Skjoldborg test station

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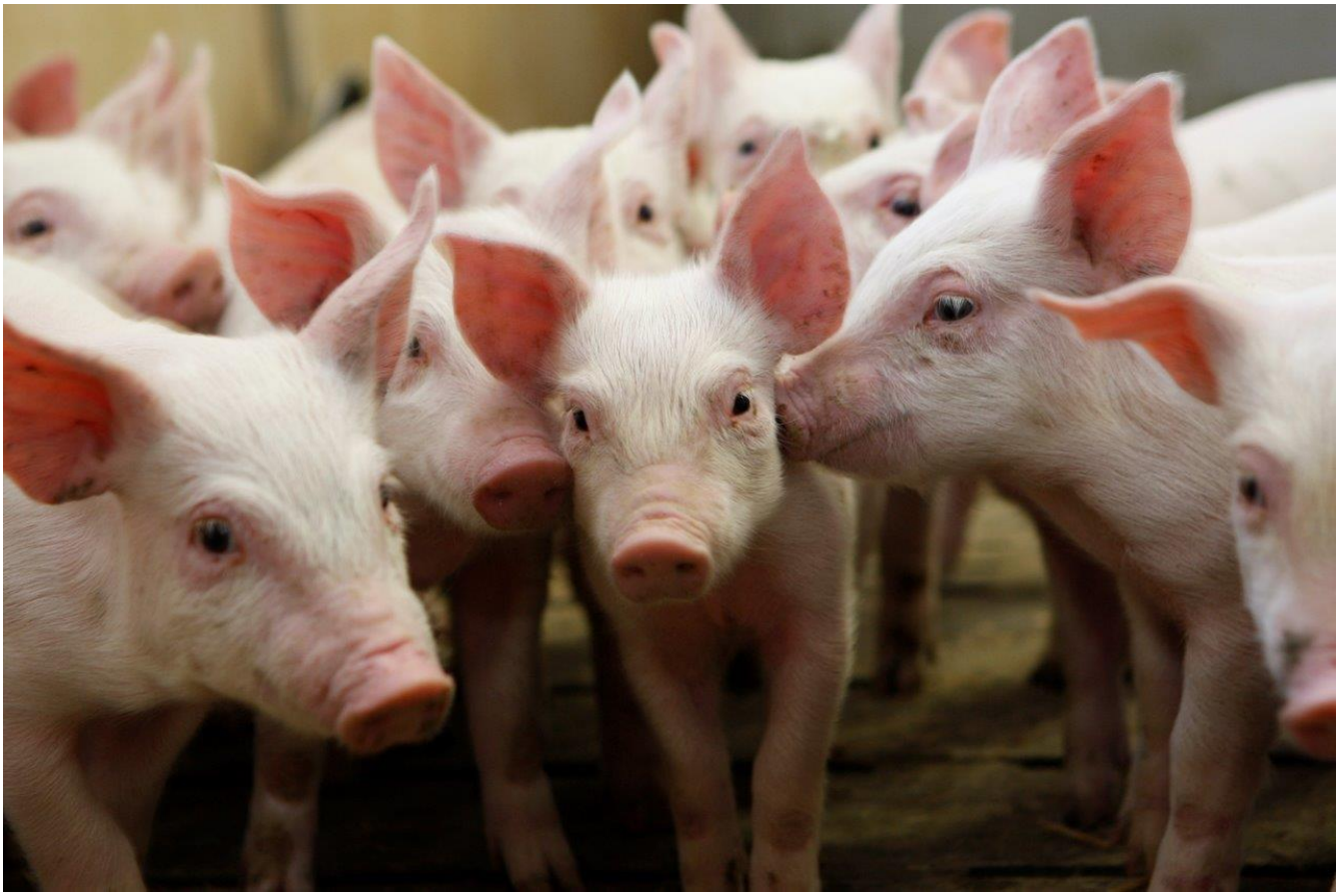

Performance effects of four weaning diets in nursery pigs (VI)

Test conducted on request from Hamlet Protein
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Content

Summary

This test aimed to test the effect of 4 different diets (FTH, FHH, FHL and ZHH) fed for the first two weeks after weaning on piglet performance until 6 weeks after weaning.

The main differences between the diets were as follows:
FTH: 10% HP **F**iberstart + **T**est SPC + **H**igh protein (18.9% Crude Protein, 3.3% Crude Fiber)
FHH: 10 % HP **F**iberstart + **H**P300 + **H**igh protein (18.9% CP, 3.3% CF)
FHL: 10 % HP **F**iberstart + **H**P300 + **L**ow protein (17.0% CP, 3.3% CF)
ZHH: 2500 ppm zinc (from **Z**nO) + **H**P300 + **H**igh protein (18.9% CP + 2.2 % CF)

Piglet performance was measured as average daily gain (ADG), feed intake (FI) and feed conversion ratio (FCR; kg feed per kg gain) under practical pig production conditions.

When piglets showed signs of diarrhoea or were unthriving they were removed to a disease pen (where necessary medical treatment was given).

It is concluded that piglets receiving the positive control diet (ZHH) for the first two weeks after weaning performed better in phase A as well as the whole test period, in terms of ADG, FI and FCR compared with the other 3 dietary groups (FTH, FHH and FHL).

When comparing the 3 diets that contained 10% HP Fiberstart (FTH, FHH and FHL) no effect of SPC type or Crude Protein level could be detected on ADG or FI in any of the feeding phases or for the total 43-day test period.

However, FCR was significantly reduced by reduced crude protein level fed in phase A (diet FHL vs. diet FTH and diet FHH).

In phase A, where the different diets were fed, no differences in FCR were observed between diet FTH and diet FHH. However, in phase C the FCR was significantly higher (less efficient) for piglets that were fed HP300 compared with the test SPC (diet FHH vs. diet FTH).

For the total test period there were no significant differences in FCR between the groups that received 10% HP Fiberstart independent on SPC type or protein level.

The test diets did not reveal any clear influence on the health parameters measured in this trial (PTO or mortality).

Introduction

This study was conducted on request from Hamlet Protein in the period January 18 (2021) to April 20 (2021) at Skjoldborg test station.

The test aimed to test the effect of 4 different diets fed the first 2 weeks after weaning on performance during the first 6 weeks after weaning.

The 4 diets were designated “FTH”, “FHH”, “FHL” and “ZHH” and differed in level of Crude Fiber (CF) and Crude Protein (CP) as well as in type of fiber and protein source (Soy Protein Concentrate, SPC)

FTH: 10% HP **F**iberstart + **T**est SPC + **H**igh protein (18.9% CP, 3.3% CF)
FHH: 10 % HP **F**iberstart + **H**P300 + **H**igh protein (18.9% CP, 3.3% CF)
FHL: 10 % HP **F**iberstart + **H**P300 + **L**ow protein (17.0% CP, 3.3% CF)
ZHH: 2500 ppm zinc (from **Z**nO) + **H**P300 + **H**igh protein (18.9% CP + 2.2 % CF)

The test was designed to test the effect of the diets on average daily gain (ADG), feed intake (FI) and feed conversion ratio (FCR; kg feed per kg gain) in weaned piglets under practical pig production conditions.

Materials and methods

Animals, diets and protocol

The test station is a conventional (Health status: Blue Spf + myc + AP6 +AP12+Vac.) integrated production, which runs weekly operation in the sow unit.

The test included a total of 4137 Danbred crossbred (Landrace/Yorkshire x Duroc) female and castrated male piglets with approximately the same number of both genders. The piglets were weaned at 25 ± 3 days of age.

Housing conditions for piglets complied fully with EU and Danish legislation. Five similar rooms of 12 double-pens where used. Rooms were cleaned and disinfected before insertion of piglets. The double-pens were traditionally structured sharing two dry feed dispensers integrated in the mid-pen wall partitioning the double-pen in two pens. Of the 12 double-pens per room only 8 were used for this trial. The piglets were group housed in pens and allocated randomly; females and castrated males mixed on both sides of the feed dispensers. Thus, two pens around 2 feeders constitute one observation (photo of pen design in Appendix A). Around 33 piglets were inserted in every pen after weaning resulting in 1033, 1034, 1032 and 1038 pigs in the FTH, FHH, FHL and ZHH group, respectively. Pens are designed as 2-climate pens with an insulated piglet nest and a slatted activity area.

At the day of weaning, all piglets were distributed in pens according to size (small, small/medium, large/medium and Large). The average body weight of piglets in the pens was in the range of 5.0 to 7.8 kg. The double-pens were allocated to one of four diets i.e., two dry feed dispensers for each diet per room. The average initial body weight of the piglets was 6.2, 6.2, 6.2 and 6.2 kg for diet FTH, FHH, FHL and ZHH, respectively

Prior to weaning, piglets received a pre-starter diet containing corn, wheat, oat, whey powder, soy protein concentrate, plasma and potato protein.

The test period was initiated at the day of weaning and was divided into three phases (Phase A, B and C). Phase A was from day 0 to day 14 (15 days), phase B was from day 14 to day 28 (14 days) and phase C was from day 28 to 42 (14 days), resulting in a total test period of 43 days.

In Phase A pigs were fed the 4 experimental diets (Table 1) and in Phase B and Phase C all pigs received the same standard diet (Appendix B, Table 1 and 2, respectively).

Table 1. Feed ingredients (%) in the test diets in phase A (6-9 kg).

	FTH	FHH	FHL	ZHH
Wheat	46.9	42.7	47.4	46.0
Barley	10.0	10.0	10.0	10.0
SPC – test[1]	5.7	-	-	-
HP300	-	6.7	1.8	13.5
HP Fiberstart	10.0	10.0	10.0	-
Soy oil	3.4	3.5	3.2	2.9
ZnO	-	-	-	0.3
Premix[2]	24.0	27.0	27.6	27.3

[1]Soy Protein Concentrate – type unknown to TestPig

[2]Containing whey powder, skimmed milk powder, potato protein, vitamins, minerals, amino acids, phytase, xylanase, calcium formiate and benzoic acid

The diets fed in phase A were formulated and delivered by Hamlet Protein. Diet FTH, FHH and ZHH were formulated to contain 18.9% crude protein and diet FHL was formulated to contain only 17% of crude protein. Diet ZHH was a positive control diet containing medical doses of ZnO (2500 ppm) and no HP Fiberstart. Diet FTH was formulated with an unknown (to TestPig) SPC whereas the SPC included in diet FHH, FHL and ZHH was HP300. HP Fiberstart provided about 1 percentage points extra crude fiber (CF) to diet FTH, FHH and FHL (3.3% CF) compared to diet ZHH (2.2% CF). Diets fed in phase B and C were formulated by TestPig*** and optimized to provide nutrients according to the Danish feeding standards for piglets in the weight intervals of 9-15 and 15-30 kg, respectively. The phase B and C diets were produced on farm under the supervision of TestPig***. The composition of the diets is given in Appendix B. None of the diets contained antibiotics.

The diets fed in phase A were pelleted (2 mm) and the diet in phase B and C were fed as meal feed. All diets were fed *ad libitum*. The diets were supplied when requested by a sensor in one of the 2 feed dispensers up to several times per day. When delivered to the individual feed dispensers, the amount of diet dropped into the feeders was registered by weight. The pigs had permanent access to fresh water from 2 types of nipple drinkers; one separate and one that was built into the feed dispensers.

If pigs showed signs of diarrhoea, they were moved to a disease pen (taken out of test) where medical treatment was given.

Registrations

The piglets were weighed when allocated to the pens at the day of insertion. Subsequently, they were weighed when changing to phase B and phase C diets and at the end of test. All pigs in one pen were weighed as a unit. Whenever a pig was taken out of the study due to death or disease the weight was recorded.

Before change to the next feeding phase any feed residues in the feed dispenser were weighed and subtracted from the amount supplied in the previous phase.

The amount of feed produced per feed dispenser per day was recorded by the feeding computer.

The normal procedure was followed in respect of registration of any medical treatment (including treatment days) against diarrhoea and infections.

Calculations and statistics

Average daily gain per piglet was calculated as the difference in weight at insertion and exit of each feeding phase (A, B and C) as well as the overall period from weaning to end of trial at day 43. The body weight used was an average of the piglets in the double pen sharing the two dry feed dispensers.

Feed intake (FI) was calculated as the amount of feed provided per feed dispenser minus the remaining feed residues and feed taken out for chemical analyses in the feeding periods.

In all calculations, data were adjusted for number and weight of piglets taken out of trial.

Pigs taken out of study (PTO) were calculated as percentage of the initial number of piglets in each phase (A, B and C) as well as the total period (A-C).

All statistical analyses were done in cooperation with the Danish Technological Institute, Department of field trials, technology and analysis, Aarhus, Denmark. Animal performance data were statistically analysed by the GLMM procedure of R (R Core Team, 2014).

ADG, FI and FCR in phase A, phase B, phase C and the total test period were analysed in a Gaussian mixed effect model including “initial body weight at day 0”, “weekly batch” and “diet” (FTH, FHH, FHL and ZHH). “weekly batch” was included in the model as a random parameter and “diet” was included in the model as a fixed parameter. Statistical significance was accepted at $P<0.05$.

Standard model control for all outcome variables were performed to assure that the normality assumptions for the models were met. This was not true for FCR in phase C and FCR in the total test period and therefore the test statistics were not accurate. To obtain a more accurate test of treatment effect, bootstrapping was applied to the analysis of FCR in phase C and FCR in the total test period (A-C).

Data on PTO were not statistically analysed and hence these data are only presented in a descriptive way.

Results and comments

In general, piglets maintained good health during the experiment. Based on veterinary diagnosis (lung disease), all pigs in test received treatment with Doxycyclin (Doxx-Sol®) in the drinking water for the first 5 days after weaning. There were no other treatment days against any specific diseases for pigs that stayed in test.

The results on performance in terms of ADG, FI and FCR for the different feeding phases is presented in Table 2.

Phase A

ADG, FI and FCR were significantly influenced by diet in phase A (P<0.001 for all three parameters) and the pairwise comparisons show that the positive control diet (ZHH) resulted in a higher ADG (264 g/d) and FI (281 g/d) as well as improved FCR (1.06 kg/kg) compared with diet FTH, FHH and FHL. When comparing diet FTH, FHH and FHL there were no significant differences in ADG (176, 187 and 171 g/d for group FTH, FHH and FHL, respectively) and no significant differences in FI (212, 222 and 218 g/d for group FTH, FHH and FHL, respectively). However, the FCR was as expected significantly higher in the low protein group (FHL) compared with diet FTH and FHH (1.20, 1.18 and 1.27 kg feed per kg gain for group FTH, FHH and FHL, respectively).

In Figure 1 (Appendix C), the accumulated feed intake in each of the four dietary groups during the first 15 days after weaning is illustrated. It shows how the feed intake is rather similar during the first 4-5 days after weaning. However, from day 5 and onwards it is clear that the feed intake is increased when piglets receive the positive control diet (ZHH).

Table 2. Average daily gain (ADG), feed intake (FI) and feed converstion ratio (FCR) in phase A (6-9 kg) phase B (9-15 kg), phase C (15-30 Kg) and the whole test period (A-C) of pigs fed the four experimental diets.

		Diet					
	Phase	**FTH**	**FHH**	**FHL**	**ZHH**	**P-value**	**LSD**
ADG, g/d	A	176^{b}	187^{b}	171^{b}	264^{a}	<0.001	12
	B	530^{b}	550^{ab}	550^{ab}	558^{a}	0.04	21
	C	815	790	811	828	0.18	35
	A-C	498^{b}	497^{b}	500^{b}	533^{a}	<0.001	16
FI, g/d	A	212^{b}	222^{b}	218^{b}	281^{a}	<0.001	9
	B	707	726	720	737	0.10	25
	C	1224^{b}	1234^{b}	1246^{b}	1308^{a}	<0.001	36
	A-C	704^{b}	717^{b}	713^{b}	755^{a}	<0.001	20
FCR, kg feed/kg gain	A	1.20^{c}	1.18^{c}	1.27^{b}	1.06^{a}	<0.001	0.04
	B	1.34	1.34	1.32	1.35	0.07	0.02
	C	1.51^{b}	1.58^{a}	1.53^{ab}	1.57^{ab}	0.007	0.04
	A-C	1.42^{ab}	1.44^{b}	1.42^{ab}	1.41^{a}	0.02	0.03

^{x} Values are LS-means (n=16).

^{ab} LS-Means within rows without a common superscript differ (P<0.05).

Phase B

In phase B and C all pigs received the same diet, however, ADG in phase B was significantly influenced by diets fed the previous 2 weeks (P=0.04). The weight gain was highest in group ZHH (558 g/d), lowest in group FTH (530 g/d) and the ADG in group FHH (550 g/d) and FHL (550 g/d) was in between. The FI in phase B followed the same pattern as ADG, however the differences were not statistically significant (P=0.10), with values of 707, 726, 720 and 755 g/d in group FTH, FHH, FHL and ZHH, respectively. There was a tendency (P=0.07) that the diets fed in phase A influenced the FCR in phase B and the pigs fed the low protein diet (diet FHL) in phase A tended to have a more

efficient FCR in phase B (1.32 kg/kg) compared with group FTH, FHH and ZHH (1.34, 1.34 and 1.35 kg/kg, respectively).

Phase C

The weight gain in phase C was not significantly affected by diet (P=0.18) and the average daily gain was 815, 790, 811 and 828 g/d in group FTH, FHH, FHL and ZHH. However, FI was significantly influenced by diets fed in phase A (P<0.001) with increased FI in group ZHH (1308 g/d) compared with group FTH, FHH and ZHH (2335, 1234 and 1246 g/d, respectively). The increased FI in group ZHH is most likely a consequence of larger pigs in this group due to the higher ADG in the previous 4 weeks. Surprisingly, FCR was significantly influenced by diet (P=0.007) in phase C with significant differences between group FTH and FHH (1.51 and 1.58 kg/kg, respectively) and intermediary values in group FHL and ZHH (1.53 and 1.57 kg/kg, respectively). The authors of this report are not, from their knowledge about the differences between the diets, able to give a plausible explanation on the differences in FCR between diet FTH and FHH in phase C.

Total test period

The overall picture after the 6-week long test period is that piglets fed diet FTH, FHH or FHL during the first 2 weeks after weaning performed similarly in terms of ADG (498, 497 and 500 g/d) and FI (704, 717 and 713 g/d) and FCR (1.42, 1.44 and 1.42 kg/kg, respectively). In comparison, the positive control diet (ZHH) resulted in higher performance with ADG of 533 g/d, FI of 755 g/d and FCR of 1.41 kg/kg. The overall FCR in group ZHH did however not differ significantly from diet FTH and FHL.

The average piglet weight (± standard deviations) on day 43 was 27.4 (± 2.0), 27.3 (± 2.3), 27.4 (± 2.4) and 28.8 (± 2.9) kg for group FTH, FHH, FHL and ZHH, respectively.

In Table 3, Table 4 and Table 5 the number of pigs taken out in percentage of the number of pigs inserted in each phase of the study is presented. The reason for taking the pigs out included different kinds of veterinary observations e.g., diarrhoea, hernia, arthritis etc. The health data were not statistical analysed. It may be argued that the number of pigs moved to the disease pen was higher in group ZHH during phase A compared with the other 3 dietary groups (8, 8, 7 and 13 pigs from group FTH, FHH FHL and ZHH, respectively). However, it may just be a coincidence that PTO (mainly due to arthritis) was higher for this group. The descriptive data did not indicate any other corelations between diets and the number of pigs taken out or correlations between diets and the reasons for taking pigs out.

Table 3. Pigs taken out of study (PTO, number of pigs) in phase A (day 0-14) divided on the experimental diets and the reason for taking it out and PTO in % of total number of experimental pigs.

Reason	FTH	FHH	FHL	ZHH
PTO:				
Disease pen	8	8	7	13
Dead	0	0	0	0
Euthanized	0	0	1	3
Reason:				
Diarrhoea and un-thriving	3	7	4	2
Arthritis	4	1	2	7
Cerebrospinal Meningitis	0	0	0	0
Blood ear	0	0	0	1
Tail biting	0	0	0	1
Hernia	0	0	0	3
Other	1	0	2	2
PTO (% of total):				
Disease pen (%)	0.8	0.8	0.7	1.3
Dead (%)	0	0	0.1	0.3

Table 4. Pigs taken out of study (PTO, number of pigs) in phase B (day 15-28) divided on the experimental diets and the reason for taking it out and PTO in % of total number of experimental pigs.

Reason	FTH	FHH	FHL	ZHH
PTO:				
Disease pen	15	17	16	15
Dead	0	0	0	1
Euthanized	1	2	4	2
Reason:				
Diarrhoea and un-thriving	8	11	9	4
Arthritis	4	3	5	4
Cerebrospinal Meningitis	0	1	0	2
Blood ear	3	2	3	4
Hernia	1	1	3	1
Tail biting	0	0	0	0
Other	0	1	0	3
PTO (% of total):				
Disease pen (%)	1.5	1.7	1.6	1.5
Dead (%)	0.1	0.2	0.4	0.3

Table 5. Pigs taken out of study (PTO, number of pigs) in phase C (day 19-42) divided on the experimental diets and the reason for taking it out and PTO in % of total number of experimental pigs.

Reason	FTH	FHH	FHL	ZHH
PTO:				
Disease pen	9	8	10	2
Dead	0	1	0	0
Euthanized	0	2	1	0
Reason:				
Diarrhoea and unthriving	3	5	4	2
Arthiritis	3	2	5	3
Cerebrospinal Meningitis	2	2	0	0
Blood ear	0	0	0	0
Hernia	0	0	1	0
Tail biting	0	0	0	0
Other	1	2	1	1
PTO (% of total):				
Disease pen (%)	0.9	0.8	1.0	0.2
Dead (%)	0.0	0.3	0.1	0.4

To sum up the data in table 3 to 5 the percentage of pigs moved to a disease pen and the percentage of pigs that died during the 6-week test period is presented in Table 6.

Table 6. Pigs taken out of study (PTO, %) in the total test period (day 0-42)

Reason	FTH	FHH	FHL	ZHH
Disease pen (%)	3.1	3.2	3.2	2.9
Dead (%)	0.1	0.5	0.6	1.0

Conclusion

It is concluded that piglets receiving the positive control diet that contained medical doses of ZnO for the first two weeks after weaning performed better in phase A as well as the whole test period, in terms of ADG, FI and FCR compared with the other 3 dietary groups that contained 10% of HP Fiberstart.

When comparing the 3 diets that contained 10% of HP Fiberstart no effect of SPC type or SPC inclusion (CP level) could be detected on ADG or FI in any of the feeding phases or for the total 43-day test period.

However, FCR was significantly reduced by reduced crude protein level fed in phase A.

In phase A, where the different diets were fed, no differences in FCR were observed between the diets that included two different types of SPC (HP300 or a test SPC). However, in phase C the FCR was significantly higher (less efficient) for piglets that were fed HP300 compared with the test SPC.

For the total test period there were no significant differences in FCR between the groups that received 10% HP Fiberstart independent on SPC type or protein level.

The test diets did not result in any clear effect on the health parameters measured in this trial (PTO or mortality).

Appendix A. Photo of the pens used for test

Appendix B. Feed ingredients in test diets

Table 1. Feed ingredients (%) in the diet used in phase B (9-15 kg).

	%
Wheat	61.1
Barley	10.0
Soybean meal	10.0
AlphaSoy	10.1
Soy oil	1.5
Premix[2]	7.3

[1]Unknown to TestPig

[2]Containing vitamins, minerals, amino acids, phytase, Ronozyme and benzoic acid

Table 2. Feed ingredients (%) in the diet used in phase C (15-30 kg).

	%
Wheat	41.3
Barley	25.0
Soybean meal	26.9
Soy oil	1.7
Premix[2]	5.1

[1]Unknown to TestPig

[2]Containing vitamins, minerals, amino acids, phytase, Ronozyme and benzoic acid

Appendix C. Average accumulated feed intake

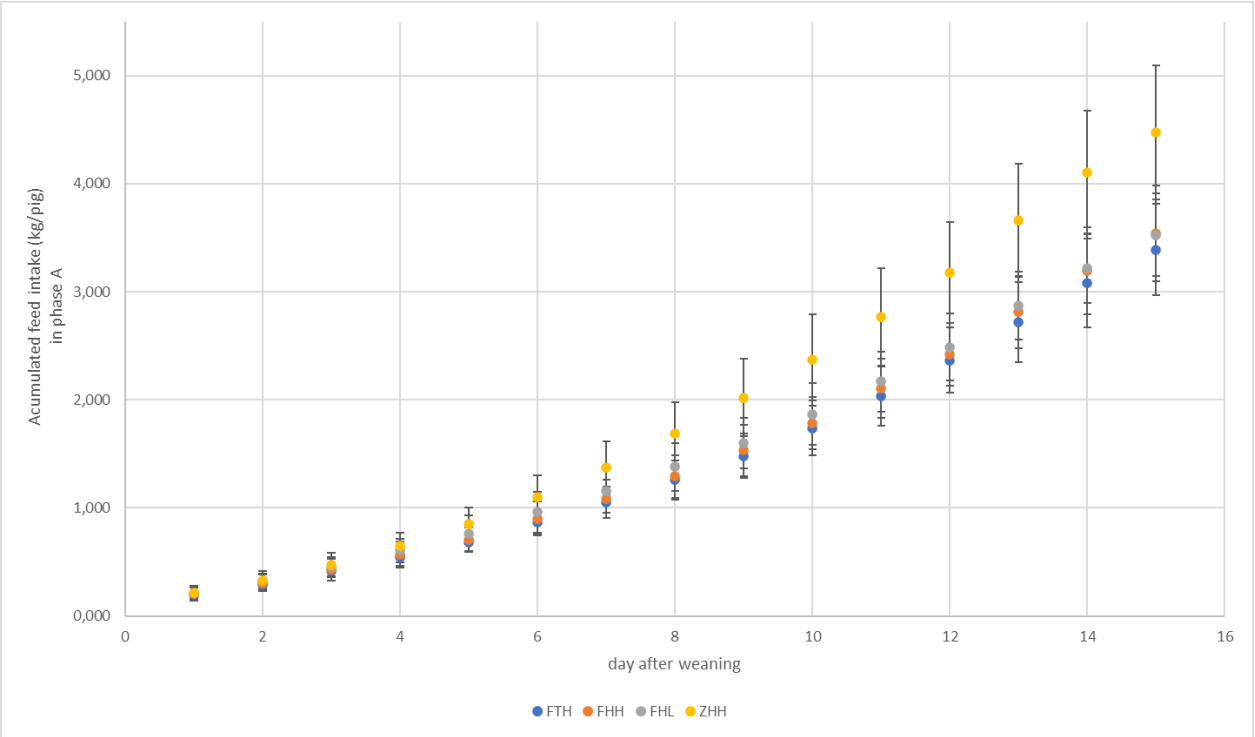

Figure 1. The average accumulated feed intake (kg/pig) during the first 15 days after weaning divided on the 4 dietary treatments (FTH, FHH, FHL and ZHH). Values are means ± standard deviations (error bars).