

ANNUAL REPORT 2007



1st edition, October 2007

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Lay out / print: Tafdrup@co

Photo front page: Mads Armgaard, GAB

ISBN 87-91460-09-3

Preface

Economy and feed prices

Most pig producers will remember 2007 for the extreme rises in grain prices. On October 1, 100 kg wheat cost approx. DKK 200, if you could get wheat at all.

This is positive for the pig producers who own land and thereby cultivate their own grain, but it is a tough time for those who depend on purchasing the feed for their pigs. It is a historic situation that the production of pigs does not yield a positive gross margin, and the structural development is accelerating all over Europe. Hopefully, we will soon be witnessing rising pig prices.

American pig producers were able to use maize in the autumn 2007, which costs half the price of grain in Europe. This is a decisive competitive advantage, and we therefore need rules and trade mechanisms that ensure a fast neutralization of market imbalances. If and when equal conditions are obtained, Danish pig producers will succeed!

Productivity and efficiency

The number of pigs per sow/year is still increasing: in 2006 it averaged 24.9 and the top 25% producers reached 27.8 pigs per sow/year. Lately, we have seen a positive development in decreasing mortality rates in weaner and finisher facilities. It seems that breeding for survival – live pigs on day 5 – is a success, and perhaps the disease picture headed by PMWS is stabilising. The demonstration project “DKK +25 per finisher” also indicates that it is often possible to increase the level further by simple measures.

We need to stop the increasing sow mortality rates, and the aim is that 25% of the sows that today end at DAKA will end at the slaughterhouse in five years. In co-operation with the regional pig production committees, Danish Pig Production is preparing a focused campaign aimed at offering the individual sow owner the possibility of significantly reducing mortality and costs.

Animal welfare and DANISH Product Standard

Danish authorities, politicians and animal welfare organisation always keep an eye on the pig industry, and 2007 was no exception when transport and shoulder ulcers gave the pig industry widespread press attention.

The government has ordered the Ministry of Justice to establish two work groups. One group is to prepare a bill on rooting and enrichment material (straw) for finishers, and the other is to make proposals for solving shoulder ulcer problems.

The shoulder ulcer problem needs to be solved through improved management and not through further legislation. Fortunately, the number of reports to the police has significantly dropped, and it has also been agreed with the practising vets that together with the person in charge of the herd they must focus on shoulder ulcers at every health visit to the herd.

DANISH Product Standard

Danish Pig Production is implementing a new quality assurance scheme called DANISH Product Standard. In the future, all pig producers will be visited every third year by an impartial auditor, who is also a pig expert, from the regional pig production committees who will ensure that the production meets the requirements of Danish legislation not least in terms of animal welfare.

The aim is to create goodwill in the Danish society and at the same time create market access to the German market. In Danish Pig Production we hope that the scheme and the auditors will be well-received as they are supported by all parties – Danish Crown, TiCan, the private slaughterhouses, Danish Pig Producers' Association etc.

Environmental authorisations

On January 1, 2007, a new Act on Environmental Authorisations came into force that contains significant distance requirements in terms of odour. Unfortunately, the municipal reform has at the same time caused huge

delays of up to six months waiting before case-handling even starts. At the time of writing, 700-800 cases have still not been handled. To put it mildly, this is an unsatisfactory situation for a dynamic business such as the pig industry!

Thank you

As can be seen from this annual report, there has been a great deal of scientific activity in Danish Pig Production this last year.

We are working on finding nutritional and technological solutions to the environmental challenges. We have a documented and efficient breeding system. We ensure a high level of reproduction and AI. We conduct investigations that improve management, feeding and housing facilities, and we work with health and disease management, etc. These are all players in the game of the future competitiveness.

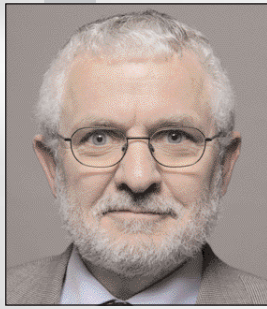
On behalf of Danish Pig Production we would like to thank you for the great support from the pig producers, and a special thank you to our employees and partners. Thank you all for yet another exciting year.

Yours sincerely
Danish Pig Production

Lindhart B. Nielsen /
Orla Grøn Pedersen



Danish Pig Production



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Elected at the Annual Meeting*



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Danish Pig Production*

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Budget and strategy

Danish Pig Production

Danish Pig Production is founded by three basic organisations: the Danish Bacon and Meat Council, Danish Agriculture, and the Danish Pig Producers' Association. Besides representatives from these organisations, the board consists of pig producers elected at the Annual Meeting and members elected by the regional pig production committees.

Budget and strategy

Danish Pig Production safeguards strategy, development and information tasks concerning the live pig, and has an ordinary net budget for the year 2007/2008 of DKK 98.3 million and DKK 6.0 million for DANISH Product Standard. The contribution from the Pig Levy Fund amounts to DKK 81.5 million. The remaining part of the amount originates from the Per mille Levy Fund and from the fee on the sale of semen and breeding stock, which means that, in the future, Danish and foreign users of DanBred genes will be contributing to the development.

The overall goal of Danish Pig Production is to:

- Increase public acceptance
- Ensure future competitiveness
- Ensure satisfactory quality of breeding stock, weaners, finishers and pork, and thereby create market access.

Activities and new projects

Over the last years, Danish pig Production has significantly increased the budget on the environmental area. Areas such as reduction of odour and ammonia emissions require significant resources until reliable and financially acceptable solutions are found. Danish Pig Production will continue to work on improving animal welfare, and this work is particularly aimed at pig producers and their advisors within areas such as sow units with shoulder ulcers and increasing mortality rates. In an effort to improve the efficiency and the economy in the finisher production, feed conversion ratio and mortality rates are being investigated in various trials. A comprehensive demonstration project comprising 200 finisher herds has been initiated with the aim of increasing the gross margin significantly.

As a new initiative, Danish Pig Production has implemented DANISH Product Standard, which is supported by all parties in the pig industry. Danish Pig Production is currently involved in more than 100 scientific projects, and will initiate new projects within the areas below in the financial year 2007/2008.

New projects

1. Public acceptance
 - Environment

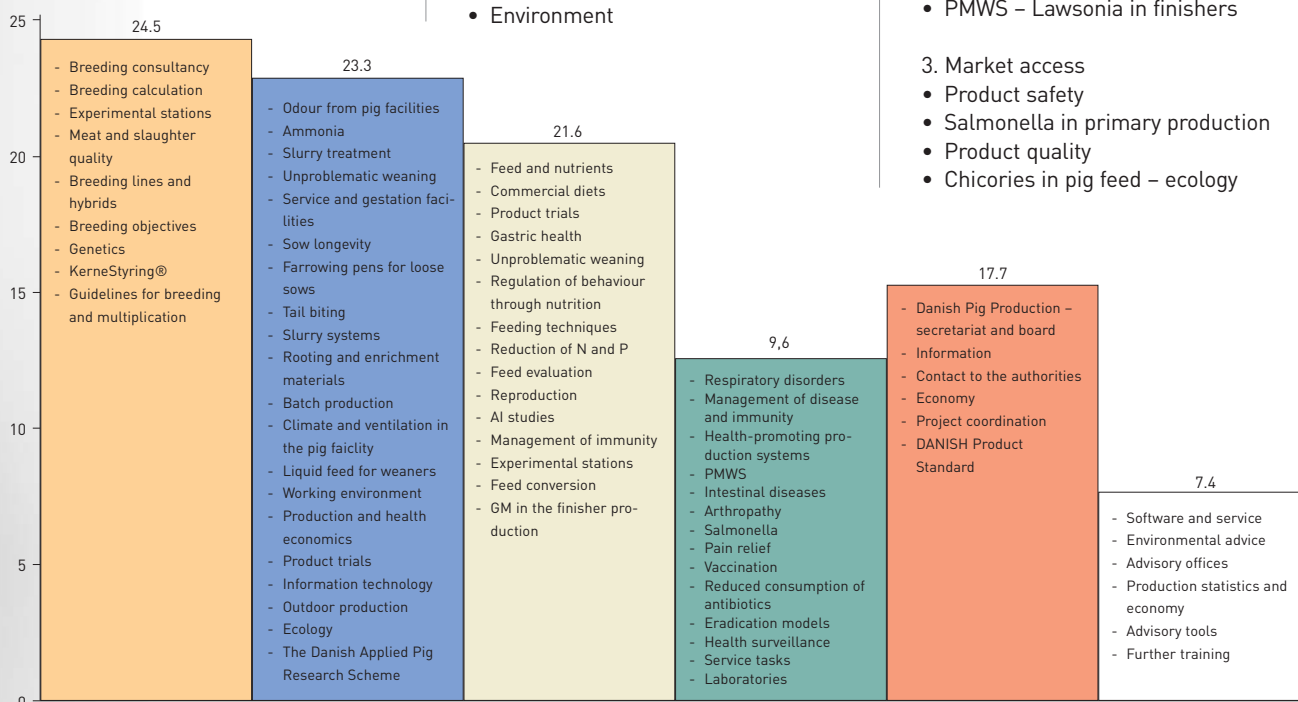
- Reduction of energy consumption
- Reduction of odour from pig facilities
- Certification/BAT (specifications and documentation of air purification technologies)
- Animal welfare
- Sow longevity
- Farrowing pens for loose sows
- Welfare standards EU
- The sow's dilemma / shoulder ulcers

2. Competitiveness

- Efficiency
- Pigs and Health (not the Pig Levy Fund)
- Genome selection
- Increased farrowing rate – demonstration project
- Cheaper feed from bioenergy by-products
- Feed intake and feed efficiency
- Becoming familiar with the grain
- The use of rape in feed
- Education material: pig nutrition
- More pigs for slaughter / fewer dead and destroyed pigs
- Access to plenty of clean water
- Product trial, equipment for pig facilities
- Housing and production systems
- The farrowing facility – without shoulder ulcers
- Managed allocation of straw – maximum use
- Management of health and immunity
- Influence of management on disease in piglets
- PMWS – Lawsonia in finishers

3. Market access

- Product safety
- Salmonella in primary production
- Product quality
- Chicories in pig feed – ecology



Market prices of weaners

What determines the market price?

Market prices of weaners react to expectations to the economy in the pig production. The market prices are also highly influenced by changes in the actual conditions for costs in weaner or finisher production.

Increasing feed prices

When feed prices increase, the market price of weaners drops. This drop is due to the fact that approx. two thirds of the feed required for producing 1 kg carcass are used in the production of finishers.

Expectations for the future

Correspondingly, weaner prices are affected by future expectations of drops or rises in finisher prices.

Market prices and patterns

The market price of weaners is therefore normally higher than the Estimated Weaner Price in the period December-April as an increasing finisher price is expected from Easter and through the summer. For many

years, the market price of weaners has fluctuated in a fairly stable pattern compared with the Estimated Weaner Price. This price is calculated on the basis of the realised prices and feed prices as opposed to the market prices that react to expectations. Thereby, very large differences may arise between the market-based weaner price and the Estimated Weaner Price.

Feed prices rise

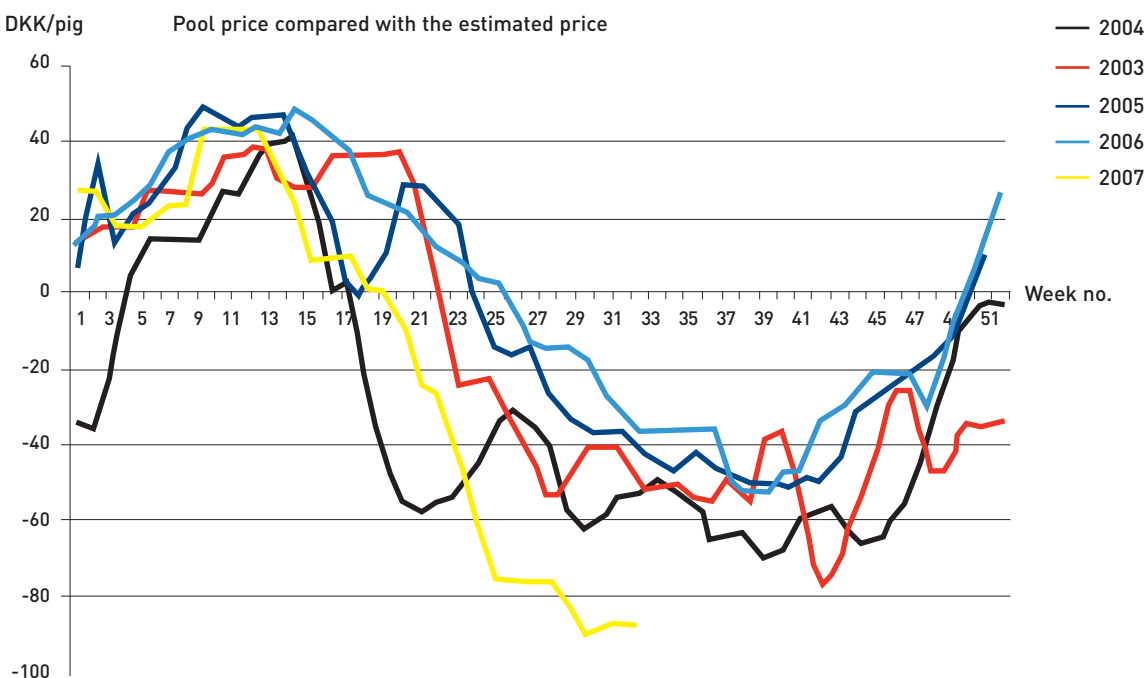
The price of grain was significantly higher in 2007 than normally, partly because of the demand for, in particular, maize for bio ethanol, and partly because of market speculations.

In the US, maize prices dropped in August 2007 to approx. half the price of wheat in Europe. Feed prices in North and South America are now far lower than in Europe. The large price differences between maize and wheat are caused by EU policies on GMO that largely prevent the import of maize to Europe. Low feed prices in the US combined with a low dollar

rate only reduce the competitiveness of the Danish pig producers on the export markets. It has been suggested that the requirement for setting aside be cancelled in the EU. This would increase the cultivation area of grain, particularly in France and Germany. There are furthermore great possibilities of increasing the production of maize and grain in Brazil, the Ukraine, Belarus and Russia. It is too soon to say whether the grain price will stay high above DKK 100 per 100 kg. However, despite the increasing costs in pig production, it must be expected that the finisher price does not rise until we see clear indications of a decreasing pig production.

Poultry, pork or beef

If feed prices keep rising, a new price relationship may arise between poultry, pork and beef. The smallest amount of feed is used per kg poultry, and the most per kg beef. Poultry may thereby end up in the strongest competitive position, if prices determine the consumers' choice of meat.



Productivity

Development

The number of sows and produced pigs dropped from 2005 to 2006. The export of weaners increased from 3 million in 2005 to 3.5 million in 2006. In this period, the production of pigs dropped by 0.1 million, and the number of produced finishers consequently decreased in 2006 by 0.6 million. In 2007, the sow population is expected to reach a peak, and, combined with an increase in pigs per sow/year, this leads to an increase of 0.4 million produced pigs. The slaughter weight continues to increase.

Control results

The development in sow productivity is shown in table 2. The number of weaned pigs per sow/year increased from 2005 to 2006 because of more liveborn piglets/litter. The number of litters per sow/year dropped slightly in this period due to more non-productive days and a higher weaning age. The number of first parity litters continues to increase.

The feed conversion per produced pig decreased in 2006 as a result of more piglets per sow/year. Weaner mortality dropped by 0.6 percentage points from 2005 to 2006. In that same period, the daily gain increased by 10 g, which, despite a higher age and the same weight at weaning, results in a lower age at 30 kg.

In the finisher production, the feed efficiency increased slightly in 2006 (see table 3). The slaughter weight increased by 1.3 kg and the daily gain increased by 24 g. Mortality dropped by 0.3 percentage points and was in 2006 level with the mortality rate in 2003.

Many pig producers have a lot to gain particularly in areas such as feed efficiency and daily gain. The best fourth have a daily gain that is almost 40 g higher and a feed conversion that is 0.2 FUgp lower per kg gain than the average. The bottom fourth have a mortality rate that is 1.1 percentage point higher than the average.

Table 1. Development in population, production and slaughter weight

	1999	2000	2001	2002	2003***	2004	2005	2006	2007*
Sows, 1,000	1,080	1,070	1,130	1,128	1,130	1,141	1,143	1,123	1,150
Prod. million**	22.5	22.4	22.9	24.0	24.6	24.9	25.8	25.7	26.1
Slaughter weight,kg	76.6	77.1	77.9	78.1	77.7	78.5	80.7	81.2	82.0

* Projection

** Incl. export of live animals, and sows, boars, gilts, etc.

*** 53 weeks

Table 2. Productivity, sows and weaners

Year	Average production results				
	2004 All	2005 All	2006 All	2006 Bottom 25%	2006 Bottom 25%
Weight/sold pig, kg	30.6	31.2	31.3	31.5	31.7
Feed/produced pig, FUgp*	108	109	107	-	-
Prod. pigs/sow/year	23.7	24.3	24.9	22.0	27.8
Litters/sow/year	2.24	2.24	2.23	2.14	2.31
Sows/year	303	327	331	263	399
First parity litters, %	22.3	22.5	22.7	22.3	22.7
Liveborn/litter	12.9	13.2	13.5	12.8	14.0
Stillborn/litter	1.5	1.7	1.7	1.7	1.7
Weaned/litter	11.1	11.3	11.6	10.7	12.3
Age at weaning, days	31	31.4	31.7	33.1	29.9
Weaning weight, kg	7.3	7.3	7.3	7.5	7.1
Non-productive days/litter	15.6	15.4	15.7	21.7	11.3
Mortality post-weaning, %	4.4	3.8	3.2	4.2	2.3
ADG post-weaning, g	420	429	439	427	450
Age at 30 kg, days	86.1	85.9	84.9	88.0	82.2

* Incl. feed for young sows

Table 3. Productivity, finishers

Year	Average production results				
	2004 All	2005 All	2006 AlleAll	2006 Bottom 25%	2006 Bottom 25%
Prod. pigs	4,242	4,472	4,582	4,054	4,527
Daily gain, g	833	849	873	814	909
Feed/kg gain, FUgp	2.88	2.88	2.87	3.09	2.67
Weight at transfer to finisher facility, kg	32.4	32.8	33.0	34.0	32.3
Av. slaughter weight, kg	78.0	80.2	81.5	81.7	81.4
Av. lean meat %	60.2	60.2	60.3	60.3	60.4
Dead and culled, %	4.5	4.3	4.0	5.1	3.5
Incidence of pleurisy recorded rec. at slaughter	26.5	24.8	21.0	25.2	18.0
Total incl. deduction, %	16.8	17.7	17.8	18.9	16.3



Business Check Pigs

Benchmarking

The Danish Agricultural Advisory Service has developed Business Check Pigs, a benchmarking product that presents the farmers who participate individually. The individual producer can use Business Check to compare himself with other pig producers. The product is aimed at pig producers with more than 600 sows/year, 9,000 produced finishers or 350 LU.

Business Check includes all income and costs related to the production of pigs. This also includes wages to the owner and rate of return on invested capital. However, it does not include internal transfers and costs for spreading of livestock manure. The bottom line result must thereby cover environmental costs and risks.

If the herd belongs in the good end of the scale in terms of earning capacity, it is fairly easy to see which factors form the basis of this and the producer can keep working with these. If, however, the herd belongs at the bottom of the scale, Business Check is a good tool for the producer to form an outline of which areas need improvement compared with the herds he benchmarks himself with. However, even though you are number one in your class, it will generally always be possible to pinpoint areas that can be improved.

Business Check includes five production categories, and integrated herds are split into another four categories according to the percentage of produced finishers (see table 1). In each category, the herds are sorted according to rate of return. The rate of return shows the yield of the invested capital during the financial year. The average of the five best herds and of all herds in the various groups are shown in table 1.

Rate of return = $\frac{\text{Result before interest}}{\text{Tied capital}}$

Results in 2006

The results in Business Check Pigs 2006 reveal many interesting tendencies. For instance, in the integrated herds there is a tendency to an aver-

Table 1.

	Number	Rate of return, %		Change in settlement for "break-even point"	
		Top 5	Alle	Top 5	All
Sow units - 30 kg	30	14,9	9,1	1,97	0,99
Sow units - 7 kg	21	10,6	7,3	1,27	0,75
Integr. 10-25%	14	13,0	9,7	1,77	1,18
Integr. 25-50%	11	12,1	9,4	1,43	1,06
Integr. 50-90%	17	15,3	8,4	1,57	0,86
Integr. 100%	11	10,9	7,6	1,26	0,75
Finishers 7-100 kg	9	7,7	6,0	0,84	0,40

gely higher yield, the smaller the percentage of produced finishers. The traditional weaner producers (up to 30 kg) and finisher producers (from 30 kg up) generally have a better return than the corresponding 7 kg producers and WTF producers. There are several reasons for this. One of them is found in a newer (and thereby heavier investment-wise) production apparatus among the 7 kg producers and WTF producers.

The most profitable pig herds are found among the finisher producers.

However, this is also where the greatest difference between the five best herds and the average is found. This indicates that many finisher producers hold a huge unexploited potential. If the difference between the financially best and poorest finisher producers is analysed more closely, it is not surprising that the gross margin makes the greatest difference. Of this, primarily the settlement and the price per FUp are creating the difference between the best and the poorest producers.

Break-even point

Business Check Pigs also calculates how much the settlement can drop, all other things being equal, before a result breaks even. This key figure is also shown in table 1.

The settlement in Business Check Pigs 2006 averaged DKK 9.79 per kg. In table 1, it is seen that the integrated herds with 10-25% finisher production were able to handle an average drop in the settlement of DKK 1.18,

while the WTF producers had a break-even point of only DKK 0.40.

Among the top 5 herds, the sow herds with production of 30 kg pigs and finisher producers were able to handle a drop in settlement of almost DKK 2, before reaching their break-even point.



International competitiveness

Background

Every year, the costs related to producing pork are collected in a number of countries in the context of Interpig. Below, a preliminary analysis is presented of the 2006 production costs in the countries that participate in Interpig.

Interpig

Interpig is an international economy group established to standardise the collection of efficiency figures and financial costs in the pig industry of the individual countries. Annually, more countries join Interpig, and this year Brazil, the US and Canada joined the member list. The individual countries each collect their own data.

International competitiveness

Costs are lowest in Brazil, closely followed by Canada. In these countries, the production costs amount to approx. DKK 7 per kg carcass. Canada had the lowest feed costs per kg carcass in 2006. In the US, the feed prices increased significantly in 2006 because of the increased production of biofuel. Feed prices in Brazil were also fairly high in 2006. The strong competitiveness of the US, Canada and Brazil was therefore primarily due to lower costs for construction and wages.

Wages per kg pork are very low in Brazil. This is not caused by a small amount of labour per produced pig, but by very low wages. In Brazil, approx. four times as much labour time is spent per produced pig as in Denmark.

Competitiveness within the EU

The Netherlands and Denmark have the lowest production costs per kg carcass of the EU members of Interpig. The break-even point for these countries averages DKK 9.50 per kg carcass.

Italy has the highest production costs: the production of one kg carcass amounts to DKK 14.30.

Production costs must be related to the finished product and the possible sales price of the product. The high production costs in Italy are due to,

among other things, a very high slaughter weight of 130 kg and a one-sided focus on production of hams. In each country, individual production characteristics often affect the production costs and outlets.

Unfortunately, Spain is not a member of the group. Spain probably has the lowest break-even point within the EU.

Feed costs

If we disregard Italy, the average feed costs amount to DKK 5.10. In Denmark, the feed costs per kg carcass amounted to DKK 4.80 in 2006, which is slightly below the average.

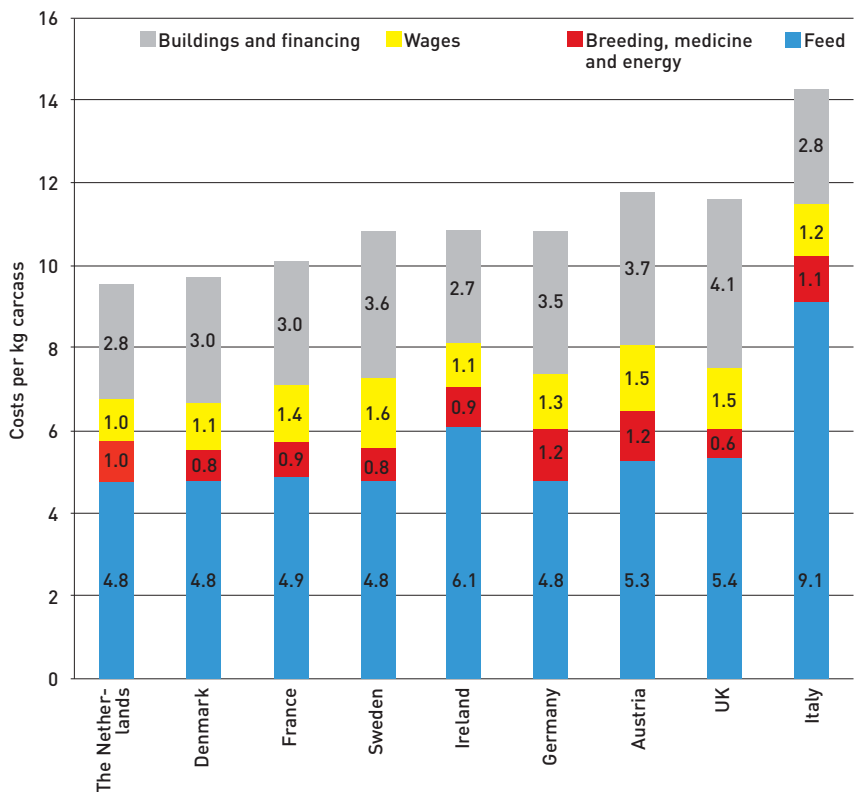
If the feed consumption is standardised with the same start and finish weights, there is a surprisingly small difference in feed conversion per kg gain.

The number of produced pigs per sow/year is a key factor in low feed costs per kg carcass, and here Denmark and the Netherlands still top the list with 25.9 and 25.1 weaned pigs per sow/year, respectively.

Buildings and financing

The average costs for building and financing per kg carcass include storage of slurry. In Denmark, costs for building and financing amount to approx. DKK 3 per kg carcass, which is fairly good. The quality and thereby the durability of buildings vary greatly from country to country.

The depreciation periods on buildings may therefore differ. In the calculation shown here, depreciations are set to 20 years on buildings and ten years on equipment, except for Denmark and Sweden where assets are depreciated over periods of 25 years and 12 years.



Interpig, production costs 2006

Genetic progress, sale and production level

Genetic progress

Table 1 provides an outline of the genetic progress of the individual breeds over the last four years. The variation in genetic progress between the breeds is due to different breeding objectives, differences in genetic parameters and number of performance-tested animals. The trait "killing-out percentage" is included in the breeding objective for the sow breeds due to a relatively negative development in this trait. As shown in table 1, this development has not yet stopped, but as an average for all breeds there is no trend in this trait.

Sale of breeding stock

As seen in table 2, the sale of hybrid gilts is still increasing. This increase is due to a large, stable sale in Denmark and an increasing sale for export. The increasing export is largely attributed to the fertility of Danish breeding stock.

The sale of purebred gilts also increased, which was mainly due to the establishment of new multiplication herds. The boar sale has decreased slightly.

Production level

Tables 3-6 show the production results achieved at the test station and in the nucleus herds in 2006.

In the last year, the number of performance-tested boars and female pigs increased by 3.8% and 1.9%, respectively. However, for both genders in Hampshire the number has dropped 15.7% for boars and 13.3% for female pigs. This drop is caused by the fact that Hampshire is being phased out. Also Duroc is experiencing a decrease in testing, while the extent of testing has increased for Landrace and Large White. Station testing is largely unchanged compared with last year.

Litter size has increased for all breeds in the nucleus herds.



Litter size has increased.



Also gain in weaners and finishers increases.

Genetic progress, sale and production level

Table 1. Genetic progress over the last four years for the three breeds.

Breed	Year	Daily gain (30-100 kg), g/day	Feed conversion, FUp/kg daily gain	Lean meat %	LP5	Conformation, points	Daily gain (0-30 kg), g/day	Killing-out percentage, %	Longevity, %	Progress DKK/year
Duroc	03/04	18.8	-0.037	0.14	-	0.04	4.0	0.14	-	7.94
	04/05	20.6	-0.035	0.14	-	0.03	3.8	0.17	-	7.97
	05/06	15.9	-0.044	0.23	-	0.02	1.7	-0.03	-	7.57
	06/07	20.4	-0.040	0.13	-	0.05	3.7	0.03	-	7.81
Average	4 years	18.9	-0.039	0.16	-	0.04	3.3	0.08	-	7.82
Landrace	03/04	9.6	-0.019	0.09	0.16	0.03	-1.1	0.02	0.41	10.61
	04/05	19.9	-0.041	0.05	0.32	0.04	0.2	-0.13	-0.04	18.90
	05/06	12.3	-0.037	0.01	0.46	0.04	-1.1	-0.15	0.23	23.11
	06/07	5.7	-0.013	-0.05	0.43	0.03	-0.4	-0.04	1.57	20.35
Average	4 years	11.9	-0.028	0.03	0.34	0.04	-0.6	-0.08	0.54	18.26
Large White	03/04	15.6	-0.025	0.01	0.30	0.06	0.2	-0.04	0.80	17.38
	04/05	7.1	-0.022	0.08	0.28	0.07	-0.9	-0.01	2.30	17.40
	05/06	-2.7	-0.007	0.05	0.58	0.03	-0.8	-0.04	0.20	25.12
	06/07	3.6	0.002	-0.02	0.36	0.05	1.1	-0.12	2.20	16.85
Average	4 years	5.9	-0.013	0.03	0.38	0.05	-0.1	-0.03	1.38	19.18
Average 3 hybrids	4 years	13.9	-0.020	0.10	0.36	0.04	1.3	0.02	0.48	12.54

Table 2. Sale of breeding stock in 2004/2005 and in 2005/2006

	Female animals				Boars			
	2004/05		2005/06		2004/05		2005/06	
	DK	Export	DK	Export	DK	Export	DK	Export
Landrace	5,546	2,409	6,508	2,181	87	265	67	309
Large White	1,914	2,026	3,283	1,546	160	330	157	403
Duroc	54	197	58	98	1,056	622	1,022	885
Hampshire	2	8	0	4	22	6	16	7
All 4 breeds	7,516	4,640	9,849	3,829	1,325	1,223	1,262	1,604
Purebred total**	12,164	-	13,682	-	2,813	-	2,866	-
Hybrids*	255,760	43,452	260,886	57,530	2,750	346	2,200	183
Hybrids total**	299,212	-	318,416	-	3,096	-	2,383	-

* Export incl. F2 females

** Incl. export.

Table 3. Average production results of boars performance tested at Bøgildgård, 2006.

Breed	Number	Daily gain (30-100 kg), g/day	Feed conversion, FUp/kg gain	Lean meat %	Killing-out percentage
Duroc	1,568	1,006	2.30	59.9	26.7
Hampshire	1,018	885	2.41	62.0	25.4
Landrace	1,292	920	2.40	61.2	27.0
Yorkshire	1,289	928	2.34	61.2	26.3
Total	5,167				



Table 4. Nucleus herds – average production results for boars, 2006

Breed	Number	Daily gain, g*		Lean meat %	Conformation, points	Scanning objective	Scanning weight, kg
		0-30 kg	30-100 kg				
Duroc	8,080	384	1,039	60.4	2.92	8.1	93.6
Hampshire	2,251	363	876	62.3	2.95	7.7	90.6
Landrace	18,713	382	978	62.2	2.93	8.3	91.6
Large White	15,460	359	920	61.6	3.06	8.4	90.2
Total	44,504						

* Note that daily gain 30-100 kg is calculated on the basis of weighing of live animals, which means that the calculation of gain at the performance test did not take into account differences in killing-out percentage between the breeds.

Table 5. Nucleus herds – average production results for young sows, 2006

Breed	Number	Daily gain, g*		Lean meat %	Conformation, points	Scanning objective	Scanning weight, kg
		0-30 kg	30-100 kg				
Duroc	9,743	385	990	60.5	2.98	7.8	92.5
Hampshire	3,280	368	845	62.1	3.05	7.8	89.7
Landrace	23,144	384	935	62.1	3.06	8.3	90.8
Large White	17,419	362	887	61.5	3.14	8.5	89.6
Total	53,586						

* Note that daily gain 30-100 kg is calculated on the basis of weighing of live animals, which means that the calculation of gain at the performance test did not take into account differences in killing-out percentage between the breeds.

Table 6. Nucleus herds – litter size of purebred litters, 2006

Maternal breed	Litter size	LP5	Per cent gilt litters
Duroc	10.1	-	74.0
Hampshire	8.7	-	64.7
Landrace	15.0	11.4	60.1
Large White	14.3	11.7	61.8



Genetic progress, sale and production level

Survival of DD and HD offspring

In one herd, the difference in survival from birth to slaughter between Duroc offspring and HD offspring was studied.

The aim was to investigate if there were differences in the pigs' chances for survival depending on whether Duroc boars or hybrid boars with Hampshire as sires were used. The study included 478 sows that produced 5,851 Duroc hybrids and 3,067 HD/DH hybrids.

The survival curves (figure 1) show that, for all hybrids, mortality peaked in the first days after birth and was successively reduced until 7 weeks of age. Mortality was subsequently more or less constantly decreasing until slaughter.

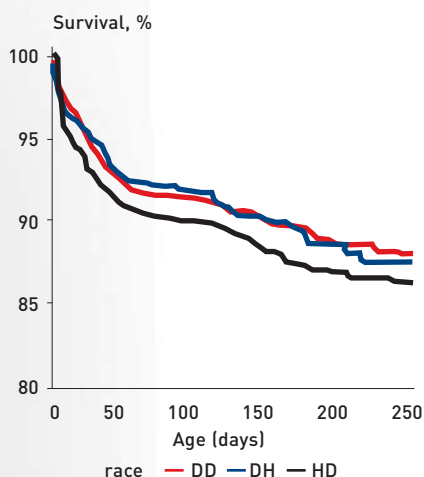


Figure 1. Survival curves for DD, DH and HD

The greatest difference between the combinations of breeds occurs within the first ten days after birth when 96.6% of the offspring of Duroc boars were still alive compared with 95.4% of the offspring of HD boars. However, the statistical analyses revealed no significant genetic difference in survival between offspring of Duroc boars and HD/DH boars ($P=0.067$).

The small difference seen within the first ten days after birth remained unchanged in the entire period from day 10 to day 200, but there was furthermore no significant difference from day ten onwards in mortality

between the combinations of breeds ($P=0.575$).

The study revealed no significant difference in survival between offspring of Duroc boars and offspring of HD/DH boars. It furthermore showed that it was not possible to document differences in mortality causes between the combinations of breeds or differences in reproduction traits for the offspring. The study also showed that offspring with HD or DH fathers had a lower gain than offspring of Duroc. There were no differences in lean meat percentage.

Survival project

It is desirable to improve the survival rate of pigs as that will significantly improve the economy of Danish pig production. With the breeding objective LP5, the survival the first five days after farrowing will be improved, among other things. This contribution to improved survival is a trait of the sow. To further strengthen the survival up to slaughter, it is currently being investigated whether the boar breed has heritability in the trait survival (defined as an animal being alive at a given day, day x). If heritability is found, it may be possible to include survival in the breeding objective for Duroc.

In 2006, a study was initiated in a production herd where the survival chances of offspring of Duroc boars with YL sows are studied.

In this herd, matings with named semen will be recorded and all newborn piglets will be ear-tagged before cross-fostering to ensure that the kinship of every single pig in the herd is known. Subsequently, all dead/cul-



Recording of survival in offspring of different Duroc boars.

led pigs until slaughter will be recorded and date of culling stated. Approx. 15,000 pigs/year are expected. With this information, it will be possible to analyse whether the trait is heritable. Once this has been established, it will be evaluated whether it may become a future breeding objective.

Project Pigs and Health

Project Pigs and Health consists of two subprojects. These are two separate projects that only have the pig and its genetic mass as common denominator.

The project Healthy Pigs aims at selecting commercial pigs for improved resistance to a number of diseases, primarily various types of pneumonia and hernia. For pneumonia in pigs, four regions in the genetic mass have currently been found that seem to affect resistance to these types of diseases. If we succeed in finding the genes causing this resistance, it will be possible to test pigs for these genes, and then, through selection, ensure that the trait is passed on to future generations of pigs.

Researchers from Aarhus University, Denmark's Technical University and Copenhagen University are involved in this project, and Danish Pig Production is in charge of the practical part of testing the effects in live pigs.

In the other subproject, special model pigs will be bred for use in the pharmaceutical industry in the development of new drugs for treatment of humans.

The model pigs are special mini pigs whose ancestors are the Vietnamese pot bellied pig. For the moment, genes must be transferred to mini pigs that dispose them to certain human diseases and subsequently, by cloning, identical individuals of the pigs will be created, so that lines of model pigs are bred that have these diseases or diseases identical to them. Subsequently, the pharmaceutical industry will test the suitability of the pigs as experimental animals. The project will focus on the development of model pigs for analysis of treatment for, for instance, psoriasis,



Table 7. Difference between 94 Duroc boars with ≥ 50 offspring

	Sick offspring, %, phenotypical data			
	Average	Stand. dev.	Best boar	Poorest boar
Mycoplasma pneumonia	14,5	7,3	1,9	38,1
Pleuritis	53,9	10,6	26,8	72,2
Pleuropneumonia	1,3	1,5	0	6,3
Pericarditis	9,7	6,3	0	38,9

arteriosclerosis and Alzheimer's disease.

This subproject is handled by researchers from the Institute of Human Genetics at Aarhus University, the Faculty of Agricultural Sciences of Aarhus University (previously the Danish Institute of Agricultural Sciences) and the Faculty of Life Sciences at Copenhagen University (previously the Royal Veterinary and Agricultural University).

The basis of the project is the knowledge of the pig's genetic mass obtained by Danish Pig Production and Danish researchers since 2000 in close co-operation with, among others, Chinese researchers. The time horizon is four years and the overall budget is DKK 50 million, of which the Danish National Advanced Technology Foundation has agreed to fund half. Danish Pig Production co-ordinates the project.

The pneumonia project

In many commercial herds, respiratory diseases in pigs are a big problem that, despite a good environment in the pig facility, can be difficult to overcome.

In 2004-2006, 350 sows of known origin were mated with 171 named Duroc boars. Together, they produced approx. 10,000 animals that were marked individually and followed until slaughter. The pig producers recorded dates for mating and farrowing, litter size, survival/mortality rates in the weaner facility and prevalence of hernia. These herd data were correlated with information on the origin of the animals, which is stored in the Pig Breeding Databank.

At approx. 35 kg, two thirds of the pigs

were sold to two finisher producers, i.e. the pigs were slaughtered from three different pig production facilities.

At the slaughterhouse, all pigs from the trial were evaluated and pneumonic lesions recorded at the Extended Health Control. Evaluations were made of Mycoplasma/SEP pneumonia (regular pneumonia, pneumonia caused by the bacteria Mycoplasma Hyopneumoniae), chronic pleuritis (chronic adhesive pleurisy caused by Actinobacillus Pleuropneumonia), and pleuropneumonia on a scale from 0 to 3, and pericarditis on a scale from 0 to 1.

Results from lung evaluations of 9,690 pigs are now being analysed. The phenotypic data reveal that there are differences between suppliers in production results, slaughter results and remarks made for pneumonic lesions, particularly in terms of Mycoplasma pneumonia where there is a difference of more than ten percentage units between the best and the poorest herd.

Data are now being analysed to establish heritability and other genetic parameters. It will furthermore be analysed whether there is a correlation between the various respiratory diseases and production traits such as gain.

Table 7 shows the results of the lung-evaluated pigs and differences between Duroc boars with 50 or more offspring. The results are shown for the best boar and the poorest, and for the average.

The F4 project

In 2003 a selection project was initiated to increase resistance to post-weaning diarrhoea caused by E. coli

149 F4, and this happens parallel with the usual index selection in Landrace, Large White and Duroc. It has been a requirement for nucleus herds for a long time that the boars used should be F4 resistant, and, as of April 1, 2007, this requirement also applies to multiplication herds.

Boars relevant for breeding are F4 tested in connection with transfer to AI quarantine to ensure that their F4 status is known when they are transferred to the AI stations. Breeding sows are in principle not tested for F4. However, it is an economic advantage to test boar dams. Siblings of the boars will naturally often obtain known genotype at the same time, and as the tested sows are indeed the best sows of the breeds, we will indirectly obtain a huge gain in the form of daughters also producing offspring of known genotype.

Both Duroc and Large White are approaching 100% resistant populations. However, for all breeds the current test strategy will be followed for some years to come. This way, the percentage of resistant animals will be pushed towards 100%, but the genotype will not be known of all animals. When the percentage of resistant breeding stock in a given population reaches 97-98%, we plan to test the remaining animals of unknown F4 status. Thereby, the costs for F4 testing and the loss in genetic progress for other breeding objective traits are minimised.

Genetic causes of boar taint

Boar taint is most often caused by a high level of skatole (chemical substance deposited in fat) and/or androstenone (sex hormone deposited in fat). Boar taint can be reduced through castration, but this affects lean meat growth negatively. It is therefore preferred to investigate other methods for reduction of boar taint.

In a joint venture in 2005-2006 with Great Britain and Norway, among others, the levels of skatole and androstenone were measured in samples from slaughtered Landrace boars. Landrace is the breed where the highest level and the largest spre-



Genetic progress, sale and production level

ad in skatole content are found. The aim of the investigation is to find the gene(s) responsible for boar taint in pork.

In this trial, 7,000 fat and meat samples were collected from Landrace boars at three Danish slaughterhouses. From the submitted samples, 500 couples of brothers were selected; one with a high skatole content and one with a low.

These 1,000 samples from the siblings have now been analysed for skatole and androstenone. Researchers are currently working on finding single genes with importance for boar taint as part of the four-year-long European project called SABRE (Cut-ting Edge Genomics for Sustainable Animal Breeding). Results from the project will be available in 2009 at the earliest.

The Pig Genome Project

The Department of Breeding and Multiplication and the Faculty of Agricultural Sciences are co-operating on a project on identification of essential chromosome areas in the pig genome. The project is split into five phases and is financially supported by the Directorate for Food, Fisheries and Agri Business under the Innovation Act.

The aim is to identify chromosome areas where single genes or gene complexes influence economically important traits in the pig production. The project focuses on mapping of genes for traits that are difficult to improve through the traditional breeding methods (BLUP-based index selection). Furthermore, the project includes general disease resistance, production traits and meat quality traits.

Localisation of these genes in the pig genome will make it possible to develop and implement more efficient breeding plans that also include selection for traits with low heritability.

The project comprises the following intermediate goals:

- Selection of a set of gene markers that can be used for large-scale genotyping in pigs.

- Identification of chromosome areas and single genes that affect significant traits such as disease resistance, meat quality traits and production traits.
- Development and implementation of methods for identification of QTLs (Quantitative Trait Loci, genes or gene complexes controlling quantitative traits such as gain) in pigs.

The project is split into five phases, of which the first three are completed. In the first phase, methods for large-scale geno-typing were developed and implemented. These were used in the second phase, where it was shown for a number of chromosomes that it is possible to identify significant QTLs. In the third phase, knowledge of DNA markers and pigs' traits were correlated. The fourth and fifth phases aim at identifying chromosome areas in the pig genome.

Study of DNA markers

On the basis of two studies (Genome Scan and Breeding for Disease Resistance), it was possible with DNA markers to establish where in the genome, genes exist that are important to certain traits. The most valuable DNA markers are those that are linked to specific pig diseases, that display low heritability, or that are difficult to record and therefore also difficult to improve through the traditional breeding methods (such as pneumonia).

Gene-based selection makes it possible to use the natural genetic variation as it will suffice to select on the genes that have a positive effect on animal health and production. However, research has also demonstrated that there is often a complex interaction between different genes that affect the same trait. It is therefore essential to investigate whether these traits will be affected negatively in connection with gene-based selection before the gene markers are taken into large-scale use. When this is established, it will be possible to much more efficiently utilize the effect of the individual gene marker if their mutual effect is described.

In order to be able to consider the results in the Genome Scan project as general and to be able immediately to use them in the current selection programme, they need to be tested in other genetic backgrounds in a larger number of animals representing several families. The interaction between the informative DNA markers and their influence on other traits also need to be established.

In this project it is therefore planned to:

- Verify results from the Genome Scan project in other genetic backgrounds by testing selected DNA markers (SNPs) for the traits pneumonia and survival in production-relevant material.
- Establish the interplay between the individual gene areas (QTLs) and their specific effects by including gene expression analyses.

The project is a joint venture between the Faculty of Agricultural Sciences and the Department of Breeding and Multiplication that started December 1, 2006, and runs for two years. The project is financially supported by the Directorate for Food, Fisheries and Agri Business under the Innovation Act.

Longevity in sows

Over the last years, there has been an increasing focus on the number of sows culled early from the production. Therefore, longevity is included in the breeding objective. Sow longevity is defined as "the sow's productive lifetime", i.e. her age at culling or the total number of litters she produces.

A sow's longevity is not known until she is culled. Consequently, the genetic progress is significantly reduced due to the delays between the animals with known longevity and those selected for further breeding. It is therefore necessary to look for other traits that indirectly describe sow longevity. One of these is "conformation" that has been part of the breeding objective for years now with good results. However, the problem with sow longevity is not yet solved, and therefore alternative traits have been studied, including a sow's chan-



ces of being mated for her second litter compared with those mated as gilts, which describes the sow's ability to complete an entire production cycle.

A sow's ability to be mated for her second litter was studied among Landrace and Large White in multiplication herds. It was here proved that this indirect longevity trait is heritable.

The results show a heritability of 0.162 for Large White and 0.169 for Landrace. The financial value of this alternative breeding objective for longevity is DKK 0.85 per percentage unit improvement. This means that every time the percentage of sows mated for their second litter increases by 1 percentage point, the costs per produced finisher are reduced by DKK 0.85.

The traits lean meat content and gain have turned out to be negatively correlated with longevity. This means that a large genetic potential for lean meat content and gain reduces the genetic potential for longevity.

However, the opposite applies to the trait conformation, where a large genetic potential increases the genetic potential for longevity of the sow. As the traits lean meat content, gain and strength are measured in the nucleus herds when the animals weigh 100 kg, these measurements provide crucial information for use when estimating breeding values for longevity.

Shoulder ulcer project

Shoulder ulcers in sows are an increasing problem for Danish pig producers and this is reflected in an increasing treatment frequency for shoulder ulcers in slaughter sows. Shoulder ulcer problems are severe as the animals suffer and the pig producer risks being reported to the police and fined. It is interesting whether anything can be done in terms of breeding to avoid this problem. It is currently being investigated whether it is possible to eliminate shoulder ulcers by way of breeding measures. It will be investigated whether there is a genetic variation or resistance to shoulder ulcers.

The project is split into two phases. The first phase is a prestudy where shoulder ulcers and condition are recorded of the sows in a commercial herd, and on the basis of these data the study will be adjusted to phase 2 in which the prevalence of shoulder ulcers in sows will be recorded in a large number of commercial herds.

Phase 1 began in the summer of 2007, and phase 2 will be initiated in the autumn 2007.

Longevity and conformation

In 2001, a project was initiated with the aim of establishing the correlation between conformation assessment of gilts and the longevity of the same animals as sows.

Data are collected in several production herds with female animals of known origin. In practice, this means that the producers either buy their breeding stock or breed them on-farm by way of "Nucleus Management®". Strength has been assessed on 16,050 gilts weighing 90 kg, and the producers submit production data and elaborate description of the culling cause of the assessed animals.

When the final data have been collected, the data, for instance of the sows' reproduction, will be analysed more closely. It is expected that the current conformation assessment in the breeding herds will influence the longevity of the production sows. Furthermore, the project will probably provide information on the traits affected in the sow when the new breeding objective for longevity is included.



AI and quality assurance

Semen sale

The sale of semen from DanBred's AI stations increased by 7.7% in 2006/2007 compared with the previous year. A total of 5,039,653 semen doses were sold corresponding to approx. 82% of all services being performed with semen from DanBred AI stations. The calculations are based on an estimated sow population of 1,158,000 in Denmark. The calculation does not include services made with on-farm AI. Figure 1 shows the sale of semen from DanBred's AI stations over the last five years.

Quality assurance at the AI stations

The aim is to have as high-quality semen doses as possible. The quality assurance process on the AI stations includes:

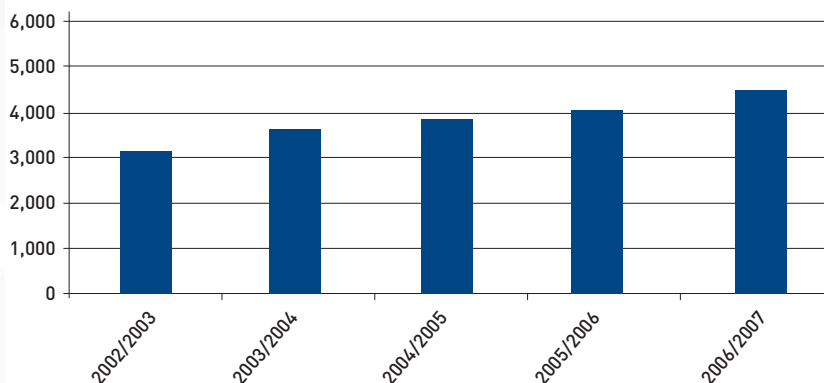
- Inspection of the semen quality at collection
- Assurance that semen is not damaged during production of doses
- Inspection of correct dilution of the semen

The inspection of the semen during collection includes an assessment of sperm motility and of the number of sperm defects. Only semen of satisfactory quality is approved for sale. All materials used in the production must be sperm friendly, i.e. they must not be capable of damaging the semen. For this purpose, Danish Pig Production has a new instrument (CASA) that measures the movement of sperm in detail. This new method is significantly more accurate than using a microscope for assessing the semen as is the case today. It is expected that CASA for material test will be taken into full use at the end of 2007.

Unannounced inspection of AI stations

Semen doses from the AI stations are routinely subject to spot checks in addition to the AI stations' own inspection procedures of semen doses. Doses for the spot checks are collected without the AI stations being aware beforehand that the doses will be used for a spot check. The results from the latest inspection (January 2007) revealed that as for the number of sperm per dose all AI stations in

Thousand doses



Sale of semen from DanBred's AI stations the last five years.

the spot check complied with the guidelines for the AI stations. Inspections are performed regularly and include all DanBred's AI stations.

Machines for semen analysis - CASA

An instrument that is able to measure the movement of sperm cells (CASA) was studied.

The results revealed great accuracy in the measurements of sperm movement. Even very small differences in sperm movement can be measured - something that was not possible previously. In the future, the instrument will probably be used for routine inspection of semen shelf-life and investigation of the damaging effect of materials in semen production. The instrument will be central in optimising the production at the AI stations as this new instrument can detect even small negative effects on sperm.

Morphology

An investigation was made of semen from boars with reduced fertility. This semen was compared with semen from boars with good fertility. To a large extent, boars with reduced fertility tended to be identified on many defects on their sperm. These defects had occurred during the formation of the sperm in the testicles (primary defects). That defect sperm can cause reduced fertility is nothing new. It is, though, something new that the highly reduced fertility was mainly caused by primary defects. These results will be used in the further development of an

instrument that automatically identifies sperm with defects. Such an instrument will significantly improve the AI stations' capability of measuring semen quality.

Sperm DNA analysis

In co-operation with the Faculty of Life Sciences under Copenhagen University, genetic material from semen from Landrace and Large White boars was analysed. The aim was to clarify whether it is possible to detect boars with reduced fertility simply by analysing the genetic material. The study comprised analyses of semen from approx. 120 boars, and the genetic material was analysed for damages. The results showed that some boars with reduced fertility also had damaged genetic material, but some boars with damaged genetic mass had good fertility. The method can therefore not be used as an unequivocal sign of a boar's general fertility.

Boar variance

During the analysis of data from a comprehensive study in the Dept. of Breeding and Multiplication, an increase was found in boar influence on litter size from 2003 to 2004. This means that the female influence on litter size is reduced, which is unfortunate. In 2005, boar variance dropped again for Landrace, but not for Large White. As a solution to this problem, as of August 2005 20% more sperm is added to doses from Landrace and Large White boars. However, this has not reduced boar



variance as Large White boars are still highly influential on litter size. Future research will establish the difference between Landrace and Large White, so that boar variance for Large White can be brought to a normal level again.

Variation in litter size

In co-operation with the Faculty of Life Sciences, Copenhagen University, and Ludwig-Maximilians Universität, Germany, a three-year-study is investigated variation in litter size among Danish sows. The aim is to obtain more uniform litters in a size that the individual sow is able to take care of. The study will finish medio 2009 with a herd trial in which the relevant genetic markers found will be analysed to minimise the variation in litter size.

Extenders for boar semen

In a study with the EDTA extender, no improvements were found by modifying the extender. Having modified the EDTA extender, it was attempted to imitate the conditions in the epididymis. In the epididymis, sperm can survive for a very long time, as they lie inactive waiting to be activated. They are activated upon ejaculation of the semen, but if it is possible to store the sperm under conditions that resemble the epididymis, their lifetime might be increased considerably. Semen from 20 boars was included, and the semen was divided into four trial groups and one group with the traditional EDTA extender. In the trial groups, the salts in the extender had been changed, glucose was replaced by fructose and serum albumin from cattle was added. The motility of the semen was measured with CASA (mentioned above) on the day the doses were produced and five days later. It was not possible to find a better alternative to the traditional EDTA extender.

Hormones during AI

Previous studies have shown an increase in a hormone in the blood (prostaglandine) during both traditional insemination and intrauterine insemination that is not seen during mating. It is known that during the presence of another hormone (oxytocin), this hormone may exert a nega-

ve effect on semen transport. Therefore, a joint study has been established with Sweden Agricultural University in Uppsala in which cells from the cervix and uterus are analysed against crude semen, extender, anti-biotics and catheter, among other things. It will hereby be clarified what causes the excretion of the unwanted prosta-glandine, and perhaps it will also be clarified whether the excretion can be prevented. The preliminary results indicate that boar semen in its unextended form inhibits the excretion of prostaglandine and that the interesting "substances" with this inhibiting effect exist in the fluid in which the sperm are (seminal plasma). The aim of this study is to be able to artificially produce and add the found "substances" to the boar semen extender.

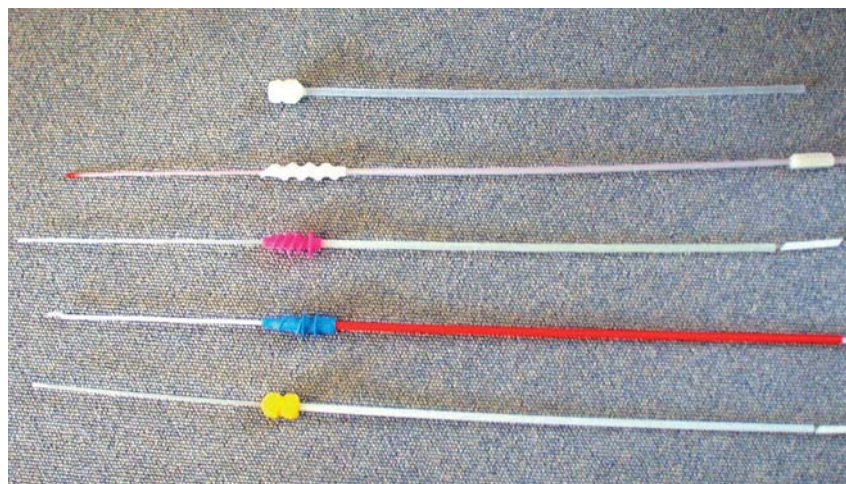
Intra-uterine insemination

A study of intrauterine AI with a two-chamber bag is now finished in the herds. The study comprised three groups (control 2 bn traditional AI, 750 m – two-chamber bag intra-uterine AI, and 500 m – two-chamber bag intra-uterine AI). Recording of the reproduction results expressed as farrowing rate and total born piglets/litter will be finished in December 2007, but, so far, the three groups are identical and at a high level. If the results correspond with the last data, it will be possible to reduce the content of a regular semen dose by 75% provided

that intrauterine AI and a two-chamber bag are used. This technique is also the preparation for possible use of sexed semen.

Sexing of semen

Sexing of bull's semen became commercially available in Denmark on May 1, 2007, and a corresponding project concerning boar semen seems promising. In a joint venture with Ovasort Ltd from Wales, Norsvin from Norway and DanBred's AI stations, a variety new proteins has been found on the surface of sperm cells during the first year of the joint venture. These proteins will be analysed to see whether they can be related to either the X or Y chromosome in sperm, which is called sex specificity. If sex specificity is detected, development of antibodies against the sex specific proteins will make it possible to bind sperm carrying the Y chromosome and thereby have the semen doses primarily yielding gilts as offspring. Clarification on the issue of sex specificity is expected at the end of December 2007.



Catheters for insemination of sows.



Rearing gilts

Feeding

The feeding strategy for the gilts during the growth period is important to the subsequent production results and longevity. It is recommended that at the time of first service, the gilts should be in average body condition. This corresponds to a backfat thickness of 12-18 mm, when measured in P2. Gilts should weigh between 130 and 140 kg. They should be given max. 2.5-3 kg feed a day during growth, depending on the diet used. However, 7-14 days before expected heat, when the gilts will be served, they must be fed ad lib. This ensures a maximum number of ovulations. After service, the gilts should be fed according to condition, but be given max. 2.0 FUsow a day the first 4-5 weeks. Subsequently, they can be fed according to condition.

It is crucial to ensure sufficient intake of calcium and phosphorus during the growth period to obtain a good bone strength. The mineral requirement for bone development is approx. 10% higher than for optimum growth. It is recommended to use feed containing 7 g calcium and 2.2 g digestible phosphorus per FUsow. This also ensures a deposit of sufficient mineral reserves.

Healthy stomachs

The gastric health of gilts is decisive to the animals' well being when they enter the sow unit. The use of coarsely ground feed is the best insurance against changes in the white part of the stomach. Coarsely ground feed must be used at the latest when the gilts weigh 70 kg. The grinding of the feed should result in these particle sizes: 50% < 1 mm, 35% between 1 and 2 mm, and 15% between 2 and 3 mm. This is also called "medium-coarse ground feed".

The fibre content of the feed does not affect the white part of the stomach, but is an essential factor in managing gilts' feed intake to make them more uniform. Wheat is therefore not suitable for gilts, as wheat reduces the texture of the gastric content. When the gilts weigh approx. 60 kg, the energy content in the feed should be reduced. This makes it easier to limit gain and still fill the stomach and

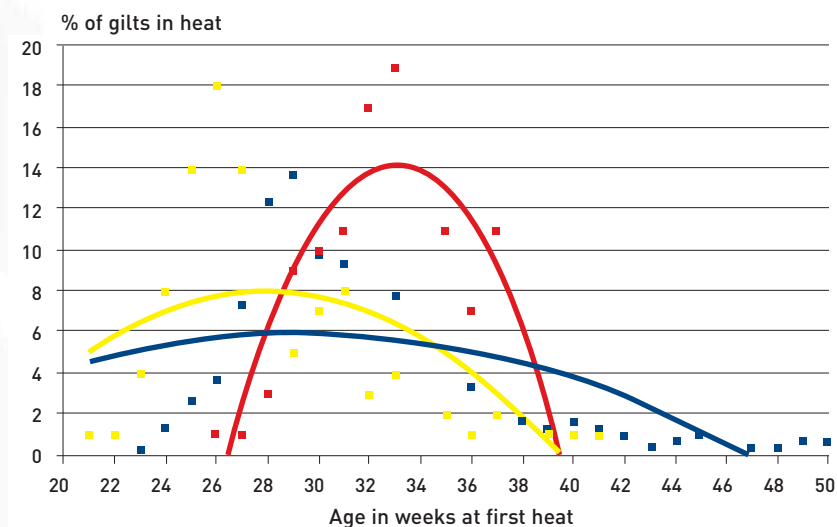


Figure 1. Age at puberty (first heat) in three herds

intestinal tract. A diet containing barley and oats will be the best choice.

Control of heat

A stable production requires even batch sizes when sows are transferred to the farrowing facility. The number of gilts per batch is normally the factor causing the largest variation in batch size.

It is important to be able to introduce a certain number of gilts within a limited period of time. If the gilts have already been in heat, they will be cycling, and it will be impossible to change the 21-day cycle. To be able to stimulate the gilts to reach heat, they must be prepuberal. At the same time, they must be old enough to become cycling. The best stage to synchronise heat in gilts is when the gilts have a backfat thickness of 12-18 mm measured in P2. Thin and fat gilts will often cause problems and should be culled. Figure 1 shows the age at first heat in Danish gilts. There is a large variation in age at first heat. Thus, it should not be expected that all gilts will be stimulated to come in heat at the same time.

In two herds with two-week batch farrowing, it was attempted to get the gilts into heat at a certain weekday. The factors used were: 1. to ensure an optimum feed level in all gilts; 2. to ensure daily boar contact through the front of the pen; and 3. to ensure that

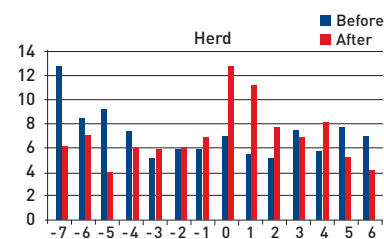


Figure 2. Weekday for service of gilts. Day zero is the day of the service of sows in a herd with two-week batch farrowing

a sufficient number of gilts were stimulated. The results were not convincing as can be seen in figure 2. It is now being investigated whether a more consistent use of the boar will improve the management of the time of heat. This includes the aforementioned strategies supplied with letting the boar enter the gilt pen every day for minimum 15 minutes.



Efficient boar contact is important to stimulate puberty and to heat control.

Feeding the highly productive sow

Nutrient supply of the sow

Every year, the feed conversion improves and the productivity increases as a result of the genetic progress. This is also expected to have an effect in the sow unit so the sows must perform better on the same feed, because the requirements for amino acids, minerals and vitamins are determined per FU_{sow}. It cannot be ruled out that, at some point, a deficiency will occur in some of the nutrients, and the standards are therefore routinely evaluated.

Micro minerals

The micro minerals selenium, iron, zinc, copper and manganese play an essential part in the function of the sow, and deficiencies in one or more of these micro minerals will reduce the sow's reproductive ability and longevity. In 2000, an American study revealed that giving the sows organic micro minerals (SowPak) in stead of regular minerals (control) increased the sows' productivity and longevity after the third litter (see figure 1). This result is now being investigated in three herds to study whether supply of organically bound micro minerals increases sow productivity and longevity compared with non-organically bound micro minerals.

Haemoglobin

A Danish analysis of 500 blood samples revealed that sows have an average haemoglobin level of 11.8 g per 100 ml, which is in the low end of the scale compared with the current references (10.0-16.0 g per 100 ml). A low haemoglobin level may increase, for instance, the number of stillborn piglets. In one herd, the sows were given 100 ppm additional iron in the lactation period. However, this did not increase the haemoglobin level at weaning and does therefore not seem to be able to affect the haemoglobin level. A current trial is pointing towards the liver, folic acid and vitamin B12 as possible restrictors.

Phase feeding during lactation

It is assumed that the sow's feed intake the first 10 days of the lactation period will benefit her in the form of a reduced weight loss. The feed intake after day 10 will benefit the piglets in

the form of a higher milk yield of the sow.

Phase feeding with two diets (start and end diet) was therefore compared with traditional feeding with just one diet (end diet) in the entire lactation period. The start diet was formulated to stimulate the sow's feed intake and gastric health, and contained 100 FU_{sow} per 100 kg and 25% fluted barley. It was also possible to use the start diet in the service facility and for gilts weighing more than 90 kg. The end diet was formulated to benefit the milk producing capacity of the sow. Among other things, the diet included additional short-chained fatty acids in the form of coconut oil, and the starch/fibre ratio was adjusted to benefit the peristalsis of the intestines and the supply of starch. Fishmeal was also added to maintain a high protein digestibility. The diet contained 111 FU_{sow} per 100 kg.

In two herds, phase feeding was therefore compared with traditional feeding with the end diet in the entire lactation period. The start diet was also used in the service facility and for gilts weighing more than 90 kg, and the reproduction results were satisfactory. The start diet replaced a regular lactation diet that is normally used for this category of animals. Identical production results were achieved whether the sows were given one or two diets in the lactation period.

If phase feeding is used, approx. 50% of the regular lactation feed can be replaced by a start diet in practice. This provides for cheaper feeding of the sows as the start diet is significantly cheaper than a lactation diet, but it also requires a double feeding system.

Protein in the lactation period

Experience from practice shows that additional protein in the feed the last four weeks of the gestation period increases the birth weight of the piglets. In one herd, half of the gestating sows were given a diet until transfer to the farrowing facility that complied with the current amino acid standards for gestating sows. The other half of the sows were also given that same diet, but four weeks before expected farrowing they switched to a diet complying with the current amino acid standards for lactating sows. Both groups followed the same feeding strategy, ie. they received the same amount of energy. All pigs in approx. 100 litters per group were weighed. The results revealed no differences in litter weight or spread in the pigs' weight within the litter. It is therefore still recommended to use gestation diets that comply with the current amino acid standards. An increased protein content in gestation feed is expensive and will influence the discharge of nitrogen from the sow unit.

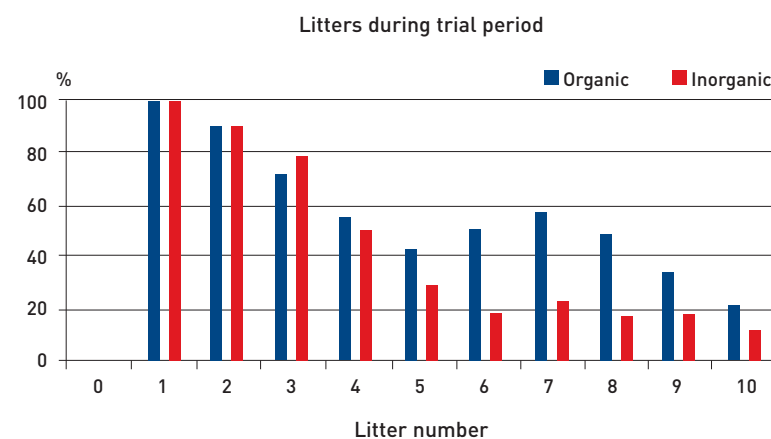


Figure 1. Importance of micro minerals to the number of litters before culling.



Liquid feed management

We want to be in control

The aim is that liquid feeding must work optimally in Danish herds. We need to optimise feeding and correct use of the liquid feeding system technique. Several pig advisors need to specialise in liquid feeding.

Danish Pig Production and the advisory offices under the Danish Agricultural Advisory Service are part of a joint project in which herd manuals and advisory tools are being developed. A work group in the context of this development has developed a concept for improving liquid feed management.

Liquid Feed Manual

The Liquid Feed Manual is the herd owner's daily guidelines of liquid feed management. The manual contains fact sheets that step by step describe good practice for the most important tasks of liquid feeding.

The manual also contains a description or draft of the liquid feeding system and suggestions for tasks to be included in the work plan. It furthermore includes a number of appendices containing feed curves, checklists, etc.

V11 - Rengøring



Godt vådfoder kræver god hygiejne:

1. Vådfodertank skal rengøres indvendigt ca. én gang om ugen med en højtryksrensner. Det er især vigtigt at rengøre den øverste del af vådfodertanken (dåb, låget med gevind). Fermenteringsbænk skal også rengøres i den øverste del uden at tømme tanken.
2. Foderindløb til lamm duserne skal rengøres for foderefter rester af våde rester af foder. Rengøringen skal foretages ca. hver anden uge.
3. Skæntæske skal tømme ca. en gang om måneden.
4. Rørstreg i vådfoderpantag bør kun rengøres ved sanering eller hvis der er problemer, som kan skyldes dårlig fermentering (undersøges ved mikrobiologisk analyse).
5. Ved problemer med f.eks. diarré eller nedsat adelyst anbefales det i første omgang at tilføje 2 procent myersyre i 4-5 dage. Hvis det ikke løser problemet, skylles rørstregene med koldt vand. Hvis problemet stadigvæk ikke er løst, skal rørstregene rengøres med varmt vand og basisk rengøringsmiddel efterfulgt af en desinfektion.
6. Efter rengøring af rørstregene bør vådfoderpantaget pudse med mælkesyrebakterier, som man selv kan producere ved at fermentere korn eller færdigfoder.
7. Vandtank med koldt vand skal tømme og desinficeres én gang om ugen.



Mangelfuld rengøring af vådfodertank og foderindløb medfører:

- Vækst af skimmelsvampe, som kan producere toksiner, der er giftige for græsene.
- Klumper af råddent foder, der falder ned i fodergruppen og udfodres til græsene.

Automatisk skylning af vådfodertank er ikke rengøring.

Hvis vådfodertanken (dåb, låget) ikke rengøres, kan der komme skimmelsvampe i den øverste del af tanken.

The fact sheets are exact guidelines. The front describes the "how" and the back the "why".



Mini manuals ease the introduction to the liquid feed computer.

Mini manuals

It can be difficult to become familiar with a liquid feed computer. Many farmers and employees only learn the most basic functions. However, it is necessary to be able to use all aspects of the programme to ensure optimum feeding.

In an attempt to ease the introduction to the liquid feed computer, the companies have drawn up mini manuals for the most common systems at the request of the liquid feed management group. These contain brief and exact descriptions of the 15 most common functions.

The mini manuals have the same structure, which means that it is easy for staff and advisors to learn new systems when they come to a new pig facility.

The following four systems now come with a set of mini guidelines:

- Big Duchtmann: MC99NT
- AcoFunk: FunkiNet AutoFeed
- AcoFunk: AutoFeed 5000 and 2000
- Skjold Datamix: MultiFeeder 5000

Liquid feed management = advisory course

Today, liquid feeding is considered a risk factor of a high feed conversion. This must be changed, and the manual cannot do this alone. It must be implemented, and routine follow-up and adjustment must be integral parts of this.

The Liquid Feed Manual and the mini manuals are now complete, and many nutrient advisors specialise in liquid feed management.

Advice in liquid feed management is an advisory course. The advisor ensures that the entire feeding and the use of

the system are optimised. The herd owner, the staff and the advisor should set common goals for the improvements to be made during this course.

Based on the Liquid Feed Manual and the mini manuals, the work routines and check routines of the herd will be analysed. Follow-up and adjustments will be made with agreed intervals.

The Liquid Feed Manual and advice in liquid feed management can be obtained from your regional pig advisory office.

Dimensioning

When new systems are dimensioned, it must be ensured that the technical solutions match the nutritional requirements. Not one liquid feeding system should be set up without the involvement of a liquid feed advisor. Checklists and spread sheets are available to the liquid feed advisors in this new advisory tool, and they can be a help in avoiding inappropriate solutions that are difficult to rectify at a later point in time.

Vådfodermanagement



Vådfodermanual version 1.0 - 2007




The Liquid Feed Manual plays a part in making the advice in liquid feed management very concrete and focused.



Liquid feed

Pig Stabiliser

The effect of Pig Stabiliser from the company "Vådfodereksperten" was studied in ten herds where it had been used for minimum six months (report 0707). Pig Stabiliser consists of lactic acid bacteria and is used to improve the fermentation of liquid feed.

Pig Stabiliser is used as part of a concept that, besides the addition of Pig Stabiliser, also includes measures such as heating of water, disinfection of the liquid feed system, increased attention to the hygiene in the liquid feed system, decalcification of water, etc. The results from this study were compared with results from previous studies of fermented liquid feed.

The study revealed that loss of synthetic amino acids also occurs when Pig Stabiliser is used, and the extent of this loss is identical to that seen during fermentation without Pig Stabiliser. The population of lactic acid bacteria and yeast was at a level also seen in previous studies.

However, the study demonstrated that the population of entero bacteria and mould and the concentration of acetic acid were lower in the herds in which Pig Stabiliser was used. The study did not demonstrate whether one or more of the measures included in the concept "Pig Stabiliser" alone are capable of causing these differences.

Quality of liquid feed

Many herd owners experience pro-

blems with a low feed intake when large amounts of residue are fermenting in the pipe lines. At the same time, synthetic amino acids are lost when feed is fermented leading to poor production results. If, on the other hand, the feed is not sufficiently fermented, there is a risk of pathogen bacteria growing in the feed.

It is currently being studied whether it is possible to obtain a high feed intake, prevent the loss of synthetic amino acids and avoid the presence of pathogen bacteria in liquid feed by using a starter culture. The project is made in co-operation with the Faculty of Agricultural Sciences, Aarhus University, and the Faculty of Life Sciences, Copenhagen University.

In the first year of the project, a series of starter cultures already available on the market was investigated. The results show that many starter cultures affect the microbiological properties of liquid feed positively during the first hours of fermentation, for instance, when a clean/disinfected system is started. However, when fermentation has been active for a while and the natural microflora is established, the effect of these starter cultures is greatly reduced or is not seen at all.

Another study during the first year demonstrated that E.coli breaks down synthetic lysine and, to a smaller degree, other synthetic amino acids (methionine and threonine). E. coli in liquid feed is therefore unwanted as is

may be pathogenic and as the amino acid content in the diet is reduced.

In one part of the project, the types of lactic acid bacteria and yeast are investigated that occur naturally in liquid feed in herds with either a low or a high feed intake among the weaners. If it turns out that one or more types of lactic acid bacteria or yeast in liquid feed increase the feed intake, it may be possible to use these micro organisms as starter cultures in herds with a low feed intake.

It is unknown what causes a low feed intake of fermented liquid feed. Results from this project show that a low pH (pH=4.0) in liquid feed does not in itself reduce the feed intake of weaners compared with liquid feed with a pH of 4.3 and pH 5.2. It is therefore likely that high concentrations of metabolites in fermented liquid feed influence the feed intake.

Acetic acid is one of the metabolites suspected of causing a low feed intake. However, preliminary results show that a high concentration of acetic acid (90 mM) does not influence the feed intake compared with a normal concentration of acetic acid (30 mM) in fermented liquid feed. Preliminary results reveal a reduction in feed intake, though, when the concentration of acetic acid is unusually high in liquid feed (120 mM).



The concept "Pig Stabiliser" resulted in a reduced content of entero bacteria, mould and acetic acid in liquid feed.



Preliminary results show that the content of acetic acid in liquid feed must be unusually high (more than 90 mM) before it reduces the feed intake of weaners.



Feeding of weaners

Product trials

The following products were studied in the last year: Formi and formic acid (BASF), EggsTend 88 (Scanimal Health ApS), Energy Water (JOTO ApS), Aviprox and Aviplus (Vetagro srl).

A positive effect was found of adding 0.6% Formi in combination with 0.6% formic acid to weaner diets. The production value tended to be 5% higher compared with the control group. This increase was caused by a higher daily gain the first two weeks after transfer to the weaner facility. The production value was 5% and 7% higher, respectively, compared with control when Aviprox and Aviplus were added. This was primarily caused by an increased daily gain and, for the weaned piglets given Aviplus, an improved feed conversion.

The other products did not show a positive effect on the production value (trial reports 772, 789 and 791).

Weaner diets

Three feeding concepts were investigated for weaners:

Group 1: Control diet with fishmeal.

Group 2: A cheap, low-energy diet without fishmeal, but with a high content of dehulled soybean meal.

Group 3: A low-energy diet without fishmeal, with a high content of dehulled soybean meal and dried whey and coconut oil.

There was a higher treatment frequency for diarrhoea in group 2, but there were no differences in mortality between the groups. The pigs in groups 2 and 3 had a production value that was 13% and 5% lower, respectively, when the same feed prices were used for all three diets. However, there are great price differences between the diets, and a calculation with the feed prices in the autumn 2006 revealed an 18% better production economy in group 2 and a 7% better production economy in group 3 (trial report 769).

Commercial diets

Weaner diets from five different companies on Zealand were purchased and analysed. The highest production value was obtained with the diets Prima 7 and Unik Total from ØA. Because of the improvement in pro-

ductivity, the pig producer can pay DKK2 and DKK18 more, respectively, per 100 kg diet 1 and diet 2 from ØA compared with the control feed. The diet from SAG Dalmoose yielded a significantly better production value than the diets from DLG and the diets from Roskilde Andel.

The pigs in the group given SAB's diets had a higher treatment frequency for diarrhoea compared with the



The production value differed for the commercial diets investigated during the last year.

pigs given the diets from ØA. There were no differences between the other groups (trial report 787).

Zinc with and without organic acid

This trial was conducted in a herd with a high frequency of diarrhoea. The feed to which organic acids were added had a slightly reducing effect on the prevalence of diarrhoea. A combination of organic acids and 2500 ppm zinc (prescribed by the vet) the first 14 days post-weaning significantly reduced the prevalence of diarrhoea and the mortality rate. The production value per pig was DKK8 higher with a combination of organic acids and zinc when taking into regard feed prices, health and productivity (trial report 778). The addition of 2500 ppm zinc alone the first 14 days post-weaning increased the production value by 8% and reduced the frequency of treatments for diarrhoea from 1.8 days to 0.5 days per pig (trial report 778).

Soybean meal

Soybean meal is the cheapest and most important protein source for weaners, but is typically only included

in limited amounts in weaner diets due to the fear of encountering diarrhoea problems.

In one trial, the effect of increasing the inclusion rates of regular soybean meal was investigated: 10, 16, 22 to 27%. In two groups, dehulled soybean meal was added in low and high inclusion rates. The pigs were included in the trial when they weighed 9 kg. As of autumn 2007, only dehulled soybean meal will be available in Denmark.

There was a linear correlation between an increasing inclusion of regular soybean meal (10-27%) and a decreasing production value. The pigs given the highest dose of regular soybean meal had a 4% lower production value than the pigs given the lowest dose. The lower productivity was offset by a better economy (spring 2007) as the pigs given the highest dose of regular or dehulled soybean meal had an actual production value that was up to 30% higher than those given 10% soybean meal as soy is cheaper.

When the inclusion of regular soybean meal is increased by 1%, the treatment frequency for diarrhoea increased by 0.04 days per pig, but there was no effect on mortality. There were no differences in the bottom line



Up to 30% can be gained on the bottom line by using 27% soybean meal in weaner feed.

result or in the frequency of treatments for diarrhoea regardless of whether the pigs were given regular or dehulled soybean meal (trial report 796).

Mineral premixes

Changing the tolerance levels

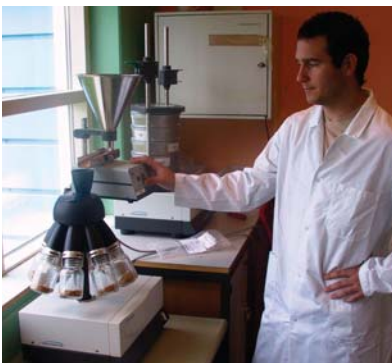
A test of Danish analysis laboratories revealed that analyses for free amino acids in mineral premixes are so accurate that the tolerance for deficiencies in mineral diets can be reduced from 50% to 35%. This means that if a mineral diet contains more than 65% of the declared amino acid content the Feedstuff Act has not been violated.

Samples to be included in the test were submitted by the companies producing mineral premixes. There was generally good agreement between the declared content and the analysed content of free amino acids in these samples. The greatest deviation between declaration and analysis was found in a sample that originated from an unannounced collection of mineral diets (see below).

The diets that were most difficult to handle were those containing the lysine source Biolysine 65. As these particles are very large (approx. 2 mm) compared with the rest, it is difficult to avoid segregation when samples are split.

Unannounced collection

In the summer of 2006, mineral premixes were collected from a number



The tolerance level of free amino acid deficiencies in mineral premixes is now reduced from 50% to 35%.

of pig producers located on Zealand without the suppliers knowing about it beforehand. One bag of mineral diet representing each category of animals in the herd was used. Samples were collected from the companies Nutrio, Vilomix (NAG) and Vitfoss.

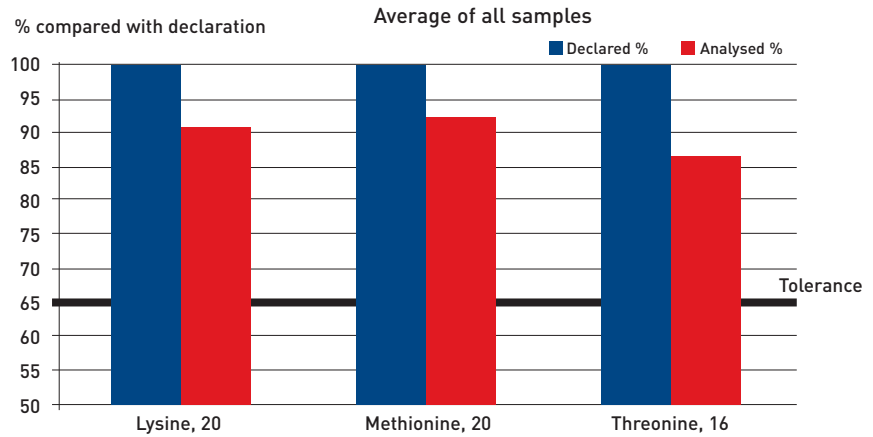


Figure 1. Deviation in % of free amino acid content compared with declaration (=100%).

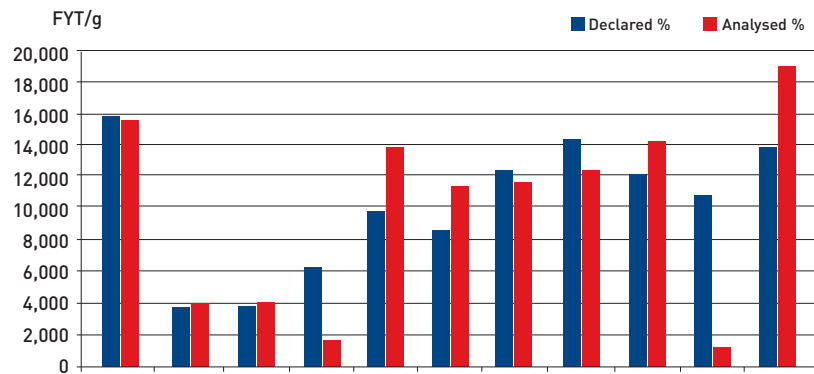


Figure 2. Phytase content compared with declaration.

Each bag was randomly picked and subdivided according to the TOS principles (Theory Of Sampling). It is expected that a correctly mixed mineral premix is evenly distributed in all bags of a pallet.

Analyses were made of content of lysine, methionine and threonine and of content of phytase if that was declared.

Free amino acids

The analyses showed that the chemical methods used at the Danish labs are sufficiently accurate for determining free amino acids in mineral diets. It is therefore expected that the average deviation is close to zero when 20 samples are collected. The analysis showed that, as an average, lysine, methionine and threonine were lacking in the mineral diets collected for the analysis (see figure 1).

Compared with the declared values,

there was significantly less lysine in the samples from Nutrio and Vilomix. The methionine content was significantly lower in the samples from Vilomix and the threonine content was significantly lower in the samples from Nutrio compared with the declared values. Only one sample (from Vilomix) exceeded the new tolerance level as it had a threonine deficiency of more than 35%.

Phytase analyses

Eleven of the diets contained phytase (Ronozyme). The content of nine of these diets corresponded to the declaration.

One mineral premix for finishers from Nutrio only contained 30% of the declared amount of phytase, and one mineral premix for weaners from Vitfoss only contained 10% of the declared amount of phytase (see figure 2).



Environmental authorisations

Tighter environmental requirements

Over the last 25 years, Danish agriculture has been subject to increased environmental requirements.

A new environmental regulation for all livestock facilities larger than 3 livestock units (LU) came into force in January 2007. All producers with livestock farms larger than 75 LU must obtain environmental authorisation if they wish to extend or modify their production. Producers with farms between 15 and 75 LU can make do with authorisation from the local authorities, but these livestock farms are, in some areas, subject to the same environmental requirements as livestock farms larger than 75 LU.

An environmental authorisation focuses on the discharge of nitrogen and phosphorus to the aquatic environment and on emissions of ammonia and odour from livestock facilities.

Water Frame Directive

The next major target area will be compliance with the Water Frame Directive. This will focus on the environment in streams, lakes and coastal waters. It is the aim that, by 2015, "good ecological status" as stated in the Directive will have been achieved in 95% of all Danish waters. Firstly, ecological status needs to be defined, and secondly, before 2009, action plans must be drawn up listing objectives for nutrient impact to obtain a good ecological status in waters by 2015.

Possible intervention in streams

In streams, environmental objectives will focus on physical conditions and discharge of ochre and waste water. It is expected that, for instance, stopping weed cutting etc. will improve the physical conditions in streams. This will result in a higher water level, and areas along streams will in the future be flooded at times.

Possible intervention in lakes

It is primarily necessary to reduce the phosphorus impact in the lakes. The most effective way to achieve this is through extensive farming in river valleys (such as grazing).

Possible intervention in coastal waters

In coastal waters, it is necessary to

The new environmental regulation and consequence of nuisance distance for finisher facilities.

Finishers, distance, m	Urban zone 5 OU _E /m ³	Total dwellings 7 OU _E /m ³	Individual dwellings 15 OU _E /m ³
Delvis fast gulv: 75 DE	230 m	120 m	80 m
Delvis fast gulv: 250 DE	460 m	350 m	145 m
Delvis fast gulv: 500 DE	810 m	625 m	300 m
Drænet gulv: 75 DE	230 m	175 m	110 m
Drænet gulv: 250 DE	660 m	490 m	220 m
Drænet gulv: 500 DE	1.110 m	850 m	440 m

reduce nitrogen leaching to meet the environmental objective by 2015.

Ammonia and environmental authorisations

In 2007, a 15% reduction in ammonia emission is required compared with the reference pig facility (partially slatted floor). This requirement will increase to min. 25% in 2009.

This requirement might not sound like much, but, as many producers of, for instance, finishers often choose to have drained floors in the lying area (which causes more emissions than the reference pig facility), the requirement for a 25% reduction in 2009 will, in practice, correspond to a reduction of approx. 35%.

The standard figures for the reference pig facility will be evaluated in 2007. Politically, there is a desire to have a dynamic basis for the standards and that the authorisation procedure be technology-driven and efficient in terms of the environment and costs. The basis for defining a reference pig facility is therefore in play once again. In the long term, there is a risk that the requirements will be so strict that it will often be necessary to install expensive environmental technology. It is our aim that the economic consequences of an adjusted basis for the reference pig facility are not unduly distorted.

Odour and environmental authorisations

Producers with livestock farms larger than 15 LU must currently comply with the new rules on nuisance distance for odour when extending or modifying their production. This means that up to one third of the producers can no longer extend or modify their production. In the long

term, these producers will stop production when the facilities are worn down.

The new rules stipulate that a livestock farm must have a maximum odour emission corresponding to 5 OU_E/m³ in urban areas, 7 OU_E/m³ in total dwellings, and 15 OU_E/m³ in individual dwellings in rural areas. This is a significant tightening compared with previous odour regulations.

If a producer wishes to extend his production, he has the following options:

1. To extend on the current premises without conflicting with the nuisance distance for odour.
2. To move the new facility to premises located far from neighbours.
3. To maintain the current premises and invest in environmental technology to comply with the nuisance distance.

For more information on how to interpret the odour guidelines, see brief 0709.



Development of odour-reducing technologies is a huge challenge.



Feed and ammonia emissions

Calculation of ammonia reduction

In the new Environmental Act, a calculation model is adopted for calculating feed interventions that can reduce ammonia emissions. Two possibilities were authorised; the addition of benzoic acid to feed and a reduction in protein content.

For benzoic acid, the rules stipulate that a 1% reduction in emissions is factored per gram benzoic acid per feed unit, ie. the normal inclusion rate in weaner feed of 0.5% = 5 g less per kg reduces the ammonia emissions by 4-5% - depending on the content of FUgp per kg in the feed. In finisher feed, it is allowed to add up to 1% benzoic acid, which reduces the ammonia emissions by 9-10% at 1.0-1.10 FUgp per kg in the feed.

When the effect of reducing the protein content in the feed is included, it is necessary to include the protein content and the current feed conversion ratio. On the basis of protein content and feed conversion, it is possible to calculate how much nitrogen will end up in the slurry (N ex animal). The current calculation of N ex animal is then compared with a reference equation for N ex animal. The reference equation calculates the production of N ex animal for the same weight category of pigs if the protein content and feed conversion equal the national average of 2005.

The reduction in ammonia emissions is then calculated as 1.5 x reduction in N ex animal. It is possible to use a factor of 1.5 because the reduction in ammonia emissions is greater than the reduction in nitrogen content in the slurry, because the content of ammonium drops more than the content of nitrogen and because pH in slurry drops when the protein content in feed is reduced.

As a rule of thumb it is concluded from these somewhat complicated calculations that a 10 g reduction in crude protein per FUgp reduces the ammonia emissions by approx. 15%. In many cases, the use of reduced protein content may meet the requirements of the new Environmental Act for ammonia emissions from finishers and sows. For weaners, the combination of benzoic acid and low-

protein feed only meets the requirements if the feed conversion is good. Benzoic acid in itself can help improve the feed conversion.

The exact requirements for ammonia reduction depend on the flooring in both existing facilities and in the extension, and on the scale of the extension.

Figure 1 shows combinations of feed conversion and protein content that reduces ammonia emissions by 15% and 20% compared with the reference for finishers in the weight interval 32-106 kg.

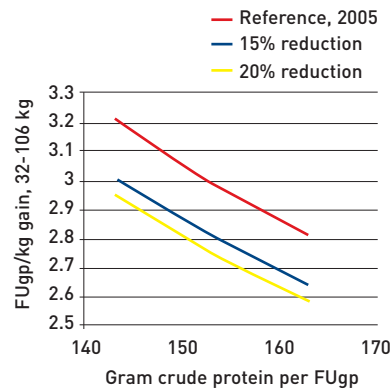


Figure 1. Effect of protein content and feed conversion on ammonia emissions.

Trials with protein in climate chambers

Three protein levels were studied in finisher feed: 14%, 17% and 20%. Measurements were made of ammonia emissions, odour and pH in slurry, and the digestibility of the diets was measured at the Danish Institute of Agricultural Sciences.

The trials in the climate chamber demonstrated that pH in slurry drops when the protein content drops, and that pH is slightly lower in slurry from female pigs than in slurry from castrates. The latter is due to the fact that female pigs have a better feed conversion.

In this trial, a clear reduction was found in the ammonia emission with decreasing protein content, and the reduction was level with the reduction in total N in the slurry. As mentioned, other trials have demonstrated that the reduction in emissions is greater than the decrease in total N in slurry.



Figure 2. Finishers in climate chambers.

There was no effect of the protein content on odour emission.

In the digestibility trials, it was concluded that the discharge of nitrogen in urine was 42% lower and nitrogen in faeces and urine was 37% lower with 14% protein than with 20% protein in the feed.

Measurements of urine from the digestibility trials demonstrated that pH was higher in urine than in slurry. pH varied from 8.0 with 14% protein to 8.6 with 20% protein in the feed.

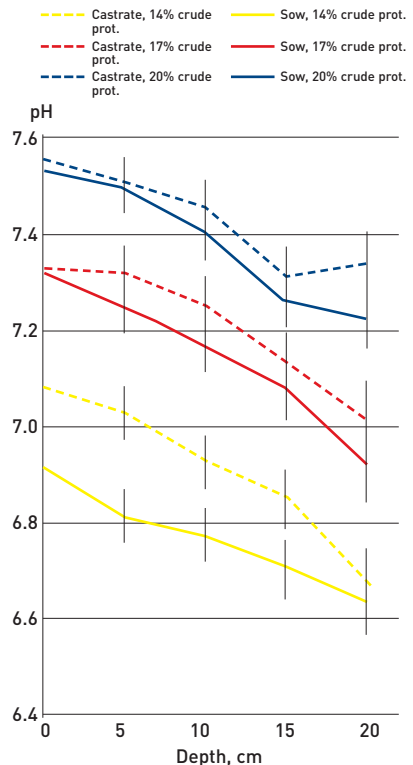


Figure 3. Level of protein and pH in slurry.



Low-protein feed for finishers

Reduced protein supply

An investigation was made to improve the knowledge of the financial consequences production-wise of reducing the protein supply under the current minimum standard for digestible crude protein for finishers.

The point of departure (hereinafter called "standard") was a regular diet that complied with all amino acid standards. The standard diet contained 146 g total protein per FUgp or 125 g standardised digestible crude protein per FUgp.

Subsequently, the ratio between crude protein and amino acids was locked and adjusted from 16% below to 8% above the standard.

Results

In table 1, it is shown that a supply of protein and amino acids 8% above the standard increased the production value by 4%, which was significant. This was primarily due to a higher lean meat percentage. A deficiency compared with the standard had the opposite effect. A 16% deficiency had a highly negative effect, while the effects were moderate from 8% below to 8% above the standard.

When the production value was calculated, the same feed price was used in all groups and regard was not made to the manurial value.

The gross margin depends on the current price relations, and in table 1 and

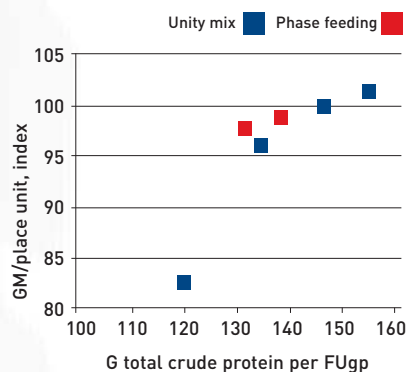


Figure 1. With phase feeding it is possible to significantly reduce the total protein content per FUgp without losses occurring in GM.

in figure 1, autumn 2006 prices are used. With these prices, the savings on protein feedstuffs and free amino acids at a deficiency compared with the standard were largely able to outweigh the drop in productivity, except for the lowest protein level. In terms of the supply of protein and amino acids, there is an interval from 8% below to 8% above the standard that results more or less in the same gross margin (see table 1).

Furthermore, in figure 1 it is seen that phase feeding results in a marginally better gross margin than a unity mix if the content of total protein is to be brought down to 130-140 g per FUgp. However, the profitability of phase feeding also depends on the investment costs.

The feed conversion of the pigs in this

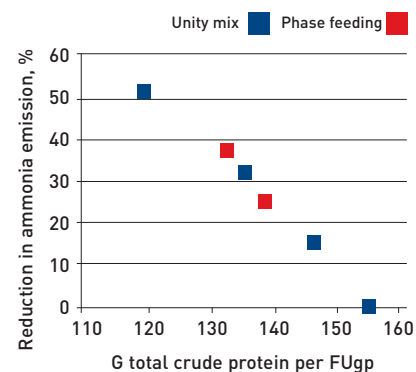


Figure 2. Reduction in ammonia emission compared with the highest protein level.

trial was much better than the national average, which means that the content of nitrogen in the slurry per 1.4 LU was down to 109 kg per ha with the highest protein level and dropped to 72 kg per ha with the lowest protein level.

In figure 2, it is seen that the reduction in protein content is highly important to N ex animal and to the ammonia emission. In the figure, the calculation includes a 15% reduction in ammonia emission per 10% reduction in N ex animal, corresponding to the regulations in the Environmental Act.

Overall, this trial demonstrates that it is possible to obtain a large reduction in ammonia emissions from finishers by using low-protein feed, and that the first part of the reduction is largely free under the same price conditions as in the autumn 2006.

Table 1. Results from a trial of ideal protein level for finishers 31-109 kg

Group	Stand.-16%	Stand.-8%	Stand.-8% 3 phases	Stand.-4% 2 phases	Stand.	Stand. +8% Δ
Total crude protein, g/FUgp	119	134	132	139	146	155
St. dig. crude protein, g/FUgp	102	115	113	120	126	134
Blocks	73	96	68	87	97	87
Feed intake, FUgp/day	2,73	2,72	2,76	2,74	2,71	2,71
Feed conversion, FUgp/kg gain	2,83	2,73	2,73	2,71	2,69	2,67
Daily gain, g	965	1000	1012	1014	1008	1017
Lean meat %	59,0	59,3	59,4	59,5	59,7	60,0
Production value, index*	82	94	96	98	100	104
Gross margin, index**	87	96	98	99	100	102
Kg N ex storage with 1.4 LU/ha	72	86	83	91	99	109

*With the same feed price and the same manurial value. **Incl. current feed price and manurial value

Reduced phosphorus discharge

Sow units

A trial revealed no negative effects on sow productivity, longevity and bone strength of eliminating mineral phosphorus from gestation feed and adding 1.0 g mineral phosphorus to the lactation feed if the feed contains 1,500 units phytase.

The result was the same in herds with purchased feed and feed mixed on-farm and in herds with dry feed or liquid feed.

Trial

It is possible to reduce the phosphorus supply by approx. 13% in relation to the current standard by eliminating mineral phosphorus in diets for gestating sows after the implantation period. Furthermore, the addition of phytase may increase the digestion of phytinbound phosphorus. However, this alone does not guarantee a balance at field level (approx. 22 kg phosphorus/hectare). This balance can only be obtained by eliminating mineral phosphorus from the feed in the entire gestation period and adding 1.0 mineral phosphorus per FU_{sow} to the lactation diet.

In a 36-month-trial conducted in four pig herds, the abovementioned methods for reducing the phosphorus discharge were studied (see trial design). Both dry feed and liquid feed, and both purchased feed and feed mixed on-farm were represented in the four herds. In all trial groups, a double amount of phytase (1,500 units) was

added to all the diets. However, the lactation diet in trial group 1 did not include phytase, as the basic content of phosphorus was very high. A group of sows given plenty of phosphorus in the entire cycle constituted the control group. The effects were measured on the sows' productivity, longevity and bone strength.

Results

Approx. 3,500 gilts were transferred to production during the trial period, and they were monitored until they were culled from production. There were no differences between the groups, which means that the reduction in phosphorus did not affect the reproduction results in the four herds.

The sows' maternal traits expressed as the ability to tend to a fixed number of piglets in the farrowing facility were not affected by the reduction in phosphorus.

No differences were found between the groups in the number of culled sows, and the number of sows culled due to "leg problems" was the same in all groups.

Bone strength

The bone strength was measured on 331 sows. From each animal, both forelegs were cut just above the carpus. The bones were subsequently scanned with DEXA at the Department of Small Animal Clinical Sciences, the Faculty of Life Science under Copenhagen University (previously the Royal

Veterinary and Agricultural University). One set of bones per animal was scanned simultaneously.

The results demonstrated that the bones had the same tensile strength in all groups, which means that also the bone strength was unaffected by the reduction in phosphorus.

Finishers

The natural content of phosphorus in rapeseed meal and sunflower meal is approx. 1.7 times higher than in soybean meal. Therefore, in finished diets with rapeseed meal and sunflower meal as partial replacements of soybean meal, the natural phosphorus content can typically be 10-14% higher per FU_g. A trial will clarify whether finishers can make do with this in combination with phytase without the addition of mineral phosphorus.

The preliminary results demonstrate that the best combination of environment and production economy seems to be the treatment with 0.4 g phosphorus per FU_g and 1,500 units of phytase. The trial is halfway finished.

Table 2. Trial design. The feed's content of calcium and phosphorus in different cycles

Group	Control	Trial		
		1	2	3
Gestation period: First 4 weeks	6.0 g phosphorus & 7.0 g calcium per FU _{sow}	Natural phosphorus & 6.5 g calcium per FU _{sow} + 1,500 enheder fytase	3.7 g phosphorus & 6.5 g calcium per FU _{sow} + 1,500 units phytase	Natural phosphorus & 6.5 g calcium per FU _{sow} + 1,500 units phytase
4 weeks – transfer to farrowing facility	6.0 g phosphorus & 7.0 g calcium per FU _{sow}	Natural phosphorus & 6.5 g calcium per FU _{sow} + 1,500 units phytase	Natural phosphorus & 6.5 g calcium per FU _{sow} + 1,500 units phytase	Natural phosphorus & 6.5 g calcium per FU _{sow} + 1,500 units phytase
Lactation + empty periods (boars & gilts)	6.0 g phosphorus & 8.0 g calcium per FU _{sow}	6.0 g phosphorus & 8.0 g calcium per FU _{sow}	4.7 g phosphorus & 1,500 units phytase	Natural phosphorus + 1.0 g mineral phosphorus & 7.5 g calcium per FU _{sow} + 1,500 units phytase
Phosphorus consumption per sow/year (1,400 FU _{sow})	8,400 g	6,160 g	5,430 g	5,080 g



Spread of ammonia and odour

Validation of OML-DEP

According to the new Environmental Act, ammonia emissions from a pig facility must be calculated and the impact on nearby nature areas must be assessed. If there is a distance of 300-1,000 m to vulnerable nature, spread and deposition of ammonia must be calculated using the program OML-DEP.

In order to validate the accuracy of OML-DEP, Danish Pig Production and the National Environmental Research Institute (NERI), Department of Atmospheric Environment, have measured the spread of ammonia around a pig facility with 1,344 place units for weaners and 1,344 place units for finishers. The pig facility was specifically picked because it is situated flat ground and far away from other livestock farms. Furthermore, the measurements had to be made in a period when there was no spreading of livestock manure.

Measurement of ammonia spread Danish Pig Production measured the ammonia emissions from the pig facility, while NERI measured the concentration of ammonia 75 m, 150 m and 300 m from the pig facility. The measurements were made over a period of 85 days in the summer 2006. A number of meteorological parameters were also measured.

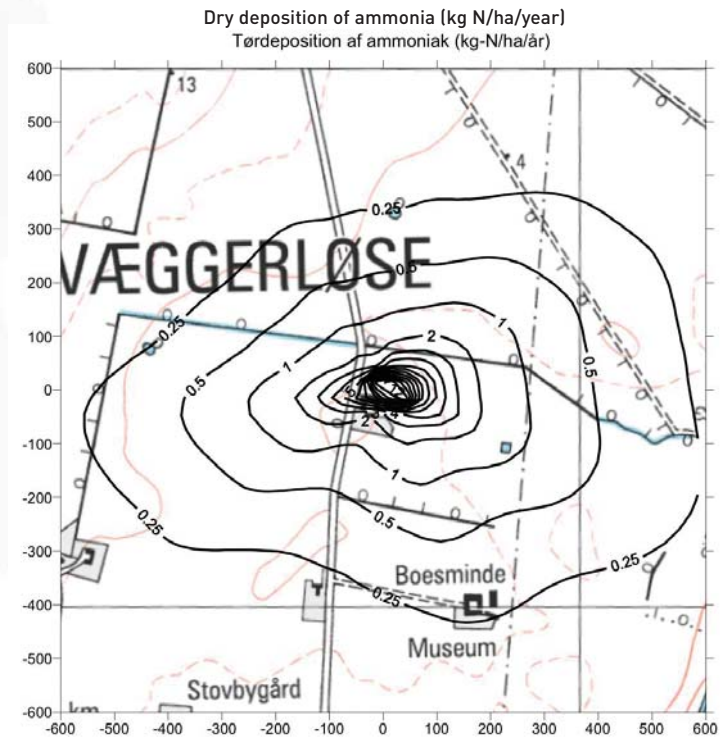
Results

Ammonia emissions from weaners and finishers averaged 0.019 and 0.18 g $\text{NH}_3\text{-N}$ per hour/place unit, respectively. For weaners, it was lower than expected based on standard figures for livestock manure. For finishers, it was slightly higher due to dunging on the solid floor during the warm summer.

The ammonia concentration around the pig facility showed a very clear gradient as the concentration 75 m away from the facility was 3-20 $\mu\text{g NH}_3\text{-N/m}^3$, while the concentration 300 m away was close to the background level of 1-2 $\mu\text{g NH}_3\text{-N/m}^3$. In comparison, the typical background concentration in Denmark is 0.5-3 $\mu\text{g NH}_3\text{-N/m}^3$ – peaking in the spring.

Measured and calculated spread

All 27 points of measurement, except



The figure shows an OML-DEP calculation of dry deposition of ammonia in kg N/ha scaled to one year. In comparison, a pig production facility located 300-1,000 m from vulnerable nature must not increase the deposition of ammonia by more than 0.6 kg N/ha annually. There is thus good correlation between the requirements in the new Environmental Act and how ammonia is spread and deposited.

those around the slurry tank, showed good correlation between the measured and the calculated ammonia concentrations. It was not possible to measure the emissions from the slurry tank, but if an estimated emission was included, a good correlation was achieved for all points. In conclusion, OML-DEP is able to very accurately measure the spread of ammonia.

Assessment of odour in the field

The odour level was also assessed around the same pig production facility where Danish Pig Production and NERI measured ammonia concentrations.

The assessment was made with an American device called a Nasal Ranger.

With the Nasal Ranger, an odour assessor inhales a mixture of contaminated air and purified air through a nasal mask. Opposite the nasal mask is a dial through which the contaminated air is drawn, and on the side



Field measurement of odour.

are two carbon filters that purify the contaminated air.

This trial demonstrated that it is possible to assess the odour level around a pig production facility, but that a great deal of development is still required before the technique can be used in connection with odour case-handling.

Environmental technology

Need for technology

The new Act on Environmental Authorisation that came into force on January 1, 2007, has tightened the requirements for odour and ammonia emissions. This has increased the need for environmental technologies that reduce the environmental impact from livestock facilities. Many different technologies are being developed nationally and globally for reduction of odour and ammonia emissions. The greatest development takes place in Denmark and the Netherlands, but also researchers in the US and German are studying environmental technologies.

Vertical biofilter with wood chips

In the US, the primary research within environmental technology to the agricultural industry is focused on biological purification of air. The latest novelty in the US is the vertical biofilters where wood chips are used as filter material. In co-operation with South Dakota State University, Danish Pig Production is the first outside the US to have two vertical biofilters produced for a pig facility in Denmark. The two biofilters are placed by a WTF facility with 2/3 solid floor in the pens and have been investigated for a year.

The vertical biofilters are constructed as a silo with the walls of the silo filled with wood chips. The air from the pig facility is blown into the silo and is pressed through the walls of the silo whereby it is treated by the microbial activity in the filter. To avoid variable air flow through the entire filter, the walls of silo are conic; they are 35 cm thick at the bottom and 70 cm at the top. Before passing the filter, the air from the pig facility is moistened with a high-pressure system. This increases the humidity of the air to approx. 90%. The high-pressure system for moistening the air is not used in the US. However, in the US only the wood chips are moistened.

Measurements show positive and stable results in terms of odour reduction. During measurements in the winter and summer, emissions averaged 430 and 690 $OU_E/sec./1,000$ kg pig, respectively. In both periods, odour was reduced by approx. 60%. However, no reduction in ammonia was seen.



Above, two vertical biofilters by a WTF facility. Below, an illustration of the conical shape.

During the trial period, the pressure loss above the biofilters was 40-60 Pa at maximum ventilation performance, which was an acceptable pressure loss for air purifiers. However, by the end of the trial, an increasing pressure loss on the filters was recorded. The increasing pressure loss was probably caused by incipient blocking of the inside of the filters with dust and growth of biofilm. However, it was possible to wash the inside of the filters and this also reduced the pressure loss.

In all the trials of air purifiers, Danish Pig Production experienced blocking of the filters for periods of time, regardless of whether the purifiers were chemical or biological. It must therefore be emphasised when developing these systems that it must be possible to wash the filters.

Biological air filtration – SKOV A/S

In 2006, SKOV A/S introduced a new generation of their biological air purification system – the Farm AirClean BIO 3U that is built into a container.



Biological air purifier from SKOV A/S called Farm AirClean-BIO 3U.

During summer conditions when odour emissions peak, Danish Pig Production tested the air purifier from SKOV A/S in terms of odour and ammonia reductions. The trial was conducted with normal and with double filter sizes. The trial included a weaner facility and a finisher facility with pit ventilation.

Odour emission before the filter averaged 670 $OU_E/sec./1,000$ kg pig in both types of facility. Purification reduced odour emission by approx. 30%, and there was no difference between normal and double filter sizes.

Ammonia concentrations before the filter averaged 2.6 ppm in the weaner facility and 4 ppm in the finisher facility. In both facilities, the ammonia concentrations were reduced to 1 ppm after the filter. However, in the finisher facility, the ammonia concentration was reduced to 0.4 ppm after the filter with double filter size.

The filters were washed manually every week, which is a prerequisite for the above results. SKOV A/S has developed an automatic purifier for their air purifier. It is believed to be ready for testing at the end of 2007.

German biofilter – BIOREX-Hartmann

The German BIOREX-Hartmann biofilter is a new product on the Danish market. Measurements of the filter in Germany have revealed positive results in terms of odour and ammonia reductions. Before it passes through the filter, the air from the facility is led in under the filter into a pressure chamber. The filter material consists of 60 cm wood slabs at the



Environmental technology

bottom laid out crisscross to form a matrix. On top of the wood slabs are 10 cm of wood chips impregnated with a patented mix of enzymes and bacteria. On top of this are 20 cm of wood chips. The wood chips are moistened with a moistening system that is regulated via two dew sensors placed among the wood chips. The filter, which is sold from BIOREX Technology, has just been set up in a finisher facility where the Danish Applied Pig Research Scheme will be making measurements.



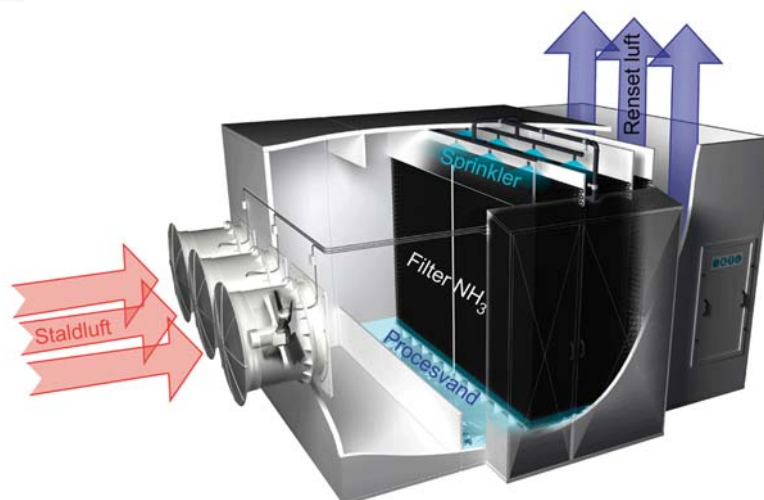
The BIOREX-Hartmann biofilter established by a finisher facility.

Chemical air purifier – Bovema S-air

The Dutch air purifier sold in Denmark by Farmtech A/S was investigated in a weaner facility and a finisher facility both with partial purification. Partial purification was established in both types of facility, i.e. more than 60% of the ventilation air was purified annually. In both facilities, the reduction in ammonia amounted to more than 95% above the purifier. However, odour was not reduced by leading the air through two steps in the air purifier. In the first step, water was recirculated, and in the second step, sulphuric acid mixed at pH 1.5 was recirculated. Because of the lack of odour reduction, the air purifier is now being marketed as a one-step purifier solely for reduction of ammonia from pig facilities.

Chemical air purifier – ScanAirclean

ScanAirclean A/S stocks a central air purifier from the Dutch company INNO+. The air purifier consists of a two-step filter with plastic elements. In the first step, sulphuric acid mixed at a pH of 2.2 is recirculated to remove ammonia. In



Bovema S-air one-step purifier for removing ammonia from the outlet air.



ScanAirclean's central purifier from the Dutch company INNO+.

the second step, a cleaning fluid is circulated primarily to remove odour. The first system is now established in a pig facility with 600 sows for breeding. All outlet air from the facility is collected in central channels, and is then led to the purifiers. The air purifier is currently being tested.

Air purification – Turbovent

TLV-Biotrickling is a new type of air purifier from Turbovent Environment A/S. It consists of an air purifier for reduction of ammonia and dust and a biological odour purification unit of eight horizontal biotrickling modules in a series. In the summer 2007, experiences with a newly-established proto-

type of the TLV-Biotrickling air purifier were analysed. The prototype was installed in connection with a finisher facility and had a capacity of 6,000 m³/hour. The study did not demonstrate any reductions in odour or ammonia. This lack of effect may be caused by the system not having had enough time to build up a sufficiently active biofilm.

Experiences with a prototype of the model TLV-Ammon that solely purifies for ammonia and dust were also analysed. This purifier employs the well-known technique with sulphuric acid for reduction of ammonia. With the prototype system, ammonia concentration was reduced by more than 95% on average. In late summer 2007, a study was initiated of the finished model of TLV-Ammon.

Membrane technology

Previous research has shown that it is possible to reduce odour from pig facilities with membrane technology. Subsequently, experiences with a prototype of an air purifier from Bioscent Technology ApS based on membrane technology were studied. The prototype was hooked up to a finisher facility and had a capacity of 1,000 m³/hour.

The air purifier consisted of three modules, and each module consisted of a tube system made by membranes. The exhaust air from the pig facility was blown past the tubes before being let out. Inside the membrane pipes, a cleaning fluid circulated con-

sisting of acid in the first module and base in the last two modules.

In connection with this study made during the winter, the odour concentration was reduced from 5,250 to 1,650 OUE/m³. The ammonia concentration was reduced from approx. 17 ppm to approx. 1 ppm.

Bioscent Technology ApS who came up with the idea and who has developed the trial system is now working on teaming up with a partner who can produce the membrane modules at a realistic price.

Economy of air purification

There are no catalogue prices on air purifiers from the individual companies as the prices vary according to the individual construction project. The pig producer therefore has to obtain prices from several suppliers when investing in a new facility. Danish Pig Production calculates the operating costs in connection with the studies, and this provides the expected costs related to using air purifiers over time.

The costs for electricity for ventilation normally average DKK 3.40 per produced pig.

In the study of the biological air purifier from SKOV A/S in a finisher facility, all outlet air from the facility was purified. Operating costs for water and electricity for operating the purifier and ventilation to the entire facility amounted to DKK 9.50 per produced pig.

In the study of Bovema S-air in a finisher facility with partial purification, more than 60% of the total annual ventilation from the facility was purified. The operating costs for water, acids and electricity for the purifier and the entire ventilation of the facility amounted to DKK 9,50 per produced pig. The operating costs for the remaining technologies will be available when the trials are finished.

Collection of air

Collecting the air from several facility sections holds some advantages in connection with air purification. To ensure a good function, it is essential that the air purifier, channel system and ventilation system are delivered

as an entire solution. Experiences of the last years from the many trials of air purifiers have shown large and small flaws in construction, adjustment and subsequent use of the systems. Suppliers as well as users of ventilation systems and air purification systems must relate to the fact that the systems are complicated.

Alarm and emergency ventilation

The effect of a traditional automatic

A reliable ventilation system with channel system and air purification system includes, among other things:

- Alarm system and the possibility for emergency ventilation
- Calculation and description of ventilation capacity and pressure conditions
- Alarm for critically high and low operational pressures
- Instructions upon delivery of the system and adjusted manuals

emergency opening device largely disappears when the air is led through a channel system and an air purifier. It is therefore now even more important that the alarm system that raises alarm in case of ventilation failure is frequently checked and that errors are rectified immediately. Emergency ventilation is ensured by establishing doors, shutters and windows that can be opened to obtain natural buoyancy.

Ventilation output and pressure loss

The lowest energy consumption and the lowest level of noise are obtained through a low pressure loss. The expected pressure loss must therefore not be exceeded when the system is delivered nor during the subsequent operation. A high pressure loss reduces the air output. During dimensioning, a ventilator must be selected that can suppress incipient blocking of the air purifier to prevent an increase in pressure loss from affecting the ventilation output. It is an advantage if the systems are equipped with a routine check of the pressure loss above the purifier.

Instruction and user manual

When channel systems and air purification systems are delivered, they must be accompanied by instructions and user manuals adjusted to the system in question.

Ozone treatment of slurry – BioAqua

The company BioAqua A/S who normally deals in purification of waste water has constructed a trial system that treats the slurry in the pig facility with ozone. Once a week, the slurry is sluiced out from the facility to a container. From here, the slurry is emptied into the treatment system that is built in a container. During this treatment, the slurry is fractionated. The liquid part is returned to the slurry container in the pig facility, while the solid part and a foam fraction are emptied into the slurry tank.

During treatment, pH increases whereby the ammonia emission increases. This may be used positively to separate and collect part of the ammonia from the aqueous part into, for instance, an acid bath. Alternatively, sulphuric acid can be added to the slurry in the treatment container before the slurry is returned to the pig facility. Preliminary measurements of odour concentration in the ventilation exhaust from pig facilities with and without ozone treatment of the slurry show that this method for odour reduction holds great potential.



When slurry is treated with ozone outside the facility, it is fractionated. By flushing the liquid part back to the slurry container, odour is reduced. However, problems with increased ammonia emissions due to the ozone treatment still need to be solved.



Slurry separation

Advantages of slurry separation

Separation of slurry is normally only an issue in Denmark when transport of nutrients over large distances is necessary. Separation may help solve the following problems in the herd:

- Improvement of the phosphorus balance
- Transportation of N and P
- Possibility of extending a production without acquiring more land
- Reduction of ownership requirement

Fractions at slurry separation

During low-technological slurry separation, two fractions form: a liquid fraction and a fibre fraction. The liquid fraction normally contains 75-80% of N and 30-50% of P. The fibre fraction contains 20-25% of N and 50-70% of P depending on the type of system used.

In volume, the liquid fraction constitutes approx. 90% and the fibre fraction approx. 10%. In proportion to volume, the fibre fraction has a very high nutrient content. As a result, the transport costs for livestock manure measured per LU decrease if only the fibre fraction is exported away from the farm.

Reduction of ownership requirement

If minimum 75% of the livestock manure is treated in a low-technological slurry separation system, the ownership requirement can be reduced by 25%. If the percentage of treated livestock manure is lower, it will be possible to obtain a proportional reduction in the ownership requirement.

Utilization of nitrogen

The utilization of N varies greatly in the two fractions. In the liquid fraction, the utilization of N is very high (approx. 80-90%). Depending on the time of spreading, the utilization of N in the fibre fraction varies from 10% to 50%. In their interpretation of the new regulation on livestock manure no. 1695, 2006, the Danish Forestry and Nature Agency has therefore authorized that pig slurry after processing can be spread with up to 168 kg N/ha against the previous 140 kg N/ha. In principle, 120 kg N/LU.

120 kg N per LU – regulation

The following requirements apply:

1. The total number of LU in the fractions formed must not be changed in proportion to the number of LU before processing.
2. The number of kg N per LU can only be increased in fractions that have a concentration of organic nitrogen lower than the livestock manure before processing.
3. No fraction can have a content below 40 kg N per LU.

Completion of 1 results in a decrease in the number of LU/ha in the fibre fraction. Therefore, the overall requirements for the harmony area are not changed. According to 2, only the liquid fraction can be spread with up to 168 kg N/ha. On the basis of 3, it is calculated that the fibre fraction must contain min. 10% of total N.

Extending a production

The owner of a pig herd with 250 LU would like to extend his production in an area densely populated with livestock. The producer has 179 ha land at his disposal, which corresponds to the required harmony area. There are no possibilities in the locality for more slurry agreements.

In connection with an extension of his production, the producer invests in slurry separation equipment. If the livestock units in the fibre fraction can be deposited, 25% of N is removed with the fibre fraction. The liquid fraction can be spread according to the 168 kg/LU rule or with 20% more slurry per ha than crude slurry. Overall, he can extend his production by up 60% on the 179 ha of available land if only the liquid fraction is used for fertilizing. Outside the premises, he needs to find 107 ha for the fibre fraction. The harmony area requirement will remain the same as before slurry separation, but the transport-heavy liquid fraction can be used close to the herd.

Costs of separation

Several brands for slurry separation are available. The different types have varying separation efficiency of N.

The costs of slurry separation ranges

% N in fibre fraction	Potential extension
10	33 %
15	41 %
20	50 %
25	60 %

N removed from the fibre fraction and exported according to the possibilities for extending a production.

between DKK 6-18 per tonne crude slurry depending on the type of system. Generally, the costs per tonne crude slurry increase with increasing amount of N in the fibre fraction.

Fibre fraction

The fibre fraction can be used as, for instance, regular livestock fertilizer or for biogas systems. Alternatively, it can be burned. Livestock fertilizer is defined as waste if it is burned. As a result, three things need to be taken into account if the fibre fraction is to be burned:

1. If the fibre fraction has not been degassed, a waste incineration levy must be paid. This levy amounts to DKK 330 per tonne product.
2. A waste heating levy must be paid of DKK 37 per tonne fibre fraction. However, this levy is returned for the part that can be used for industrial purposes.
3. The ashes can be reused as fertilizer or for industrial purposes, otherwise a levy must be paid of DKK 375 per tonne deposited ashes.

If burning the fibre fraction is to be economically profitable, it must be exempt from the waste incineration levy.

As the first in Denmark, Samson-Bimatech has developed a system for burning of the fibre fraction. The technology of this system is based on thermal pyrolysis. It costs approx. DKK 3 million, and has a capacity to burn fibre from 1,000 LU crude slurry.



Gestation facilities

Sows in groups

By 2013, all sows must be housed in groups no later than four after service (see Act no. 295). It is estimated that currently approx. 70% of all gestating sows are housed in groups. Group-housed gestating sows should be fed individually in crates or via Electronic Sow Feeding (ESF). Feeding systems where competition may arise for the feed can affect the sows' reproduction and longevity negatively.

Hospital pens

Trials have shown that it is possible to reduce the percentage of dead and destroyed sows if a sufficient number of hospital pens are available and if a treatment strategy is drawn up in co-operation with the vet.



If the hospital pen is placed inside the gestation pen, it is easy to move sows to and from the hospital pen.

Preliminary results from investigations of hospital pens for group-housed gestating sows:

- Lameness was the primary cause for transfer to a hospital pen (75%).
- Sows stayed in the hospital pen for 22 days on average.
- 80% of the sows that had stayed in a hospital pen were able to return to the gestation pen or be transferred to the farrowing facility.
- 25% fewer dead/destroyed of sows due for culling.

Overall evaluation of the feeding stations included in the product trial

Company	ACO Funki	Agro Products	Big Dutchman	BoPil	KJ Klima-technik	Skiold
Access	****	*	****	**	***	**
Space	***	***	***	****	**	***
Access to trough	****	****	***	****	***	****
Feed remnants and caking	****	***	***	****	***	****
Feed wastage	****	****	***	****	****	****
Collection of feed samples	**	**	****	**	****	**
Accuracy of dosing	Meal ** Liquid ***	Meal *** Pellets **	Meal *** Pellets *	Meal * Pellets **	Meal ** Pellets **	Meal *** Liquid ***
Bridging	**	**	***	**	**	***
Timing of dosing	****	****	****	***	****	****
Exit	****	****	****	***	****	**
Safety - separation	****	**	****	****	*	****
Information on leftover list	***	***	****	**	**	**

****=very good, ***=good, **=less good, *=poor. Report no. 0709.

In three herds with ESF, hospital pens corresponding to 5% of the place units in the gestation facility were established. The hospital pens were placed either inside the gestation pens or in a separate section in the gestation facility.

Sows normally stand up during the daily allocation of bedding (straw), which means that it is easy to detect unthrifty or injured sows. This makes it possible to start treatment immediately and thereby shorten the treatment process.



It must be easy to collect feed samples from the feeding stations (ESF). Feeding stations must be calibrated minimum four times a year.

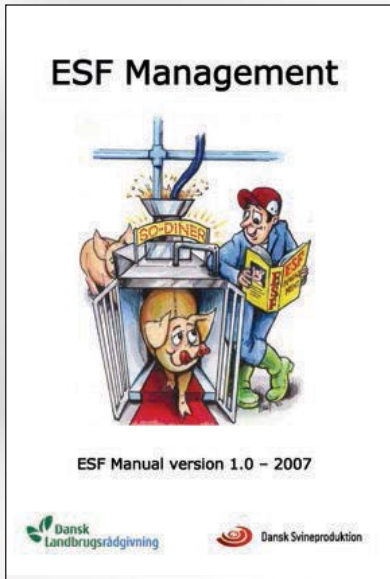
Product trial – ESF

Six brands of ESF feeding stations sold in Denmark were studied. They were assessed on the basis of a number of check points essential to the feeding and safety of the sows and to the daily management. None of the feeding stations received the scores "very good" or "good" under all points. There is thus still a need for the manufacturers to improve the feeding stations.



Speed of closure and pressure on the entry gates must be checked regularly to prevent several sows from gaining access to the station at the same time.





The Guidelines contain detailed descriptions of the most important procedures in ESF facilities.

Get the most of Electronic Sow Feeding

Electronic Sow Feeding is a feeding system that makes exact and individual feeding of gestating sows possible. In a well-functioning ESF facility, the sow group is calm and the sows are in appropriate condition and are thereby well-prepared for the forthcoming farrowing. However, the system needs to be adjusted to the individual herd, and efficient and well-thought-out work routines are important.

To benefit optimally from the possibilities of the system, the producer must be able to assess technical possibilities as well as the animals' reactions to the system in practice. This is where the ESF Guidelines will be used in combination with an applied advisory course.

Advisory course

The ESF Guidelines are a management tool that, together with an applied advisory course, ensures efficient utilization of the possibilities in the ESF system. Efficient utilization is obtained, for instance, by analysing and adjusting the daily routines in the facility, and once these are in place, the sows will be calm and in appropriate condition, and thereby be in the

best possible health when they are moved to the farrowing facility. An advisory course in a facility with electronic sow feeding will typically concentrate on various parts of the ESF system according to the needs of the involved parties. The first step could be, for instance, incorporating the best routines in the use of leftover lists or adjust the stations to provide the expected amount of feed. It often turns out that the stations, for various reasons, feed significantly more or less than expected.

It is an advantage to participate in an advisory course to get a good start on a new system or to become confident with the routine management of an existing system, and not least for adjusting stations and calibrating sows in the system.

Specialised advisors

We now have 15 advisors specialised in giving advice on the use of ESF Management. They all participate in an ESF work group to stay up to date with the latest knowledge and experience and to ensure that they have a strong group of colleagues to consult. These are essential elements in a binding advisory course.



Managing an ESF facility requires a good overview.

Fact sheets

The ESF Guidelines include fact sheets structured according to the same template as the other advisory tools in the development work (Guidelines for Farrowing Facilities and the Liquid Feed Manual).

The front of the fact sheets provides a

step by step description of good practice of the most important procedures in ESF facilities. On the back, the procedures are explained in details, and, if necessary, the issue is further elaborated in an appendix.

The ESF Guidelines also contain suggestions for a weekly work plan and for monthly checks. ESF Management is designed to be adapted to the daily management in the individual pig production facility.

New ESF facilities

When new ESF facilities are established, it is important to get started on ESF Management immediately, preferably already during the dimensioning and planning of the facilities. ESF Management is ordered at the local pig advisor.

Development Project

ESF Management is developed in the context of the Development Project, which is established in co-operation between Danish Pig Production, the Danish Agricultural Advisory Service and the regional pig production offices under the Danish Agricultural Advisory Service.

H11 - Indstilling, justering og kapacitet af foderstationer

Almind og mellemstøtninger

Foderkurv	Normal sv. Fed sv. Mager sv.	Slyde
Produktionsniveau 3	100 100 100 100	
Almind mellem portioner, sek.	100 100 100 100	20
Foderstationer pr. station	20 20 20 20	30
Overbudsniveau, sek.	100 100 100 100	100
Foderstationer, sek.	100 100 100 100	100
Blåse op til, sek.	20 20 20 20	30

Foderkurv	Normal sv. Fed sv. Mager sv.	Slyde
Produktionsniveau 3	100 100 100 100	
Almind mellem portioner, sek.	100 100 100 100	20
Foderstationer pr. station	20 20 20 20	30
Overbudsniveau, sek.	100 100 100 100	100
Foderstationer, sek.	100 100 100 100	100
Blåse op til, sek.	20 20 20 20	30

Hudtemperatur (T_{sk}):

- Tjek skærmtemperaturen og kalibrer på indgangsgulvet.
- Tjek af antenner på stationerne vikler, og at antenner sidder i det rigtige område.
- Tjek tilstedeværelsen af foder.
- Tjek af alle sener skal nå til alle sener uden i løbet af 14-16 timer.
- Tjek ændringer mellem portionerne og skærmtemperaturen på stationen.
- Check Mager sener og gylle har en længere afstand end normale og teste sener, så sikrer på deres foderkurver skal agere, så tabet øverste.
- Fremtidige tekniske løsninger stationernes kapacitet.
 - Mere end 10 % nødder eller havre i blandingen.
 - Tombagsgøringsmiddel.
 - Indeholder af sener igennem stationer/strøring.
- Tjek foderstyringsstat. Billedet skal være mellem 22 og 25.
- Foderstationen kan indstilles, så den lukker, når alle sener har ædt eller et passende antal timer.

Forkert indstilling af foderstationen

Forkert indstilling kan medføre en eller flere af nedenstående punkter:

- Uens og uregelmæssig og overvældende portioner.
- Blødderproblemer.
- Fremtidige og sener hvis sener der ikke får foder som forventet.
- Variation i hud.
- Reduceret kalibrerings.
- Mange gørbeslag.
- Lang tørrheds.

Det frekvens at overføre restfoder mængden fra det foregående foderstation.

The fact sheets provide detailed descriptions, for instance, on how adjust a system.

Farrowing facilities

Sows in crates and loose sows

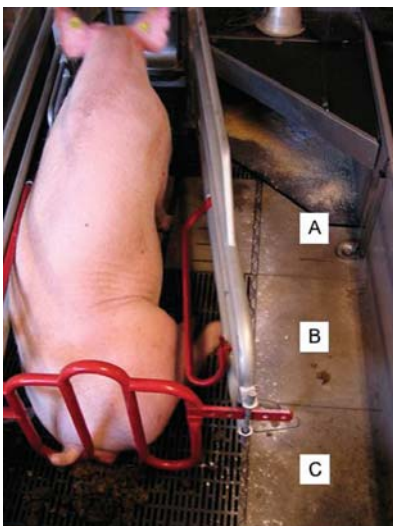
Generally, the farrowing pen has not changed over the past 10-15 years. To make sure that the farrowing pen in the future also meets the requirements for welfare, increasing productivity and efficiency, research in the years to come will focus on developing the future farrowing pen – not only for loose lactating sows, but also for sows in crates.

Traditional farrowing pen with crate

A new project running over several years is aimed at developing a new concept for farrowing pens and farrowing facilities. This includes floor, trough, handling of manure, ventilation, etc.

In 2007, research was initiated on floor profiles in the activity area as poor pen hygiene constitutes a problem in traditional pens with partially slatted floors. This is especially due to the fact that piglets dung in the pen side opposite the creep area. A pre-study revealed that it is difficult to influence the piglets' habit of dunging opposite the creep area.

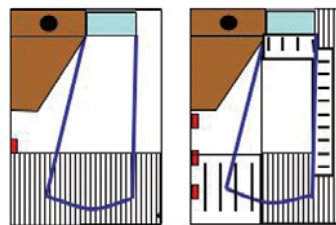
As a consequence of manure pass-through in this area of the pen, the design of floors and slurry container



A pre-study showed that in several litters it was possible to keep the solid floor in the entire creep side free of manure. However, too many litters dunged in the area the furthest away from the creep area. Further research will therefore be based on draining of area C.

should be changed while aiming at the smallest slurry surface possible. The solid floor area of the creep side of the pen should therefore be increased.

A pre-study was initiated to demonstrate whether solid floor can be established in the entire creep side of the pen. The rest of the pen had slatted floor except under the sow's shoulders. Many litters kept the solid floor clean – also in the area that traditionally has slatted floor at the back of the pen. However, many litters also dunged on the solid floor the furthest away from the creep area. Solid floor in this area



Traditionel delvist spaltegulv **Forsøgssti**
Traditionel, parti- **Trial pen**
ally slatted floor

The floor profile to the right is expected to be tested by the Danish Applied Pig Research Scheme.

is not a good solution, and, in the future, the floor profile of the farrowing pen should be based on a model with drained floor in a larger part of the pen.

Straw for nesting

Legislation stipulates that materials be supplied for nesting before farrowing. Previous trials have shown that nesting material makes the farrowing process faster and less complicated. An investigation was therefore initiated with two different amounts of nesting material (100 g a day vs 1,000 g a day) to document whether the amount of straw supplied before farrowing affects the farrowing process and thereby improves productivity. Sows do not start nesting until approx. 24 hours before farrowing.

No production results are available from the investigation, but experience shows that supplying large amounts of straw is not without problems. Handling slurry in the facility has not yet caused problems, but the straw

slips away from the sow and it retains moisture from the trough.

Until results become available, it is recommended to supply, for instance, approx. 100-200 g a day until 1-2 days before expected farrowing. Subsequently, increase the amount until farrowing begins.

Cooling

In the summer and autumn of 2006, high-pressure cooling supplemented with ceiling inlets in a diffusely ventilated farrowing facility was investigated. The sows had a significantly higher feed intake when cooling was used. However, the difference was smaller than expected. In the control group without cooling, the feed intake was 200 FU vs 219 FU per sow in the period from farrowing until day 30 of lactation. There were no significant differences in the number of sows that were treated or culled from the farrowing facility. There were no differences either in the sows' water intake or in the prevalence of shoulder ulcers. In both groups, primarily "thin" sows developed shoulder ulcers.

High-pressure cooling is capable of lowering the temperature in the facility by only 4-5 degrees Celsius. In a diffusely ventilated facility, insulation of the roof surface will have the same effect on the temperature as high-pressure cooling, and could therefore be considered as an alternative.



In one trial, the effect of supplying 1,000 g straw per sow a day as nesting material was studied.



Farrowing facilities

Current activities in the context of the Danish Applied Pig Research Scheme are based on developing systems for efficient floor cooling and cooling of the ventilation air.

Loose lactating sows

Production-safe farrowing pens for loose sows are being developed in co-operation between Danish Pig Production, pig producers, the equipment industry and Aarhus University, the Faculty of Agricultural Sciences.

Five proto types of pens were investigated for loose farrowing and lactating sows. The aim was to evaluate



Solid floor in the farrowing pen makes it easier to, for instance, supply nesting material.

the function of the pens, and, on the basis of this evaluation, select pen types for further investigation in production facilities where the level of piglet mortality can be established.

Sows are very active before farrowing. In this trial, the sows laid down up to 100 times a day before farrowing – regardless of pen type. Half of the sows laid down up to 50 times a day before farrowing. The sows were calmer during farrowing when they had had the opportunity to display nesting behaviour. In the first 24 hours after giving birth to the first piglet, the sows laid down 1-18 times – regardless of pen type.

Sows prefer to farrow isolated away from other sows. Four of the pen types had a solid floor area with closed pen sides on 2-3 sides. In 80% of the farrowings in these pens, the entire litter was born on the solid floor. In less than 2% of the farrowings in these pens, the entire litter was born on the slatted floor.



This sow lies on the solid floor and against a sloped lying wall.

As the solid floor in the sows' activity area was heated, the majority of the piglets were born on a warm floor. Previous studies have shown that this has a positive effect on the piglets' chances for survival.

There is a significantly smaller risk of the piglets being crushed if the sow is supported when she lies down. The pens were equipped with sloped lying walls on 1-3 sides to support the sow when she lies down. In all the pens, the sows laid down by a sloped lying wall more than half the times.

In terms of, for instance, labour, it is important to have a good level of hygiene in the pens. In this trial, it was possible to affect the sows' position in the pens when dunging. The sows dunged away from the lying area and partly away from feed and watering places. Furthermore, the sows often oriented towards the inspection alleys when dunging.

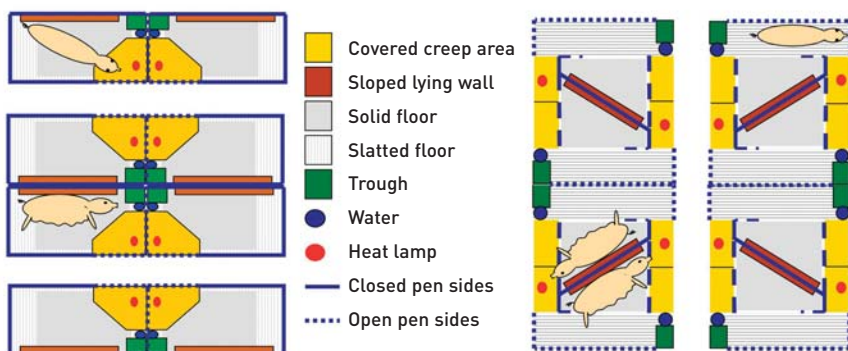


The sows often oriented towards the open pen side when dunging and urinating – but in many cases the hind quarter was turned over the solid floor.

This means that it was possible to a certain extent to influence the direction of the sow's head, whereas the direction of the hind quarters was not affected sufficiently, which contributed to the poor hygiene.

The trial of the proto types generated a great deal of knowledge on the importance of various pen elements to the way the sows, piglets and staff use the pen.

Four of the pen types had different dimensions and were significantly larger (6.5-7.3 m²) than, for instance, the recommended traditional farrowing pen (4.9 m²). However, it is essential that the potential be evaluated under Danish production conditions. In order to gain large-scale experiences, the principles and results from the studied pen types must be adjusted to the recommended pen dimensions for traditional farrowing pens to be able to conduct trials in existing or future facilities.



Examples of pen designs for loose farrowing sows designed on the basis of the results and experiences from the trial of proto types. These examples have a pen area of approx. 5 m².

Housing of weaners and finishers

Trials and development activities

Trials and development activities initiated concerning housing of weaners and finishers are often based on welfare, compliance with legislation or on production economy. For instance, tail biting and leg problems must be avoided to consider the pigs' welfare. Feed consumption and labour must be as low as possible to benefit the producer's economy. Optimum loading facilities benefit both the economy and pig welfare.

Sorting pigs according to sex and tail biting

It is believed that sorting pigs according to sex may have a positive effect on the prevalence of tail biting. Therefore, the number of tail bitten pigs in pens where the pigs are sorted according to sex was compared with the number of tail bitten pigs in pens where the pigs were not sorted according to sex. The preliminary results of this study show that the frequency of tail biting in pens with female pigs was slightly lower than in pens with castrates and in pens with pigs of both sexes. However, seen from a practical point of view, there was a limited average difference in the frequency of tail biting between pigs sorted according to sex and pigs in groups of both sexes. It is therefore concluded that sorting pigs according to sex has a very small effect on tail biting.

Tail docking

In co-operation with Aarhus University, the Faculty of Agricultural Sciences, the effect of four different tail lengths was studied on tail biting. The study comprised four different tail lengths:

- Undocked tail
- 3/4 tail
- 1/2 tail
- 1/4 tail

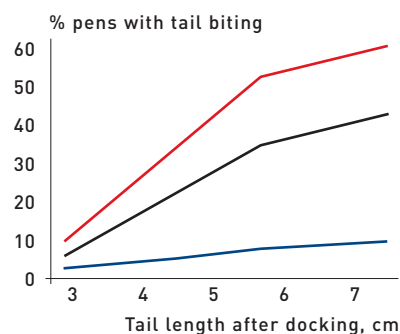
It is illegal to dock more than half of the tail, even in herds with documented tail biting problems. Permission therefore had to be obtained from the Animal Experiment Inspectorate to include a trial group with only one quarter tail length.

The trial is completed in three of the

four herds, and the results show great differences in the occurrence of tail biting between the herds. The last herd is not finished.

Increased tail length after docking significantly increased the risk of tail biting, particularly because the group with very short tails had the lowest risk. The relative increase in risk was the same in all three herds.

The pigs with undocked tails had the highest frequency of tail biting, but in some batches the recording of data was interrupted as tail biting started already in the weaner period.



Frequency of tail biting in relation to the length of the docked tail in three different herds. The frequency of tail biting for pigs with undocked tails is not shown.

Despite herd differences in tail biting, the herds did not differ significantly from each other in terms of pen design and use of enrichment materials. The finishers in the herd with the lowest tail biting frequency were housed in pens with fully slatted floors and were fed liquid feed in long troughs. Cleats were used as enrichment material. We hope that the detailed data material from the trial on the effect of docking will help us understand the herd differences. For instance, the trial revealed differences in tail length between the four herds already at the time of docking. Together with behavioural observations, this will be included in analyses of the trial.

Housing of weaners and finishers

A good feed conversion ratio, good health status and low labour are essential in keeping a healthy economy in the finisher production. This,

among other things, is the background for investigations of restrictive dry feeding and floor design in finisher pens and housing weaners in litter.

Restrictive dry feeding

The increasing slaughter weight has made it necessary to be able to manage the feed strength in the last part of the growth period. Management of the feed strength will improve particularly the feed conversion and lean meat percentage of castrates. For many years, there has been virtually no development in restrictive dry feeding systems. To start the development in this area, Danish Pig Production is co-operating with a company on development and test of equipment for restrictive supply of dry feed for finishers. This company is developing a system that with a snail conveyor is able to feed and supply dry feed quickly and uniformly in a long trough. When the system is reliable, it will be compared with ad lib dry feeding in tube feeders.

Floor design and floor quality in finisher pens

In order to improve pigs' leg health and their comfort when lying down, a project has been initiated in co-operation with Aarhus University, the Faculty of Agricultural Sciences, and a number of floor companies. Among other things, this involves testing of soft floors in the pigs' lying area compared with solid concrete floor. The soft floor is made of 40 mm bonded foam with a top layer of 2 mm rubber mat. The project is conducted in four finisher herds where the pens have 1/3 solid floor in the lying area.

The preliminary results vary and depend on the herd. In one of the herds, it seems that the pigs make less of a mess in the lying area as their preference for lying on a soft bed prevails over their need for thermal comfort. This corresponds to results from the initial investigations at Research Centre Foulum. In another herd, the exact opposite is seen; here the pigs in pens with soft floor start messing at lower temperatures than pigs in pens with solid concrete floor in the lying area.



Housing of weaners and finishers



Finisher pen with soft floor in the lying area.

Housing weaners in litters

For many years, it has been common practice to sort pigs at weaning to have as uniform competition in the pen as possible. Sorting means that, simultaneously with being moved, the pigs also have to form a new hierarchy, and they are exposed to new bacteria from pigs born in other farrowing pens.

There is today a tendency towards less sorting and towards maintaining stable groups, for instance, housing in litters. Some pig producers even choose to move the sow and let the pigs stay in the farrowing pen until sale or transfer to the finisher facility. For these types of housing to be profitable, a higher productivity is required, as the design of the facility becomes more expensive because of smaller pens. Weaning in the farrowing pen

furthermore requires significantly more farrowing pens, as a pen is used both as farrowing pen and as weaner pen. However, some of these extra costs are expected to be paid by less wash and moving.

On this background, investigations were initiated of both litter-wise weaning and weaning in the farrowing pen (FT-30). The results from one of the herds where litter-wise weaning was compared with sorted pigs revealed no differences between two types of housing in terms of daily gain and mortality. This herd had high levels of health and production, and this may have played a part in the lack of differences.

Pick-up of pigs for slaughter

New legislation that came into force on January 1, 2007, stipulates that pigs must not stay in pick-up trucks for more than two hours.

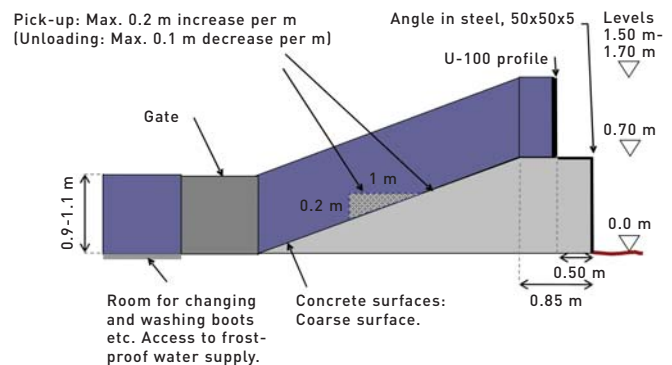
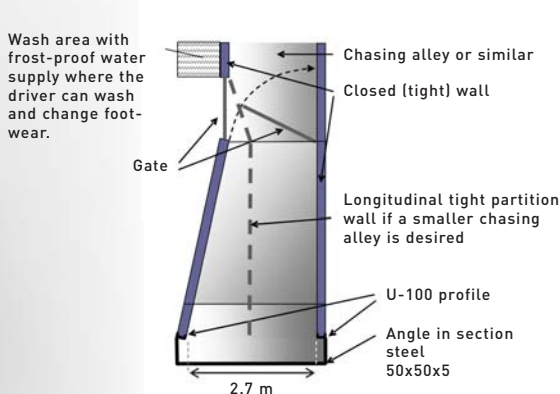
Housing requirements apply to all types of pick-up facilities – also to pick-up trucks. On top of this, many transport trucks have been replaced, which has resulted in new recommendations for loading platforms and access conditions.

The fact that the housing requirements apply to pick-up facilities means that both design (such as

space and water) as well as the use of the facilities must meet the requirements for housing units. These requirements apply regardless of how long the pigs stay there. Pick-up trucks that are only used for transporting pigs to another place where they are immediately loaded onto the transport truck must meet the requirements for transports lasting less than 8 hours.

As the transport trucks become bigger and heavier, new requirements are made to both loading platforms and access conditions. On areas for driving, there must be a minimum free height of 4.5 m, while the free height must be 5.5 m where pigs are loaded. Furthermore, the trucks are very low, and the access conditions must therefore be as plane as possible.

More details on requirements and recommendations for pick-up of pigs can be found in Danish at www.infosvin.dk.



Recommended design and dimensions of loading platforms for pick-up of pigs. To the left, the platform is seen from above, and to the right, it is seen from the side. The sketches are not true to scale, and unless otherwise stated, dimensions are stated in mm.



Rooting and enrichment materials

Enrichment

Enrichment of pigs' immediate environment is still a hot topic. This particularly applies to the possibilities for complying with the statutory requirements for welfare and cross-compliance. Know-how on various methods for allocation of enrichment materials is also in demand, and, this year, Danish Pig Production (DSP) completed a development project and published a product outline.

Development project

W. Domino A/S, SKIOLD A/S, the Faculty of Agricultural Sciences, Aarhus University, and DSP co-operated on developing dispensers and transport systems for enrichment materials. Development was initiated of a system for transport of straw and sphagnum from the storage to the pens and of a dispenser for allocation of materials in the pens. The study demonstrated that particularly the homogeneity (particle size) of the material is important to the function of systems and dispensers. Other properties, such as straw variety, dryness and length, are essential to the requirements for and to the function of transport systems and dispensers.

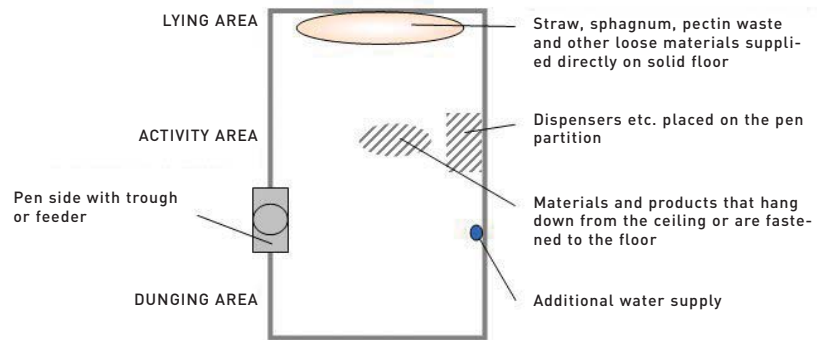
Guidelines

In 2006, the Danish Ministry of Justice issued a set of guidelines for the use of rooting and enrichment materials (see brief 0625). The aim of the guidelines is to elucidate and define the interpretation of the rules of the Ministry of Justice and of the Danish Veterinary and Food Administration.

The final decisions on the interpretation of the rules belong under the judiciary, but the guidelines are a good point of departure for the pig producer.

The guidelines divide the materials into three categories: rooting materials, enrichment materials, and materials that qualify as both at the same time. The method of allocation plays a significant part for some of the materials.

The number of pigs is also an essential factor to the requirements made. Examples are given of wooden blocks, rope and straw blocks, and of dimen-



Examples of where to place various kinds of material.

sions of dispensers for pens housing up to 18 pigs. Adjustments need to be made if a pen houses more than 18 pigs.

If materials are used that meet the requirements for rooting materials (such as dry feed under special conditions), the producer must supplement with enrichment material and vice versa.

It is not a requirement that all pigs must be able to root at the same time, and dispensers can be used regardless of floor type.

Product outline

Brief no. 0715 from Danish Pig Production can be used as a supplement to the guidelines. The brief gives an outline of available products that are either rooting and enrichment materials or have a direct relation to the supply of rooting and enrichment materials.

The outline provides a general evalua-

tion of whether the products can constitute or play a part in another material constituting rooting material, enrichment material or both at the same time. For instance, wood hanging down from the ceiling can constitute enrichment material, whereas wood lying on the floor can constitute both rooting and enrichment material. The outline also provides guiding prices and other relevant information on the products.

When the pig producer selects dispensers or troughs etc., he must assess, for instance, the financial investment and be aware that some products occupy free pen area. Other areas of attention are described in the brief. When the material is placed in the pen, it is of course necessary to try to prevent the material from becoming dirty. It is furthermore also important that the location of material or dispensers etc. does not disturb the pen function.

	Rooting material	Enrichment material	Supplements required
Straw rack	X	X	
Rope – on floor	X	X	
Rope – not on floor		X	X
Bedding on floor	X	X	
Straw etc. in blocks – on floor	X	X	
Wooden blocks/branches – on floor	X	X	
Wooden blocks/branches – not on floor		X	X
Deep litter	X	X	
Dry feed in feeder	X		X
Blocks in dispenser		X	X

Practicability of various materials as rooting and enrichment materials and the need for supplying other materials (source: Guidelines on rooting and enrichment materials, the Danish Ministry of Justice, 2006).



Hospital pens for weaners and finishers

Experiences with hospital pens

It has been a requirement since 2005 that all pig facilities must have hospital pens. Now the pig industry has quite a lot of experience with the use of hospital pens and their effect on pig health.

Design

In many pig facilities, the location and design of hospital pens are not optimal. The pens are often placed in cold and draughty locations, and the design is often inappropriate in terms of pen dimension, cover, flooring, heat and ventilation.

In order to gain experience with the design of hospital pens, the Danish Applied Pig Research Scheme monitored three herds for a period of time after the hospital pens were optimised.

Experiences obtained in the study:

- Good pen dimensions are 2.0 x 4.0 m
- Smallest pen width is 1.6 m
- Solid floor with floor heating and bedding
- Simple dry feeder
- Pens for recovered pigs



Hospital pen for finishers.

Rubber mats

Hospital pens must have soft bedding in the lying area. A soft lying area can be established with, for instance, rubber mats. Unfortunately, most rubber mats have a relatively short lifespan as the pigs bite them to pieces. Another disadvantage of the rubber mats is that they are warm to lie on, which increases the risk of dunging in the lying area. When installing a rubber mat, the rail and the screws keeping the mat in place on the side pointing towards the dunging area must be



Rubber mat fastened to a countersunk rail.

countersunk. This will make it easier to scrape the mat free of manure if the pigs dung in the lying area.

One week in a hospital pen

In the three herds, sick pigs were housed in a hospital pen for a minimum of one week. It was often possible for these pigs to stay in the hospital pen for up to four weeks. While in the hospital pen, the pigs had a daily gain of 700-800 g/day.

Most of the sick pigs recovered. A total of 385 sick pigs were ear-tagged and recorded. 75% of the sick finishers recovered and were picked up for slaughter. Slightly fewer of the sick weaners (68%) fully recovered and were sold at 30 kg or picked up for slaughter.

Unthrifty weaners

Diarrhoea and poor wellbeing were the most frequent causes for moving weaners to a hospital pen (63%). However, only 30% of the sick finishers were moved to a hospital pen due to diarrhoea or poor wellbeing.

Finishers with poor legs

The finishers often suffered from poor legs (25%) or tail bites (25%) when they were moved to a hospital pen. Only 18% of the sick weaners suffered from tail biting or poor legs.

Healing of tail wounds

The hospital pens were most successful when finishers with tail bites were moved to a hospital pen, as the wounds healed on 86% of the pigs.

Positive growth after disease

Sick pigs were weighed upon transfer



Recording of a sick pig in one of the three herds.

to the hospital pen, when they were reported recovered and upon delivery for slaughter. The finishers weighed 45 kg at transfer and approx. 70 kg when they had recovered. In the remaining part of the growth period, the recovered finishers had a daily gain of 1,000-1,100 g.

Make an objective assessment

A sick pig must be destroyed if it is in a lot of pain or if there is no prospect of it recovering. Experience from the three herds showed that pigs with severe diseases such as cerebrospinal meningitis only had a 50% chance of recovering. Very sick pigs must be housed individually and the climate in the pen must be adjusted to the needs of the individual pig.

2% of the place units

The number of available hospital place units depends on the disease profile of the herd, but generally the number of hospital and buffer units must correspond to 5% of the place units. The hospital pens constitute approx. 2% of the place units, and the remaining 3% are buffer pens, whereby moving recovered pigs back to a section with healthy pigs can be avoided. The number of hospital place units must at all times be adjusted to the current situation as there must always be one hospital unit available.

Animal welfare, inspection and legislation

Shoulder ulcers

Danish Pig Production's aim is to reduce the prevalence of shoulder ulcers to an absolute minimum and halve the number of reported shoulder ulcers by the end of 2007.

The industry has entered into an agreement with the Danish Veterinary Association to increase the efforts against shoulder ulcers. Among other things, this agreement states that the herd vet must check the frequency of shoulder ulcers in all sow herds. If the frequency is high or is increasing, an action plan with preventive measures must be agreed upon, and if the action plan does not work, the vet must increase the frequency of his visits.

Finally, Danish Pig Production will initiate a number of specific scientific projects aimed at obtaining more knowledge on how to detect shoulder ulcers early and how to prevent them. This work will focus on, for instance, types of treatment, nutrition and design of housing.

Rooting and enrichment materials

Rooting and enrichment materials are back on the political agenda again. A majority in the government's Committee for Food, Agriculture and Fisheries has requested a clarification of the rules.

Danish Pig Production participates in a work group under the Danish Ministry of Justice called "The work group on keeping of pigs" and this group was re-established in 2007 after a break. The first task of the work group was to re-evaluate the current legislation on rooting and enrichment materials - something the group is still working on.

Cross-compliance

As of spring 2007, animal welfare has become part of the cross-compliance requirements. The requirements for pigs correspond to the requirements in the EU Directive and therefore differ in certain areas from Danish legislation. There are a total of 28 welfare requirements for pigs.

Inspection of animal welfare is performed by the inspectors of the Danish

Veterinary and Food Administration in the 5% inspection.

Violations discovered during public inspections such as 5% inspections and reports to the police from the public meat inspection at the slaughterhouses, are reported to the Directorate for Food, Fisheries and Agri Business and can result in sanctions.

Many requirements are already being met in all herds. Other requirements are objective, which makes it easy to check whether they are being met. These are, for instance, space requirements, requirements for lighting and noise, requirements for recording of medicine consumption, etc.

The rules for cross-compliance also comprise requirements that are difficult to meet and to check objectively as they can be interpreted. In such cases, the subjective assessment of the inspector will be essential. This applies to, for instance, the requirement for allocation of rooting and enrichment materials, where it is not



Specific requirements for design of hospital pens are not covered by cross-compliance. Here, the Danish national legislation applies.

possible to measure how much material is sufficient. Therefore, it will be assessed in each individual case whether the amount given meets the requirement.

Shoulder ulcer problems are not directly included by the cross-compliance requirements, but they are indirectly included by virtue of the general welfare requirements. These stipulate that sick animals must receive appropriate treatment immediately and, if necessary, be isolated in suitable

accommodation with dry and comfortable bedding.

The guidelines for the cross-compliance inspection can be found in the instruction issued by the Directorate for Food, Fisheries and Agri Business.

Furthermore, a brief is available in Danish at www.infosvin.dk on implementation of EU directives showing the differences between the EU directives and Danish legislation.

Self-inspection

The Danish government has decided that all pig herds and cattle herds with more than ten animals must introduce self-inspection procedures to ensure that animal welfare conditions comply with the statutory requirements.

It was originally planned that this self-inspection was to be implemented in all Danish herds by the end of 2007. However, the order of the Danish Veterinary and Food Administration that forms the basis of the implementation of the self-inspection has not yet been published. Self-inspection procedures for animal welfare are therefore expected to be implemented in Danish herds by the middle of 2008.

Once the order of the Danish Veterinary and Food Administration is published, Danish Pig Production will be ready with a self-inspection programme for use in the pig facilities. This programme, which has been prepared in co-operation with the Danish Veterinary and Food Administration, is an instruction in good production management practices to benefit animal welfare. The instruction will ensure that the animal welfare conditions in the herd comply with the statutory requirements.

If the herd owner does not wish to use the program from Danish Pig Production, he can make his own self-inspection program. It is at all times the responsibility of the herd owner that a self-inspection program is available that guarantees and documents that the legislation on animal welfare is being met in his herd.



Animal welfare, inspection and legislation

DANISH Product Standard

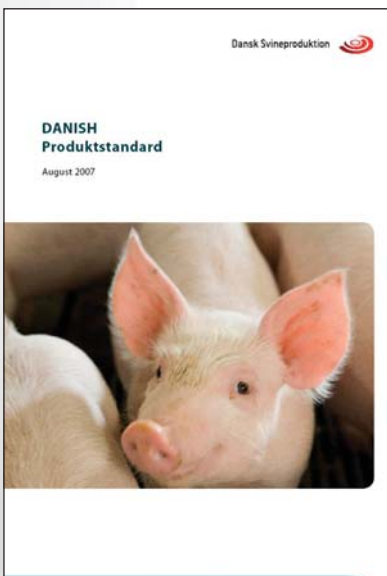
In the future, DANISH Product Standard will guarantee and document that all Danish pig herds meet Danish legislation and industrial requirements.

This scheme will be introduced in Denmark to ensure the continued free access to the huge German market. DANISH Product Standard will also

- Compliance with space requirements
- Prevention of shoulder ulcers
- Prevention of tail biting
- Design and use of hospital pens
- Rooting and enrichment materials

help ensure a generally high level of animal welfare in the pig production facilities.

Under this scheme, all Danish pig facilities must be inspected every third year based on DANISH Product Standard. This takes place at an audit (inspection) where an impartial body – DLBR Certification from the National Centre in



Front page of the DANISH Product Standard material.

Skejby – analyses the herd and the documentation for the facility with particular focus on animal welfare within the following areas:

The Pig Levy Fund pays the costs for the audit. If the pig facility is not approved at first, a follow-up audit must take place and the costs for this are paid by the herd owner.

Failure to successfully complete the follow-up audit will result in a penalty until the owner has requested yet another audit – however, the minimum penalty period is four weeks. Penalties are paid in proportion to the number of pigs produced at the CHR number in question.

The aim is to have all Danish pig producers participate in the agreement regardless of whether they supply pigs to private slaughterhouses, export live pigs or are co-operative members. The scheme is supported by all parties in the pig industry – organisations, co-operative slaughterhouses, private slaughterhouses and exporters of live animals.

All co-operative members of Danish Crown and Tican are automatically included in the scheme, while other pig producers must actively confirm their participation in writing.

Approved producers of UK pigs, organic or outdoor pigs are automatically approved in the DANISH arrangement and will not need further inspection.

The aim is to have more than 85% of the Danish pig herds audited by the end of 2010. By the end of 2007 alone, the aim is to have audited 2,000 herds.

Suitability for transport

On July 1, 2007, a penalty point system came into force for transport of animals, and for this, Danish Pig Production/DMA produced a set of information material. Text and images show examples of weaners, finishers and sows for slaughter that are suitable for transport, that are suitable for transport under certain conditions, and that are not suitable for transport. This material was made in co-operation

with the Danish Veterinary and Food Administration and will be available for download from Danish Pig Production's website at the end of 2007.

Transport

Transport of pigs received widespread public attention in 2007. In March, the national TV channel DR1 ran a series of pro-grammes documenting a number of mistakes made in connection with long-distance transports of pigs across EU borders. As a result, in April 2007 the industry decided to suspend all transports of animals lasting more than 24 hours across EU borders.

Before the ban on long transports across EU borders was lifted, the food industry and exporters agreed on a joint code of practice for the transport of pigs and cattle.

Among other things, the code of practice stipulates:

- That an independent inspection function be established
- That contingency plans be available for all transports
- That restrictions be introduced for the total duration of the transport

The independent inspection function includes, for instance, inspection of transports and lairage facilities and unannounced spot checks, while the contingency plans must include handling of unexpected events such as engine failure or delays. The contingency plans must also include requirements for handling of sick animals, space during transport and other conditions.

It is a requirement from the industry that exporters accept and comply with the requirements in the code of practice to be able to transport animals. If this is not the case, the industry will refuse to co-operate with the company in question.

A list of the exporters who have signed up for the code of practice can be found at www.dyretransporter.dk.

Welfare in sows

Satiety and gastric health

Several investigations are currently trying to establish which nutritional measures enhance the satiety and gastric health of sows.

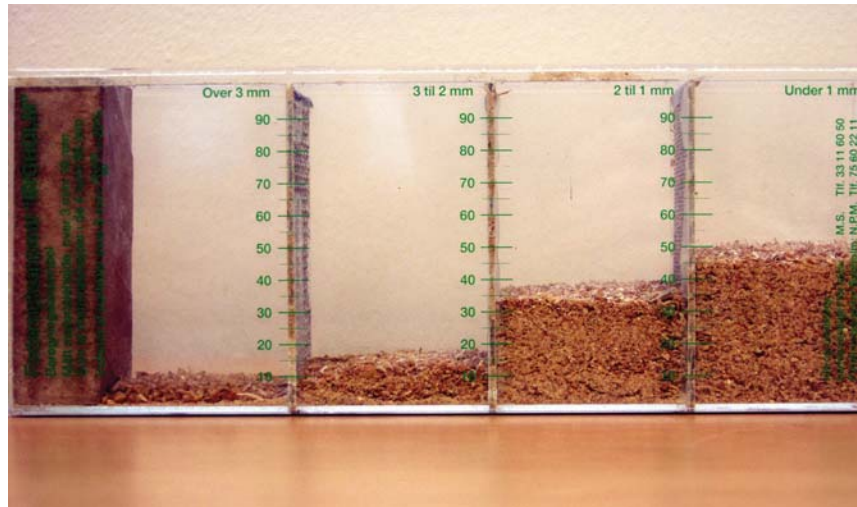
Satiety in gilts and sows

In co-operation with the Faculty of Agricultural Sciences, Aarhus University, and supported by the Danish Directorate for Food, Fisheries and Agri Business (DFFA), the second year of a project has started aimed at establishing the importance of diet composition for sows' overall satiety periods. The effect of 15 ingredients and 17 diets has been analysed on water binding capacity and intumescence. Samples were analysed both before and after pelleting to investigate how the pelleting process influences these parameters. Preliminary results indicate that sugar beet pulp, potato pulp and pectin feed have the highest water binding capacity and intumescence. The ingredients and diets with the highest water binding capacity and intumescence will subsequently be studied in a herd where blood samples will be collected for analysis of various so-called "satiety" hormones and where behavioural studies will be made. Hormone profiles compared with behaviour can be used for predicting satiety in sows. Furthermore, the influence of the diets on gastric health will be investigated.

Gastric changes

Gastric changes occur almost exclusively in the white part of the stomach immediately after the mouth of the oesophagus. Theoretically, gastric changes in this part occur when acid and enzymes produced in the lowest part of the stomach "flush" onto the white part of the stomach where the mucosa is unprotected. To prevent this, the "acid" environment in the lowest part of the stomach must be kept there (this will result in a pH gradient from the top to the bottom of the stomach). This can be achieved by changing the texture of the gastric content from a thin texture into a more porridge-like texture.

Financially supported by DFFA under the Act on EU funds, Danish Pig



Bygholm sieve with grain ground "medium coarse".

Production conducted a demonstration project to investigate this theory, which included knowledge from finisher area on the effect of feeding on the gastric health of sows and gilts. The demonstration comprised nine sow herds, and the following factors were studied: phase feeding in the lactation period, pelleted feed run through a Pellet Cross machine and rolled oats excluded from the pelleting process, and the addition of fibre (beet pellets, pectin, and greenmeal). It was overall concluded that fibre did not have the desired positive effect on gastric health, but that an increase in particle size in the feed was efficient. Here it is recommended to grind the grain medium coarse to coarse (photo 1). The project also included the making of

- An image series and a video illustrating procedures for removing stomachs from gilts and sows
- An image series showing gastric changes and their classification (gastric index – see photo 2)
- A manual for reducing gastric changes in gilts and sows
- A standardised procedure for classification of gastric changes at Danish laboratories.

Cross-references to these points can be found at Danish Pig Production's website (www.danishpigproduction.dk).

As a spin-off from this demonstration project, the effect of meal feed versus

pellets on gastric health is being investigated in four sow herds. In two herds, a control group and a trial group are being investigated at the same time, while the trial design for the two other herds is meal feed versus pellets in a before and after period. In all four herds, the trial takes place in the gestation and lactation periods. The primary analysis parameter is gastric health, and stomachs are therefore removed from all culled sows, ie. slaughtered, dead and destroyed sows. At the same time, sieve profiles are made of the pelleted feed and of the meal feed. Preliminary results indicate a positive effect on the gastric health of feeding with meal feed, which means that the calculated gastric index (the white part of the stomach) drops when meal feed is used. It is expected that the trial will be finished by the end of 2007.



The inside of a stomach with gastric index 0. The white part of the stomach is smooth and nacreous.



Welfare in sows

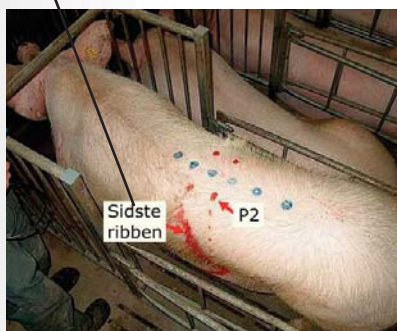
Managing body condition

Correct management of body condition is one of the most important factors in ensuring a good longevity, a high productivity, and a low feed conversion, and it is one of the most essential prerequisites for preventing the development of shoulder ulcers.

Today, visual assessment of the body condition is the best method for assessing sows' feed condition. However, the visual assessment must be adjusted regularly, and therefore assessments of the body condition should be compared with measurements of backfat on a quarterly basis. Sows must have a backfat thickness of 15-20 mm measured at scanning point P2. This measurement is then compared with the visual assessment split into four groups (see figure 1).

Sows' body condition should be assessed regularly throughout the entire production cycle and preferably at farrowing, at weaning, at the first gestation check, and approx. 60 and

Last rib



Scanning of backfat thickness in P2.

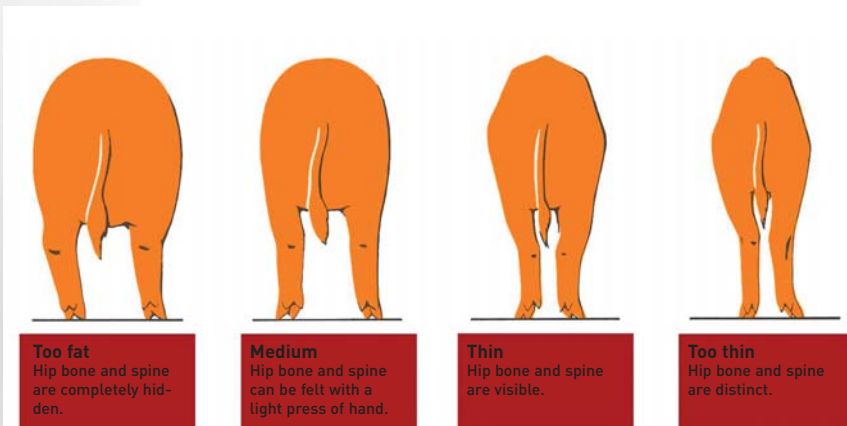


Figure 1. Visual outline of sows in different groups according to condition.

90 days into gestation. It is necessary to make that many assessments to be able to detect sows that are either too fat or too thin. This means that besides assessing the body condition, the producer must also act on the information by either increasing or reducing the feed dose of the individual sow.

During lactation, the feed dose should be increased concurrently with the sow's milk producing capacity. Therefore, the feed dose must be 2-3 FUsow a day at farrowing and increase to 5-6 FUsow after the first week of lactation. The sows are subsequently fed according to approximate appetite. The aim is that the sow has an intake of approx. 180 FUsow during four weeks of lactation.

Shoulder ulcers – applied measures

Danish Pig Production has initiated applied measures to prevent shoulder ulcers. It has by now been documented which types of sows are at risk of developing shoulder ulcers and this knowledge is included in the preventive work.

Classification into “degrees”

Classification of shoulder ulcers into “degrees 1-4” is an important tool in handling shoulder ulcers in the herds and at the slaughterhouses.

More documentation is necessary to establish that there is agreement between assessments on a live animal and the slaughter findings.

In a recently finished study, a correlation was found between the size of a shoulder ulcer and the degree; i.e. large ulcers are generally also more serious ulcers.

Slaughterhouse study

In the early summer, Danish Pig Production and the Danish Veterinary and Food Administration's “mobile animal welfare unit” initiated a comprehensive slaughterhouse study consisting of several phases. The first phase was a pilot project aimed at shedding light on the classification of degrees of shoulder ulcers before and after slaughter. In the study, the assessments of several people were compared.

Preliminary results reveal some disagreement between the assessments. Furthermore, high degree shoulder ulcers were seen that could not be detected on the live animal when the current recognised scale of 0-4 was used. This is because a shoulder ulcer has many stages from development to healing. The current scale does not take into account healed ulcers.

In a study made at Copenhagen University, LIFE, it was demonstrated, among other things, that swellings and skin that is not freely moved after healing were also definite signs of degrees 3 or 4. This can be used as supplement when evaluating whether an animal is qualified for slaughter.

The pilot project under Danish Pig Production underlines that scoring of shoulder ulcers is difficult and requires training and experience. The study therefore questions the use of a 1-4 scale alone. The project also indicated that mild degrees of shoulder ulcers are generally difficult to find again after the slaughter process.

It is expected that the study will result in more simple and practical guidelines in terms of evaluation of shoulder ulcers.

Do ulcers come from inside or outside?

Several pig producers have experienced delivering a sow for slaughter in

One (or more) of the conditions below are definite signs of severe shoulder ulcers (degrees 3 or 4):

- Ulcers with a diameter of more than 5 cm
- Solid swelling
- Skin that is not freely moved over its supporting tissue on the shoulder

good faith and subsequently been told that the sow had a high degree shoulder ulcer. This has sparked a debate on whether shoulder ulcers occur from the inside or from the outside.

In the further process of the slaughterhouse study, a number of sows will be monitored. Here it will be ensured that the sows only develop shoulder ulcers in degrees 1 or 2. At the slaughterhouse, they will be examined again to analyse whether there is correlation between the assessments. The second phase of the study was initiated in the summer 2007.

Thermography

A pre-study will assess whether heat-sensitive cameras or scanners are able to reveal the outbreak of a shoulder ulcer before it can actually be seen with the naked eye. If applicable, it will be possible to use this technique to further illustrate the problems in determining when shoulder ulcers occur. Preliminary results reveal that the heat-sensitive cameras are the most promising device.

New knowledge of shoulder ulcers

Even in herds with a well-implemented action plan, shoulder ulcers still occur. In the autumn 2007, a group of specialists from Danish Pig Production was set up that together with the herd advisors will be visiting ten herds. Despite a dedicated effort, these producers still witness shoulder ulcers among their sows. In this project it will be assessed whether we really need more knowledge or whether known measures can eliminate the prevalence of shoulder ulcers if used correctly.

Documented knowledge on prevention of pressure ulcers in humans will be included in the work.

Risk sows are:

- Sows in poor conditions (conditions 1 and 2)
- Sows that have previously suffered from shoulder ulcers
- Sows with troubled gait or disease
- Old sows

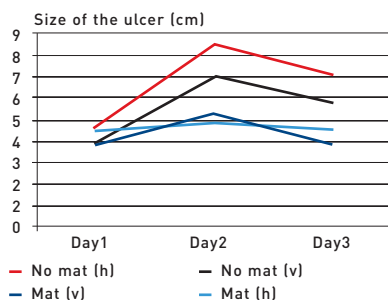
Rubber mats work

A study showed that the size of a shoulder ulcer was reduced among sows given rubber mats compared



Shoulder ulcer degree 1. The use of a mat in due time can limit shoulder ulcers.

with a control group of sows that were only treated locally. Even in the cases where the shoulder ulcers worsened, they were still smaller in size among sows given mats compared with the control group. The study also showed that thin sows benefited the most from the mats. Sows with a good condition also benefited from the mats, but this effect was not recorded until day 21.



The average size of shoulder ulcer in 303 sows with shoulder ulcers that were treated locally and were given a mat compared with control sows. The letters h and v denote right and left shoulders, respectively.

Trial with rubber mats

In a product trial, four brands of rubber mats are being studied. The mats are compared in terms of handling in the daily management in farrowing facilities. This includes hygiene on the mats, cleaning of the farrowing pen, wash etc. The durability of the mats will also be assessed.

The trial is conducted in four herds with different floor designs (fully slatted floor or partially slatted floor) and different feeding principles (dry feed or liquid feed). All brands of mats are represented in each herd. No results are yet available.

Reduced lying time

Long, uninterrupted periods of lying down are a recognized risk factor for bed sores in humans. It is assumed that such a risk also applies to sows. In an attempt to reduce the risk of shoulder ulcers, it may be appropriate to increase the number of times the sow gets up and lies down during the day. Preliminary results from a pre-study reveal that frequent feeding in the farrowing facility can make the sow stand up at each feeding. This study comprised five daily feedings from transfer and until the 7th day of lactation. From that point onwards, feed was supplied seven times a day. The study will therefore be extended to include three more herds where the effect on shoulder ulcers will also be studied. Because of the increased number of feedings, there may be an increased risk that the sow crushes the piglets when she lies down, and this is therefore also included in the study.



This rubber mat – Kraiburg Atlas, 18 mm – has a documented positive effect on shoulder ulcers. It is one of four mats that together with a shoulder vest are being studied in terms of handling, durability etc.

Welfare in sows

Heritability

We know that Landrace sows are at greater risk of developing shoulder ulcers than Large White sows. However, we do not know whether there is heritability for shoulder ulcers. Therefore, a study was initiated aimed at documenting whether there is heritability for shoulder ulcers. The study is being conducted in six commercial herds with LY sows of known origin. The study will include data from 8,000 sows and 24,000 farrowings.

Development in sow mortality

Danish Pig Production aims to reduce the national average proportion of sows euthanized or found dead in the herds from 15% to 11% over the next five years. The background for this is that increasingly more sows are destroyed.

A high mortality rate does not necessarily indicate a low level of welfare in a herd. Many sows that are destroyed today would five years ago have been sent to slaughter. But focus has changed, and so has the limit for what is acceptable when sows are sent to slaughter.

Sow mortality is reduced through intervention in due time, good prevention and consistent handling of unthrifty, sick and injured sows. Hospital pens must also be used early in the disease process to minimize the recovering period.

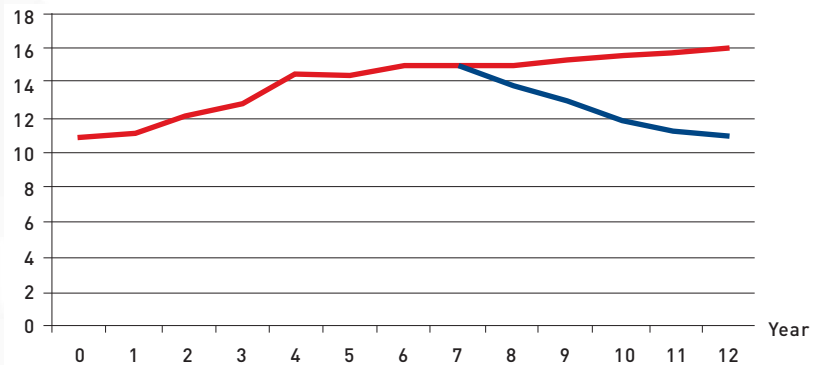
Economy

The best fourth of the sow units has an average mortality of 10% of the number of sows/year.

Every time a sow is destroyed, it corresponds to a loss of minimum DKK 2,000 on the bottom line. It is thus crucial that every-body is monitoring sow mortality, both in terms of animal welfare, job satisfaction in the herd, and of the economy of the production.

Measures

Danish Pig Production has a wide range of current and future activities that will generate knowledge and information to the advisor and the



Development in sow mortality (% of sows/year) 2000-2012. The red curve without an applied effort, the blue with an applied effort.

sow producer in their fight against a high mortality rate.

One of these activities is a demonstration project for reduction of sow mortality. Twenty demonstration herds that are evenly distributed among the regional advisory offices will be selected in order to put focus on the problem.

On the basis of data and experiences from herd visits, an outline will be made of all measures that are relevant for the individual producer for increasing the longevity of gilts and sows. Making a problem visible will motivate lasting changes to root new work processes in the herds.

Key figures in the herd

Insufficient recording is one of the reasons why some producers are not sufficiently aware of the number of destroyed sows. The herd staff is not aware of that there is a problem nor what causes the problem.

The key figure for sow mortality in the individual herd can be seen from the production report.

In order to initiate a dedicated effort in the individual herd, all sows leaving the herd must be recorded with codes for slaughter, euthanized or found dead.

Recordings take time, and the herd staff and the advisors must therefore be bound to use them in the future for a healthier sow unit.

Ten-point plan

Danish Pig Production has drawn up a ten-point plan for reducing sow mortality. This information is also available in English and Russian at www.infosvin.dk.

Ten-point plan for reduction of sow mortality:

1. Only mate gilts and sows of medium condition that have strong even legs and uniform and healthy hooves
2. Assess all sows after each round of farrowing – particularly condition, hooves and movement
3. Individual feeding of sows should be possible in all sections of the facility
4. All sections in the facility should have non-slip flooring
5. Establish a sufficient number of hospital pens
6. Activate all sows during the daily supervision, possibly in connection with allocation of straw
7. Move sows with tender legs, stiff gait, hoof injuries, no appetite or sows that have been attacked to a hospital pen
8. Strategies for treatment are described by the herd vet and are agreed with the staff in charge of the sow unit
9. Destroy sows with severe injuries
10. Record all departing sows with an activity and a cause. Use codes of recording in the Integrated Farm Management System or AgroSoft or print the recording form from www.infosvin.dk.



DKK +25 per finisher

Improved productivity

Many pig producers do not utilize the potential to improve the production results. The desired improvement nationally in, for instance, feed conversion is non-existent.

Demonstration project

Danish Pig Production is currently in charge of a large-scale demonstration project called "DKK+25 per produced finisher" aimed at increasing the productivity in finisher herds by incorporating existing knowledge. The increased profit will come from improvements of one or more of the following parameters:

Value of improvements in productivity, DKK/finisher

1% dead	DKK 6
0.1 FUgp per kg gain	DKK 8
0.5 percentage point lean meat	DKK 5
+/- 10% delivered in basic weight range	DKK +/-3
1 kg from slaughter weight of 82 kg with 75% within basis	DKK 4
50 g daily gain	DKK 0-6

The project is conducted in close cooperation with 12 regional pig production advisors and 13 vets working in pairs to implement the measures and thereby increase the profit in the individual herds. The pig producers in the project have committed to six visits from the pig production advisor besides the 12 annual visits by the vet.

At a preliminary visit, each herd was systematically analysed from A to Z by a team consisting of the herd vet, the pig production advisor and three specialists from Danish Pig Production (ventilation, health and nutrition). Subsequently, the various measures were assessed and given a priority. In an action plan, it was assessed which improvements could be expected and an estimate was given of the expected bottom line result. The action plans will be then implemented in the individual herds, and the results will be analysed after a year.

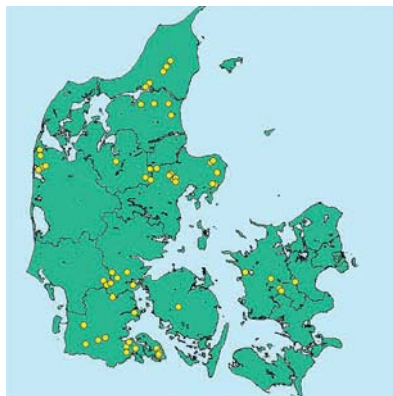


Figure 1. Geographical location of the herds in phase 1.

From DKK 3 to DKK 52

Fifty-six herds have been visited in the first phase of the project, and action plans have been drawn up estimating the effects in the individual herds. The expected net gain varies from approx. DKK 3 to DKK 52 per finisher.

The project will continue in phase 2 where it is planned to include 150 herds in an advisory process with the vets and advisors involved in phase 1.

Typical problems

Some of the problems we encountered were seen in many of the herds, and these are problems that all pig producers should be aware of to achieve the best possible results. Below, some of the typical mistakes are described in detail.

Drying and warming the facility

All the pig producers were made aware of the importance of drying and warming the facilities before transferring pigs; this is an essential prerequisite for achieving good production results.

After cleaning, the facilities must be dried and warmed to give the pigs the best possible start. As a rule of thumb, 1.5-3 kWh is required per m² floor surface. In all herds in the project, the amounts of heat and oil required for drying were calculated and the effect is monitored routinely via checklists. It is easy to check whether the facility is dry: place a



In a facility of approx. 200 m², approx. 75 l oil are typically required to dry up the facility.

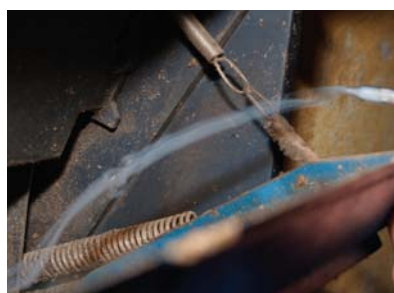
thermometer on the floor and compare with the thermometer in the facility. When the temperatures are identical, the facility is dry.

Dimensioning of ventilation

Regardless of ventilation principle, all systems must be correctly dimensioned. It is furthermore important that the climate control is adjusted correctly, and in facilities with air intake through wall inlets, the pig producer must be particularly aware of the control parameter "outdoor temperature compensation" and wind impact.

Avoid draught

In order to avoid draught in the animals' activity zone, compensation for the outdoor temperature must ensure that the out-put of the system is reduced in periods with large temperature fluctuations and decreasing temperature. With this measure it takes



Due to wind pressure on the building/wall inlets, the air from the facility is pulled out through the wall inlets.



DKK +25 per finisher

slightly longer to reach the desired temperature in the facility.

Wind impact

In facilities with air intake through wall inlets, the movement of the air is often disturbed by the wind impact. In periods with heavy wind, the subpres-



Example of adjustable wind shield.

sure is changed in the facility causing an uneven distribution of air with the risk of draught in the activity zone of the animals.

The influence of the wind can be reduced by placing an adjustable wind screen in front of the air intake.

Minimum ventilation

The minimum ventilation is "the smallest amount of air" necessary to remove the humid produced by the animals. If the minimum ventilation is too low, the result will be poor air quality especially during cold periods, for instance in the morning. In diffusely ventilated facilities there is also a risk of losing humid and warmth to the attic. If the minimum ventilation is too high, the facility will be drained of heat. In order to



The feed must be ground finely to ensure a good feed conversion ratio.

ensure a good climate in the facility, a strategy must be made for minimum ventilation, which for finishers must be in the interval 6-15 m³/pig/hour.

Grinding

Pig producers mixing their own feed on-farm must routinely check that the grinding of the feed is sufficiently fine. It is recommended that minimum 60% of the particles be under 1 mm and 40% be 1-2 mm in a sieve analysis of ground grain. Remember also that supplementary feed and soybean meal must be ground to minimise the risk of segregation.



Check the consumption of ingredients and the mixing accuracy in your on-farm mixing system.

Accuracy of mixing

It is necessary to routinely check that the on-farm mixing system mixes as expected. This is easy to check and provides a guarantee that the feed is composed as desired. The mixing accuracy is calculated on the basis of



Liquid feeding requires particular attention to the feed curve, daily adjustment of the feed supply and to feed hygiene.

the total consumption of the individual ingredients over a period of time. It is subsequently checked that the composition of the feed in per cent corresponds to what is desired and that the consumption of purchased ingredients corresponds with the recording of the feed computer.

Liquid feed

There is a great risk of incorrect recording of data in the liquid feed computer. Check ingredient values (content of dry matter and feed units) and check that the energy content of the diet is minimum 0.3 FU_{gp} per kg and that the dry matter percentage is minimum 24%. The feed curve must be scrutinised. Supervise a feeding every day, and reduce the amount fed in pens where all the feed is not eaten 30 minutes after feeding. It is recommended that the feed curve is so high that the amount of feed must be reduced in min. 30% of the pens housing pigs up to 60 kg. The maximum feed strength must be in the interval 2.7-2.9 FU_{gp} a day.

Feed hygiene

A poor feed hygiene is in particular a



Correctly adjusted feeder: there is feed on the platform and not in the troughs with water valves.

risk if liquid feed is used. The liquid feed tank must be cleaned once a week and the feed tube once every 14 days.

In hospital pens, it is important that the producer is aware of old liquid feed in the troughs as the pigs rarely eat up. The troughs must therefore be emptied of old feed residue every day. Alternatively, use dry feed.



Pigs must have easy access to water.

Adjustment of feeder

The feeders must be adjusted to provide easy access to feed without causing feed wastage. This requires daily inspection and possibly adjustment.

Water

Immediately before a new batch of pigs is transferred to a pen, the drinking nipples should be checked to ensure that the output is sufficient. Recommended output is 1-4 litres a minute.

Moving/mixing of pigs

Moving and mixing of pigs cause stress and aggression. Yet, in many herds it is standard procedure to sort pigs once or several times.

The best procedure is to sort the pigs upon transfer to the pen and only move pigs in emergencies, for instance, in case of disease. It is not important that the pigs are not completely identical in size. Actually, it is an advantage if 1-2 pigs per pen can be slaughtered before the rest, as that makes more room for the remaining pigs towards the end of the growth period.



With restrictive feeding, supervision is easy around feeding.

Time for supervision

There must be time for thorough supervision. The pigs must be supervised when they are active. If the pigs are fed restrictively with liquid feed, it is natural to supervise a feeding and check that all pigs are healthy. When



Example of a hospital pen with deep litter.

ad lib feeding is employed, the producer must walk into the pens and get the pigs to stand up every day to find the sick pigs in time. It may ease the supervision if straw is supplied at the same time. Pig producers must pay close attention to spot pigs with pneumonia or leg problems so that treatment can be initiated as quickly as possible.

Hospital pens

It is crucial that sick pigs have optimum conditions. In herds with fully sectioned management, every section must be equipped with hospital pens – or the sick pigs must be moved to a hospital facility where they can remain once they have recovered.

Hospital pens must have a draught-free location, which means that outer pens are often a wrong choice. Hospital pens must have soft bedding in 2/3 of the net area and have tight-fitting cover.

Statistics in the herd

Recording of the daily observations, disease and mortality provides a good general view of the health status. This is needed when elucidating causes of disease together with the practising herd vet. A weekly statistic of mortalities shows whether the disease situation is under control or where to set in.

The best treatment

It may be necessary to examine sick pigs or samples at a lab to establish the best possible treatment. If vaccination is being considered, it is absolutely essential to know the importance of the disease when deciding whether vaccination is a good solution.

Lawsonia diarrhoea

In many of the herds, blood sample analyses revealed that the pigs were not infected by Lawsonia until they were transferred to the finisher facility. This may be because the infection is postponed due to medication in the weaner period. If diarrhoea is a problem in the finisher facility, it should be checked whether the weaners are vaccinated against Lawsonia diarrhoea. Whether treatment in the weaner period is necessary can only be determined by not using medication in a few pens regularly. It is impossible to tell the difference between a treatment that has worked and a problem that has disappeared.

The correct delivery weight

A lot of money can be earned by slaughtering pigs at the optimum weight of 82 kg. If all or many of the



Post-mortem of a sick pig.

pigs are weighed before delivery for slaughter, it is possible to hit the right weight. Some producers do not feel that they have the time for weighing the pigs, so they do it by eye, which, in some cases, is a very expensive method. Most producers ought to also weigh minimum two pigs per pen and then compare the remaining pigs with these. The delivery weight must be checked via Landmandsportalen.



Controlling coccidiosis without the use of Baycox®

Introduction

Approx. 95% of all piglets in Denmark are treated annually for coccidiosis with Baycox®. Coccidiosis is triggered by the intestinal parasite *Isospora suis*. *Isospora suis* is probably present in more or less all sow herds. If untreated, coccidiosis can trigger severe clinical symptoms with diarrhoea and high mortality rates. However, it is not certain that infected piglets will develop clinical coccidiosis, and it is therefore a possibility that treatment with Baycox® can be omitted or minimised. This is particularly relevant as the first herds with resistant coccidia are now appearing. Furthermore, routine treatment with Baycox® includes costs for labour and medicine. It is therefore desired to study alternative control options.

Materials and methods

The effect of three different treatments was investigated in two sow herds:

1. Standard cleaning (high-pressure cleaning + cold water) + Baycox® treatment
2. Standard cleaning, but no Baycox® treatment (control)
3. Standard cleaning, intensive cleaning, and drying with liming or Stalosan, and no Baycox® treatment.

The investigation was made in the farrowing facility during three rounds of farrowing. In both herds, coccidia were detected before the start of the trial. Faecal samples were routinely collected from the piglets to monitor the development in infection pressure. Mortality and medical treatments were also recorded, and the piglets were weighed at weaning. The results were computed separately for the two herds, as the owner of the one herd was already liming routinely and also had a high infection pressure.

Results

The main results from the study are shown in table 1. There were no significant differences in weaning weight between the groups within the herds. There were no significant differences in mortality between the three groups, except between groups 2 and 3 in one

Table 1. Average weaning weight and mortality rates in piglet litters in the two trial herds. Numbers written in parenthesis denote the interval for 50% of the observations.

Group	Herd 1			Herd 2		
	1	2	3	1	2	3
Number of pens	52	51	49	60	60	60
Average weaning weight, kg	8.3 (7.7-8.9)	8.3 (7.7-8.8)	8.2 (7.5-9.1)	7.1 (6.5-7.8)	7.2 (6.5-7.9)	7.2 (6.5-7.7)
Average mortality, %	5.6	6.0	4.9	3.3	4.4a	2.6 b

herd (see table 1 – different letters denote significant differences).

There was a large difference in infection pressure between the two herds. Herd 2 had significantly more positive samples in both the preliminary trial round and during the trial than herd 1. Even though complete sectioning with wash and liming of the entire section was already standard procedure in herd 2, this was not enough to prevent clinical coccidiosis in the herd. Coccidia were detected in 60% (group 2) and 40% (group 3) of the pens, respectively.

There was no correlation between weaning weight and detection of oocysts in the individual pens, just as there were no differences in the number of medical treatments between the three groups.

Discussion

In group 2 (without Baycox® treatment and with standard cleaning), a lower daily gain and higher mortality rates were expected compared with groups 1 and 3. In this investigation, a difference in mortality was only found in herd 2 where the extra cleaning reduced mortality.

However, it was not possible to detect a clear effect of treating with Baycox® on the average weaning weight or mortality. In herd 1, the sows stayed in the farrowing facility for three weeks, which made it possible to efficiently dry up the farrowing pens before piglets were born. It is likely that this drying may have played a part in reducing the infection pressure with coccidia. In herd 2, the sows stayed in the farrowing facility for one

week before farrowing. Here, the two farrowing facilities were managed with complete sectioning. Thus, in both herds management played a part in reducing the infection pressure. Despite this, liming in herd 2 did not prevent clinical coccidiosis.

When the figures from the three treatment rounds were compared, no differences were found in prevalence of coccidia, mortality or weaning weight. It was not possible to detect an increase in infection pressure over time in group 2 or a reduction in infection pressure in group 3.

Restrictions had been imposed on cross-fostering (only before day 2), and separate footwear was used in the individual treatment groups.

These measures have probably played a part in generally reducing the infection pressure in the pens, which in turn may explain the lack of difference between the treatments. The results therefore underline the importance of good management practices in the farrowing facility.



PMWS

PMWS is still causing problems

PMWS is still the cause of huge losses in pig facilities where the pigs suffer from the disease. Over the last years, it seems that the disease does not strike as severely among weaners, but has moved on to finishers. However, finisher mortality is not that high – the problem seems to be many non-uniform and unthrifty pigs.



Unthrifty pig.

In the past year, Danish Pig Production has been involved in a wide range of activities centred on elucidating the cause of PMWS and finding the best method to prevent the disease. These studies are made in close co-operation with the National Veterinary Institute, DTU (previously the Danish Institute for Food and Veterinary Research).

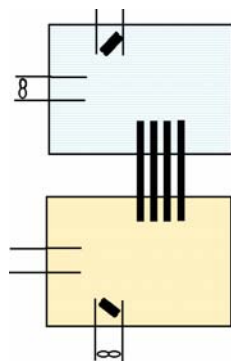
PMWS airborne infection

Previous studies indicate that PMWS is able to transmit through the air. To further analyse this, several studies were made in two containers. These containers were connected with a ventilation pipe to enable the air to be transferred from one container (PMWS sick pigs) to the other (healthy pigs).

The studies reveal that it was possible to transmit PMWS through the air from the “sick” container to the “healthy”, particularly when infection with PRRS virus took place at the same time. This result demonstrates that it is important to isolate PMWS sick pigs in separate hospital sections to reduce the infection and thereby the scope of the disease, and that it is, at the same time, important to be in control of PRRS.

Infection dynamics

In ten herds suffering from PMWS,



Trial design with container.

the offspring of ten sows were examined from one to twelve weeks of age. The pigs were blood-sampled and samples were collected from noses and faeces. All samples were analysed for PCV2 virus, which plays an important role in the development of PMWS. The study showed that both pigs suffering from PMWS and healthy pigs excrete PCV2 virus in identical amounts and at the same time. All animals excreted virus from the nose within the first week of life, whereas the excretion from faeces did not start until around the ninth week of life.

The study demonstrates that it is not possible to determine whether the individual pig will develop PMWS by analysing the excretion of PCV2.

Test of vaccine

The only PMWS vaccine allowed on the Danish market, Circovac, is currently being investigated in one herd. It is the intention to try the vaccine in further two herds. Experience from other countries shows that Circovac can reduce mortality by some per cent and result in more uniform pigs. It will be interesting to see how much difference the vaccine can make under Danish conditions and whether it gives value for money.

Blood samples for diagnostics of PMWS

Previous studies in 74 PMWS herds and in 74 healthy herds have pinpointed PRRS infection and poor bio security as factors that increase the risk of PMWS. In those herds, 8-12-week-old weaners were blood-sampled. Renewed analyses and statistical analysis of the results from the study show that it is possible to distinguish sick and healthy herds with a relatively large certainty. This result formed the basis for allowing the Circovac vaccine to be supplied on the basis of a blood sample analyses where 7 out of 10 blood samples must be positive. Previously the diagnosis was based on post-mortems of – often – several pigs.



Blood sample tubes.

Different types of PCV2 virus

Investigations made in PMWS herds and in healthy herds of the genetic material of PCV2 virus (sequence analyses) show that all viruses that are isolated from the first PMWS outbreak in 2001 until today belong to the same group (group 1).

Studies of old PCV2 viruses isolated from before the first PMWS outbreak show that these belong to another group (group 2). This and foreign studies indicate that a shift has taken place from group 2 to group 1 in connection with PMWS outbreaks. This may indicate a different virulence in the two groups of viruses.

Information

For more information, see www.dansksvineproduktion.dk or www.PCVD.org.



Vaccination tried in practice

Clinical trial

Danish Pig Production is investigating whether selected vaccines are able to prevent disease in regular herds. A clinical trial such as this requires the authorities' permission.

Such investigations will always be made in co-operation with the companies selling the vaccines, and often support is also obtained from other sources such as the Innovation Act, the Directorate for Food, Fisheries and Agri Business.

Trial hosts

It is essential that the producers are willing to help investigate the vaccines under everyday production conditions. This is an advantage for the producer who will obtain unique knowledge of whether a vaccine works under concrete conditions in his herd. Participation in such an investigation often requires a particular effort from the producer and his staff, and compensation is naturally made for labour and production losses.

Vaccination of finishers
 PRRS
 Mycoplasma pneumonia
 Lawsonia
 Mycoplasma arthritis*

Vaccination of sows
 PCV2 virus
 Mycoplasma pneumonia
 Pleuropneumonia

*Development of a new vaccine

Vaccines under investigation

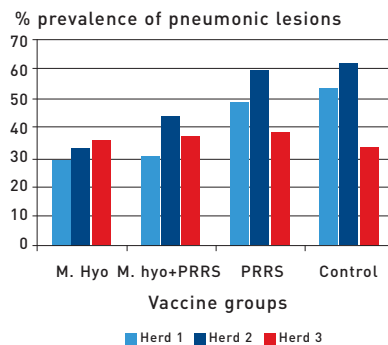
Vaccination of sows
 It is a fairly long investigation process in a herd when sows are vaccinated to assess the pigs' immune response against disease as the final aim. Six months pass from the sow is vaccinated until pigs are slaughtered. Furthermore, an investigation often requires participation of many pigs to obtain a significant basis on which to assess the effect.

Known vaccines used in new ways
 It was investigated whether vaccina-

tion of sows against Mycoplasma pneumonia and pleuropneumonia protects their offspring against these diseases. This is investigated in a herd with batch operation on three sites. The result will be available in the autumn 2007.

Two vaccines protect simultaneously

Vaccines against PRRS and Mycoplasma pneumonia, respectively, were administered to piglets simultaneously with the aim of providing additional protection against pneumonia in the finisher period. The investigation was conducted in three herds. The results show no effect on daily gain compared with pigs that were not vaccinated. However, there was a protective effect on lung changes caused by Mycoplasma pneumonia. This protective effect did not improve when vaccinating with both vaccines. This may be explained from the fact that



The figure illustrates the prevalence of pneumonic lesions in pigs in the three vaccination groups and control in the three herds.

there were no indications of an active PRRS infection in the herds (trial report 788).

New vaccine against PMWS

The new vaccine against PCV2 is administered to sows to protect the pigs against disease post-weaning. In the spring 2007, vaccination of sows with PCV2 vaccine was initiated in one herd. It is still possible for more trial hosts to have the vaccine tested in their herds. The results of this trial will be available in 2008.



Trial pigs used for development of a vaccine against Mycoplasma arthritis.

New type of vaccine against Lawsonia
 A new vaccine against Lawsonia is being tested. This is a new type of vaccine in that it is administered in the drinking water instead of as an injection. The vaccine consists of live organisms that do not cause disease themselves, but provides protection of the pigs against Lawsonia disease. Danish Pig Production is investigating the effect of the vaccine on weaners in three herds. Over the summer 2007, pigs in one herd were studied from weaning to slaughter. The overall results are expected at the end of 2008.

Development of a new vaccine

No vaccines are available against Mycoplasma arthritis. Lameness caused by arthritis can be a huge problem among breeding stock and in many finisher herds. An efficient vaccine will reduce the need for antibiotics for treatment.

For a couple of years, Danish Pig Production has been supporting – professionally and financially – a development project in which the Veterinary Institute, DTU, is working on developing a vaccine under experimental conditions. Once this development is complete, it is the plan that Danish Pig Production will head a clinical trial of prevention of Mycoplasma arthritis with vaccination.

Elimination of Ap2

By partial depopulation and Marbofloxacin

Pig producers whose pigs suffer from several respiratory disorders may benefit from carrying out a medicated elimination of lung diseases. With partial depopulation, Mycoplasma pneumonia and PRRS are highly likely (80-90%) to be eliminated simultaneously with Ap2 (\leftarrow 50%). Expectations to the elimination are particularly great for young animals:

- Less disease and lower mortality rates
- Improved weight gain
- Lower consumption of medicine
- Higher price on sale of weaners or growers

Particularly breeding and multiplication herds may find acute elimination for Ap2 relevant. Here, the pigs in the sections struck by the disease are removed or eutanized and the remaining pigs are medicated.

Project

For more than a year, three sow herds have been free of Ap2 after having performed partial depopulations combined with the fluoroquinolone Marbofloxacin (an antibiotic of the fluoroquinolone type). The eliminations were conducted as a clinical trial.

Elimination plan

- Minimum 500 meters to the nearest neighbour
- All sows and gilts are vaccinated with Porcilis App.
- Four-week farrowing stop
- After three weeks of farrowing stop, all pigs under ten months were moved off-site
- The following week, the remaining grown animals were medicated twice with Marbofloxacin in double doses (4 mg per kg)
- Farrowing facilities, weaning facilities and finisher facilities were washed and disinfected before the sows again started farrowing
- No introduction of new SPF gilts until three months after the medication

Repayment time

Once all costs for the elimination were included, the repayment time was 1.5-5 years.

Are the results final?

After approx. one year, the herds were declared free of Mycoplasma pneumonia and PRRS. However, the results for Ap2 are only preliminary. When all sows have been replaced, the herd owner must complete a six-month-control period and will then obtain Ap2-free status. This is due to fear of outbreak of the infection, as App bacteria can survive on the tonsils (in the throat) for a long time.

Resistance

A significant reason for the completion of this project was the fact that the industry had a desire to investigate how this type of medication affected the fluoroquinolone resistance in certain intestinal bacteria. This would serve as the basis for an attempt to change the highly restrictive rules for the use of quinolones in Denmark, so that they might be used for elimination purposes. There is particular focus on quinolone resistant Salmonella bacteria that can be transmitted to humans via infected pork. Only few Salmonella bacteria were isolated from the three herds - too few to perform statistical work on the results.

At the same time, resistance to fluoroquinolones in the intestinal bacterium E.coli was measured as that is considered an indicator bacterium for Salmonella.

E.coli

Figure 1 shows that the development in quinolone resistance in coli varies greatly in the three herds. Herd 2 stands out in still having a slightly increased level of resistance after 92 days.

Campylobacter

This intestinal bacterium is the cause of multiple gastric infections in Danes every year. However, more than 95% of the cases are triggered by infection with Campylobacter from poultry. Isolation and testing of Campylobacter was carried out as a re-request from the National Food Institute. In two out of the three herds, the resistance to fluoroquinolones was high before medicating and only increased marginally. In the third herd, the resistance increased significantly in connection with medication (see figure 1).

Further process

Danish Pig Production is currently negotiating with the Danish Veterinary and Food Administration on the further process. Danish Pig Production would like to make it possible for more herds to use fluoroquinolones for Ap eliminations.

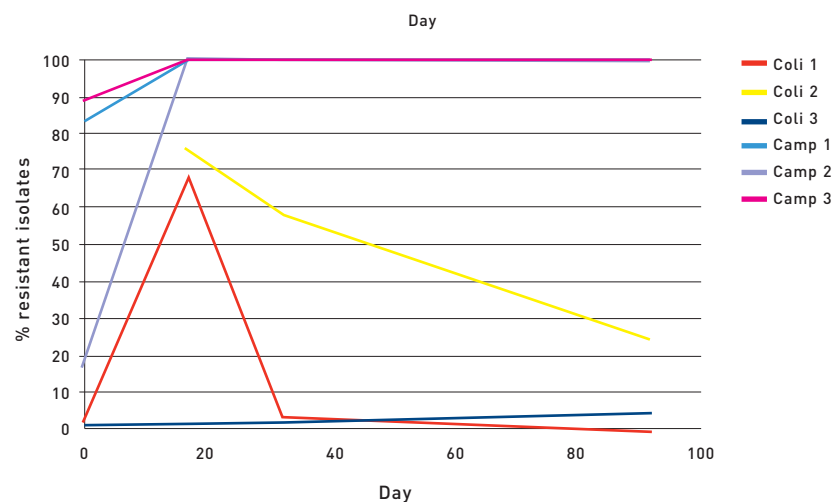


Figure 1. Resistance to fluoroquinolones in the intestinal bacteria E.coli (coli) and Campylobacter (camp) in the three herds. Day 0 denotes the level prior to medicating.



Information from Danish Pig Production

Annual Meeting and Congress

At the Congress for Pig Producers you will be presented with new knowledge and inspiration, and with 1,950 participants, 98 speakers and 70 presentations, it is the largest pig event in the world. It is also an excellent opportunity for socialising.

Before the Congress, Danish Pig Production holds its well-attended Annual Meeting where the current situation in the Danish pig industry is summarised. What are the political, financial and professional challenges in a constantly changing world and business?

The Congress offers a highly varied program including issues such as the world around us, management, economy, sow units, weaners/finishers, feed, welfare and health, and environment and housing units.

Speakers present their latest knowledge and provide examples of how they believe Danish pig production will develop in the future, and what pig producers, staff, and advisors can do to meet the requirements.

In 2008, the Annual Meeting and the Congress will be held on October 20 and 21.

www.dansksvineproduktion.dk

On Danish Pig Production's web you will find a myriad of useful information on all the areas in which a modern pig producer needs to be updated. These include:

- News
- Legislation
- Publications
- Weaner and finisher prices

InfoSvin

A large part of the web is a separate

part called "InfoSvin". Here all information is presented and ordered logically and systematically so that it works as an efficient and comprehensive encyclopaedia for Danish pig producers. You can access InfoSvin directly on this address: www.infosvin.dk.

Fact sheets in several languages
You can also find a wide range of technical subjects accompanied by practical guidelines on our website. These are made in A4 format and can be printed and placed wherever you may need them. As a novelty, we now co-operate with the Danish technical magazine SVIN and, monthly, SVIN will include a new topic with practical guidelines in Danish, English and Russian.



We look forward to seeing you again
at the Annual Meeting and Congress on
October 20 and 21, 2008.

Published results: 2006-2007

Reports

- No. 0602: Effect of the slurry additive E-booster on ammonia emission from a finisher facility
- No. 0603: Low-protein feed for weaners – effect on ammonia and odour emissions
- No. 0604: Investigation of air purification based on membrane technology
- No. 0605: Studies of work time in service facilities
- No. 0701: Experiences with ear sores in eleven herds
- No. 0702: Effect on gastric health of additional fibre in feed for gestating and lactating sows
- No. 0703: Effect of letting the nurse sow keep three of her own piglets
- No. 0704: Pressure and temperature in and around central exhaust units with air purifier from Skov A/S
- No. 0705: Grinding of wheat, barley and soybean meal
- No. 0706: Accuracy when dosing dry feed via electronic feed stations
- No. 0707: The "Pig Stabiliser" concept for liquid feed
- No. 0708: Sprouted wheat – consequence for nutrient content and loss of dry matter

Trial reports

- No. 756: Importance of air change to odour and ammonia emissions from finisher facilities
- No. 757: Effect of extra fibre and texture of the feed on gastric health in sows
- No. 758: PMWS – post-mortem findings and diagnosis
- No. 759: Financial importance of weaning after 4 or 5 weeks
- No. 760: Influence of feed on the texture of gastric content in finishers
- No. 761: Correlation between infection of respiratory diseases and gain in finishers
- No. 762: Mortality rates among weaned piglets before and after diagnosing PMWS
- No. 764: Drained floor in T pens without stalls for gestating sows

- No. 765: Drained floor in T pens with one feeding and resting stall per sow for gestating sows
- No. 766: Design of weaner pens with liquid feeding in short or long troughs
- No. 767: Green meal in finisher feed does not affect the frequency of gastric changes, productivity or colour of the fat
- No. 768: Coarsely ground meal feed – effect on ammonia and odour emissions
- No. 769: Diets for weaners
- No. 770: Shelf-life of semen doses
- No. 771: Accuracy of gestation scanning
- No. 772: Aviprox and Aviplus in feed for weaners
- No. 773: Foetal death in highly fertile sows
- No. 774: Mechanical stimulation of sows during service
- No. 775: Partial cleaning with the two-step Bovema S-air air purifier in a finisher facility
- No. 776: Bovema S-air two-step purifier investigated in a weaner facility during the summer
- No. 777: Oxytocin for nurse sows
- No. 778: Effect of zinc and organic acids on diarrhoea in the weaner period
- No. 779: 2.0 bn vs 1.5 bn sperm cells in mixed semen doses
- No. 780: Two vitamin D3 sources: 25-hydroxy vitamin D3 as an alternative to the traditional vitamin D3 source
- No. 781: Interrupted nursing increases feed intake immediately after weaning
- No. 782: 0, 80 and 100% organic feed for finishers
- No. 783: Effect of rubber mats on shoulder ulcers
- No. 784: Sows' behaviour and use of sloped lying wall and piglets' use of creep areas in farrowing pens for loose sows
- No. 785: Phase feeding of lactating sows
- No. 786: Single and double WTF
- No. 787: Commercial weaner diets purchased at Zealand in the winter 2006-2007
- No. 788: Vaccination against pneumonia and PRRS
- No. 789: EggsTend 88 in weaner feed

- No. 790: Spread of ammonia around a finisher facility
- No. 791: Energy Water in feed for weaners and finishers
- No. 792: The addition of peroxide to acidified slurry in a finisher facility with drained floors
- No. 793: The effect of a sow having functioned as a nurse sow
- No. 794: Longevity of sows as part of the breeding objective
- No. 795: Importance of breeding in production herds

Other information material

- Ten-point plan for handling of shoulder ulcers
- Use the hospital pen in time
- Ten-point plan for reduced sow mortality
- Guidelines for suitability for delivery

Note:

You can sign up for "News from Danish Pig Production" (only available in Danish) at www.dansksvineproduktion.dk and receive an e-mail with links to the latest publications. The InfoSvin database is available at www.infosvin.dk.



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