

Skjoldborg test station

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The effect of “Sky Mountain” on performance and health status of weaning piglets

Test conducted on request from Chr. Hansen (ID: 80593)
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Page 1 of 12

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Sammendrag

Formålet med denne test var at undersøge effekten af probiotikummet SKY Mountain i et antibiotikafrit fravænningsfoder til de mindste fravænnede grise (gennemsnitlig startvægt på 4,2 kg). Grundet deres lave fravænningsvægt blev disse grise opstaldet i såkaldte babygris-stalde i de to første uger efter fravæning inden de blev overflyttet til klimastalden. Effekten af SKY Mountain på produktionsresultaterne i form af tilvækst, foderudnyttelse, udtagne grise og medicinforbrug blev undersøgt i denne 2-ugers periode.

Testen omfattede følgende to forsøgsbehandlinger:

1. Kontrol (standard fravænningsblanding)
2. Kontrolblandingen + 0,1% SKY Mountain

Ingen af grisene i test blev rutinemæssigt behandlet med antibiotika eller zink oxid.

I testen indgik 40 stier (20 stier pr behandling) og der var hhv. 494 og 492 grise i kontrolgruppen og SKY Mountain gruppen.

Den statistiske analyse af data blev gennemført vha. GLMM-proceduren i software-pakken R.

Resultaterne viser en tendens ($P=0,07$) til forbedret daglig tilvækst i SKY Mountain gruppen sammenlignet med kontrolgruppen (hhv. 162 og 151 g/dag). Testen viste ingen forskelle i foderoptagelse, foderudnyttelse, antibiotikaforbrug eller dødelighed imellem de to behandlinger.

Summary

The objective of this study was to investigate the effect of the probiotic SKY Mountain in an antibiotic-free diet on small weaned piglets (4.2 kg in average). Due to their low weight, these piglets stayed in "preweaning" rooms for the first two weeks after weaning before being transferred to the standard weaning rooms. The effect of SKY Mountain on production and health was investigated in this two-week period.

The test included the following two experimental treatments:

1. Control (standard commercial diet)
2. Treatment (Control + 0.1 % SKY Mountain)

No prophylactic treatment, including the use of antibiotics and/or zinc oxide, was routinely applied in any of the treatment groups.

In total the test included 40 pens (20 pens per dietary treatment) and the total number of pigs was 494 and 492 in the Control group and the SKY Mountain group, respectively.

The parameters recorded were body weight, feed intake and mortality. Weight gain and feed conversion ratio was calculated.

Statistical evaluation was performed by applying the GLMM procedure of the software package R.

The results indicated a tendency ($P=0.07$) to improved ADG in the SKY Mountain treated group compared with the Control group (162 vs 151 g/day, respectively). The data showed no differences in feed intake, feed conversion ratio, antibiotic treatments or mortality between the two dietary treatments.

Introduction

This study was conducted on request from Chr. Hansen in the period January 21 (2019) to April 08 (2019) at Skjoldborg test station.

The objective of the study was to investigate the effect of the probiotic Sky Mountain in an antibiotic-free diet on small weaned piglets. Due to their low weight, these piglets were kept in “pre-weaning” rooms for the first two weeks after weaning before being transferred to the standard weaning rooms. The effect of SKY Mountain on production and health in the “pre-weaning” rooms were investigated.

The test was designed to test the effect of diets on average daily gain (ADG), feed intake (FI) and Feed Conversion Ratio (FCR; kg feed per kg gain) in small 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. This means, that every week, the sows farrow and piglets are weaned.

The test included a total of 986 Danbred crossbred (Landrace/Yorkshire x Duroc) female and castrated male piglets with approximately the same number of both gender. The piglets were weaned at 25 ± 3 days of age.

Housing conditions for piglets complied fully with EU and Danish legislation. Four similar rooms of 4 pens were used. Rooms were cleaned and disinfected before insertion of piglets.

The piglets were group housed in pens and allocated randomly according to gender. Around 25 piglets were inserted in every pen after weaning. 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 the pens according to size (Small or Large). The average body weight of piglets in the pens was in the range of 3.4 to 5.0 kg. The pens were allocated to one of two diets i.e. two dry feed dispensers for each diet per room. The average initial body weight of the piglets was $4.2 (\pm 0.5)$ and $4.2 (\pm 0.2)$ kg for the Control and the SKY Mountain-diets, respectively. In total the test included 40 pens (20 pens per dietary treatment) and the total number of pigs was 494 and 492 in the Control group and the SKY Mountain group, respectively.

The test period was initiated at the day of weaning and finalised at day 14 after weaning.

The diets fed in the test were formulated and produced by Nutrimin (Ans, Denmark). The composition of the diets is given in Appendix B. All diets were made as meal feed (no heat treatment) and delivered in 25 kg bags on the test station and bags containing the Control diet were marked with a red label and bags containing SKY Mountain diets were marked with a green label. The compositions of the test diets were unknown for the personnel at the test station.

In each pen two different feeding troughs (vertical and horizontal) were used for manual feeding of dry feed and manual feeding of wet feed (dry feed + water), respectively (see picture in Appendix A).

The pigs were fed *ad libitum* with dry feed in the vertical feeders. The wet feed (dry feed mixed with water) was fed 4 times each day during the working hours (evenly distributed between 07:00 and 15:00 hours) and one time in the evening (between 20:00-23:00 hours). The pigs had permanent access to fresh water from a nipple drinker located in the pen.

Registrations

The piglets were weighed when allocated to the pens at the day of insertion and when the test was finalised on day 14. 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 date and weight was recorded.

Every time a new 25 kg bag was opened it was noted for which pen it was used. Each bag was dedicated for only one pen.

The standard procedure was followed in respect of registration of any medical treatment (including date and treatment days) against diarrhoea and other infections. Furthermore, whenever a pig was taken out of the study due to death or disease the date and weight the piglet was recorded.

Extra registration

In addition to the registrations made by the staff at the test station Chr. Hansen were responsible for registrations of individual weights of each piglet in test. The individual weights were recorded by an external technician on the same days as when the pen weights were recorded. Chr Hansen were responsible for processing these data (calculations, statistical analyses and interpretation of the results). On request by Chr. Hansen the result is presented in Appendix D. The results in Appendix D will not be further commented in this report.

Feed analyses

Feed samples were analysed for dry matter, crude ash, crude protein, crude fat, crude fiber and lysin by Agrolab LUFA (Kiel) and for Sky Mountain activity by Chr. Hansen (Hørsholm).

Calculations and statistics

Average daily gain per piglet was calculated as the difference in weight at insertion and exit of the test. The body weight used was an average of the piglets in each pen.

Feed intake (FI) per pen was calculated as the total amount of feed used for this pen (number of bags x 25 kg) minus the amount of feed (kg) in the last bag opened and minus any feed residues in the dry feed dispenser. The wet feed troughs were always emptied by the pigs before the test was finalised.

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.

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 the total test period were analysed in a Gaussian mixed effect model including initial body weight at day 0, group number and diet (Control, Mountain Sky). "Group number" 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 $P < 0.05$.

The number of observations did not allow for statistical analysis of medical treatments and PTO.

Results and comments

The expected and analysed chemical composition of the diets is presented in Appendix C.

The results (Table 1) indicate a tendency ($P=0.07$) to higher ADG in the SKY Mountain group compared with the Control group (162 vs 151 g/day).

The FI was almost identical in the two dietary groups, with values of 224 and 227 g/d ($p=0.64$) as well as the FCR with values of 1.42 and 1.41 ($p=0.89$), in the Control and SKY Mountain group, respectively.

Table 1. Initial Body weight (BW) (CV%) and Final BW (CV%), Average daily gain (ADG), feed intake (FI) and feed utilisation (FU) of pigs fed the two experimental diets.

	Control	SKY Mountain	P-value	LSD-value
Initial BW, kg	4.2 (12)	4.2 (12)	-	-
Final BW, kg	6.5 (14)	6.7 (12)	-	-
ADG, g/d	151	162	0.07	13
FI, g/d	224	227	0.64	11
FCR, kg feed/kg gain	1.42	1.41	0.89	0.06

^x Values are LS-means ($n=20$).

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

The LSD values (Table 1) indicates that the test was scaled to identify differences of 13 g/d, 11 g/d and 0.06 kg feed/kg gain in ADG, FI and FCR, respectively.

In 1 out of the 40 pens in test signs of diarrhoea were observed for several pigs at day 4 and all pigs in this pen were treated with Tilmovet® (Huvepharma) in the wet feed for 3 on each other following days. The pen that received this group antibiotic treatment was fed the Control diet. Apart from the group treatment 33 individual piglets (out of 986 pigs in test) were medical treated against diarrhoea with injections of Streptocillin® (Boehringer Ingelheim) or Alamycin (ScanVet) for 3 on each other following days. Of these pigs, 12 were from the Control group and 21 from the SKY Mountain group.

Apart from antibiotic treatments against diarrhoea 14 and 17 pigs from the Control and SKY Mountain group, respectively, were treated for arthritits or Cerebrospinal Meningitis with injections of Streptocillin® (Boehringer Ingelheim) or Alamycin (ScanVet) for 3 on each other following days. There were no other treatment days against any specific diseases for pigs in test.

In table 2 the number of pigs taken out (PTO) of the study is presented. The reasons, for taking the pigs out, included different kinds of veterinary observations e.g. diarrhoea, hernia, arthritits etc. The trial was not designed to analyse health data. However, the data shows that the PTO is very low and apparently not related to the dietary treatments.

Table 2. Pigs taken out of study (PTO, number of pigs) in the test period (day 0-14) and the reason for taking it out and PTO in % of total number of experimental pigs.

	Control	SKY Mountain
PTO:		
Dead	1	0
Euthanized	2	1
Reason:		
Cerebrospinal Menigitis	0	1
Hernia	1	0
Un-thriving	1	0
Other	1	0
PTO as % of total number of pigs	0.60	0.20

Conclusion

The results revealed a tendency to improved ADG in the SKY Mountain group compared with the Control group. The data showed no differences in feed intake, feed conversion ratio, antibiotic treatments or mortality between the two dietary groups.

Appendix A. Photo of the pens used for test



Appendix B. Feed ingredients of the two diets used in test

	Control, %	SKY Mountain, %
Barley	10.0	10.0
Wheat	48.1	48.1
Soy protein concentrate	6.1	6.1
Potato protein	2.5	2.5
Blood plasma	5.0	5.0
Fish meal	3.0	3.0
Milk powders	20.0	20.0
Minerals, vitamins, amino acids etc.	5.3	5.2
SKY Mountain	0	0.1

Appendix C. Chemical composition of feed (E=expected and A=analysed)

Expected (E) and analysed (A) chemical composition of the phase A diets^a

	Control		SKY Mountain	
	E	A	E	A
Dry Matter %	92.9	92.2	92.9	93.2
Crude Protein (N*6.25), %	20.1	20.2	20.1	20.1
Crude Fat, %	5.1	4.7	5.1	4.6
Crude Fiber, %	2.1	2.4	2.1	1.9
Crude Ash, %	6.4	6.1	6.4	5.5
Lys, g/kg	14.1	14.8	14.1	13.5
Sky Mountain, CFU/g feed	<1 x 10 ⁵	0.9 x 10 ⁵	2.8 x 10 ⁶	4.5 x 10 ⁶

^a Nutrient-analyses were performed by AGROLAB LUFA (n=1).

Appendix D – Written by Jens Noesgaard Jørgensen from Chr Hansen

Impact of Sky Mountain on Weight Uniformity in weaned piglets

Trial ID 80593

Individual weights were initiated for 986 piglets.

Four piglets were removed before the end of the study and their days on trial were 2, 6, 12 and 13 days, respectively. They were all males and two was from the group of small piglets and two from the group of large piglets. Three was control piglets and one was from the Sky Mountain group.

Eight piglets did not gain in weight during the study. Six of these belonged to the group of large piglets and two to the group of small piglets. Five were males and 3 was females. The eight piglets were evenly distributed over the treatment and control group.

These 12 piglets were removed from the dataset before statistical evaluation. The remaining 974 piglets were evenly distributed over the treatment group (Sky mountain) and the control group, with 487 piglets in each. 492 was categorized as large and 482 as small piglets. Finally, 506 was females and 468 were males. The piglets were housed in 40 pens with a range of from 19 to 30 piglets per pen.

Table 1. Raw means for weights and gains (Standard deviation in parenthesis)

Parameter	Sky Mountain	Control	All
N	487	487	974
Weight in, kg	4.19 (0.6)	4.18 (0.6)	4.18 (0.6)
Weight out, kg	6.82 (1.5)	6.66 (1.4)	6.74 (1.4)
Gain, kg	2.63 (1.1)	2.48 (1.2)	2.56 (1.1)
Average Daily Gain, g/day	188 (83)	177 (80)	183 (81)

Pen means were computed for the 40 pens, including SD(pen), CV(pen) [CD(pen)/mean(pen)*100] and Uniformity [1 – CV(pen)].

The pen data was analyzed using proc mixed in SAS, and the applied mixed model was:

$$Y_{ijkl} = \mu + \text{treatment}_i + \text{size}_j + \text{room}_k + e_{ijkl}$$

where

Y_{ijkl} = is the recorded trait value from the l 'th pen.

treatment_i = the effect of the i 'th treatment, $i = \{\text{control, Sku Mountain}\}$

size_j = the effect of the j 'th size, $j = \{\text{small, large}\}$

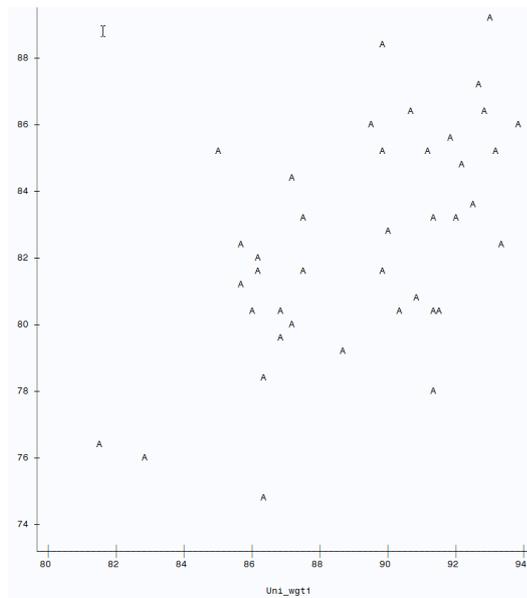
room_k = the random deviation of the k 'th room, $k = \{B1, B2, B3 B4\}$

e_{ijkl} = The random deviation for the l 'th pen, $l = \{1, \dots, 40\}$

The statistical analysis showed that size significantly affected all parameters in Table 2, except the standard deviation for weight out.

There were not found any significant effect of treatment on pen weight averages. However, an unexpected significant effect on all dispersion parameters were observed for pen weight in with the smallest dispersion found in the Sky mountain group. The dispersion parameters related to weight out showed a tendency to reduced dispersion in the Sky mountain supplemented group, expect for the standard deviation for weight out (Table 2).

An co-variation between uniformity for weight in and weight out was observed (Figure 1)



Figur 1. Co-variation between uniformity for weight out (y-axis) and weight in (x-axis) with a regression coefficient of 0.48 (P<0.05)

Using the uniformity for weight in as a covariate in the analysis of uniformity for weight out no significancy or tendencies were observed for piglet size and treatment group, respectively.

Table 2. LS-values for pen weigh means, standard deviations, coefficient of variation (CV) and uniformity

Parameter	Control	Skymountain	Contrast	P-value
Weight in, kg	4.21	4.22	0.01	0.84
Weight out, kg	6.67	6.82	0.15	0.35
SDin, kg	0.462	0.416	-0.046	0.04
SDout, kg	1.207	1.131	-0.076	0.24
CVin, %	11.26	10.11	-1.15	0.04
CVout, %	18.22	16.68	-1.54	0.08
UNI-in	88.74	89.89	1.15	0.04

UNI-out	81.77	83.32	1.54	0.08
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It can be concluded that there was an unfortunate difference in weight dispersion between the two treatment groups at initiation of the study, with the Sky mountain group showing the smallest dispersion.

A tendency toward an increase in uniformity for weight out was observed for Sky mountain supplemented piglets, amounting to app. 1.5%. When adjusted for the uniformity at initiation of the study supplementation of Sky mountain increased the uniformity with 0.90% [P=.28].