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INTESTINAL DIGESTIBILITY OF PHOSPHORUS FROM RUMINAL MICROBES

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P UTILISATION IS LOW

Current practice

Per cow-year		
Feed	7,408 kg at 4.2 g P/kg DM	31.1 kg
-Milk:	9,420 kg at 0.96 g P/kg	- 9.0 kg
-Gain:	40 kg at 6.1 g P/kg	- 0.2 kg
-Featus:	24 kg at 10.2 g P/kg	- 0.2 kg
-Urine:	3.0 mg P/kg/d	- 0.7 kg
Faeces:		21.0 kg

P utilisation: (Milk+growth+featus) x100/feed ≈ 30%

36% P UTILISATION SEEMS MAX – WHY?

Current recommendation

Per cow-year		
Feed	7,408 kg at 3.5 g P/kg DM	25.9 kg
-Milk:	9,420 kg at 0.96 g P/kg	- 9.0 kg
-Gain:	40 kg at 6.1 g P/kg	- 0.2 kg
-Featus:	24 kg at 10.2 g P/kg	- 0.2 kg
-Urine:	3.0 mg P/kg LW/d	- 0.7 kg
Faeces:		15.8 kg

P utilisation: (Milk+growth+featus) x100/feed ≈ 36%

HIGH INEVITABLE LOSS WITH FAECES

- Loss with faeces = 2.1 g per kg feed DM at 3.5 g P / kg DM
  - Indigestible feed P
  - Incomplete reabsorption of recycled P (saliva)
  - Low digestibility of microbial P

OBJECTIVE

To estimate intestinal digestibility of rumen microbial P

Experiment with multi-fistulated dairy cows:

- Harvest of microbes
- Effect of dietary P on rumen microbial synthesis, P content and metabolism

Experiment with rats

- Estimate intestinal digestibility of rumen microbial P
- Verify the rat model to estimate intestinal digestibility of microbial matter in dairy cows

HARVEST OF RUMINAL MICROBES

- 4 multi-fistulated lactating cows
- Latin sqare design, 16 observations
- Diets: HIGH-P (3.1 g/kg DM)
  LOW-P (2.2 g/kg DM)

- Microbes isolated by sequential centrifugation of rumen fluid
- Microbial synthesis: RNA in microbes and duodenal samples

DIGESTIBILITY IN RAT MODEL

Measurement of digestibility of microbial matter in rats

- 5 groups of 5 male Wistar rats (65 g LW)
- 5 diets, fed at 10 g/d, varying content of microbial matter
- Diets adjusted to 16 g N
- Diets fed for 4 d followed by a balance period of 4 d.
- Apparent and true digestibility estimated by linear regression

RAT DIETS WITH RUMINAL MICROBES

Experimental diets adjusted to 1.5 or 3.0 g P/kg DM

Requirement

	Control	High15	High30	Low15	Low30
Ingredients (g/kg)					
Casein	113	62	11	57	3
Microbes High-P		106	211		
Microbes Low-P				119	237
N-free mixture	841	786	732	778	714
Mineral/vitamin	46	46	46	46	46

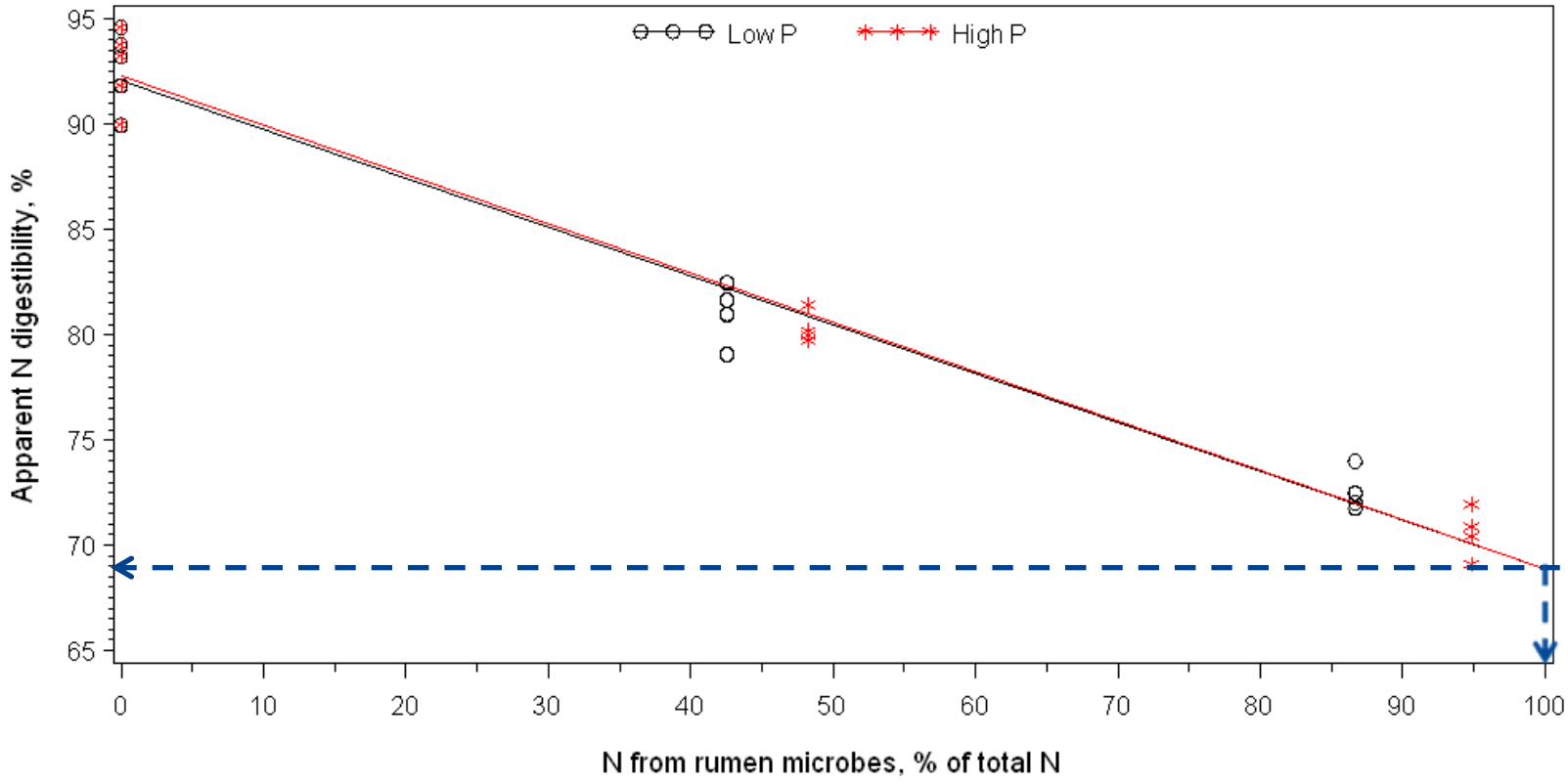
RESULTS FROM COW EXPERIMENT

	Diet		SE	Diet effect
	High P	Low P		P-value
Feed intake, kg DM/d	19.9	19.9	0.5	NS
P intake, g/d	63	44	2	<0.001
Duodenal P, g/d	100	74	3	<0.001
Minimum P recycling to the rumen, g/d	37	30	4	NS
P in rumen microbes from fluid, % of DM	1.52	1.44	0.02	<0.05
Microbial OM synthesis, kg/d	2.9	3.1	0.1	NS
P in microbial net synthesis, g/d	54	52	2	NS
Ruminal NDF digestibility, %	65	68	1	0.11

RESULTS FROM RAT EXPERIMENT

	Control	High15	High30	Low15	Low30	SE
Feed intake,						
DM, g/d	5.9	9.5	9.6	9.1	9.2	0.3
P, mg/d	5	20	29	19	31	0.6
N, mg/d	98	166	164	152	160	6
Digestibility						
DM, %	96	94	94	94	93	0.3
P, %		53	39	52	42	2
N, %	93	81	73	80	71	0.6
Amino acids, %	96	92	89	91	89	0.4

ESTIMATION OF DIGESTIBILITY



ESTIMATED DIGESTIBILITY

	RAT Total tract digestibility	COW Small intestinal digestibility	
		NRC	NorFor
Microbial N, %	69 ± 0.8	64	-
Microbial AA, %	88 ± 0.5	80	85
Microbial P, %	43 ± 4.1	-	-

The rat model is suitable for prediction of cow intestinal digestibility of rumen microbial matter

MICROBIAL METABOLISM CAUSES HIGH P LOSS

From cow experiment

- Feed intake 19.9 kg DM/d
- P in microbial net synthesis: 53 g P/d

From rat experiment

- Digestibility of microbial P: 43%

Loss of indigestible microbial P: 30 g/d or 1.5 g/feed DM

~ 43% of recommended feed P

CONCLUSION

- The rat model is suitable for prediction of cow intestinal digestibility of rumen microbial matter
- The estimated intestinal digestibility of rumen microbial P is 43%
- Low digestibility of microbial P causes a very high loss of P with faeces and is a main cause of the low P utilisation in dairy cows