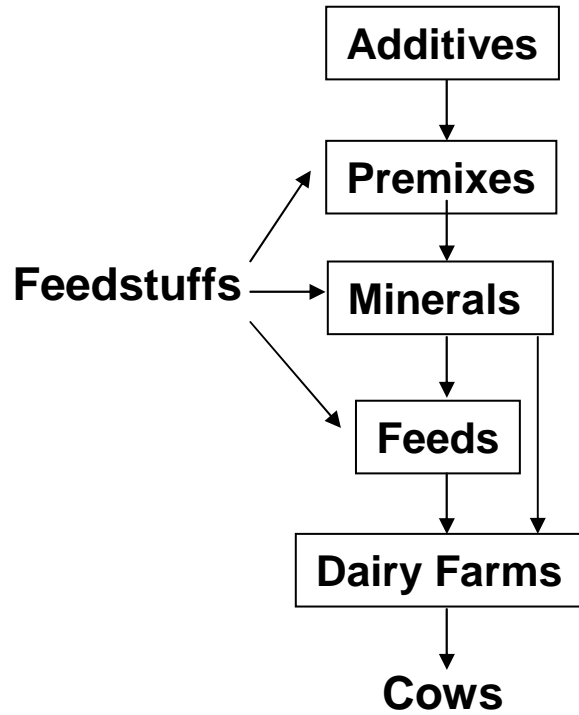
70 % cows  
20 %



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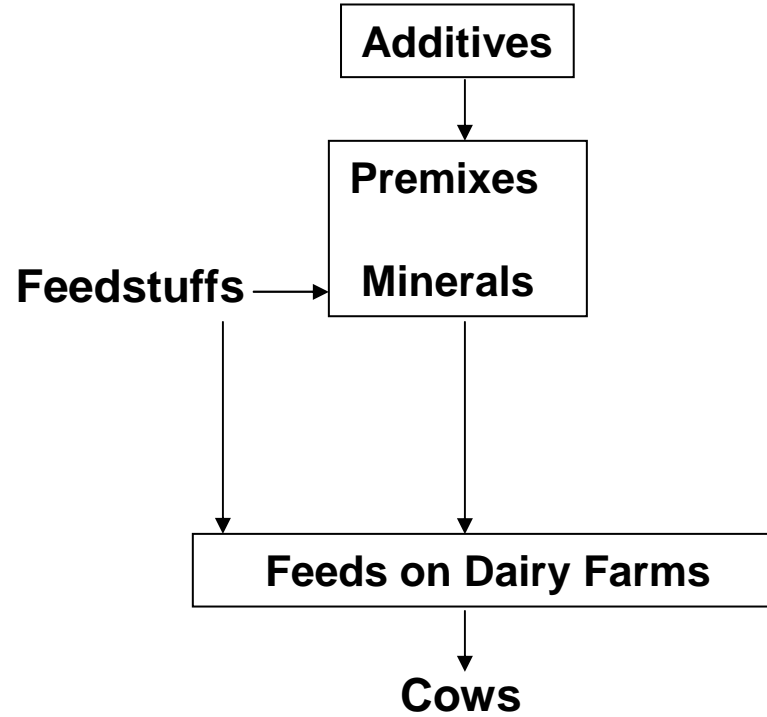


### Traditional



US	30%
EU	80%
Trends	↘ ↘ ↘
US	
EU	

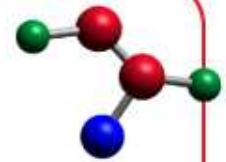
### Large Farms



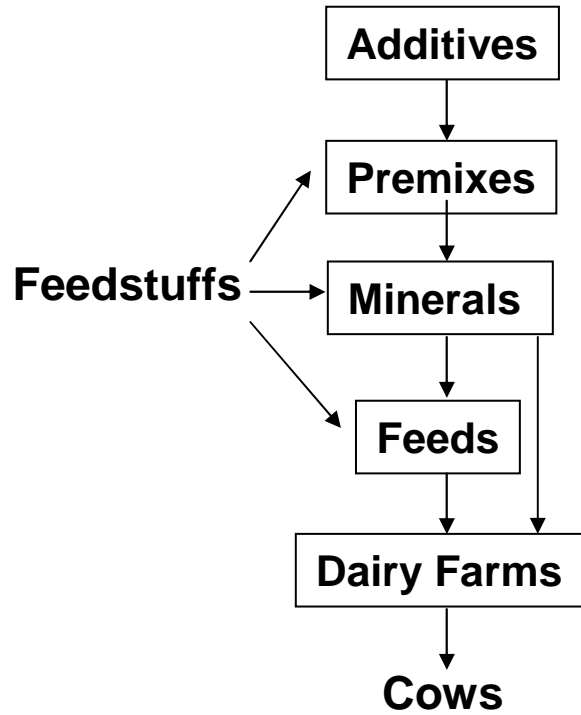
70 % cows
20 %
↗ ↗ ↗
↗



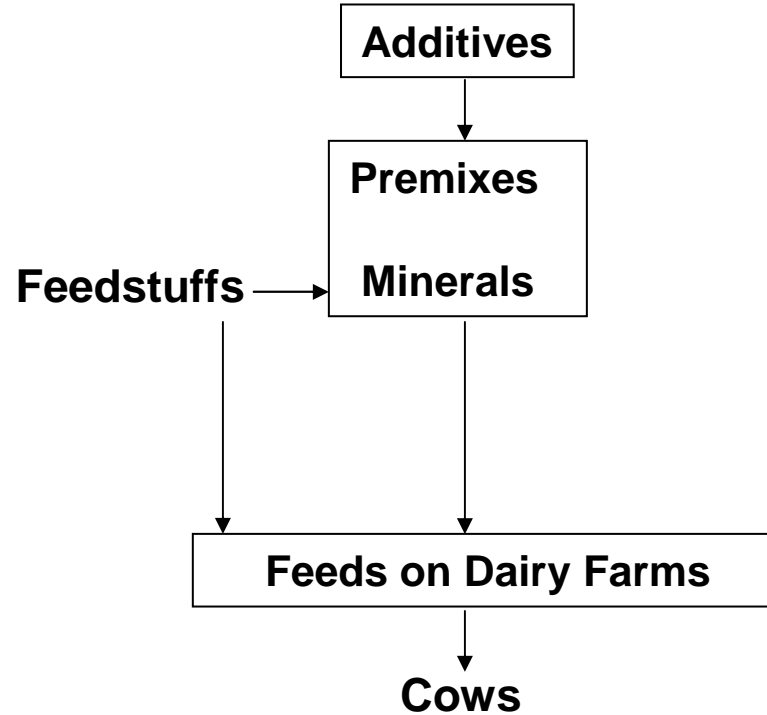
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### Traditional



### Large Farms



US 30%  
 EU 80%

Trends US ↘  
 EU ↘

70 % cows  
 20 %

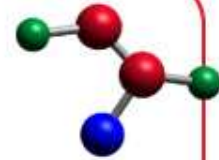
↗ ↘

**Localized animal concentrations  
 => Rednex EVEN MORE IMPORTANT**



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## Feed industry position

- Feed industry is
  - not sitting by idly
  - already implementing empirical, practical approaches to reducing diet CP

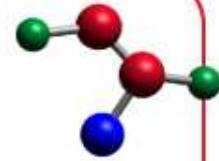
But also:

- very excited by Rednex project
- eagerly awaiting results
- will be happy to have sound science to help design reliable, widespread feeding programmes



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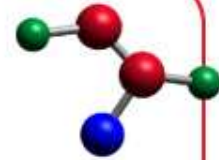
## Tools to use Rednex

- Feeds
- Software
  - Least-cost feed formulation programmes
  - Ration optimization programmes
- Models
  - Almost 1 per country, sometimes more
  - (+): diversity reflects differences between feeds and practices between countries
    - Forages (wet vs dry silages; expeller rape; ...)
    - Feeding systems (+/- robots; automatic feeders, TMRs...)
  - (-): slows dissemination and adoption of new knowledge (cf US & large farms)



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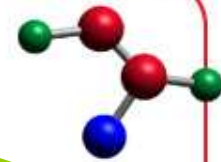
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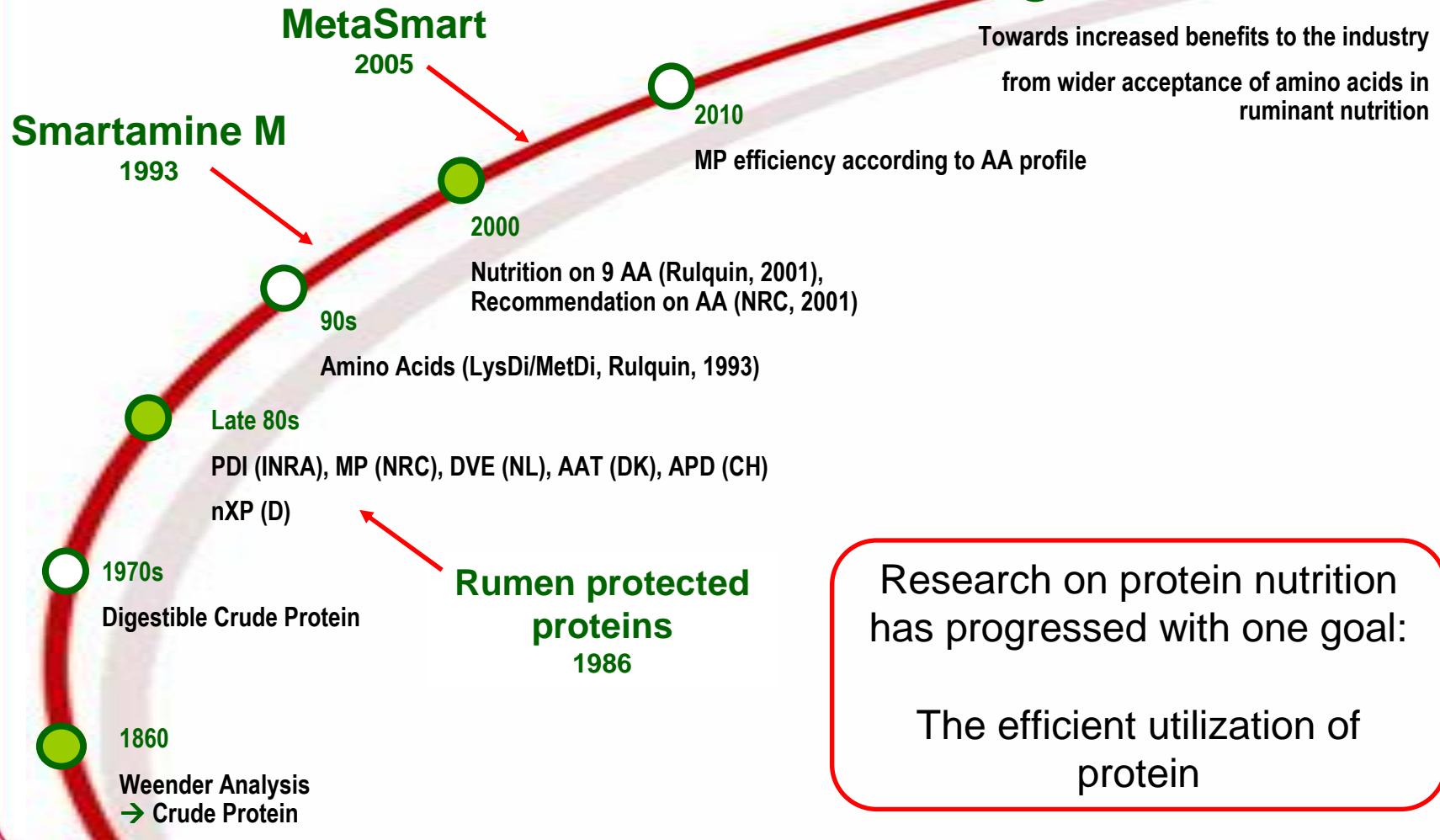
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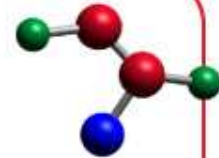


# Protein Nutrition Timeline

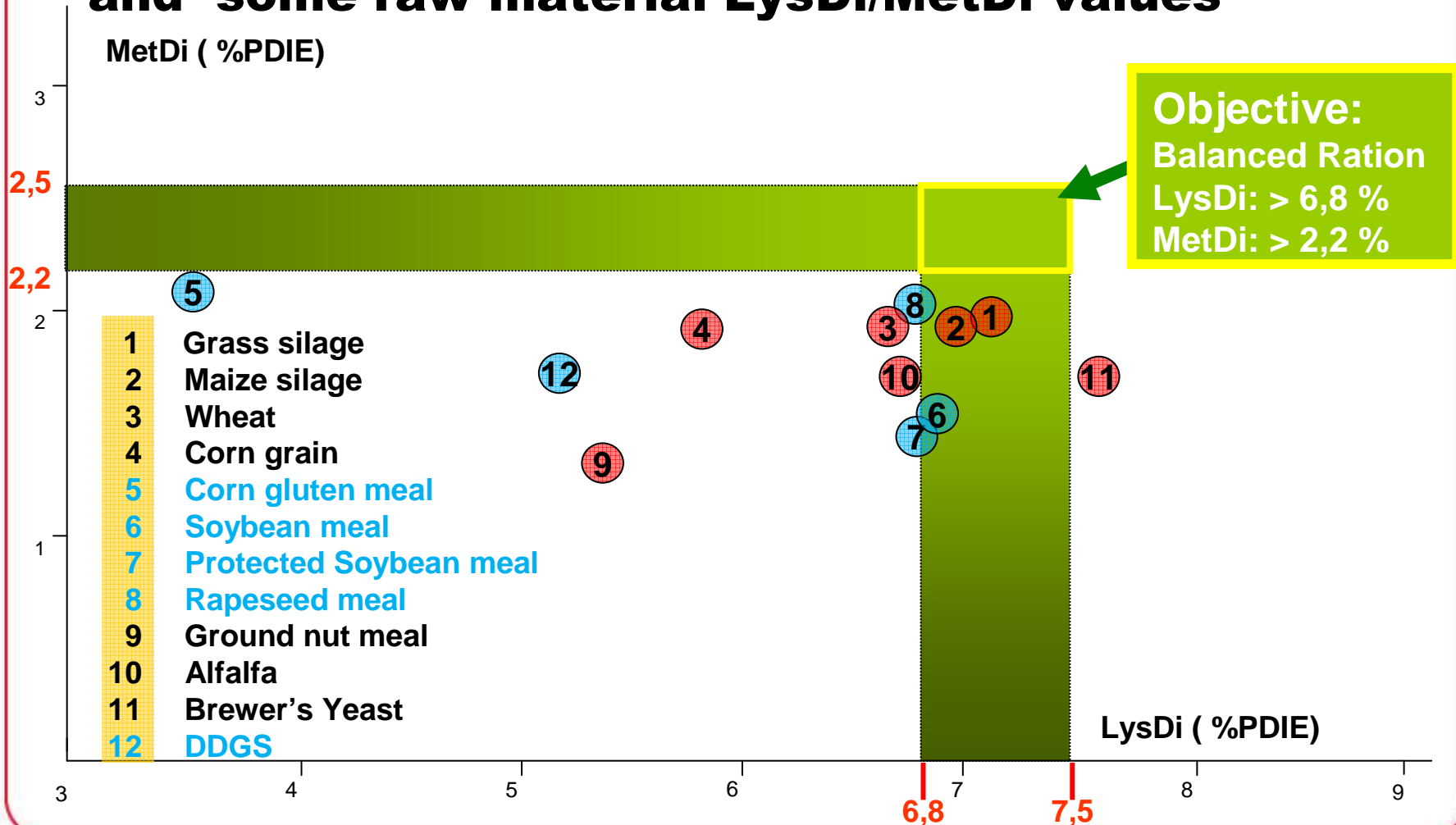




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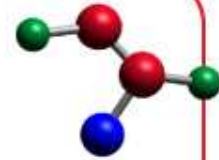
# Methionine and Lysine requirements for dairy cows and some raw material LysDi/MetDi values





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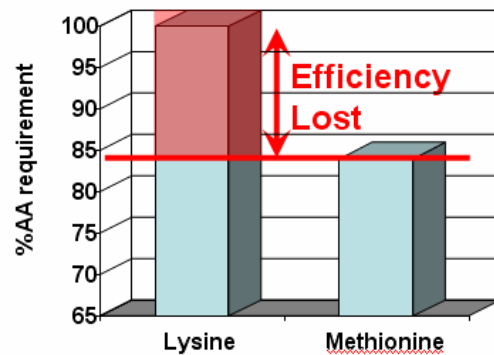
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## Amino Acid Balancing: Two options – One goal: To improve efficiency of protein utilization

### Unbalanced

LysDi /MetDi = 3,7:1



94 – 99 % of Lysine requirement

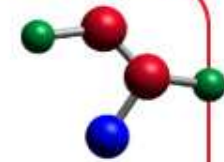
82 – 88 % of Methionine requirement

☹️ **Loss of AA and energy**

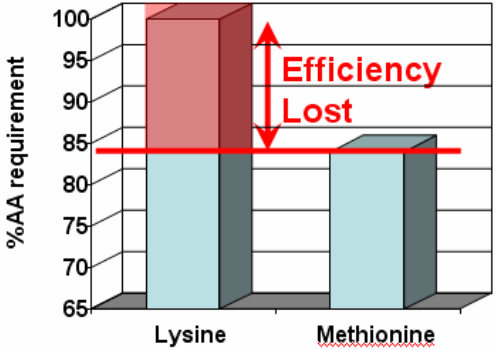
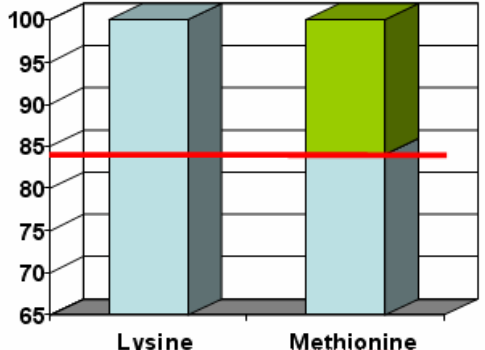
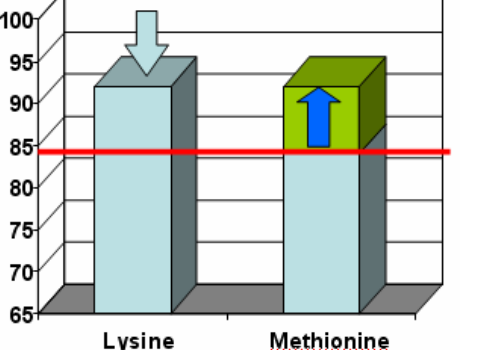
☹️ **Negative effects on  
production, health,  
fertility and  
environment**



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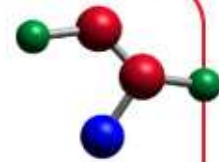
# Amino Acid Balancing: Two options – One goal: To improve efficiency of protein utilization

<b>Unbalanced</b>	<b>A</b> <b>Balanced</b>	<b>B</b> <b>Balanced</b>
<b>LysDi /MetDi = 3.7:1</b>	<b>= 3.1:1</b>	<b>= 3.1:1</b>
 <p>A bar chart with the y-axis labeled '%AA requirement' ranging from 65 to 100. The x-axis has two categories: 'Lysine' and 'Methionine'. A horizontal red line is drawn at approximately 84%. The Lysine bar is tall, reaching about 100%, with a red arrow pointing down from its top to the red line, labeled 'Efficiency Lost'. The Methionine bar is shorter, reaching about 82%.</p>	 <p>A bar chart with the y-axis labeled '%AA requirement' ranging from 65 to 100. The x-axis has two categories: 'Lysine' and 'Methionine'. A horizontal red line is drawn at approximately 84%. Both the Lysine and Methionine bars are tall, reaching about 98%.</p>	 <p>A bar chart with the y-axis labeled '%AA requirement' ranging from 65 to 100. The x-axis has two categories: 'Lysine' and 'Methionine'. A horizontal red line is drawn at approximately 84%. The Lysine bar is tall, reaching about 95%, with a light blue arrow pointing down from its top. The Methionine bar is shorter, reaching about 82%, with a blue arrow pointing up from its top.</p>
<p>☹️ <b>Loss of AA and energy</b></p> <p>☹️ <b>Negative effects on production, health, fertility and environment</b></p>	<ul style="list-style-type: none"> <li>▶ Improved protein efficiency</li> <li>▶ “Better” and “more healthy” ration</li> <li>▶ Improved milk protein production</li> <li>▶ Less N pollution</li> </ul>	<ul style="list-style-type: none"> <li>▶ Improved protein efficiency</li> <li>▶ Lower CP resp. PDI</li> <li>▶ “Better” ration at same or lower costs</li> <li>▶ Same or better milk protein production</li> <li>▶ Less N pollution</li> </ul>



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## Balancing dairy rations for Lysine and Methionine with MetaSmart® has a positive impact on several parameters



Improving milk ingredients



Increasing milk yield



Improving N-efficiency  
Reducing N-excretion



Reducing  
metabolic problems



Improving reproduction

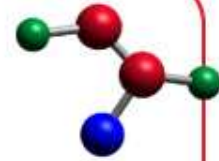


Is profitable



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# Option B



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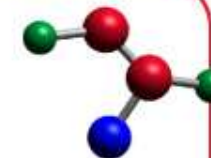
## Supplementation of Met and selection of highly digestible rumen undegradable protein to improve nitrogen efficiency for milk production. (1)

(adapted from Noftsger, S. and N.R. St-Pierre. 2003. J. Dairy Sci. 86 958-969)

Treatment	Hi RUP, Hi CP	Hi RUP, Low CP	Hi RUP, Low CP, AA
NDF, %	32	32.1	32.1
CP, %	18.4	16.9	16.9
RDP, %	10.6	10.1	10.1
RUP, %	7.8	6.8	6.8
MP balance, g/d	-7	-68	-275
RDP balance, g/d	161	51	49
RUP balance, g/d	-8	-81	-332
Lys, % MP	6.56	6.52	6.51
Met, % MP	1.69	1.74	2.04
Lys MP / Met MP	3.88	3.75	3.19



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## Characteristics of diets (2)

(adapted from Noftsger, S. and N.R. St-Pierre. 2003. J. Dairy Sci. 86 958-969)

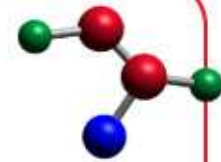
Treatment	Hi RUP, Hi CP	Hi RUP, Low CP	Hi RUP, Low CP, AA	Price of RM (€/T)(dec 08)
Dry matter intake (kg/day)	23.3	23.2	23.6	
Corn silage	8.7	8.7	8.9	130
Alfalfa silage	2.9	2.9	3.0	200
Ground shelled corn	4.6	5.2	5.3	160
Soybean meal (48%)	2.1	1.7	1.8	270
Whole cottonseed	2.0	1.9	2.0	250
Soy hulls	0.8	0.8	0.8	180
Porcine meat meal				400
Blood meal	0.9	0.6		420
MetaSmart® Liquid*			0.024	7000
Megalac	0.1	0.1	0.1	600
Tallow	0.1	0.1	0.1	500
Urea		0.04	0.04	300
Minerals & vitamins	1.1	1.1	1.1	600
Cost / diet (€/cow/day)	4.84	4.69	4.70	



Lower cost



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## Results : Improved protein efficiency (3)

(adapted from Noftzger, S. and N.R. St-Pierre. 2003. J. Dairy Sci. 86 958-969)

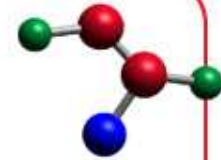
Treatment	Hi RUP, Hi CP
Dry matter intake (kg/day)	23.3 b
Milk (kg/day)	46.2 b →
MP Allowable Milk	48.9
Fat (kg/day)	1.67
Protein (kg/day)	1.38 b →
Fat %	3.64
Protein %	2.98 a
MUN (mg/dL)	17.28 a →

- Decrease of CP% only → lower milk and milk protein yields
- Decrease of CP% + balanced Amino Acid → same yield



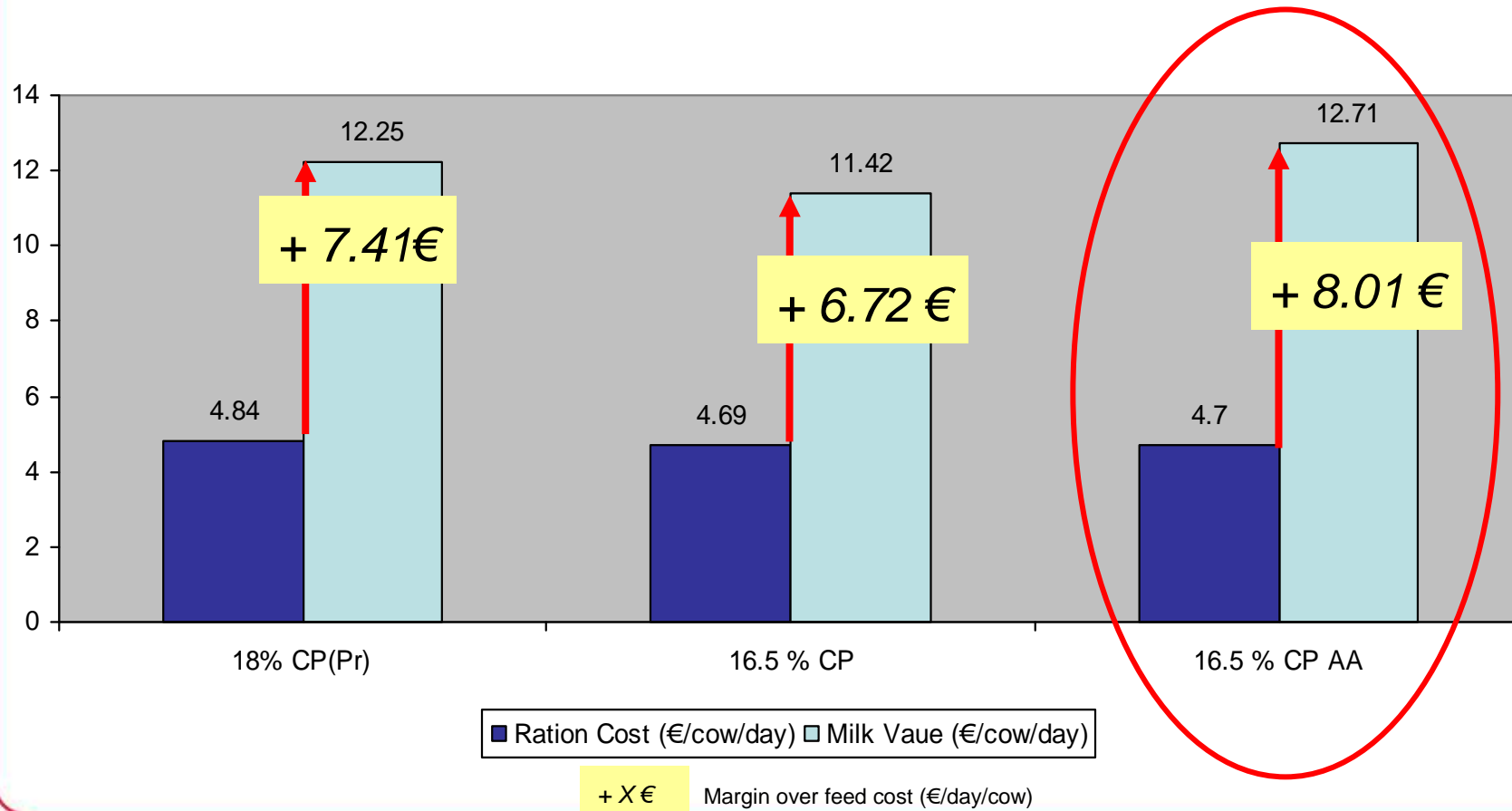
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## Income over feed costs (4)

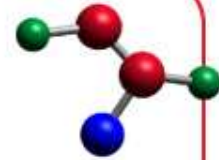
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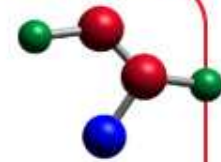
# **Metabolisable protein requirement depends on diet amino acid profile**

**Dr. H. Rulquin**

UMRPL, 35590 St Gilles, France



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# Database

DCAARET: Trials with Met, Lys, & Met + Lys supplementation from 1976-2009:  
640 diets

Met & Met+Lys

F1 : 505

(PDIN-PDIE)/UFL > -8

F2 : 451

MetDI < 2.5

F3 : 347

- outliers

F4 : 336

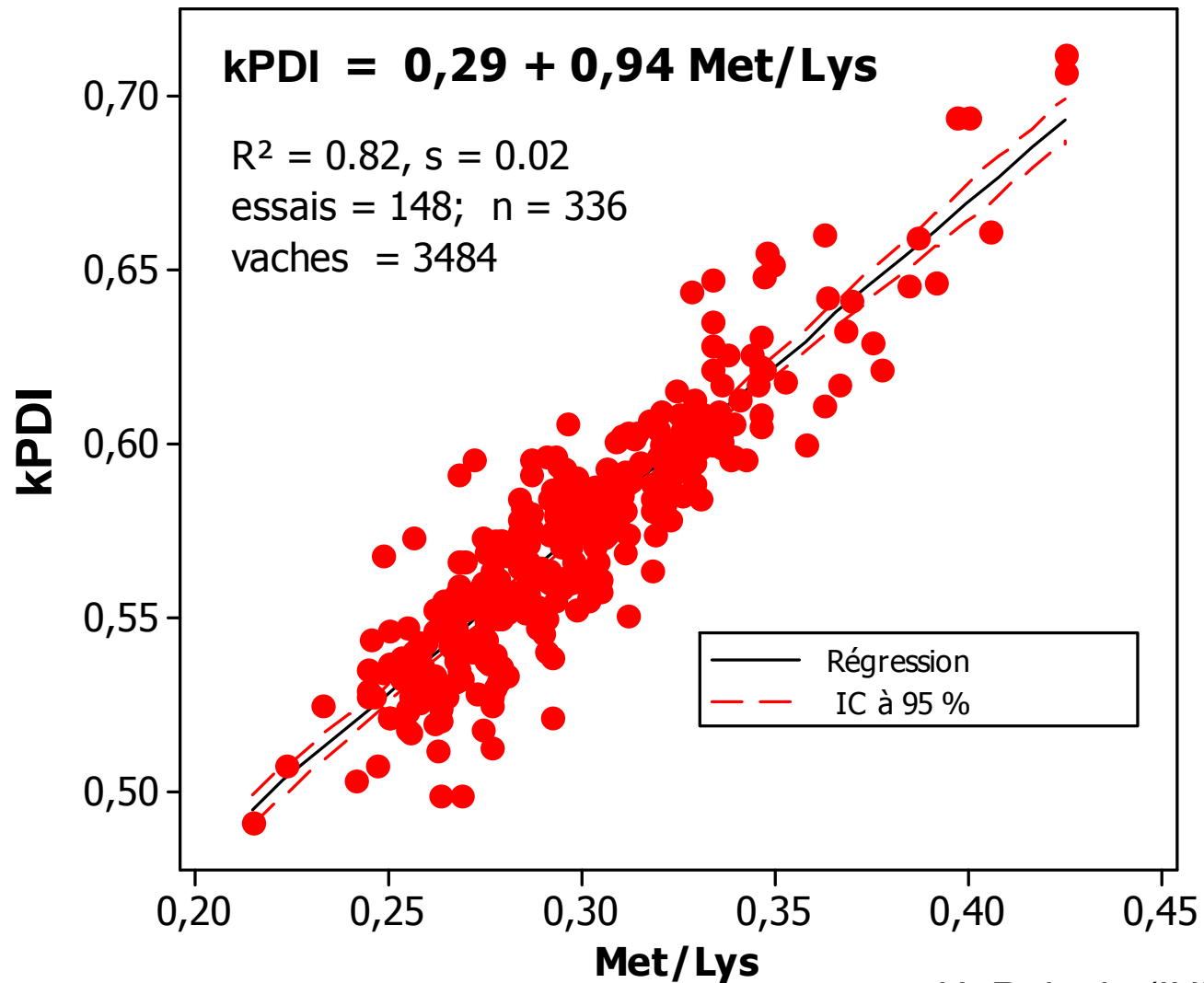
# Database characteristics

<b>Data</b>	<b>Average</b>	<b>Standard deviation</b>	<b>Minimum</b>	<b>Maximum</b>
<b>DMI, kgDM/day</b>	20.6	3.3	11.6	30
<b>CP (% DM)</b>	16.5	2.2	13.2	26.1
<b>MetDI (% PDIE)</b>	2.05	0.23	1.5	2.5
<b>LysDI (% PDIE)</b>	6.87	0.72	5.44	13.25
<b>MetDI/LysDI</b>	0.299	0.037	0.17	0.425

# Database characteristics

<b>Variable</b>	<b>Average</b>	<b>Standard Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
<b>Milk, kg/day</b>	31.8	6.6	15.6	52.7
<b>Milk protein, g/kg</b>	31.1	2.1	26.8	38.8
<b>Butter fat, g/kg</b>	37.4	4.9	22.7	51.5

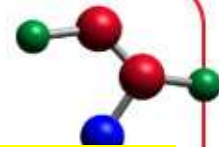
# MP efficiency according to AA profile





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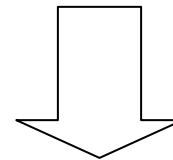
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## 2 ways to use improved MP efficiency

Example: Increase in MP efficiency for a « standard » 600 kg cow

	Control	+ 6g MetDI
LysDI, g/day (% PDIE)	142 (6.84)	142 (6.80)
MetDI, g/day (% PDIE)	38 (1.83)	44 (2.11)
MetDI / LysDI ratio	26.8%	31.0%



MP efficiency increase	$0.94 * (0.310 - 0.268) = 0.04$ pts ou + 6.2% (0.04 / 64)
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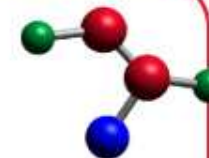
## 1) Use the current PDI supply better

	Control	+ 6g MetDI
Milk protein, g/day (PDI for prod. x kPDI)	$1695 \times 0.64$ <b>= 1085 g</b>	$1695 \times (0.64 + 0.04)$ <b>= 1152 g</b>
<b>Milk protein increase (g/day)</b>	<b><math>1152 - 1085 = + 67 \text{ g/cow/day (+6.2\%)}</math></b>	
<b>Milk protein content increase (g/kg)</b>	<b><math>(67/35) = + 1.9 \text{ g/kg}</math></b>	



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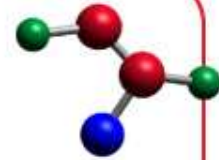
## 2) Reduce PDI supply

	Control	+ 6g MetDI
<b>PDI needed for milk, g/day (Milk Protein/kPDI)</b>	$1085/0.64$ <b>= 1695 g</b>	$1085/(0.64+0.04)$ <b>= 1596 g</b>
<b>Reduction in PDI needed, g/day</b>	<b><math>(1695 - 1596) = 99 \text{ g/day}</math> (5.8 %)</b>	



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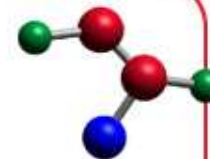
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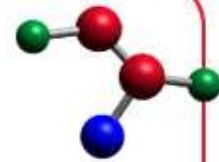


# Example from Research Institute

Young et al, Hillsborough University (N Ireland), July 2008,  
BSAS 2009



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## Protocol design

## Option B

### ◆ TMR diet

- 40% forage
  - 60% grass silage
  - 40% maize silage
- 60% concentrate (compound feed vary among groups)



#### STANDARD GROUP

CP: 17.5% in DM

#### Amino acid balance

Lysine 6.9%

Methionine 1.9%

Ratio 3.63 : 1

#### LOW CP GROUP

CP: 14.5 % in DM

40 g of MetaSmart Dry

#### Amino acid balance

Lysine 6.9%

Methionine 2.3%

Ratio 3.0 : 1



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## Lower CP diet with MetaSmart® performed as well as high CP diet

Effect of dietary regime on food intake and milk production (210 day average)

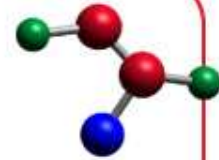
	<b>Standard TMR 17.5%CP</b>	<b>Low Protein 14.5%CP + MS</b>	<b>sig</b>
DMI (kg/day)	19.8	19.6	ns
Milk yield (kg/day)	33.5	33.4	ns
Milk fat (%)	3.81	3.85	ns
Milk protein (%)	3.40	3.38	ns

Young et al., 2008

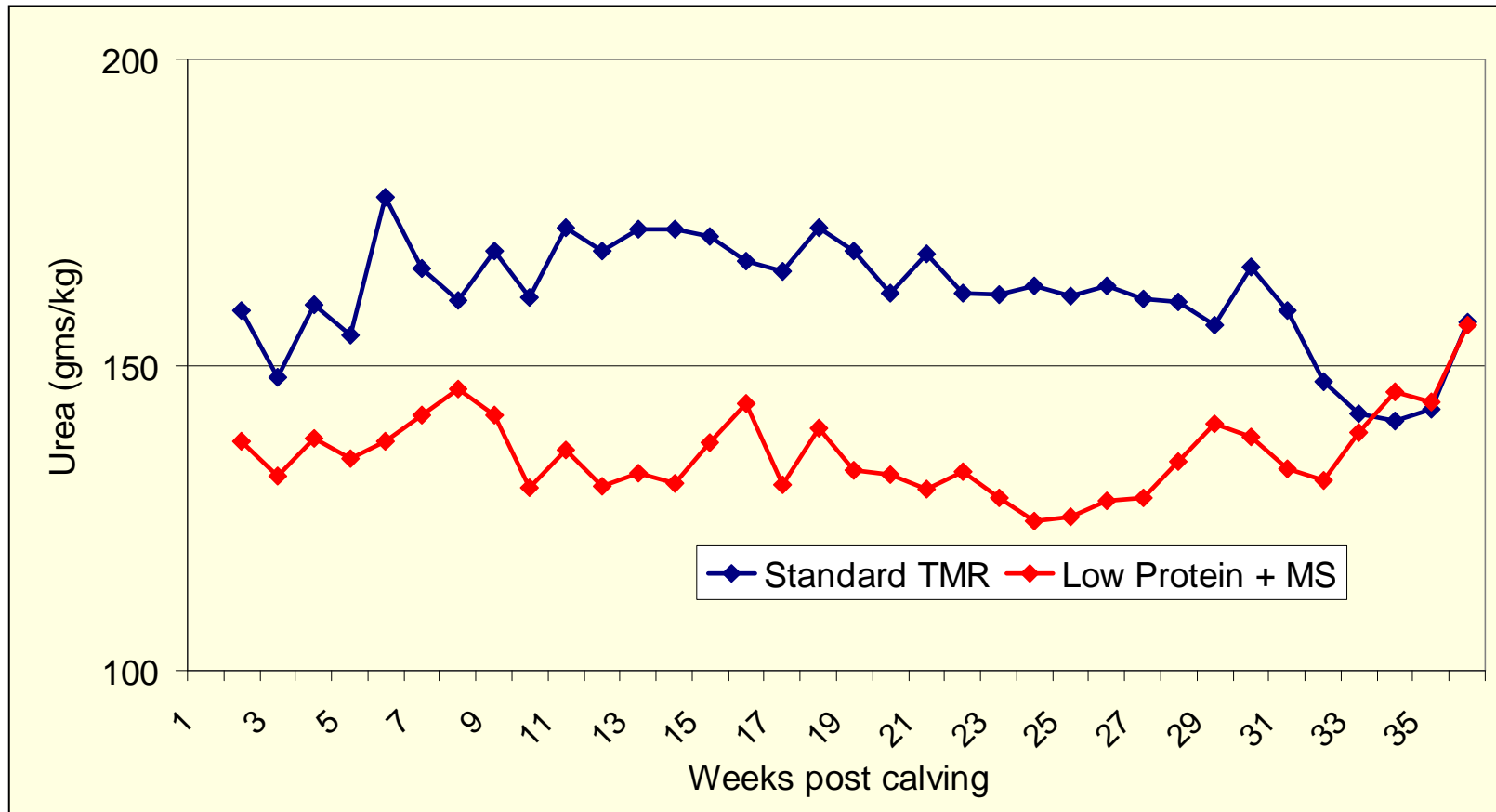


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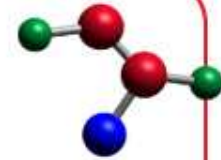
## Positive effect on Milk Urea with Lower CP diet including MetaSmart®



Young et al., 2008



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# Protein efficiency was greatly improved in lower CP diet with MetaSmart®

N efficiency of the two rations

	<i>Standard TMR</i>	<i>Low Protein</i>	<i>sig</i>
Milk N/N intake (proportion)	0.31	0.38	***

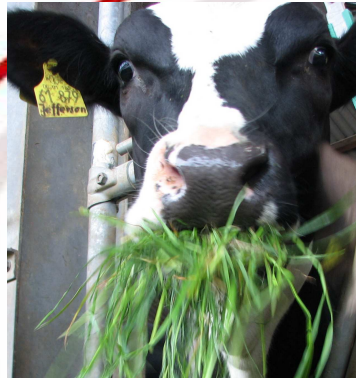


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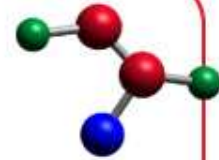
# SmartMILK under German Conditions





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## Challenge

1. No official Amino Acid System in Germany.
  - DE System also used in PL and CZ
2. Rapeseed meal (protected and un-protected) in high quantities in German, Polish and CZ rations
  - Methionine level in RSM is not as low as in SBM.
  - Lysine level is lower than in SBM
3. Very low milk prices and low cost of protein feeds in 2009.

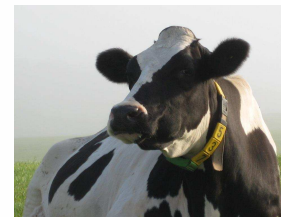


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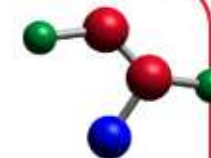
## Farms

		<b>Farm A</b>	<b>Farm B</b>
<b>Cows</b>	<b>n</b>	<b>93</b>	<b>55</b>
<b>Milk yield</b>	<b>kg/year 2008</b>	<b>10,187</b>	<b>10,059</b>
<b>Fat</b>	<b>%</b>	<b>3.89</b>	<b>4.08</b>
<b>Protein</b>	<b>%</b>	<b>3.50</b>	<b>3.41</b>
<b>Housing</b>		<b>Free stall barn</b>	<b>Free stall barn</b>
<b>Milking</b>		<b>2 x/day</b>	<b>2 x/day</b>
<b>Feeding</b>		<b>TMR Mixing wagon  2 groups</b>	<b>Automatic feeding stations Feeding wagon without mixer Lockboy (11x/day) 1 group</b>





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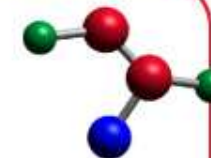


## Ration composition Farm A (kg/day)

Component	Without MetaSmart	Protein reduced + MetaSmart®
Grass silage 1. cut	6.5 kg DM	not changed
Maize silage	<b>5.2 kg DM</b>	<b>5.4 kg DM</b>
Straw, wheat	0.6	not changed
Wheat/Maize 1:1	<b>3.6</b>	<b>4.0</b> ↑
Sugar beet pulp, dry	<b>1.0</b>	<b>1.4</b> ↓
Rapeseed meal	<b>2.7</b>	<b>2.1</b> ↓
Rapeseed meal, protected	<b>2.7</b>	<b>2.1</b> ↓
Glycerol, crude	0.2	not changed
Urea	0.08	not changed
Limestone	0.05	not changed
Vitamine-mineral-mix	0.14	not changed
Supplement with MetaSmart®	0	0.100 (30 g)



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## Ration composition Farm B (kg/day)

Components	Before Without MS	Protein reduced + MetaSmart®
Grass silage 1. cut	17.0 (4.5 kg DM)	not changed
Grass silage 2. cut	6.0 (3.2 kg DM)	not changed
Maize silage	14.0 (5.6 kg DM)	not changed
Straw, wheat	0.5	not changed
Protein concentrate, 38% CP	3.2	2.4
Sugar beet pulp, dehydrated	0.7	1.1
Barley	0	0.5
Supplement with MetaSmart®	0	0.110
Limestone	0.030	not changed
Salt	0.020	not changed
Vitamin-Mineral-Mix	0.110	not changed
Triticale/maize 1:1	2.0	not changed
Rapro, rumen protected RSM	1,5	not changed



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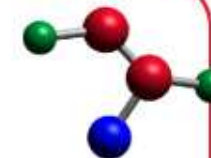
## Ration parameters

		Farm A		Farm B	
		Control	MetaSmart®	Control	MetaSmart®
DM	kg/day	21.5	21.5	20.3	20.3
NEL	MJ/kg DM	7.0	7.0	6.8	6.8
Crude fibre	g/kg DM	16.1	16.0	18.1	17.9
Starch+ sugar	g/kg DM	26.7	28.3	23.4	24.5
Crude Protein	g/kg DM	17.7	16.5	17.0	16.2
Ruminal balance	g/kg DM	40	15	23	4
Lysine	% of requirement	96.5	96.9	96.2	96.2
Methionine	% of requirement	87.0	100	84.5	98.8



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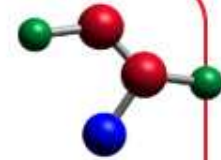


## Effects of MetaSmart® in a reformulated ration on milk yield, milk composition and nitrogen efficiency

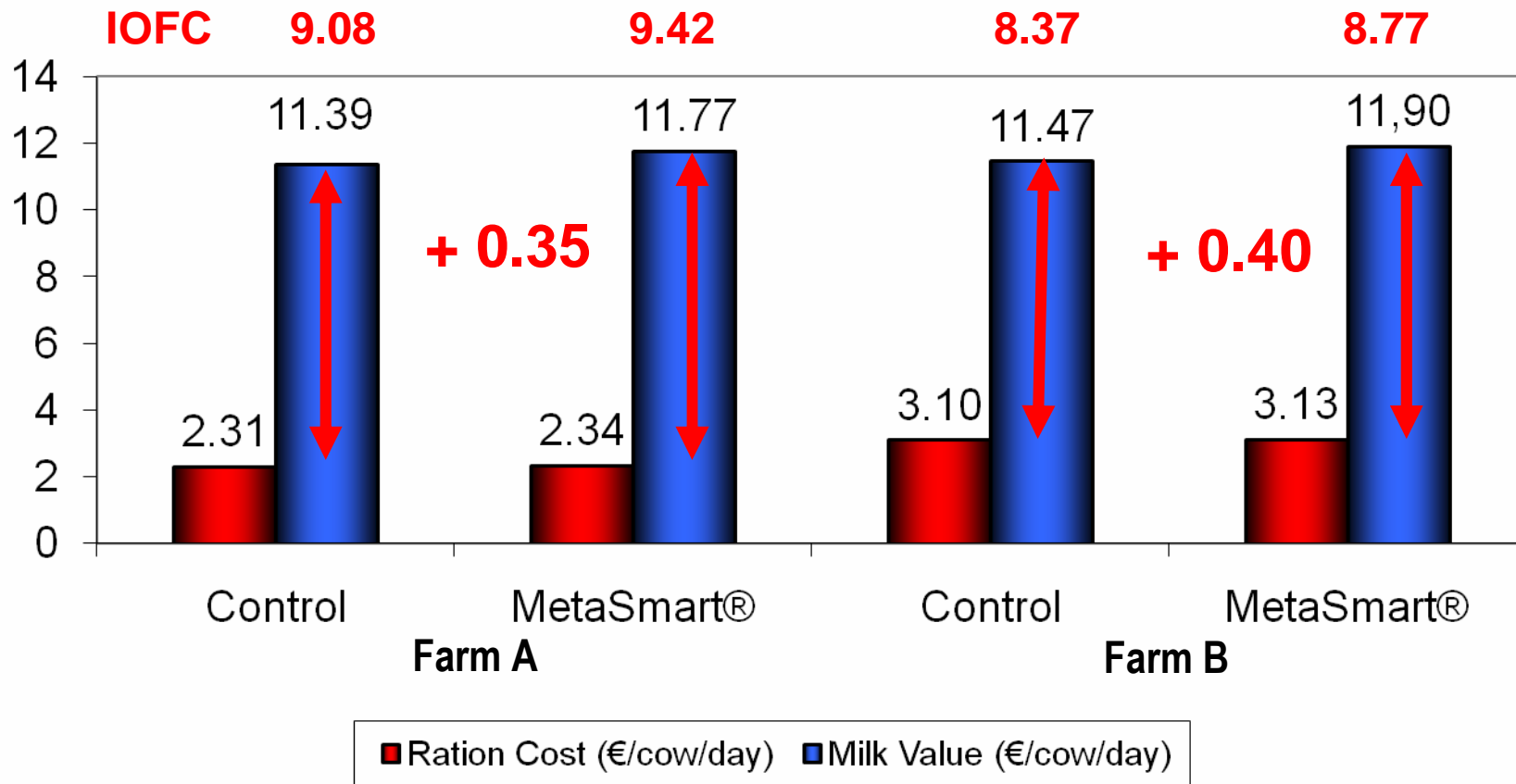
		Farm A			Farm B		
		Control	MetaSmart®	Diff.	Control	MetaSmart®	Diff.
Milk	kg/day	33.2	34.1	+ 0.9	33.45	34.8	+ 1.35
Protein	%	3.45	3.51	+ 0.06	3.42	3.43	+ 0.01
	g/day	1146	1197	+ 52	1142	1192	+ 50
Fat	%	3.84	3.80	-0.04	4.19	4.13	- 0.06
	g/day	1273	1294	+ 21	1400	1435	+ 35
Milk urea	ppm	217	202	- 15	252	195	- 57
N-efficiency	%	29.5	33.1	+3.6	32.5	35.6	+ 3.1



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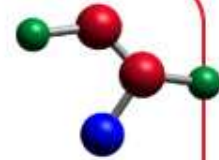
## Economical benefits – Milk price: 32 ct/kg milk





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## Presentation outline

### Introduction

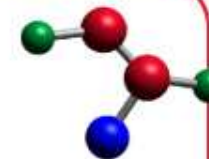
1. The feed industry – a quick overview
2. AA nutrition – Current practice
  - A seminal trial: Ohio State University
  - AA impact on MP efficiency
    - the « Rulquin Equation », follow-up to the « Rulquin Ratios »
  - Illustrations
  - **Field validation**
3. **Economics and Putting this into practice**

### Conclusion



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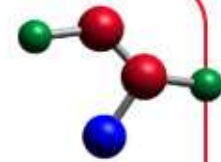
# Analysis of 11 reformulation field trials with MetaSmart® in Europe





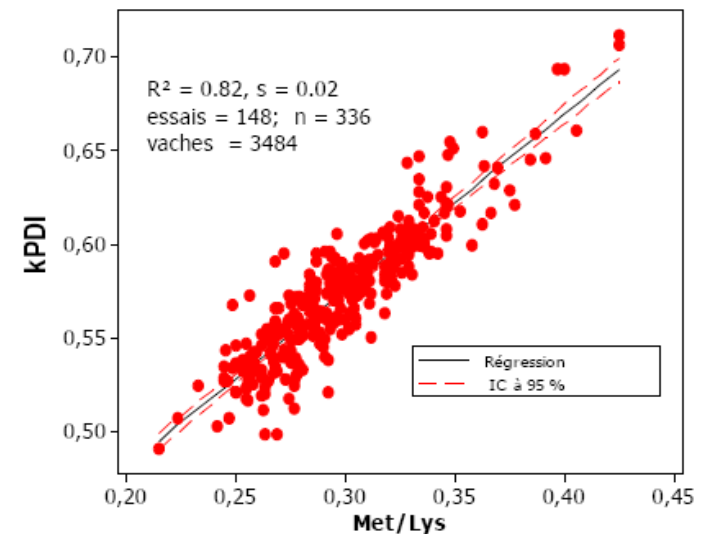
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## Field trial goals

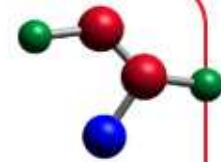
1. Demonstrate efficacy of lower CP diets balanced for AA with MetaSmart®
2. Confirm increased N efficiency according to Rulquin equation under field conditions
3. Evaluate impact on farm performance





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## Field trial conditions: Animals

- Total cows on farms: 5 500
- Over 2 200 cows actually in trials
- Breeds
  - Holstein: 9 trials
  - Jersey: 2 trials
- Production level:
  - Holsteins: 9.000 – 11.000 kg milk/year
  - Jerseys: 6.000 – 7.000
- CP levels (on average):
  - Before : 16.6 %DM (min: 14.8%; max: 18.5%)
  - After re-formulation: 15.8 %DM (14.3% – 17.5%)
  - Difference: - 0.8 % (-0.4% to – 3%)





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## MP Efficiency increased 5.5% on average

Treatment		Actual MP efficiency	Met/Lys ratio	Predicted MP efficiency
		%	%	%
Average	Control	56.6	27.5	54.8
	Re-formulated	62.1	32.6	59.7
	<b>Improvement</b>	<b>5.5</b>	<b>5.2</b>	<b>4.8</b>

→ Met/Lys ratio average increased

→ Actual MP efficiency is well-predicted by Rulquin equation



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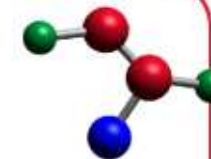
## Increased yields; or same performance for lower cost

Treatment		Milk kg/day	Protein g/kg	Fat g/kg
Average	Control	33.0	34.1	42.7
	Re-formulated	33.4	34.7	43.1
	<b>Improvement</b>	<b>0.4</b>	<b>0.6</b>	<b>0.4</b>
Up to	Control	30.3	32.1	41.0
	Re-formulated	32.6	33.6	43.5
	<b>Improvement</b>	<b>2.3</b>	<b>1.5</b>	<b>2.5</b>

→ Increase in yield, even when re-formulating to lower crude protein



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## Economic benefits

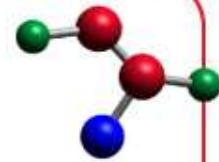
		<b>Total</b>	<b>Impact on</b>	<b>IOFC</b>
		<b>€/cow/day</b>	<b>feed cost</b>	
			<b>€/cow/day</b>	<b>€/cow/day</b>
Average	Improvement	0.23	-0.03	0.26
Up to	Improvement	0.77	-0.42	0.55

→ **Extra value: up to 77 cts/cow/day**



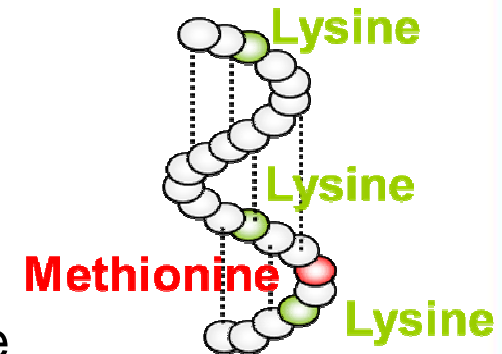
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## Take-home messages

1. Like monogastrics, cows need amino acids  
– not crude protein, PDI, DVE or MP
2. Most European rations are deficient in methionine
  - but there is a specific need for methionine to ensure proper metabolism, milk protein synthesis and fewer metabolic disorders.
3. Recommendations for methionine and lysine requirements are now available in most important Protein Evaluation Systems.
4. Methionine and lysine contents in feedstuffs are available in many databases.





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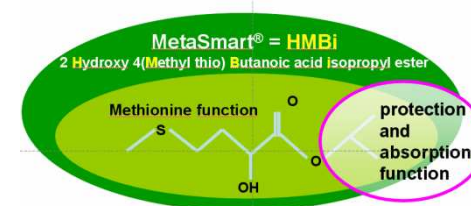
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## More take home messages

5. **MetaSmart®** is a source of rumen protected, highly bioavailable methionine which helps to fill the methionine deficiency in our dairy rations as shown in various research trials and commercial trials.

- The supply of MetaSmart® allows for a better use of the rest of dietary amino acids.
- Therefore the efficiency of protein utilization is significantly improved.
- As a result the same performance can be obtained with less protein in the diet (or better performance with same protein in the diet).

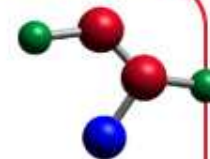


6. Amino acid balancing helps to reduce N-excretion to the environment, has positive effects on liver health and reduces the N-burden of the cow.
7. Amino acid balancing improves overall farm efficiency.



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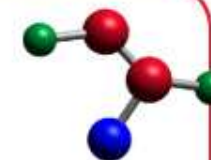
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# Environmental impact



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## Effect of HMB and HMBi supplementation on milk production, milk composition, SCC, and feed efficiency

	Treatments (% of DM)				SEM	<i>P</i> <sup>1</sup>		
	HMB: 0	0.10%	0	0.045%		HMB	HMBi	Interaction
HMBi: 0	0	0	0.15%	0.15%				
DMI (kg/d)	22.7	22.8	23.5	23.0	0.68	0.80	0.40	0.62
Milk production (kg/d)	39.8	40.7	42.3	43.2	1.23	0.46	0.04	0.99
Fat-corrected milk (kg/d) <sup>2</sup>	37.4	39.5	41.9	42.2	1.13	0.22	0.001	0.39
Milk composition (%)								
True protein	2.81	2.88	2.97	2.95	0.042	0.45	0.006	0.28
Fat	3.61	3.76	3.82	3.86	0.111	0.41	0.19	0.66
Lactose	4.79	4.91	4.86	4.83	0.031	0.13	0.77	0.03
Production (kg/d)								
True protein	1.102	1.158	1.228	1.261	0.035	0.15	0.001	0.72
Fat	1.436	1.553	1.654	1.666	0.050	0.17	0.001	0.28
Lactose	1.904	1.992	2.051	2.089	0.056	0.04	0.001	0.24
Log(SCC)	4.49	4.29	4.12	4.41	0.270	0.87	0.64	0.37
MUN (mg/dL)	12.6	13.6	12.0	11.3	0.45	0.69	0.01	0.01
PUN (mg/dL) <sup>3</sup>	15.4	16.0	14.5	16.0	1.1	0.38	0.71	0.72
Gross feed efficiency <sup>4</sup>	1.79	1.78	1.78	1.89	0.07	0.42	0.46	0.36

<sup>1</sup>Significance of the main effects of HMB, HMBi, and their interaction.

<sup>2</sup>Calculated as (0.4 × milk) + (15 × fat content).

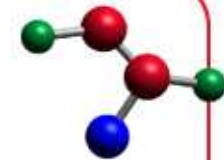
<sup>3</sup>PUN = Plasma urea N.

<sup>4</sup>Calculated as kg of milk/kg of DMI.

St-Pierre and Sylvester, 2005



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## Ingredient and expected nutrient composition of controldiet

Ingredients	DM, % of total ration	Expected chemical composition <sup>1</sup>	
Alfalfa hay	17.50	DM	59.1
Corn silage	32.50	CP	16.6
Cottonseed, whole with lint	10.00	RDP	10.5
Corn grain, ground, dry	25.00	RUP	6.2
Soybean hulls	5.08	NDF	31.3
Tallow	1.00	Forage NDF	20.0
Calcium soaps of fatty acids	1.00	ADF <sup>2</sup>	22.5
Soybean meal, solvent extracted	2.50	NFC	41.2
Blood meal, ring dried	2.73	NE <sub>L</sub>	1.63
Urea	0.31	MP <sup>2</sup>	10.9
Salt	0.40	Ca	0.74
Limestone	0.30	P	0.38
(Di) Calcium phosphate	0.38	Mg	0.36
Sodium bicarbonate	0.75	K	1.22
Dynamate (K and Mg sulfate)	0.10	S	0.21
Magnesium oxide	0.25	Metabolizable Met, % of MP	1.80
Trace minerals and vitamin premix	0.15	Metabolizable Lys, % of MP	6.81

<sup>1</sup>Calculations based on NRC (2001) model using a 650-kg cow producing 45 kg of milk at 3.50% fat, 3.00% true protein, 4.8% lactose, and consuming 26.0 kg of DM/d.

<sup>2</sup>MP = Metabolizable protein.

St-Pierre and Sylvester, 2005



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## Nitrogen partitioning of diets supplemented with HMB, HMBi, or a combination.

	Treatments (% of DM)				SEM	<i>P</i> <sup>1</sup>		
	HMB: 0	0.10%	0	0.045%		HMB	HMBi	Interaction
HMBi: 0	0	0	0.15%	0.15%				
N intake (g/d)	618	627	631	627	20	0.76	0.63	0.90
Estimated fecal N (g/d) <sup>2</sup>	202	204	204	204	17	0.76	0.63	0.90
Estimated urinary N (g/d) <sup>3</sup>	177	186	166	162	10	0.85	0.08	0.53
N milk (g/d)	184	194	205	211	6	0.15	0.01	0.74
Gross N efficiency (%) <sup>4</sup>	29.8	30.1	32.5	33.6	0.95	0.17	0.02	0.67
Environmental N load <sup>5</sup>	2.06	2.01	1.80	1.73	0.12	0.21	0.01	0.98

<sup>1</sup>Significance of the main effects of HMB, HMBi, and their interaction.

<sup>2</sup>Calculated as (N intake × 0.17) + 97, from Jonker et al., 1998.

<sup>3</sup>Calculated as 0.0259 × BW (kg) × MUN (mg/dL), from Kauffman and St-Pierre, 2001.

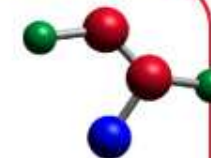
<sup>4</sup>Calculated as milk N/N intake × 100

<sup>5</sup>Calculated as kg of fecal N + kg of urinary N/g of N milk.

St-Pierre and Sylvester, 2005



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## Performance and N measurements for diets that vary in crude protein (n = 60)

		<b>18 % CP</b>	<b>16 % CP + Met</b>
DMI	kg/day	23.3 <sup>a</sup>	23.6 <sup>a</sup>
Milk yield	kg/day	46.2 <sup>a</sup>	46.6 <sup>a</sup>
Protein production	kg/day	1.38	1.44
Fat production	kg/day	1.67	1.71
Milk N production	g/day	214	228
Gross N efficiency <sup>1</sup>	g/g	31.1 <sup>a</sup>	35.0 <sup>b</sup>
Environmental efficiency <sup>2</sup>	kg/kg	2.25 <sup>a</sup>	1.89 <sup>b</sup>
Milk urea N (MUN)	mg/dl	17.3 <sup>a</sup>	13.5 <sup>b</sup>
Plasma urea N (PUN)	mg/dl	20.6 <sup>a</sup>	17.8 <sup>b</sup>

Different superscripts indicating differences at  $P < 0.05$

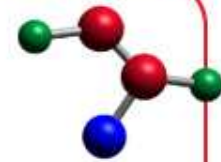
<sup>1</sup> Calculated as milk N/N intake \* 100

<sup>2</sup> Calculated as kilograms N excreted/kilogram N in milk

Noftsker and St-Pierre, 2003



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## Balancing AA's can reduce N load on land

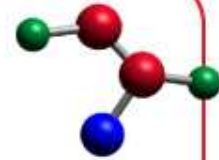
- EU Nitrogen Directive:  
Will limit manure spreading (to 170kg N per ha per year)
- Better balanced diets:  
Will help – They excrete less N in manure
- Example: OSU 2005 trial

	Control	MetaSmart
<b>Land required</b> to produce 1 million liters milk (ha)	56 ha	51 ha
<b>Stocking rate allowed</b> (cows per 100 ha)	89 cows	97 cows



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## Presentation outline

### Introduction

1. The feed industry – a quick overview
2. AA nutrition – Current practice
  - A seminal trial: Ohio State University
  - AA impact on MP efficiency
    - the « Rulquin Equation », follow-up to the « Rulquin Ratios »
  - Illustrations
  - Field validation
- 3. Economics and Putting this into practice**

### Conclusion



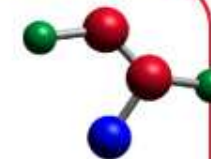
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## Product information



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## AA balancing: 3 options and their advantages

Option	Action on ration	Technical benefit	Economic benefit	
			Typical Profit*	Typical ROI
<b>Option A</b> "On top"	Add MetaSmart to ration containing enough lysine Improves performance	+ 0-2 kg milk + 0.1-0.2% fat + 0.1-0.2% protein	<b>Profit = + 45 cts</b>	<b>ROI = 260%</b>
<b>Option B</b> "Cost-neutral"	Reformulate ration - maintain same cost by improving AA balance. Intermediate performance improvement	+ 0.1 % fat + 0.1 % protein	<b>Profit = + 27 cts</b>	<b>ROI = 100%</b>
<b>Option C</b> "Cheaper ration"	Reformulate ration to reduce cost, by reducing CP in diet, thanks to AA balancing (improved N efficiency) Maintains performance	Savings: 5-10 cts 0.05 % fat (?) 0.05 % protein (?)	<b>Profit = 5-23 cts</b>	<b>ROI = 40-170%</b>

\*Profit expressed in eurocents/cow/day

...and cows benefit from lower MUN, lower N excretion, better health (liver function) and reproduction (fertility)



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## Commercial sources of RP-Met, HMB, and HMBi

### Rumen-protected methionine

Lipid/polymer protected

Fiber/lipid protected

Lipid protected

Smartamine™ M

Mepron® M85

Methioflex™

### Met analog (HMB)

Free forms

Ca salt

Alimet®

Rhodimet™ AT 88

MFP™ (CaMHA)

### Met analog (HMBi)

MetaSmart™

*Source: Dr. C.G. Schwab, UNH*



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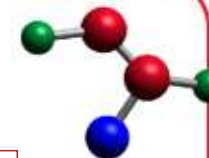
## Reasonable estimates of efficacy for some common Met sources for lactating dairy cows

	Ruminal use/loss	Absorption	Hindgut/fecal loss	Met available to cow
	(% of consumed)			
Smartamine	10-20	80-90	0	80-90
Mepron	30	35-50	20-30	35-50
Alimet/AT 88	95	5	0	5
MetaSmart	50	40-50	0	40-50

Based on a summary of research by Schwab



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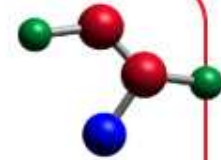


## Two Examples of Rumen Protected Lysine Products

AminoShure-L	Megamine - L
<p>Balchem Corp.</p> <p>53% Coating (fat product, feed grade) and 47% Lys-HCL (38% Lys)</p> <p>Company suggests a 64% Lys "bioavailability"</p> <p>MP-Lys = 24.3% of product</p>	<p>Church and Dwight</p> <p>80% MEGALAC and 20% Lys-HCL (16% Lys)</p> <p>Company suggests a 46% Lys "bioavailability"</p> <p>MP-Lys = 7.4% of product</p> <p><i>Source: Dr. C.G. Schwab, UNH</i></p>



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## Two Other Examples of Rumen Protected Lysine Products

### LysiPEARL™

Kemin (imported from Italy)

A matrix of 49% Lys-HCL in long chain (saturated) fatty acids of palm oil (39% Lys)

Company suggests a 50% Lys "bioavailability" (54% bypass, 91% digestibility)

MP-Lys = 19.5% of product

### LYSINE 35™

Jefo

A matrix of 44% Lys-HCL and hydrogenated vegetable oil (35% Lys)

Company suggests a 72% Lys "bioavailability" (75% bypass, 96% digestibility)

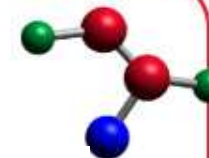
MP-Lys = 25% of product

Source: Dr. C.G. Schwab, UNH



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## Two Other Examples of Rumen Protected Lysine Products

### AjiPro™-L

Ajinomoto Heartland, LLC

A matrix of 50% Lys-HCL in hydrogenated vegetable oil (40% Lys)

Company suggests a 40% Lys "bioavailability"

MP-Lys = minimum of 16.0% of product

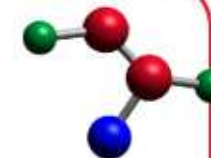
### Next one?



Source: Dr. C.G. Schwab, UNH



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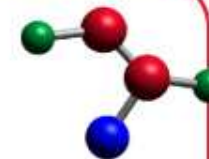
## US economics – 3 milk price situations

	2009 (Low milk prices)	2004 (Normal milk prices)	2008 (High milk prices)
<b><i>“Average” protein and fat (80 lb milk) (no AA balancing)</i></b>			
Protein	\$5.34	\$6.01	\$9.39
Fat	3.72	5.79	4.66
<b>Total milk</b>	<b>9.71</b>	<b>12.13</b>	<b>14.31</b>
<b><i>“Moderate” responses to AA balancing (+ 1 lb milk, +0.1 % protein)</i></b>			
Protein	\$5.59	\$6.28	\$9.82
Fat	3.77	5.86	4.72
<b>Total milk</b>	<b>10.01</b>	<b>12.48</b>	<b>14.80</b>
<b><i>“Above average” responses to AA balancing (+2 lb milk, +0.2% protein, +0.1% fat)</i></b>			
Protein	\$5.84	\$6.57	\$10.26
Fat	3.92	6.10	4.91
<b>Total milk</b>	<b>10.42</b>	<b>13.00</b>	<b>15.43</b>



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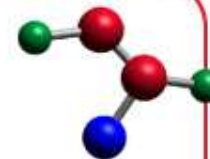


## The Kemin-Adisseo RumiTeam is here to help





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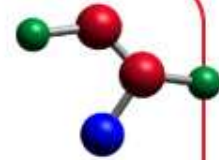
## Ruminant team

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## Presentation outline

### Introduction

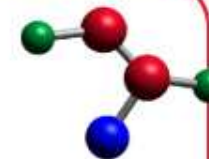
1. The feed industry – a quick overview
2. AA nutrition – Current practice
  - A seminal trial: Ohio State University
  - AA impact on MP efficiency
    - the « Rulquin Equation », follow-up to the « Rulquin Ratios »
  - Illustrations
  - Field validation
3. Economics and Putting this into practice

### Conclusion



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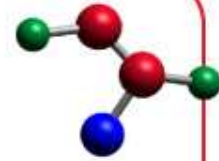
## Some of the main questions to Rednex researchers

- Keys to consistency
- Interactions with other factors
- Other AA's coming into play at low CP levels
- Establish requirements in g/day instead of %PDI
- Quantify relationship between AA's and protein yield



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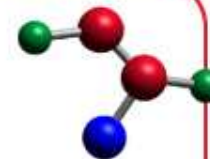
## Conclusion

- AA nutrition already has a good scientific foundation
- Already well-practiced in the field, although not yet widespread
- Two things needed:
  - Put into the main national systems,
  - Increase consistency of effectiveness, through better knowledge of other parameters at play and interactions
- The industry is eagerly awaiting Rednex results, to improve dairy farmers' nutrition, value and sustainability



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*Thank you  
for  
your attention !*

This presentation has been carried out with financial support from the Commission of the European Communities, FP7, KBB-2007-1.



It does not necessarily reflect its view and in no way anticipates the Commission's future policy in this area.



***Innovative and practical management approaches to **reduce nitrogen excretion by ruminants*****