



ANNUAL REPORT

2010

Forward - how?

The economic crisis in 2008 hit farmers as well as banks, and investments in the pig industry have been scarce since.

In 2009, investments constituted one third of the regular level of DKK 3-4 billion a year, which is generally intolerable.

That is a shame because we are actually in quite a unique situation right now where prices on land are low and interest rates historically low. That ought to kick-start generational changes, structural development and new investments.

The young generation waiting to become independent must be given the chance now, and the older generation waiting to expand their production is also standing by.

There is a future for Danish pig production

A questionnaire made by PRC reveals that Danish sow producers overall expect to have more sows in 2013 than in 2010. They, at least, are optimistic.

The primary task right now is to convince banks that the pig industry is a sound investment object.

The prognoses for pork prices the next couple of years could be better, but for the best third of the pig producers, being a pig producer is a fairly good business.

Danish pig producers who wish to play a part in the future must keep the costs of producing one weaner and one finisher lower than the competitors.

- And we believe that is possible!

Number one in Europe

International comparisons reveal that Danish pig production is still extremely competitive compared to pig producers in other European countries. We have a very high – and increasing – level of productivity.

Our genetic work is at the top.

This ensures a high efficiency on Danish pig farms, but the increasing export of high-quality weaners and breeding stock constitutes a significant source of income in the Danish pig industry.

A good example is the drastically increasing demand from other countries for hybrid gilts, which benefits an increasing number of multipliers.

In terms of environment and animal welfare, Denmark is in the lead. Many consider it a problem that the 2013 requirement is not likely to be adhered to in all EU countries. However, it may be a marketing advantage that we are able to deliver a product that is produced under legal conditions.

All this indicates that the Danish pig industry will continue to be able to contribute positively to the Danish community, in particular in the outskirts of Denmark.

Growth in balance

Pig Research Centre works systematically on preparing the Danish pig industry for the future to ensure an economically stable industry that is in balance with society's expectations.

We have come a long way with recommendations and manuals for a modern and efficient pig industry, but we can still improve:

- Handling of 35 pigs/sow/year – and maybe more – is a huge challenge to be solved.
- We need to speed up finisher production and demonstrate the potential of a professional large-scale production.
- Genomic selection is a new big initiative in breeding that presents completely new possibilities.
- Animal welfare and our image still need improvement. Unfortunately, 2010 saw a few too many bad stories: bruises, high mortality rates, increasing antibiotic consumption. We can do better than that.

- Pens for group-housed gestating sows must be improved within the foreseeable future.
- The development of environmental technologies, in particular in terms of odour reduction, is far from finished and has not yet found its place and use on the pig farms.

Challenges are plenty for Pig Research Centre and our professional partners.

Thank you to all research institutes, companies and advisors, etc. who have contributed with their efforts this year. Thank you also to the EU's Rural Development Programme granting financial support to the work of Pig Research Centre.

Keep the faith

Thank you especially to the Danish pig producers for your continued support of the work of Pig Research Centre and for the display of optimism in spite of difficult conditions.

It is essential that everybody keep the faith and answer the question: Forward – how?

Best regards

Lindhart B. Nielsen / Nicolaj Nørgaard

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Organisation in Danish Agriculture and Food Council

Spring 2009 saw the formation of the new unit organisation Danish Agriculture and Food Council (DAFC). Danish Pig Production changed names to Pig Research Centre (PRC) and became a fully integrated entity legally and financially of DAFC at the merger.

The previous basis organisations Danish Bacon and Meat Council, Danish Agriculture and Danish Pig Producers' Association made an affiliation agreement thereby assuring the interests of Danish pig producers in the new organisation.

The departments of PRC have approx. 155 employees and will continue as a centre for research and development tasks related to the live pig.

Tasks and activities of PRC are defined by a sector board, 'DAFC Pig Production', consisting of 12 pig producers:

- 3 elected by the Primary Board, DAFC
- 3 elected by Slagteriforum, DAFC
- 3 elected by the three regions for the local pig production committees
- 3 elected by the Danish Pig Producers' Association.

The Sector Board, DAFC Pig Production, safeguards the interests of the primary pig production industry, and is responsible for:

- Managing the pig producers' joint funds originating from fees on genetic material, production fees, per mille funds amounting to approx. DKK 110 million used to benefit the pig industry.
- Prioritising and implementing national research, development and trial tasks.

DAFC Pig Production determines opinions and decisions on all matters relating to the live pig alone.

The chairman of DAFC and the manager of PRC are spokesmen professionally and politically on matters regarding the live

pig. Announcements are made in close co-operation with DAFC.

PRC communicates knowledge generated through trials including information activities and channels with a clear profile to the base (pig producers, local pig advisors, companies etc.) and society co-ordinated with the communication activities of DAFC.

PRC participates in DAFC's overall political safeguarding of interests to improve framework conditions for and acceptance of Danish pig production.

PRC ensures inputs in political debates and participates in review and preparation of hearing responses in producer-related issues towards Danish authorities, politicians and the EU.

PRC is represented on public committees for legislation and administration important to Danish pig production.

Strategy

The current strategy for Pig Research Centre is laid down for the period 2008-2013. When the strategy in DAFC was determined, PRC evaluated the process and pinpointed essential areas that PRC and DAFC should focus on:

- Competitiveness and growth in balance. PRC develops and demonstrates new production technologies that benefit Danish pig producers, improve animal welfare and reduce environmental impact.
- High level of technical quality and co-operation. PRC ensures that accumulation of knowledge and development tasks take place at an internationally high level in close co-operation with local pig advisors, public research institutes, private companies and other agricultural institutions – nationally as well as internationally.
- Implementation of knowledge in practice. The technical knowledge of PRC must be implemented in practice to safeguard the competitiveness of Danish pig producers. Demonstration projects are a quick method for practical implementation of knowledge in co-operation with local pig advisors and veterinarians. The know-how and services of PRC must be easily accessible to pig producers, advisors, veterinarians and companies.
- Positive framework conditions for the industry. Pig producers must be assured of the best possible framework conditions in co-operation with politicians and authorities to ensure continued development of Danish pig industry's competitiveness. DAFC and PRC must be visible in public debates and safeguard negotiation tasks with authorities and legislators. PRC participates in setting the agenda on opinions and political goals for the Danish pig industry.
- Increased acceptance by society. It is essential to have a clear strategy for communication with society – centrally as well as locally. The pig industry must meet society with pride and openness surrounding modern production methods and open up pig farms to pupils, opinion-formers, consumers etc.
- Clear animal welfare policy. PRC must have a strong and open profile in animal welfare matters and goals for the most important areas. The pig industry must appear credible to animal welfare organisations, politicians, authorities and consumers. There must be focus on increased market-driven development within animal welfare conditions adjusted to consumers' demand and will to pay for it.

- Prompt environmental legislation. Environmental legislation must be passed as quickly as possible so that pig producers will not have to hold back in terms of farm development. This includes schemes for reporting of changes to buildings, environmental approvals, limits for odour nuisances, etc. Improved reliability and a cost level that does not adversely affect Danish competitiveness are among the requirements.
- Responsible use of antibiotics and a high level of health on Danish pig farms. A high veterinary level is a central characteristic of Danish pig production. The aim is to keep the use of antibiotics at a low and responsible level, and it must at all times be guaranteed that Danish pork does not carry any risks for the consumer.
- DanBred in continued growth. PRC organises and leads the breeding work in DanBred. Structure, new breeding methods and breeding objectives must continuously be analysed and improved. Recent examples are genomic selection, the new DanBred strategy and introduction of fees on genetic material. A joint marketing strategy will be developed in the coming years, not least on the German market. Breeding objectives will be revised in the autumn 2013.

New activities in 2011

Development tasks under Pig Research Centre include a range of technical projects each supporting the overall goals.

The Board annually prioritises new projects within the budget from a range of proposals and wishes from pig producers, pig advisors, veterinarians, companies etc.

The projects of Pig Research Centre are to an increasing extent financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Fisheries and Agriculture.

In 2011, grants amounting to approx. DKK 20 million are expected.

For the budget year 2011, the following new projects were prioritised:

Animal welfare

“2013” problems – conversion of existing buildings
Large-scale farrowing pens for loose sows
Objective welfare parameters – real-time individual surveillance of the physical location of animals

Competitiveness

Organic male pigs
Loss of amino acids in liquid feed
Grinding
Liquid feed (no residue) or dry feed for weaners
Fat quality and iodine number
Optimum diets of the month
Survival of “difficult” piglets
New pen design of farrowing pens with sows in crates
Large pig houses and herds
Individual electronic identification with UHF
Inventory control – managing work efforts

Environment

Reliability of environmental technologies
Environment in service/gestation facilities
Optimisation of air cleaners in relation to pit ventilation
Reduced energy consumption
Technologies for climate control and climate studies

Health

Injection of vaccines without hypodermic needles
Ulcers in pigs
Umbilical hernia
Viral infections and respiratory disorders in finishers
Optimum use of antibiotics: Best Practice Manual, antibiotics in feed and water, antimicrobial resistance
Eradication for pleuropneumonia using fluoroquinolone

Dissemination of knowledge and Advice

Farms with no land

Farms and herd size

Denmark had 5,041 pig farms in 2009 according to Statistics Denmark. Of these, 547 are pure sow farms; 2,185 finisher farms and 2,054 are integrated farms with sows and finishers.

Herd size still increases significantly. In 2008, 41.8% of all finishers were housed on farms with an annual production of more than 5,000 pigs, and in 2009 this increased to 44.3%. In 2008, 61.6% of the sows were housed on farms with more than 500 sows – this increased to 67.7% in 2009.

Expectations of 2013

In 2001, the EU decided that all sows must be housed loose by 2013, giving the pig producers 12 years to adapt.

In Denmark, this legislation was introduced in 1998.

To form an impression of the situation in Denmark, Hatting-KS, the Danish Pig Producers' Association and Pig Research Centre forwarded questionnaires to all Danish sow farmers with more than 100 sows asking them about their expectations of 2013.

Almost 700 producers responded, and we

thank you for that.

The survey revealed that:

- 68% of all gestating sows are already housed loose
- 94% of the producers expect to continue production after 2013
- These 94% generally expect to increase their sow population by 14% in 2013
- Among the producers who have not yet converted their facilities, half have applied or are applying for new environmental approvals and just as many intend to use the scheme for reporting of changes.

This generally shows that Danish sow producers are optimistic and have faith in the future.

Pig Research Centre is working hard to get the reporting scheme finalised, and has reason to expect this will happen during the coming winter.

Pig Research Centre is also preparing a catalogue of ideas with proposals for converting existing gestation facilities to group-housing.

The situation in the EU

However, far from all European pig producers will be ready by 2013.

The EU Commission has confirmed that there will be no dispensations as that would distort competition for the pig producers who have implemented comprehensive changes to comply with legislation.

For the Danish pig producers and for sale of Danish pork, the EU Commission is sending an extremely important signal in saying that the requirements will not be loosened.

Another consequence will be pressure from large supermarket chains. They will not accept that pigs are produced under illegal conditions, and that will give the producers who comply with the rules a significant advantage on that market.

Production of pigs in Denmark

As shown in Figure 1, slaughterings in Denmark have dropped since 2004 and constituted 19.3 million in 2009 with a drastically increasing export of 7 million weaners. This export is expected to increase to 8 million in 2010.

Overall, the production of weaners has increased slightly by approx. half a million a year, and 27.6 million weaners were produced in 2009.

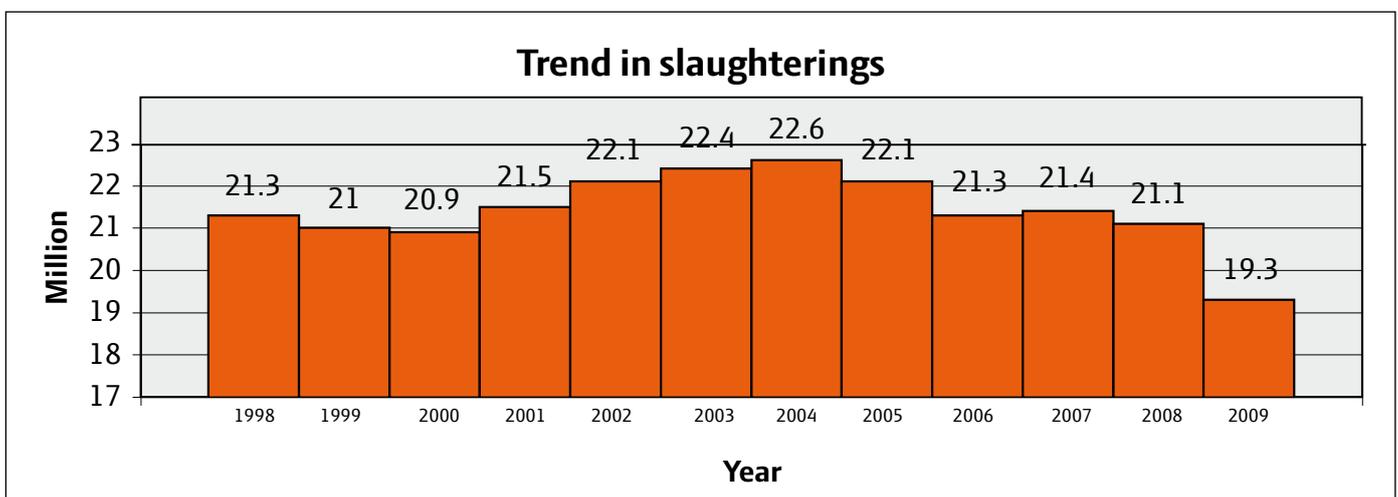


Figure 1. The trend in slaughterings includes co-operative slaughterhouses, private slaughterhouses, public abattoirs and private butchers in Denmark. Source: Statistics 2009, DAFC

Export of weaners

Since 2001, weaner prices have been averagely identical when exporting as when selling nationally, but there have been large fluctuations from year to year.

Despite largely identical prices, pig producers continue to export weaners as the possibilities for selling the animals in Denmark are inadequate. Over the last years, investments have not been made

Sows 2009	Top 25 %	50 % quantile	Bottom 25 %
Sows/year	660	588	477
Feed units per sow/year	1,522	1,532	1,529
1st parity litters, %	23.4	23.9	24.6
Liveborn/litter	14.8	14.2	13.6
Weaned/litter	13.0	12.2	11.4
Weaned per sow/year	29.9	27.6	24.8
Farrowing rate	89.1	86.8	82.8

The top 25% producers wean 5 pigs more than the bottom 25%.

Weaners	Top 25 %	50 % quantile	Bottom 25 %
Pigs produced/year	16,008	14,829	12,324
Daily gain, g	512	460	413
FCR/kg gain, feed units	1.79	1.93	2.10
Mortality	2.1	2.5	2.9
Weight/sold pig, kg	32.1	31.5	31.00

The top 25% producers have a production value that is 39% higher than that of the bottom 25%.

Finishers	Top 25 %	50 % quantile	Bottom 25 %
Pigs produced/year	7,034	6,542	5,427
Daily gain, g	974	902	812
FCR/kg gain, feed units	2.68	2.82	3.05
Av. slaughter weight	82.2	81.4	80.7
Av. lean meat %	60.2	60.3	60.1
Mortality	2.7	3.6	5.3
Rejected, %	0.3	0.3	0.4

The top 25% producers wean 5 pigs more than the bottom 25%.

in expanding the capacity of finisher place units required to produce the increase in weaners.

The production of weaners continues to increase. It is therefore necessary to establish more finisher place units, as export of weaners will otherwise continue to increase as weaner production increases.

Development in productivity

Danish sow farms wean averagely 27.6 pigs per sow/year (+14% since 2003), which is an annual increase of 0.5 pig the last seven years.

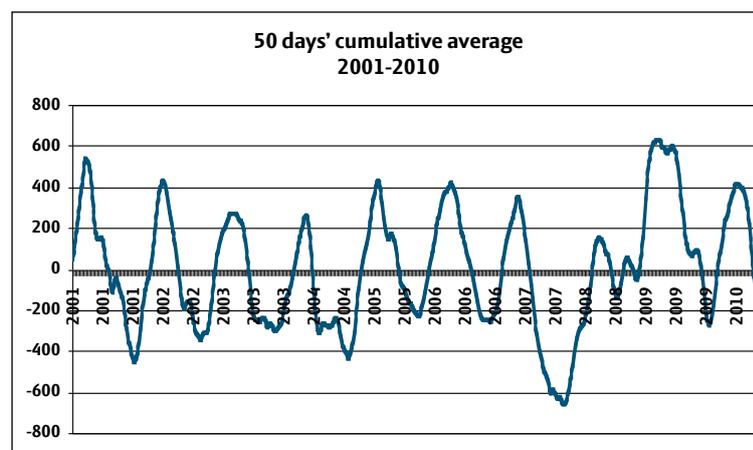
Since 2003, weaner producers have improved the feed conversion ratio by 0.05

feed units per kg, and daily gain by 37 g.

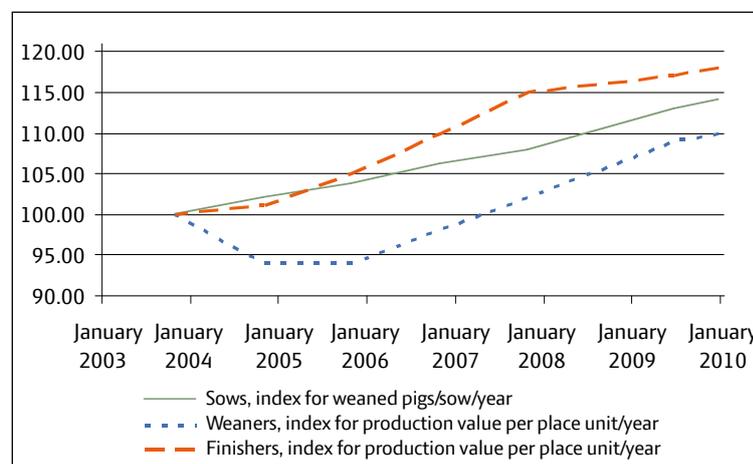
Since 2003, finisher producers have improved the feed conversion ratio by 0.06 feed units per kg; daily gain by 61 g and lean meat percentage by 0.02 percentage points.

Production results 2009

The tables comprise 666 sow farms with a total of 385,000 sows/year (35% of all sows); 545 weaner farms with a total production of 3.7 million weaners (26% of all weaners); and 849 finisher farms with a total production of 5.4 million finishers (28% of all finishers).



The increase in the export of weaner slowed in 2010.



Danish sow producers demonstrate an annual increase of 0.55 weaned pigs; feed conversion ratio among weaners and finishers improve by 0.01 feed units annually.

Operating result

Operating results for Danish pig producers improved in 2009, but are still too low. The development in operating results is shown in Figure 1, which shows that all groups had negative results in 2009, though the trend in negative results is now stopped. There is, however, still a long way to go before a balance is reached in the economy.

Recent prognoses reveal that weaner producers are expected to get a profit in 2010, while finisher producers still find it difficult to balance the economy. However, these calculations were made before the most recent increases in grain prices that have a negative impact on the average pig producer. However, this will depend on the self-sufficiency of the producer in grain, and this varies greatly between producers.

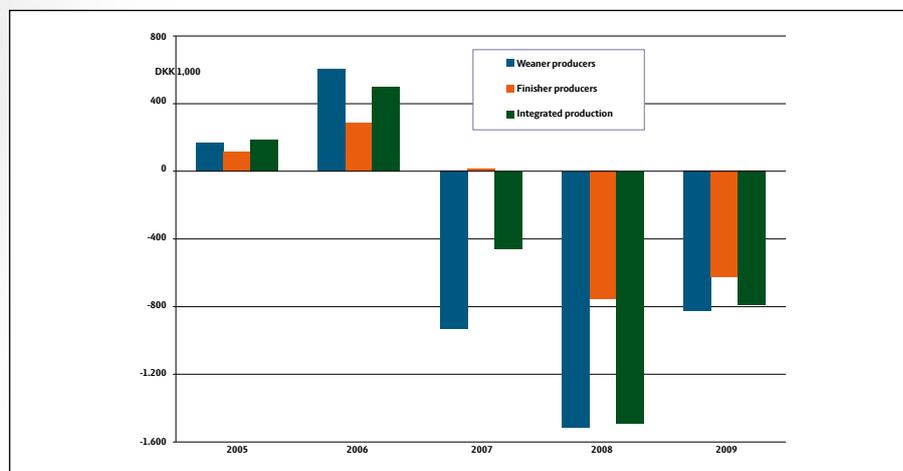
Large variations in results

Figures from 2009 reveal large variations in the results of Danish pig producers. The best make money, as shown in Table 1 that shows the profit of the best 25% in 2009.

Where the producers as an average had a negative operating result of more than minus DKK 0.5 million, the best 25% had a bottom line result of more than DKK 1

	Weaner prod.	Finisher prod.	Integrated prod.
Gross profit	6,194	3,948	5,551
Costs per unit	-3,244	-2,392	-3,060
Gross margin	2,951	1,556	2,491
Cash capacity costs	-1,456	-713	-1,159
Operational depreciation	-599	-178	-498
Result of primary operation	896	665	835
Decoupled direct EU aid	267	304	334
Financing costs	-725	-419	-693
Operating result	438	550	476

Table 1. Operating results in 2009 for the top 25% in each group.



Development in operating results for Danish pig producers, DKK 1,000.

million. However, there does not seem to be a correlation between a large production and operating result as the last years have demonstrated that earnings were not large enough to pay interest on production facilities. Many producers with new production facilities and large debts have had a low income the last years. Those with the least debt, and thereby the lowest financing costs, have managed best financially in the last years.

Economy – weaners

For 30 kg pigs, the expected 2010 gross margin will be DKK 130 per pig is expected versus DKK 136 in 2009. Accounts for 2009 demonstrate that gross margins varied from DKK 82 among the bottom 25% to DKK 177 among the 25% best of Danish weaner producers.

The result for a 30 kg pig in 2010 is expected to be minus DKK 27 when all costs have been paid. This is a slight improvement compared with 2009 figures of minus DKK 44 per pig. The improvement is attributed to decreasing capacity costs and interest.

Economy – finishers

The gross margin for finishers in 2010 is expected to be DKK 82 per pig versus DKK 100 in 2009. Accounts for 2009 demonstrate an average gross margin of DKK 91 varying from DKK 19 among

Result per 30 kg pig	2009	2010
Gross profit	328	338
Costs per unit	192	208
Gross margin	136	130
Cash capacity costs	93	86
Capital costs	87	71
Result	-44	-27

Result per finisher	2009	2010
Gross profit	400	405
Costs per unit	300	323
Gross margin	100	82
Cash capacity costs	52	49
Capital costs	82	67
Result	-34	-34

Result per 30 kg pig and per finisher.

the bottom 25% to DKK 150 among the 25% best of Danish finisher producers.

The result per finisher is expected to remain unchanged at minus DKK 34. Decreasing capacity costs and interest only compensate for the reduction in gross margin.

The project was financially supported by the EU and the Danish Ministry of Food, Agriculture and Fisheries.

Conditions

In analyses of the cost-effectiveness of a new finisher house, the most important conditions are:

- Pig prices
- Feed prices
- Production efficiency
- Investment per place unit

In the long run, pig prices and feed prices are expected to be fairly correlated. These two price categories are both decisive to the economy in finisher production. A realistic estimate of future pig prices can be obtained by analysing the trends over a long period of time - minimum 5 years and preferably 10 years. Since 2000, pig prices have averaged DKK 9.09 (excl. bonus payment), and on that basis the average pig price is set to DKK 9.60 (incl. adjustments and bonus payments). This is the expected pig price. If feed prices globally increase more than expected in the coming years, pig prices will adjust to the new cost level.

Terms of trade – feed/pig prices

For the last 20 years, terms of trade have averaged 7.8. If pig feed costs DKK 1, pig prices will be DKK 7.8 per kg.

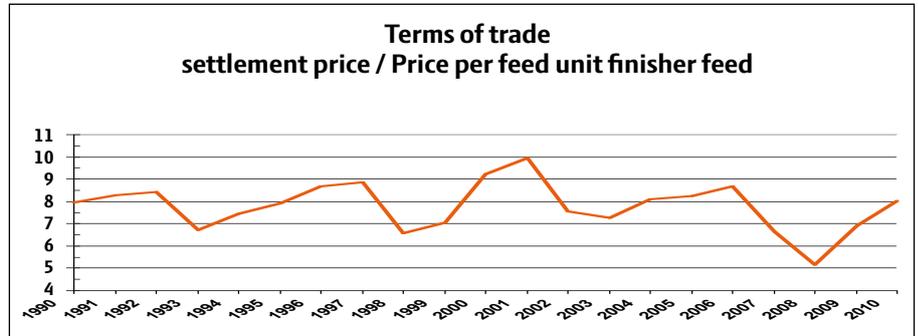
A pig price of DKK 9.60 will result in a feed price of $DKK\ 9.60 / 7.8 = DKK\ 1.23$ per feed unit.

Production efficiency

A new production facility must be reliable and economical in terms of labour, and meet environmental requirements. It must not be a limiting factor in achieving results that are among those of the 25% best in the national average. If higher production efficiency figures are being used, they should be documented by current figures. The national average is available at Pig Research Centre’s website. Below, an example is shown of how the cost-effectiveness of a new finisher house is calculated.

Basis:

- Price per place unit: DKK 2,720
- Pig price: DKK 9.00
- Settlement price: DKK 9.60



The figure shows the development in terms of trade between feed prices and pork prices.

- Feed price per feed unit: DKK 1.20
- Weaner price, delivered: DKK 366
- Interest: 5%
- Depreciation, equipment: 12.5 years
- Depreciation, buildings: 25 years
- Feed units per kg gain: 2.65
- Mortality: 2.5%
- operation/gross profit
- Rate of return = Result of primary operation/assets (invested capital)
- Break-even, settlement price, DKK/kg
- Break-even GM, DKK/pig

The price of a place unit expresses huge competition in the construction industry. The example is a pig house with 500 livestock units and air cleaning. All other conditions (medication, labour etc.) correspond to the Calculated Weaner Price.

Analysis of cost-effectiveness

	DKK/ sold pig
Sale of finishers	797
Purchase of weaners incl. delivery (1,025 pigs)	377
Gross profit	420
Costs per unit	271
GM	149
Cash capacity costs	56
Depreciation	36
Result of primary operation	57
Interest	30
Result	27

The table shows a gross margin of DKK 149 and a result per pig of DKK 27.

Key figures

Different projects are compared on the basis of their key figures. The most important key figures are

- Gross margin = GM/gross profit
- Net profit ratio = result of primary

Key figures for the project	
Repayment period	16
Break-even for pig price, DKK/kg	8.33
Break-even for settlement price, DKK/kg	8.93
Break-even GM, DKK/pig	122
Gross margin, %	35.5
Net profit ratio, %	13.6
Rate of return, year 1, %	6,7
Rate of return, annual, %	11.4

The table shows key figures characterising the project. The requirement for break-even settlement price is DKK 8.93/kg pork.

Averagely DKK 3,340 is tied per place unit in year 1. During the life of the pig house, DKK 1,940 is tied per place unit.

Surplus is realistic

The project is not sensitive to changes in interest and price per place unit. Productivity is important, but break-even GM can be achieved with the national average, i.e. mortality can increase by 1.1 percentage point; feed conversion ratio by 0.14 feed units per kg gain; and daily gain can drop by 70 g.

If the productivity is level with 25% of the best, investment in finisher production must be considered a fairly safe investment.

Genetic progress

The female breeds Landrace and Large White still show great progress in the trait "live pigs on day 5".

Progress in longevity averages approx. 0.02, which means that the likelihood of a sow being used in her second parity has increased by 2 percentage points.

Progress in FCR remains stable at approx. 0.028 for finishers, which is primarily attributed to progress for Duroc. An outline of all traits is provided in table 1.

Production level

This last year, 5,036 boars were performance-tested at Bøgildgård – of these 2,249 Duroc boars. More than 40,000 boars and 51,000 female pigs have been tested in the nucleus herds. Tables 2-3 show the average production levels.

As shown in table 5, Large White has 13.3 live pigs on day 5, and Landrace 11.8. The figures are based on the average of purebred litters used for breeding.

Breed	Year	Daily gain	FCR, -FUp/kg gain	Lean meat %	LP5	Conformation, points	Daily gain (0-30 kg), g/day	Killing out %	Longevity
		(30-100 kg), g/day							
Duroc	06/07	16	-0.042	0.23		0.01	2	-0.03	
	07/08	20	-0.039	0.13		0.05	4	0.02	
	08/09	20	-0.039	0.17		0.03	4	0.02	
	09/10	14	-0.051	0.2		0.02	1	-0.01	
Av.	4 years	17.5	-0.043	0.18		0.03	2.8	0.000	
Landrace	06/07	12	-0.035	0.01	0.45	0.04	1	-0.12	0.06
	07/08	6	-0.013	-0.05	0.43	0.02	0	-0.02	0.05
	08/09	-5	-0.003	-0.03	0.55	0	3	-0.02	0.02
	09/10	15	-0.022	0.04	0.39	0.02	1	0.06	0.03
Av.	4 years	7	-0.018	-0.01	0.46	0.02	1.3	-0.025	0.04
LargeWhite	06/07	-3	-0.005	0.04	0.55	0.02	1	0.05	-0.01
	07/08	1	0.004	-0.01	0.4	0.05	-1	-0.12	0
	08/09	-5	-0.002	0.04	0.45	0.02	2	0.02	0
	09/10	10	-0.029	0.07	0.34	0.07	1	-0.01	0.01
Av.	4 years	0.75	-0.008	0.04	0.44	0.04	0.8	-0.015	0.00
Av. 3 breeds	4 years	10.7	-0.028	0.10	0.45	0.03	1.9	-0.010	0.02

Table 1. Genetic progress for 2007-2010 for each trait and breed and an average of a D(LY) finisher.

Breed	Number	Daily gain, g* 0-30 kg	Daily gain, g* 30-100 kg	Lean meat %	Conformation, points	Scanning objective, mm.	Scanning weight, kg
Duroc	6,267	388	1084	61	2.91	7.6	95.7
Landrace	18,207	379	1013	62.3	2.95	8.3	93.7
LargeWhite	16,114	359	938	61.8	3.08	8.3	92.9
Total	40,588						

* Note that daily gain (30-100 kg) is calculated on the basis of weighing of live animals, ie. differences in killing out % between the breeds are not included.

Table 2. Nucleus herds - average production results for boars, 2009/10.

Breed	Number	Daily gain, g* 0-30 kg	Daily gain, g* 30-100 kg	Lean meat %	Conformation, points	Scanning objective, mm.	Scanning weight, kg
Duroc	8,065	392	1040	61.2	2.97	7.3	94.8
Landrace	23,181	382	1013	62.5	3.06	8	93.3
LargeWhite	19,914	361	901	61.6	3.16	8.6	92.8
Total	51,160						

* Note that daily gain (30-100 kg) is calculated on the basis of weighing of live animals, ie. differences in killing out % between the breeds are not included.

Table 3. Nucleus herds - average production results for young sows, 2009/10.

Breed	Number	Daily gain, g* 30-100 kg	FCR, FUp/kg gain	Lean meat %	Killing out %	Scanning objective, mm.
Duroc	2,249	1062	2.36	59.9	24.6	7.4
Landrace	1,396	1016	2.43	59.9	25.3	8.2
LargeWhite	1,391	935	2.43	60.7	24.8	8.4
Total	5,036					

Table 4. Average production results from performance test station Bøgildgård, 2009/10.

AI boars

Landrace and Large White boars at the AI stations are in production averagely 5.6 months and 5.2 months, respectively, whereas Duroc boars are in production averagely 10.8 months. Time in production for Duroc boars has thus increased by one month since last year. Despite longer time in production for Duroc, the average index for active Duroc boars has also increased slightly (see table 6).

Sale of semen

A total of 4,558,000 Duroc semen doses were sold in Denmark, which is a slight increase compared with last year. It is now also possible to sell Duroc semen to other countries and, as a result, 411,000 doses were sold abroad. The sale of Landrace and Large White semen in Denmark stagnated around 135,000 doses whereas the sale abroad doubled since last year.

Sale of breeding stock

The sale of purebred animals is generally dropping in Denmark, but increasing in foreign countries. In Denmark, the sale of purebred female animals has dropped from approx. 11,000 to approx. 6,000. However, the export of purebred females has increased, as shown in table 7.

This is also the case for hybrids where the sale of gilts in Denmark dropped slightly from 284,555 to 279,950 compared with last year. However, in that same period the export of hybrid gilts increased from 134,435 to 154,344. Consequently, the export of hybrid gilts constitutes one third of the total sale of hybrid gilts (see figure 1).

The total income from fees on genetic material currently amounts to DKK 59 million a year. These fees cover a large part of the trial activities of Pig Research Centre.

Maternal breed	Litter size	LP5	Per cent gilt litters
Landrace	15	11.8	55.2
Large White	15.9	13.3	59.6
Duroc	9.5	-	66.8

Table 5. Nucleus herds – litter size of purebred litters, 2009/10 (litters with code 100).

Breed	Boars transferred, i 2009/10	Active boars, August 2010	Index for active boars, August 2010	Months in production of boars departed in 2009/10
Landrace	635	317	122	5.6
Large White	808	375	120	5.2
Duroc	2375	2329	112.7	10.8

Table 6. Index and time in production of AI boars.

	Female pigs 2008/09 DK	Female pigs 2008/09 Export	Female pigs 2009/10 DK	Female pigs 2009/10 Export	Boars 2008/09 DK	Boars 2008/09 Export	Boars 2009/10 DK	Boars 2009/10 Export
Landrace	5,667	5,880	3,378	3,066	80	510	27	809
Large White	5,573	5,777	2,757	9,403	58	534	53	739
Duroc	58	62	6	411	1,149	1,285	1,058	2,145
Purebred	11,298	11,719	6,141	12,880	1,287	2,329	1,138	3,693
Purebred	23,017		19,021		3,616		4,831	
Hybrid	284,555	134,435	279,950	154,344	712	58	443	36
Hybrid	418,990		434,294		770		479	

Table 7. Sale totalled 446,393 animals in 2009/10 of which 33% were exported. In 2009/10, sale amounted to 458,625 animals of which 37% were exported. Besides the animals sold from Danish farms, 20,900 hybrid gilts were sold from DanBred Multiplication in foreign countries.

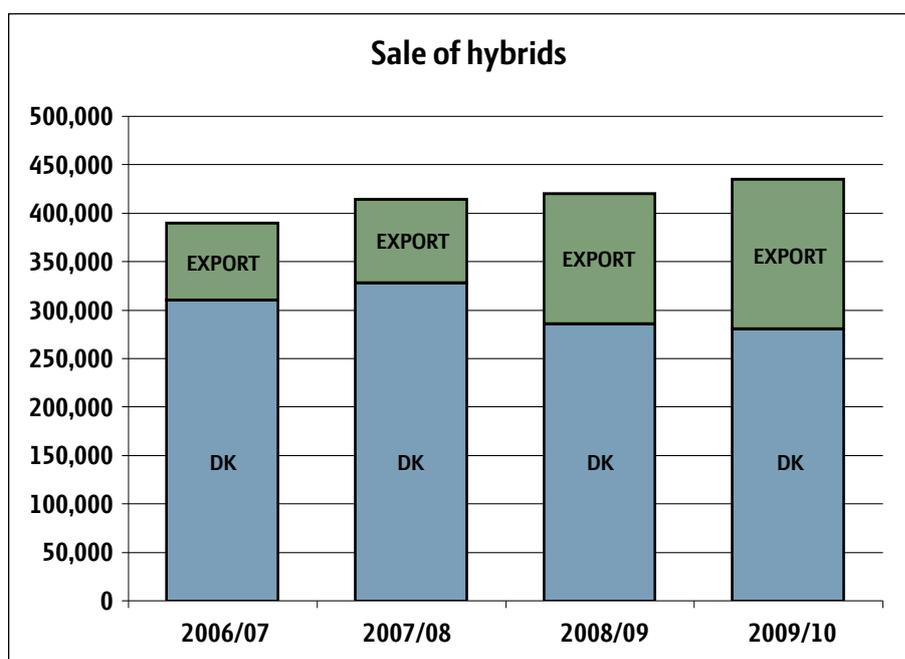


Figure 1. Sale of hybrids from Danish multiplication herds (July-year).

Genomic selection

With genomic selection it is possible to increase progress in breeding for all traits and at the same time reduce inbreeding. In practice, genomic selection means that the breeding value of an animal is determined through DNA testing, which is a great deal more accurate than previous methods.

The aim of the project "Genomic selection" is to obtain sufficient knowledge to be able to use genomic selection in pig breeding. The project is made in cooperation with The Faculty of Agricultural Sciences, Foulum, and is financially supported by the Innovation Act.

It is expected that genomic selection will be implemented in the genetic work with Duroc in October 2010.

Genomic selection in practice

A breeding system with genomic selection is not much different from a conventional breeding system.

Breeding stock will still need performance testing, and a conventional breeding value must be calculated. The breeding value is used for deciding which animals to DNA test since it is not financially possible to DNA test all animals. DNA testing also makes it possible to calculate a more accurate breeding value - a genomic breeding value - to be used for deciding if an animal will be used for breeding.

BREEDING SYSTEM WITH GENOMIC SELECTION

1. Testing of animals
2. Calculation of conv. breeding value
3. DNA testing
4. Calculation of genomic breeding value
5. Final decision in breeding

Only points 3 and 4 in the box above differ from a conventional breeding system, and researchers are therefore concentrating on the genomic breeding value and on selecting the right animals for DNA testing.

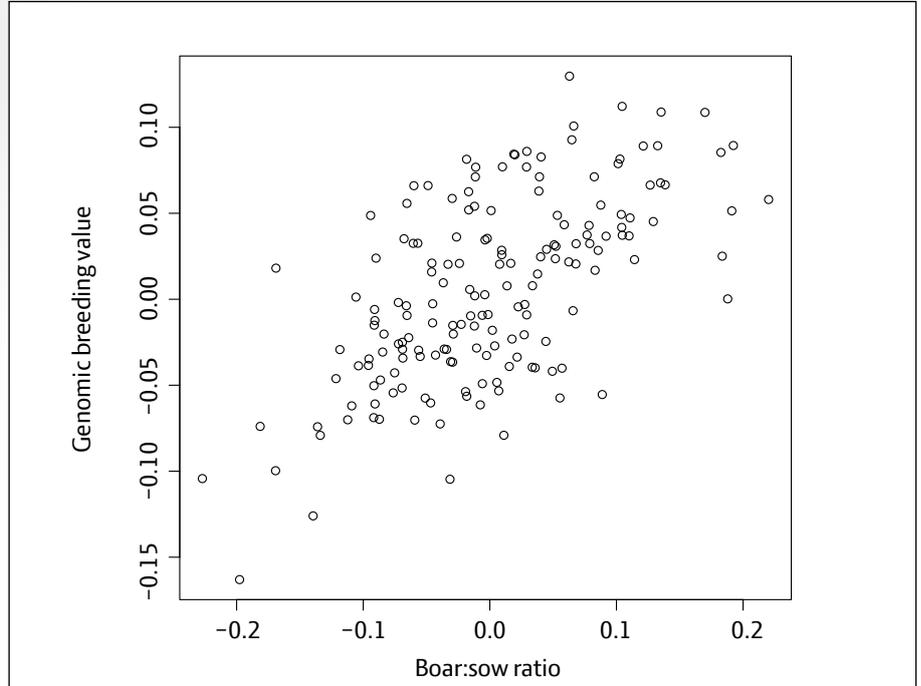


Figure 1. Correlation between breeding values and traditional breeding values of 170 young Landrace animals.

Genomic breeding value

The first analyses show that with genomic selection it is possible to calculate genomic breeding values that increase the accuracy of the breeding value at the time of selection. This paves the way for more accurate selection of breeding stock in the future.

Figure 1 demonstrates how the current breeding values for lean meat percentage in young animals can be predicted with genomic breeding values. The correlation must be evaluated in relation to the average of the parents' breeding values, which is the expected breeding value used for young animals today. With genomic breeding values, it will be possible to separate litter mates on the basis of a DNA test alone.

Genomic selection will affect all animals in the breeding system, but the greatest changes will be seen in DNA tested animals. The effect can be compared to the results obtained when testing for feed conversion at Bøgildgård. Just as an animal with good genetic traits will score the highest breeding value if tested at Bøgildgård,

an animal with good genetic traits will also score the highest breeding value when DNA tested.

In 2009, Pig Research Centre (PRC) started using a newly developed chip for DNA typing of the 2,000 best Duroc breeding stock used in breeding the last ten years. These animals now make it possible for us to implement genomic selection for Duroc.

Animals for DNA testing

It is possible to make genomic selection more efficient by carefully selecting which breeding candidates to DNA test. When a small percentage of the breeding candidates are DNA tested, we will achieve a large part of the genetic progress that would be obtained if all animals are DNA tested.

Genomic selection requires that the breeding candidates be DNA tested. The DNA tests are used for calculating accurate breeding values on these candidates. However, DNA testing is expensive (approx. DKK 1,000 per test), and it is therefore

not practically possible to test all breeding candidates (approx. 20,000 candidates per breed per year). Fortunately, it is not necessary to DNA test all candidates.

The results are based on the computer programme ADAM with which breeding strategies for pigs are evaluated through computerised simulation of our breeding system.

The potential genetic progress from genomic selection can be achieved by DNA testing a percentage of the breeding candidates (figure 2). When we implement genomic selection in the breeding system and pick breeding candidates for DNA testing on the basis of conventional breeding values, we will be able to achieve the full potential genetic progress by DNA testing only 40% of the breeding candidates. It is thus not possible to increase this progress by DNA testing more than 40% of the breeding candidates.

Approximately 80% of the progress can be achieved by DNA testing 20% of the breeding candidates, and 55% progress can be achieved by DNA testing only 5% of the candidates. It is therefore not necessary to DNA test more than 40% of the breeding candidates, and more than 50% of the progress can be achieved by DNA testing only 5% of the candidates.

The greatest genetic progress is achieved by DNA testing both sows and boars (figure 2). Progress can be increased by 7-15% by DNA testing boars as well as sows instead of only one gender. It is thereby profitable to DNA test both boars and sows in our breeding system.

We will achieve more genetic progress for the DNA tests by introducing selection strategies instead of picking breeding candidates solely on the basis of conventional breeding values. Preliminary results demonstrate that if we DNA test a small percentage of the breeding candidates and we use certain selection strategies for picking animals for testing, we will achieve even more of the potential progress from

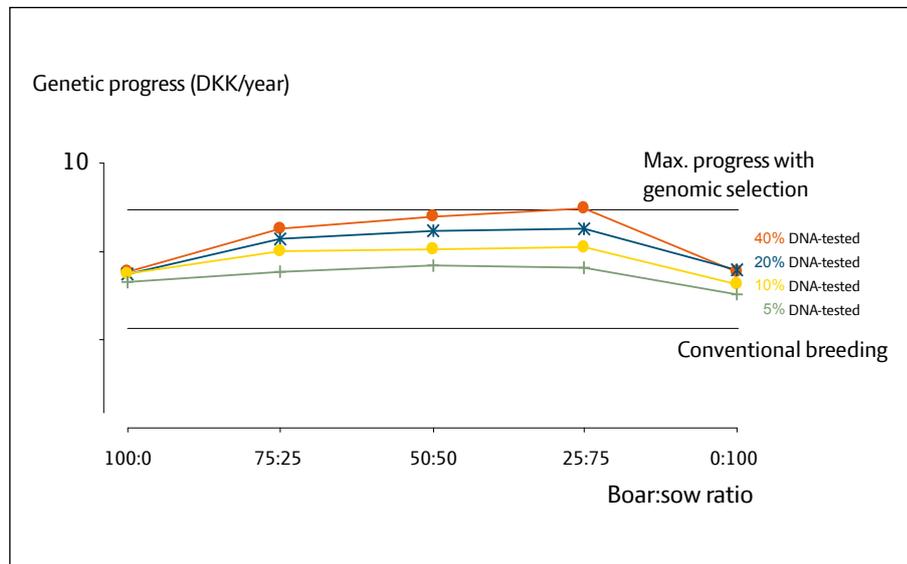


Figure 2. Expected genetic progress in the Danish breeding system with genomic selection where 5, 10, 20 and 40% of the breeding candidates were DNA tested. For each scenario, the DNA tests were separated according to gender. Genetic progress is presented in relation to the potential progress from genomic selection and progress from conventional breeding.

genomic selection. There is something to be gained from implementing selection strategies in our breeding system.

Perspectives

There is a great need for continued research as knowledge from other countries cannot be transferred directly to our breeds. With genomic selection it will become easier to breed for traits that previously were difficult to breed for. Examples of this are breeding for increased pH in meat after slaughter; improved longevity in sows; and improved maternal traits. However, to be able to include these traits in breeding, they must be measurable – either in nucleus herds or in commercial herds.

Pig Research Centre is currently compiling data on a large German sow farm with Danish LY sows with the aim of improving sow traits. Data is collected for, for instance, live pigs on day 5 (LP5), sow longevity and 14G, which is the trait for a sow's ability rear pigs. With 14G it is recorded how many piglets are weaned after placing 14 piglets with the sow within three days post-partum.

Genomic selection is expected to result in:

- Increased progress for existing traits
- Possibility for including new traits in the breeding objectives such as longevity and maternal traits – if these traits can be measured.

Project F4

Since 2003, pig breeding has centred on increasing the percentage of animals resistant to specific coli bacteria of the type F4 ab/ac. Selection for increased resistance to post-weaning diarrhoea runs parallel with the regular BLUP selection in Landrace, Large White and Duroc.

Boars that are relevant for breeding are F4 tested upon transfer to AI quarantine, ie. their F4 status is known when they enter the AI station. Sows for breeding are not subjected to F4 testing in principle. However, there is an economic advantage in testing boar mothers as it will thereby be possible indirectly to determine the F4 genotype of many boars. The siblings of the boars will also obtain known genotype, and as these sows are indeed the best sows of the breed, we will indirectly

obtain a fairly large gain as the daughters will also produce offspring of known genotype. Figure 3 shows the status for resistant performance-tested young animals.

Longevity of sows

The aim of the project on sow longevity is to develop new and more efficient methods for genetic evaluation of sows to improve their longevity, ie. their productive life.

The project includes:

- Improvement of the current methods for describing sow longevity through new statistical methods.
- Adjustment and expansion of genetic models for modelling of the time passing until a certain event occurs so that these models can be used for modelling of longevity in sows.
- Multivariate genetic models in which longevity is analysed in the same model as the other traits in the breeding objective to investigate how selection for improved longevity affects the other traits and vice versa.

Regardless of whether DNA based or traditional breeding methods will be used in the future, breeding for improved longevity in sows requires better recording and analysis of the sows' individual longevity, and longevity must be quantified as, for instance, the sow's age, the total number of pigs born or total number of litters.

Breeding against shoulder lesions

There has been a great deal of focus on shoulder lesions in sows over the last years. Danish pig producers are therefore highly interested in whether it is possible prevent shoulder lesions through breeding. To investigate this, comprehensive recordings are being made of sows on 9 commercial farms. The animals are of known origin, and kinship can be traced back to parents and grand parents.

In 2007-2009, the occurrence of shoulder lesions was recorded on LY or YL sows on these 9 commercial farms. A technician

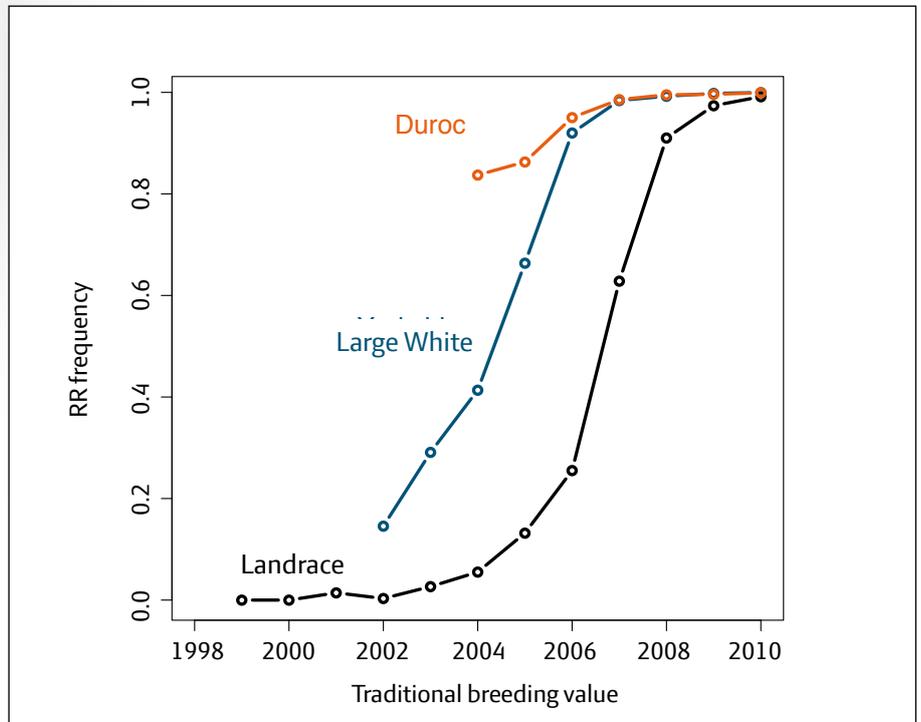


Figure 3. Annual average frequency of F4 Coli resistant performance-tested young animals in Duroc, Large White and Landrace nucleus populations, respectively.

from the Dept. of Breeding & Genetics visited the farms every week and recorded the diameter of lesions and visually evaluated the sows' body condition. Regardless of parity and age of the sows, the technician recorded shoulder lesions in the farrowing house. Body condition and shoulder lesions were scored at each visit, ie. data was recorded for each sow 4-5 times in each lactation period.

The final data was recorded in February 2010, and a total of 77,300 evaluations will have been recorded from approx. 17,091 lactation periods and from 8,790 individual sows. If a shoulder lesion is defined as a lesion of minimum 1 cm in diameter, lesions were recorded in any part of lactation in 20.1% of all 17,091 lactation periods. The probability of a sow developing a shoulder lesion between her first and last parity is 27.1%.

The material will now be genetically analysed. Genetic parameters for shoulder lesions will be calculated and the phe-

notypic correlation between shoulder lesions, body condition, herd and season will be calculated. If high heritability for shoulder lesions is established, it will be possible through selection to increase resistance to shoulder lesions in Danish pig production.

This is one of several projects on shoulder lesions under Pig Research Centre, and is financially supported by the Rural Development Programme under by the Danish Food Industry Agency.

Breeding for FCR

As opposed to, for instance, litter size, genetic progress in feed conversion ratio is difficult to measure and assess for the individual pig producer. There are several reasons for this; factors such as feed, feeding strategy, layout of the accommodation and recording methods must be identical over several years before it is possible to determine whether changes are attributed to genetic progress or to other factors. Seen on a year-to-year basis, only marginal

progress can be achieved through breeding. This is one of the reasons it is difficult to see the effect of breeding for feed conversion ratio in production herds, and why the subject is still being discussed.

Genetic progress is ensured by recording the feed conversion ratio of every single animal that is performance-tested at Bølgård. The genetic correlation between feed conversion ratio and the traits gain and lean meat percentage is also utilised.

To be able to document that breeding based on recordings of individual animals can be transferred to group level, the correlation between breeding values and the actual feed conversion ratio at group level is investigated. The most efficient way to do this is by recording the feed conversion ratio of purebred Landrace boars in a nucleus herd.

Compilation of data for the trial began at the end of 2007. The Landrace boars are weighed in the pens and feed consumption from each feeder is recorded. The final data was compiled in the autumn 2009.

Preliminary analyses demonstrate that breeding values for feed conversion are averagely dependent 1:1 with the feed conversion ratios actually recorded at pen level. There are, however, large variations as the recordings are based on pen averages.

Pigs and Health

In the project "Pigs and Health", the aim is twofold: partly to develop healthier pigs for meat production and partly to develop model pigs for medical research in human diseases. These are two separate projects that have nothing in common except for the pig and its genome. The project runs for four years (2007-2010) and has an overall budget of DKK 50 million of which the Danish National Advanced Technology Foundation funds half.

There are eight parties in the project: The Faculty of Life Sciences at Copenhagen

University; the Technical University of Denmark; Leo Pharma; PixieGene; Ellegaard Göttingen Minipigs; the Faculty of Health Sciences at Copenhagen University; and the Faculty of Agricultural Sciences at Aarhus University, and Pig Research Centre heading the management of the project.

In the project "Healthy Pigs", the aim is to identify the genes that affect production pigs' resistance to livestock diseases, primarily various types of respiratory disorders.

Parallel with the mapping of the pig genome, more than 10,000 pigs were followed from birth to slaughter in a comprehensive study. The pigs were reared under identical conditions, and disease, gain and other traits were recorded.

Currently, four regions in the genetic mass have been identified for pneumonia in pigs that seem to influence resistance to this type of disease. The genetic mass will now be analysed in detail to find the genes that trigger this resistance.

Preliminary results show that certain regions in the genetic mass affect pneumonia in pigs. In the final part of the project, this result will be verified by analysing DNA from fathers for lung recordings from 9,000 production pigs. If this turns out a success, pigs can be tested for these genes and it can thereby be guaranteed through breeding that the trait is passed on to future generations of pigs.

The result will be healthier pigs, lower consumption of medication and an improved economy in pig production.

The genes will be identified by scientists from Aarhus University, the Technical University of Denmark and Copenhagen University, while Pig Research Centre will conduct the practical testing of the effects in live pigs.

The other project, "Model Pigs", aims at improving human health. This project

concerns development of special model pigs for use in the pharmaceutical industry. Pigs are actually much more suitable for pharmaceutical trials than traditional experimental animals as pigs' organ development, physiology and metabolism have clear resemblances to those of humans.

The project focuses on developing model pigs for testing of treatment for, for instance, psoriasis, arteriosclerosis and Alzheimer's.

Several lines of cloned pigs that are likely to have genes that are sensitive to Alzheimer's and arteriosclerosis have now been made. Several sows are also pregnant with cloned psoriasis pigs of which the first were born in spring 2010. The cloned pigs that have been born will then be verified, ie. the pharmaceutical industry will test the pigs' suitability as experimental animals. The project is expected to end in 2011.

Research and development

All activities within AI research and development are co-financed by DanBred's AI stations. All projects are rooted in Pig Research Centre (PRC) and the AI stations through a joint management group that prioritises the projects.

Sale of semen

Sale of semen from DanBred's AI stations increased by 3.5% compared with 2008/2009 corresponding to approx. 95% of all matings being performed with semen purchased from an AI station. The basis of these figures is an estimated gilt and sow population of 1,082,000 in Denmark. The sale of semen the last five years is shown in Figure 1.

Sexing of semen

A new method for sexing of boar semen is the outcome of a joint venture with the Welsh company Ovasort Ltd. With this method, antibodies are used to bind sperm, i.e. sperm of one gender is bound to antibodies. It is thereby possible to separate sperm of different genders. At the end of 2010, PRC initiated a series of studies to investigate if it is practically possible to shift the balance between male and female piglets. If so, a commercial product that is easy and cheap to use at the AI stations on a daily basis will be developed. However, it must be emphasised that there is still a long way to go before this becomes a reality.

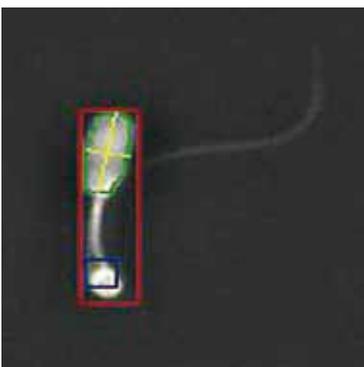


Figure 2. Sperm cell with bent tail.

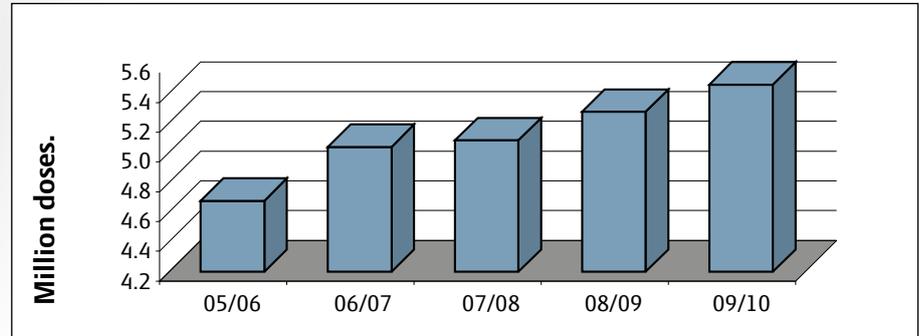


Figure 1. Sale of semen over the last 5 years.

Defect sperm

It is a well-known fact that fertility of sperm depends on the percentage of defect sperm in a dose (Report 0711). PRC is currently developing an instrument for recording of sperm defects (Figure 2). The instrument will quickly and objectively record the percentage of defect sperm in a dose. We expect to be able to analyse the capability of the instrument in the beginning of 2011.

Proteins in boar semen

Sperm consists of sperm and seminal plasma. Seminal plasma contains a variety of different substances believed to affect fertility. However, it has never been established which substances in semen affect fertility. PRC and the Swedish University of Agricultural Sciences (SLU) are currently co-operating on detecting substances that increase sperm fertility. Previous investigations demonstrated that the level of prostaglandin increased in the blood of the sow during insemination when diluted semen was used. Such an increase was not observed when raw semen was used for insemination. This increase in prostaglandin at insemination is undesirable.

The aim of the project with SLU is to detect the substance in sperm that inhibits the release of prostaglandin in the sow during insemination. When found, it will be possible to add this substance to sperm doses and thereby prevent increases in prostaglandin.

Quality control of L and Y sperm

Today, the shelf-life of boar semen is routinely analysed by subjective evaluation of sperm motility. Sperm motility is analysed three days after collection using a microscope. This method very much depends on the person using the microscope.

Together with the Danish AI stations, PRC is now implementing quality control procedures in which sperm motility of all Landrace and Large White boars will be analysed with the SpermVision CASA System. The system records a series of images of the sperm in a microscope, and sperm motility is analysed on the basis of these images. Thereby the shelf-life of sperm will be evaluated identically every single time, and it will be possible to rank boars according to sperm motility and, in the long run, reject boars on the basis of their rank. The new method will lead to a better sperm quality in general for Landrace and Large White in the future, and will hopefully contribute to reducing boar variance.

Reducing boar variance

Boar variance is the influence of the boar on litter size. Ideally, sperm ought not affect litter sizes if, that is, boars were unable to have reduced sperm quality. It has turned out that Large White boars are more often found to have reduced sperm quality than Landrace boars. Consequently, boar influence on litter sizes is greater than normally. This affects breed-

ing adversely as the sow is “punished” in index even though a low litter size may be attributed to a boar with reduced sperm quality.

In an attempt to reduce boar variance, sperm age is recorded in breeding and multiplier herds. With these recordings it will be possible to trace a mating back to a certain semen collection.

Recent analyses indicate that boar variance is lower when sperm is used on day 2 instead of day 3. It is not surprising that fresh semen is more fertile, but the benefit from fresh semen is probably greater if the boar is already suffering from reduced fertility. It is not yet clear whether part of the problems with reduced sperm quality for Large White is actually attributed to reduced shelf-life of the sperm.

Stimulation at service

A study demonstrated that it is not necessary to sit on, and thereby stimulate, the sow during insemination. However, it is essential to undertake a thorough oestrus detection that lasts approx. 1 minute. The study revealed that approx. 3-5 minutes can be saved per sow compared with previous recommendations according to which you had to sit on the sow during insemination.

The study was performed on four Danish production farms. All sows were subject to oestrus detection for approx. 1 minute according to the 5-point plan.

FIVE-POINT PLAN

- Apply pressure with a fist to the flank
- Grab and lift the inguinal fold
- Apply pressure with a fist under the genital opening
- Massage the corners of the sow's hips
- Sit on the sow (back pressure test)

The sows were subsequently inseminated; the semen doses for the trial sows were suspended above the sow with a clothes-



Lift in the inguinal fold during oestrus detection.

peg. It is important to ensure that the catheter is inserted correctly in the sow; when the inseminator does not sit on the sow, it is not noted if the semen backflows.

Quality control of AI stations

PRC routinely make unannounced audits of the Danish AI stations. These unannounced audits are described in the joint guidelines for AI stations (Guidelines for Breeding, Management and Biosecurity for AI stations). PRC routinely analyses semen doses with the self-audit programme used by the AI stations. The aim of the self-audit programme is to routinely check number of sperm per dose, whereas the unannounced audits ensure that the AI stations do not violate the guidelines when it comes to sperm per dose.

In September 2009, unannounced audits were made of Hatting AI departments in Horsens, Aalborg and Viborg. In Aalborg and Viborg, the rules were met for sperm content per dose. One semen dose from Horsens contained fewer motile sperm cells than the aim.

In December 2009, unannounced audits were made of Hatting AI departments Horsens, Ringsted, Viborg and Odense, Vestsjælland boar station and boar stations Mors 1 and 2. Results showed that all stations complied with the guidelines for sperm content.

Debate about phosphorus and phytase

Phosphorus and the use of phytase were debated frequently in 2010, and Pig Research Centre has implemented several activities on this area. Besides those described here, read more in the section on heat stability of different phytases on page 20 (Feeding of finishers).

New phosphorus digestibilities

In April 2010, phosphorus digestibilities were reduced for the following ingredients when phytase is added in increasing inclusion rates:

- Soybean meal and soy protein concentrates
- Rapeseed cake/meal and rape seed
- Sunflower meal/cake

In practice, this means that the safety margin is increased under high inclusion of phytase.

New phosphorus standard for finishers

The most recent trial with phosphorus for finishers (trial report 812) demonstrated that daily gain as well as feed conversion improved when the old standard for digestible phosphorus was exceeded. In April 2010, the standard for digestible phosphorus was raised from 2.4 to 2.5 g per feed unit.

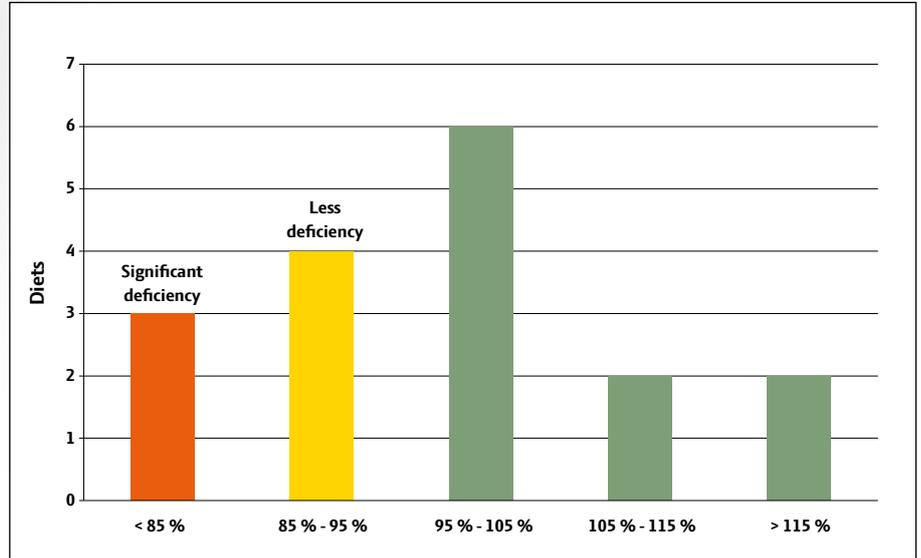


Figure 1. Content of digestible phosphorus compared with standards.

Phosphorus and zinc oxide

Foreign studies have demonstrated that a high zinc content in pig feed reduces the effect of phytase. It is therefore recommended to increase the standard for digestible phosphorus by 10% in feed for weaned piglets that includes zinc oxide prescribed by the herd veterinarian.

Suspected phosphorus deficiency

"Investigation of phytase and phosphorus levels in practice" is a project initiated in co-operation between veterinarians and

pig advisors. On farms experiencing leg problems; farrowing problems; tail biting or other behavioural problems, it was investigated whether the feed contained sufficient amounts of digestible phosphorus.

Seventeen diets from 14 pig farms were analysed for content of calcium and phosphorus and phytase activity. The content of digestible phosphorus in these diets is shown in Figure 1.

Analyses of the feed revealed that only three of these 17 diets had a content of digestible phosphorus significantly below the standard. Large variations in phytase activity were found as shown in Figure 2.

In several cases, deficiencies in digestible phosphorus were found not to be triggered by no or missing addition of phytase. The specific problems in those herds were in most cases related to other factors than phosphorus deficiency!

If phosphorus deficiencies are suspected, minimum three representative feed samples must be analysed of phosphorus and phytase activity before any conclusions are made.

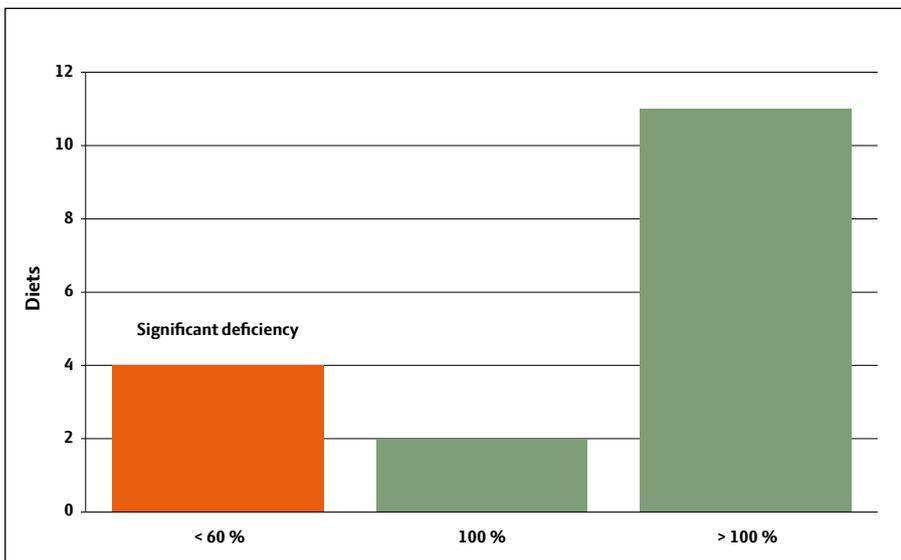


Figure 2. Recorded phytase activity compared with the intended activity.

Valine for weaners

Increasing inclusion rates of the amino acid valine in feed for weaners from 10 to 30 kg was studied in a trial to demonstrate whether the standard for valine is correct. The curvilinear correlation between increasing inclusion rates of valine and production value is shown in Figure 1.

The maximum production value from 10 to 20 kg was obtained with a valine percentage of lysine of 67% and of 65% from 10 to 30 kg. The new valine standard for weaners 6-9 kg is 7.4 and for weaners 9-30 kg 7.0 standard digestible valine per feed unit (trial report 881).

Rapeseed products for weaners

As part of an extensive project on rape products, three different types of rapeseed cake of Danish origin and two types of rapeseed meal of Polish and German origin were studied for weaners in the growth period 11-30 kg. All products were bought in Denmark and were compared with a control diet based on soybean meal.

There were no differences in production value between the groups. With German and Polish rapeseed meal there was a tendency to a lower production value of 6.4 and 7.5 below control, which is explained by a lower gain and a poorer feed conversion (Table 1).

	Control	Rapeseed cake			Rapeseed meal	
	Soybean	Scanola	Danraps	Emmelev	German	Polish
g/day	549	537	526	536	518	524
Feed units/day	1.03	1.00	0.98	1.01	0.98	1.02
Feed units/kg	1.87	1.86	1.87	1.88	1.91	1.95
Index	100	98	96	97	93	92

Table 1. Productivity and production value in the trial period 11.0-28.7 kg

The rape products contained different levels of glucosinolates: rapeseed cake had a higher content than rape seed meal. Rapeseed cake from Emmelev and the Polish and German rapeseed meal had a lower content of 4-hydroxy-glucobrassicin, which indicates that the products had been subject to strong heat-treatment reducing the content of glucosinolates. However, harmful break-down products formed.

Heat damage may also destroy amino acids, particularly lysine, and in general reduce productivity levels. The nutri-

ent content of the rape products varied greatly and this must be taken into consideration when formulating diets with rape products – simply using standard values is not enough (trial report 890).

Commercial diets

Commercial weaner diets selected by local pig advisors in Eastern Jutland were tested (2009/2010). The diets were bought from the following feedstuff producers (the obtained index for production value is written in parenthesis):

1. Control (100)
2. Aarhusegnens Andel (93)
3. DLG (103)
4. Hedegaard (104)
5. ATR (92)
6. Vestjyllands Andel (100)



Weaners can handle 15% rapeseed cake!



Weaners gained most on feed from Hedegaard.

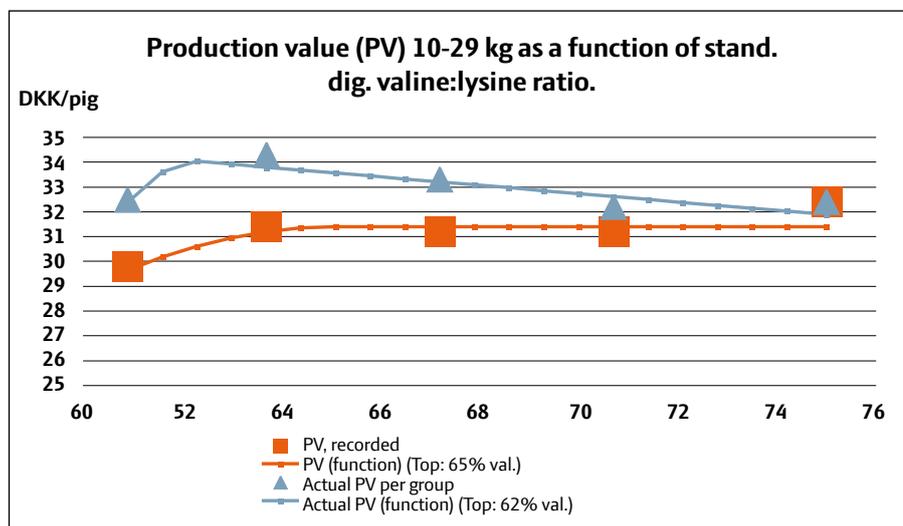


Figure 1. Correlation between valine content and production value.

The diet from Hedegaard resulted in a significantly better production value than the diets from ATR and Aarhusegnens Andel. There were no significant differences in production value between the other diets. If a pig producer uses the diet from Hedegaard, the diet can cost averagely DKK 22 and 23 more than the diets from ATR and Aarhusegnens Andel to reach the same production value (trial report 871).

Heat stability of enzymes

The heat stability of the phytases Ronozyme NP and Phyzyme XP and of the xylanases Ronozyme WX, Econase XT 25, Porzyme 9302 and Danisco Xylanase 8000 G was investigated at a trial facility where temperature and duration of pelleting and conditioning could be monitored thoroughly. The products were tested in the temperature interval 80-100 °C.

For both phytases and for the xylanases Ronozyme WX, Econase XT 25 and Danisco Xylanase 8000 G, more than 80% of the enzyme activity was preserved up to 95 °C. These products were comparable in terms of heat stability. Porzyme 9302 was less heat stable, and at 90 °C xylanase activity was reduced to half of the activity recorded at 80 °C.

Pelleting and conditioning conditions at feedmills normally do not exceed 95 °C and should therefore not cause problems for the activity of the tested enzymes with the exception of Porzyme 9302. In this trial, enzyme activity only illustrates heat stability and not the effect in the pig (trial report 875).

Porzyme 9302 and Ronozyme WX

Porzyme was previously tested with a positive outcome. Different inclusion rates were not tested at the same time, and Porzyme was never tested under Danish production conditions together with other corresponding xylanase products.

Porzyme 9302 and Ronozyme WX are therefore currently being investigated in different inclusion rates.

Zinc gluconate does not reduce tail biting

Tail biting is a common problem on many pig farms, and products are regularly marketed claiming to reduce tail biting. The effect of adding 500 g zinc gluconate per tonne finished feed was therefore investigated on a pig farm with a high prevalence of tail biting. The pigs given zinc gluconate in their feed were compared with

a control group that was not given zinc gluconate. The diets included 110 mg zinc per kg feed. The trial comprised 40 blocks and 1,439 pigs. No effect was found on tail biting of adding zinc gluconate.

Energy content in feed

The effect of four different levels of energy (102, 105, 108 and 110 feed units per 100 kg) with increasing wheat was investigated on one farm. The effect on productivity was recorded from 31 kg until slaughter at 109 kg.

The results revealed that the production values per place unit/year at the same price per feed unit were identical regardless of the energy content of the feed.

The production value per pig, where the increase in growth is not assigned a value, was also identical at increasing energy content despite a poorer feed conversion ratio and lean meat percentage.

This was partly explained by the fact that slaughter weight increased with increasing energy content. If the slaughter weight was identical in all groups, the production value per pig at the highest energy content (110 feed units per 100 kg) would probably have been lower. In herds where a higher gain is financially utilized in the form of a higher slaughter weight or more pigs produced, it may be beneficial to feed the pigs a high energy content.

When the prices of feed and finishers were included, the slightly better feed



The pigs do not pay for the extra energy.

conversion and lean meat percentage at 102 feed units per 100 kg was offset by a higher feed price, and there was no difference between the groups. The price per feed unit thereby determines the energy content, and the higher the price differences, the more movement towards a higher energy content.

An increase of the energy content of 1 feed unit per 100 kg in the interval 102-110 feed units per 100 kg feed with increasing wheat content resulted in an increase in daily gain of 6 g, a reduction in FCR of 0.01 feed unit per kg gain, and a reduction in lean meat percentage of 0.1 percentage units (trial report 865).

All projects were financially supported by the EU and the Rural Development Programme under the Danish Ministry Food, Agriculture and Fisheries.

Group	1	2	3	4
Feed units/100 kg feed	102	105	108	110
Slaughter weight, kg	82.0	83.0	83.1	83.9
Daily gain, g/day	894	917	929	942
Feed intake, FUgp/day	2.39	2.49	2.52	2.59
FCR, FUgp/kg gain	2.68	2.72	2.72	2.75
Lean meat%	60.8	60.4	60.5	60.2
Production value/pig at id. feed prices, index	100	99	99	98
Production value/place units/year at id. feed prices, index	100	100	101	100

Silos for mineral diets

Approximately half of all Danish pigs are fed feed mixed on-farm based on mineral compounds. However, trials have demonstrated that home-mixed dry feed may segregate considerably.

Segregation may also occur if the ingredients used are not identical in particle size and volume. Segregation of mineral diets may adversely affect the productivity as the pigs get more or fewer nutrients than they need.

Pig Research Centre (PRC) therefore investigated whether mineral diets segregate when stored in and used from big bags, polyester silos or fibreglass silos, respectively (Trial Report 869).

The results revealed that amino acids or minerals do segregate when stored in and used from big bags or polyester silos. However, the extent of segregation was not estimated to affect productivity. Segregation of amino acids or minerals was not observed when stored in fibreglass silos.



Segregation was observed in big bags and in polyester silos, whereas no segregation was observed in fibreglass silos.

Silo content – ETNA Tank

It is desirable to have a simple weighing system for silo control for routine monitoring of feed consumption. Leax A/S has developed a wireless recording system (ETNA Tank) for recording of silo content. A sensor is fitted on one of the silo legs, which means that the system can be used on all existing silos, and PRC therefore investigated the reliability and accuracy of the system (Report 1012).

The study revealed inadequate accuracy and reliability, and the way the system is operating today it cannot be used for routine monitoring of daily feed consumption and silo content.

The study indicated that the accuracy increased when sensors were fitted on all silo legs instead of on only one.



The ETNA tank system did not record silo content sufficiently accurately and reliably.

Energy content in feed

This season will see a new post on most accompanying feed notes: an I factor.

The I factor is used to check the feed units per kg of a diet, which simplifies the method for analysing FUGP/kg feed. This I factor will be used as a trial scheme until November 2011, and was introduced because of problems with the EFOSi analysis used when determining content of feed units.

Where energy content is declared, the accompanying notes for pig diets will include information on feed units as well as the new I factor replacing the EFOSi analysis when stating the content of feed units of a given diet. Until November 2011, PRC will continue to work on the problems related to EFOSi and determination of feed units in pig feed in co-operation with DAKOFO.

Standard values

PRC is routinely updating a feedstuff table that provides access to applicable and updated standard values for the ingredients typically used when formulating diets.

Most recently, in June 2010 (Brief 1019), phosphorus digestibility and chemical content for soybean meal and rape were updated. The inclusion of sodium was also revised for most feedstuffs.

Consequently, all diets formulated before May 2010 should be re-calculated to ensure that the nutrient standards are met and thereby ensure that the feed is not an obstacle to top results.

The above data and results are partly financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.

Fermented grain

During fermentation of grain, a microbial decomposition takes place of fibre in the grain, which increases the energy value of the grain. A digestibility trial with fermented barley and wheat revealed that the effect was greatest for fermentation of barley (trial report 873). This is probably due to the fact that barley has a higher content of fibre than wheat.

On the basis of the results of the digestibility trial, a finisher trial was conducted to investigate if the increased energy value during fermentation of grain was also found in a production trial.

Preliminary results indicate that in practice the energy value in fermented grain is half that found in the digestibility trial. This means that you can save 2-3% grain in a diet based on ½ barley and ½ wheat if the grain is fermented.

Cleaning and disinfection

Inadequate appetite among lactating sows given liquid feed is often correlated with the quality of the liquid feed. The micro organisms that are naturally present

in liquid feed may produce substances that change the taste of the feed when the feed ferments in the pipelines.

Some of the micro organisms in liquid feed may also trigger diseases such as diarrhoea, prolapsed rectum and intestinal haemorrhage, and are for these reasons unwanted in liquid feed. These pathogenic micro organisms are mainly coli bacteria, clostridia and mould fungus.

An investigation on four pig farms demonstrated that cleaning and disinfection of liquid feeding systems do not change the quality of the liquid feed if the feed does not have a significant population of pathogenic micro organisms.

For a long period, the four producers had been experiencing problems with low appetite among the sows, low weaning weight and diarrhoea among the piglets. Microbiological analyses of the feed reveal that it is unlikely that the quality of the liquid feed caused these problems.

On the basis of this investigation, it is not recommended to clean and disinfect



Liquid feed tanks must be cleaned on the inside to remove old feed, but it is not recommended to clean and disinfect the entire liquid feed system unless the liquid feed is of poor quality.

liquid feeding systems, including pipe lines, unless microbiological analyses reveal the liquid feed to be of poor quality. It is still recommended to clean liquid feed tanks approx. once a week to remove coatings of old feed.

Inoculation culture

Feed intake among weaners may be low on some farms with liquid feed – just as among lactating sows.

It was studied if the use of inoculation culture can increase feed intake. Lactic acid bacteria and yeast isolated from liquid feed in herds with a high feed intake were used as inoculation culture in a trial with weaners.

The result revealed no positive effect on feed intake and gain of adding inoculation culture to liquid feed.

The project was conducted in co-operation with the Faculty of Agricultural Sciences, Aarhus University, and the Faculty of Life Sciences, Copenhagen University.

The projects were financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries or received grants pursuant to the Innovation Act.



Energy value increases during fermentation of grain, and it is therefore expected to be possible to save 2-3% grain in the feed.

Stricter ammonia regulation

The Danish government is currently implementing the political initiatives of Green Growth.

Beginning January 1, 2011, ammonia regulations will be increased for vulnerable nature areas. Regulations for certain types of nature will by then be based on the total ammonia burden from livestock production as opposed to today when evaluations are based on the excess burden of ammonia resulting from planned extensions.

Natura 2000 nature

Ammonia regulations will be changed to a maximum total burden of 0.2-0.7 kg N/ha depending on the number of livestock farms in the proximity.

Large heaths and commons

Ammonia regulations will be changed to a maximum total burden of 1 kg N/ha (areas located outside Natura 2000 areas).

§ 3 areas and forests

Ammonia regulations will be changed to a maximum excess burden of 1 kg N/ha in nitrogen-sensitive nature types. Under current legislation, these types of nature areas are covered by a requirement for evaluation.

This will affect particularly livestock farms close to nitrogen-sensitive §3 nature and forests. When the quota of 1 kg N/ha is used up, there will be no more possibilities for development of the production facility in question.

If a producer extends his production by, for instance, 500 livestock units/finishers, the distance to §3 nature and forests must as a minimum be:

- 460 m with general BAT requirement
- 375 m with acidification

Consequently, some producers will be forced to set up parallel livestock sites instead of one site. This may make inroads into the effect of the new Agricultural Act.

Legislative requirements for animal welfare

In order to comply with legislative requirements for animal welfare, pig producers are now allowed to implement essential modifications to existing buildings without being required to apply for environmental approval.

As a main rule, the adaptation to legislative requirements for animal welfare must take place exclusively by replacing old equipment. Renovation of a pig house as such requires environmental approval.

2013: group-housed gestating sows

Examples of implementation of changes to a pig house to meet the requirements:

- Removal of all equipment in the facility
- Installation of pen partitions
- Replacement of a small percentage of the slatted floor area with drained floor elements
- 10-20% reduction in the number of sow place units as a consequence of increased space requirements for group-housed gestating sows.

A pig producer must not include existing buildings to compensate for reduced production capacity in the gestation facility.

2015: solid or drained floor

Before July 1, 2015, fully slatted floor in pig houses must be converted to solid or drained floor. There are several ways of doing this:

- Placing mats or boards in part of the pen to form a solid lying area
- Casting parts of the slatted floor in the pen
- Replacing and laying concrete elements with solid or drained floor in parts of the slatted floor area of the pen.

These changes will generally not release approval requirements as they are environmental improvements with no adverse consequences for neighbours, landscape or environment.

Changes to buildings

A series of schemes for reporting changes to production units is expected to be adapted in January 2011, whereby cases that have no environmental importance will no longer be included in the environmental approval procedure. Initially, the schemes are intended to concern manure storage facilities, silage locations and changes in certain types of animals if the number of livestock units is not increased.

It will furthermore be possible to make changes to buildings (including extensions of the pig houses) following animal welfare requirements. This is in particular interesting for sow producers as sows must be group-housed during gestation by 2013. The intention is that a pig producer can report made changes to his buildings within a certain framework without a new environmental approval being required. The environmental impact must remain unchanged, and the number of sows must therefore be reduced by 5% as changes in housing systems increase ammonia losses.

BAT standard conditions

The new BAT standard conditions are so clear and precise that applicants beforehand are able to read and assess the BAT requirements they need to comply with when applying for environmental approvals. This will simplify review processes for environmental approvals of livestock farms, which is a very positive development.

There is now generally a good technical balance in the handling of the BAT concept.

For more information on BAT, see page 24.

Total BAT costs amount to DKK 8-11 per produced pigs, distributed as follows:

Finishers: DKK 5-8 per pig
Weaners: DKK 1.30 per pig
Sows: DKK 50 per sow/year

Environmental approvals and BAT

The requirements for using the Best Available Technology (BAT) in pig feeding and housing when applying for an environmental approval have been surrounded by great deal of uncertainty. The Danish Environmental Protection Agency (EPA) therefore issued so-called BAT standard conditions for finishers, weaners and sows. For the evaluation of the standard BAT conditions, so-called Technology Sheets were made to provide technical and economic assessments of feeding principles and environmental technologies.

A Technology Sheet describes the mode of function of the technology in question; for which animals and in which housing systems the technology can be used; and what the environmental impact of the technology will be. Pig Research Centre (PRC) participated in making these sheets as the majority of the sheets are based on PRC trials of feeding and environmental technologies.

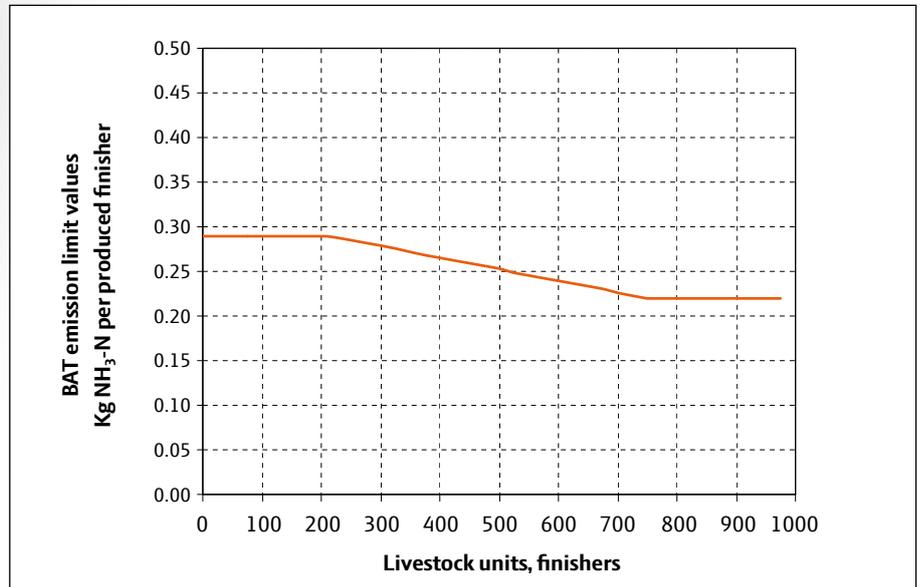
It takes BAT

Danish authorities have decided that a BAT assessment must be made for pig farms larger than 75 livestock units (LU), and that comprehensive BAT documentation must be made for pig farms larger than 250 LU (210 LU for finishers). BAT documentation includes:

- Management
- Feeding
- Layout of pig houses
- Water and energy consumption
- Storage, treatment and spreading of livestock manure.

If a technology meets political requirements for emission levels and level of costs, the technology is defined as BAT for that particular area.

In a process called 'proportionality assessment', the authorities assess whether BAT requirements have been met. This assessment ensures that the environmental requirements for the project are not more radical than necessary for the applicant based on an analysis of the environmental impact and costs brought on by the pro-



Guiding emission limit values for ammonia that can be obtained by using BAT on facilities with production of finishers (slurry-based housing systems). Source: The Danish Environmental Protection Agency.

ject. Furthermore, the technology must be obtainable for as many as possible; it must be so cost-efficient, reliable and practical that it can be implemented widely in livestock farming. This assessment is based on information in the new Technology Sheets, but a Technology Sheet does not make a technology BAT!

Economy

In the Technology Sheets, the economy of feeding technologies is based on the expected effect on gain, feed conversion, lean meat percentage and feed price. Only the effect of phosphorus on the feed price is included as in all scenarios it is expected that the standard for digestible phosphorus is met. The effect of protein levels below the standards is also described. Net economy is the overall effect of reduced productivity and lower feed prices when protein supply drops.

For technologies related to pig houses, the figures are based on analyses of the consumption of energy, water, consumables, costs related to changes in constructions, value of excess heat etc. For air cleaning and slurry treatment technologies, the figures presuppose that the pig producer signs an extended service contract. The

figures also include changes in the content and availability of nitrogen in the slurry.

Which technologies are included?

The EPA had a desire to assess both technologies that are already being used on pig farms today as well as a range of technologies that are either in development or where the effect is uncertain. For the technologies where sufficient documentation for environmental impact or reliability is unavailable an elucidation was made, which did not include economy calculations, but this can be filled in subsequently if the technology at some point is found to be sufficiently environmentally effective and reliable.

When is BAT ready?

Today, local authorities must assess whether BAT has been employed, but as of January 1, 2012, it is expected that emission levels for ammonia in BAT standard conditions will replace the general ammonia requirements in the environmental approval scheme.

For more information on BAT and Technology Sheets, visit the EPA's website (www.mst.dk).

Testing of environmental technology

Pig Research Centre (PRC) participates in the development and testing of environmental technologies used by pig producers to limit ammonia and odour emissions. The aim is to ensure that these technologies are efficient in terms of their environmental impact as well as the economy in using them.

A 'technology list' made by the Danish Environmental Protection Agency outlines the systems that have already been tested sufficiently (see the table), while PRC is continuously testing new products and technologies. A wide range of methods is available for reduction of ammonia emissions from pig houses whereas only few reduce odour emissions. Below, current investigations of new or improved environmental technologies are described.

Dorset air cleaner

Rotor A/S, a Danish ventilation company, markets a biological air cleaner from the Dutch company Dorset. The air cleaner is approved for use in the Netherlands and Germany, but foreign trials revealed that the consumption of water and the production of discharge water were too high for the air cleaner to be used on pig farms in Denmark.

The air cleaner was therefore modified and in 2009 set up on a Danish finisher farm where PRC tested its efficiency in reducing ammonia and odour over a year.

Data shows that both the consumption as well as the discharge of water were successfully reduced. The air cleaner also reduces emissions of both ammonia and odour under Danish production conditions. The results of the trial will be published in the autumn 2010.

Three-step air cleaner from SKOV A/S

For years, Danish pig producers have been using the Farm AirClean BIO system, a biological air cleaning system from SKOV A/S. Through trials, PRC has demonstrated

Technology list of the Danish Environmental Protection Agency of approved environmental technologies and their efficiency in reducing ammonia and odour emissions from pig houses.

Technology	NH ₃	Odour
Feeding		
Feeding efficiency	10-20 %	0
Reduced protein	15% if 10% less crude protein	0
Benzoic acid	1% per g/feed unit	0
Slurry technologies		
Cooling of slurry	30%	0
Acidification of slurry	70%	0
Air cleaning		
Air cleaning with acid	90%	0
Biological air cleaning	70%	30 %

that odour concentrations dropped by 30% in the summer and by 50% in the winter when ventilation air from pig houses was cleaned. Ammonia concentrations of 4-9 ppm were reduced to 1-2 ppm.

SKOV A/S has improved the system to increase the reduction in odour. The controller was optimised and the washing robot in the air cleaner modified. Furthermore, a third filter element was installed, ie. the air cleaner may consist of three vertical cellulose filters if large odour reductions are required. To ensure that all filters

are evenly loaded with air, a perforated air distribution board is fitted before the first filter element.

Recordings made in Germany in 2009 indicate that the air cleaner is improved in terms of odour reduction. PRC is now investigating the air cleaner to document the reduction in ammonia and odour and the costs of running the system on a Danish finisher farm.

Air cleaner from Munters A/S

In the summer 2009, PRC made a series of



Air cleaner with acid from Munters A/S.

preliminary recordings of an air cleaning system developed by Munters A/S (previously Turbovent) that demonstrated a 90% reduction in ammonia. The system was subsequently modified by Munters A/S, and is now ready for a comprehensive test. The aim is to document its efficiency in reducing ammonia emissions over a long period of time and the costs of running the system.

The air cleaner is constructed as a tube without filter elements. Nozzles at the bottom of the air cleaner sprinkle acidic water into the air stream whereby air is cleaned. A drip catch at the top of the system retains the acidic water in the air cleaner.

It remains to be clarified if acidic water is released with the exhaust air from such systems to potentially damage building parts. Part of the investigation of Munters' system thus concerns the amount of acidic water released from air cleaner to the surrounding environment.

Cooling of inlet air

Odour emissions from pig houses are highest in the summer when ventilation systems run on maximum performance. In an investigation of a ground cooling/heating system from the Dutch company INNO+, it was therefore determined whether ammonia and odour emissions could be reduced when the inlet air in a farrowing house was warmed or cooled, respectively, so that the ventilation rates in the housing unit varied less. Over a year, the system was capable of keeping the temperature of the inlet air to the farrowing house between 4.3 and 19.6 C° despite the fact the outdoor temperatures ranged from -4 to +32 C°.

Odour emissions from the trial facility generally tended to be lower in the summer. However, on the hottest summer days, odour emissions from the trial facility were 39% lower than from the control facility, which shows that cooling the inlet air may neutralize the release of very high odour emissions in warm weather. It was

not possible to record a significantly lower ammonia emission over an entire year.

Pit ventilation

Ammonia and odour originate from slurry, and PRC investigated if the majority of these substances can be collected in air that is emitted through pit ventilation. If so, a large reduction in ammonia and odour emissions from pig houses will be possible by cleaning this air with an efficient air cleaner.

It was studied how much odour and ammonia emission originates from pit ventilation and ceiling exhaust, respectively, at a pit ventilation capacity of 16 and 54 m³/h per pig place, respectively. The remaining ventilation air up to maximum output (100 m³/h) was emitted through the ceiling.

The results demonstrated that when 16 m³/h were sucked out through pit ventilation, 61% of the overall odour emissions and 70% of ammonia emissions from the pig house originated from the pit ventilation.

When 54 m³/h were sucked out through pit ventilation, 90% of odour emissions and 94% of ammonia emissions were collected in the pit ventilation. Here the overall emissions of both odour and ammonia from the pig house were significantly higher than during pit ventilation at 16 m³/h, and higher than expected. The most realistic way forward is therefore setting pit ventilation at approx. 10-20% of maximum capacity.

The working environment in the pig house was equally good with both settings evaluated on the basis of ammonia and odour concentrations in the room.

Frequent emptying of slurry pits

In 2009, PRC investigated whether it is possible to reduce odour emissions from pig houses with slurry systems by changing the frequency of emptying of the pits.

In a trial section, slurry was emptied once



Odour emissions may be reduced by frequently emptying slurry pits.

a week, whereas it was emptied in the control section when the pits were full (40 cm). In the period June-November, 50% lower odour emissions were recorded the day after the trial section was emptied compared with the control section. However, there was no significant difference in ammonia emission from the section regardless of emptying strategy.

The investigation is currently being repeated in the climate chambers at PRC's Experimental Station Grønholm where it is being studied for how long the reduced odour emissions last after emptying.

Acidification

Infarm A/S is the only company with a Technology Sheet on acidification of slurry with 65-70% reduction in ammonia emission from pig houses.

In the summer 2010, the company Jørgen Hyldgård Staldservice A/S installed its first acidification system on a finisher farm where PRC will test the system.

New trial facilities

At Experimental Station Grønhøj, Pig Research Centre (PRC) has designed four facilities for development and testing of new technologies before these are studied on commercial pig farms. The projects concern:

- Feeding
- Pit ventilation
- Handling and treatment of slurry
- Air cleaning

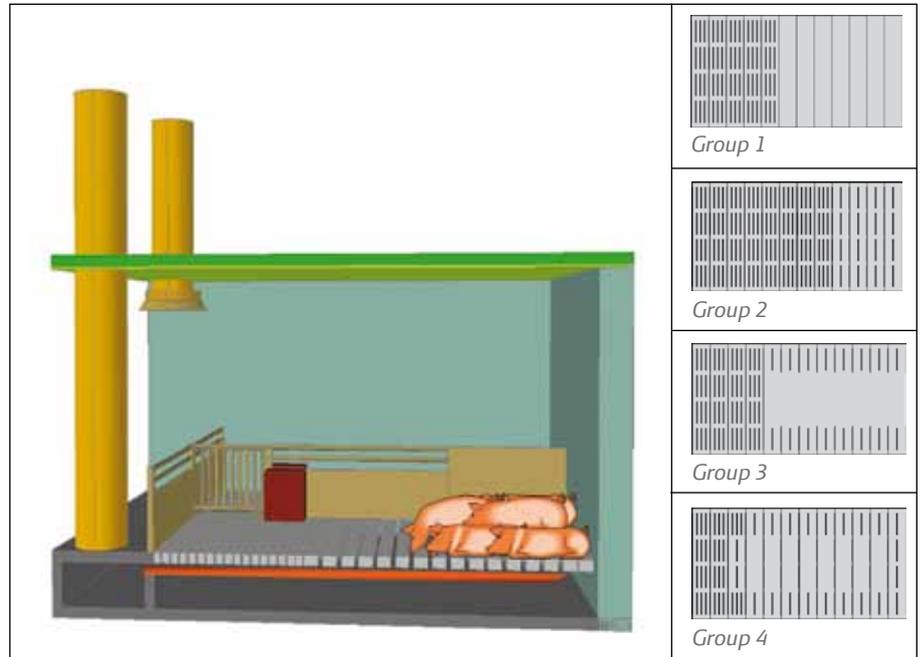
Feeding

Several of the most dominant odour compounds emitted from slurry contain sulphur. PRC therefore investigated the effect of reducing sulphur in pig feed to reduce the concentration of sulphur in slurry. In one trial group, the sulphur concentration was minimised, whereas in the other it was minimised and also fibre was added to the feed. Increased fibre content in pig feed supposedly increases the microbial activity in the large intestine and in slurry, and consequently potential odorants are incorporated into the biomass. The control feed was a traditional finisher diet. The investigation ran for two growth periods. The results from the first period revealed a moderate reduction in odour emissions that was not statistically significant, whereas the results from the other period revealed significant reductions. The investigation did not clearly demonstrate the effect of reducing sulphur in pig feed, and this is therefore still being investigated. The investigation was made in co-operation with Aarhus University and was financially supported by the Danish Ministry of Food, Agriculture and Fisheries under Action Plan for the Aquatic Environment 3.

On behalf of the Austrian company Delacon, the effect of their product Fresta® F Plus on ammonia emission was studied. Delacon had previously found a positive effect on ammonia concentrations when the product was added to feed. However, no effect was found on ammonia emissions at the trial facilities at Grønhøj.

Pit ventilation

In a series of investigations, pit ventilation, different types of flooring and different



Pit ventilation with suction points placed under the pigs' lying area improves ventilation efficiency as the natural air flow in the slurry pit is utilized in the process. In groups 3 and 4, the opening of the slatted floor was reduced by 40% compared with group 2 with traditional slatted floor.

positions of suction points were studied with the aim of developing pit ventilation for fully drained finisher pens. This will drastically improve the working environment and reduce costs related to air cleaning.

The results demonstrated that it is possible to collect the majority of ammonia, odour and hydrogen sulphide in a small part of the total ventilation capacity. A certain flow of air through the slatted floor is important to the efficiency of pit ventilation. Furthermore, placing the suction points below the pigs' lying areas instead of under the dunging area also markedly

increased the efficiency.

In 2010, full-scale pit ventilation will be investigated.

SmellFighter

In the summer 2009, a project financially supported by the Danish Food Industry Agency under the Innovation Act and with participation of BioAqua A/S, Infarm A/S and PRC was made on optimising the process of treating slurry with ozone and acid (the SmellFIGHTER).

Once a week, slurry was emptied from the pig house to a treatment facility where

Extract of results of recordings of ammonia and odour at a desired air output of 10 m³/h per pig with pit ventilation.

Gruppe	1. Partially solid floor		2. Drained floor		3. Specially drained, ventilation dunging area		4. Specially drained, ventilation lying area	
	Exhaust	Ceiling	Exhaust	Ceiling	Pit	Ceiling	Pit	Ceiling
Air output, m ³ /h/pig		57		52	10	49	10	48
Odour conc., OU ₂ /m ³		290		480	890	170	1230	200
Odour emission, OU ₂ /s per 1000 kg		66		99	31	33	47	38

it was mechanically separated. The thin fraction was treated with ozone and acidified with sulphuric acid to pH 5.5 before it was returned to the slurry pits of the pig house. Between the weekly emptying, it was necessary to separate and acidify the slurry once more to improve the effect on ammonia emissions. For two production batches in the period April-August 2009, a 40% reduction in odour and ammonia emissions was recorded from the climate chambers with slurry treatment, in comparison to the climate chambers in which the slurry pits were emptied approx. every 6 weeks.

In 2010, the process was optimised further to enhance the effect on ammonia and, consequently, slurry is now acidified six days a week and treated for odour during separation and ozonation once a week.

In the summer 2010, Pig Research Centre initiated an investigation of a full-scale SmellFIGHTER on a finisher farm.



Together with Saint-Gobain Weber, two air cleaning modules with LECA® as filter material are set up in a finisher section at Experimental Station Grønhøj. Reductions in odour and ammonia emissions in the trial modules will be recorded in 2011.

CEBONA

Pig Research Centre is participating in a joint venture on development of cost-efficient biofilters for reduction of odour from pig houses. The project includes detailed investigations of the way the physical characteristics of different filter materials affect chemical and biological processes and mechanisms essential to the elimination of sparingly soluble odorants. The aim is to improve the design of biofilters for livestock houses with emphasis on maximum elimination of pollutants and minimum energy for operation.

The project, which is supported by The Danish Council for Strategic Research, began in January 2009 and will run for four years. Aarhus University, Aalborg University, SKOV A/S and Saint-Gobain Weber are also involved in the project. The project is simply called CEBONA, which is an abbreviation of Cost-Effective Biofilter for Odour Nuisance Abatement for Intensive pig production.

LECA® as filter material

Together with Saint-Gobain Weber, PRC is



At Experimental Station Grønhøj, trial modules are set up for testing of different filter materials in the CEBONA project.

studying the use LECA® as filter material in biological air cleaners. The project is financially supported by the Ministry of Food, Agriculture and Fisheries under the Innovation Act.

The aim is to develop a LECA® filter module for biological air cleaning that reduces odour and ammonia emissions from pig houses with a minimum consumption of energy. Previous full-scale studies showed that LECA® is an efficient medium for air cleaning, but also that the potential of LECA® as filter material is highly dependent on an optimum filter design.

At Experimental Station Grønhøj, two air cleaning modules are installed with LECA® as filter material in a finisher section where odour and ammonia reductions will be recorded in 2011. The project will be completed by the beginning of 2012.

Trials

The project "Solid floor, no mess" investigated a series of technologies for reducing mess on solid floor in finisher pens. On ten farms, the following elements were investigated:

- Alternative air intake
- Stocking density
- High-pressure cooling
- Floor cooling
- Pit ventilation
- Demonstration: reduction of mess through enhanced climate controllers

Unacceptable level of mess

Because of large variations and pronounced problems with mess on some finisher farms, a cross-disciplinary analysis was made to determine the level acceptable pursuant to the requirements in the Animal Protection Act: "Pigs must have access to a physically and temperature-wise comfortable lying area that is sufficiently drained and clean, and where all animals can lie down at the same time". In practice, this means that pigs' lying area must be clean, and that fouling, if any, must be cleaned minimum once a day.

However, in some quarters of the year, on half of the farms 10-50% pens were observed with mess in the entire lying area, and this is unacceptable in terms of working environment and animal welfare.

It is therefore concluded that solid floor in the lying area is not a reliable solution for



Ceiling inlet over dunging area.

Mess, % of lying area	Control	Trial	
40 kg	4.6	1.9	ns
60 kg	11.5	6.2	***
90 kg	21.9	12.6	***

ns=not significant

***Statistically significant: P<0.001

all pig producers. In pens with solid floor, the producer must be prepared to make an extra, manual cleaning effort in periods.

Alternative air intake

Increased air flow in finishers' lying area in warm periods is one successful method for reduction of mess.

Several methods have been studied: ceiling fans, air led directly into the pen via pipes under the cover, and ceiling inlets where the air is led towards inspection alley and lying area, respectively.



Ceiling inlet over lying area.

Mess, % of lying area	Control	Trial	
40 kg	13.0	8.2	ns
60 kg	20.2	12.1	*
90 kg	30.8	17.8	**

ns=not significant

*Statistically significant: P<0.05

** Statistically significant: P<0.01

Ceiling fans were inefficient, which may be due to the fact that they just mix the air in the pig house. With the other three techniques, the alternative air intake comes from directly outside, and did reduce the extent of mess from around 60 kg already. The percentage of pens with pigs requiring treatments dropped by 39-45% regardless of whether the starting point was high or low.

Demonstration of climate controllers

Demonstration of enhanced climate controllers was the only one of the other techniques that reduced mess in the pens. The best recommendation for reducing mess is:

- Efficient drying of the pig house before transfer of pigs
- Climate management adjusted to the pigs' behaviour in this order:
 - o Adjust temperature in facility
 - o Increase sprinkling frequency
 - o Increase air flow in the lying area by using alternative air intake.

Per cent pens with mess in the entire lying area listed as an average of all groups in each of the ten herds. Recordings are divided according to the quarters in which they were made. Data for Herd 4 is not yet available, but is estimated to be level with herd 3.

Herd	1st quarter	2nd quarter	3rd quarter	4th quarter
1		26	16	8
2		22	23	24
3	1	0	8	4
4				
5			1	0
6	1	1	1	1
7	4	2	14	4
8	5	7	55	36
9		3	4	0
10		4	20	7

Biogas

Break-even analyses of biogas systems based on pure livestock manure revealed that the price of biogas produced on electricity should be raised from approx. DKK 0.76 to approx. DKK 1.10 per kWh.

Biogas and slurry

In Denmark, biogas systems receive slurry from livestock farmers, and they also collect the degassed biomass. Dry matter content of the slurry contributes slightly, but positively to the gas yield.

To obtain a sufficiently high gas yield, a range of purchased energy compounds, sludge and industrial waste are used. As a result, gas yield increases significantly compared to using slurry only.

However, the consequence of comprehensive extensions of the biogas sector based on livestock manure in Denmark would be that in particular pig slurry would need to be concentrated as biogas facilities based on 100% livestock manure will otherwise not be profitable.

Slurry separation

This may be solved through concentration of the dry matter content of slurry. In 2010, approx. 2% of all slurry was separated in Denmark.

Costs of slurry separation

There are many manufacturers of slurry separation systems. A system for a farm often costs approx. DKK 1 million, while unit costs can be kept at approx. DKK 6/tonne.

On a farm with 500 livestock units (LU), slurry separation will cost approx. DKK 18 per tonne slurry. Mobile decanters are now seen to be gaining ground.

They have a capacity of up to 100 tonnes/hour versus the capacity of farm systems of approx. 6 tonnes/hour. This may reduce the cost per tonne slurry slightly, particularly if the capacity is well utilized.

Slurry separation products

During slurry separation, the fibre fraction obtained may contain up to 30% of slurry N, but that is only 10% of the slurry's volume. For pig slurry, 75 kg artificial fertilizer N (N_{min}) is required to replace 100 kg N_{pig}. 100 kg N_{pig} in the liquid fraction can be replaced by approx. 88 kg N artificial fertilizer, while only 45 kg N_{min} is required to replace 100 kg N_{fibre}.

Advantages at sector level

As a result, the maximum limit for liquid fractions is 120 kg N/LU corresponding to 1.68 LU/ha. The overall harmony area remains the same, though, as the environmental impact of the fibre fraction is correspondingly higher.

When separating slurry, approx. 90% of the original slurry volume can be spread on approx. 60% of the harmony area of a pig farm. Assuming that the remaining 40% of the harmony area is located away from the farm, the overall costs for spreading of the liquid fraction and the fibre fraction will be somewhat lower than for spreading of slurry.

Transport of one tonne slurry 1 km costs

approx. DKK 1. If slurry separation costs DKK 18/tonne, the remaining 40% of the harmony area of a pig farm must be located more than 55 km away in order for slurry separation to be economically more attractive than regular slurry handling.

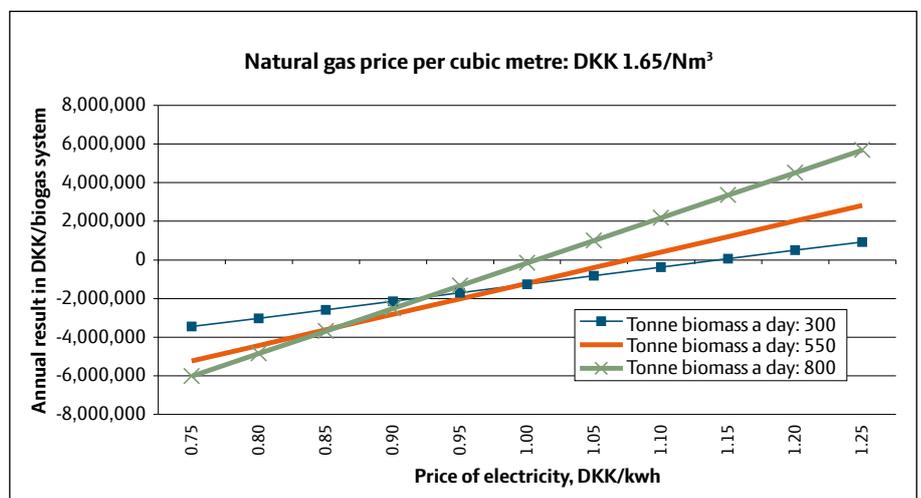
For the individual farm, however, the break-even distance may be somewhat smaller depending on slurry agreement etc. For most pig producers, slurry separation will increase costs for slurry handling.

Break-even analysis

The break-even analysis therefore assumed that the biogas systems pay the costs of slurry separation.

Approx. 17% of the biomass in the system must originate from fibre fractions corresponding to approx. 67% of the livestock manure lead to the biogas system having been separated on-farm.

The figure below illustrates the economy in biogas systems of three different sizes at varying electricity prices and a natural gas price of DKK 1.65 per Nm³ corresponding to the current gas price.



Group-housing before 2013

By January 1, 2013, all facilities for gestating sows and gilts must be designed for group-housing. Accommodating gilts and gestating sows in stalls will be legal until four weeks after service.

It is estimated that approx. 30% of the place units for gestating sows still need converting from stalls to group-housing. Though time is running out, satisfactory production results and a good level of animal welfare must be obtainable with the design of future facilities.

Renovation or new buildings

In many cases, existing facilities with stalls can be converted to group-housing within the current framework. However, each case must be reviewed by relevant professionals – see page 23 on environmental regulation.

New buildings are often chosen when a pig producer wishes to increase the number of sows in his production.

Feeding principle

Whether existing buildings are renovated or new ones built, it is essential to opt for a feeding principle and pen layout in which individual feeding of the sows is possible to be able to manage body condition.

Below, the challenges of different feeding principles are summarised.

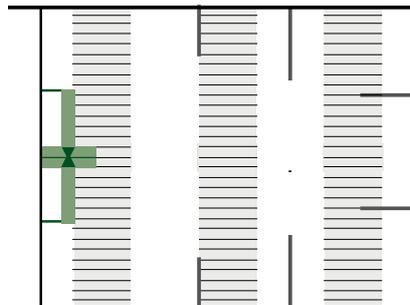
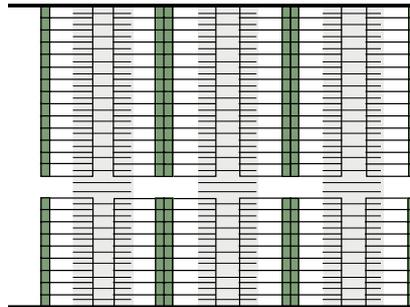
Electronic sow feeding

All sows must be assured of access to a feeding station and enough time to eat their ration; each station should therefore serve max. 65 sows (with more than one station per pen). Place the stations in locations with free access.

Gilts and sows can be fed individually with minimum four feed curves.

In stable groups, hierarchy will only have to be formed once and there will therefore be no need for separation of sows. Separation areas must allow for minimum 2 m² per sow. Alternatively,

spray-mark sows to be moved. Young gilts must be trained in a separate training pen designed as the gestation pens.



Example of a facility with stalls converted to group-housing and electronic sow feeding. The lying area has a large nesting box with bedding.

Feeding/resting stalls

The new batch of sows transferred each week should be distributed on several pens according to body condition so that the sows can be fed almost individually. It may also be necessary to feed some sows extra feed individually when liquid feed is used.

The stalls must comply with design recommendations (min. 65 cm wide (inside measurements) and min. 210 cm long (inside measurements from back of the trough)). The back gate guarantees that the sows can eat and rest in safety.

Establish drained floor in connection with the lying area, and fully slatted floor with sprinkling in the dunging area.

Floor feeding and long troughs

In some feeding principles, the sows are not fed individually, and they are there-

fore not recommended. If these principles are used, do not transfer sows to the pen until four weeks after service. Upon transfer, sort the sows into 2-3 groups according to body condition to minimise the risk of uneven body condition scores.

The recommended group size is approx. 15 sows. Approximately 10% additional place units are required for sows that need to be moved due to injuries or poor body condition score.

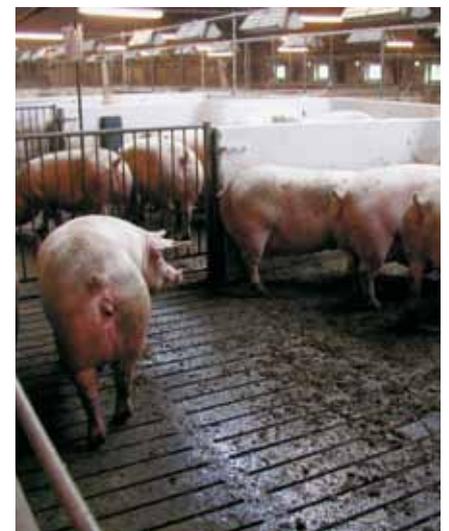
Feed the sows once a day when all sows in the pen are assured of access to the feed.

Particular for floor feeding:

- Feed is spread across the solid floor (1.3 m² per sow)
- The feeders must contain the entire feed ration
- Meal (and not pellets) is recommended as sows take longer to eat meal

Particular for liquid feeding in long troughs:

- Min. 50 cm trough space per sow
- The trough must hold the entire feed ration
- If there are two troughs in the pen, feed in both 'at the same time'



The challenge to floor feeding and feeding in long troughs is to ensure that the individual sow is able to eat the entire feed ration without stress.

Background

In 10-20 years, pig farms will consist of very large units. This in particular applies to sow farms that will accommodate 2,000-6,000 sows. For a pig producer to be able to maintain control of such a large production unit and maintain a sound economy, it is essential that logistics, daily management and herd health function as a unity.

Pig Research Centre has therefore initiated a project on future production systems. The result will be a report describing the structure of 2-3 large production facilities where consideration is made to logistics, infection protection, feeding, future animal welfare, environment and financial framework conditions.

Objective

Future production systems must be reliable in production and robust in terms of new diseases.

The systems must be flexible and be capable of handling productivity increases and variations in batch sizes and sales weight without jeopardising the flow of batch operation.

They must be economical in terms of labour and hold a high degree of automation to keep wage costs at an acceptable level.

The pig producer must be able to maintain control of the production as drops in productivity are often attributed to inadequate control and overview.

Stable level of health

A strong sow unit in terms of health with as high a level of immunity as possible is obtained by introducing and spreading herd diseases as much as possible in the herd. For growing animals (piglets, weaners and finishers), it is the other way round: ie. farrowing facilities, weaner facilities and finisher facilities must be run on an all in-all out basis. Variations in production must be handled on buffer and collecting sites, and not by moving pigs back in the system. Nurse litters are made by moving sows and not pigs between sections.

Flexibility

Flexibility can be achieved by, for instance, having several small sections, which will make it easier to make changes in weaning age, pool agreements and length of the pigs' stay in the farrowing facility without jeopardising batch operation. With this strategy, the producer can decide whether to keep the pigs in the farrowing facility 0, 2, 4 or 7 weeks post-weaning, and he will be more flexible in terms of buyers and extension of the production. Preliminary financial calculations demonstrate that weaning pigs in the farrowing house may be a financially interesting alternative to weaning and housing on a weaner facility.

Capacity costs of two sections of 340 place units will increase by DKK 1.50 per produced finisher compared with a section of 680 place units. This amount will likely be recovered by increased flexibility and improved options for pool agreements.

Economical

Sound logistics on a pig farm will reduce the work required for the individual tasks.

Alleys for transport of animals and staff must be wide as that will make moving of pigs faster; transport alleys between sections must be 1.6-1.8 m wide.

Pen sides and sections must be designed so that the majority of the washing is handled by washing robots. This makes supervision and moving of animals the two dominant tasks in future production systems.

Overview

Overview is maintained through planning of the work and staff management. It is important to split large tasks into smaller tasks and to communicate know-how directly to the staff by showing them what to do and involve new staff member in the tasks during their training.

A maximum batch size of, for instance, 100 sows and several batches a week will increase specialisation and will help the producer stay in control.

Herd management and recruitment of new employees will be handled increasingly by professional HR companies who will also handle supplementary training and wage fixing. The result is professional handling of HR matters, and the producer will not risk losing control.



Large production sites with many standardised buildings may be the future in Denmark as seen in the US.

Value in use

Rooting and enrichment materials must be of use to the pigs and be easy to handle in the pen.

Allocation is a challenge

The allocation of high-value rooting and enrichment material is a challenge in traditional finisher accommodation most slurry systems are unable to handle straw. Most systems can handle only very small amounts of straw on the floor, but straw is an excellent rooting and enrichment material because of the pigs' interest in the material.

Pig Research Centre (PRC) is therefore working on alternatives to straw and on developing cost-effective dispensers for materials that are practical in finisher pens with drained floor and that the pigs find interesting. The novelty value of the material and the flexibility of the dispensers in relation to choice of material are also elements included in the trial. The work will furthermore include inspiration obtained during visits to, for instance, the Netherlands.

Traditional materials

When traditional materials, such as wooden blocks on a chain, rope, wooden crosses, Bite-Rite, etc. are used, it is essential to keep the novelty value of the material in mind. Pigs will stay interested if the materials keep a certain novelty value. Experience shows that an outbreak of tail biting can be stopped successfully by giving the pigs a combination of materials when signs of incipient tail biting are observed.

Long straw or cut straw?

PRC is currently analysing data from a trial in which 100 g cut or long straw are supplied per pig/day. The results indicate that in pens with long straw the percentage of rooting behaviour directed against pen mates drops and that pigs spend more time occupied by the straw. The results also indicate that the consumption of straw varies according to the pigs' age, which is why it is not necessary to supply the same amount of straw throughout

the entire growth period to ensure permanent access.

There are many drawbacks to handling long straw in pens with slatted or drained floor as the pigs pull long straw onto the slatted floor. Long straw does not pass through the slats, but accumulates with faeces on the slatted floor. Straw that does pass through the slats may block the slurry system.

Frequent allocation of straw

By allocating straw several times a day, it is assumed that

- The straw will be available for a longer period of time
- The pigs will direct more behaviour towards the straw instead of towards pen mates
- The straw will become less dirty
- Less unused straw will pass into the slurry pit

PRC has therefore initiated a trial on two finisher farms where straw is allocated up to four times a day in amounts of 25-100 g per pig per day.

These activities are conducted in co-operation with The Faculty of Agricultural Sciences, Aarhus University. *The project was financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.*

Straw or sphagnum

A recent trial demonstrated that heat-treated sphagnum is just as good as straw as rooting and enrichment material for finishers. The difference between the two materials is that more sphagnum is required to ensure the same availability and it is much more expensive compared with straw.

Straw for sows in stalls

Together with the company JH Staldservice, PRC is investigating allocation frequency and minimum amount of straw required to ensure that sows in stalls have permanent access to rooting and enrichment material.

The investigation is being conducted on a farm with 800 sows. Preliminary results indicate that approx. 100 g per sow a day is required for the sows to be assured of permanent access. Gilts have slightly lower requirements. It is important to split the ration on several daily allocations to give the sows the highest benefit of the straw.



Automatic allocation of cut straw to sows in stalls with JH-ministrø from the company JH Staldservice.

Dry feed in feeders

In Denmark, we distinguish between rooting materials and enrichment materials. Both types of material must be available in pens in the form of one or more materials. Feed in tube feeders functions as a rooting material, but some type of enrichment is also required.

Tube feeders

With good tube feeders, pigs have access to fresh feed and feed wastage is kept to a minimum. The feed falls into the trough or onto the platform without coming into contact with the water. This reduces the risk of a build-up of clotted humid feed that may trigger growth of fungi and bacteria.



The trough is divided thereby preventing the feed area from filling with water if a pig is playing with the nipple drinker.

It must be easy for the pigs to use the feeders without getting injured. Good feeders are easy to operate and clean, and have a high durability.

Weaners

Pig Research Centre (PRC) is analysing data from a trial of tube feeders for weaners. The final results are available by the end of 2010.

The trial comprised the following five feeders:

- Ergomat XXL with shoulder partition, KJ Klimatechnik A/S
- FunkiMat, ACO-Funki A/S
- Maximat Weaner, Skiold A/S
- PigNic, Big Dutchman A/S
- Tube-O-Mat VI+ Jumbo, Egebjerg International A/S



With tube feeders made of transparent material it is easy to see if there is feed left in the feeder.

The trial was conducted at a weaner facility where the pigs were housed in double pens from 7 to 30 kg with 30-35 pigs in each of the two pens. The pigs were fed meal feed ad lib. The pigs were phase fed and were given three different diets during this period.

The production value or gross margin per pig was calculated on the basis of daily gain and feed conversion for each feeder. There was no significant difference in production value per pig.

However, in the evaluation of the function of the feeders, a number of differences were demonstrated:

- The risk of bridging
- Easy to clean and easy to check if the feeder is completely clean
- Durability

Finishers

PRC is currently testing tube feeders for finishers. Until autumn 2011, the following five feeders will be tested in terms of production value and functionality:

- ErgoMat, KJ. Klimatechnik A/S
- FunkiMat – finishers, ACO Funki A/S
- MaxiMat Porker, Skiold A/S

- Tube-O-Mat Top, Egebjerg International A/S
- Vissingmat 100 with platform, Sdr. Vissing Staldinventar A/S

Each feeder will be tested with minimum 26 batches of pigs before the average production value is calculated.

The test is conducted at a finisher facility where the pigs are housed in double pens from 30 to 100 kg with 34 pigs in each of the two pens. The pigs are fed meal ad lib.



A clear scale and a simple method for setting the feeder.

Pen types

There are two main types of farrowing pens for loose sows: Swing-side where the sow is accommodated in a crate, for instance around farrowing, and pens where the sow is loose from transfer to the farrowing unit and until weaning.

Swing-side

On one farm, Pig Research Centre (PRC) demonstrated that accommodating the sows in a crate before and during farrowing did not affect the number of live-born piglets compared with pens where the sows were loose before and during farrowing. Piglet mortality was significantly higher in pens where the sows were loose in the first days post-partum compared with pens where the sows were housed in a crate the first days post-partum. Opening of the crates on day 4 or day 7 did not affect piglet mortality (trial report 859).

Pens for loose farrowing sows

PRC recorded production results on several pig farms with both traditional farrowing crates and pens for loose farrowing and lactating sows. Sows with low piglet mortality (ie. 0 or 1 dead piglet) were found in both pen types. However, in the loose pens, the percentage of sows with high piglet mortality (two or more dead piglets during lactation) was higher than in the crates. As a result, the average piglet mortality was highest in pens with loose sows.

The activities of Pig Research Centre in this area are financially supported by the Danish Ministry of Food, Agriculture and Fisheries and the EU.

Thermal environment in the house and in the pen

PRC investigated the thermal environment in four sections with farrowing pens for loose sows. The results showed that in newly built facilities where the ventilation was dimensioned and designed according to the conditions, ventilation and pens functioned satisfactorily and lying behaviour of sows and piglets was correct. In renovated facilities previously designed with traditional farrowing crates, it was considerably more difficult to create an



Example of pens in an existing section – this poses huge requirements to management of thermal conditions.

optimum thermal environment for sow and piglets.

In 2010, a trial was conducted in a commercial herd of \pm heat in the solid floor - outside the creep area - during farrowing. Preliminary results indicate that piglets born in pens with floor heat had a higher weaning weight than piglets born in pens without floor heat.

Piglets' use of the creep area was also recorded in this trial. It seems that piglets in farrowing pens for loose sows stayed by the sow for minimum 24 hours after birth whereas the piglets in traditional farrowing crates largely used the creep areas. In pens with floor heating outside the creep area, the piglets remained outside the creep area for a longer timer compared with pens without floor heating.

Hygiene in pens

Several investigations indicate that approx. 80% of observed sows face away from the trough when defecating and urinating. It is therefore important that the floor by the trough is slatted and that



To maintain a high level of hygiene, you need slatted floor by the trough as sows often face away from their trough when defecating.

the dimensions of the pen (more than 2 m wide) encourage the sows to defecate in other places than on the solid floor or by the trough.



It is essential for the piglets milk intake and growth to have free access to the sow's udder.

Space by the udder

Trials have shown that sufficient space by the udder prolongs milk letdown, which increases piglet gain.

Management

PRC interviewed pig producers and their staff on farms with pens for loose farrowing sows. One focus area is prevention of illness.

If sows become sick during farrowing, the consequences will often be fatal for the litter as the piglets are very close to the sow the first days post-partum and thereby are at high risk of getting crushed. 'Best practice' in this area will be summarised in Fact Sheets supplementing Guidelines for Farrowing Facilities (for traditional farrowing crates). The Fact Sheets will be revised gradually as we gain more knowledge of and experience with loose farrowing sows. The updated Fact Sheets will be available for download at PRC's website.

2013

Pig producers who are building new premises before 2013 – and increasing the number of farrowing pens – should consider whether the traditional farrowing pens can be designed in such a way that they can be used for loose sows at a later point. However, there are no easy solutions. If the pig house is designed with full slurry pit and diffuse ventilation, it may subsequently be converted to loose housing, but this involves considerable changes and investments.



DANISH Production Standard

By the end of 2010, all Danish pig producers had had their first DANISH audit. Round two of the audits began in the autumn 2010.

In round two, the management group behind the DANISH scheme adopted a range of tightenings. Non-compliances observed at the first audit that have still not been rectified will result in a new audit. This applies within several areas such as:

- Rooting and enrichment materials
- Insufficient hospital pens
- Alarm systems
- Tails docked too short
- Sick/injured pigs not accommodated in hospital pen

		Less good husbandry practice	Satisfactory husbandry practice	Good husbandry practice
Annual audits	Farms with sows and weaners (7 til 30 kg)	12/year	12/year	9/year
	Farms with finishers	6/year	6/year	4/year
Public welfare audits		50 %	> 5 %	≤ 5 %

Minimum annual audits and risk of public welfare audits correlated to husbandry practice and farm.

It is thus crucial to inspect all sections on the site routinely to ensure that statutory requirements are fulfilled. It is furthermore extremely important that all pig producers ensure correct recording of data on production size, sales agreements and moving of pigs in the CHR register.

New animal health advice

New regulations for Health Advice Agreements (HAA) on pig farms came into force on July 1, 2010. Pig producers with productions of more than 300 sows, gilts or boars, 3,000 finishers or 6,000 weaners are now obliged to sign an HHA with a vet. Producers with fewer pigs also need an HHA if they wish to keep drugs for treatment of animals on-farm. It is still possible for them to sign up for the scheme for free.

All pig producers with an HHA are assigned to one of three categories:

- Good husbandry practice
- Satisfactory husbandry practice
- Less good husbandry practice

The group determines the number of health audits required. It will also affect the risk of being selected for public welfare audits.

For pig producers wishing to be able to administer medical treatment (as previously), the minimum number of annual health audits is shown in the table.

Limit values and yellow card

As part of the Welfare Agreement, the Danish Veterinary and Food Administration laid down limit values for antibiotic use and mortality rates. In 2011, limit values for shoulder lesions will also be determined.

The objective of limit values is for the individual farmer and veterinarian to be able to benchmark a farm with other farms.

At the turn of the year, several pig producers received a yellow card from the Danish authorities as their use of antibiotics was too high. Together with the herd veterinarian, they must prepare an action plan on how to reduce the use of antibiotics.

Together with several pig advisors, Pig Research Centre is writing a 'Best Practice Manual' that will serve as a tool for preparing such an action plan.

Limit values for antibiotics and mortality rates are found at the Danish Veterinary and Food Administration's website www.fvst.dk.



Examination of a shoulder lesion



Self-auditing of animal welfare

In the future, all pig producers with a Health Advice Agreement will be required to comply with rules on self-auditing of animal welfare conditions. The aim is routinely to ensure that pig producers comply with animal welfare legislation.

For the self-audit programme to be as efficient as possible for the individual producer and veterinarian, Pig Research Centre (PRC) has made ‘a basic package’ containing the following elements:

- ‘Self-audit Scheme for animal welfare on Danish pig farms’, which is a step by step analysis of current legislation and the requirements and recommendations of the industry on animal welfare.
- The form ‘On-farm self-audit programme’, which illustrates the elements the self-audit programme on the farm.

The publication ‘Self-audit Scheme for animal welfare on Danish pig farms’ is approved by the Danish Veterinary and Food Administration and fulfils the minimum requirements for self-auditing.

Consequently, the self-auditing procedures on a pig farm must as a minimum fulfil the obligations for documentation

described in the section “Requirements for documentation” in each Appendix in the publication. This applies regardless of whether the pig producer uses the PRC publication or makes his own self-audit programme.

Pig producers can download materials such as forms for practical implementation of the requirements for documentation and additional descriptions of various procedures to adapt and update their self-audit programme. The material is available for download at PRC’s website www.vsp.lf.dk. The publication ‘Self-audit Scheme for animal welfare on Danish pig farms’ is also available in English and Russian for pig producers employing foreign labour.

The practising veterinarian audits the self-audit programme of a pig farm annually when providing health advice on-farm.

If, during an audit or another inspection, non-compliances in terms of welfare are observed, the pig producer and his veterinarian must prepare an action plan documenting how to rectify this. An action plan may contain several rectifying measures including specialised advice from construction companies or pig advisors.

In 2011, a veterinary mobile unit under the Danish Veterinary and Food Administration is expected to start randomly examining vet audits of Danish pig farms.

Cross-compliance

Cross-compliance regulations greatly influence whether a pig producer is eligible for full agriculture aid.

There is a total of 28 welfare requirements for pigs all deeply rooted in EU legislation. Specific Danish statutory requirements are not covered by cross-compliance.

Auditing

Cross-compliance audits are not independent audits, but are performed in connection with existing public audits.

For instance, animal welfare audits are handled by auditors from the Danish Plant Directorate/Danish Veterinary and Food Administration in connection with the 5% audits.

It should be noted that non-compliances observed at the public audits will be reported to the Danish Food Industry Agency and may result in sanctions. This also applies to, for instance, non-compliances observed at the 5% welfare audits and reports made to the local police at the public meat inspections at Danish slaughterhouses.

New leaflet

Cross-compliance audits are complex, and it is difficult to grasp the process from audit to possible sanctions. A new leaflet containing guidelines on, for instance, how to handle the process if the authorities observe cross-compliances has therefore been published. The leaflet can be downloaded from PRC’s website www.vsp.lf.dk.



Dedicated effort

In January 2008, Pig Research Centre (PRC) initiated a project called Sow Life aimed at reducing sow mortality rates on 17 Danish sow farms.

In a dedicated campaign, pig advisors, veterinarians and PRC representatives together visited 17 sow farms. Specific advice was given to the pig producers on what to do on their farm to reduce mortality rates. On all 17 farms, mortality rates were high in 2007.

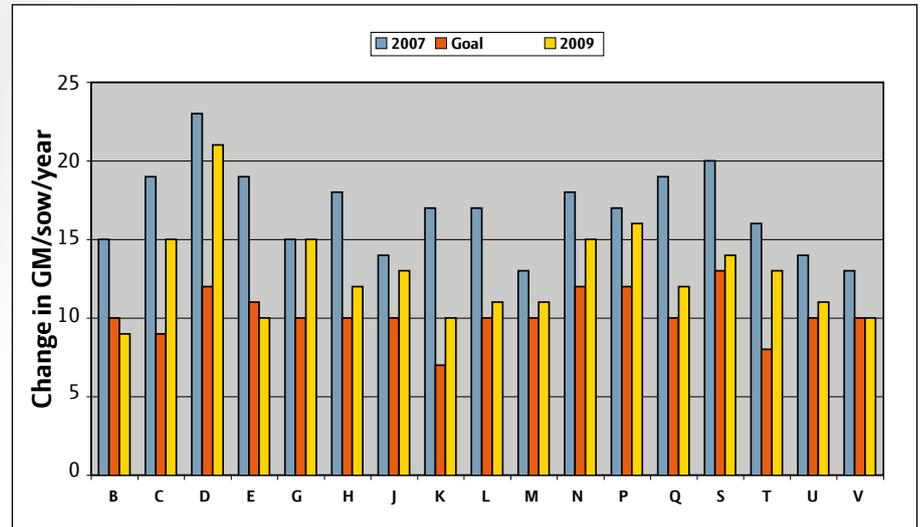
The project demonstrated that it is possible to reduce sow mortality through a joint, dedicated work effort from pig advisors, herd managers and staff (see Figure 1).

“The systematic advisory process with joint visits from pig advisor and vet and with the participation of all key staff members of the farm proved very productive. As a result of intelligible strategies and tangible work procedures and goals combined with follow-up, their recommendations were quickly implemented.”

Based on 2007 annual reports and production figures for the period 2007-2009 of the participating farms, the development in gross margin (standardised with sale of weaners at 8 kg) was calculated as an average and individually for these farms – see table 1.

Gross margin average covers large differences between the farms. It should be noted that the farm with the drastic change in GM (+1100) had an unusually low starting point in 2007. The difference in GM between the remaining 16 farms is normal among Danish sow farms.

The campaign did not focus exclusively on production and economy. It also made problems relating to co-operation and



Annual sow mortality rates on the 17 farms (B-V) in 2007, their goal and the 2009 result, respectively.

communication on large farms visible where in particular introduction procedures of new employees are not optimum. Farm owners must therefore be very aware that herd managers get the sup-

plementary training required in relation to new employees and the daily work. This seems to be a decisive factor in further increasing productivity levels and reducing sow mortality rates.

Average of the 17 farms in Sow Life	2007	2008	2009
Key figures			
Liveborn pigs/litter, weighted	14.43	14.42	14.44
Weaned/litter	12.53	12.53	12.54
Non-productive days/litter	19.49	17.63	15.70
Lactation sows (standardised), days/litter	35.64	35.62	35.67
Litters/sow/year	2.12	2.14	2.17
Weaned/sow/year	26.58	26.85	27.19
Farrowing rate	87	88	89
Other key figures			
Feed consumption/sow/year, excl. feed for gilts	1390	1394	1399
Per cent first parity sows	29.4	29.3	28.2
Annual replacement rate	62	63	61
Slaughtered sows, % of sows/year	41	44	45
Annual gilt need from 22 weeks, sow/year	0.71	0.71	0.68
GM/sow/year at standardised sale at 8 kg			
Sales income weaners	5793	5854	5928
Sales income slaughter sows	501	535	551
Feed costs	1738	1743	1749
DAKA sows	38	34	30
Gilt costs	1386	1380	1328
GM/sow/year	3132	3233	3372
Change in GM per sow/year (comp. with 2007)	0	101	240

Table 1: Selected production figures as an average of the 17 farms in Sow Life in the period 2007-2009.

Trial design

Blood samples were taken from 1,825 sows just before farrowing. In the subsequent lactation period, 43 sows died and post-mortem examinations were performed on 37 of these.

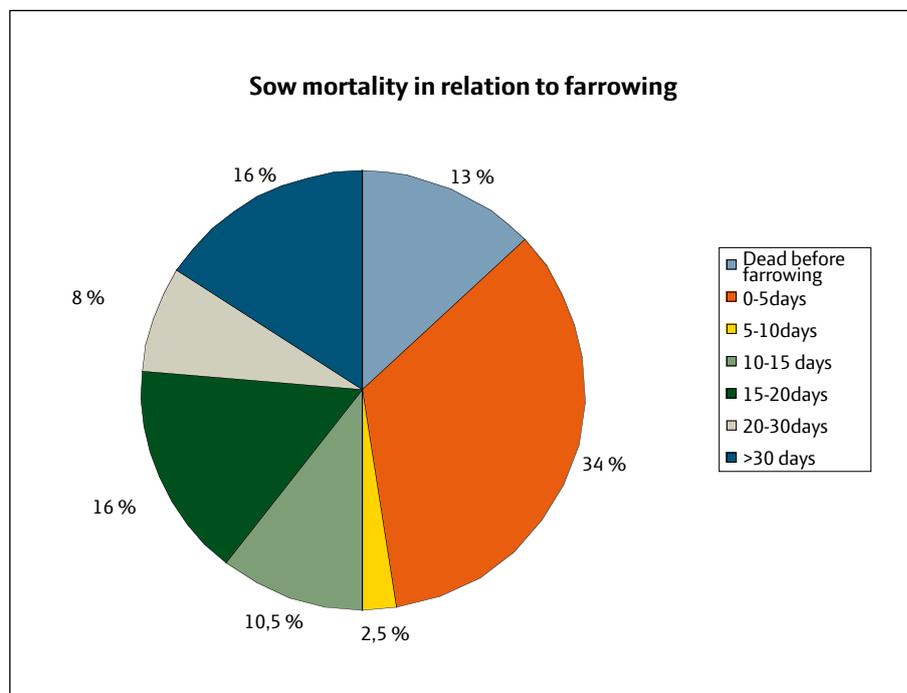
The post-mortem examinations confirmed gastric ulcers as an important cause of why sows die in the farrowing facility. Torsion of the organs and prolapse of either uterus or rectum were also identified among the reasons why some sows did not manage through lactation. With microscopic analyses of tissue samples diagnoses were found that had not been found during the post-mortem examination. Chronic nephritis was detected in 32.4% of the dead sows. Blood samples taken one week before expected farrowing could not be used to identify sows that subsequently died before weaning.

The aim was to document at what point in the farrowing process sows die. National figures reveal that approx. 2% of all mated sows, 5% of all sows/year and 30% of all dead sows die in the farrowing facility. To prevent and thereby reduce these numbers, thorough knowledge is required of what causes the sows to die and exactly when.

The results of the trial, including blood values recorded a week before farrowing, will be published in a trial report. Blood values were recorded with the expectation of being able to identify sows at risk of dying in the subsequent farrowing/lactation periods before they even farrowed.

Method

Post-mortem examinations of 37 of the 43 dead sows revealed the following primary mortality causes: Prolapse of uterus or rectum (25%); heart or circulatory failure (16%); torsion of liver, spleen, stomach and/or intestines (16%); gastric ulcer (14%); farrowing problems (11%); and universal intestinal haemorrhage (5%). Liver fibrosis and peritonitis were only identified in one sow. In three cases (8%), the cause of death was not clarified at the post-mortem examinations.



Time of death of sows in relation to farrowing. Significant correlations between time of death and causes of death were not identified.

The concentrations of acute-phase proteins, white and red blood cells, and platelets were described with a haematological profile. The biochemical profile covered the content of a series of minerals and enzymes in serum.

On the day the sows farrowed, the majority were tested for the ketone substance Beta-HydroxyButyrate (BHB) in the milk. In 5 of the 19 herds, a few sows were identified with signs of ketosis. The sows that died between blood sampling and weaning were subjected to post-mortem examinations, and tissue samples from selected organs were analysed microscopically. The objective was to establish whether essential pathological changes are actually hidden from the eye.

Serum was analysed biochemically for each of the sows that died between blood sampling and weaning, and the results compared with serum from two sows with the same parity from the same herd.

Results

The impact of nephritis did not affect blood results at the time of blood sampling.

It was not possible to identify significant differences in blood values between dead and live sows.

New know-how on prevention of shoulder lesions

In 2007, a range of projects were initiated to reduce the prevalence of shoulder lesions.

The projects were financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.

Some of the activities are finished and the results published:

- Demonstration project "Healthy shoulders" (Report 1006)
- Correct management of body condition (Trial report 862)
- Frequent feedings in the farrowing facility (Trial report 847)
- Vitamin B12 for gestating sows (Trial report 850)

"Healthy Shoulders", "Correct management of body condition" and "Frequent feedings" all demonstrated that it was possible to reduce the prevalence of shoulder lesions significantly. The know-how generated can generally be implemented on all farms in the continued efforts in reducing the percentage of sows with shoulder lesions and the severity of these lesions.

Three activities are not yet finished: "Breeding against shoulder lesions", "Floor cooling in farrowing pens" and "Preventive effect of rubber mats in farrowing pens".

Researchers in the project "Breeding against shoulder lesions" recorded more than 70,000 evaluations of shoulder lesions from approx. 9,000 individual sows. Data is currently being analysed. Read more on this project in the section "Genetic Research and Development".

The preventive effect of rubber mats in farrowing pens is being investigated on two farms. Concrete floor was compared with traditional rubber mats and very soft rubber mats. The practical part of study is completed, and the results are expected in the autumn 2010. On one of the two farms, a preventive effect was found when



A scoring system is underway to make it easier to uniformly determine whether a shoulder lesion is "mild" or "severe". The size of the lesion will form a significant part of this scoring.

using a very soft rubber mat. No effect was found on the other farm.

As only few sows develop shoulder lesions, it is recommended to place soft rubber mats in the farrowing pen if the sow is a "risk sow" or if the sow is showing signs of incipient shoulder lesions.

The effect of floor cooling under the sow in farrowing pens is also being studied. No effect is so far seen on the frequency of shoulder lesions. The study will be completed in the autumn 2010.

New scale

A new clinical scale for evaluation of shoulder lesions has been in development since 2008. The scale will include three scores: no, mild and severe shoulder lesions. It will be used in connection with the self-audit programme and will form part of the "yellow card scheme". The scale is therefore essential for pig producers and veterinarians to be able to evaluate shoulder lesions on the most uniform basis. The aim is also to minimise discrepancies between the slaughter control and the pig producer in terms of the severity of a shoulder lesion on a slaughtered sow.

The scale is made by a group of representatives from Aarhus University (The Faculty of Agricultural Sciences), Pig Research Centre, the Danish Veterinary and Food Administration, Copenhagen University, and the Danish Veterinary Association. The work consists of three stages. As part of the process, 169 sows were thoroughly examined and described by different people working with sows on a daily basis. Clinical descriptions were subsequently compared with results obtained through other clinical examination methods, such as the use of thermal cameras, scanning and skin biopsies. Destroyed sows were also described and lesions scored after the sows were destroyed. All methods are included in the new scale.

A preliminary scale based particularly on "size" was evaluated by 24 people such as veterinarians, pig producers, technicians and specialists. The results will form the basis of the final scale.

When the new scale is implemented, various instructions such as on-line training in the use of the scale will be available. It is expected to take the scale into use by the end of 2010.

Programme: "Better Legs"

The programme "Better Legs" is a two-year project that finishes in the spring 2011. All subprojects are well underway and some are close to completion.. *The programme is financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.*

The projects:

- Evaluation of legs
- Causes of leg disorders
- The good life
- Socialisation
- Pens for gilts
- Gilt manual

Evaluation of legs and movement

The aim is to develop a simple and accurate method for evaluating leg position and movement.

The result of the evaluation will be correlated with the leg health of the gilt/sow. No results of this work are available yet.

Causes of leg disorders

Factors causing leg problems were thoroughly investigated on a sow farm with a high frequency of leg problems. Nineteen sows that had been lame for several weeks were culled and shipped to the Lab for Pig Diseases in Kjellerup for post-mortem dissections. There turned out to be multiple underlying problems causing lameness among the gestating sows on this sow farm. The most significant causes were:

- Chronic articular changes
- Arthritis
- Hoof injuries

Causes of leg disorders will also be investigated on another sow farm.

Good and bad days

Sows with chronic injuries to hips and/or elbow joints sometimes went from being lame to not being lame. This switch can probably take place from day to day, and daily inspection of the sows is therefore essential.

Pain relief is often a good solution for sows with leg problems as very few cases of lameness are triggered by an infection. On each farm, the herd veterinarian pointed out sows that only required pain relief and sows that required treatment with antibiotics. It was also decided whether to move a sow to a hospital pen.

The good life

The impact of growth rate on leg health among gilts is being investigated in a trial comprising two groups of gilts fed differently.

- Approximate ad lib feeding until 2.5 feed units/day
- Restricted feeding (80% of ad lib)

The gilts are subsequently monitored until they are culled as sows from the farms. Gilts fed restricted during growth weigh 15-20 kg less at service than the gilts fed ad lib. It is still too soon to conclude whether the growth rate influences the sows' time in production.

The first farrowings in this investigation indicate that flushing gilts with a high feed dose before service results in similar litter sizes in the two groups.

Focus on young animals

Young animals form the basis of good sow farms. The following sections describe investigations aimed at benefiting gilts and young females on sow farms. The first results are expected in the autumn 2011.

Pens for gilts

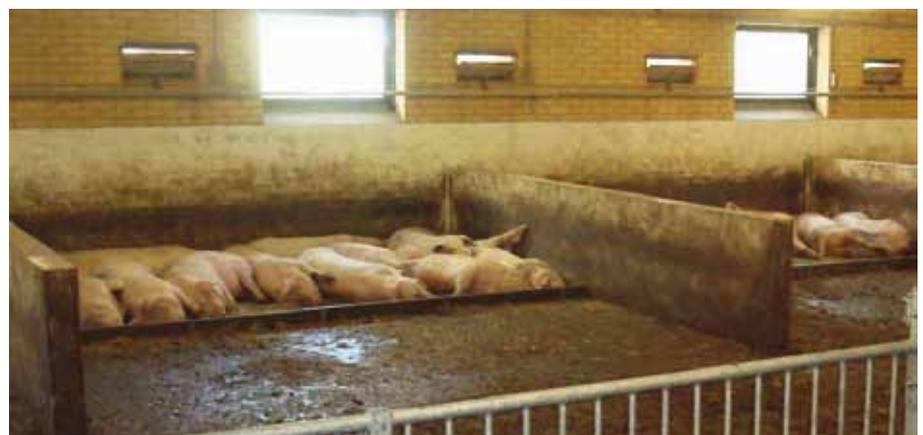
Some pig producers have a large percentage of the gilts that never make it to service. Slippery floors in gilt pens will result in tendencies to slip and consequently more gilts are culled. More knowledge on layout of pens for gilts is therefore required – both for accommodation of small stable groups of 8-12 gilts per pen as well as for socialisation of gilts in large dynamic groups of up to approx. 40 gilts per pen.

Pig Research Centre is currently investigating if fouling can be reduced through various measures.

Low stocking densities provide a relatively large dunging area compared with the number of animals in the pen, and faeces may accumulate in places where the animals do not step on it thereby pushing it through the slats. Sprinkling may help prevent accumulation of faeces on the slats.

Gilts and young sows are vulnerable

It is important to introduce gilts gently



The desired use of lying areas with a low stocking density in a pen is that all lying areas are used and that the gilts fill them up from the back wall. Boards of wood placed crosswise in the lying area between the back wall and the slatted floor will make it possible to keep straw in the back half end of the lying area. By keeping the back area of the lying areas particularly attractive, the risk of fouling and of inappropriate use of the lying areas is reduced.

to life in the gestation facility to avoid unnecessary stress or injury. Gilts constitute a fairly large part of slaughtered and destroyed animals. This is often due to leg problems that are largely attributed to conflicts related to the formation of hierarchy that takes place within the first days in a new group. Because of their low weight, gilts and young sows are the lowest-ranking in a group of gestating sows.

Socialisation of gilts

The effect of socialisation on longevity until service for the third litter is being studied on two farms with group-housed gestating sows and electronic sow feeding (ESF). Through socialisation, the animals gain experience with ranking in groups with older and bigger animals before service.

The gilts are transferred to a separate training pen located in the gestation facility approx. one month before transfer to the service facility. The pen accommodates 30-35 gilts and the study comprises the following groups:

- The gilts stay in the training pen until service – total of 4 weeks
- After two weeks in the training pen, the gilts are introduced to the older sows for another two weeks

A gate separates the training pen from the sow pen. When the gilts are trained and subsequently mixed with the older sows, the training pen will be included in the total area available to the animals.

Grouping of gilts

It is being investigated if the percentage of gilts making it to service for the second litter increases if the accommodation in the gestation facility benefits the young animals.

Farm 1:

Gilts are housed either separately in a dynamic gilt group or in stable groups with sows.

Farm 2:

Gilts are housed either in a dynamic sow group or in stable groups with sows.

The gilts' conditions will differ according to the group they are housed in during gestation. In dynamic groups, gilts more often meet foreign animals and this may increase hierarchy fights. When gilts are part of a group with sows, they are more likely to lose the hierarchy fights than when housed in groups with other gilts.

The gilt manual is now available

The way gilts are handled on a farm is decisive to the productivity of the sow unit, and the gilt manual centres on 'Best Practice' for management and handling of gilts.



Gilts being moved in the inspection alley

Be in control of the gilt unit

The gilt manual includes farm management, selection of gilts, growth and service. It also includes tools for calculating the number of gilt needed, for dimensioning of gilt place units and purchase strategies. Pig producers will also find guidance on whether to buy gilts or produce them on-farm.

The programme "Better Legs" clearly demonstrated the potential in utilising our knowledge on gilt production even more and showed that many pig producers will experience productivity increases by systematising the flow of gilts or changing routines and work procedures.

Take what you need

The gilt manual can be used as an aid in pinpointing problems on a pig farm and solving them. It can be used as an 'encyclopaedia' in which some parts stand alone, and chapters on certain subjects or work routines can be studied alone. The aim is for the pig producer together with his advisor to improve productivity through a joint effort and with the use of this manual; for instance increased use of gilts, improved reproduction and enhanced longevity among the sows.

The gilt manual consists of:

- **Goals and action plans**
- **Timeline** describing the flow of gilts through a herd
- **Fact Sheets** describing good practice for the most important routines such as synchronisation of oestrus, self-audit, gilt training and management of immunity
- **Appendices** such as spreadsheets and other tools for illustrating consequences and possibilities in the herd.

Pain relief

Since June 2009, Danish piglets have been treated with pain relieving medicine when castrated. This was started partly by demands from the German market and partly by recommendations from the Danish Animal Protection Committee, but is, as of January 1, 2011, part of Danish legislation. Foreign studies have demonstrated that this treatment mainly affects the pain after castration. In 2010, several brands of pain relieving medicine were approved for use during castration of pigs.

Possible side-effects to this treatment caused by the risk of increased tendency to bleed after castration are being discussed. Investigations made by Pig Research Centre (PRC) indicate that there is no correlation between bleeding and mortality and slow growth, respectively, in pigs treated with pain relieving medicine. PRC is still working on more practical methods for reduction of the pain during castration. These activities are financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.

Improvac

Together with Pfizer, PRC is studying the Improvac vaccine. Improvac is a vaccine given to male pigs at 30 kg and again max. four weeks before slaughter. The vaccine affects the general sex hormones. It supposedly reduces male pig odour while preserving the positive traits of producing male pigs, ie. improved feed conversion ratio and higher lean meat percentage,



Improvac is being studied on Danish male pigs.

up to four weeks before slaughter. After the second vaccination, male pigs behave as castrates. According to foreign studies, male pig odour and behavioural problems related to production of male pigs disappear when this vaccine is used. The study of Improvac in Denmark will document whether these positive traits can be found in Danish male pigs when compared with castrates. The results are expected in the beginning of 2011.

Organic pig production

The Danish Animal Welfare Society wishes to gradually eliminate castration of male pigs in a process starting January 1, 2011, and running until 2014. From this point on, they will no longer have their brand associated with meat from Danish organic pigs if castration is still practised in organic pig production.

Feeding with chicory root

PRC studied feeding 15% dried chicory root to approx. 500 pigs 2-5 weeks before slaughter; the results revealed a reduction in skatole recorded on the slaughter line. Samples of neck fat and neck fillet from approx. 50 pigs from each of the three groups were subject to sensory evaluation for skatole and androstenone with lab equipment (HPLC). Compared with the control male pigs, chicory root reduced skatole and the concentration of male odour in meat and fat, and boar taint in meat. There were no differences in androstenone levels and boar taint in fat between the control pigs and the male pigs given chicory. Boar taint in meat was reduced compared with the control male pigs, but not to the same level as for the young females. The study comprised three groups:

1. Male pigs, control (419 pigs)
2. Male pigs, chicory root (496 pigs)
3. Young females (184 pigs)

All pigs in groups 1 and 3 were fed control feed the entire trial period. The pigs in group 2 were given control feed until 14 days before the first pig was slaughtered after which they switched to a diet including 15% chicory root.

On all pigs, skatole was recorded in fat with the equipment available at the



Chicory root reduces boar taint.

slaughterhouse. Fifty pigs per group were also selected for sensory evaluations and 20 pigs from groups 1 and 2 were selected for analysis of the bacterial composition of the gastro-intestinal tract. The addition of chicory root changed the fermentation process in the gastro-intestinal tract. Chicory root is fairly expensive (DKK 6-7.50 per kg in 2009/2010), and feed costs will increase by approx. DKK 40-50 per male pig when 15% chicory root is added in the last period up to slaughter. It is currently not profitable to add chicory root to feed for male pigs.

Fermentable carbohydrates in pig feed, such as chicory root, change fermentation processes in the large intestine; as a result, the bacterial flora will increasingly ferment carbohydrates. Tryptophan is used for bacterial growth, and the amount of tryptophan available for production of skatole thereby drops. Consequently, the deposit of skatole in the pigs' fatty tissue drops. For more information, see trial report 876.

The project is financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.



Chicory root affects the bacterial composition of the intestines.

Activities

On the areas SPF (Specific Pathogen Free), health and diagnostics, Pig Research Centre (PRC) handles the service activities delivered by the Laboratory for Pig Diseases in Kjellerup, the SPF Health Inspection and SPF Health Status. All activities are financed through user payment covering all expenses and a small contribution for coverage of the capital bound for the activities.

SPF Health Inspection

SPF Health Inspection is performed on all breeding and multiplication farms that have signed an agreement with the SPF Health System on declaration of red SPF status. There is an increasing demand for breeding stock with a health declaration in Denmark as well as in Europe.

On July 2010, 236 CHR numbers were given red SPF status. This is few compared with 2009, but is mainly attributed to the fact that farms are getting bigger. Inspections take place at monthly audits in the form of a clinical inspection and blood samples are taken to document the health status of the farms.

The Health Inspection monitors animal welfare on Danish breeding and multiplication farms with particular focus on shoulder lesions, tail biting, stocking density and hospital pens. Since 2007, when the task was described in detail by the board of PRC, animal welfare has improved on Danish pig farms.

The SPF Health Inspection also functions as practising veterinarian for a number of breeding and multiplication farms and as supervising veterinarian on all Hatting AI stations and quarantine facilities.

Laboratory for Pig Diseases

Since January 1, 2010, the Lab is the only laboratory in Denmark to which practising veterinarians can ship pigs for post-mortem examinations for production diseases. Until January 1, this task was handled by the DTU Veterinary Institute. The Veterinary Institute still performs a range



A high level of hygiene helps ensuring that pigs sold have a high health status.

of specialised examinations for detection of bacteria and viruses.

In 2010, the Lab is expected to perform more than 3,500 post-mortem examinations and organ examinations. Bacteriological analyses, including analyses for resistance, will be made in connection with these examinations.

The Lab analyses the majority of the serological examinations made in the Danish SPF system, and in 2010, it is expected also to provide serological examinations for PRRS.

Diarrhoea is an increasing problem among Danish weaners. The Lab was granted aid to a PhD project under the Faculty of Life Sciences, Copenhagen University, with the participation of the DTU Veterinary Institute and in co-operation with other departments of PRC. The project runs for three years, and together with other PhD projects it forms part of a comprehensive project mapping causes of diarrhoea in pigs from birth to slaughter.

SPF Health Status

SPF Health Status is in charge of maintaining the SPF database of all SPF herds in Denmark. At www.spf-sus.dk, the SPF status of all SPF herds is shown.

The Danish SPF system declares pig herds for the following diseases:

- Pleuropneumonia (Ap types 1-10 and 12)
- Pneumonia (Myc)
- Pig dysentery
- Rhinitis
- PRRS (DK and Vac)
- Lice
- Mange

The website also shows Salmonella level and DANISH certification for each farm.

As of October 1, 2009, there were 3,219 Blue SPF herds and 253 Red SPF herds.

SPF Health Status also updates SPF health regulations and SPF transport regulations. Currently, eight carriers are approved SPF carriers.

- As of October 1, 2009, 98% of all breeding stock sold in Denmark had SPF status.
- 73% of all Danish sows had SPF status and thereby 73% of all weaners had SPF status.
- 39% of Danish finishers had SPF status.

PMWS/PCV2/PCVD

PMWS is still a problem in Denmark. Today the disease affects not only weaners, but also finishers. Besides increased mortality rates, the disease is also characterised by low gain and non-uniform pigs. Scientists have successfully isolated PCV2 virus from aborted pig foetuses, and it is therefore believed that PCV2 may also cause reproductive problems, but probably only in new herds where the animals never before have met PCV2 virus.

The disease has changed characteristics, and therefore the name has changed from PMWS to PCVD (Porcine Circovirus Disease) encompassing all disease complexes where PCV2 is an important part of the cause. The virus is assumed to be widely spread among pigs in most parts of the world.

Vaccination

The disease was previously controlled fairly successfully through changes in management routines, but in the last years specific PCV2 vaccines have become available. Today, these vaccines are highly common in Denmark. The vaccines can be divided into two groups: one for sows and one for pigs. One of the vaccines can be mixed with a vaccine against *Mycoplasma hyopneumoniae*, and pigs can thereby be vaccinated against both diseases with one injection.

Are there PCV2 negative herds?

In 2009, 28% of all herd submitting blood samples for analysis of PCV2 virus were found negative, ie. PCV2 was not identified in any of the blood samples. Herds may become PRRS negative over time, and this might also be the case with PCV2. To investigate this in detail, it was decided to check whether these PCV2 negative herds really were free of PCV2 or whether they were simply coincidental findings.

Follow-up on negative herds

The investigation included follow-up in some of the PCV2 negative herds. Only herds where blood samples were taken from finishers and where PCV2 was not

subsequently detected were included in the follow-up. Furthermore, some herds that were suspected by the veterinarian of being PCV2 negative were also included. In step one, follow-up blood samples were taken according to the below plan to ensure PCV2 was still not detectable in the herd:

- Ten samples of pigs weighing 30 kg
- Ten samples of pigs weighing 45 kg
- Ten samples of pigs before slaughter.

If PCV2 was not detected in any of these blood samples, the herd was monitored for a year. Approximately every second month, 30 blood samples were analysed for PCV2.

Unfortunately, PCV2 was detected in most of the herds in the follow-up blood samples. However, two herds were monitored since January 2010.

Herd 1

Herd 1 is a pure finisher herd with pigs in two age groups where the pigs were vaccinated with Ingelvac@CircoFLEX. When the herd was included it was free from PRRS. PCV2 was not detected in samples taken in January and March 2010, but in May massive findings of PCV2 were suddenly seen. This coincided with the herd

becoming infected with PRRS and stopping vaccinating against PCV2. Vaccination was promptly resumed, and for the rest of 2010 PCV2 was not found in the blood samples.

Herd 2

Herd 2 is an integrated herd, where the pigs are not vaccinated against PCV2. In January and March 2010, the herd was free of PCV2, but for the rest of 2010 all samples were PCV2 positive.

Explanation

Unfortunately, in most PCV2 negative herds PCV2 was identified in follow-up blood samples. In very few herds, it was not possible to detect PCV2 in the follow-up samples, but once the herds had been monitored for a while, PCV2 was detected. Therefore PCV2 free herds do not exist, but are due to variation over time.

In herd 1, the increase in PCV2 coincided with the herd becoming infected with PRRS and the termination of vaccinating against PCV2. When vaccination against PCV2 was resumed, the level of PCV2 dropped. This indicates that vaccination is a good method for controlling the level of PCV2.



The investigation of PCV2 negative herds is sponsored by the Boehringer Ingelheim European PCV2 Award 2009 presented in this picture.

M.M.A.

M.M.A. (Mastitis-metritis-agalactiae syndrome) is a complex of problems observed in sows and gilts around farrowing. The disorder is characterised by, for instance, reduced/terminated milk production, fever, deterioration of the pig's general condition, no appetite, mastitis and metritis.

Piglets are often affected the most as the sow's milk supply fails, and this may increase the percentage of weak piglets.

M.M.A. is triggered by multiple factors such as inflammations, indigestion, calcium deficiency, dehydration, metabolic disorders and stress.

Treating M.M.A.

It can be very difficult to treat M.M.A. correctly because of the multiple causes triggering the disease. Antibiotic therapy is recommended if the disease is caused by inflammation. Pain relieving drugs belonging to the group of NSAIDs (Non-Steroidal Anti-Inflammatory Drugs) are also effective. The economic effect of using NSAIDs has not been investigated on Danish farms.

Clinical trial

Together with the pharmaceutical industry, Pig Research Centre initiated a clinical trial on treatment of M.M.A. in which the effect of antibiotics and pain relief on the health and productivity of sows suffering from M.M.A. will be studied.

The trial is conducted on three farms where many sows suffer from M.M.A. For a sow to be included in the trial, it must develop M.M.A. within three days post-farrowing. In this trial, M.M.A. is defined by the sow showing two of the following symptoms: reduced appetite, fever (> 39°C), abnormal udder or flux from the uterus.

Four treatments

For two consecutive days, the sows are treated according to one of these four strategies:



Trial drugs

- Antibiotic therapy
- NSAIDs
- Antibiotic therapy + NSAIDs
- Nothing

The sows in the trial are randomly assigned to one of the four treatments. The drugs are stored in identical bottles, and staff members do not know which treatment a sow is receiving (blinded study). The trial comprises 35 sows per treatment (total 140 sows) on each farm.

The effect of the treatments is recorded in terms of:

- Recovery
- The sow's feed intake
- Gain of the litter in the first three weeks post-partum
- Diseases among sow and piglets in the first three weeks post-partum

Remarkable effect

The trial is not yet finished, and results have therefore not yet been analysed.

However, four months after trial start, a positive effect was observed on the occurrence of M.M.A. on two of the farms where 100% and 70% of the sows, respectively, were treated for M.M.A. at the beginning of the trial. After a short while, this dropped to 20-30%.

The reduction may be attributed to:

- Increased awareness of when to start treatment
- Stricter criteria for treatment
- The pig producer waits a few more hours before starting treatment which makes some sows symptom-free
- Every other week, the inclusion of sows is evaluated together with a trial veterinarian and the syndrome is discussed.

Increases in the use of antibiotics

From 2008 to 2009, the overall use of antibiotics for treatment of pigs increased by 11.5% in Denmark; a development that attracted massive press coverage and increased political awareness. The industry therefore initiated a series of activities to analyse the reasons for this increase and how to reverse the trend.

Research programme: Optimum use of antibiotics

Pig Research Centre (PRC) set aside funds for a comprehensive research programme on optimisation of the use of antibiotics in the Danish pig industry. The programme consists of six subprojects:

1. A manual for optimum use of antibiotics: "Good Antibiotic Practice".
2. Optimised supply of antibiotics in feed/water.
3. Optimised recording of drug use.
4. Antimicrobial resistance.
5. Good weaning starts in the farrowing facility.
6. Eradication of pleuropneumonia with flouroquinolone.

Good Antibiotic Practice

In September 2010, researchers began working on a manual on the use of antibiotics. The aim is to compile all available know-how and experience in an applicable manual that partly describes how to reduce the use of antibiotics through prevention of disease and partly describes the most optimum use of the antibiotics necessary for treatment of a disease. The manual is written by a group of local pig veterinarians, pig advisors, researchers from the Faculty of Life Sciences at Copenhagen University and veterinarians and consultants from PRC. Representatives from the Danish Veterinary Association and the Danish Veterinary and Food Administration are also involved. Subprojects 3 and 4 include work with guidelines for treatment and alert committee. The remaining projects will begin in January 2011.

Guidelines for treatment

PRC is represented in a committee dedicated to updating veterinary guidelines

for treatment of pigs. An updated version will be available in autumn 2010.

Alert Committee

In the autumn 2009, the Danish Veterinary and Food Administration formed an alert committee for veterinary use of antibiotics. The aim is to strengthen surveillance and prepare proposals for optimum use of antibiotics in livestock farming. PRC is represented in this committee as are the Danish Veterinary Association and the Danish Veterinary and Food Administration.

Voluntary stop for cephalosporins

Effective from July 1, 2010, the pig industry introduced a two-year voluntary stop for the use of cephalosporins. Cephalosporins may trigger a type of resistance called ESBL (Extended Spectrum BetaLactamase) considered very severe by the health authorities. The voluntary stop was introduced to meet this concern and to prevent continued restrictions on the use of antibiotics in treatment of pigs.

- Consequences of restriction
In the course of the next two years, it will be analysed whether the voluntary stop affects animal welfare, the consumption of antibiotics and the development in resistance.
- Critically essential antibiotics
Antibiotics that are critically essential in treatment of humans (cephalosporins and fluoroquinolons) are hardly ever used in Danish pig production. Since 2007, the use of cephalosporin in Danish pig production has decreased, and in 2009 it dropped to 99 kg (1 per mille of the total use of antibiotics for pigs). Following the voluntary stop, the use of cephalosporin is expected to be insignificant. Flouroquinolon was not used at all in 2009.

Research on resistance

PRS is co-operating with several organisations such as the National Board of Health, the Technical University of Denmark, Statens Serum Institut and the Faculty of Life Sciences at Copenhagen University on optimising research and advice on resistant bacteria in pig production. These bacteria include MRSA and

ESBL (resistance to cephalosporins).

- MRSA CC398
MRSA is a staphylococcus that has grown resistant to the drugs normally used for treatment of staphylococci in humans. One type called MRSA CC398 is found in pigs in particular and can transmit to humans. It does not affect healthy human beings, but may trigger disease in humans with a weakened immune system or in case of inflammation of, for instance, surgical wounds.
- Slight increase in MRSA CC398
The table below shows the number of Danes from whom MRSA CC398 has been isolated correlated with findings of other types of MRSA. From 2008 to 2009, findings of MRSA CC398 among Danes dropped while there was a slight increase compared with 2007.
- EU analyses of MRSA CC398
EU analyses reveal that only 5-7% of Danish pig farms are MRSA CC398 positive, which is very few compared with other countries. This corresponds well with results from screenings made for MRSA CC398 on participants at PRC's annual pig congress in 2008 where 3.5% of all farmers were identified as carriers of MRSA CC398.

MRSA in Danes

Year	CC398	All MRSA	% CC398
2003	1	239	0.4
2004	14	547	2.6
2005	6	851	1.1
2006	9	706	1.3
2007	14	659	2.1
2008	65	854	7.6
2009	39	811	4.8

Source: Statens Seruminstitut.

New type of diarrhoea among newborn pigs

Pig Research Centre (PRC) and the Veterinary Institute at the Technical University of Denmark have started a four-year long research project to map the causes of a new type of diarrhoea in newborn piglets that has greatly affected the wellbeing of piglets over the last years. The project employs three PhD students, one of them attached to PRC.

The aim is to document the clinical course on selected farms that for a long period of time have experienced problems with a type of piglet diarrhoea that does not respond to traditional treatment (vaccination/antibiotics) and where it was not possible to establish the cause of disease on the basis of standard laboratory analyses.

Systematic clinical examinations will be made of piglets and sows on these farms, and material will be compiled for diagnostic examination. At the Veterinary Institute, the material will be analysed microscopically and with different methods that are able to recognise gene sequences belonging to bacteria and viruses with possible correlation to the disease. It is the hope that when a couple of farms have been analysed, it will be possible to identify a correlation with, for instance, a virus or a bacterium that can explain the disease. Until then, it will not be possible to further investigate prevention of the disease.

At the time of writing, one farrowing batch on one farm has been followed clinically. It was concluded that virtually all litters were affected, but that the problem is only consistent and severe for the wellbeing of the piglets in gilt litters. Hungry piglets seem to have no particular problems with the disease and post-mortem examinations revealed that piglets with diarrhoea had full stomachs and did not appear dehydrated. Mortality was low and piglets that suffered from severe cases of diarrhoea early in life recovered clinically well before day 10. However, in terms of wellbeing and growth, there is no doubt

that the disease is severe. Lab results from this farm are not yet available.

Lawsonia in finishers

Together with the Faculty of Life Sciences at Copenhagen University and the Veterinary Institute at the Technical University of Denmark, PRC studied associations between diarrhoea, lab results and daily gain in finishers. The project is financially supported by the Innovation Act.

On five finisher farms infected with PCV2 and *Lawsonia*, the effect of diarrhoea without antibiotic treatment was investigated. A 117 g/day reduction in daily gain was recorded among finishers where watery diarrhoea was observed once; and a 477 g/day reduction in daily gain was recorded among finishers where watery diarrhoea was observed more than once.

There were large differences in the presence of watery diarrhoea on the farms in this trial. On one farm, 28% of the pigs suffered from watery diarrhoea, while on the other four farms it varied from 3% to 8%.

On each farm, five fast growing pigs and five slow growing pigs, 50 pigs in all, were selected for closer examination.

In 14 pigs, a high number of *Lawsonia* was found in faeces (more than 1 million *Lawsonia* bacteria/g faeces): of these, 12 (86%) were slow growing pigs. This indicates that a high number of *Lawsonia* does put the pigs at risk of slow growth.

Infection dynamics in sows and weaners

A project made in co-operation with the Veterinary Institute at the Technical University of Denmark with financial support from the Innovation Act investigated infection dynamics of *Lawsonia* among sows and weaners. According to the results there does not normally seem to be a massive dissemination of *Lawsonia* in farrowing facilities.

On farms with a low presence of *Lawsonia* in the farrowing facility, low infection pres-



A litter of pigs severely affected on day 2-3 post-partum.



The look of diarrhoea varies – here foamy.



Thin and slimy diarrhoea.

sure post-weaning may be maintained without the use of antibiotics post-weaning through strict management of the infection pressure in the farrowing facility combined with operating farrowing and weaner facilities on an all in-all out basis.

On one farm, results indicate that the infection in the weaner house may originate from the pigs as well as from bacteria in the environment that survived cleaning and disinfection (trial report 868).

Electronic identification

Electronic identification of livestock animals is used for several types of farm animals.

The principle is simple: a reader emits radio waves with a given frequency. The energy of the radio waves activates a chip in an animal's ear tag that returns information to the sender on, for instance, the unique number of the chip.

This technology is called Radio Frequency Identification (RFID).

The use of RFID is exploding

The RFID technology has undergone dramatic development over the last years.

The heavy increase in the use of RFID is attributed to several factors. Productivity requirements increase in all parts of

production, and RFID is considered an efficient tool for monitoring processes and optimisation in all types of manufacturing companies, in warehouses and in retailing.

Agricultural production can be considered like any chain of supply, and there is therefore no reason the agricultural industry should not benefit from the technological development of RFID and from expertise and know-how from other industries in terms of optimising and monitoring processes.

Pig Tracker

On January 1, 2009, Pig Research Centre initiated a project on the Pig Tracker with financial support from the Innovation Act and made in co-operation with Prosign RFID and RF-LabelTech and the Danish Meat Research Institute.

The aim is to develop a new electronic ear tag that is based on a frequency that is higher than the one used by the existing tags with the use of UHF (Ultra High Frequency). Consequently, it will be possible to read several pigs at a time, for instance during driving of pigs through a gate to a pick-up facility, and it will be possible to read from a distance of up to 3 m with a stationary scanner. Handheld scanners have a reading distance of up to 1 m.

The project demonstrated that the use of UHF-RFID fully lives up to the expectations to the new technology. An almost 100% accurate reading was achieved of groups with 20-30 pigs during driving through an alley with reading distances of up to 2.5 m. Reading distances of up to 1 m were obtained with the handheld scanner.

Benefits

Routine monitoring of the location of individual pigs will be possible with this technology. In a sales situation, animals can easily be located and print-outs made of the unique numbers of the animals sold. It will of course be possible to make all types of recordings in connection with driving/loading: weight, medical treatments, feeding etc. The use of UHF-RFID in pig production and probably also in production of other animals presents a wide range of opportunities.

The latest results from the project are available at www.pigtracker.dk where also a practical demonstration of scanning of pigs during driving is available.



Identification of animals during driving of pigs between two production sections.

Increased litter sizes equal increased requirements

Danish sows produce large litters, and this increases the requirements to sows as well as management. Pig Research Centre (PRC) is running a series of activities under the heading "35 pigs per sow/year" with the aim of solving problems related to the handling of large litters.

Breeding for maternal traits

Traits that improve a sow's ability to rear her own piglets and increase the survival rate of piglets are being investigated in hybrid sows.

The results are compiled in LP5 = "live piglets on day 5" and 14P = "the sow's ability to rear minimum 14 pigs until day 21". Sow's longevity—expressed as a sow's productive life—is recorded on commercial sow farms as it cannot be recorded in breeding herds. It will be investigated whether the results can be used for genomic selection.

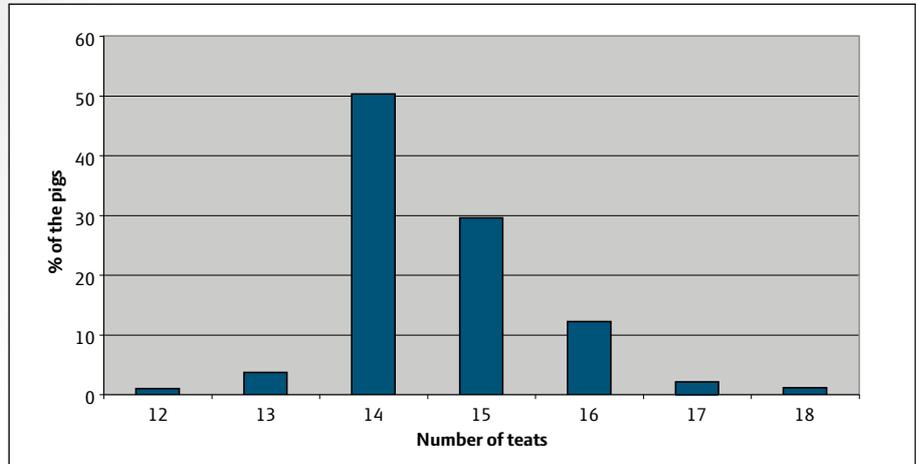
Feeding of the sow

Colostrum differs from sow milk, and in the beginning of lactation, sows do not produce much milk. Therefore, a transition diet is being studied for use around farrowing that contains less protein and more medium-chain fatty acids originating from coconut oil. The intention is for this diet to reduce primarily the protein load of the sow.

It is also being studied whether additional coconut oil increases the level of glycogen in newborn piglets and increases the sow's production of colostrum. The transition diet will be fed as phase feeding from 1, 3 or 5 weeks before farrowing until day 5 post-farrowing.

FCR on sow farms

On some farms, feed conversion ratios are high without this being reflected in the production results. The causes of varying feed conversion ratios are being mapped on ten sow farms. This work will also include the development of a simple recording system for accurate determination of feed conversion on sow farms.



Number of teats on four-week-old female pigs.

More room for lactation

Sows take up more room in width when they are lying down than when they are standing. A farrowing pen must also be wide enough for piglets to be able to nurse unhindered.

In 2008, PRC published recommendations for "lactation width", which is the room required by sow and piglets for lactation. New crate designs for use in traditional farrowing pens have been developed that meet the recommended lactation width. The new crates can be placed in traditional farrowing pens with a pen width of 170-180 cm and a length of 260-270 cm. These crates are currently being studied by PRC to establish the effect of increased lactation width on the number of weaned pigs per litter and litter weight at weaning.

It will also be investigated whether sows may risk getting caught in the pen sides when the space of the crate is increased.



Farrowing crate with increased space by the sower as opposed to a traditional farrowing pen, which is expected to improve productivity.

Milk

An investigation revealed that sows with 15 teats only weaned 15 pigs in 10% of the observed cases. From the other sows with 15 teats, runts were moved to another litter or piglets died either because they had a bad teat or because they could not manage. It is being investigated how to distinguish good teats from bad teats on gilts during the growth period, and whether a teat needs to be lactated for minimum one lactation period in order for it to work optimum in the following lactation.

Experts on farrowing facilities

Through direct contact with groups of farrowing experts in the local pig advisory offices, it is ensured that know-how and experience are implemented in practice. Updated fact sheets from the manual "Guidelines for Farrowing Facilities" are available in English and Russian at www.vsp.lf.dk.

In demonstration herds, four local pig advisors are investigating if it is possible to increase productivity by four pigs from 28 to 32 weaned pigs per sow/year or from 31 to 35 weaned pigs per sow/year. The results are expected in the autumn 2011.

The activities are financially supported by the Danish Ministry of Food, Agriculture and Fisheries and the EU, and are aimed at securing a high level of production without adversely affecting the welfare of sow and piglets.

Dedicated focus

High production results in weaner and finisher production require skill, know-how, systematics and general control of the production. As demonstrated in three projects, it is possible to increase pig producers' earnings significantly through a dedicated advisory process.

+ DKK 25 per finisher

In the project "+DKK 25 per finisher", the aim was to increase earnings per pig through practical implementation of the vast amounts of know-how available on this area. The project was made in close co-operation with a group of production advisors, veterinarians and herd owners.

The second, and final phase, of the project is now complete, and the results show the same tendency as seen in phase 1. It is generally possible to improve productivity when the most significant areas for improvement are singled out.

Forty-nine pig producers participated in phase 2, and they averagely obtained the following improvements in the year they participated:

Daily gain, g	+ 34
FCR, FUgp/kg	- 0.12
Dead/culled, percentage unit	- 0.5
Lean meat%	+ 0.2
GM/pig, DKK	+ 14

The 49 pig producers were promised a DKK 21 increase per pig, but achieved only an average of DKK 14. This must be seen in the light of these facts:

- Not all proposals were implemented
- Too few visits by advisors
- These are before and after comparisons, ie. factors outside the action plans may have affected the results (positively as well as negatively).

Of the 49 pig producers, 34 achieved a positive net result, and the remaining 15 achieved a lower result.

Generally, project +DKK 25 underlined the potential for economic improvements and it showed that the know-how available is far from always implemented in practice. It was also demonstrated that motivation, adaptability and dedication to the right advice are essential to create changes on a pig farm.

Growth Management – Pigs

Growth Management – Pigs is an advisory tool where know-how and practical experience on production of pigs from 7 kg to slaughter are summarised. The tool is developed under the Development Co-operation by an expert group consisting of local advisors and PRC representatives. The manual includes:

- Giving pigs a good start in life
- Thermal environment
- Loading of pigs for slaughter
- Mixing accuracy when mixing feed on-farm
- Feed hygiene
- Work plans

Speeding up finisher production

The project "Speeding up finisher production" runs for 2010 and 2011, and will maintain focus on advisory methods and compilation of knowledge to benefit the production economy of Danish pig production.

A subproject called "Management of the Daily Production" investigates herdsman advice. An experienced practitioner will be observing work procedures of a farm and will be making proposals for optimisation in co-operation with the herd veterinarian and advisor of the farm.

A "weaner passport" is also in the works. The idea is that the passport will include all sorts of information concerning the batch of pigs delivered; information that

H22 - Overbrusningsstrategi

1. Brug faddyser beregnet til marksprøjen.
2. Placer overbrusning over gadearealet.
3. Overbrusning virker gennem afkøling af grisene - ikke stakluften.
4. Overbrus efter følgende anbefalinger:

Smågrise over 20 kg:

Udøstempertur: °C	Hyppighed, gange / time	Varighed, minutter
Fra 16 - 18	1 - 2	1 - 2
Fra 18 -	2 - 3	2 - 3

Der overbruses i lüdrummet kl. 9 - 20

Støbeavliv:

Udøstempertur: °C	Hyppighed, gange / time	Varighed, minutter
Fra 14 - 18	1 - 2	1 - 2
Fra 18 -	2 - 3	2 - 3

Der overbruses i lüdrummet kl. 9 - 20

Korrekt placering af overbrusning med faddyser

Ønsket overbrusningsområde

Vær opmærksom på:

- Brusere der for kort tid ad gangen, kan alle grise ikke nå ind under bruseren med aggression til følge.
- Brusere der for ofte, bliver stalden fugtig.
- Brusere der i lejet bliver lejearealet fugtigt.
- Brusere der på foderautomaterne, kan det medføre kagedannelser i automaten.
- Brusere der om natten? Tjek, om uret i styringen passer (tagte styringer er falske for strømsvigt).
- Vindstrøm, der giver fugt på gange og lejer.
- Tilkædede dyser.
- Ved overbelegning kan de lavest rangerede grise ikke undgå at blive overbruset.
- Manglende overbrusning trods rigtigt indstilling i styringen kan skyldes, at kuglehænen er lukket!

VERKSTMANAGEMENT - SVUK[®] Version 1.0 - marts 2010 49

The concept Growth Management centres on specific instructions and close follow-up routines.

a finisher producer can base actions upon and use for optimising his production.

Finally, we will also enhance our knowledge by investigating all in-all out operation at herd level; the possibility of cheaper feed (for instance rape and sunflower meal); and different management tools.

All projects were financially supported by the EU and the Rural Development Programme under the Danish Ministry of Food, Agriculture and Fisheries.

Efficiency and improvement

In 2009, a two-year joint venture was initiated between Pig Research Centre, Organic Denmark and the Danish Animal Welfare Society to improve farrowing huts and outdoor runs for growing pigs. Options for treating *Lawsonia* without the use of medication will also be investigated.

Farrowing huts

Twenty-two farrowing huts with a new design were studied, and the number of weaned pigs per litter in the huts recorded and compared with traditional A-shaped huts.

There does not seem to be any differences in productivity between trial and control. The farrowing huts were in use for 11 months and the trial period thus included both a cold winter and a warm summer.

In the winter, the immediate environment was poorer than in the A huts, which is attributed to the fact that the room height in 70 cm higher than in traditional A huts, and the pig producer therefore decided to shut the integrated doors at night to prevent direct wind impact.

However, in the summer, the climate in the huts was more comfortable as it was possible to open the entire front of the hut and the back gate. A "barrel" hung in the middle had three functions:

- Prevent the sow from lying down with her back towards the middle
- Shelter for piglets
- Collection point for piglets in connection with castration

The first function was not fulfilled as sows do not always lie down with the back against the walls. The other two functions were satisfactory. Unfortunately, the construction is too weak, and the "barrel" and suspension unable to handle the impact from the sow. Video surveillance was installed in three huts, and the recordings were used to analyse sows' lying behaviour in order to demonstrate the sows' use of barrel and lying walls.

Facilities with outdoor runs

In one herd, an outdoor run with slatted floor in eight pens was converted. The following sub-elements are included:

- Extended stay on the slatted floor before the pigs reach the solid floor
- Shelter over the solid floor
- Insulated roof over the outdoor run
- Wind-breaking net on the front of the pen
- Sprinkling over slatted floor
- Open pen sides in dunging area
- Roughage several times a day

The solid floor required daily scraping. Because of frequent rain and wind, the runs never dried regardless of whether they were covered. The thermal environment was investigated and the results demonstrated that an immediate environment with a low wind speed could not be created anywhere in the outdoor run.

In the spring, 16 pens with new pigs were started up, and the solid floors were successfully kept clean without daily scraping.

To obtain a dry solid floor outdoors, it is important that the route of moisture and manure to the slatted floor is short. Preliminary conclusions show that it is not



In a dry warm summer, 75% of the solid floor in the outdoor run was successfully kept clean.

realistic to establish solid floor in outdoor runs in large, connected runs.

Lawsonia-induced diarrhoea

Faecal samples taken from five outdoor herds and five organic herds in 2009 unexpectedly demonstrated that *Lawsonia* was not the factor triggering diarrhoea. The highest prevalence of *Lawsonia* was observed in the organic herds.

It was therefore decided to test a 'package' consisting of PCV2 vaccination, chicory, benzoic acid and reduced protein level in the feed. However, benzoic acid is not approved for use in organic pig production and it was therefore only possible to test this in outdoor herds.

For the last two years, the local pig advisory offices have focused on feed management, and this has played a major part in reducing the prevalence of diarrhoea on the farms.

The original *Lawsonia* trial was therefore not conducted, and work is now aimed at enhancing the pigs' general immune status to prevent diarrhoea.



Farrowing huts are distinctly different from A huts in design.

LOCAL PIG ADVISORS

Purpose

The overall purpose of co-operation between pig veterinarians, local pig advisors and Pig Research Centre (PRC) is to ensure optimum health, welfare and productivity in Danish pig production through co-ordinated and dedicated advisory processes. This was strengthened in 2010 through several projects.

Information meetings

In May and June 2010, PRC arranged information meetings for pig veterinarians and advisors in Sorø, Horsens and Aalborg where 125 veterinarians and pig advisors participated.

The meetings included information on:

- Binding Health Advice
- Self-audit scheme for animal welfare on Danish pig farms
- Self-inspection in practice
- Project Sow Life – status
- Cross-compliance
- Phosphorus, phytase and feed quality - status
- Antibiotic consumption and resistance - status

The aim of the meetings was to create an understanding of the challenges facing the different groups.

Synergy in advisory processes

Under the heading “Synergy between veterinarian and pig advisor”, 119 herd inspections were made in co-operation between a practising veterinarian and a local pig advisor up to September 1. The aim is to demonstrate that co-operation between veterinarian and advisor creates value for the pig producer. The project includes 24 veterinary practices and 15 advisory centres, and a total of 109 veterinarians and advisors have held joint herd inspections.

The project is partly financed by the EU and the Danish Ministry of Food, Agriculture and Fisheries. It demonstrates how pig producer, veterinarian and pig advisor can find common grounds for future collaboration. Clear agreements are made on

how to reach the goals that are set out. This will make it easier subsequently for veterinarian and advisor to follow up on the agreements made.

Action plans are forwarded to PRC as documentation for the agreements made, and these plans show that many effort areas were pinpointed in the 119 herds. For instance:

- Increasing farrowing rates from 80% to minimum 88%
- Implementing self-audit programmes
- Enhancing oestrus with the AHA effect
- Reducing mortality in the farrowing facility
- Reducing the use of medication for weaned pigs
- Improving feed hygiene
- Vaccination strategies

PRC implements follow-up procedures through telephone interviews with some of the pig producers. Furthermore, advisors and veterinarians will be asked to evaluate their experiences of the joint visits.

Communicating with practice

Nine veterinary practices that are all specialised in pig production were selected for improving co-operation between pig advisors and PRC. Staff from PRC holds

meetings with veterinary practices minimum twice a year where activities under PRC are presented.

At these meetings, PRC, in turn, gets inputs on relevant problems and on what is going on in practice.

Interest groups

Two interest groups, “Better legs” and “Diarrhoea”, have been set up for veterinarians with the aim of sharing experiences and knowledge between veterinarians and PRC.

The future

With close communication as the starting point, the long-term intention is to pinpoint specific veterinary areas of development and develop management tools for use on pig farms like the ones known from Development Co-operation. Firstly, an antibiotic manual will be made with the aim of reducing the use of antibiotics. The synergy in collaboration between pig advisors and veterinarians will also be given a high priority.



Pig Research Centre staff and veterinarians discussing how to improve co-operation.

New website

In October 2009, Pig Research Centre launched a new website at www.vsp.lf.dk replacing the old www.dansksvineproduktion.dk and www.inforsvin.dk.

The new site communicates news and statements from the Danish pig industry to the world to a greater extent than the old website. News and statements are produced by Pig Research Centre as well as Danish Agriculture and Food Council.

The website is a central place for knowledge and news for all people working professionally with pig production. From the outset, the website was constructed on the basis of the needs of the users.

Construction of the website

The Danish part of website is based on four "pillars":

- **Current:** News, weaner prices, meeting calendar, information on annual pig congress.
- **Knowledge:** Practical knowledge database for optimising pig production (previously known as InfoSvin).
- **Services:** Download of various software programmes, signs for use on farms etc. can be ordered here.
- **About us:** About the organisation and the local pig advisory offices.

English website

In June 2010, the English website was launched as a supplement to the Danish site. The English site presents Pig Research Centre and the Danish pig industry with particular emphasis on environment and animal welfare – both are topics that interest foreign parties with an interest in Danish pork. The English site is found at www.pigresearchcentre.dk.

Hits

www.vsp.lf.dk is a popular site. Since the launch in October 2009 and until September 2010, the site had almost 600,000 showings and was visited by 54,000 unique visitors. The pages most visited are the front page and subpages containing weaner prices. Most visitors (87%) are



English website.

from Denmark, but visitors come from all over the world. Many come from Germany and other Scandinavian countries.

User surveys and development

In the spring 2010, staff from PRC conducted a user survey at www.vsp.lf.dk in the form of a series of qualitative interviews with different user groups. Overall, the survey demonstrated great satisfaction with the website, but it also pinpointed areas for improvement. As a result of the user survey, some parts of the website will be revised.

The survey also revealed a desire for simplifying the front page, which is one of the central elements in the work the coming year. It is the plan to conduct user surveys on a regular basis.

News letter and text services

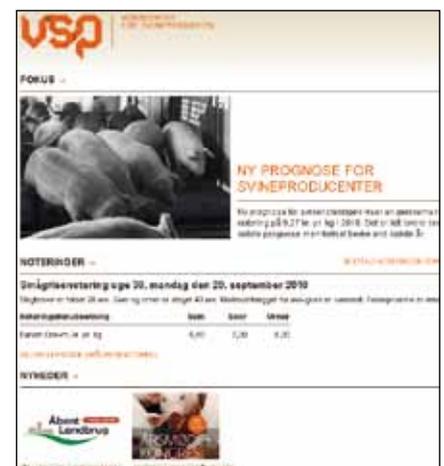
Besides the website, Pig Research Centre is also offering a news letter and a text service. The news letter currently has 1,900 subscribers and is published on e-mail every Thursday.

The news letter contains information on the latest research results and the latest weaner prices. The news letter was updated graphically in 2010, and is designed like the website.

If you subscribe to the text service, you will receive weaner prices as a text message

on your mobile phone the minute they are published.

Subscribe to the news letter and the text service at www.vsp.lf.dk.



News letter from Pig Research Centre.

Reports

- No. 0910: Nutrients in grain harvested in 2009
- No. 0911: Blood values in Danish sows
- No. 0912: Increased farrowing rates
- No. 0913: No correlation between ear necroses and PCV2
- No. 1001: Biofilter combined with Farm AirClean BIO module from SKOV A/S
- No. 1002: DKK +25 per finisher, phase 1
- No. 1003: Five strategies for socialisation of gilts
- No. 1004: Gestating sows in stable groups fed via electronic sow feeding
- No. 1005: Litter-wise housing of weaners
- No. 1006: Healthy shoulders – practical handling of shoulder lesions
- No. 1007: Methods for recording ketosis in sows
- No. 1008: Biological air cleaner from VengSystem
- No. 1009: Liquid feeding systems with no residue for ad lib feeding of weaners
- No. 1010: Fermentation of ground maize under different temperatures – lab study
- No. 1011: Treating Lawsonia diarrhoea – top 20 veterinarian advice
- No. 1012: Accuracy of ETNA Tank sensors
- No. 1013: Pilot study of TLV biotrickling air cleaner from Munters A/S
- No. 1014: Chemical air cleaner from Bioscent Technology
- No. 1015: Prototypes of pens for loose farrowing and lactating sows
- No. 1016: Nutrients in grain harvested in 2010

Other reports

- No. 35: Export of weaners to Germany
- No. 36: Economy in delivering finishers from the southern part of Denmark to German slaughterhouses in 2008

Trial reports

- No. 849: Floor profile and pen design for loose lactating sows
- No. 850: Vitamin B12 for gestating sows
- No. 851: Rooting and enrichment materials for finishers
- No. 852: Different levels of amino acids for heavy pigs
- No. 853: Transport of meal feed mixed on-farm
- No. 854: Farrowing induction and extended farrowing surveillance
- No. 855: Study of the PCV2 vaccine Circovac® in three herds
- No. 856: Optimum oestrus when serving gilts
- No. 857: Effect of cooling method on sperm motility recorded with CASA
- No. 858: Benzoic acid for finishers
- No. 859: Effect of farrowing crate on piglet mortality in swing-side pens
- No. 860: Satiating feeding of gestating sows
- No. 861: Effect of benzoic acid and protein on odour and ammonia emissions
- No. 862: Managing body condition of gestating sows
- No. 863: Correlation between sperm motility and fertility of Large White semen
- No. 864: Loose sows' rolling behaviour depending on level vs tilted floor and on location of creep area
- No. 865: Energy content of finisher feed
- No. 866: Cooling ventilation air in a farrowing house with a ground cooling/heating system
- No. 867: Lawsonia vaccination increases gain
- No. 868: Transmission of Lawsonia on Danish pig farms
- No. 869: Storage method affects segregation of mineral diets

- No. 870: Chicory for weaners
- No. 871: Commercial weaner diets purchased in Eastern Jutland 2009/2010
- No. 872: 11, 13 or 15 suckling piglets by the sow
- No. 873: Fermentation of grain increases nutrient digestibility
- No. 874: Behaviour during lactation – effect of pen type
- No. 875: Heat stability of phytase and xylanase products in pig feed
- No. 876: Male pigs fed 15% dried chicory root

Other information material

(also available in Russian)

- Correct recording of drugs and dead animals
- Avoid remains of hypodermic needles
- 10-point plan for efficient sorting of pigs for slaughter
- How to drive pigs easily
- 3 ways to a successful DANISH audit
- Correct storage of dead animals
- Self-audit scheme for animal welfare on Danish pig farms

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