AGVANCE
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WEBINAR:

Setting the cow up for success:

Protein nutrition in early lactation

Presented by SHAUN BALEMI

KEY QUESTIONS

1. Protein overview, measurement, and requirements

2. Types of protein available and how protein works in the cow

3. Practical application, milk urea and other measurables

WHAT IS FEED PROTEIN?

Feed protein is made up of true protein (TP) and non-protein nitrogen (NPN)

Commonly measured as crude protein (CP)

Calculated as NPN + RDP + RUP/UDP = MicroP + RUP = MP/Amino Acids

Protein fractions:

A1 = Ammonia

A2 = Soluble true protein - quick

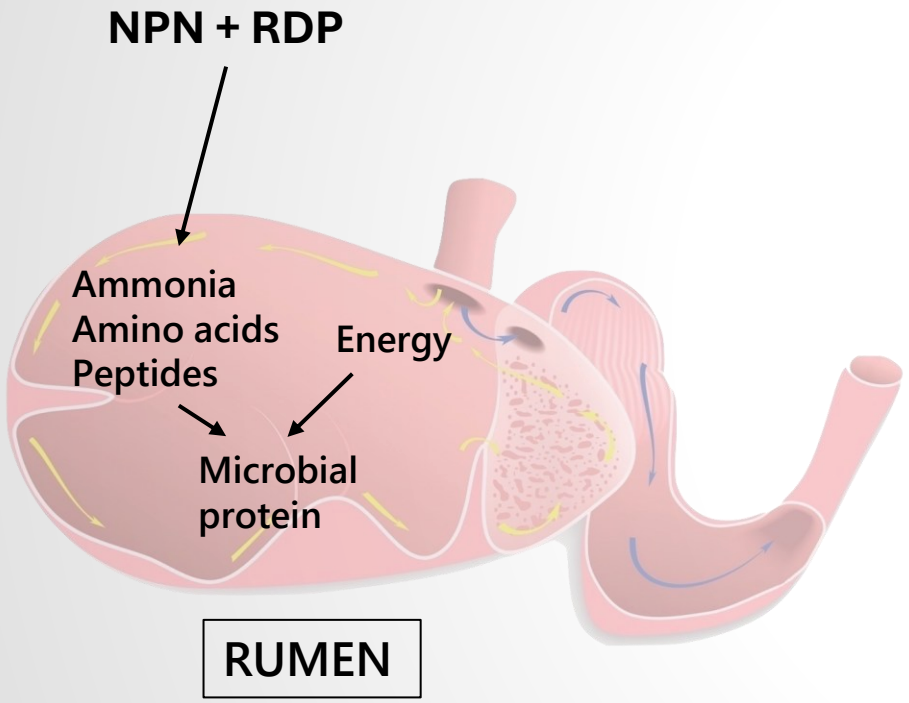
B1 = Moderately degraded

B2 = Slowly degraded

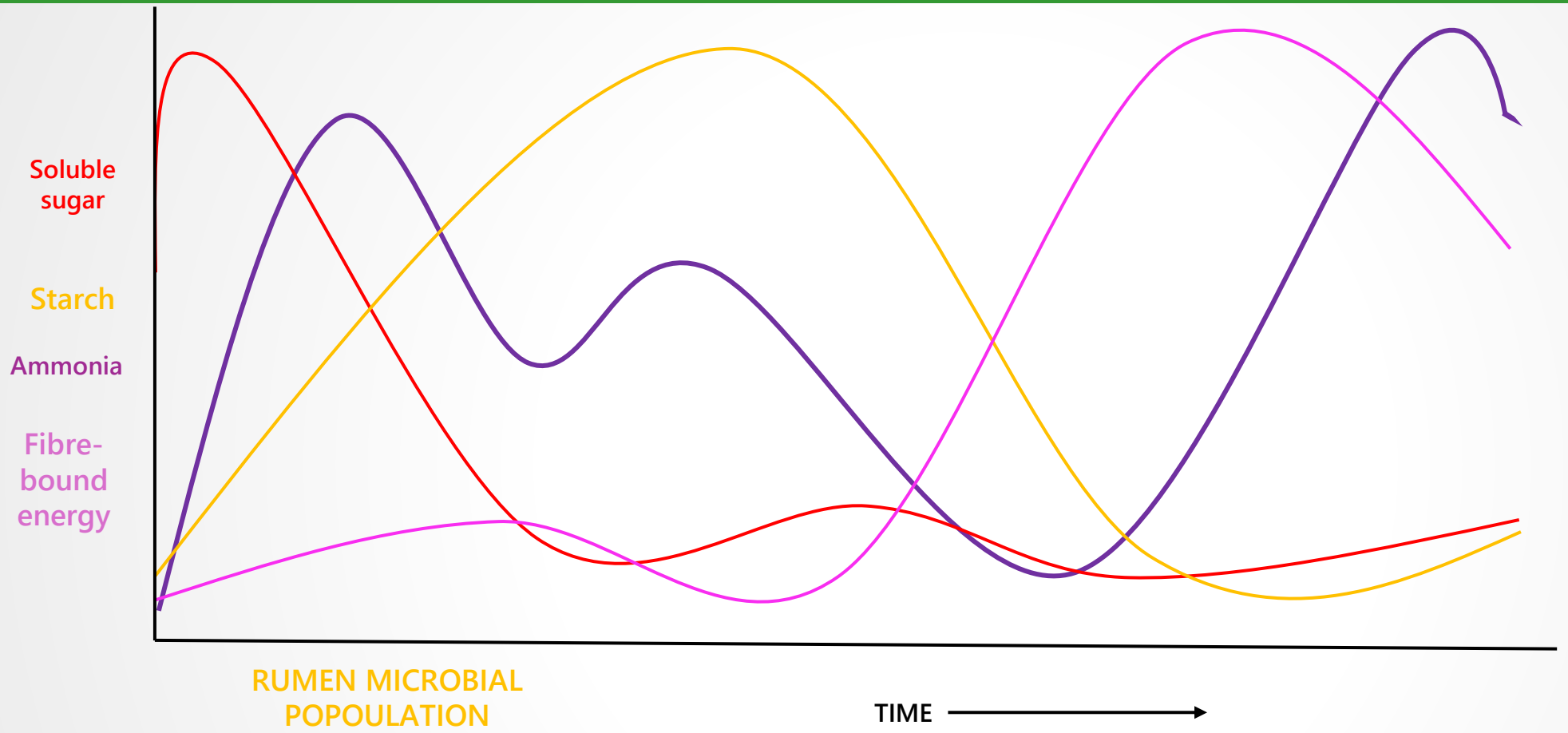
C = Poorly available

End up as **amino acids (AA)**

PROTEIN METABOLISM



PROTEIN METABOLISM



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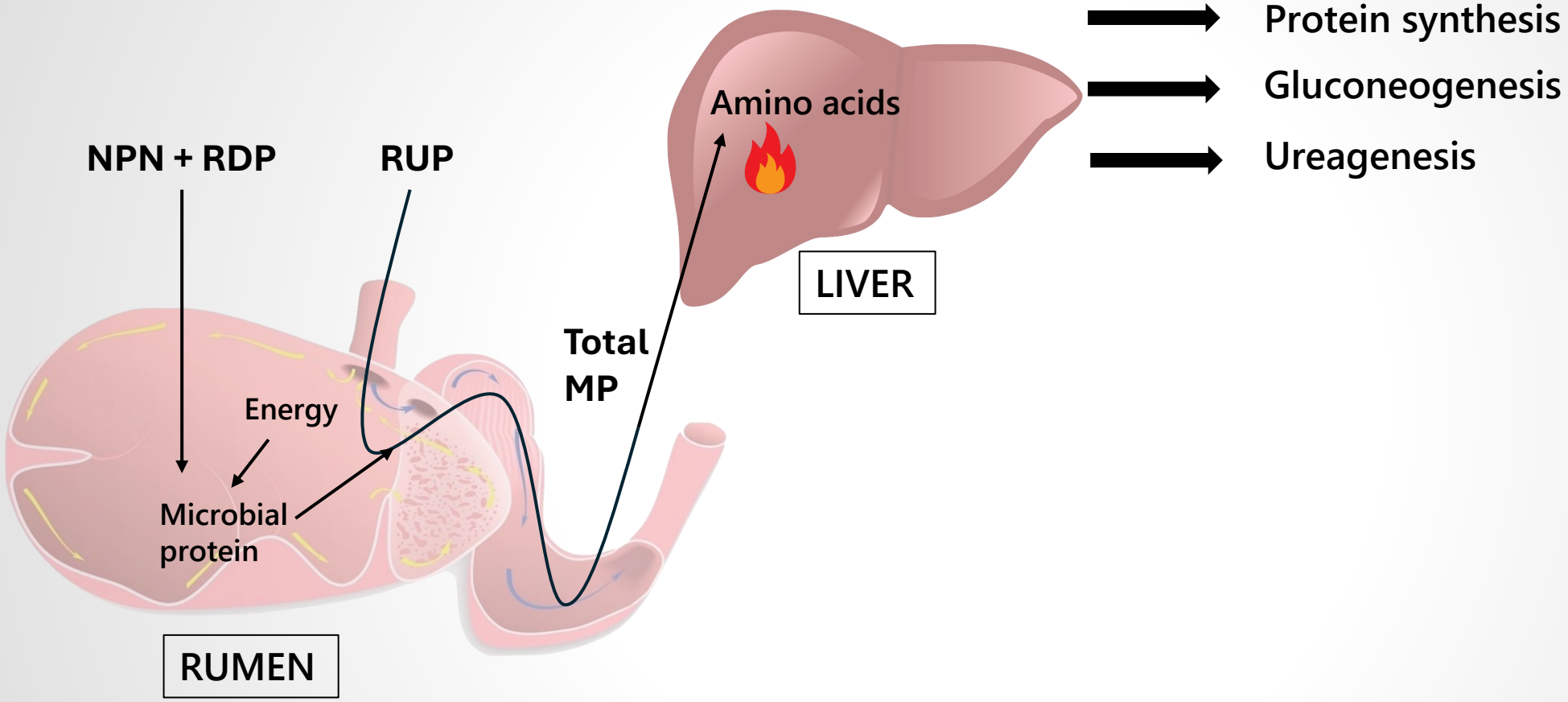


NON-PROTEIN NITROGEN (NPN)

A1, protein fraction, also measured as nitrogen % in herbage

NPN is quickly broken down by the rumen microbes into ammonia

But ammonia is toxic, so as concentration builds, it is passed out of the rumen via the portal vein into the liver, where it is converted to urea

RUMEN DEGRADABLE PROTEIN (RDP)

A1, A2 and some B1 - encompasses all protein that is utilised in the rumen

RDP is used to build the all-important microbial protein

RDP is also broken down into peptides and amino acids along with ammonia by rumen microbes

These peptides and AAs are also used to build microbial protein and can help to modulate ammonia production

(John, W.R. 1996, Wright, D.E., Lambert et al., 1999)

METABOLISABLE PROTEIN - MP

Metabolisable protein (MP) = Microbial protein + RUP

Rumen varies, so microbial protein varies, so MP varies.

The better you fed the rumen the more microbial protein it can produce.

High RDP, high milk urea = opportunity to increase microbial protein by increasing energy density and/or rumen stability.

RUMEN UNDEGRADABLE PROTEIN (RUP)

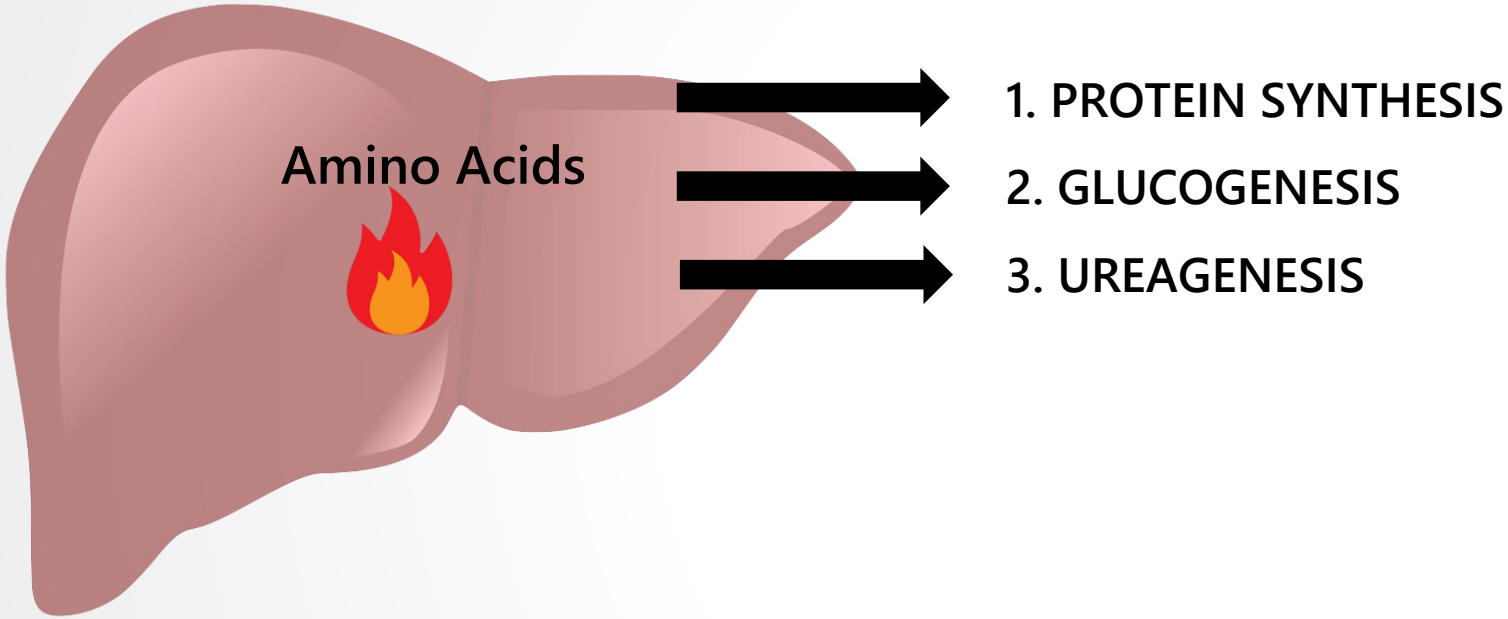
RUP/UDP is also known as rumen bypass protein

It is the fraction of protein that the rumen microbes cannot break down; therefore, it moves through the rumen intake and is absorbed in the small intestine.

Protein is often heat-treated to increase RUP%. Alters protein structure, blocking microbial enzyme digestion

RUP contributes directly to amino acid supply to the liver rather than increasing rumen ammonia

PROTEIN METABOLISM



1. PROTEIN SYNTHESIS
2. GLUCOGENESIS
3. UREAGENESIS

1. Export proteins

Albumin, various transport proteins and VLDL components, which are critical for the liver's ability to get rid of fat build-up

2. Constitutive proteins

These remain in the liver for structure, function, metabolic balance, and enzyme production

- ✓ Less ketosis/fatty liver
- ✓ Better immune system and oxidative function
- ✓ Metabolic balance
- ✓ Stronger appetite

GLUCONEOGENESIS

Gluconeogenesis is a critical function when energy supply does not meet demand

Gluconeogenesis is burning stored and supplied amino acids as an alternative energy source when propionate supply is limited

- ✓ Stronger appetite
- ✓ Better peak milk
- ✓ Better reproduction
- ✓ Less condition loss
- ✓ Less ketosis

UREAGENESIS

Key role of the liver is to detoxify ammonia (urea cycle) from the rumen into urea excreted via the urine and milk

Detoxifying wastes both ENERGY and AMINO ACIDS

High NPN diets stress the urea cycle

Poor liver health can upset urea cycle efficiency, increasing milk and blood urea levels due to decreased metabolic urea use

- ✓ Less energy and AA wasted
- ✓ Stronger appetite
- ✓ Better liver function
- ✓ Better animal health

PROTEIN REQUIREMENTS?

Only really useful in the dry period, transition period and fresh period

COW STAGE	4.7-5.2 BCS	>5 BCS	Ketosis history
Dry period	12% CP	14% CP	14% CP
Transition period	14% CP	18% CP	18% CP
Fresh period	16% CP	16% CP	16% CP

PROTEIN MEASUREMENTS

Crude protein – CP% & metabolisable protein - MP%

Non-protein ammonia – NPN%

Rumen degradable protein – RDP%

Rumen non-degradable protein – RUP%

Protein fractions:

A1 = Ammonia *Rumen absorption only*

A2 = Soluble true protein, quick, very available *Rumen absorption only*

B1 = Moderately degradable protein *Some rumen & some intestinal absorption*

B2 = Slowly degraded, fibre-bound protein *High intestinal absorption*

C = Poorly available, non-degradable *Some intestinal absorption*

Amino acid profile - AA%

SUPPLEMENTARY PROTEIN SOURCES

SOYA MEAL
CP = 44-48%
NPN = Low
RDP = 65%
RUP = 35%

CANOLA MEAL
CP = 34-37%
NPN = Low
RDP = 60%
RUP = 40%

SUNFLOWER MEAL
CP = 26-50%
NPN = Low
RDP = 25%
RUP = 75%

DDG CORN
CP = 28%
NPN = Low
RDP = Low
RUP = 65%

DDG WHEAT
CP = 20-25%
NPN = Low
RDP = 11-13%
RUP = 47-57%

PEAS
CP = 20-26%
NPN = Low
RDP = 80%
RUP = 20%

PALM KERNEL
CP = 14-20%
NPN = Low
RDP = Low%
RUP = High%

PROLIQ
CP = 7-12%
NPN = Low
RDP = ??%
RUP = ??%

SINGLE-CELL PROTEIN
CP = 65%
NPN = None
RDP = ??%
RUP = ??%

AMINO ACIDS
- Methionine
- Lysine
- Histidine
- Many others

But why do some protein sources give us different results in the cow?

Ratio of NPN *to* RDP *to* RUP

1. Utilisation
2. Feed passage rates
3. Rumen stability
4. Rumen capacity
5. Protein availability

READING THE FEED

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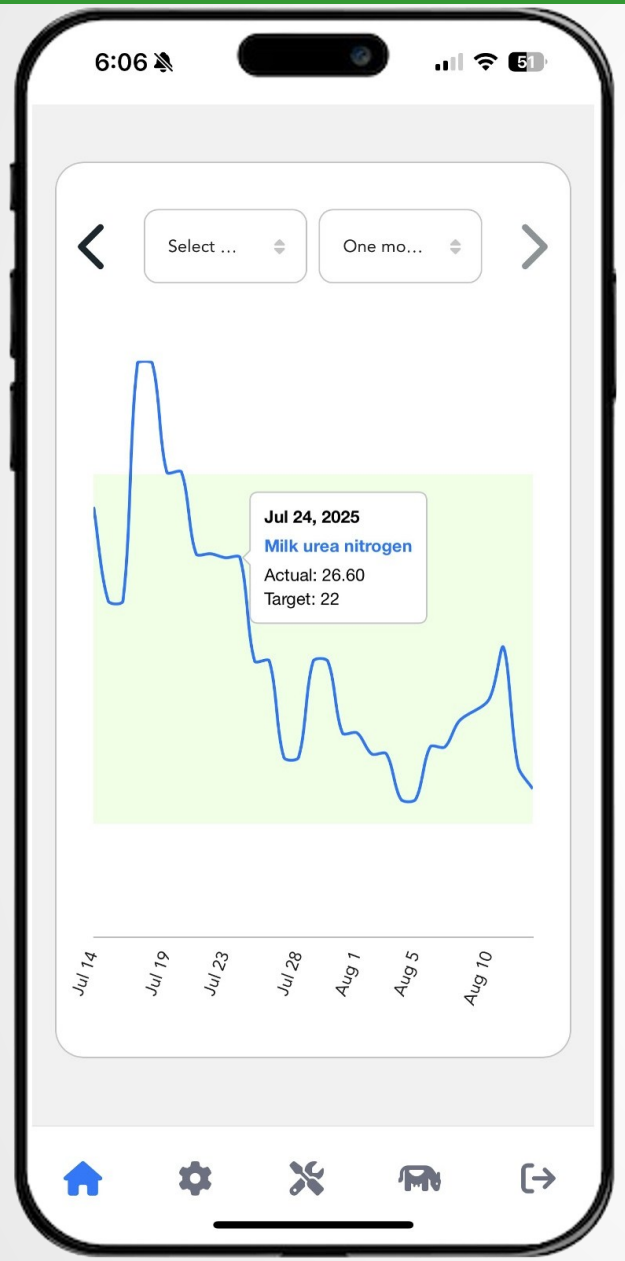
Analysis		Level Found	Medium Range*	Low	Medium	High
Nitrogen	%	3.6	4.0 - 5.0			
Nitrogen	%DM	3.7				
Phosphorus	%	0.37	0.38 - 0.45			
Potassium	%	3.1	2.5 - 3.0			
Sulphur	%	0.37	0.30 - 0.40			
Calcium	%	0.51	0.60 - 1.00			
Magnesium	%	0.21	0.20 - 0.30			
Sodium	%	0.060	0.150 - 0.300			
Chloride	%	0.73	0.30 - 2.4			
Dry Matter*	%	28.5	12.0 - 30.0			
Crude Protein	%DM	23.4	20.0 - 30.0			
Acid Detergent Fibre (seq)*	%DM	19.6	20.0 - 30.0			
Neutral Detergent Fibre*	%DM	41.1	30.0 - 45.0			
Lignin*	%DM	4.0				
Ash*	%DM	10.2	7.0 - 14.0			
Organic Matter*	%DM	89.8				
Soluble Sugars*	%DM	11.7				
Starch*	%DM	< 0.5				
Crude Fat*	%DM	3.7				
Digestibility of Organic Matter in Dry Matter (DOMD)*	%	72.5	65.0 - 80.0			
Metabolisable Energy*	MJ/kgDM	11.6	9.0 - 12.0			
Non Structural Carbohydrate*	%DM	21.7				
OMD in-vivo*	%DM	80.8				
Grass Staggers Index*	me	1.8	(<1.8 recommended, >2.2 increased risk)			
K/Na Ratio*		52	(<10 recommended, >20 increased risk)			
Ca/P Ratio*		1.4	(>1.5 recommended, <1.2 increased risk)			
DCAD*	me/kg	378	(<200 recommended, >200 increased risk)			

PROTEIN FRACTION	% DM	% CP
Crude Protein	**22**	
RDP	16.5	75
RUP	5.5	25
A1	0	0.3
A2	6.1	28
B1	9.5	43
B2	5.8	26
C	0.6	2.7
Lysine	6 g/kg DM	
Methionine	2 g/kg DM	

MILK UREA - OVERVIEW



Nitrogen/CP/RDP is broken down in the rumen by specific microbes into ammonia

Once the ammonia level gets above a certain concentration in the rumen, it must be removed

Milk and blood urea levels are indicators of the nitrogen that could not be utilised by the rumen

MILK UREA - TARGETS THROUGH THE SEASON?

Lactation Stage	AVERAGE RANGE
FRESH	MU 10-30
EARLY	MU 6-28
PEAK	MU 15-35
MIDDLE	MU 15-40
LATE	MU 17-45

Does milk urea tell us if we are feeding enough protein or not?

All milk & cow data must be looked at in combination

MILK UREA: WHAT DO WE OFTEN SEE?

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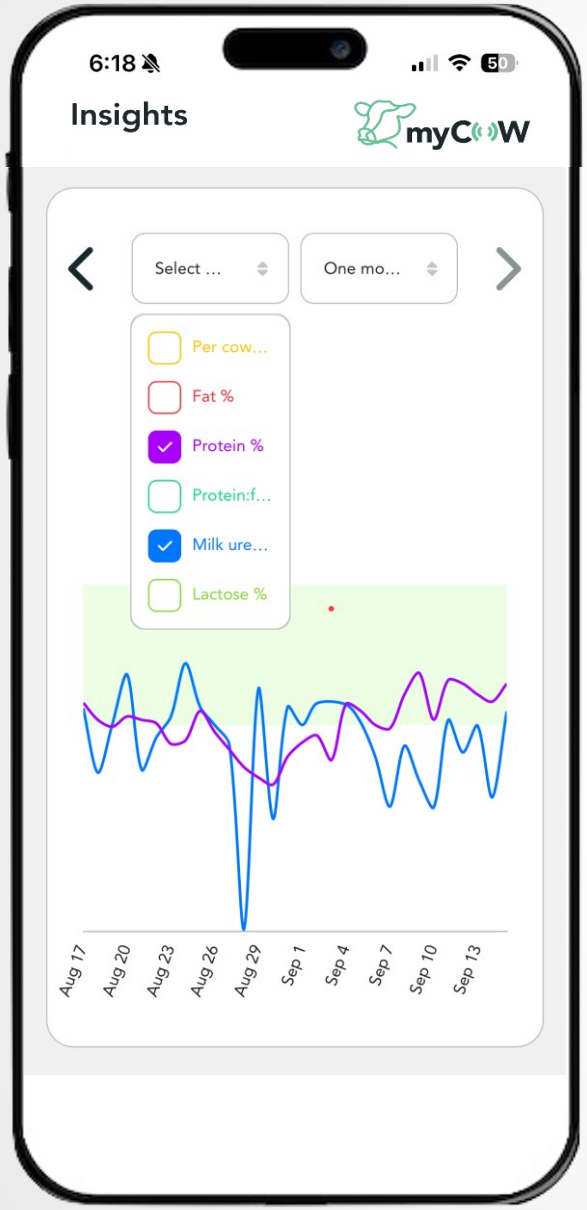

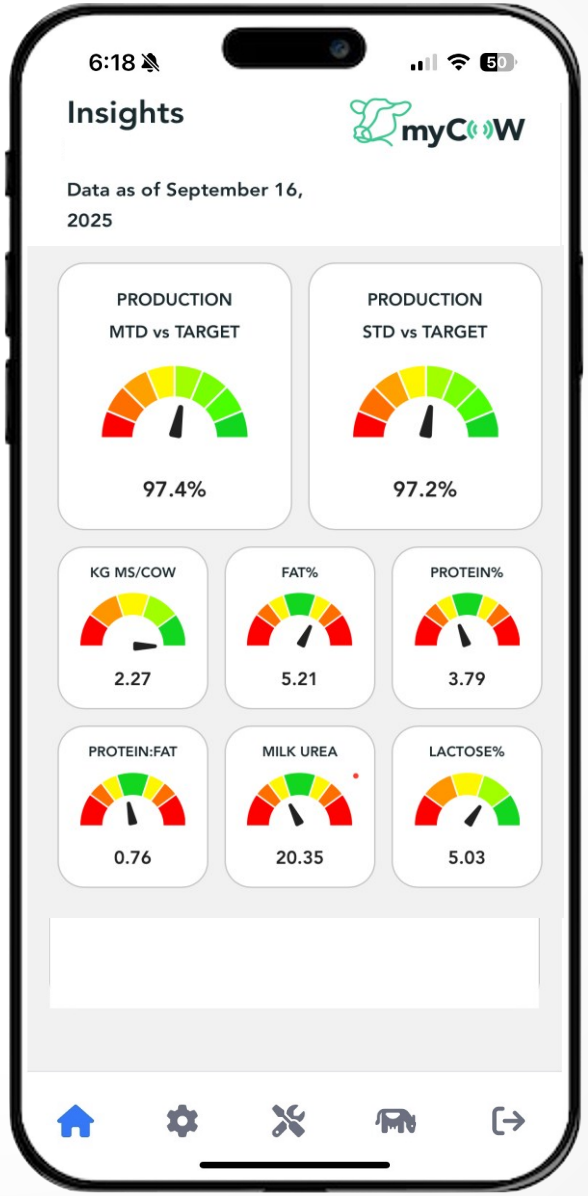

MILK UREA: HOW DO WE SHIFT THE NEEDLE?

Supplying more rumen degradable protein will stimulate high milk urea
BUT will this equal more milk?

Supplying a higher energy-dense feed will help the rumen utilise more ammonia
Starch, soluble sugar, better quality feed (higher ME)

Increasing amino acid supply will drive appetite and cow performance
Amino acids = MP... MP = RUP + MicroP

Amino acids will not shift milk urea, but will shift both fat% and protein%
Higher production per cow while maintaining balanced milk solids % is the key goal!

MILK UREA: LATEST NZ RESEARCH?

Research article Journal of New Zealand Grasslands 85: 276-283 (2023) 275

Grazing management practices and pasture composition on Waikato and Canterbury dairy farms diverging in bulk milk urea content

Chris B. GLASSEY[1,*], Roshean R. WOODS[2], Charlotte REED[1], Nauvoo PURIRI[1,3], Gavin SCOTT[4], Alison HODGKINSON[4], Racheal BRYANT[5].

Relationships between dietary factors and nitrogen partitioning to milk and urine in temperate grazing dairy cattle

Article *in* New Zealand Journal of Agricultural Research · November 2023

DOI: 10.1080/00288233.2023.2278734

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J. Dairy Sci. 108:579–596
https://doi.org/10.3168/jds.2024-25394
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A systematic review and meta-analysis of cow-level factors affecting milk urea nitrogen and urinary nitrogen output under pasture-based diets

Mancoba C. Mangwe,[1] Winston A. Mason,[2] Charlotte B. Reed,[3]* Olivia K. Spaans,[3]† David Pacheco,[4] and Racheal H. Bryant[1]
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[4]AgResearch, Palmerston North 4410, New Zealand

Research article *Journal of New Zealand Grasslands 86: 189-200 (2024)* 189

Bulk milk urea as an indicator of herd dietary nitrogen surplus and nitrogen use efficiency on Canterbury dairy farms

Roshean R. WOODS[1*], Ina (J. B.) PINXTERHUIS[1], Barbara KUHN-SHERLOCK[2], Nicole M. WHEADON[1] and J. Paul EDWARDS[1]

SUMMARY – QUESTIONS – DISCUSSION

1. Can we/should we be using urea to boost protein?

2. If we can't use soya meal due to GHG, what can we use?

3. Can we rely on CP% to balance protein levels in the feed?

THANK YOU FOR ATTENDING

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