Life without zinc oxide

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Agenda

- Zinc oxide and antibiotics
- Antibiotic resistance – a case
- Alternative solutions
- Phase feeding without zinc oxide

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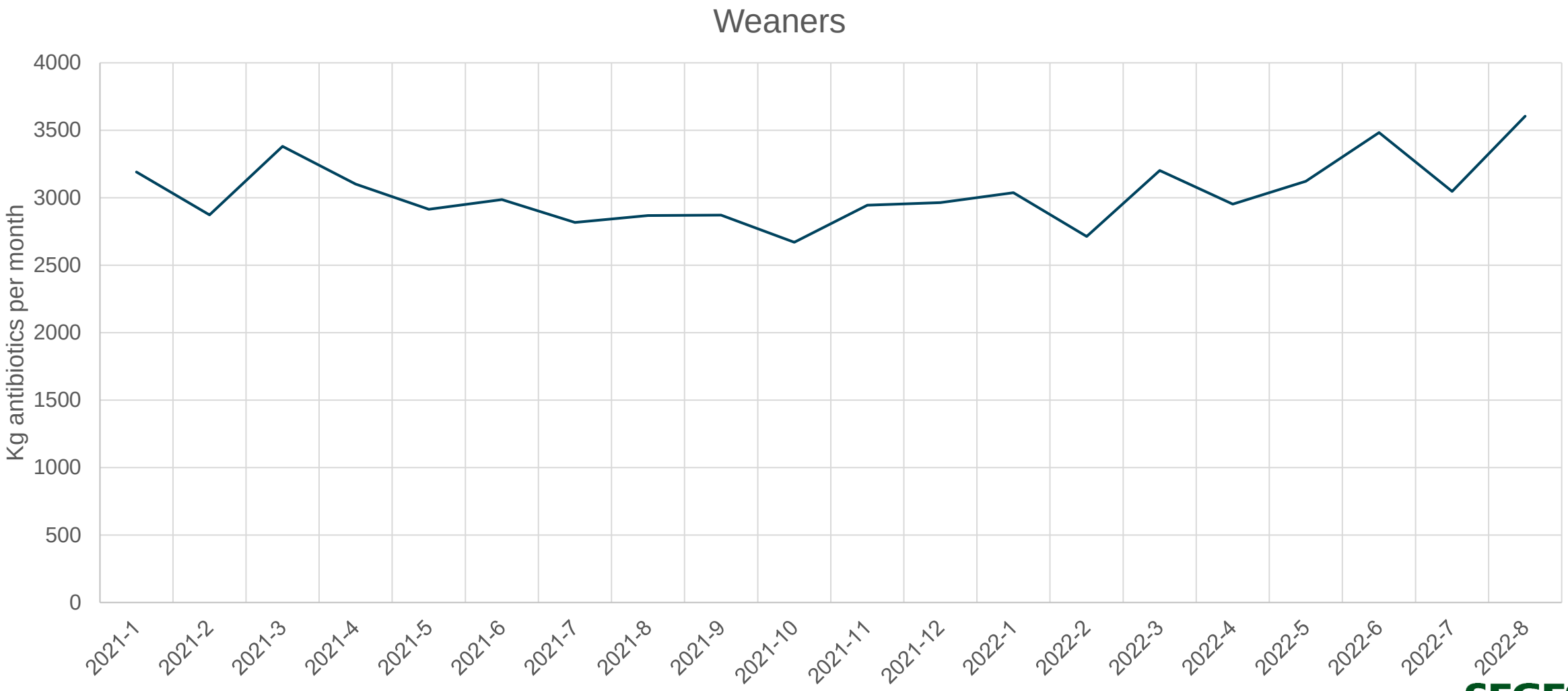
Antibiotics - weaners



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Why do we see weaning diarrhea?

Antibodies from sow milk

Stress

Infection risk

Environment

Bacteria

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Is it necessary to use antibiotics?

- Antibiotics work! (medd. 1229)
  - Higher average daily gain
  - Better feed conversion

- BUT!!!!
  - Sometimes antibiotics are not necessary
  - 50% of treated pens did not contain pathogenic bacteria such as E.coli (medd. 1229)
  - Resistance

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Antibiotics and weaning diarrhea – a case

- E. coli can rapidly develop resistance to several antibiotics

- 1,200 sows, 40,000 30 kg pigs
- Pen-wise medication in water
- Sock samples before each treatment
- Autopsy of dead piglets within the first two weeks

	No of samples	Neomycin
September	11	73%
October	15	40%
November	5	20%

Used from June to August

Antibiotics and weaning diarrhea – a case

- E. coli can rapidly develop resistance to several antibiotics

- 1,200 sows, 40,000 30 kg pigs
- Pen-wise medication in water
- Sock samples before each treatment
- Autopsy of dead piglets within the first two weeks

	No of samples	Neomycin	Florfenicol	Trimetroprim
September	11	73%	0%	27%
October	15	40%	33%	47%
November	5	20%	80%	80%

Used from June to August

Used from September to November

Used from September to November

Make sure you use the right antibiotics.
Consider finding other solutions than antibiotics

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Feeding solutions

- Less protein => less diarrhea
- More amino acids => less diarrhea
- First aid feed used for critical periods
- Coarse grinding => less diarrhea
- Manual and frequent feeding before and after weaning

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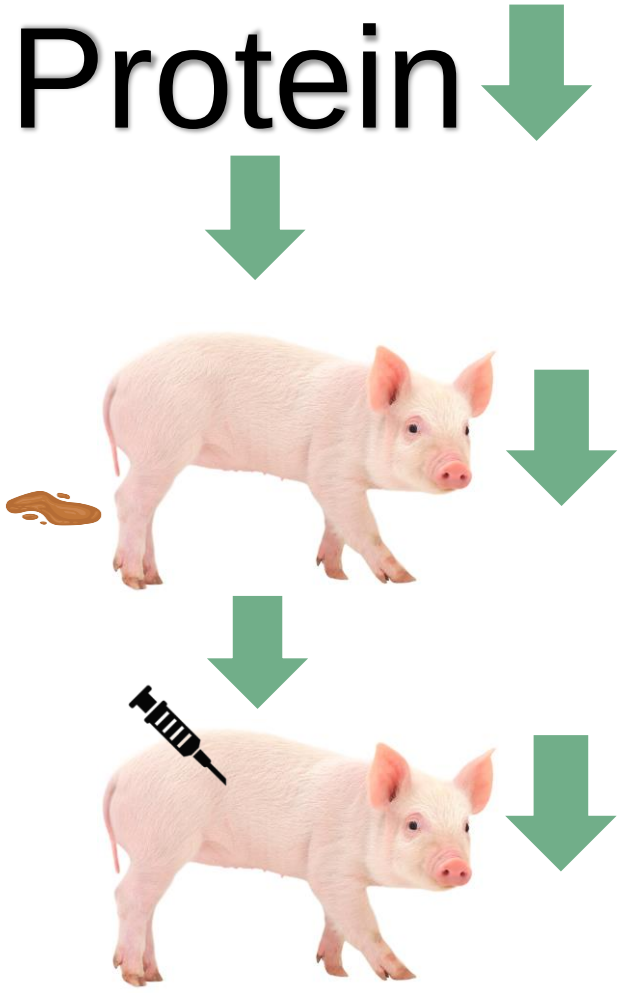
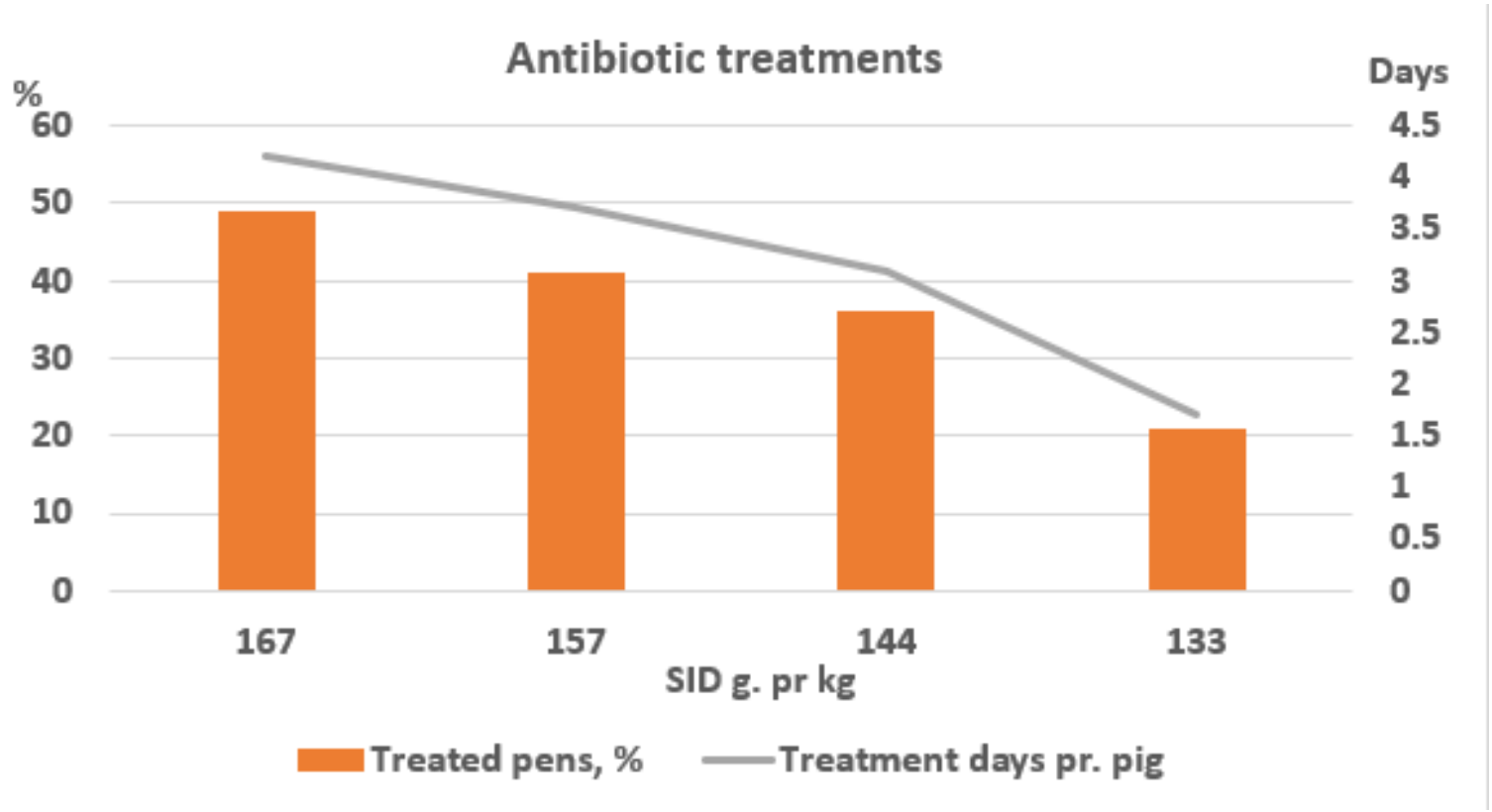
Less protein => less diarrhea

- Low protein diets reduce diarrhea and thereby antibiotic treatments





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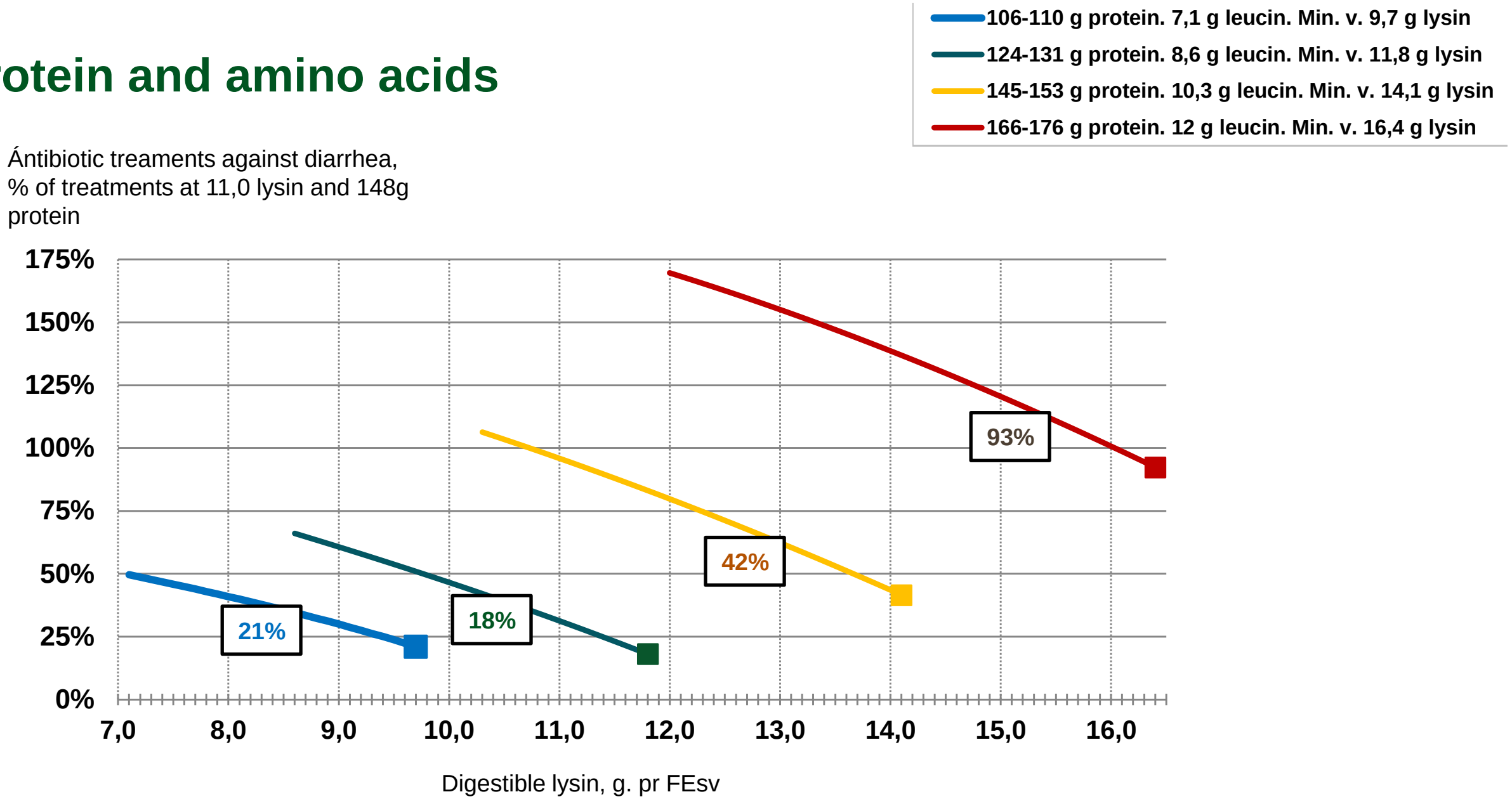
Medd. 1175, Kjeldsen N.J, Lynegaard J., Bache J.K. 2019 Link
Medd. 1203, Kjeldsen N.J, Grove S.S., Bache J.K. 2020 Link

Protein and amino acids



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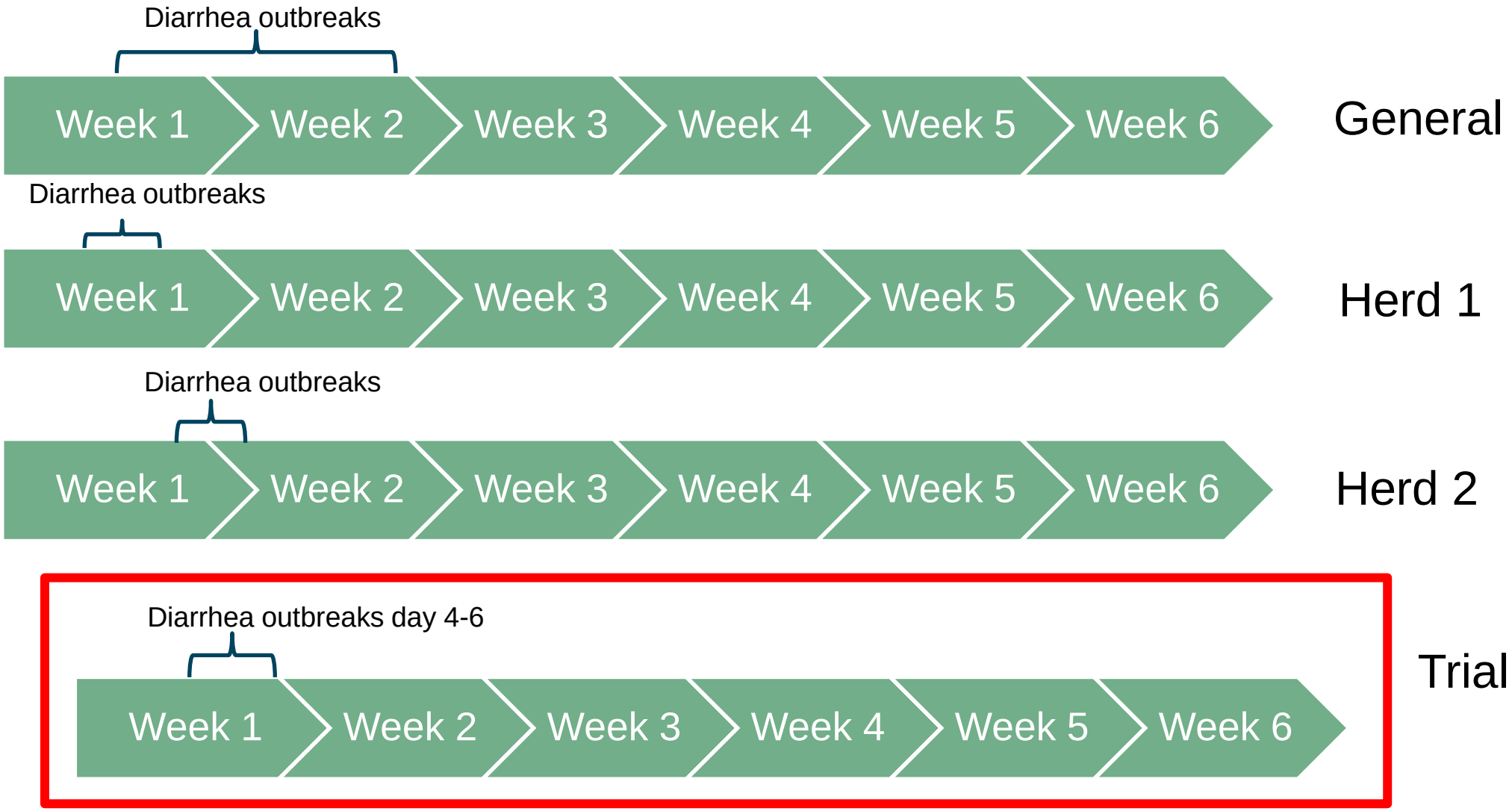
First aid feed

- Weaning diarrhea often occurs at the same time after weaning



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First aid feed

Control

Week 1 | Week 2 | Week 3 | Week 4 | Week 5

Trial

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Feed

	Control	Trial
Energy	Isoenergetic	
Crude protein, %	17.5	12.2
SID protein, g per kg feed	152	107
SID Lysine, g per kg feed	11.9	9.1

Minor changes: fibre, whey, organic acids

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Results – day 0-9 after weaning

	Control	Trial	P-value
Replicates, pens	45	45	
Avg. weaning weight	6.9	6.9	-
Number of dead and moved	8	10	-
Avg. daily gain, g	79	93	-
Weight day 9, kg	7.7	7.8	0.05

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Results – day 0-35

	Control	Trial	P-value
Replicates, pens	45	45	
Avg. daily gain, g	340	343	0.72
Weight day 35, kg	19.0	19.2	0.65
Treated pens, %	98	85	0.01
Treatment days per pig	4.8	3.2	<0.0001
Dead and moved, Number %	 46 3.1	 53 3.6	0.47

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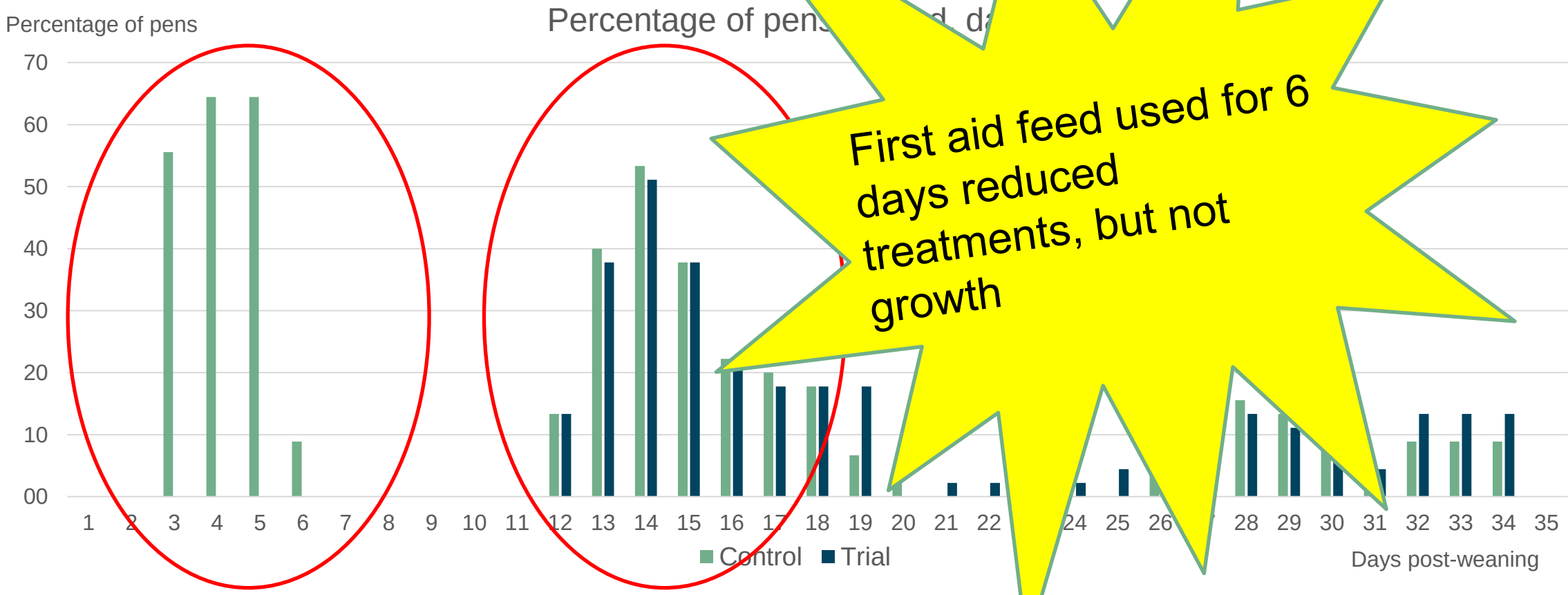
Treatments



First aid feed used for 6 days reduced treatments, but not growth

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Coarsely ground feed

- Changes the consistency of the stomach content
- BUT increases feed used per kg weight gain

	Fine	Coarse
7-30 kg	Fine, pelleted feed	Coarse feed
30-115 kg	Fine, pelleted feed	Fine, pelleted feed

Fine, pelleted feed
80% below 1mm

Coarse feed
60% below 1mm

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Treatments

	Fine/Fine	Coarse/Fine	P-value
7-30 kg			
Treated pens, %	42.1a	21.7b	0.018
Treatments per pig, days	2.7a	1.5b	0.024

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Productivity 7-30 kg

	Fine/Fine	Coarse/fine	P-value
Feed intake, FEsv/day	0.84a	0.81b	0.003
Daily gain, g/day	511a	476b	<0.0001
Feed conversion, FEsv/kg gain	1.65a	1.71b	<0.0001
Production value, index	100a	88b	<0.0001

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Productivity 30-115 kg

	Fine/Fine	Coarse/Fine	P-value
Feed intake, FEsv/day	2.89b	2.94a	0.044
Daily gain, g/day	1092b	1106a	0.042
Feed conversion, FEsv/kg gain	2.63	2.64	0.349
Lean meat %	60.8	60.8	0.873
Production value, index	100	100	0.983

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Productivity 7-115 kg

	Fine/Fine	Coarse/Fin	value
Feed intake, FEsv/day	2.05	04	
Daily gain, g/day	856a		
Feed conversion, FEsv/kg gain	2.40		
Production value index	100		

Coarse feed reduces diarrhea, but also productivity for weaners

Medd.1227 Link

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A concept trial

Optimized feed recipe

Wet feed

Reduced mixing





Farrowing | Week 1 | Week 2 | Week 3 | Week 4 | Weaning | Week 1 | Week 2 | Week 3 | Week 4 | Week 5

Trial: 3 litters moved together
Control: Mixed

Meddelelse 1222, Sørensen, T. 2021 Link

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Trial with frequent feeding of wet feed

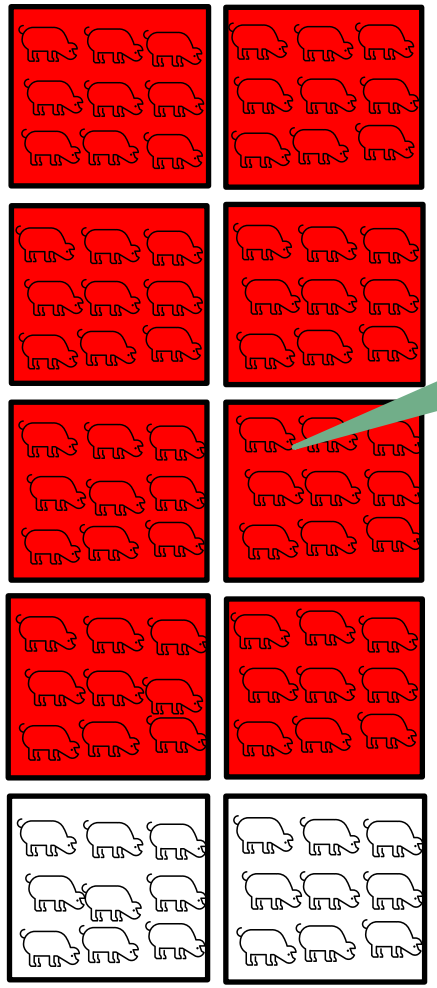
Frequent feeding - day 5 post weaning

Results – treatment against diarrhea

Control

77% Treated

3.1

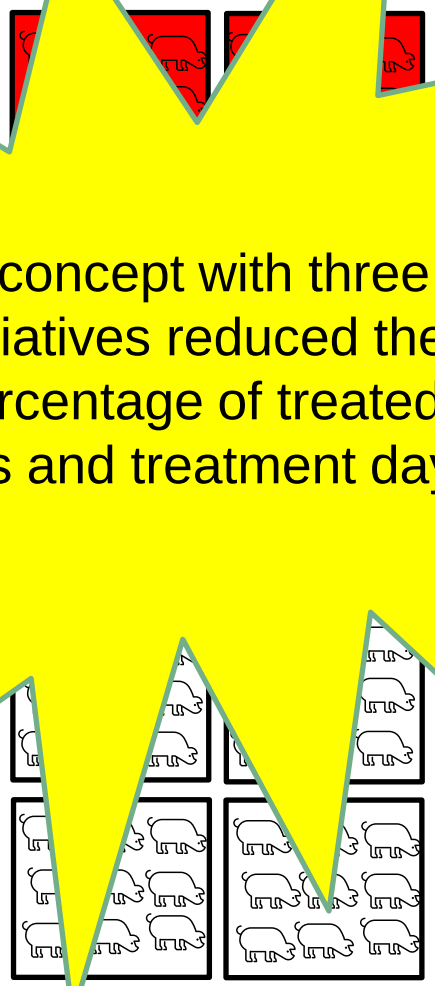


Trial- Conc

29% treated pens*

A concept with three initiatives reduced the percentage of treated pens and treatment days

0.9 treatment days**



*p=0.0001
**p<0.0001

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Results

Group	Control	Trial	P- value
No. pens	48	51	
No. pigs	1,630	1,770	
Weaning weight	6.3	6.5	0.334
Weight day 35 after weaning	18.5	19.8	
Daily gain, g	350	368	0.109
Dead, %	No difference		

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Phase feeding without zinc oxide

Group	Week 1	Week 2	Week 3	Week 4	Week 5-8
3 – phase Control	Diet 1		Diet 2		Diet 3
4 phases	Diet 1+	Diet 1,5	Diet 2		Diet 3
2 phases - Cheap	Diet 2				Diet 3
2 phases - Expensive	Diet 1				Diet 3
Stepwise shift	Diet 1		Stepwise shift from 1 to 3		Diet 3

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Background

- Weaners are normally feed a 3-phase diet
  - ~~Rules regarding zinc oxide~~
  - Nutrient recommendations
    - Amino acids
    - Copper
  - Economy

Blandingstype	**Standard** (1,65-1,8 FEsv / kg tilv. 6-30 kg)			
Vægtinterval, kg	6-9 6-15	9-15	9-30	15-30
Leucin, histidin og isoleucin i % af "idealprotein-profil"	86	86	88	90
Normkolonne	*14*	*15*	*16*	*17*
Normer for fordøjeligt protei				
Lysin	**11,0**	**11,0**	**11,5**	**11,5**
Methionin	3,5	3,5	3,7	3,7
Methionin + cystin	5,9	5,9	6,2	6,2
Treonin	6,8	6,8	7,1	7,1
Tryptofan	2,3	2,3	2,4	2,4
Isoleucin	5,0	5,0	5,4	5,5
Leucin	9,5	9,5	10,1	10,4
Histidin	3,0	3,0	3,2	3,3
Fenylalanin	5,9	5,9	6,2	6,2
Fenylalanin + tyrosin	10,5	10,5	10,9	10,9
Valin	6,9	6,9	7,2	7,3
Protein, min.	130	132	140	143
Protein, maks.	138	140	148	151

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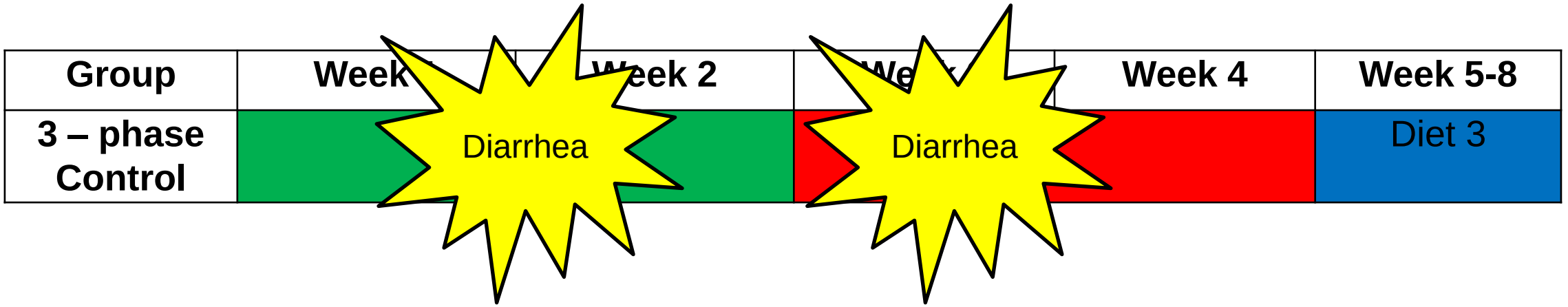
Diarrhea at different times



Will different phase feeding strategies affect diarrhea outbreaks?

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Questions

- Will fewer shifts in feeding reduce diarrhea treatments?
- Can we increase feed intake within the first 14 days by using a more expensive/better weaning diet?
- Are there any differences between small and large piglets?

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Trial design

Group	Week 1	Week 2	Week 3	Week 4	Week 5-8
3 – phase Control	Diet 1		Diet 2		Diet 3

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Trial design

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4 phases	Diet 1+	Diet 1,5	Diet 2		Diet 3

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2 phases - Cheap	Diet 2				Diet 3

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4 phases	Diet 1+	Diet 1,5	Diet 2		Diet 3
2 phases - Cheap	Diet 2				Diet 3
2 phases - Expensive	Diet 1				Diet 3

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Trial design

Group	Week 1	Week 2	Week 3	Week 4	Week 5-8
3 – phase Control	Diet 1		Diet 2		Diet 3
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2 phases - Cheap	Diet 2				Diet 3
2 phases - Expensive	Diet 1				Diet 3
Stepwise shift	Diet 1		Stepwise shift from 1 to 3		Diet 3

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Feed – ingredients

Group	Week 1	Week 2	Week 3	Week 4	Week 5-8
3 phase -control	Diet 1		Diet 2		Diet 3
4 phases	Diet 1+	Diet 1,5	Diet 2		Diet 3
2 phases - cheap	Diet 2				Diet 3
2 phases - expensive	Diet 1				Diet 3
Stepwise shift	Diet 1		Stepwise shift from 1 to 3		Diet 3

	Diet 1+	Diet 1	Diet 2	Diet 3
Wheat	51.0	50.5	49.8	47.0
Barley	20.0	20.0	20.0	20.0
Soy bean meal	**0.0**	**7.0**	**16.8**	**26.1**
Soy bean concentrate - Vilosoy		**5.5**	**0.0**	**0.0**
Soy bean concentrate - Ax3 Digest	**6.6**	**0**	**0**	**0**
Potato protein	3.0	4.0	4.0	0.0
Blood plasma	**5.0**	0.0	0.0	0.0
Whey powder	**8.0**	3.0	0.0	0.0
Fish meal	0.0	2.0	0.0	0.0
Price per FEsv, DKK	3.56	2.59	2.27	1.78

Diets 1+, 1 and 2 included 1.16 FE/kg, 138 g dig. protein/FE and 11.6 dig. g lysine/FE
Diet 3 included 1.12 FE/kg, 150 g dig. protein/FE and 12.0 g dig. lysine /FE

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Results – general

	3 phases - control	4 phases	2 phases - cheap	2 phases - expensive	Stepwise shift
Pens, no.	145	80	83	76	76
Pigs, no.	1667	902	931	865	865
Weaning weight, kg	6.0	6.0	6.1	6.1	6.0
Finish weight, kg	31.4	31.8	31.4	31.5	31.7

Weaning weight from 4.5 to 8.0 kg

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The first 14 days – higher feed intake

Weaning to day 14	3 phases - control	4 phases
Average daily gain, g	127	134
Feed intake, FEsv	0.20	0.22*
Feed conversion, FEsv/kg gain	1.62	1.64

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The first 14 days – higher feed intake

Weaning to day 14	3 phases - control	4 phases	2 phases - cheap	2 phases - expensive	Stepwise shift
Average daily gain,g	127	134	124	130	134
Feed intake, FEsv	0.20	0.22*	0.19	0.20	0.21
Feed conversion, FEsv/kg gain	1.62	1.64	1.61	1.63	1.62

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The entire period 6-30 kg

6-30 kg	3 phases - control	4 phases	2 phases - cheap	2 phases - expensive	Stepwise shift
Average daily gain,g	494	503	496	494	498
Feed intake, FEsv	0.77	0.78	0.77	0.77	0.78
Feed conversion, FEsv/kg gain	1.56	1.55	1.55	1.56	1.56

The entire period 6-30 kg

6-30 kg	3 phases - control	4 phases	2 phases - cheap	2 phases - expensive	Stepwise shift
Average daily gain, g	494	503	496	494	498
Feed intake, FEsv	0.77	0.78	0.77	0.77	0.78
Feed conversion, FEsv/kg gain	1.56	1.55	1.55	1.56	1.56
Production value, current feed price, index	100	100	101a	98b	102

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Treatments

	3 phases - control	4 phases	2 phases - cheap	2 phases - expensive	Stepwise shift
Pens treated (flockwise), %	36.5	32.6	30.4	49.1	49.1
Pens not treated (individual or flock), %	9.3	15.9	8.8	12.4	7.2

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Conclusion on phase feeding

- Will fewer shifts in feeding reduce diarrhea treatments?
  - No
- Can we increase feed intake within the first 14 days by using a more expensive/better weaning diet?
  - Yes, but not from 6-30kg
- Are there any differences between small and large piglets?
  - Yes. They have a lower avereage daily gain and higher level of treatments
  - They don’t need different feeding

A cheap 2-phase feeding is as good as an expensive 2-phase feeding or the traditional 3-phase feeding in terms of productivity and diarrhea

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Conclusion

Make sure you use the right antibiotics. Consider finding other solutions than antibiotics

Less protein => Less diarrhea Additional amino acids => Less diarrhea

First aid feed used for 6 days reduced treatments, but not growth

Coarse feed reduces diarrhea, but also productivity for weaners

A concept with three initiatives reduced the percentage of treated pens and treatment days

Different strategies for phase-feeding did not change productivity or treatments