

Protein requirements Germany - nXP

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Protein requirements (nXP = undegraded feed protein (UDP) + microbial protein (MP) at the duodenum)

Net protein requirements: 6.25 x

- Endog. losses via urine (UNe) g/day = 5.9206 log live weight (kg) – 6.76
- Endog. losses via faeces (FNe) g/day = 2.19 kg dry matter intake (kg)
- Surface losses through skin, hair etc. (VN) g/day = 0.018 live weight (kg^{0.75})
- Milk protein
- Protein gain (pregnancy)

Protein requirements (nXP = undegraded feed protein + microbial protein at the duodenum)

Utilisation of absorbed nXP-amino acid-N at the duodenum:

milking cows:	75%
growing animals:	70%

Absorption of nXP-amino acids-N: 85%

Proportion of the nXP-amino acid N in the non-ammonia-N: 73%

nXP requirement = net requirement x 1.33 x 1.18 x 1.37 (milking cows)
 = net requirement x 2.1 (milking cows)
 = net requirement x 1.43 x 1.18 x 1.37 (growing animals)
 = net requirement x 2.3 (growing animals)

Flow of nXP at the duodenum:

(Regressions from 335 measurements with a wide range of rations and levels of feed intake)

$$1. \text{ nXP (g/kg DM)} = [187.7 - (115.4 (\text{UDP/CP}))] \text{ DOM} + 1.03 \text{ UDP} \quad (\text{Sy.x} = 8.88)$$

$$2. \text{ nXP (g/kg DM)} = [11.93 - (6.82 (\text{UDP/CP}))] \text{ ME} + 1.03 \text{ UDP} \quad (\text{Sy.x} = 8.91)$$

If the feedstuff/ration contains more than 7% fat:

$$3. \text{ nXP (g/kg DM)} = [196.1 - (127.5 (\text{UDP/CP}))] (\text{DOM} - \text{DXL}) + 1.03 \text{ UDP} \quad (\text{Sy.x} = 9.01)$$

$$4. \text{ nXP (g/kg DM)} = [13.06 - (8.41 (\text{UDP/CP}))] (\text{ME} - \text{MECL}) + 1.03 \text{ UDP} \quad (\text{Sy.x} = 8.93)$$

UDP (g/kg DM), CP without added urea (g/kg DM), DOM (g/kg DM),
ME (MJ/kg DM), MECL = ME from fat (MJ/kg DM)

(Sy.x when only CP, instead of UDP is included: 10.40 – 10.95)

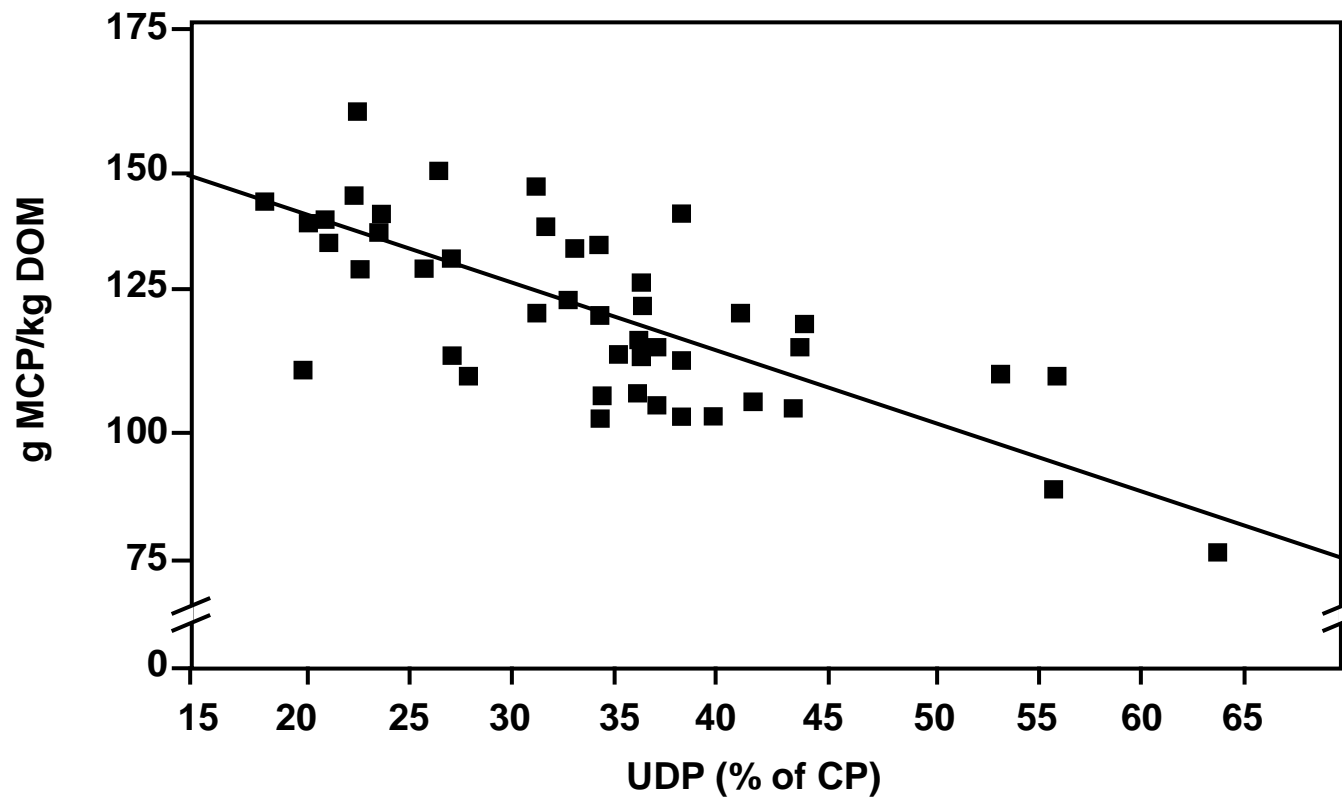
Rumen N-balance (RNB)

$$\text{RNB (g/kg DM)} = [\text{CP(g/kg DM)} - \text{nXP (g/kg DM)}] / 6.25$$

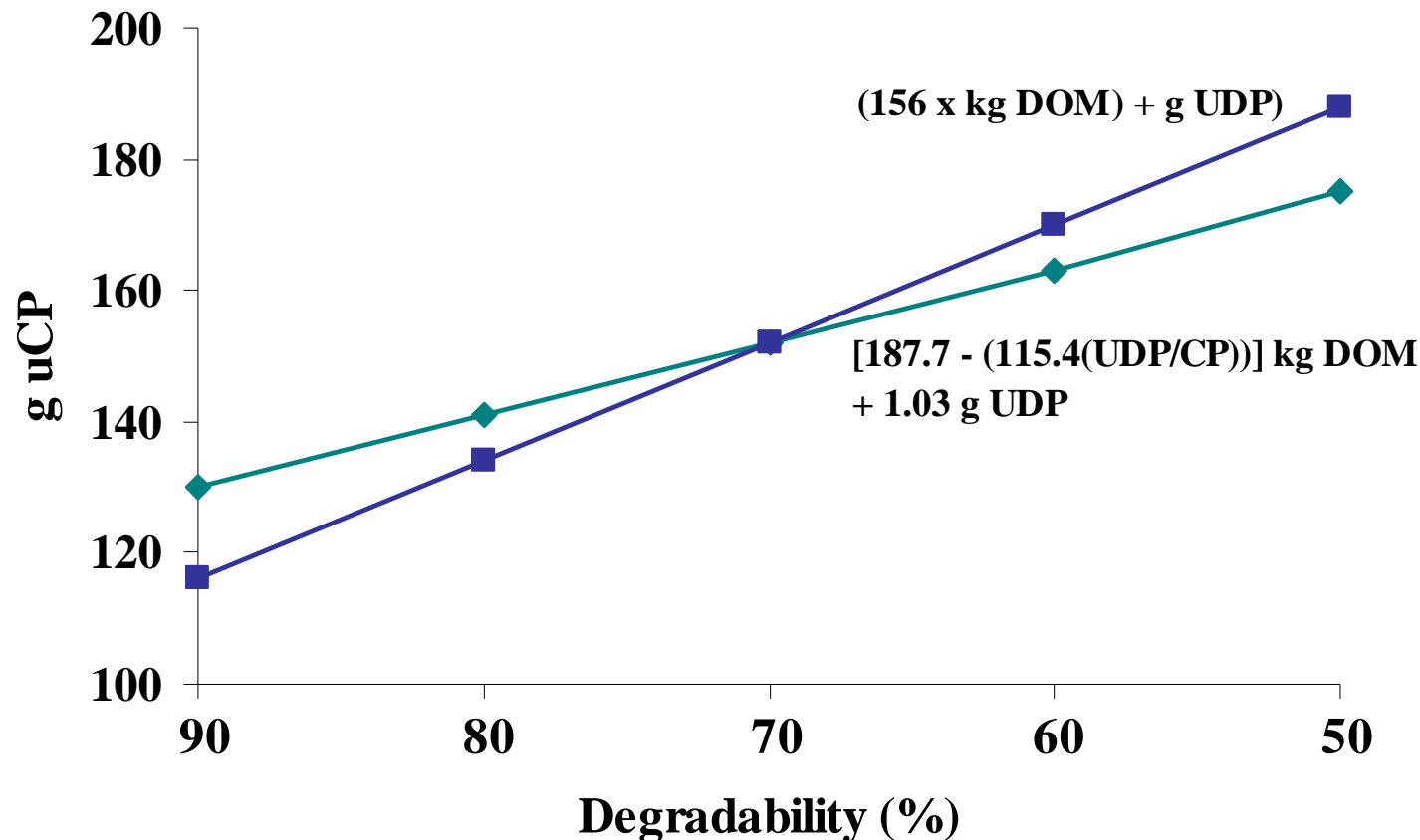
(should be between -0.3 g N*/MJ ME and 0 g N/MJ ME)

* 20% of N for microbial N can originate from recycled N. Mean
Microbial protein N = 10.1 g/MJ ME: $(10.1 : 6.25) \times 0.2 = 0.3$

Relation between microbial crude protein (MCP) at the duodenum and undegraded feed protein (UDP) (Gabel 1983)



Effect of ruminal degradability of feed crude protein on the uCP amount at the duodenum applying regression or addition (MP + UDP) calculations (Example: 1 kg DM, 0.63 kg DOM, 180 g CP)



Prediction of utilizable crude protein (uCP) at the duodenum by multiple regression resp. by addition of microbial protein (MCP) and measured undegraded feed protein (UDP), n = 327

Estimation	Measured : Estimated	
	r ²	cv (%)
Multiple regression		
uCP = [188.5 – (116.5(UDP/CP))] DOM + 1.03 UDP	0.91	8.60
Addition of MCP + UDP		
uCP = MCP + UDP (MCP = 181.1 x kg FOM)	0.87	10.37

FOM = fermented organic matter in the rumen (measured)

DOM = digested organic matter in total digestive tract (measured)

CP = crude protein

Microbial crude protein (g MCP) synthesis per kg fermented organic matter (FOM)

	n	mean	range
Braunschweig + Rostock (GER)	327	181	69 – 266
Stern et al. 1994	not given	188	63 – 313
NRC 2001	not given	186	75 - 338

Further research is needed with regard to:

- **Amino acid (AA) requirements**
 - AA composition of endogenous and body protein
 - AA absorption
 - AA partition and utilisation
 - AA use for gluconeogenesis
- **AA composition of microbial protein (MP) and UDP**
- **Estimation of MP-synthesis and degradation of feed protein**