

Ideal protein and low protein diets for piglets

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STØTTET AF

Svineafgiftsfonden

SEGES
INNOVATION

Agenda

- Danish recommendations for amino acids in diets for piglets

- Low protein and modified amino acid profiles !

Recommendations are based on large experiments!

- Amino acid experiments – principles

- Curvilinea-plateau (CL-P) and Broken line (BL)
- Inverse methods

- Experiment 1: threonine / lysine balance

- Also used for lysine requirement at constant leucine

32,000 piglets 7-30 kg

- Experiment 2: addition of 4 amino acids to low protein diets

- Effect on productivity

28,000 piglets 7-30 kg

- Experiment 3: addition of 5 amino acids to 4 levels of protein

- Effect on productivity
- Effect on treatments against diarrhea

6,600 piglets 7-30 kg

- Niels Morten Sloth was the projekt leader of these 3 experiments
 - Very complicated designs to lead in practical farms!
 - I was mainly involved in design and interpretations – including recommendations!

- **The main purpose :**



- Sometimes knowing the conclusion makes it easier to follow the presentation 😊

Danish recommendations for amino acid profile (standard ileal digestible - SID)

Periode	2015-2019	2021-2022	
Piglet weight	6-30	6-15 kg	15-30 kg
Name of profile*	100	86 %	90%
Lysine	100	100	100
Threonine	62	62	62
Methionine	32	32	32
Met + cys	54	54	54
Tryptophane	21	21	21
Isoleucine	53	46	48
Leucine	100	86	90
Histidine	32	28	29
Valine	67	62 (93%)	64 (95%)
Phenylalanine + tyrosine	100	95	95

This means that protein from ingredients are reduced 14% at same lysine level

Lysine was increased 5%
Protein was decreased 5-7%

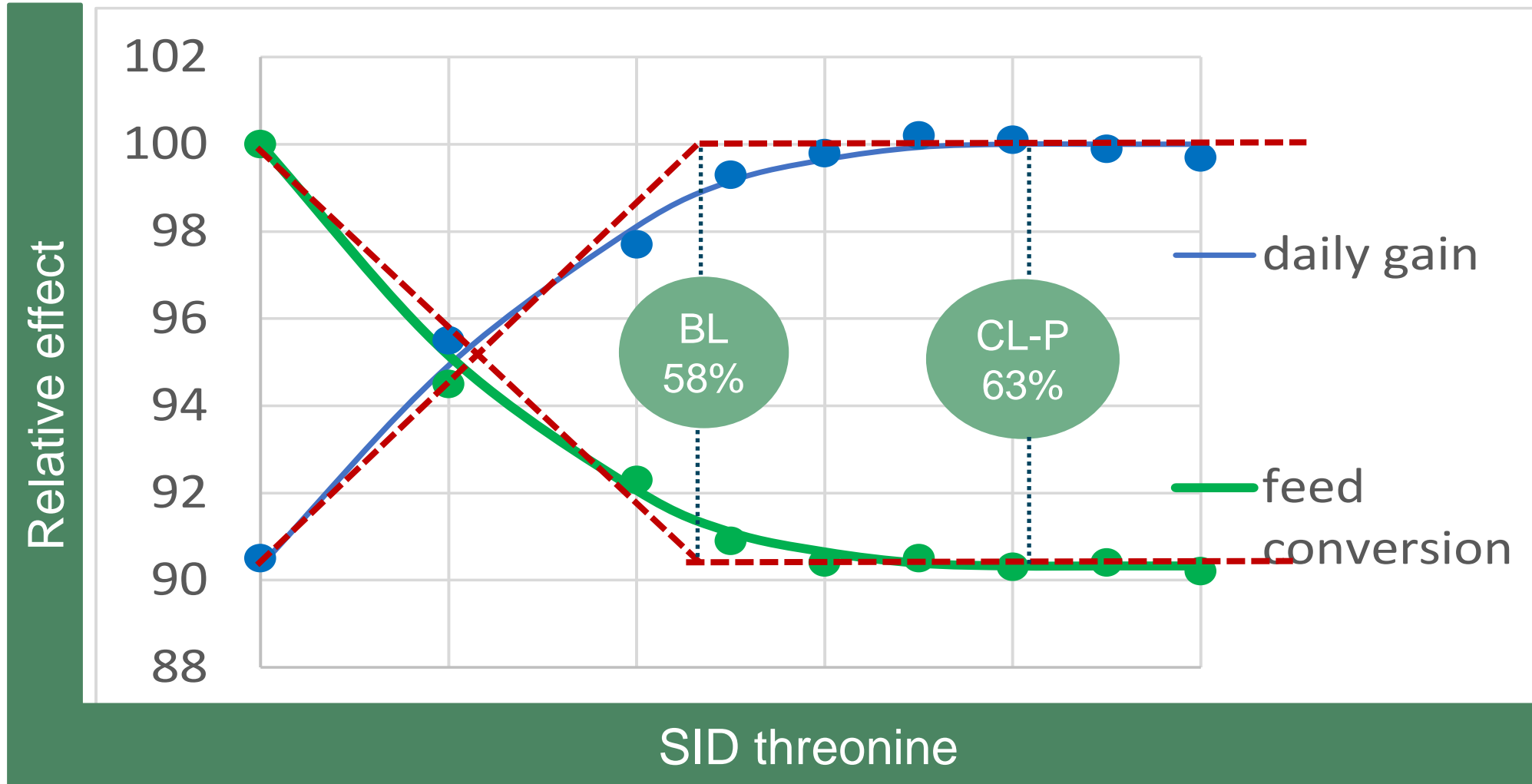
Less diarrhea because of more free amino acids and lower protein

*Refer to leucine, isoleucine and histidine as % earlier Danish profile

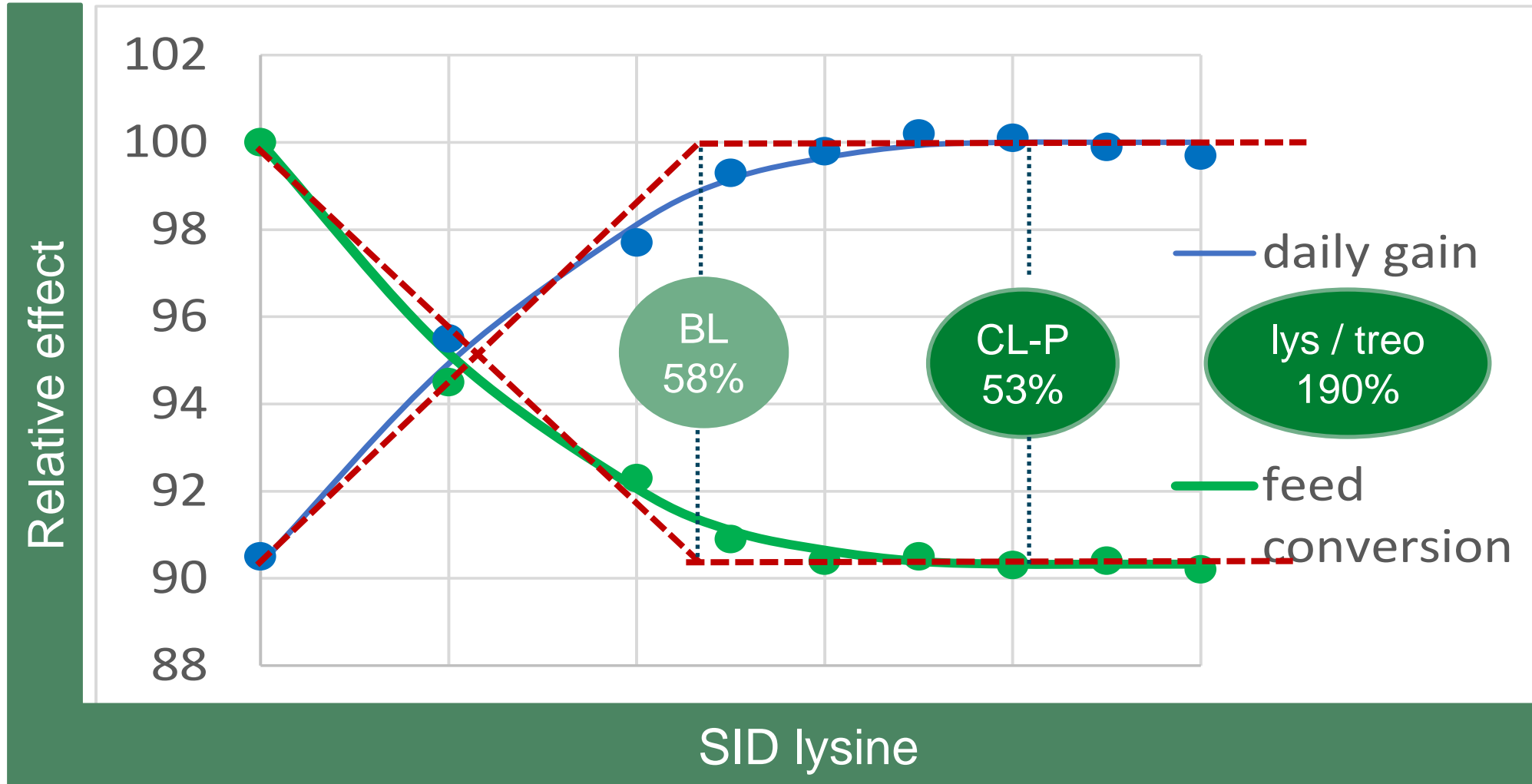
Design of experiment and model influence conclusions!

- Next 4 slides are principles
 - More ideal curves - than one experiment can find
 - The principles are supported by experiment 1 !

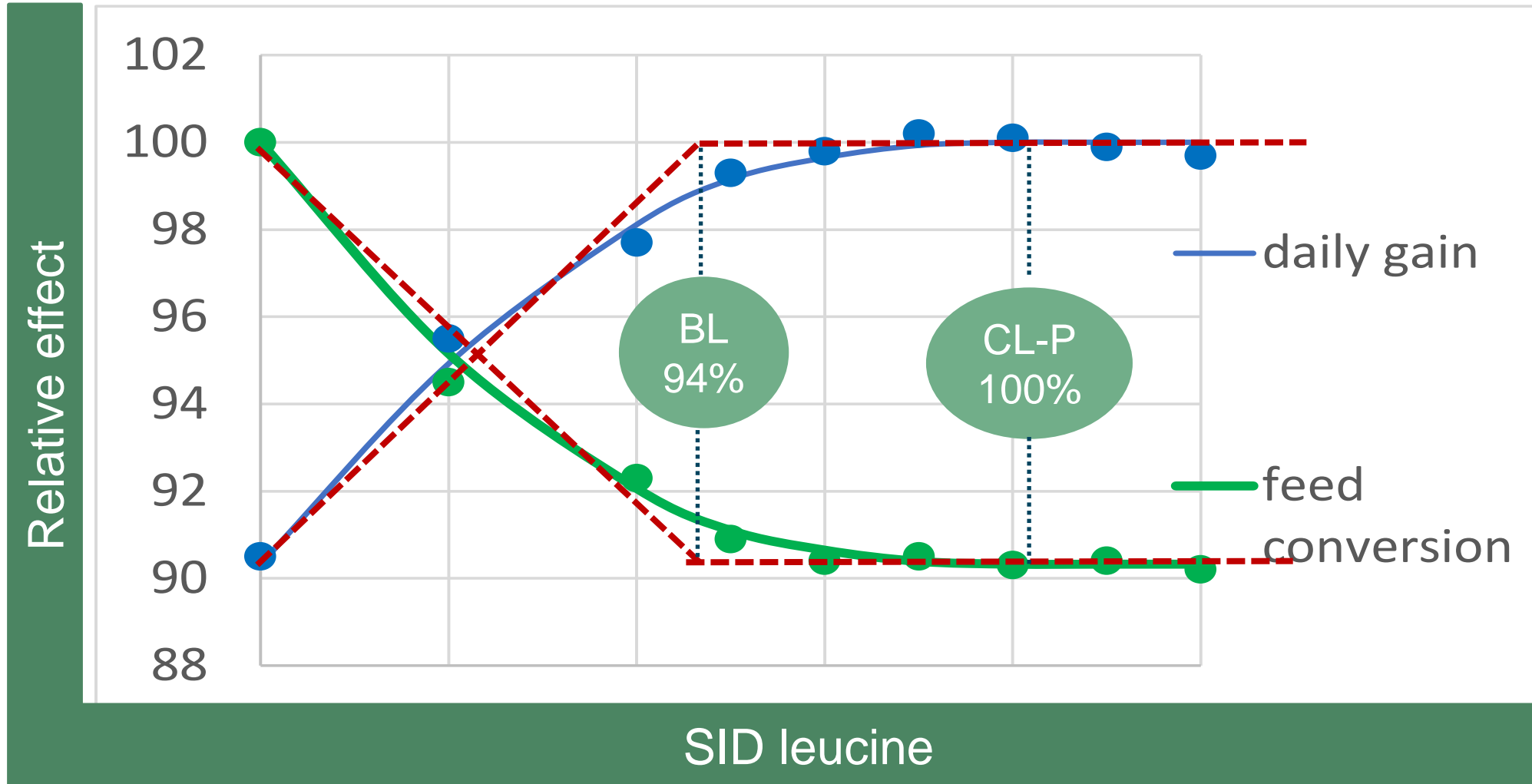
Traditional design : Increased threonine, constant lysine



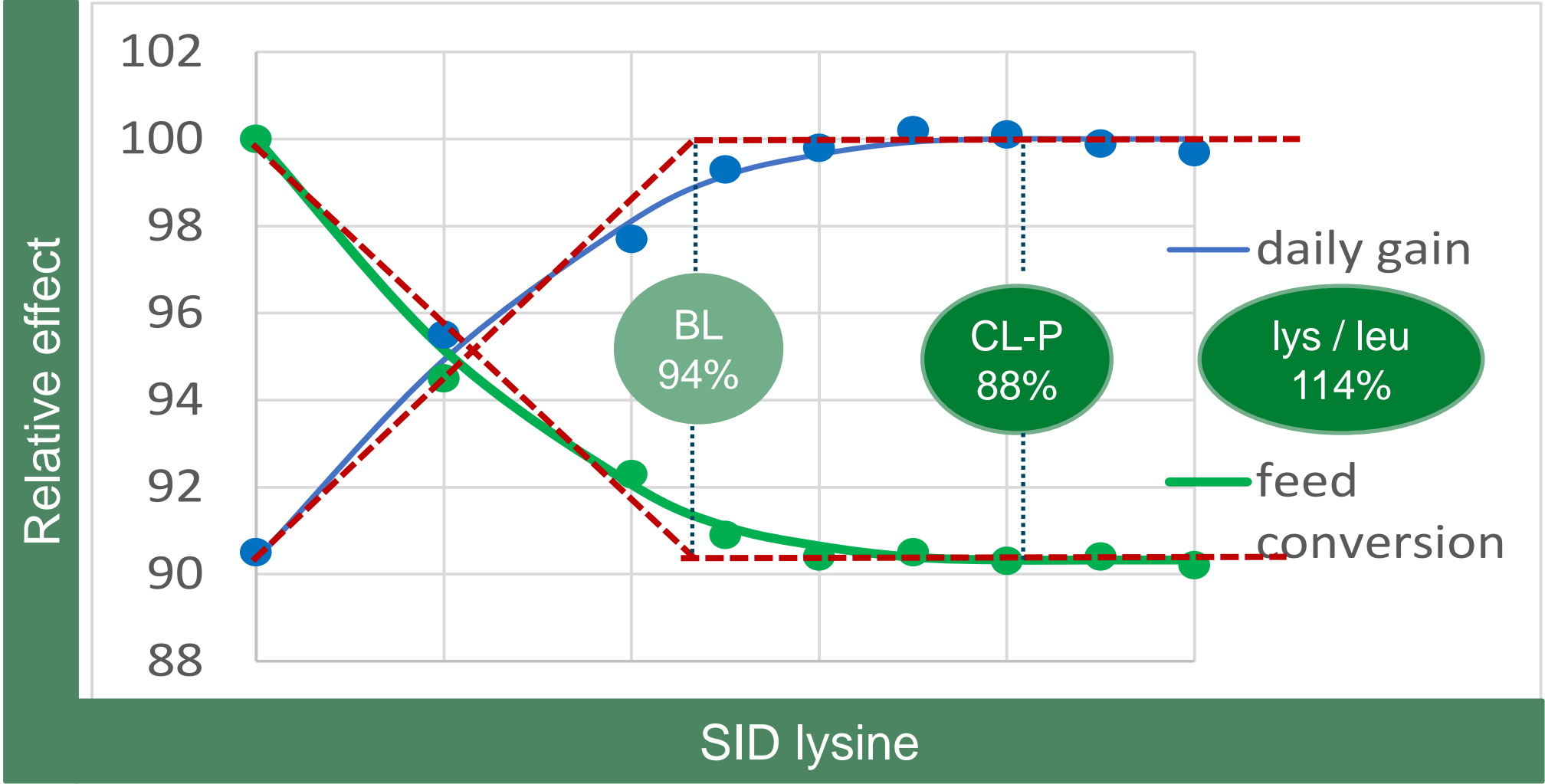
Inverse design : Increased lysine, constant threonine



Traditional design : Increased leucine, constant lysine



Inverse design : Increased lysine, constant leucine (protein)



Design threonine and lysine (one ● is 1,270 piglets)



4 diets to make 25 diets

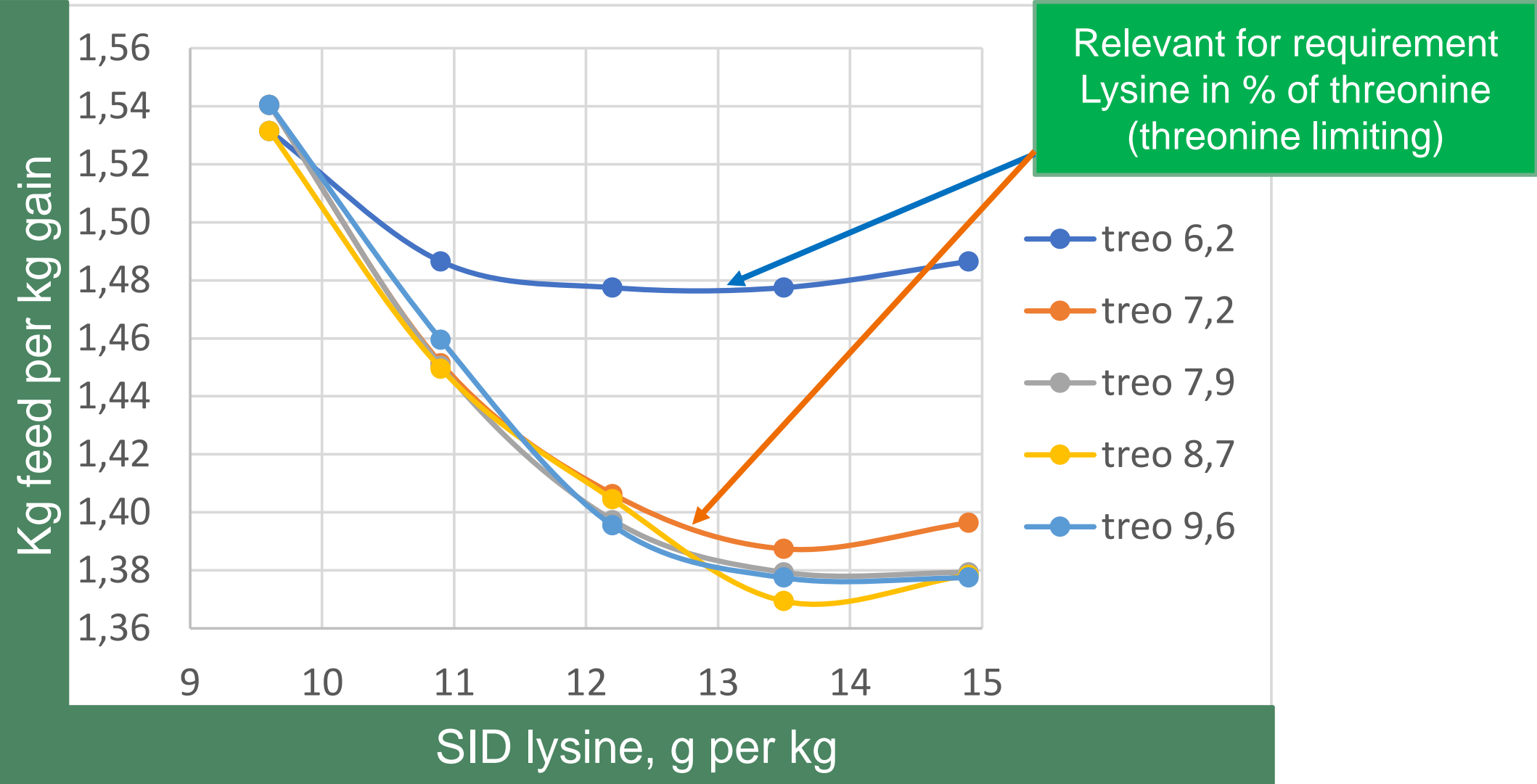
All diets "same" protein level except protein from threonine+lysine

SID leucine = 11,9 g per kg

From this design only the inverse approach is shown

- Increased lysine at constant and limiting threonine
- Increased lysine at constant and limiting leucine
 - Protein was limiting, and probably leucine and histidine the most limiting

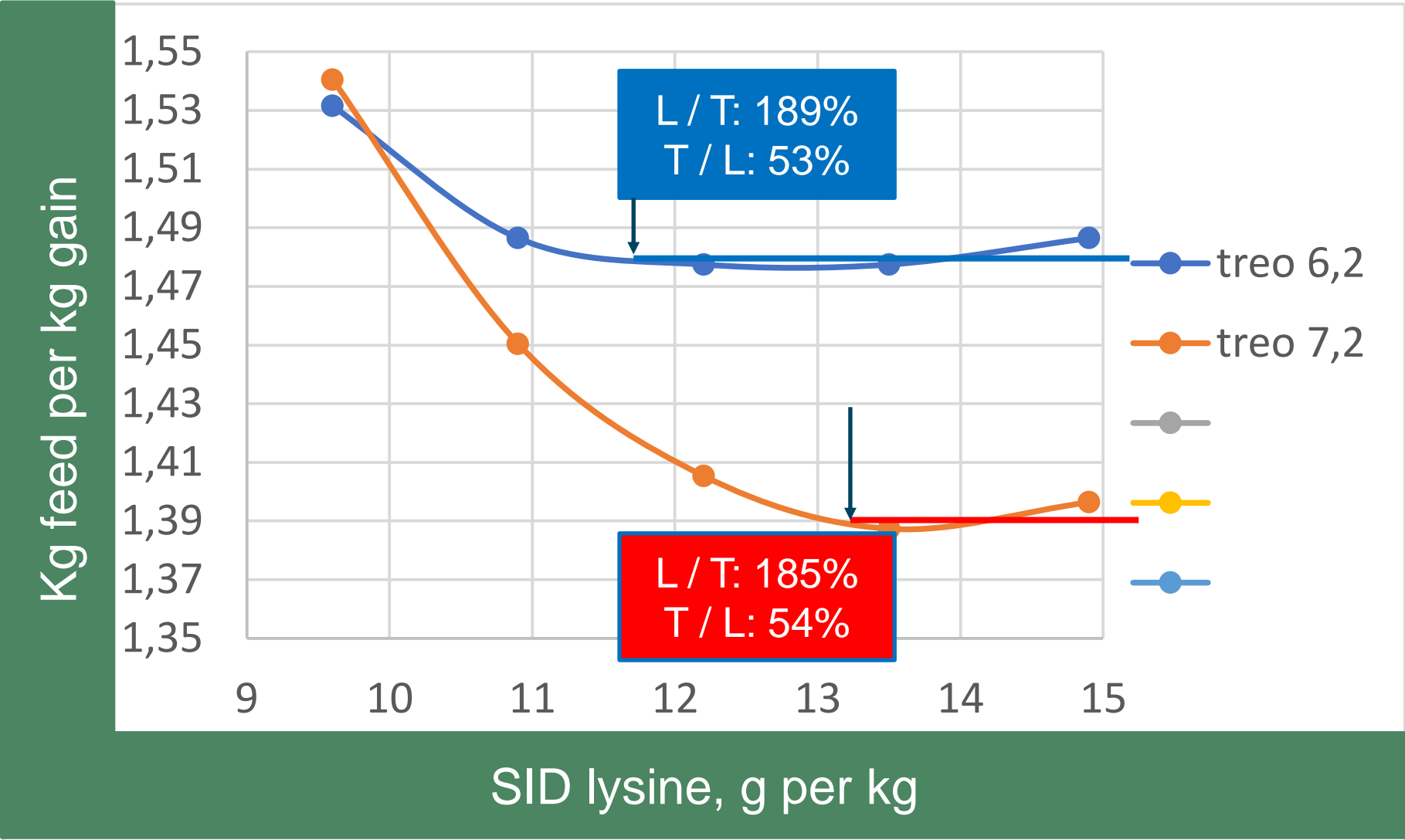
Effect of increasing lysine (inverse approach)



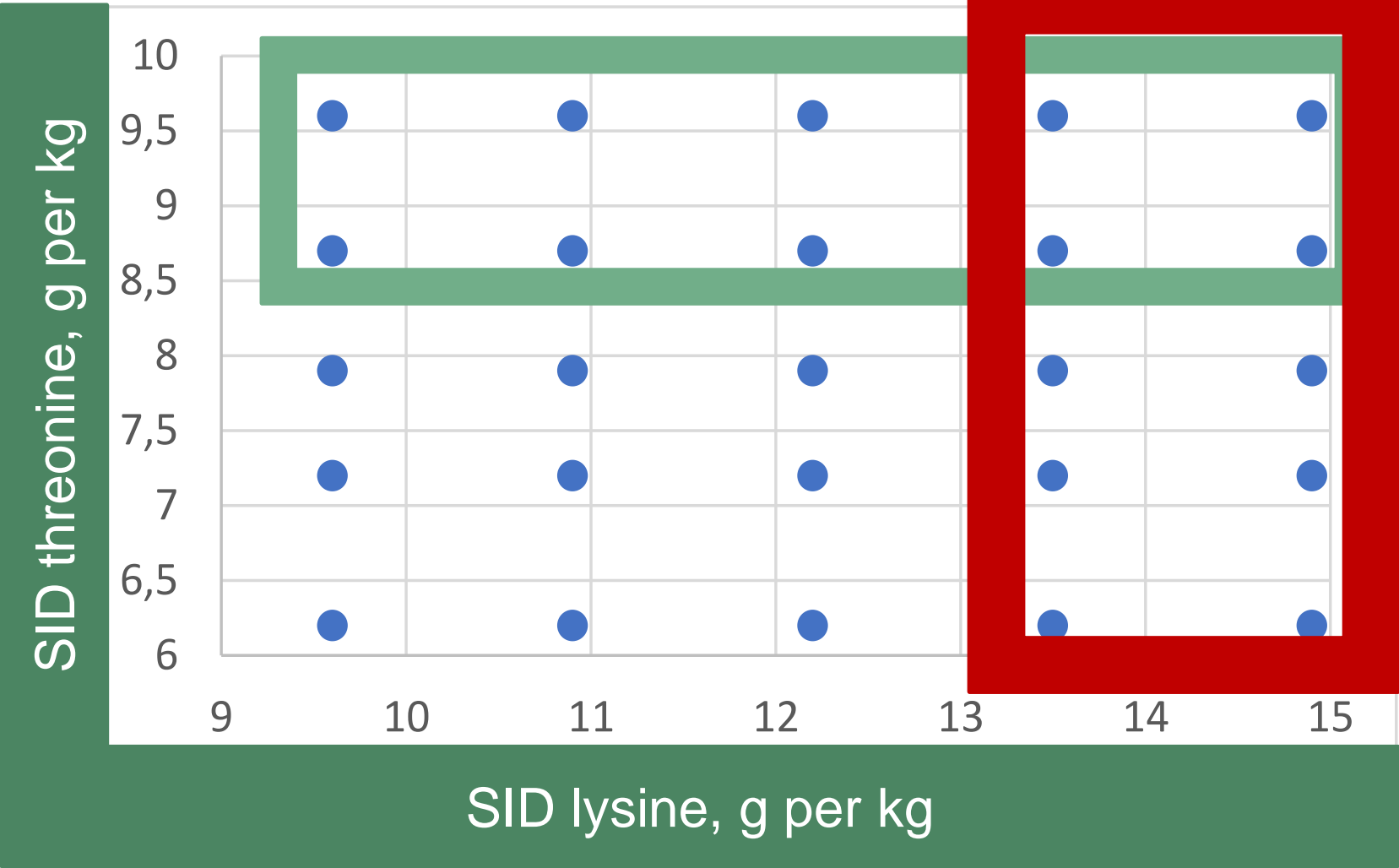
Design threonine and lysine



Effect of increasing lysine (inverse approach)



Design threonine and lysine



Requirement of
SID lysine
(enough
threonine)
12,6 BL
13,5 CL-P
Avg: 13,0 g/kg

Requirement of
SID threonine
(enough lysine)
Avg: 7,5 g/kg

58%

3 approaches to ideal protein

Traditional

63%

threonine not
limiting for
lysine utilization

Inverse

53%
(lys / thr = 189%)

lysine not
limiting for
threonine utilization

Max response
threonine

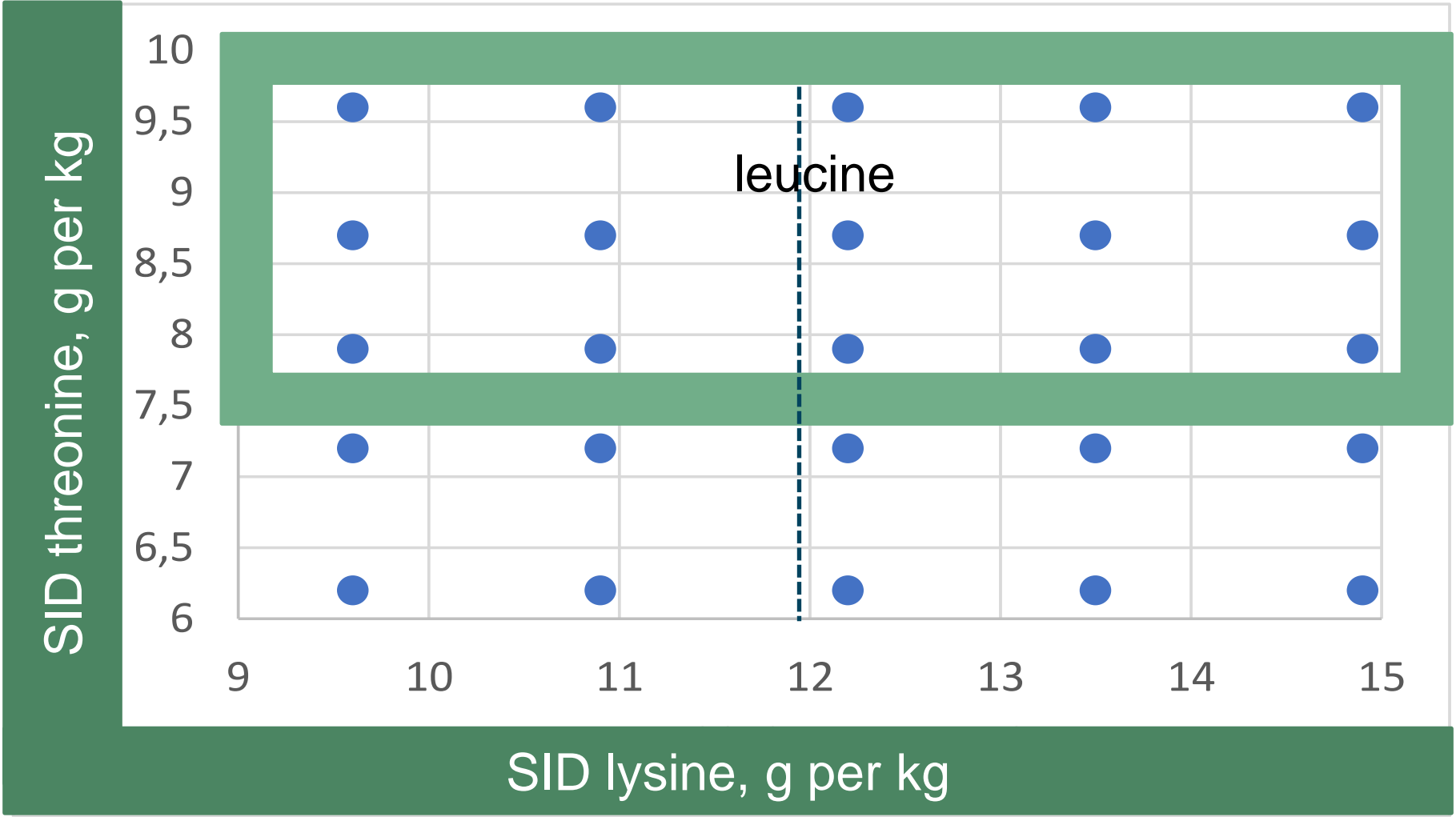
versus

Max response
lysine

58%

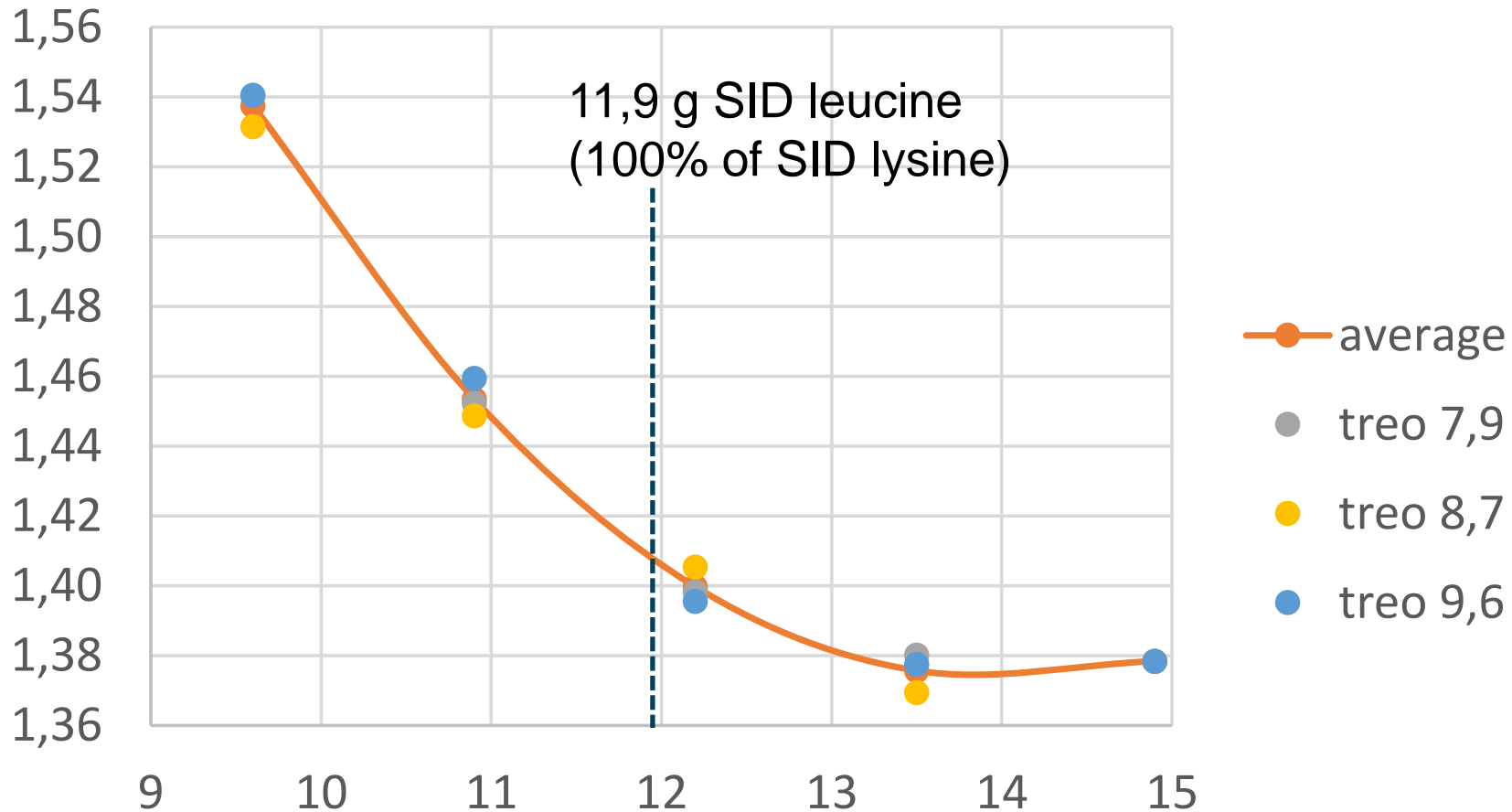
Equal limiting !

Effect of lysine at constant 11,9 g SID leucine per kg



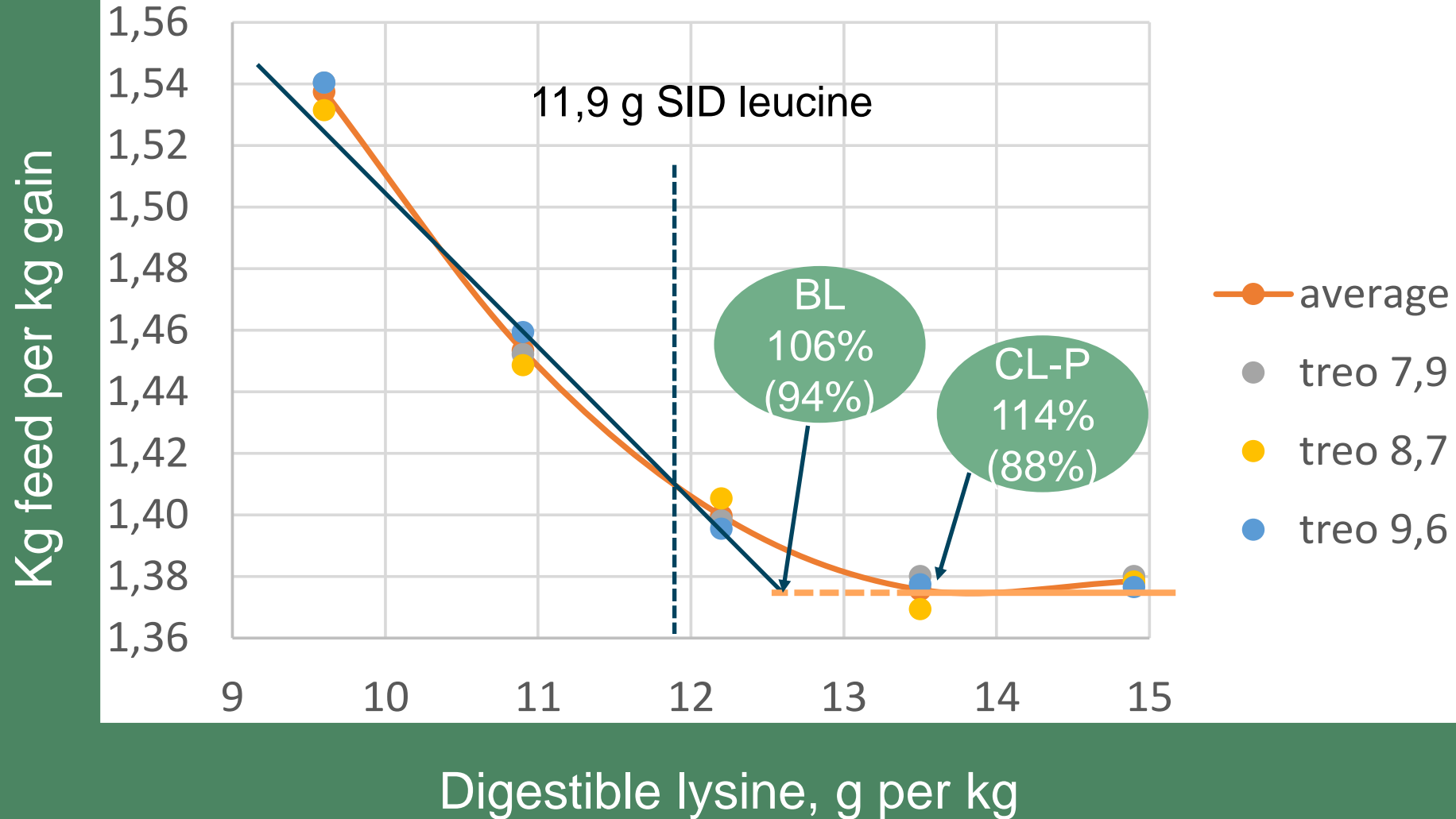
Lysine versus leucine

Kg feed per kg gain



SID lysine, g per kg

Lysine versus leucine



Conclusion lysine vs leucine (protein)

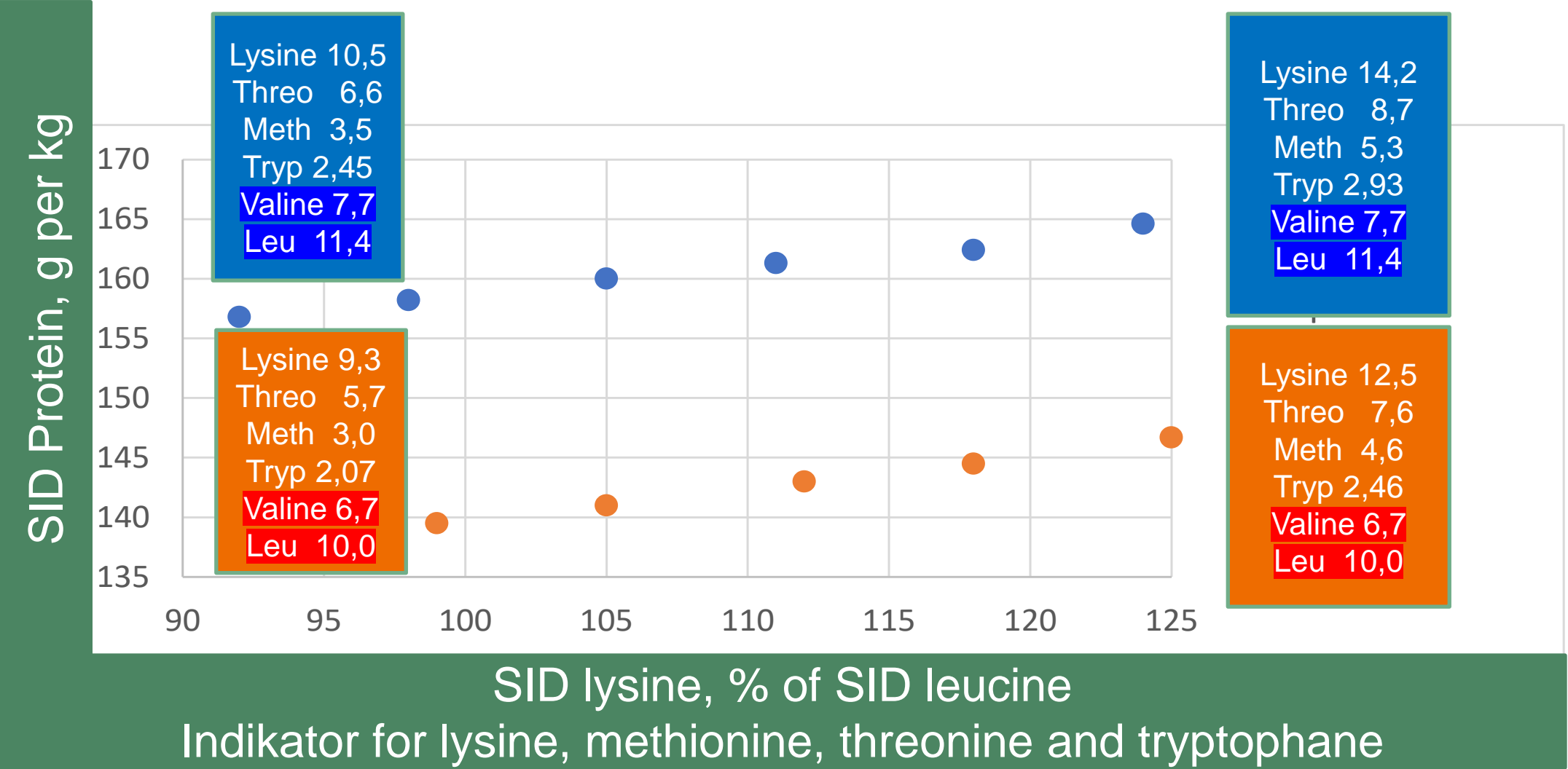
- Increased lysine compared to international profile (100%)
 - Better results, when protein (leucine) is constant and limiting
 - Until 114% / 88%
 - In this case histidine was probably co-limiting and reached 28% of lysine
- **What happens if we increase 4 amino acids ?**

Experiment 2 – increasing levels of 4 amino acids

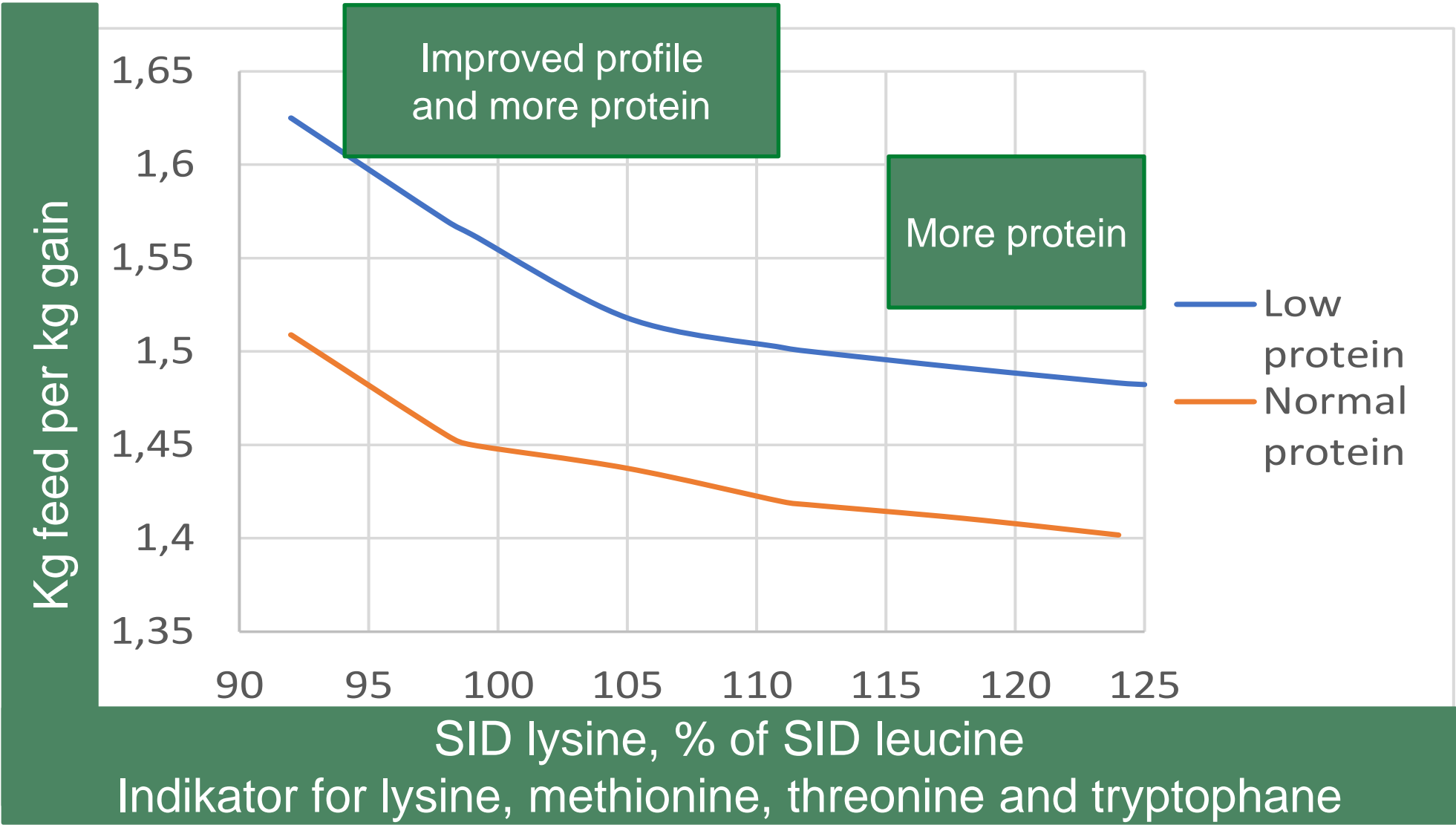
- 2 levels of protein
- 4 levels of lysine, threonine, methionine and tryptophane
- Levels as percent of earlier "ideal profile"

- Lysine / leucine is an indicator for level of added 4 amino acids

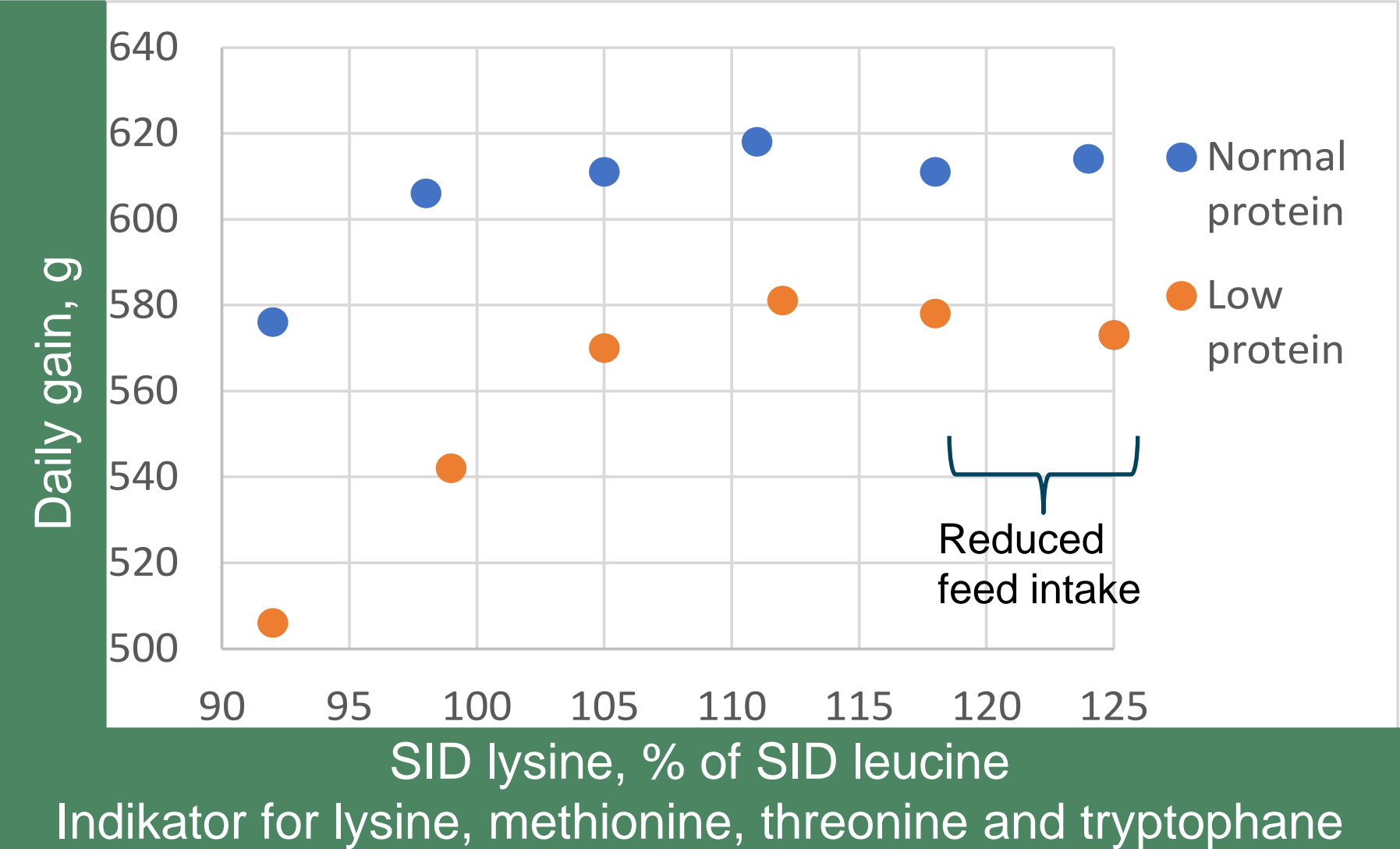
Design experiment 2. ● = 1300 piglets



Exp. 2. Effect of increasing dose of 4 amino acids



Daily gain max at lysine / leucine = 112-115 %



Indikator for lysine, methionine, threonine and tryptophane

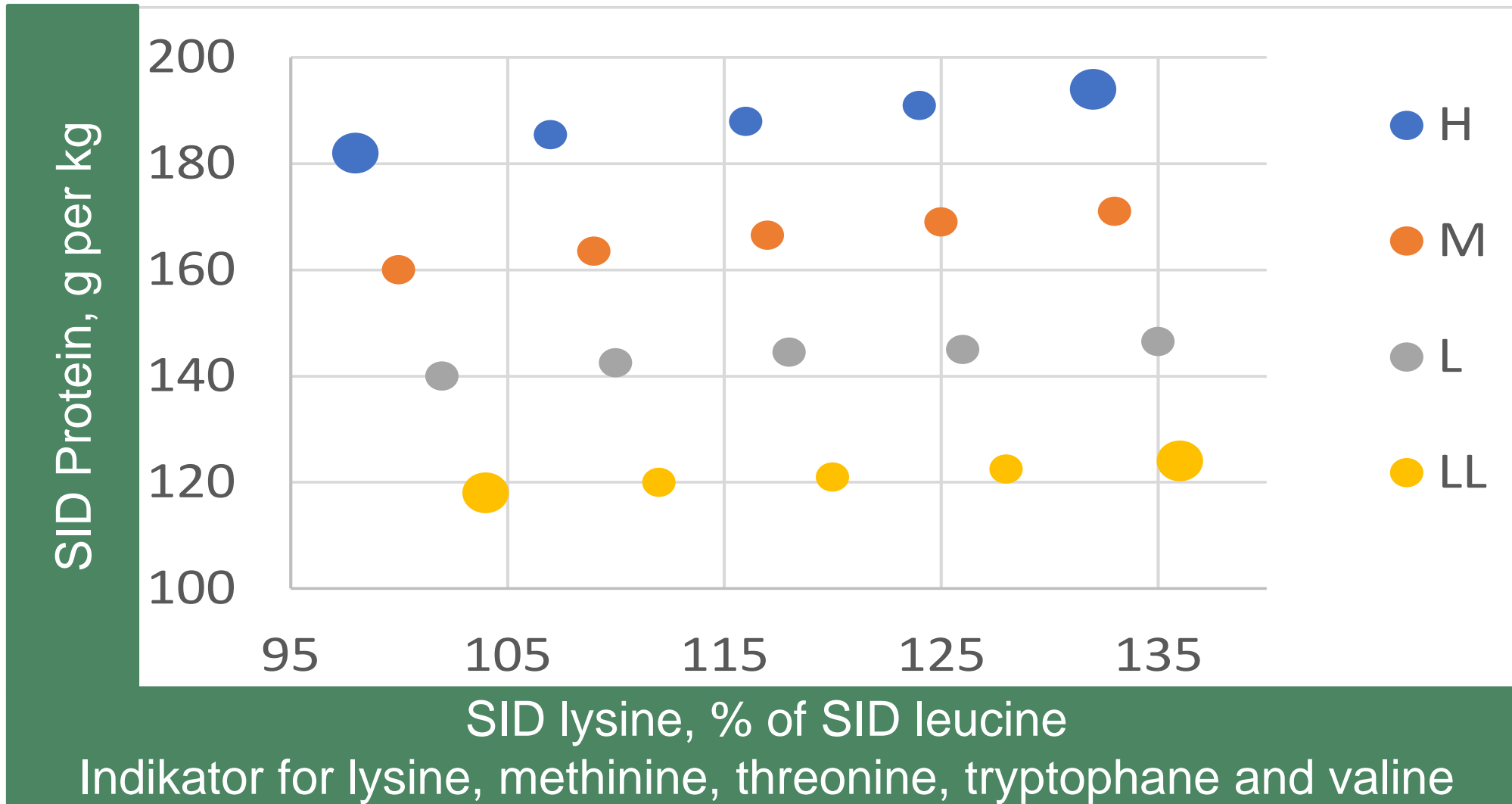
Experiment 3

- 4 levels of protein

H = High
M = medium
L = low
LL = very low

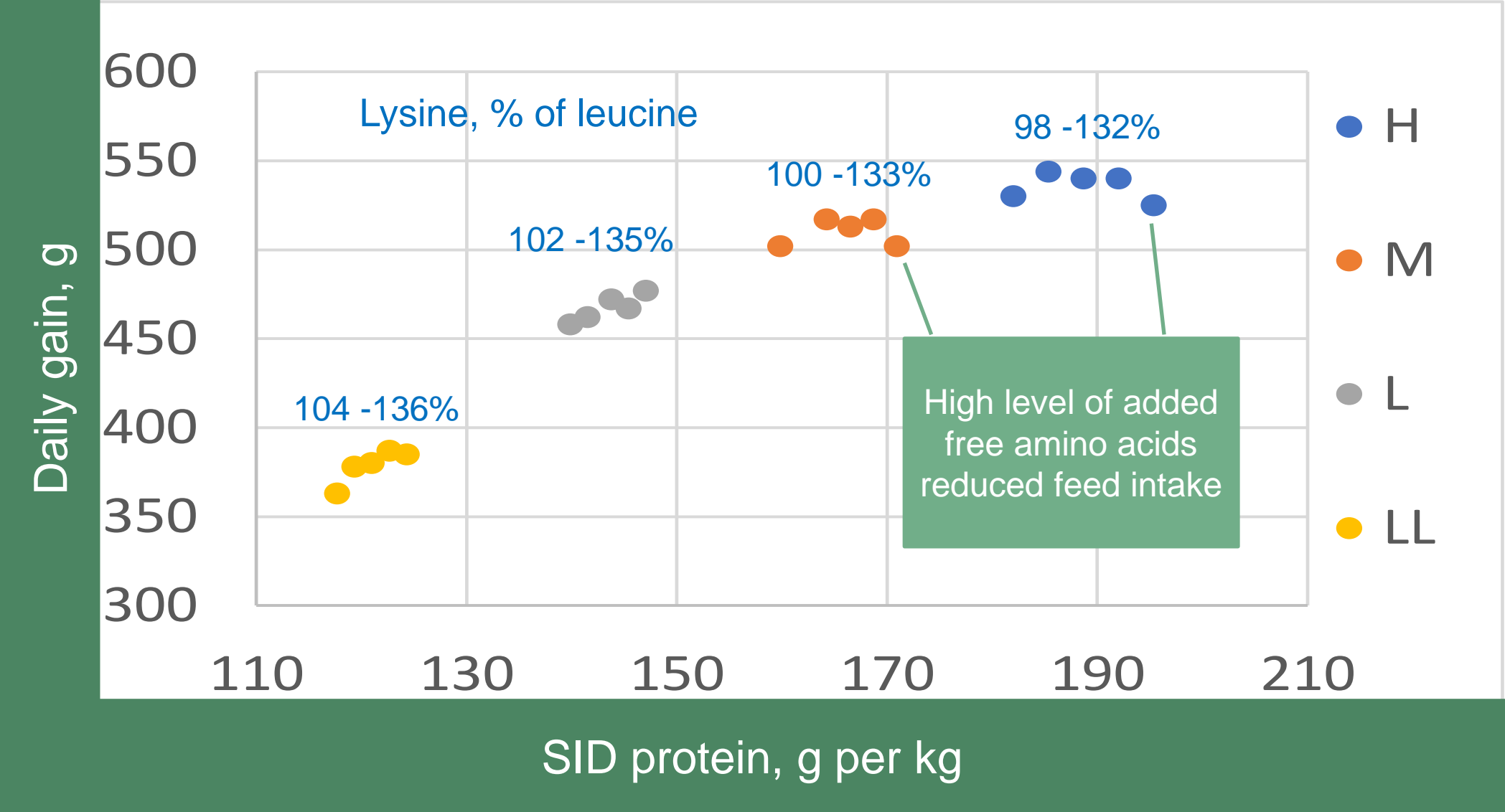
- 5 levels of added amino acids
 - Including lysine, methionine, treonine, tryptofane and valine
- Lysine / leucine is an indikator of level of all 5 amino acids compared to leucine

Experiment 3, design. A ● is 23 pens of 12 = 276 piglets

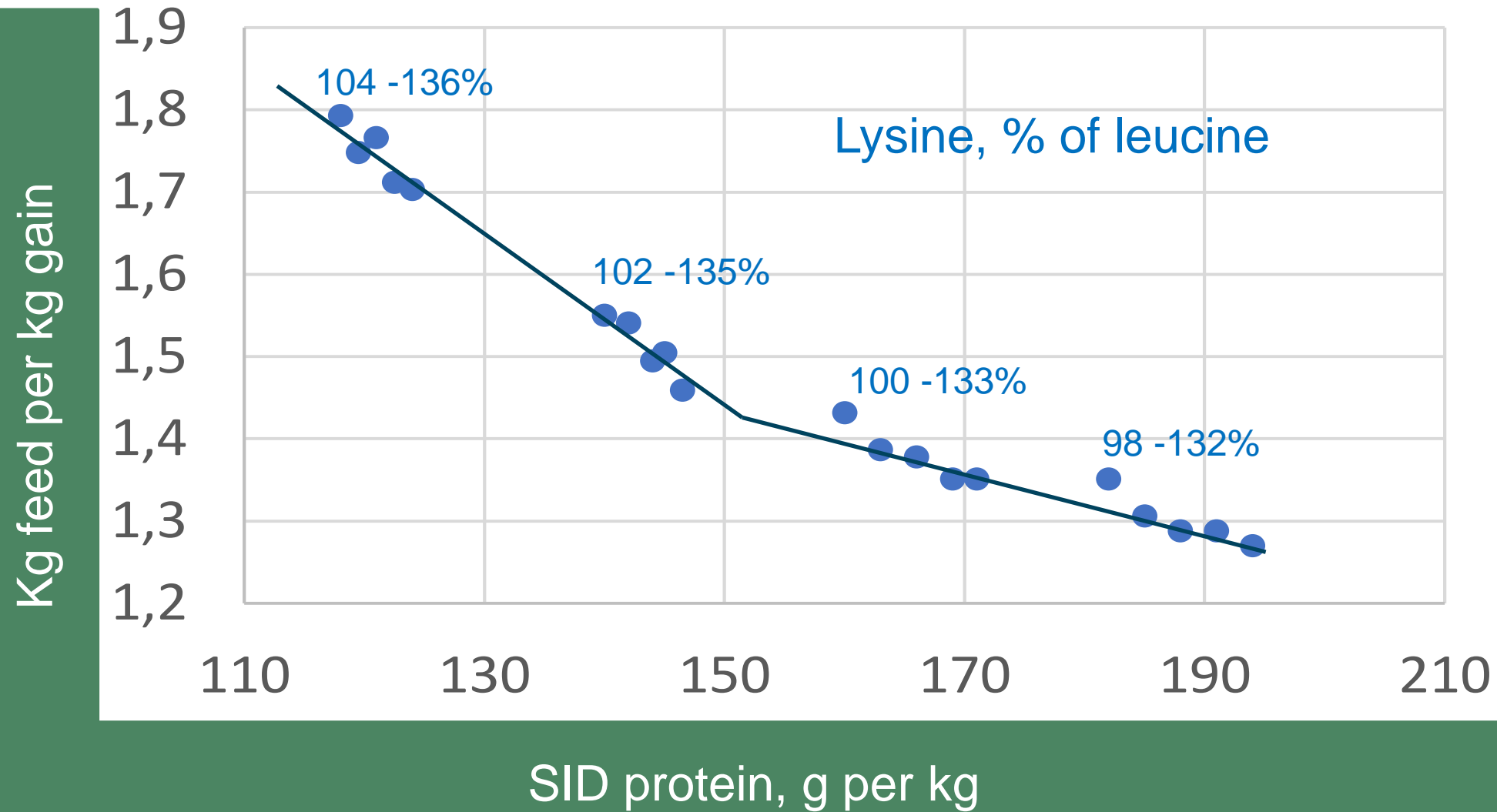


Indikator for lysine, methinine, threonine, tryptophane and valine

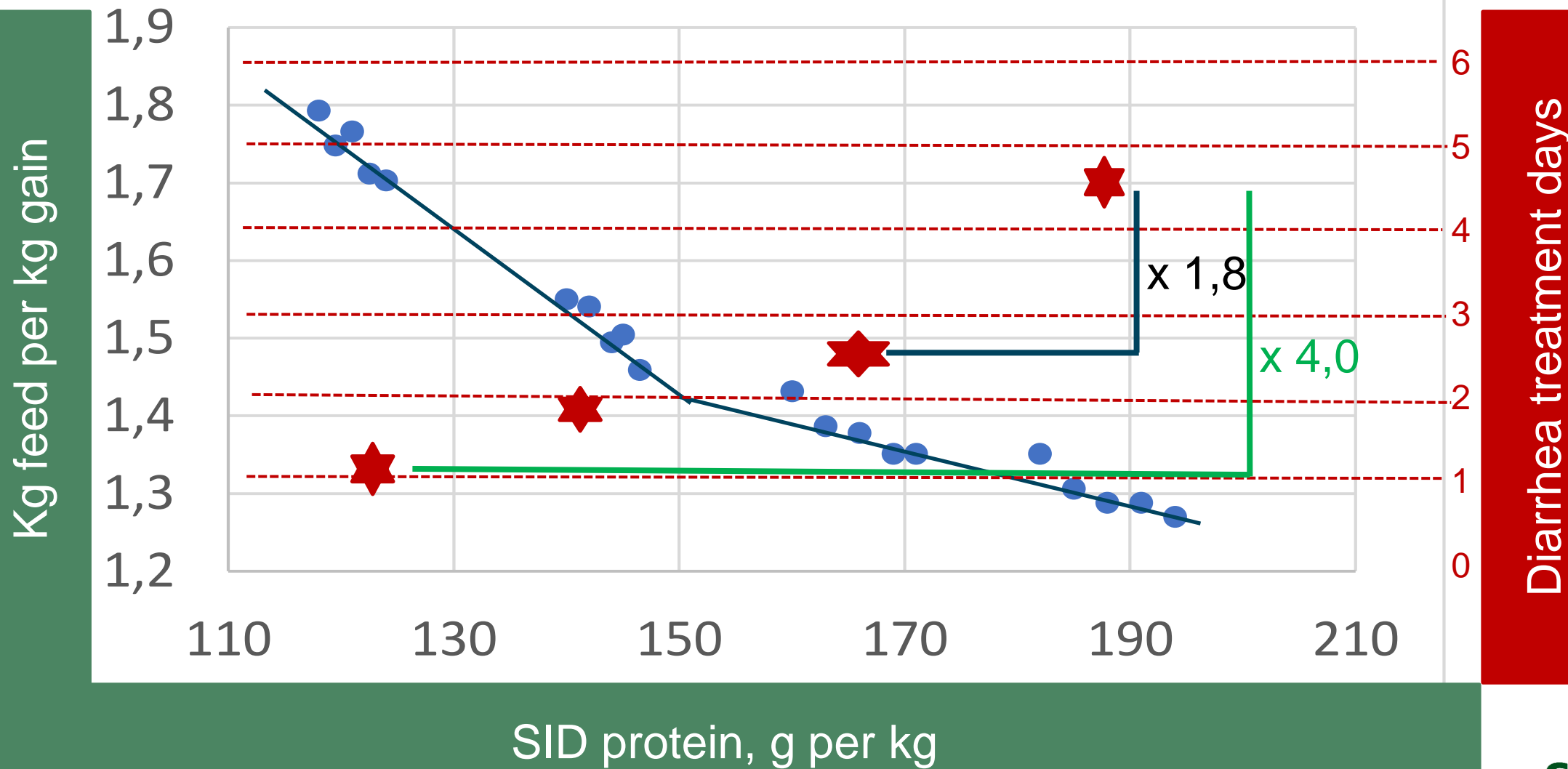
Daily gain, experiment 3



Feed conversion as function of digestible protein, exp. 3

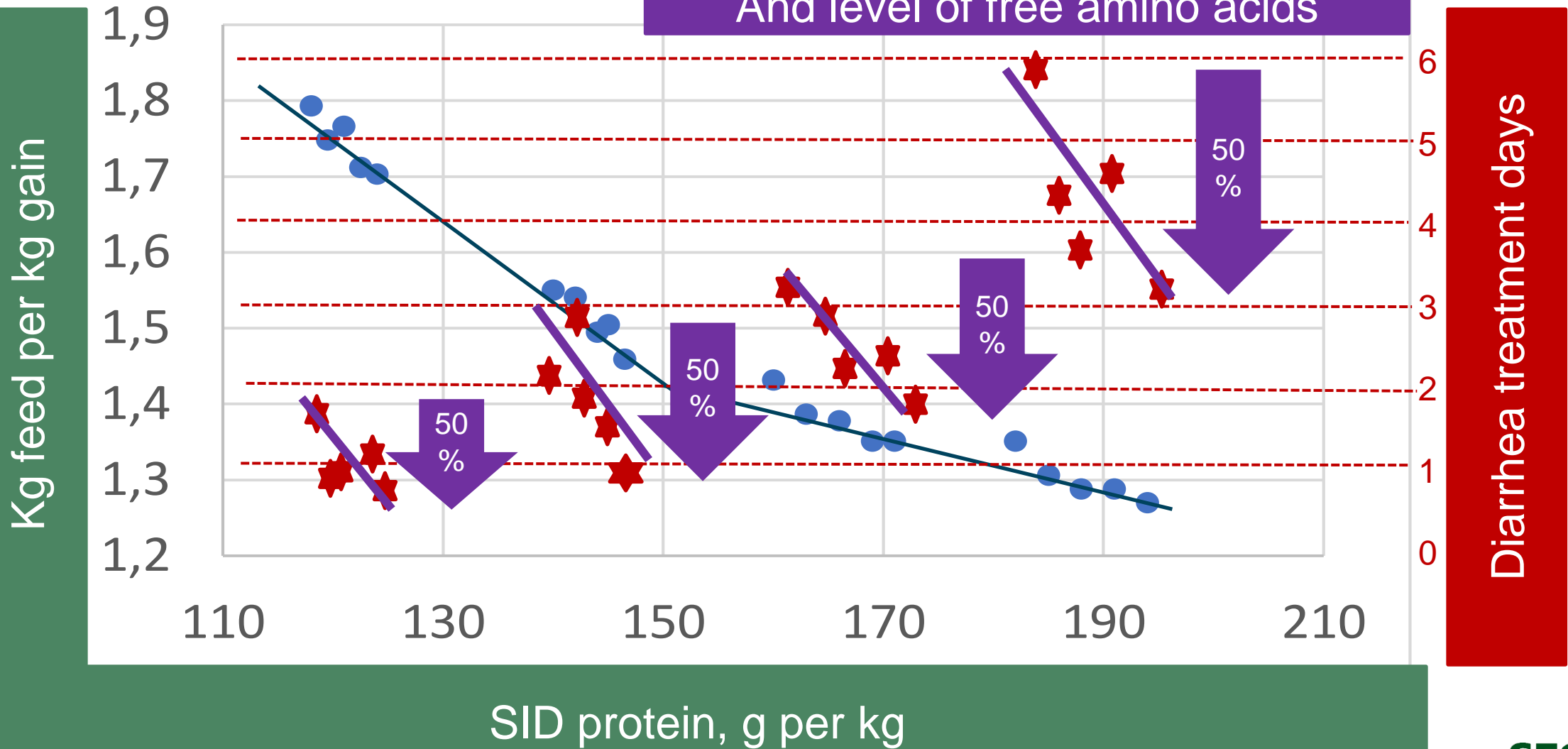


Feed conversion + diarrhea as funktion of digestible protein, exp. 3



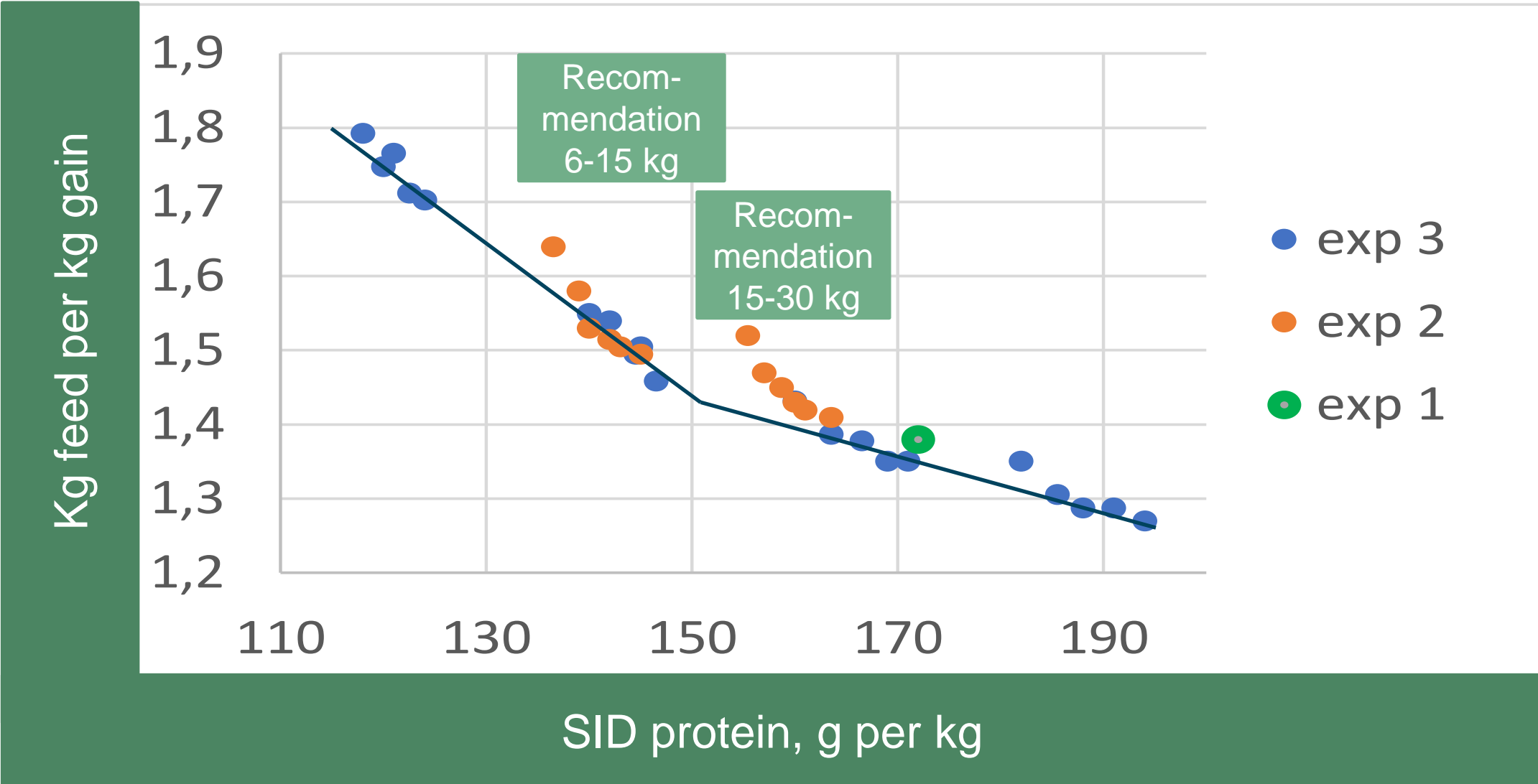
Feed conversion + diarrhea as funktion of digestible protein

And level of free amino acids



Feed conversion all 3 experiments

(threonine / lysine = average of best 6 treatments, requirements both fulfilled)



Main conclusions

- More protein improves growth and feed conversion
 - But increases diarrhea treatments
 - We added 0,5% benzoic acid 7-30 kg and 1,0% calciumformiate 7-15 kg
 - And achieved < 1,3 kg feed pr. kg gain without zinc!
- Adding 5 amino acids 35% above normal (135% lysine / leucine)
 - Improved daily gain and feed conversion - at all protein levels
 - 50% reduction in diarrhea treatments - at all protein levels
 - At least same effect as 2500 ppm zinc in Danish experiments
- To consider
 - 35% extra amino acids are expensive
 - > 25% extra amino acids = lower feed intake at the higher protein levels
 - Extra high dose in critical periods ?

Danish recommendations for amino acid profile (SID)

Piglet weight	6-15 kg	15-30 kg
Name of profile*	86 %	90%
Lysine	100 (116% of leu)	100
Threonine	62	62
Methionine	32	32
Met + cys	54	54
Tryptofane	21	21
Isoleucine	46	48
Leucine	86	90
Histidine	28	29
Valine	62 (93%)	64 (95%)
Phenylalanine + tyrosine	95	95

We use "inverse" fase feeding

6-9 kg : LL protein
 9-15 kg: L protein
 15-30 kg: medium protein

Economic optimal
 and diarrhea "friendly"

Not maximum gain !

*Refer to leucine, isoleucine and histidine as % of international – and earlier Danish profile

Thats all – folks !