

Annual Report 2006

06

Danish Pig Production



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# Preface

For the first three quarters of 2006, the price was DKK 9.30 per kg. Adding the bonus payment to this, we have a reasonable financial situation, but certainly not exultation, for many Danish pig producers.

Unfortunately, the Danish slaughterhouses are not capable of matching the German slaughterhouses, and as the Danish sow producers at the same time have a highly competitive product, the export of weaners is increasing.

Nevertheless, the economy of the Danish pig producers is still at the same level as that of their German colleagues due to a higher efficiency – particularly in the sow unit.

## **Agricultural Act and environmental legislation**

With the new Agricultural Act it has become easier to exploit the advantages of large productions, and the reduction of the ownership requirement of land is important for the future production of finishers.

The exact opposite effect will be the result if the government adopts the draft for new environmental legislation. The distance requirements for individual houses are an actual obstacle, and the ammonia regulation based on the best facility plus a further 25% is unnecessarily strict.

Politically, there is a lot of focus on finding a solution through advanced environmental technology. However, the individual pig producer does not have the financial resources to act as a guinea pig for technical experiments.

Danish pig production by no means excludes the use of new technology. But the technology tested so far costs DKK 10-20 per pig and the reduction in odour is far from convincing.

## **Environmental effect by the feed trough**

In combination with the genetic progress and an optimum design of pig facilities, the composition and amount of feed has resulted in and still results in significant environmental improvements.

In 2015, the discharge of nitrogen will be reduced by 50% compared with 1985, and the ammonia emissions will be reduced by 70%. In relation to the Action Plan for the Aquatic Environment III with maximum 25 kg phosphorus per hectare, the pig sector may reach the objectives far earlier than predicted.

## **Efficient production**

Our breeding system, DanBred, stands strong. Now, 24.3 pigs are produced per sow/year, and for the best fourth the number is 27.3. With the conversion of the breeding objective pigs born per litter to live piglets day 5 even more piglets and more viable piglets are being weaned. We actually expect an annual increase of one pig per sow/year.

The average pig producer is some way from reaching the optimum average of six litters. Sow longevity is therefore a new breeding objective that results in more litters per sow and fewer culled sows.

Health-wise, there is particular focus on mortality, while the PMWS situation seems to have stabilised and perhaps even improved. The old lawsuit concerning the PRRS vaccines was finally concluded when a settlement was reached between the parties.

## **Demonstration projects**

In co-operation with the local advisors, Danish Pig Production has initiated a series of demonstration projects. The aim is, with existing know-how, to improve feed conversion and increase gross margin among a large group of pig producers. It will, at the same time, become clear how others can make an effort to improve their results.

## **Animal welfare and housing facilities**

Danish Pig Production continues its comprehensive animal welfare campaign, and, with the 5% inspections, clearer instructions on rooting materials, feed enhancing satiety etc. will slowly, but surely emerge.

However, the shoulder ulcer situation is still highly unsatisfactory. The pig

producers should only be held accountable for what can be assessed from visiting the facility.

In terms of loose lactating sows, the trials give ground for cautious optimism, but we still have a long way to go.

## **Fee on genes**

Also abroad, the Danish breeding stock is highly valued, and every year the export increases. This is one of the reasons why Danish Pig Production has introduced a sales fee on all breeding stock regardless of whether they are sold in Denmark or to another country. This fee also makes it possible to reduce the production fees and put an end to the payments of the co-operative slaughterhouses to the scientific research and development.

## **Thank you**

Finally, on behalf of Danish Pig Production, a big thank you to all our partners. Without you, it would be impossible to carry out the extensive research and development that helps ensure the future for the Danish pig producers.

Yours sincerely  
Danish Pig Production

Lindhart B. Nielsen /  
Orla Grøn Pedersen



# Danish Pig Production



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Lindhart Bryder Nielsen,  
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*Farmer Thorkild Jensen,  
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# Budget and strategy

## Danish Pig Production

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

## Tasks

Danish Pig Production safeguards strategy, development and information tasks concerning the live pig, and has an ordinary net budget for the year 2006/2007 of DKK 88,535 million. The contribution from the Pig Levy Fund amounts to DKK 75,535 million, an amount that has been significantly reduced compared with last year. This is due to the implementation of a number of savings and increases in user payment. As a new measure, a fee on the sale of breeding stock and semen has been introduced which means that in the future both Danish and foreign users of DanBred genes will be contributing to the development.

## Strategy and new projects of Danish Pig Production

For years now, Danish Pig Production has been making significant increases

in the budget on the environmental area. Areas such as reduction of odour and ammonia emissions require significant resources until reliable and financially acceptable solutions are found. Danish Pig Production will continue the animal welfare campaign aimed at producers and advisors, and a number of scientific projects are being made in this area concerning, for instance, loose lactating sows and reduction of tail biting. In an effort to improve the efficiency and the economy in the finisher production, trials concerning feed conversion and mortality have been initiated. Furthermore, a comprehensive demonstration project comprising 200 finisher herds has been initiated with the aim of increasing the gross margin significantly.

On adoption of the budget for the year 2006/2007, Danish Pig Production decided to initiate the following new projects:

## External environment

- Nutritional possibilities for reducing ammonia emission
- Reduction of ammonia – chain analysis
- Biological purification of air – reliable and standardised
- Reduction of odour emission from housing facilities – membrane technology

- Odour measurements on the scene of nuisance – objective evaluation of odour on the scene of nuisance

## Efficiency

- Feeding strategy for heavy pigs
- Successful dry feeding
- Micro minerals for sows
- Technologies for good feed conversion (restrictive dry feeding)
- Gilts – longevity
- Feeding at pen level
- Sexing of boar semen
- Demonstration project, finisher production
- More pigs for slaughter
- Demonstration project, sow mortality
- Mortality in the farrowing facility
- Fewer dead and destroyed weaners and finishers
- Dead sows in the farrowing facility
- Alternative feeding strategy 7-30 kg
- Reduction in finisher mortality

## Housing and production systems

- Solid floor in the farrowing pen without a mess

## Animal welfare

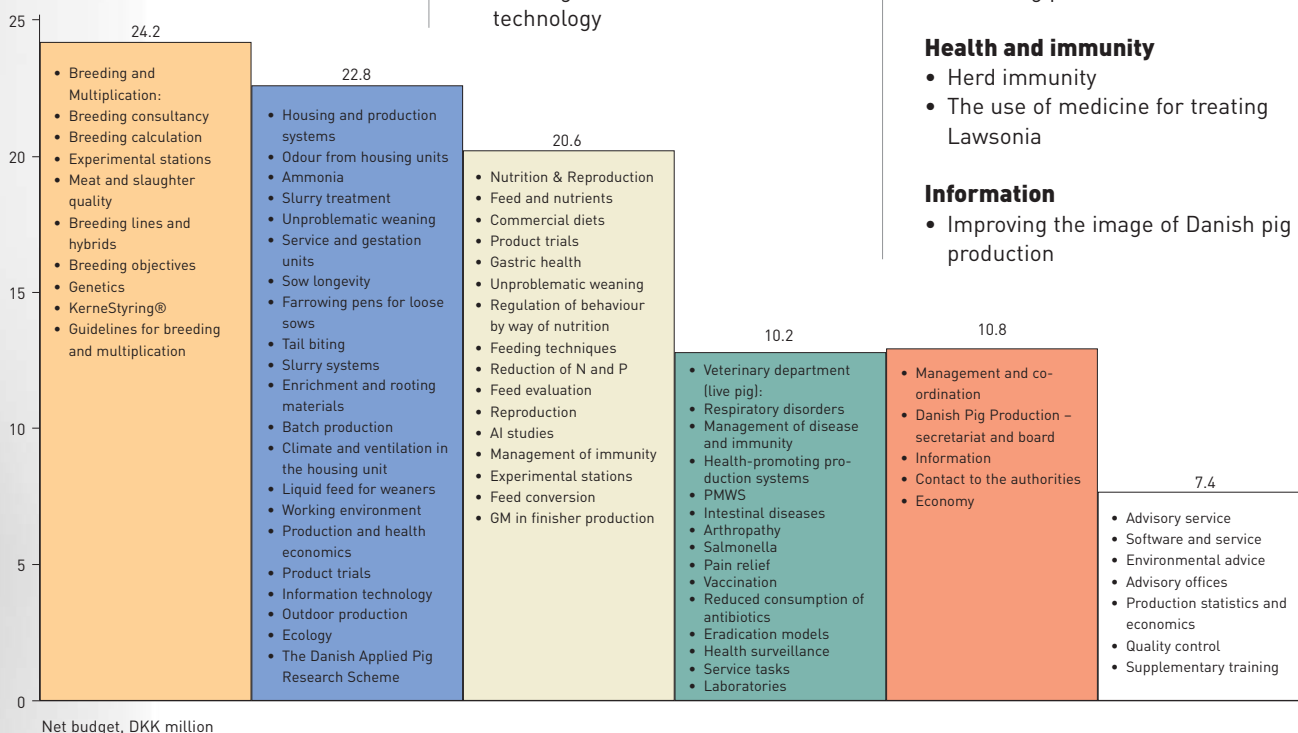
- Survival and vitality
- Sow longevity
- Guidelines for gestating sows
- Farrowing pens for loose sows – studies of different types of farrowing pens

## Health and immunity

- Herd immunity
- The use of medicine for treating Lawsonia

## Information

- Improving the image of Danish pig production



# Sale of pigs and development in structure

## Sale of pigs

Never before have so many weaners been transported and exported as today.

Previously, the integrated production was the predominant type of production, but figures from the CHR register and the Zoonosis register reveal that even though half of the sows are housed in integrated herds, they only produce one third of the finishers, while the rest are produced in specialised finisher productions. This means that every year 14 million weaners are transported within the Danish borders and to this can be added a rapidly increasing export of approx. 3.8 million weaners.

The export of live animals has increased rapidly over the last years. Based on the development in the export from January 2006, we expect an export of 350,000 7 kg pigs (+12%), 3.4 million 30 kg pigs (+25%), 630,000 finishers (+34%) and 160,000 sows (+5%). As the numbers written in parentheses show, the export of 30 kg pigs and finishers is drastically increasing.

## Framework conditions

The framework conditions have been changed, so that now differentiations are made between production units that consist of one or more sites and animal husbandries of one site.

In addition, the Agricultural Act has been modified so that the ownership requirement for land is now significantly lower than previously. Furthermore, the ownership requirement now applies to herds and not, as before, to the individual animal husbandry. As a result, producers owning several sites are free to place their production at the environmentally most appropriate place.

The ownership requirement in Denmark has been a great disadvantage to the production of finishers as the land requirement per finisher is approx. twice that of the ownership requirement per weaner. Furthermore, less strict ownership requirements will also make it possible to establish larger production units.

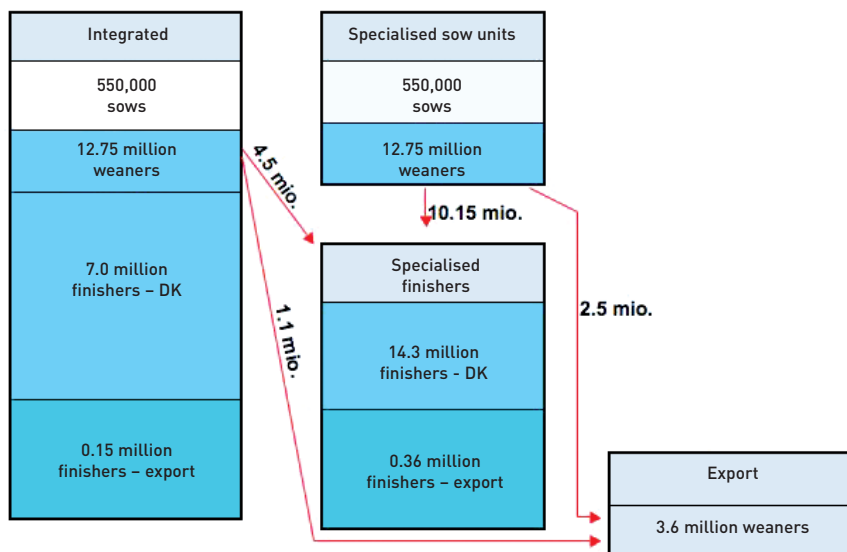


Figure 1. Sale of pigs 2006 – estimate based on the CHR register and Zoonosis register.

## Herd structure

For many years, the development in structure has been characterised by a halving in the number of finisher production units every ten years. There has also been a tendency towards specialising the production units in the production of weaners and finishers, respectively, to obtain larger and more rational units. Particularly within weaner production, rationalisation benefits can be obtained in batches up to 100 sows per batch. The total number of sows

in a herd depends on the batch operation system. A production unit with 21 batches of sows (week operation) can have up to 2,100 sows. However, the large herds often consist of a sow unit, a weaner unit and one or more finisher units.

Table 1. Production in relation to harmony requirements and ownership requirements

| LU  | Sows with wea. until 30 kg | Produced weaners | Produced finishers | Harmony requirement, ha | Old requirements, ha ownership, ha | New requirements, ha ownership, ha |
|-----|----------------------------|------------------|--------------------|-------------------------|------------------------------------|------------------------------------|
| 75  | 200                        | 5,155            | 2,440              | 54                      | 13                                 | 13                                 |
| 250 | 660                        | 17,200           | 8,125              | 179                     | 77                                 | 49                                 |
| 500 | 1325                       | 34,400           | 16,250             | 357                     | 256                                | 103                                |
| 750 | 1990                       | 51,600           | 24,375             | 536                     | 434                                | 156                                |
| 950 | 2520                       | 65,300           | 30,850             | 679                     | 577                                | 299                                |

## Development in the structure of Danish pig production

|                   | 1975   | 1985   | 1995   | 2005  | 2015  |
|-------------------|--------|--------|--------|-------|-------|
| Herds             | 84,400 | 41,500 | 20,400 | 8,300 | 3,500 |
| Divided among:    |        |        |        |       |       |
| Sows              | 28,300 | 11,600 | 3,700  | 800   | 880   |
| Sows/finishers    | 38,900 | 19,400 | 9,800  | 3,700 | 1,000 |
| Weaners/finishers | 17,200 | 10,500 | 6,900  | 3,800 | 1,620 |



# Productivity

## Development

In 2005, Denmark produced the highest number of pigs ever. However, the export of weaners increased from approx. 1.9 million in 2004 to approx. 3 million in 2005. The production of pigs increased by 0.8 million from 2004 to 2005; the increase in the export of weaners therefore resulted in a 0.3 million decrease in the number of produced finishers. The number of sows seems to drop in 2006, and this will result in slight decrease in the number of pigs produced. The reason is probably that some of the small sow production units no longer have sows in their production.

## Results from units with production control

Productivity in the sow unit still increases (see table 2). The number of live-born piglets, the number of weaned

piglets per litter and sows/year increased, which reduced the costs per weaned pig. From 2004 to 2005 the number of pigs weaned per sow increased by 0.8 pig, which is a higher increase that seen previously. This was caused by an apparent stop in the decrease in the number of litters per sow/year and by an annual increase of 0.3 piglets/litter in the number of liveborn piglets/litter. The number of non-productive days/litter dropped slightly and weaning age increased slightly, which in total maintains the same number of litters/sow/year as the year before. The feed conversion per produced pig increased by 1 FUsow in 2005 despite more weaned pigs per sow/year. The feed conversion still increases per sow/year, which reduces the economic advantage in weaning more pigs per sow/year compared with previous years.

Weaner productivity improved in 2005 compared with the previous two years. Mortality dropped by 0.6 percentage points and the daily gain increased by 9 g. The negative effect of PMWS seems to be decreasing. The productivity in finisher production was affected by a 2.2 kg increase in finisher weight in 2005 (see table 3). The daily gain increased by 16 g and the feed conversion remained at the same level as the year before, which is very positive. Mortality decreased by 0.2 percentage points. There is in finisher production a large unexploited potential in improving feed conversion and reducing mortality. The best 25% of the herds have a feed conversion that is 0.14 FUp lower per kg gain than the average and the number of dead/culled pigs is 1.1 percentage points lower. Furthermore, the daily gain is approx. 90 g higher in the best 25% of the herds.

Table 1. Development in population, production and slaughter weight

|                      | 1999  | 2000  | 2001  | 2002  | 2003*** | 2004* | 2005  | 2006* |
|----------------------|-------|-------|-------|-------|---------|-------|-------|-------|
| Sows, 1000           | 1,080 | 1,070 | 1,130 | 1,128 | 1,130   | 1,141 | 1,143 | 1,110 |
| Prod. million**      | 22.5  | 22.4  | 22.9  | 24.0  | 24.6    | 24.9  | 25.7  | 25.5  |
| Slaughter weight, kg | 76.6  | 77.1  | 77.9  | 78.1  | 77.7    | 78.5  | 80.7  | 81.5  |

\* Projection \*\* Incl. export of live animals and sows, boars, gilts, etc. \*\*\*53 weeks

Table 2. Productivity, sows and weaners

| Year                       | Average production results |          |          |                 |               |
|----------------------------|----------------------------|----------|----------|-----------------|---------------|
|                            | 2003 All                   | 2004 All | 2005 All | 2005 Bottom 25% | 2005 Best 25% |
| Weight/sold pig, kg        | 29.9                       | 30.6     | 31.2     | 31.0            | 30.5          |
| Feed/produced pig, FUp*    | 108                        | 108      | 109      | -               | -             |
| Prod. pigs/sow/year        | 23.5                       | 23.7     | 24.3     | 21.1            | 27.3          |
| Litters/sow/year           | 2.25                       | 2.24     | 2.24     | 2.14            | 2.3           |
| Sows/year                  | 284                        | 303      | 327      | 255             | 406           |
| First parity litters, %    | 22.0                       | 22.3     | 22.5     | 23.2            | 21.9          |
| Liveborn/litter            | 12.6                       | 12.9     | 13.2     | 12.7            | 13.7          |
| Stillborn/litter           | 1.4                        | 1.5      | 1.7      | 1.7             | 1.6           |
| Weaned/litter              | 10.9                       | 11.1     | 11.3     | 10.6            | 12.1          |
| Age at weaning, days       | 31                         | 31       | 31.4     | 33.0            | 30.1          |
| Weaning weight, kg         | 7.3                        | 7.3      | 7.3      | 7.6             | 7.1           |
| Mortality post-weaning, %  | 4.2                        | 4.4      | 3.8      | 5.6             | 2.3           |
| ADG post-weaning, g        | 416                        | 420      | 429      | 411             | 440           |
| Age at 30 kg, days         | 86.1                       | 86.1     | 85.9     | 89.9            | 82.2          |
| Non-productive days/litter | 16                         | 16       | 15.4     | 21.4            | 11.2          |

\* Incl. feed for young sows

Table 3. Productivity, finishers

|  | Average production results |          |          |                 |               |
|--|----------------------------|----------|----------|-----------------|---------------|
|  | 2003 All                   | 2004 All | 2005 All | 2005 Bottom 25% | 2005 Best 25% |
| Prod. pigs                                       | 4,143                      | 4,242    | 4,472    | 4,167           | 4,618         |
| Daily gain, g                                    | 832                        | 833      | 849      | 756             | 937           |
| Feed/kg gain, FUp                                | 2.85                       | 2.88     | 2.88     | 3.03            | 2.74          |
| Weight at transfer to finisher facility, kg      | 31.6                       | 32.4     | 32.8     | 32.9            | 32.5          |
| Av. slaughter weight, kg                         | 77.1                       | 78.0     | 80.2     | 79.3            | 81.1          |
| Av. lean meat %                                  | 60.1                       | 60.2     | 60.2     | 60.4            | 60.1          |
| Dead and culled, %                               | 4.0                        | 4.5      | 4.3      | 5.9             | 3.2           |
| Incidence of pleurisy recorded rec. at slaughter | 22.7                       | 26.5     | 24.8     | 34.4            | 18.3          |
| Total incl. deduction, %                         | 13.7                       | 16.8     | 17.7     | 20.8            | 16.3          |



# Production economy

## Even the best can get better

When we talk of unsatisfactory results, attention is often naturally directed towards production units with results below the average. However, even the best have an unexploited potential and can get better.

For instance, mortality from birth to slaughter has increased by a couple of percentage points over the last years for both the top and the bottom. A potential that is expected to be there or that can as a minimum be re-established. It is also a good example of a potential that is not being exploited. Similarly, there is an unexploited potential in feed conversion.

Figures 1 and 2 clearly show that it is important to concentrate on the factors that can affect the feed conversion and mortality negatively and that not only the producers with the lowest results can benefit from changing their routines. The top 25 and bottom 25 are the 25% producers with the best and the poorest results, respectively, arranged according to gain.

## Focus on mortality

On average, 4% of the finishers die before they reach slaughter weight. If this figure is transferred to a unit with a couple of hundred livestock units, a reduction in mortality of a couple per cent will increase the profit and the annual operating result by approx. DKK 100,000.

## Focus on feed

The boars used today have a genetic potential for a feed efficiency better than 2.5 feed units per kg gain. The average feed conversion is approx. 2.9 feed units. In a unit with a production corresponding to a couple of hundred livestock units, a reduction in feed conversion of 0.2 feed units per kg gain will increase the profit by approx. DKK 100,000.

## Focus on management

It is highly likely that the production economy of most finisher producers can be improved as shown by the above examples. Corresponding calculations can be made for weaner productions.

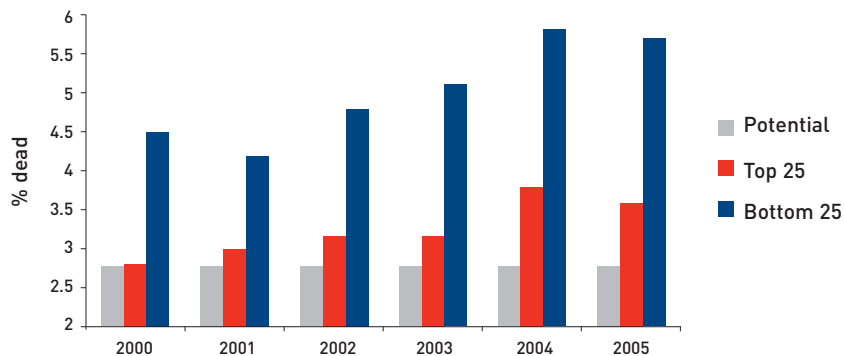
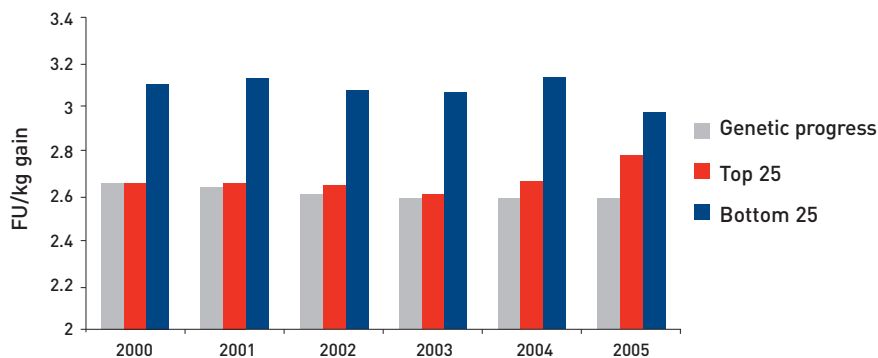


Figure 1. Development in mortality over the last 6 years among finishers.



Development in feed conversion per kg gain over the last 6 years among finishers.

Danish pig producers generally have a significant unexploited potential. This potential will be realized through the current focus on management in which the vision is to bring all available know-how into the pig facilities.

The new guidelines developed in close co-operation with the local pig advisory service and Danish Pig Production form a good basis for this work. The Guidelines for Farrowing Facilities for tending to sows and piglets and Growth Management for weaners and finishers have been implemented and are in great demand. More guidelines are on the way, such as guidelines for gestating sows and guidelines for managing liquid feeding systems.

## Focus on follow-up

Regardless of how excellent these guidelines are, they do not necessarily improve the bottom line result. The pig producer, the staff in the facility and the advisor must together decide where to intervene.

The results will improve when weak points in the system are found and clear agreements are made on who does what and when, and not least when to follow up. Advice accompanied by consistent follow-up will have the desired effect on the bottom line.



# Comparison of Danish and German prices

## Price

In both Denmark and Germany, the price per kg slaughter weight is published every week for the best weight group and for basic meat percentage.

## Settlement price

What the pig producer is actually paid per kg pork varies greatly compared with the price. Before settlement prices can be compared, corrections must be made for weight and lean meat adjustments, and various costs paid by the producer must be deducted. The pig producer is also able to influence the size of his deductions and bonuses and costs. The pigs' quality and the producer's business talents all affect the settlement price. This in particular applies when finishers are delivered to a German slaughterhouse.

In Germany, they have different ways of settling the pigs (settlement masks), which makes it difficult to calculate the settlement price. It is recommended to make trial deliveries to the slaughterhouses you would like to get in touch with. At the same time, you will have different options for negotiating bonuses for number of pigs delivered and for quality, and costs of, for instance, Vorkosten (classification, veterinary costs, rejection, loading platform fees, etc.).

Large-scale suppliers will typically be able to obtain lower deductions and perhaps bonuses for amounts or quality and thereby obtain a slightly higher settlement price than small suppliers. If the pigs are delivered directly to the slaughterhouse, Vorkosten may be, for instance, 0-1.3 Euro per finisher.

## Corrections of price

Two pig producers will hardly ever obtain the same settlement price at the same price. The corrections in table 1 are therefore the best offer. Some producers will experience a smaller difference than the one shown and others a greater difference. Together with an expert, the individual producer should form a detailed outline of what the adjustments will be in his case.

## Export of finishers

The German slaughterhouses would

Table 1. Corrections when calculating the settlement prices in Denmark and Germany.

| Price  | Denmark | Germany |
|--|---------|---------|
| Slaughter weight, kg   | 81      | 93      |
| Lean meat %  | 60      | 56      |
| Weight deduction, ore per kg                                       | -8      | -13     |
| Adjustment of lean meat %, ore per kg                              | -1      | -17     |
| Deductions for incidence of pleurisy rec. at slaughter, ore per kg | -2      | 0       |
| Slaughter weight correction, ore per kg                            | 0       | -4      |
| Vorkosten (classification etc.), ore per kg                        | 0       | 0-(-10) |
| Transport (200/180 pigs/load), ore per kg                          | 5       | -55-65  |
| Reloading, vet control, ear tags etc., ore per kg                  | 0       | -18     |
| Additional payment, ore per kg                                     | 70      | 0       |
| Total correction, ore per kg                                       | 64      | -117    |
| Total difference, ore per kg                                       |         | -1.81   |

like to receive heavier finishers than the Danish slaughterhouses. Even though the slaughter weight is perhaps only 10-12 kg heavier than in Denmark, there are a number of production conditions that need to be accounted for.

The lean meat percentage should be above 60 upon delivery to a Danish slaughterhouse, otherwise the lean meat percentage may be too low for the German market. Because of the way lean meat percentage is calculated in Germany, the lean meat percentage of Danish pigs drops by 3 percentage points all other things being equal. Furthermore, due to the increased slaughter weight, a drop in lean meat percentage must be expected.

The feed strength should be adjusted over the last 4-5 weeks of the growth period. The feeders must be suitable for large finishers and must be adjusted frequently to avoid unnecessary feed wastage.

The production should be planned so that entire batches of pigs are transported at a time, as the transport costs will otherwise be too high.

Every load of finishers should be weighed at the nearest weigh bridge. A killing-out percentage of approx. 20% is normal if the pigs are not weighed until 1-2 hours after loading. A reduction in feed conversion of approx. 0.01 FU<sub>g</sub> can be expected per kg increase in slaughter weight. However, considerable variations can occur between herds.

The terms of payment are approx. 10 days, and there is no VAT if pigs are delivered directly to a German slaughterhouse. An increased slaughter weight results in more livestock units (LU), also even though the kg gain produced do not increase. Therefore, be aware of the production permit. In Denmark, the last produced kg weigh heavily when LU is calculated. From 66.4 kg slaughter weight (87 kg live weight) and up, only 1,527 kg carcass are required to constitute an LU. Thereby, the number of pigs that can be produced drops by a greater percentage than the slaughter weight increases.

Table 2. Pigs produced with different slaughter weight

| Slaughter weight, kg | 81      | 93      |
|----------------------|---------|---------|
| Produced pigs        | 10,000  | 8,000   |
| Kg carcass           | 810,000 | 744,000 |
| Livestock units      | 309     | 309     |

## Settlement conditions

German settlement masks are all different, but generally the basic lean meat percentage is 56. The basic weight, for instance, lies between 84 and 102 kg. If the lean meat percentage is higher than the basic, it is honoured with a small bonus of typically 0.01 Euro per percentage point, whereas if it is below the basic, 0.03-0.04 Euro per percentage point are deducted. If the pigs have a low slaughter weight, for instance below 73 kg, 0.02 Euro are deducted per kg.

# Genetic progress, sale and production level

## Genetic progress

Table 1 provides an outline of the genetic progress of the individual breeds over the last four years. The variation in genetic progress between the individual breeds is caused by different breeding objectives and genetic potential between the sow breeds and the boar breeds. The breeding objective was revised in April 2006.

The number of live piglets per litter five days after farrowing (LP5) is a breeding objective combined of litter size and survival. Both sow breeds have produced high genetic improvement in this trait.

Killing-out percentage was included in the breeding objective for the sow breeds last year due to a fairly strong negative trend in this trait. As table 1 shows, this development has not yet stopped. However, as an average for

all breeds, there is no trend in this trait.

A new trait, longevity, was included in the breeding objective for the sow breeds earlier this year.

## Sale of breeding stock

As seen in table 2, the sale of hybrid females is unchanged at a high level. A slightly higher sale is seen among the purebred females. The development towards increased use of AI is reflected in the decreasing sale of live boars.

## Production level

Tables 3-6 show the production results achieved at the test station and in the nucleus herds in 2005/2006.

Since 2004/2005, the number of performance tested animals has dropped by 7.1%.

The number of performance tested boars has dropped by 9.7%. The number of performance tested Large White boars and Landrace boars has dropped by 1.6% and 7.2%, respectively, and the number of tested Hampshire boars and Duroc boars has dropped by 13.7% and 16.2%, respectively.

Testing of young females in the nucleus herds has dropped by 4.5%. However, the number of tested Large White young females increased by 3.8%.

Testing at the test station has increased by 33%. This increase is due to the fact that last year's disease problems have now been overcome.

Table 1. Genetic progress in the last four years, per breed and year and stated as an average per breed and year.

| Breed            | Year    | Daily gain<br>(30-100 kg),<br>g/day | Feed conver-<br>sion, FUP/kg<br>daily gain | Lean<br>meat<br>% | LP5  | Conforma-<br>tion,<br>points | Daily gain<br>(0-30 kg),<br>g/day | Killing-<br>out<br>percentage.<br>% | Longevity,<br>% | Progress,<br>DKK/year |
|------------------|---------|-------------------------------------|--|-------------------|------|------------------------------|-----------------------------------|-------------------------------------|-----------------|-----------------------|
| Duroc            | 02/03   | 21.4                                | -0.043                                     | 0.14              | -    | 0.03                         | 4.0                               | 0.04                                | -               | 8.08                  |
|                  | 03/04   | 19.0                                | -0.036                                     | 0.14              | -    | 0.04                         | 3.3                               | 0.14                                | -               | 7.79                  |
|                  | 04/05   | 20.6                                | -0.036                                     | 0.14              | -    | 0.03                         | 3.8                               | 0.18                                | -               | 8.02                  |
|                  | 05/06   | 16.1                                | -0.043                                     | 0.23              | -    | 0.02                         | 1.5                               | -0.03                               | -               | 7.49                  |
|                  | Average | 4 years                             | 19.3                                       | -0.040            | 0.16 | -                            | 0.03                              | 3.2                                 | 0.08            | -                     |
| Hampshire        | 02/03   | 10.8                                | -0.016                                     | 0.10              | -    | 0.01                         | 0.5                               | 0.02                                | -               | 3.62                  |
|                  | 03/04   | 14.6                                | -0.033                                     | 0.18              | -    | -0.01                        | -0.2                              | 0.06                                | -               | 5.96                  |
|                  | 04/05   | 14.2                                | -0.040                                     | 0.23              | -    | 0.02                         | -1.1                              | 0.03                                | -               | 7.03                  |
|                  | 05/06   | 24.0                                | -0.056                                     | 0.15              | -    | 0.05                         | 2.2                               | -0.01                               | -               | 9.29                  |
|                  | Average | 4 years                             | 15.9                                       | -0.036            | 0.18 | -                            | 0.02                              | 0.9                                 | 0.03            | -                     |
| Landrace         | 02/03   | 16.7                                | -0.029                                     | 0.08              | 0.20 | 0.03                         | 0.4                               | -0.01                               | 0.4             | 13.78                 |
|                  | 03/04   | 9.6                                 | -0.020                                     | 0.10              | 0.18 | 0.03                         | -1.1                              | 0.01                                | -0.1            | 11.11                 |
|                  | 04/05   | 20.3                                | -0.041                                     | 0.04              | 0.34 | 0.04                         | 0.1                               | -0.13                               | 0.4             | 20.04                 |
|                  | 05/06   | 7.4                                 | -0.040                                     | 0.01              | 0.44 | 0.05                         | -1.1                              | -0.17                               | 0.1             | 21.91                 |
|                  | Average | 4 years                             | 14.9                                       | -0.033            | 0.06 | 0.27                         | 0.04                              | -0.4                                | -0.08           | 0.27                  |
| Yorkshire        | 02/03   | 11.9                                | -0.025                                     | 0.04              | 0.17 | 0.06                         | 2.2                               | -0.09                               | 0.8             | 11.89                 |
|                  | 03/04   | 15.7                                | -0.025                                     | 0.01              | 0.31 | 0.06                         | 0.3                               | -0.05                               | 2.2             | 18.95                 |
|                  | 04/05   | 7.2                                 | -0.022                                     | 0.08              | 0.28 | 0.07                         | -0.9                              | -0.03                               | 0.0             | 15.35                 |
|                  | 05/06   | -1.7                                | -0.007                                     | 0.05              | 0.53 | 0.03                         | -0.5                              | 0.04                                | 2.3             | 25.01                 |
|                  | Average | 4 years                             | 8.3  | -0.020            | 0.05 | 0.32                         | 0.06                              | 0.3                                 | -0.04           | 1.4                   |
| Average 4 breeds | 4 years | 14.6                                | -0.032                                     | 0.11              | 0.29 | 0.04                         | 1.0                               | 0.0                                 | 0.82            | 12.39                 |



# Genetic progress, sale and production level

Table 2. Sale of breeding stock in the periods 2004/2005 & 2005/2006

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

\* Export incl. F2 females \*\* Incl. export.

Table 3. Average production results of boars performance tested at Bøgdgård, 2005/2006

| Breed       | Number | Daily gain, g/day<br>(30-100 kg) | Feed conversion<br>(FUp/kg gain) | Lean<br>meat % | Killing-out<br>percentage,<br>% |
|-------------|--------|----------------------------------|----------------------------------|----------------|---------------------------------|
| Duroc       | 1,580  | 1,011                            | 2.32                             | 59.8           | 26.5                            |
| Hampshire   | 969    | 882                              | 2.44                             | 62.0           | 25.1                            |
| Landrace    | 1,298  | 933                              | 2.41                             | 61.0           | 26.8                            |
| Large White | 1,281  | 939                              | 2.35                             | 61.1           | 26.0                            |
| Total       | 5,128  | -                                | -                                | -              | -                               |

Table 4. Nucleus herds – average production results for boars, 2005/2006

| Breed     | Number<br>(0-30 kg) | Daily gain, g/day<br>(30-100 kg) | Daily gain,<br>g/day % | Lean<br>meat % | Conformation,<br>points |
|-----------|---------------------|----------------------------------|------------------------|----------------|-------------------------|
| Duroc     | 8,413               | 383                              | 1,036                  | 60.3           | 2.91                    |
| Hampshire | 2,670               | 360                              | 867                    | 62.2           | 3.00                    |
| Landrace  | 17,291              | 383                              | 969                    | 62.2           | 2.94                    |
| Yorkshire | 14,457              | 361                              | 935                    | 61.5           | 3.07                    |
| Total     | 42,831              | -                                | -                      | -              | -                       |

Table 5. Nucleus herds – average production results for young sows, 2005/2006

| Breed       | Number<br>(0-30 kg) | Daily gain, g/day<br>(30-100 kg) | Daily gain,<br>g/day % | Lean<br>meat % | Conformation,<br>points |
|-------------|---------------------|----------------------------------|------------------------|----------------|-------------------------|
| Duroc       | 10,258              | 364                              | 984                    | 60.4           | 2.98                    |
| Hampshire   | 3,784               | 366                              | 835                    | 62.1           | 3.09                    |
| Landrace    | 21,303              | 385                              | 931                    | 62.1           | 3.08                    |
| Large White | 17,223              | 364                              | 903                    | 61.4           | 3.14                    |
| Total       | 52,568              | -                                | -                      | -              | -                       |

Table 6. Nucleus herds – litter size of purebred litters, 2005/2006

| Maternal breed | Litter size (purebred<br>litters in nucleus herds) | LP5  | Percentage<br>of gilts |
|----------------|--|------|------------------------|
| Duroc          | 9.9  | -    | 68.6                   |
| Hampshire      | 8.6  | -    | 70.0                   |
| Landrace       | 14.4   | 10.7 | 51.8                   |
| Large White    | 14.2   | 11.4 | 61.7                   |

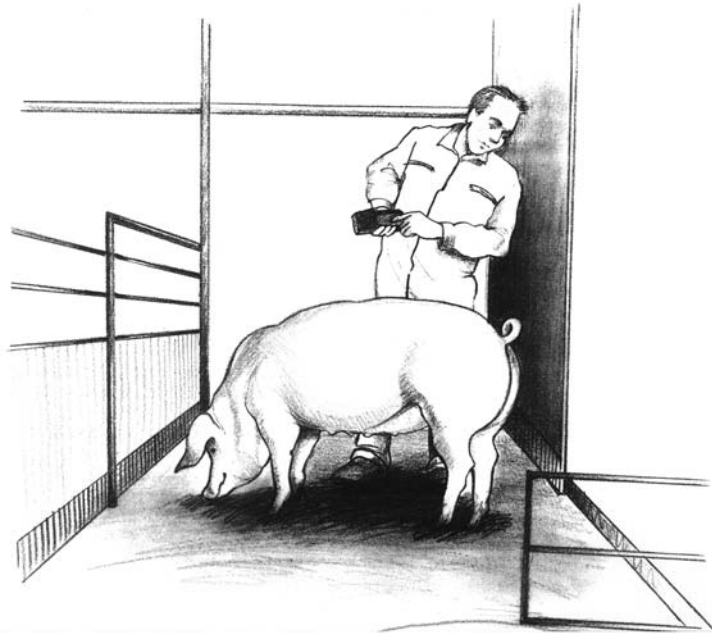
## Sow longevity included in the breeding objective

In the pig production sector, there has been an increasing focus over the last years on the number of sows that are culled too early from the production. Sow longevity is defined as "the sow's productive life", i.e. her age at culling or the total number of litters she produces.

A sow's longevity is not known until she is culled from the production. The use of this type of data will cause a significant reduction in the genetic progress due to delays between the animals of which we know the longevity and the ones selected for further breeding. We are therefore forced to look for other traits that only indirectly describe the sows' longevity. "Strength" is one of these traits that has been included in the breeding objective for years now. Because of this, the average strength for all breeding sows today is level with the average of the best 25% animals in 1996. However, even this great genetic progress is not enough to solve the problems concerning sow longevity.

Danish Pig Production has decided to include an alternative trait in the breeding objective. Among the gilts served for their first litter, the new trait is defined as the probability of the same female animal being served for her second litter. With this definition, this trait describes the sow's ability to complete an entire cycle. Information on the period until service after the first farrowing is achieved at an earlier point in time, which is an advantage in the efforts in finding a useful trait for selection. However, only sows in multiplier herds can provide information on longevity, and these data are collected from reports made in the multiplier herds over a long period of time.

Sows' ability to be served for their second litter was studied among Landrace sows and Large White sows from multiplier herds. It was proved that this indirect longevity trait is heritable. The results show a heritability of 0.162 for Large White and 0.169 for Landrace. The financial value of this alternative breeding objective for



*One of the aims of breeding for strength is to improve the leg position, strength and movement of the breeding stock.*

longevity was found to be DKK 0.85/percentage point improvement. This means that every time the number of sows served for their second litter is increased by one percentage point, the costs per produced finisher are reduced by DKK 0.85.

### The super sow project

This project, which was initiated in the autumn 2001, was terminated in the spring 2005. Analyses of the data from the project continued during the spring 2005, and through analyses made of super sow data at the Danish Institute of Agricultural Sciences (DIAS) it was demonstrated that litter size in 2004 – as opposed to data collected previously – was affected by father effect. On this basis, it was decided to stop the collection of data. The recordings of disease and behaviour data (shoulder ulcers, sow temperament, MMA, etc.) show very low heritability (below 5%). Correlated with the fact that these are either/or recordings, this means that it cannot be justified (on the basis of super sow data) to include these traits in the breeding work. It furthermore turned out that pigs' birth weight and our knowledge of mortality from day 5 to day 21 cannot be used in the breeding work.

Litter weight at day 21 is a "wild card" that has been recorded on a large number of the litters. Heritability (depending on breed and statistical model) can be calculated to 0.15-0.20. It has so far been decided to suspend this possibility due to reservations concerning the consequences of an increasing milk yield.

### Strength and longevity in sows

In 2001, a project was initiated with the aim of establishing the correlation between strength assessment of gilts and the strength of the same animals as sows. Data are collected in several production herds with female animals of known origin. In practice, this means that the producers either buy their breeding stock or breed them at the farm by way of KerneStyring®. Strength will be assessed on 16,050 gilts weighing 90 kg, and the producers submit production results and elaborate description of the culling cause of the assessed animals.

As of March 2006, culling causes had been recorded for 15,700 sows. When the final data have been collected, the data, for instance of the sows' reproduction data, will be analysed more closely. It is expected that the current strength assessment in the breeding



# Research and development

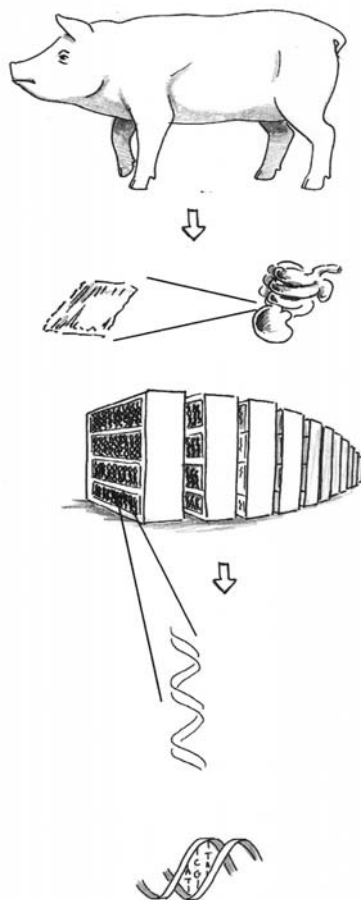
herds influences the longevity of the production sows. Furthermore, the project will probably provide information on the traits affected in the sow when the new breeding objective for longevity is included.

## The F4 project

The aim of this project is to make the four breeds in the breeding system resistant to diarrhoea caused by *E. coli* 149 F4 ab/ac. This type of diarrhoea is estimated to be the most common type in Danish pig production and is estimated to cause a loss of minimum 200,000 weaners a year. The resistance is linked to a single gene that comes in two versions: a version giving resistance (R) and a sensitive version (S). Only animals with the resistance version in "double doses" (RR) are resistant. When the project began in September 2003, there was a great difference in the spread of the F4 resistance among the breeds. The Landrace population had approx. 1% resistant animals; the Large White population approx. 20%; Hampshire probably 100%; and Duroc approx. 88%.

The management of boar use has led to the expected increases in the resistance among Landrace and Large White to *E. coli* 149 F4 ab/ac. Thus among the Landrace population, approx. 35% of the tested boars are now resistant (August 2006). Correspondingly, approx. 75% of the Large White boars tested are resistant. During 2005, the testing of boars was supplemented with testing of boar mothers in cases when this was more economical than testing of boars alone.

A strategy was initiated for Duroc in the spring 2006. In the quarantine of future AI boars, boar mothers are tested. If it is not possible to determine the genotype of young boars on the basis of the genotype of their parents or if sample material cannot be obtained from the mother, the boars will be tested. As of March 2006, only Duroc boars of genotype RR will be used in the breeding work. The strategy described for Landrace, Large White and Duroc is expected to run for a number of years after which



*The pig genome project is divided into sub-objectives to be reached in each phase. The project will make pig breeding and the economy of pig production more efficient.*

sows with unknown genotype might be tested. A strategy for the Hampshire breed has not been decided upon yet.

## The pig genome project

The Department for Breeding and Multiplication and DIAS are co-operating in a project on identification of essential chromosome areas. Using the basic knowledge of SNPs (Single Nucleotides Polymorphisms, a small genetic change in the hereditary mass) obtained in the Sino-Danish genome project, the pig genome project utilises essential knowledge of genes, SNPs and sequencing of genes. The project is divided into five phases, and is financially supported by the Directorate for Food, Fisheries and Agri Business through the Innovation Act.

Phases 1-3 have now been completed and phases four and five were initiated at the end of 2005. By using biotechnological methods such as SNP based DNA typing and QTL analyses (Quantitative Trait Loci, genes controlling quantitative traits such as gain), the aim of the project is to identify chromosome areas in which single genes or gene complexes exist that greatly influence economically important traits in pig production. The project focuses on mapping of genes for traits that are difficult to improve through traditional breeding methods (BLUP based index selection). These are particularly traits with a low heritability and traits that are difficult to measure. This applies in particular to general and specific disease traits.

The project will make breeding more efficient and thereby improve the economy of Danish pig production. The first phases of the project have been successfully completed and genes with a highly significant effect on important hereditary traits have already been identified. This information was utilised in the second phase during which it was shown that it was possible to identify significant QTLs for a number of chromosomes. In the third phase, knowledge of DNA markers was linked with the pig's traits. The aim of the fourth and fifth phases is to identify chromosome areas in the pig genome.

Data were used from the projects Breeding for Disease Resistance and the pig genome project as they produced phenotypic data and DNA sequence data, respectively, that make it possible to study whether phenotypic differences are conditional upon molecular genetic differences in the hereditary mass of the pig. Selection of SNP based markers and type definition of 1.8 million SNP genotypes will also continue as will the calculation of genetic maps for all chromosomes.

## Boar importance to litter size

In the period 2003-2004, the boar's influence on the number of piglets born per litter (PBL) significantly increased. In this period, the variation in litter size that could be attributed

to the boar increased from 5.2% to 7.5% among Landrace sows and from 2.8% to 5.9% in litters from Large White sows. A corresponding development was also found in analyses made by DIAS.

To further study the problem, statistical analyses were made that partly describe the development in various traits measured on the boar semen and partly use statistical models in which litter size is analysed on equal terms with traits measured from boar semen. The models used include the boar as random explanatory effect and the kinship between the sows as genetic effect.

The data material for the analyses was produced in co-operation between Danish Pig Production and the AI stations who provided information on producers that had purchased semen in the different weeks. The Department for Nutrition and Reproduction made a great effort in linking information on semen doses with recordings from breeding and multiplier herds of sow ID and date of service.

The results show that the increase in the boar's influence on litter size is not correlated with changes in the correlations between the traits measured on the boar semen. The analysis results of time sequences show that the average amount of crude semen per dose increased by approx. 0.5 ml in August 2003. In that same month, the variance of the amount of crude semen per dose doubled (from 5 to 11). The average motility, calculated per month, and the variance on motility in the crude semen were fairly constant in the period 2003-2005. On the basis of the analyses it was not possible to detect one single factor causing the increase in boar variance on litter size.

### Sow experiment at Grønhøj

The sow crossbred experiment at Grønhøj investigated the fertility and longevity in the same production environment of different combinations of breeds. The combinations used were YL, (DY)L and zigzag (L and Y). Data are currently being analysed and a final report is expected later this year.

Table 1. Difference between 62 Duroc boars with more than 50 offspring

|                           | Sick offspring per boar, %, phenotypic data |                    |           |            |
|---------------------------|---|--------------------|-----------|------------|
|                           | Average                                     | Standard deviation | Best boar | Worst boar |
| Mycoplasma pneumonia      | 14.5  | 7.4                | 3.7       | 37.8       |
| Chronic adhesive pleurisy | 53.3  | 10.1               | 30.9      | 71.2       |
| Pleuropneumonia           | 1.5   | 1.6                | 0         | 6.4        |
| Pericarditis              | 7.9   | 4.0                | 0         | 20.9       |

### Salmonella resistance in pigs

Many traits in pig breeding are very difficult or financially impossible to improve through the traditional breeding methods. Studies of the Salmonella bacterium have found a small percentage of examined pigs that were not infected with Salmonella. As only a small percentage of the animals displayed resistance, we may be dealing with a genetically conditioned resistance related to a single gene.

A genetically conditioned resistance to Salmonella infections will be of great financial importance to the pig production industry as large parts of the pork market focus on the prevalence of Salmonella. The current precautions in terms of production and slaughtering against Salmonella infections of meat products are efficient, but not 100% efficient, and they are at the same time difficult and expensive.

In hens, a gene that results in resistance to Salmonella infection has been identified. This is another important reason to search for a corresponding resistance in pigs. A project aimed at discovering a resistance gene was initiated in 2004 and was finished in the summer 2006, during which 600 animals in the first generation and 200 animals in the next generation were tested for resistance.

The aim was firstly to see whether there is a hereditary resistance to Salmonella. To prove that we may be dealing with a resistance controlled by a single gene, it was necessary to identify a number of litters in which at least two individuals did not respond to the Salmonella infection.

The project was divided into two phases; in the first phase the possibility

of a genetic resistance was investigated. In this phase, 600 pigs were inoculated with the type of Salmonella most common in Denmark. Of these 600 pigs, 40 male pigs and female pigs, approx. 7% of the pigs, did not form antibodies against Salmonella, which is an indication that the pigs could be resistant. The 21 "resistant" female pigs were served in October/November 2005 with the "resistant" boars. In April/May 2006, the 200 offspring from these female pigs were inoculated with the same type of Salmonella as the first generation.

The preliminary results show that 8% of the pigs do not form antibodies, which is the same number as in the first generation. This probably indicates that several genes contribute to resistance and that several factors influence resistance to Salmonella. The results will be analysed in detail in the autumn 2006.

### The pneumonia project

Lung disorders in finishers are a major problem in production herds. It was therefore discussed whether there may be a heritable variation for various lung disorders. In the Sino-Danish genome project and in the project Breeding for Disease Resistance, offspring of Duroc boars were recorded and analysed for presence of various diseases. It was concluded that there are significant differences in the frequency of lung diseases between the offspring of the different boars (see table 1). To investigate this difference, the variation between the offspring of the boars and the heritability of two financially important lung diseases will be elucidated.

In 2005, data were collected from a



sow herd with 650 sows of known origin. The sows were served with named Duroc boars, and six to eight litters were produced from each boar. The producer recorded and reported dates for service and farrowing, litter size, survival/mortality in the weaner facility, prevalence of hernia and both parents of the litter. The herd data will be correlated with information on the origin of the animals, which is stored in the Data Bank. A third of the pigs were sold at 35 kg to two finisher producers. The pigs were thereby slaughtered from three different herds. At the slaughterhouse in Holstebro, all the pigs from the trial were evaluated and lung lesions recorded during the extended health control (EHC). Approximately 13,000 pigs were produced and slaughtered in the trial. The phenotypic data show that there is a difference between the suppliers of the pigs both in terms of production results, slaughter results and lung lesions, particularly in terms of Mycoplasma lung disease for which the level is more than 10% lower in the best herd. Data will be analysed in detail with the aim of determining heritability and other genetic parameters. Furthermore, the correlation between the various lung diseases and production traits, for instance daily gain, will be investigated. Table 2 shows the percentage of the different lung diseases.

*Table 2. Incidence of pleurisy recorded at slaughter*

|                              |       |
|------------------------------|-------|
| Number of pigs slaughtered   | 6,347 |
| Pneumonia, %                 | 14.3  |
| Chronic adhesive pleurisy, % | 52.3  |
| Pleuropneumonia              | 1.2   |
| Pericarditis, %              | 8.5   |

### Study of survival

In November 2004, a trial was initiated parallel with the pneumonia project in the same herd to investigate differences in survival from birth to slaughter in Duroc and HD offspring. For a period of time, the herd will therefore also receive HD semen from two boars each week to produce both HD and D sired litters. In the trial

period, survival of 2,000 HD hybrids will be compared with the survival of D hybrids. The trial will provide useful information on differences in survival between offspring of the two boar breeds.

### Genetic causes of boar taint

Boar taint is often caused by a high level of skatole. Boar taint can be reduced through castration, but this affects growth negatively. It is therefore interesting to study other methods for reduction of boar taint.

Both content of skatole and of androstenone have been found heritable, and there is in the EU a desire to find genetic ways to solve the problem. The aim of the project is to find the gene(s) responsible for boar taint in pork. In co-operation with British scientists, the content of skatole and androsterone will be measured in 2005 in samples from slaughtered, performance tested Landrace boars. 8,000 fat and meat samples have been collected from Landrace boars at three slaughterhouses. Among the samples, 500 sibling couples will be selected; one with a high skatole content and one with a low. To reach this objective, tissue samples have been collected from all slaughtered Landrace boars over a long period of time. Afterwards, the animals will be selected for further work. The first 600 fat samples have been submitted to Norway for androsterone analyses, and subsequently samples will be sent to Scotland for DNA analyses where the gene technological work with finding single genes with importance for boar taint will be conducted.

### Risk in using PRRS vaccinated boar semen

PRRS vaccination of the boars for part of the AI stations has now worked for five years. In this period, the system has guaranteed the possibility to use the genetic material from PRRS infected breeding herds in all parts of pig production. The veterinary department has investigated the risk for herds in an area with a low PRRS prevalence for infection through semen from PRRS vaccinated boars.

Breeding and multiplier herds in Zealand and in Lolland-Falster are rarely infected with PRRS. Since 2001, 37 active breeding and multiplier herds in Zealand and in Lolland-Falster have been attached to Danish Pig Production. Of these, 30 have received semen from the positive system for long or short periods of time. In this period, one of the 30 herds has become infected with PRRS. Assuming that infection through semen caused this, the annual risk of semen infection is less than 1%. Compared with the rest of the country, approx. 7-8% of the herds are annually infected with either vaccine virus or Danish PRRS, so the risk is low. Other causes therefore trigger the infection.

All other things being equal, rejecting semen from PRRS vaccinated boars at the AI stations will jeopardize the quality of the breeding stock – this particularly applies in connection with purchase of semen for production of gilts. It is estimated that it will cost approx. 8-10 index points on the purchased semen if PRRS vaccinated boars are rejected. In a closed production herd with 500 sows/year with production of young females, rejecting PRRS vaccinated boars will cause an annual loss of approx. DKK 70,000 corresponding to more than DKK 100 per sow/year. The annual production loss of DKK 70,000 must be correlated with the annual risk of PRRS infection, which is less than 1%. One case per 120 years with an annual insurance premium of DKK 70,000 means that the total costs of avoiding the one case amounts to more than DKK 8 million.



# AI and control of processed products

## Semen sale

The sale of semen from Danish DanBred AI stations increased by 6.2% compared with 2004/2005. Approximately 4.7 million semen doses were sold corresponding to approx. 79% of all services being performed with purchased semen. The calculations are based on an estimated population of 1,146,000 sows and gilts in Denmark. Figure 1 shows the sale of semen over the last five years.

## Control of the number of sperm per dose

The routine control of semen doses has shown satisfactory results. Analyses of semen doses from Danish DanBred AI stations show that the number of sperm per semen dose is uniform and that the doses contain the correct number of sperm.

## Microbiological control of semen doses

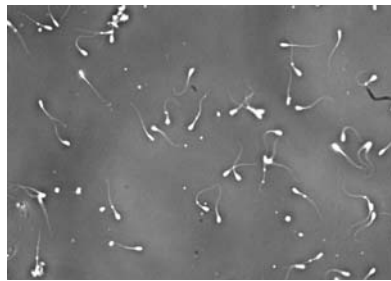
Semen doses are routinely checked for germ content to ensure that semen doses from the AI stations do not contain bacteria. There were satisfactorily few positive samples in 2005/2006.

## Semen quality – examination of defect sperm

In pig production, it is essential that the semen has as high a fertilization capacity as possible. There will always be some boars with reduced fertility. The aim of this trial was to examine whether it is possible to detect boars with reduced fertility on the basis of a semen examination. During such an examination, the number of defect sperm is counted.

It was expected that some boars with reduced fertility would not have defect sperm. It was also expected that boars with a high fertility would not have defect sperm.

The preliminary results do not lead to a clear conclusion as the trial both found boars with reduced fertility and normal sperm, and boars with a high fertility and defect sperm. Further investigations will clarify whether the type of defect is essential and how conclusive one examination of the semen defects is.



Sperm.

## Semen quality – examination of the sperm motility

Assessment of the sperm motility has always been the preferred method for evaluating semen quality. Danish Pig Production has purchased an instrument that can analyse this with significantly more accuracy than the eye. The instrument consists of a microscope to which a camera and a computer are attached. The computer analyses a number of images and is then able to accurately determine the speed and pattern of movement of the sperm in the microscope.

With this method, it is possible to measure very small effects on the semen – effects that were previously difficult to measure but that may be important to the fertilizing capacity of the semen.

## The number of live sperm can predict the boar's fertility

Analyses have shown that measurement of per cent live sperm in semen doses may predict the boar's fertility. Over the last two years, semen doses from approx. 1,500 boars have been analysed and linked to approx. 190,000 litters. The results revealed a clear correlation between the number of live sperm in the semen doses and the litter size. This effect did not only apply to the semen dose in question, but also to the boar's fertility. It is thus possible to predict the boar's fertility on the basis of a few semen analyses. The results confirm previous analyses, but for the first time show distinct differences between the breeds. With this method, it may be possible to detect some of the boars with reduced fertility before they are used at the AI stations.



Collection of semen.

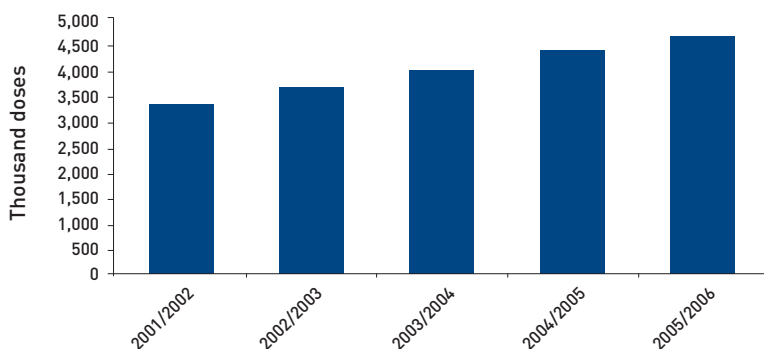


Figure 1. Development in sale of semen from 2001 to 2006.

## Semen quality – analysis of the fertilizing capacity of the sperm

In co-operation with the Royal Veterinary and Agricultural University, the fertilizing capacity of sperm is being analysed. With this method, it will be possible to analyse how many per cent of the sperm in a dose that are actually capable of completing the fertilization process. This method supplements the above-mentioned methods for analysing the semen quality.



# Insemination

## Reduction in labour and number of semen doses

A trial compared one versus two services per sow/heat in three well-managed production herds. In both groups, the producers practised their usual routines for heat check. The sows in the control group were inseminated twice with a 24-hour interval: the first insemination took place max. 16 hours after standing heat was first recognized. The sows in the trial group were inseminated once per heat max. 24 hours after standing heat was first recognized.

It was concluded that pig producers who have a high production level and who have a systematic heat control and service strategy are able to obtain a farrowing rate identical to that achieved with two inseminations per heat by only inseminating once per heat. However, there is a risk of losing up to 0.5 piglets born per litter. It is also possible to save up to 25-50% of the time spent in the service facility. The time saved in the service facility was primarily spent in the farrowing facility (see trial report no. 734).

In another trial dealing with saving time, insemination equipment is investigated. The instrument "Mr. Stimulus" was developed to stimulate the sow's flank by way of compressed air while the sow takes the semen herself from the semen bag stand. The results will be available by the end of 2006.

## Reducing the semen dose

In a current trial, the sows are inseminated with production semen. The doses contain 2 billion sperm cells (control) and 1.5 billion sperm cells (trial), respectively. Both semen doses have an insemination volume of approx. 80 ml. The preliminary results show no differences in reproduction results expressed as the total number of piglets born per litter and farrowing rate.

## Intra uterine insemination

Previous trials have revealed reductions in the reproduction results during intra uterine insemination when the amount of semen and the insemination volume are reduced.



Female organs with a intra uterine insemination catheter. Note that the inner tube is led through the cervix to the uterus.

A current trial with intra uterine insemination with a two-chamber bag will clarify whether it is possible to reduce the number of sperm cells in a semen dose while at the same time maintaining an insemination volume of approx. 80 ml and without compromising the reproduction results.

## Shelf-life of boar semen

The longer semen doses can keep, the easier it will be to plan ahead for the AI stations and for the pig producers. Thereby the workload of the AI stations will be distributed over the entire week. It would be advantageous for the pig producers that semen collected and delivered on, for instance, Monday, can last for longer than Wednesday at noon so that it can also be used for returners and gilts. A current trial will clarify whether it is possible to store production semen for more than the guaranteed 2.5 days and still achieve the same reproduction results.

The preliminary results indicate that there are no differences in farrowing rate or litter size between semen doses produced Friday and used Monday/Tuesday and semen doses produced on Monday and used Monday/Tuesday.

## Sexing of boar semen

Danish Pig Production is co-operating with the Welsh company Ovasort Ltd.



Insemination with a two-chamber bag.

together with Norsvin, the Norwegian breeding and AI organisation, and DanBred's AI stations on sexing of boar semen. With sexing of boar semen, it is possible, in the lab, to separate the sperm cells resulting in gilts from the sperm cells resulting in boars. Antibodies developed against proteins on the sperm cell surface are used for sexing whereby the sperm cells resulting in boars are bound. It is then possible to produce semen doses that in 70-90% of the cases will result in gilts only. Provided the project is a success, a delicate economic estimate will be approx. DKK 250 million a year. The project runs for three years, but we expect a clarification by mid-2007 of whether sexing is possible.

# Test for gestation

## Test of two-dimensional ultrasound scanning

Gestation tests aim at positively finding the empty sows so that they can be served again or be culled. Thereby non-productive days are saved. The scanner must not diagnose gestating sows to be empty.

Two-dimensional scanning was studied in two herds. The managers performed the scanning according to the instructions of the vendor. Of a total of 1,195 sows that were served, 88.6% farrowed and 7.8% were served again. 3.5% of the sows died, or were culled after service as being empty or due to other causes. Fifty-six sows (4.7%) were rebred or culled before they could be scanned. Scanning does not affect the number of non-productive days for this latter part of the returners. Scanning of the remaining 1,139 sows diagnosed 29 as empty (2.5%). Of these, two sows farrowed at expected time, giving birth to a litter of acceptable size. Thus 7% of the sows were incorrectly diagnosed as "empty". It is recommended to always scan empty sows once again before culling them.

The managers were in doubt of the result when scanning eight of the sows. These sows all returned later. If a manager is in doubt about the result of the scanning, it is recommended to repeat the test 1-2 days later to prevent having too many non-productive days. At the scanning, the managers found 1,102 of the sows to be gestating. However, 46 of these did not farrow. Almost half (22) were later rebred or were culled with the code "culled, empty". The scanning thus only diagnosed half of the empty sows. It is not clear whether these sows were empty already at the time of scanning. The majority of the rebreedings of sows diagnosed to be gestating were performed within the first three weeks after the scan. This indicates that the sows were empty when they were scanned.

## Experienced technicians

On the basis of these results, another trial was initiated. At Experimental Station Grønhøj, 119 gestating and 26 empty sows were scanned by four experienced scanning technicians. The sows were subsequently slaughtered

to investigate whether the diagnoses were correct. A total of 387 scans were made. The results were clearly better than those of the managers. This may partly be due to the fact that the sows did not have time to abort or absorb the foetuses after the scan.

The technicians were in doubt of the diagnosis of five of the sows (1.3%). Of these, two were gestating and three were empty. Sixty-one of the scanings showed empty sows. None of these sows were gestating. Of the 323 scans with the diagnosis "gestating", two sows were empty (1%). This shows a very low error rate among scanning technicians. Some of the empty sows were diagnosed as gestating due to liquid in the uterus or cysts in the ovaries. Half of the cases in which the technicians were in doubt were caused by abnormally small foetuses.

For an experienced operator, scanning for gestation is a good tool. It is recommended to scan the sows after 3.5 weeks and after six weeks.

## Foetal death

Upon slaughter of 82 gestating sows, the number of yellow bodies on the ovaries was counted. Each yellow body shows where one egg has been loosened. The number of ovulations denotes how many piglets the sow would have been able to deliver. Each sow had an average of 25.3 ovulations. This is a high number compared with previous Danish studies and with more recent foreign studies. At slaughter on day 30, 20.1 foetuses were left resulting in a foetal death of 21%. This is a lower early foetal death in Denmark compared with foreign



Ovary with a paraovarial cyst. This is harmless to the sow, but may lead to errors at scanning.



Scanning image of a paraovarial cyst. The dark area appears like the image of a foetus.



Foetus and foetal vacuole day 28.

studies. It seems that the high litter size is the result of a high number of ovulations in the sows and a lower early foetal death.

## Adenomyosis

Adenomyosis is a disorder during which the glands of the mucosa grow into the muscle layer of the uterus. It is unknown what triggers this disorder, but it is most frequently seen in older sows. This study did show that often adenomyosis is seen in the tissue under the smallest foetuses on day 30. Adenomyosis may be the reason why older sows deliver fewer and more non-uniform piglets.

# Feed hygiene and industry codes

## EU regulation

The new EU rules for production of food and feed came into force on January 1, 2006. The aim is to produce safe feedstuffs and food and this involves the entire chain from “pen to plate”. The new rules mean that farmers must be able to document that their production methods conform with the established “good management practice”. Furthermore, it must be possible at any time to trace the feed back to its origin.

## Good management practice

Good management practice concerns sensible and responsible use of and production of feed. The Feed Hygiene Regulation includes requirements concerning cultivation of crops, purchase, storage, feeding and on-farm transport of feed, and concerning infection protection, education etc. Most of the requirements are already fulfilled by the producers. The novelty is that they need to be able to document this.

## Industry codes

In co-operation with other agricultural organisations, Danish Pig Production has made a description of “good management practice in primary production” – a set of so-called Industry codes.

Using the Industry codes is the easiest way to check whether you meet the requirements in the Feed Hygiene Regulation. Together with a number of documents that you already possess, the Regulation will constitute a significant part of the documentation needed in connection with an inspection.



*A complete set of Industry codes can constitute part of the documentation at an inspection.*

It is easy to use the Industry codes. They are structured as a table in which you select the work processes concerning agricultural production. This could be mixing of feed, for instance. It furthermore says which control points are required and how to document these. For instance, that the feed mixer is checked for accurate intake of ingredients. Below the table, the individual points are elaborated.

When you have selected the relevant processes, sign the classification and check whether you actually comply with the mentioned control points. The majority of the control points are regular routines at most farms. You must be able to provide the signed set of Industry codes during an inspection.

## Additives and HACCP

If a producer uses premixes or feed additives in their pure form in his production, he must report this to the Danish Plant Directorate and the use must comply with the HACCP principles.

Note that failure to report is covered by the rules for cross-compliance, which means that mistakes may lead to deductions in the hectare support.

HACCP is an abbreviation for Hazard Analysis and Critical Control Points. With HACCP, you need to go through the daily feed routines in the herd and pinpoint areas in the production where errors may jeopardize the health of animals or humans or damage the environment. These areas are called critical control points. When you have completed this risk analysis, you must describe how you are going to avoid errors and what to do if errors occur after all. You must also describe how you will ensure that the errors will not occur again.

In co-operation with the remaining agricultural organisations, Danish Pig Production has made proposals for how to describe HACCP. The proposals can be downloaded from the website of the National Centre and be adapted to your own herd.

In the example below, a risk analysis is shown for certain premixes with statutory maximum limits.

The Industry codes and examples of HACCP plan can be downloaded from [www.landscentret.dk/branchekode](http://www.landscentret.dk/branchekode)

Table 1. Example of risk analysis for premixes containing vitamin A, vitamin D, copper and selenium.

| Steps            | Potential risk factor  | Seriousness |        |      | Probability |        |      | Measure                     |
|------------------|------------------------|-------------|--------|------|-------------|--------|------|-----------------------------|
|                  |                        | Low         | Medium | High | Low         | Medium | High |                             |
| Receipt of goods | Incorrect good         |             | x      |      | x           |        |      | Industry codes for GMP, 2.1 |
| Storage          | Mixing with other feed |             | x      |      | x           |        |      | Industry codes for GMP, 2.2 |
| Dosage           | Dosage is too high     |             | x      |      |             | x      |      | HACCP plan                  |
| Mixing           | Non-homogeneous mixing |             | x      |      |             | x      |      | HACCP plan                  |

If “Seriousness” and “Probability” are evaluated to minimum “Medium”, a HACCP plan must be made. Otherwise it will be sufficient to refer to the Industry codes for Good Management Practices.

# Liquid feed

## Fermented grain

Previous trials have shown that it is possible to improve the daily gain and feed conversion in heavy pigs and weaners by using fermented grain as the pigs have an improved utilization of the grain when it is fermented. This may be due to a higher digestibility of fermented grain. In a digestibility trial made in co-operation with the Danish Institute of Agricultural Sciences, increases in FUGP content during fermentation of barley and wheat, respectively, are being investigated.

The effect of fermented grain for weaners and finishers is currently being investigated in a WTF production. Preliminary weaner results show that the trial feed containing fermented grain resulted in poorer production results compared with the control feed without fermented grain. The pigs given fermented grain in the weaner period also managed less well than the control pigs in the finisher period when they were still given feed containing fermented grain. The effect of fermented grain in finisher feed is currently being studied when the pigs in the control group and the trial group have been given the same feed without fermented grain in the weaner period.

The reduced production results with fermented grain to weaners were probably caused by a large amount of feed residue in the pipeline and mixing tank (more than 50% of the feed soup) in which the finished diet kept fermenting. Fermentation of finished liquid feed has previously been seen to result in poor production results due to, among other things, loss of synthetic amino acids. Particularly WTF herds experience large amounts of residue – percentage-wise – of weaner feed in the pipeline. The residue should not exceed 50% of the feed soup.

## Liquid feeding system without residue

Unwanted fermentation of finished liquid feed can be avoided by using liquid feeding systems without residue. Currently, experiences in Danish and German pig farms with the function of various liquid feeding systems



*When using fermented grain, the residue of finished liquid feed in the pipeline and tank should not exceed 50% of the feed soup to reduce the further fermentation of the finished diet. A trial has shown that pipeline fermentation of finished liquid feed containing fermented grain may reduce the production results among weaners.*

without residue for feeding of weaners are being analysed. In these systems, the pipelines are emptied with a push medium such as, for instance, water or fermented grain.

Preliminary results from a herd in which fermented grain served as the push medium show that up to 50% fermented grain was fed at some valves instead of weaner feed. Ad libitum feeding was employed in the herd, which means that not all valves were active during each feeding.

If restrictive feeding is employed where all valves are active during each feeding, there is a risk that the first and the last valves on the pipeline feed the push medium instead of feed. The producer must therefore include a large safety margin when calculating the line between feed and push medium in the pipeline.

## Fat in feed

A homogenous and efficient mixing of fat in liquid feeding systems is essential to ensure that all animals on the pipeline are fed a homogenous mix. At the same time, fat deposits in the mixing tank and pipelines are avoided. It is necessary to add an emulsifier to the fat to ensure proper mixing of the

fat in water. To obtain a good mix, it is important to

- Ensure a minimum temperature of the fat of 60°C (preferably 65°C)
- Add fat as the first ingredient to the water
- Spray the hot fat into the water with a squirt under high pressure

It is important to regularly take samples of the fat/water mixture to check that the fat is mixed satisfactorily.



*This picture clearly shows the difference between good and bad mixing of fat in water.*

# Feeding of weaners

## Weaning after 4 or 5 weeks

Weaning after four and five weeks was studied in four herds. The extra week of suckling increased the weaning weight by 1.4–1.9 kg per pig. The prevalence of diarrhoea and mortality post-weaning were reduced when weaning age was increased from four to five weeks, but the differences were not always significant.

With five weeks' weaning, more lactation feed and more weaner feed were used in the farrowing facility. The sows did not lose more weight in the nursing period with an extra week's weaning. The farrowing rate tended to be lower in the subsequent litter, but there was no difference in litter size, when the sows nursed for five weeks.

Particularly producers selling 7 kg pigs can benefit from weaning after five weeks. More pigs will reach a sufficiently high weaning weight so that the majority of the weaners can be sold at weaning (above 6 kg). For more information, see trial reports no. 663, 722, 750 and 752.

## Weaning, feed type and feed intake

The effect of weaning age and feed type on productivity and health post-weaning was studied in a trial. The pigs in the trial were weaned after 27 days or 33 days, and were given diets based on either wheat, rice, rice + 10% sugar beet pellets or rice + 7% barley hulls and 7% potato flour. The addition of colouring agents to the feed that also coloured the manure made it possible to see whether the pigs had eaten before weaning on day 27. The results showed that regard-

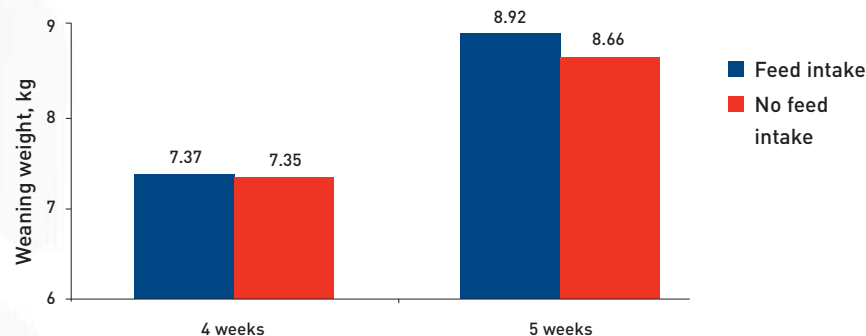


Figure 1. Weaning weight of pigs that had had a feed intake or no feed intake before weaning.

less of weaning age, diets containing rice resulted in a 50 g higher weaning weight compared with the pigs given wheat. Pigs weaned after five weeks that had eaten in the farrowing facility had a higher daily gain than pigs that had not eaten. Weaning weight and productivity of pigs weaned after four weeks were not influenced by whether the pigs had eaten feed in the farrowing facility.

No effect was found of weaning age, but an effect was found of feed type on the prevalence of diarrhoea. The majority of the treatments for diarrhoea (2.1 days/pig) were seen among the pigs given rice + barley hulls + potato flour. For more information, see trial report no. 752.

## Topfeed feeding concept

Topfeed is a feeding concept consisting of three diets given to the pigs as they reach a certain weight. This feeding concept was compared with the use of two simple control diets in the period from weaning to approx. 30 kg. The

use of the Topfeed feeding concept resulted in the same productivity in the weaners as the simple feed. No effect was found on diarrhoea and mortality. There was no difference in age at slaughter measured on the pigs given the same diet from 30 kg to 100 kg. The diets from Topfeed should therefore not be more expensive than the control feed (see also trial report no. 747).

## Commercial diets

Weaner diets from five different companies were purchased, investigated in practice and compared with a simple control diet. The diets were purchased anonymously via pig producers.

The highest production value was obtained by using the diets Bio Start 3 and 6 from S.A.B., but they did not deviate from the diets from ØA and DLG. There were no differences between the other diets.

In order to obtain the same productivity as with the control feed, diet 1

Table 1. Study of five commercial diets for weaners.

| Company  | Control | SCA           | DLG                 | S.A.B.      | ØA              | Carl Rasmussen & Hempler |
|--|---------|---------------|---------------------|-------------|-----------------|--------------------------|
| Diet 1   | Control | Bonus Denmark | Grisette            | Bio Start3  | Prima7          | Start 3 Agrow Vitacel    |
| Diet 2   | Control | Control       | Kvikstart plus Acid | Bio Start 6 | Unik Total syre | Start 5 Agrow            |
| Daily gain, g                                  | 565     | 583           | 588                 | 615         | 594             | 595                      |
| FUgp/day                                       | 1.00    | 1.03          | 1.04                | 1.06        | 1.05            | 1.07                     |
| FUgp/kg  | 1.78    | 1.76          | 1.77                | 1.72        | 1.77            | 1.80                     |
| Production value using same price per FUgp/pig | 65.2a   | 66.7a         | 68.1ab              | 72.8b       | 68.7ab          | 66.6a                    |
| Index  | 100     | 102           | 105                 | 112         | 106             | 102                      |



The companies were unaware that their weaner diets were included in a trial (trial report no. 745)

and diet 2 from S.A.B. can cost DKK 11 and 14 more, respectively, per 100 kg.

When there is no difference between the other diets, this means that the price of these must be the same as that of the simple control feed to reach the same end result. In table 1, the diets included in this trial are shown (see also trial report no. 745).

### Glutamine and glutamic acid for weaners

The purpose of adding extra glutamine and glutamic acid to pig feed is to add more energy and nutrients to the pigs' intestine to rebuild the intestinal mucosa that is destroyed during a diarrhoea outbreak. This trial comprised four groups:

1. Control
2. 50% extra glutamic acid
3. 50% extra glutamine
4. 50% extra glutamine and glutamic acid

There were no significant differences in diarrhoea, mortality or productivity between the groups. For more information, see trial report no. 749.

### Vitamins

The inclusion of vitamins is often one of the essential sales parameters in feed trade situations. Generally, the Danish vitamin standards should be met. The standards determine the amount of vitamins that must be added to the diet regardless of the feed's natural content.

Three different inclusion rates were studied – the inclusion rates were determined by DLG and DSM Nutritional Products. The aim of the increased dosage of vitamins was to increase the productivity of the pigs. The results showed that an increased inclusion of vitamins did not increase the productivity (see also trial report no. 744).

### Protein content and protein sources

Many weaner diets have a reduced protein content in order to improve health. This was studied in two herds. The results showed that weaners given a low-protein diet in which the protein content was 18% and the amino acid content was 20% below the standard, had 1.4 days fewer of treatments and a 28 g lower daily gain than the pigs given a diet complying with the standards. The financial benefit of fewer treatments constituted DKK1-2 per pig, whereas the reduction in productivity resulted in a loss of DKK 7 per pig.

The prevalence of diarrhoea was not influenced by whether the protein sources of the feed were based on soybean meal, regular fishmeal and potato protein, or on dried milk, a ground soy protein product and LT fishmeal, regardless of whether the comparison included two low-protein diets or two normal diets. In one of the herds, the diets containing dried milk, a ground soy protein product, LT fishmeal and heat-treated grain resulted in a 20 g higher gain the first three weeks post-weaning. In the other herd, there were no differences in productivity depending of the ingredients. If you decide to use expensive ingredients, make sure the costs are covered by an increased productivity (See also trial report no. 740).

Two other trials investigated diets formulated on the basis of alternatives to fishmeal: HP 300 = ground soya protein product, and C\*HYPROW (hydrolysed wheat protein). The results show that these products may be an alternative to a control diet containing fishmeal, but that it is essential that the diets meet the Danish standards for amino acids when formulated. Furthermore, it is essential to thoroughly analyse, with current prices, whether the feed costs will increase. Only the pigs can reveal the total economy in replacing the protein ingredients (see also trial reports no. 729 and 743).



# Feeding of finishers

## Tube feeders without water

Tube feeders are widely used for feeding of finishers, as they normally result in a good level of feed hygiene and a limited level of feed wastage because the pigs only let out small amounts of feed at a time.

However, with tube feeders, the pigs risk eating too much when it is possible for them to mix feed and water in the feeder. Particularly towards the end of the growth period, when the pigs weigh more than 60 kg, the feed intake may become too high which may result in a low lean meat percentage and a poor feed conversion.

It was investigated whether it is possible to limit the feed intake towards the end of the growth period (from 60 kg) by turning off the water in the tube feeders. Tube feeders of the type Faaborg 3-in-1 from ACO Durofarm were used in the pens. The pens were equipped with additional drinking bowls. The trial comprised one herd using meal feed and one herd using pelleted feed.

The trial demonstrated that it was possible to reduce the feed intake by turning off the water in the tube feeders and that the lean meat percentage increased by 0.2 percentage units when pelleted feed was used and by 0.7 percentage units when meal feed was used. However, it is not recommended to turn off the water in tube feeders in herds where meal feed is used, as the trial also demonstrated that the daily gain dropped by 87 g/day and that the feed conversion was

reduced by 0.1 FU<sub>g</sub> per kg gain in the herd using meal feed, and this was primarily attributed to feed wastage. The overall production value dropped by 11% when the water was turned off in tube feeders with meal feed.

## Feeding according to sex

Castrates have a higher feed intake than female pigs but they also have a lower capacity for meat depositing. These factors result in a lower lean meat percentage and a poorer feed conversion for castrates compared with female pigs.

Castrates eat more than female pigs from tube feeders from which the pigs are fed unrestrictedly. In the above-mentioned trial with tube feeders, the pigs were divided according to sex. The results showed that castrates had a significantly higher feed intake than female pigs. This reduced the production value of castrates by 11% compared with female pigs due to a poorer feed conversion and a lower lean meat percentage.

When pigs are fed liquid feed restrictively and are divided according to sex in the pens, it is possible to manage the allocation of feed to prevent the castrates from eating too much feed. Preliminary results from a current trial show a 3% increase in production value when the pigs are divided according to castrates and female pigs. The improved production value is explained by the fact that the castrates are unable to eat the feed from the female pigs when they are divided according to sex.

The preliminary results also show that even though the castrates and the female pigs follow the same feed curve and thereby get equal amounts of liquid feed, castrates have a poorer feed conversion and a lower lean meat percentage than female pigs.

## Vitamin D<sub>3</sub>

The addition of vitamin D<sub>3</sub> in the form of hydroxy vitamin D<sub>3</sub> was studied in a herd in the period from weaning to slaughter. Hydroxy vitamin D<sub>3</sub> is the first product during transformation of synthetic vitamin D<sub>3</sub> in the liver. The addition of the product to the feed simplifies the vitamin D<sub>3</sub> metabolism. The aim of this trial was therefore to investigate whether hydroxy vitamin D<sub>3</sub> was easier for the pigs to absorb and whether it affected the production value. The feed was formulated to contain the same total amount of vitamin D<sub>3</sub> for the pigs in the three groups:

1. 100% vitamin D<sub>3</sub>
2. 50% vitamin D<sub>3</sub> and 50% hydroxy vitamin D<sub>3</sub>
3. 100% hydroxy vitamin D<sub>3</sub>

There were no differences in production value for weaners or finisher regardless of the vitamin D<sub>3</sub> source added. However, analyses of vitamin D<sub>3</sub> in the feed revealed differences between the groups. The total amount of vitamin D<sub>3</sub> affected the vitamin D<sub>3</sub> content in the blood and the bone strength. The differences found in bone strength between the three groups were so small that they had no influence on the welfare of the pigs.



Tube feeders (Faaborg 3-in-1) with water and without water. The feed intake is reduced when the water is turned off in the tube feeder, but this is only recommended when pelleted feed is used as there is a great risk of feed wastage when using meal feed in tube feeders without water.



# Feed conversion in finishers

If the feed conversion in finishers improves, the profit increases. An improvement of 0.2 FUgp per kg gain corresponds to approx. DKK 15 per pig, and this is not an unrealistic scenario in many herds. Besides an increase in profit, an improved feed conversion also benefits the environment. If the feed conversion improves by 0.2 FUgp per kg gain, the discharge of nitrogen and phosphorus can be reduced by 10%.

The national average for finisher production units has not revealed any development in feed conversion over the last ten years, and the genetic potential of the pigs is not being fully utilized.

Therefore, a number of projects under Danish Pig Production have concentrated on feed conversion in finishers.

## Risk factors

The factors estimated to have the greatest influence on the feed conversion in finishers were analysed in 100 herds with a good feed conversion (max. 2.75 FUgp/kg gain) and in 100 herds with a poor feed conversion (min. 2.92 FUgp/kg gain).

The factors that have the greatest impact on the feed conversion are shown in table 1, and here the relative risk of causing a poor feed conversion is shown for each factor. For instance, the risk of a poor feed con-



*Liquid feed and mixing on-farm require thoroughness to obtain a good feed conversion.*

*Table 1. Most significant factors for a poor feed conversion in finishers, preliminary analysis*

| Risk factor                                      | Relative risk |
|--|---------------|
| Feed mixed on-farm                               | 2.5           |
| Liquid feed                                      | 2.6           |
| Grower facility                                  | 5.1           |
| Continuous management in finisher sections       | 2.9           |
| Respiratory disorders requiring group medication | 4.2           |
| Number of unthrifty pigs increased by 1%         | 1.3           |

version is 2.5 times higher in herds with feed mixed on-farm than in herds with pelleted feed.

## Demonstration project

A project was conducted with the aim of demonstrating whether it was possible to improve the feed conversion by 0.2 FUgp per kg gain using existing know-how. The project received financial support from the Directorate for Food, Fisheries and Agri Business (EU funds).

In five herds, a group of experts within health, nutrition, housing design and climate analysed the most significant causes of a poor feed conversion. An action plan was agreed upon for each herd, and the local advisor ensured that the plan was followed.

The project demonstrated that it is possible with existing know-how to improve the feed conversion.

Several of the five producers made the same mistakes – mistakes that



*Batch operation in finisher facilities and no grower facility increase the chances of obtaining a good feed conversion.*

were estimated to be significant reasons for the poor feed conversion, such as:

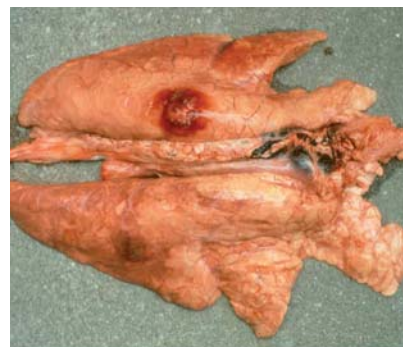
- Incorrect management of climate resulting in, for instance, draughts and poor air quality
- Incorrect temperature strategy
- Inadequate preparation of the facility for new pigs, i.e. the facility was not warm and dry
- Moving and mixing of pigs in the finisher period
- Too coarse grinding of the grain
- Inadequate focus on the feed curve in liquid feeding systems

## New project in 200 herds

Together with 20 vets and pig advisors, a comprehensive project was initiated in 2006 with the aim of increasing the profit in finisher production units. The plan is to include 200 herds in the project.

## Carbohydrate-degrading enzymes

Previous trials have shown that the enzyme product Porzyme 9300 from Danisco containing the enzyme xyl-



*Respiratory disorders increase the risk of a poor feed conversion. Unthrifty pigs must be moved to hospital pens and treated in time, so they can get well and do not infect the other pigs in the pen or facility.*

# Feed conversion in finishers

anase is able to improve the productivity of finishers. However, other products on the market are claimed to have the same or greater effect. These products have not been tested in typical Danish pig diets.

Therefore, trials were initiated to investigate the effect of Bergazym P from Berg & Schmidt in feed mixed on-farm and in purchased finisher feed.

The use of carbohydrate-degrading enzymes can improve gain and feed conversion in pigs as the enzymes are able to improve the pigs' digestion of the feed. Part of this improvement can be measured with the in vitro analysis EFOSi when the enzymes are added to the analysis in the dose that the company recommended for finished feed. Table 2 illustrates the effect of adding various carbohydrate-degrading enzymes ( $\beta$ -glucanase and xylanase) to selected ingredients measured on EFOSi. Generally, the figures reveal that the addition of enzymes increases the energy value. The results from this lab study cannot be used directly for predicting the effect of the various enzymes on pig productivity.

## Grinding

We know from previous trials that

the degree of grinding greatly influences the pigs' utilization of the feed. It is currently being investigated to what level various types of grinding equipment can grind the feed.

Experience shows that grain is often ground too coarsely and this results in a poor feed conversion. One reason for using relatively coarse feed could be regarded to the pigs' gastric health. However, an extended health control of the stomachs should always be made to check whether a coarser grinding is necessary. Feed mixed on-farm – even finely ground – rarely causes gastric health problems.

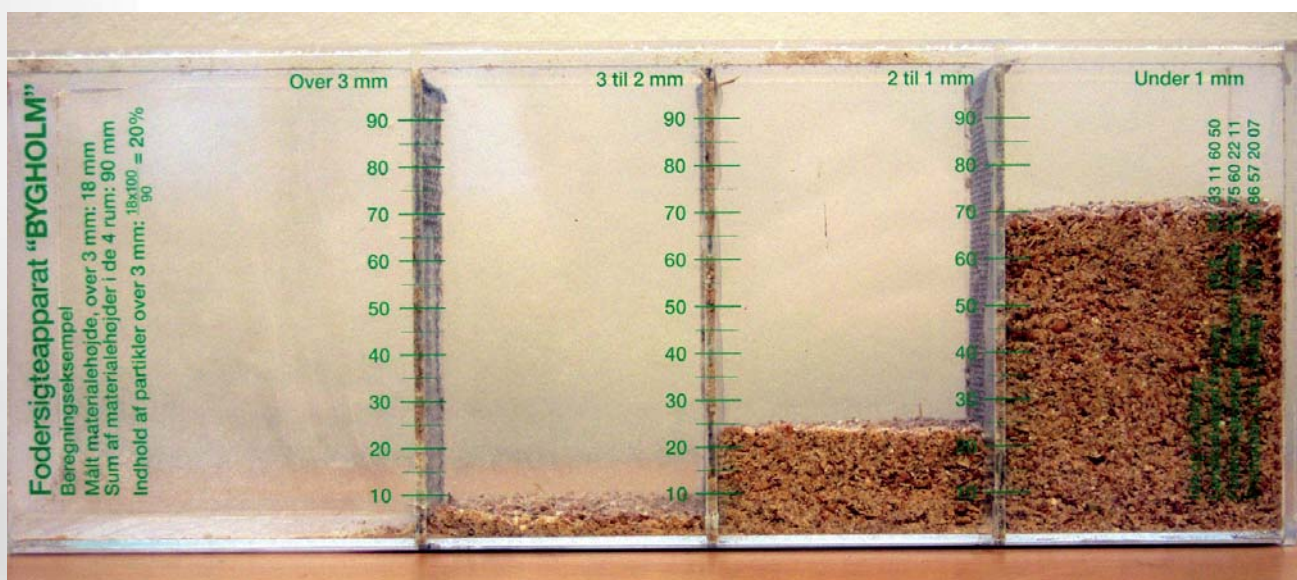


*Preliminary figures from a trial show that often the producers use a mesh size is used that is too large to obtain a good feed conversion in finishers.*

Table 2. Effect of the addition of enzymes on EFOSi value.

|                                  | Feedstuff |       |            |              |
|----------------------------------|-----------|-------|------------|--------------|
|                                  | Barley    | Wheat | Wheat bran | Soybean meal |
| EFOSi, % (without extra enzymes) | 79.8      | 86.7  | 48.7       | 72.4         |
| Enzyme effect, percentage units  |           |       |            |              |
| Porzyme 9300                     | +0.6*     | +1.0* | +0.6*      | -0.3         |
| Ronozyme WX                      | +0.5*     | +0.8* | +0.3       | +0.3         |
| Ronozyme VP                      | -0.1      | +0.2  | 0.0        | +0.5*        |
| Ronozyme WX + Ronozyme VP        | +0.3*     | +0.7* | +0.6*      | -0.3         |
| Bergazym P                       | +0.2      | +0.6* | +0.2       | 0.0          |
| Bergazym C                       | +0.2      | +0.9* | +0.3*      | +0.5*        |
| Bergazym P + Bergazym C          | +0.3*     | +0.8* | +0.4       | +0.5*        |

\* Denotes significant change in EFOSi when enzymes are added ( $P < 0.05$ ).



*If you mix your feed on-farm, you should make sure the feed is ground to an optimum feed conversion. Check this regularly by making a sieve analysis with the Bygholm sieve. Minimum 60% of the grain should, as a point of departure, be below 1 mm.*

# Environment and consequence of new authorisation procedure

## New environmental authorisation procedure

As of January 1, 2007, all livestock producers with farms larger than 75 livestock units (LU) must have an environmental authorisation if they wish to establish new units or extend or modify existing units.

At the same time, the environmental authorisation has been collected in one act which will make case-handling simpler and more uniform. The new authorisation procedure involves regulation of odour, phosphorus, ammonia emission and discharge of nitrite.

Below follows a brief description of the most important areas for Danish pig production.

## Ammonia

There will be a requirement for reduced ammonia emissions. The reference will be the "best facility" evaluated on the basis of ammonia emissions. Requirements: 2007: 15%; 2008: 20%; and in 2009 the requirement will be increased to minimum 25%.

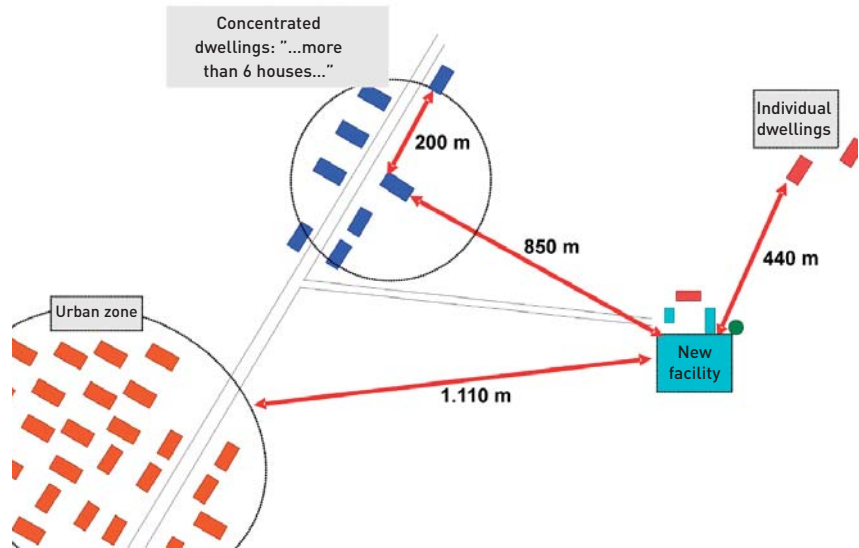
Livestock producers must not extend or modify their production within a 300 m zone from nature areas particularly vulnerable to ammonia if the result of this act is increased ammonia emissions.

In the zone 300-1,000 m from the above-mentioned areas, the maximum allowed impact of the extension is 0.7 kg N per ha. If there is one more site above 75 LU in the zone and within a distance of 1 km from one's own herd, the maximum increased impact is 0.5 kg N per ha. If there are two sites or more, a maximum increase in impact of 0.3 kg N per ha is allowed.

A number of technical solutions for reduction of ammonia emission have been developed.

## Odour

For many producers, the regulation of odour will mean new requirements for odour reduction upon establishment of or extension of their livestock production. If a producer wishes to extend his production closer to the neighbours than allowed by the new nuisance criteria, investments in odour-reducing technologies must be made.



*Odour and consequence of new odour instruction with nuisance criteria of 5, 7 and 15 OU/m<sup>3</sup> as for urban zones, concentrated dwellings, and individual dwellings in rural zones, respectively. Facility with drained floor and an annual production of 17,500 finishers (500 LU).*

The proposals for new nuisance criteria are 5, 7 and 15 OU/m<sup>3</sup> for urban zones, concentrated dwellings and individual dwellings in rural zones, respectively. As a result of the new criteria, the distance requirements will be so large that it will be difficult to find locations for large finisher units (see the illustration of distance requirements).

The proposed distance requirements are a clear tightening compared with the current FMK instructions. As a result of the new distance requirements, minimum 31% of the finisher producers in Southern Jutland and 23% in Vejle are unable to develop their productions. Furthermore, many producers will be unable to extend their productions to a size that makes it possible for them to utilize the advantages of large productions.

There is yet no efficient and stable technology for reduction of odour that can be implemented within a financially sensible framework.

## Nitrate

Agricultural areas that drain off to Natura 2000 areas particularly vulnerable to nitrogen (20-35% of the area) will be met by a requirement for reduced livestock impact per ha compared with the general harmony rules.

Areas surrounding less vulnerable Natura 2000 areas (50-65% of the area) will only be met by a requirement for reduced livestock impact if there is a small reduction in nitrate discharge to the vulnerable area. It is currently very difficult to assess the consequences of the nitrate regulation.

## Phosphorus

There will be no regulations for areas with a phosphorus number below 4.0.

Areas with a phosphorus number between 4.0 and 6.0 are allowed a maximum increase in surplus of 4 kg P/ha/year.

Areas with a phosphorus number above 6.0 will be met by a requirement for a phosphorus balance. Requirements for regulation of phosphorus only apply to drained areas surrounding vulnerable areas that drain off to Natura 2000 areas. Most producers will be able to handle the phosphorus regulation; we have seen positive results with the use of 1,500 phytase units per kg feed.

Easing of the ownership requirement In order to meet the current development in structure, the Danish government revised the Agricultural Act. Producers with farms smaller than 120

# Environment and consequence of new authorisation procedure

LU must still own 25% of the spreading area. For that part of the herd that exceeds 120 LU, the new ownership requirement is 30% of the spreading area against the previous 60% up to 250 LU and 100% above 250 LU.

The ownership requirement is now linked to the herd instead of the property. This makes it easier to place production systems more appropriately. Furthermore, the upper limit per herd will be increased to 950 LU if certain requirements for animal welfare and environment for herds above 750 LU are met. It has also been agreed to analyse whether to maintain the upper limit of 500 LU per facility. The revision of the Agricultural Act carries no environmental consequences as the requirement for spreading area remains unchanged.

## Consequences of reduced ownership requirements

The ownership requirements so far have been a significant disadvantage in connection with the establishment of large finisher units as the land requirement per finisher is approx. twice that of the land requirement per weaner.

The average farm size in Denmark is approx. 60 ha, but many pig producers today own more than 100 ha land. The ownership requirement for land therefore no longer determines whether weaners or finishers should be produced. However, the harmony requirement remains unchanged and will even be tightened in places where the land drains off to a Natura 2000 area such

as closed inlets, coves and brackish water lakes.

The increased harmony requirement increases costs for slurry handling. In areas with increased harmony requirements, a greater tendency towards producing weaners rather than finishers is expected. Furthermore, the problems concerning odour and the proposals for new nuisance criteria will reduce the number of herds that would otherwise benefit from the new rules for ownership requirement.

## Assessment of requirements for ammonia

Requirements for a 25% reduction in ammonia emissions from facilities and storage compared with the "best facility" are expected already in 2009. Table 1 illustrates different solutions. The "best facility" is a finisher pen with partially solid floor. It is expected in 2009 that a facility with solid slatted floor in minimum 51% of the pen combined with a low-protein diet and possibly lid of the slurry container will be able to meet the requirement for a 25% reduction. Alternatively, investments need to be made in technologies such as acid purification, biological purification, acidification, cooling etc. Purification of 40-50% of the housing air is sufficient to be able to meet the 25% requirement compared with the "best facility". Cooling of the slurry is a reliable method, but the costs depend on whether the excess heat can be "sold" to, for instance, weaner or farrowing facilities. This solution is too expensive for a pure finisher unit.

## Assessment of odour requirements

Currently, the Oldenburg filter and the biological air filter from Skov are the only solutions for reduction of odour, but several systems are being developed.

Studies of the biological air purifiers have shown great variations in effect, and the systems are not yet completely reliable. Research and development is therefore still needed for technologies for reducing odour from pig facilities before a stable effect can be expected. When developing his pig production, the producer must therefore consider whether moving the production to a location far away from neighbours might be an alternative solution to investing in air purification technologies. However, moving the production requires additional investments in road systems, electricity and water supply, staff facilities and possibly feed storage facilities etc.

Costs for investment and operation of technical equipment for reduction of odour amount to DKK 17-20 per produced finisher, and this must be correlated with the financial end result of the producer. Over the last five years, the financial result (after wages have been paid) for a 250 LU finisher unit has averaged DKK 0 per finisher.

The industry estimates it will cost maximum DKK 3-5 to meet the future environmental requirements if the global competitive situation is to be maintained, and the current cost level by far exceeds this.

Table 1. Possible solutions and costs of reducing ammonia and odour emissions. Production of finishers (30-102 kg): 8,750 finishers (250 LU)

| Method   | Purification of housing air, % | NH <sub>3</sub> purification effect, % | Reduction, % NH <sub>3</sub> /odour | Costs/pig, DKK* |
|--|--------------------------------|--|-------------------------------------|-----------------|
| Bench-mark (facility with partially slatted floor) | -                              | 0                                      | 0/33                                | 0               |
| Acidification                                      | 100                            | 70                                     | 60/0                                | 9-15            |
| Acid purification                                  | 100                            | 90                                     | 77/0                                | 16-18           |
| Acid purification                                  | 50                             | 90                                     | 38/0                                | 7-8             |
| Acid purification                                  | 35                             | 90                                     | 27/0                                | 5-6             |
| Biological purification/NH <sub>3</sub> and odour  | 100                            | 70                                     | 60/30-60                            | 17-20           |
| Cool and scrape                                    | 100                            | 30                                     | 26/0                                | 0-10            |
| Reduce protein by 10 g/FUgp                        | 100                            | 18                                     | 15/0                                | 0-5             |
| Lid on slurry container                            | Lager                          | 50                                     | 6/0                                 | 1-2             |
| Lid on slurry container**                          | Lager                          | 90                                     | 12/0                                | 2-3             |

\* The interval is an expression of the systems' durability, reliability and operating costs.

\*\* Acid purification of exhaust air from slurry container.



# New standards

On the basis of new measurements, new standards have been established for odour emission and ammonia loss from Danish pig facilities. The standards will be included in the future regulation of Danish livestock production.

## Ammonia

Standards for ammonia loss from housing facility and storage are used for calculating the N content in livestock manure. The standards must reflect the average loss from Danish facilities, and they are revised once a year. Changes are made if new results are available. For the manure year 2006-07, per cent ammonia loss from weaner facilities with partially solid floors is changed from 10 to 6%. Finisher facilities with partially solid floors are changed from a general loss of 12% and are divided into two categories:

Solid floor 50-75%: 8% loss  
Solid floor 25-49%: 11% loss

Today, ammonia loss is stated as percentage loss of the excreted total N from the livestock manure. However, ammonia is only lost from ammonium, which typically only constitutes approx. 70% of N in pig slurry – the rest is organically bound N. Under the Danish Institute of Agricultural Sciences, an ammonium-based system is being studied that in the future will replace the current system.

## Odour

With new measurements, DSP has established how much odour is emitted from the individual types of facility during the summer. The result is the new standards for odour emission that will be an integrated part of the new odour instruction from the Danish Ministry for the Environment. DSP has made a total of 216 odour measurements in nine of the most common pig facilities in Denmark. The individual types were each represented by four herds. The odour emissions were measured on three days with two measurements a day at an average outdoor temperature of 20°C. The measurements revealed approx. 30% lower odour emissions from farrowing facilities and finisher facilities with 2/3 solid floors compared with facilities with fully slatted floors. The floor type

Table 1. New standards for odour emissions from pig facilities.

| Type of facility  | Odour emission, OU <sub>E</sub> /sec/animal | Odour emission, OU <sub>E</sub> /sec/1000 kg animal |
|---|---|---|
| Service and gestation facilities                                    | 16  | -   |
| Farrowing facilities with partially slatted floors                  | 72  | -   |
| Farrowing facilities with fully slatted floors                      | 100   | -   |
| Weaner facilities with partially or fully slatted floors            | -   | 380   |
| Finisher facilities with partially slatted floors (2/3 solid floor) | -   | 300   |
| Finisher facilities with drained or fully slatted floors            | -   | 450   |

did not influence the odour emission from weaner facilities. This was due to that fact that even though the odour concentration in weaner facilities with fully slatted floors was twice as high, the air change was correspondingly halved compared with weaner facilities with partially solid floors, which did not result in different odour emissions from the two types of weaner facility. There were no differences in odour emissions from service and gestation facilities regardless of whether the sows were housed individually in stalls or in groups. Generally, the results also showed that finisher facilities contribute approx. 70% of the total odour impact from a herd with integrated production.

## New distance requirements

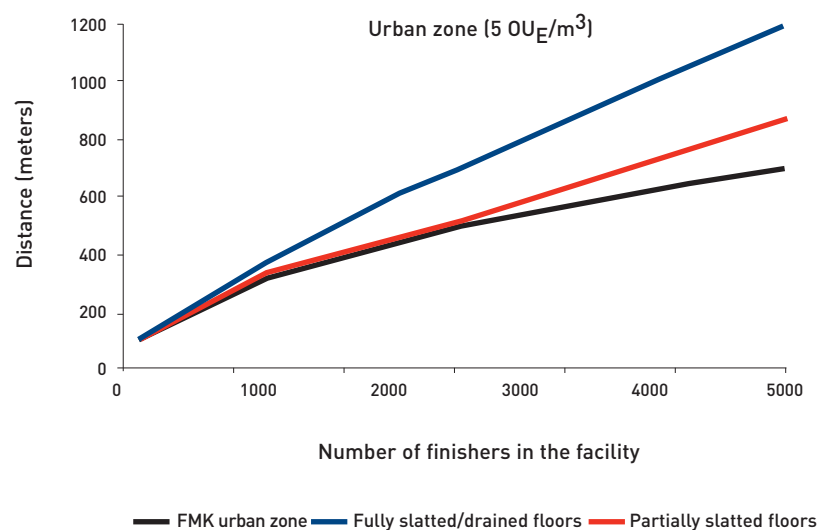
In the beginning of July, a draft for new environment legislation was submitted for public hearing. The draft

lists new limits for how much odour is allowed around pig facilities. The following limits are suggested for odour concentrations:

- 5 OU<sub>E</sub>/m<sup>3</sup> in urban zones and summer house zones
- 7 OU<sub>E</sub>/m<sup>3</sup> in concentrated dwellings
- 15 OU<sub>E</sub>/m<sup>3</sup> in individual dwellings in rural zones

Odour units (OU<sub>E</sub>) is the term used for odour units according to a European standard.

Adoption of these limits for odour concentrations together with the new standards for odour emissions will mean that large finisher producers in particular will face highly restrictive distance requirements compared with the current FMK instruction for regulation of odour from livestock units.



Consequences for distances of proposal for an odour limit of 5 OU<sub>E</sub>/m<sup>3</sup> in urban zones and summer house zones partly for finisher facilities with partially solid floors and partly for facilities with fully slatted floors or drained floors. The black curve illustrates the current distance requirements based on the FMK instruction.



A wide range of environmental technologies are by now available. Several are still being developed, and it must be stressed that no system has ever worked right from the beginning. It has always been, and is still, a great challenge to integrate air purification systems into pig facilities as they interfere with the ventilation system.

### Biological purification of air

A common characteristic for the systems classified under biological air purification is that the housing air is led through a moist filter material that contains a biofilm consisting of bacteria that transform and decompose ammonia and odorants.



*Biofilm on filter material of cellulose.*

Investigations of the first generation of biological air purification systems showed that it is possible to reduce odour emission with biological purification of air but that the purification efficiency varies greatly. The investigations also identified a number of factors important for the purification efficiency:

- Filter area in relation to amount of air
- Cleaning/changing of the filter material
- Moistening of the filter material

The filter area is decisive to how good the physical contact is between the biofilm and the housing air in relation to the amount of air. An investigation showed that the purification efficiency was higher in the winter when the amount of air was lower compared with the filter area compared with during the summer.

Cleaning or changing the filter material is essential to prevent it from clogging with dust and biofilm. Clogging of the filter material increases the counterpressure which the ventilation system will have to overcome, whereby the air output and the purification efficiency are reduced and the use of energy increased.

Moistening of the filter material is essential to provide optimum growth conditions for the biofilm. Several investigations have shown that the purification efficiency is significantly – and in some cases completely – reduced if moistening does not work.

An investigation of horizontal filters with wood chips/straw and leca showed a purification efficiency of odour of 50-90%. The drawback of horizontal filters is that they require a lot of space. Vertical filters from SKOV A/S with cellulose pads as filter materials were also investigated and here the purification efficiency of odour concentration ranged between 10% and 70%. It was furthermore shown that the vertical filters were capable of reducing the ammonia concentration in the exhaust air to 1-2 ppm with an ammonia concentration before the filters of 4-9 ppm. Vertical filters require less space and are easier to integrate into the building, and are therefore a more realistic option. The systems are still being developed with the aim of improving the purification efficiency of odour during the summer.

Future trials will focus on how the purification efficiency of the vertical filters from SKOV A/S can be improved and on how the purification efficiency can be increased by using filter materials other than cellulose. The aim is a biological air purification system that

- Has low costs for installation and operation
- Has a high and stable purification efficiency of ammonia and odour
- Easily integrates into the building
- Requires minimum labour for the farmer

### Chemical purification of air

The first air purifier in Denmark from the Dutch company Bovema S-air was investigated in a finisher production



*Study of various filter materials in horizontal filters.*

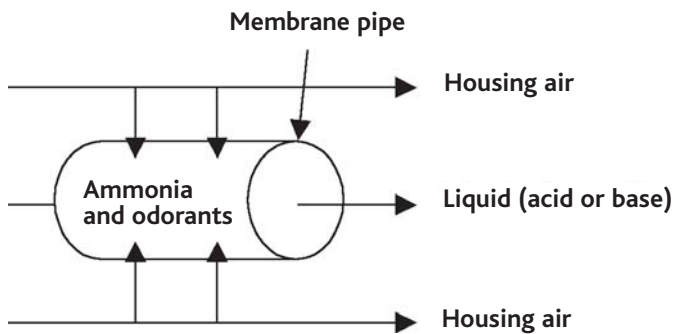
unit with 1600 place units. Dutch as well as Danish results have shown that acid purification is a highly efficient method for eliminating ammonia but not odour. Therefore, the first system in Denmark from Bovema S-air included an additional step in which the air passed through a filter element sprinkled with water. Subsequently, the air passed through a filter element constructed like the company's traditional acid purifier.

The investigation period ran from summer to winter, and in this period 28 ammonia and odour concentration measurements were made before the air purifier, after step 1 and after steps 1 and 2. The measurements revealed that the air purifier met at least 95% elimination of the ammonia that it was tested for in the Netherlands. The measurements showed no significant odour reduction in the air purifier after steps 1 and 2. However, a significant odour reduction of 17% was observed after the first step where the air passed through a filter element sprinkled with water.

### New technique for purification of air

A new technique for purifying air based on membrane technology is currently being developed. The entrepreneur company Bioscent Technology ApS is behind the technique.

Air purification based on membrane technology leads the housing air between a series of membrane tubes that are approx. 2 mm thick. Inside the membrane tubes, a liquid in the form



Principle of purification of air based on membrane technology.

of acid or base flows. The liquid cannot pass through the membrane tubes, but ammonia and odorants in the housing air can pass above the membrane tubes and accumulate in the liquid. A small investigation was made of a model system that purified 45-95 m<sup>3</sup>/hour from a finisher facility with fully slatted floors. The investigation showed that the system was capable of reducing the odour concentration by approx. 50%. The system was capable of reducing the concentrations of ammonia and hydrogen sulphide to a level close to 0.

Work has now been initiated to develop a system that can handle the total amount of air from a finisher facility. The prototype will be tested to evaluate its purification efficiency and the economy under practical conditions.

### Central air ducts

The first systems with central air purification have now been established in individual facilities. Experiences show that collecting exhaust air is a complicated process and many things can go wrong.

Ducts with a cross-sectional area of up to 20 m<sup>2</sup> in a 2000 m<sup>2</sup> building are not unusual. The large cross-sectional area was chosen to keep a relatively low air speed in the duct. Calculations have shown that the air speed in the large ducts is significantly lower than during traditional ventilation where the normal maximum dimension is a diameter of 80 cm in the chimney flue. Measurements in central ducts showed that the air output is, to a large degree, lost due to loss of pressure above the air purifier and, to a minor

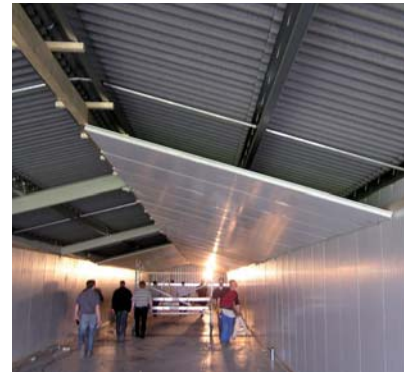
extent, due to loss of pressure in the central duct. It is therefore not profitable to over-dimension the cross-sectional area in central ducts. Joint ducts of moist-absorbing materials such as plywood cannot be recommended – not even when the duct is insulated. Experience shows that the air humidity of the exhaust air during the winter is so high that moisture accumulates in duct constructions made of



Even though the duct of plywood is insulated, fungi still form on the boards.

“soft” wood materials. Thereby rot and fungi form on and in the duct wall. Instead, we should look towards the Netherlands where they use sandwich elements with smooth surfaces of plastic-treated steel plates and foam as insulation material. These ducts are at the same time easy to clean.

Measurements of output and loss of pressure have shown that regular ventilators are less suitable for air purification and for central exhaust. This is due to the fact that they are developed to resist a counterpressure of 30-40



The sandwich elements with smooth surfaces are easy to clean.

Pa. Counterpressures of 200-250 Pa have been measured in systems with central duct and air purification, and this resulted in new requirements for the exhaust units. They need to be even more pressure stable, i.e. they must be capable of maintaining a stable high air output during increasing pressure loss.

Many examples have shown a distinctly lower maximum ventilation rate than assumed. This is partly due to clogging of the air purifier and partly due to the fact that the air output in the housing area may drop significantly at just a slight increase in pressure loss above the air purifier. Dutch analyses show that the energy used for ventilation of finisher facilities can be reduced by choosing central exhaust with frequency-regulated exhaust units instead of a triac-regulated exhaust unit in the individual section.

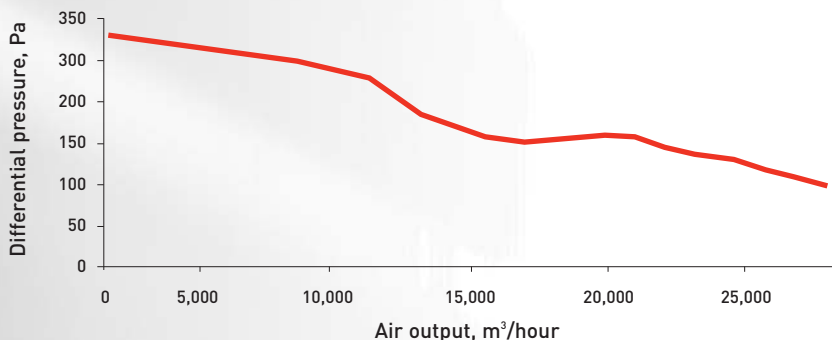
In a Danish weaner facility with central purification of air and gradual hooking up of the exhaust units, 10.8 kWh were used per place unit/year. This was not significantly different from the traditional decentralized exhaust.

The exhaust units in systems with central ducts must be operated as little as possible to use as little energy as possible. This is achieved when exhaust takes place above open draught controls between the individual sections and the central duct.

On warm days, measurements have shown insufficient air output in sections with a great need for ventilation due to the fact that sections connected

# Environmental technology

Environment



*Ventilator characteristic of an exhaust unit in a system with joint outlet and purification of air. The air output drops significantly when the pressure loss increases. The ideal ventilator has a curved characteristic.*

on the same central duct are adjusted independently of the maximum ventilation need. Experience therefore shows that excellent overview is required by the staff to distribute the air according to the ventilation requirements between the sections. However, the measurements also indicate that development of the systems and controls is still required and that it is necessary to thoroughly consider the adjustment of the systems from the beginning. Purification of air and central exhaust require establishment of alternative openings for emergency ventilation. Furthermore, an alarm system must be installed to alert the staff if ventilation fails.

### Hydrogen peroxide for acidified slurry

DSP participated in the testing of the first acidification system from Infarm A/S. The trial was conducted in a finisher herd and showed a 70% reduction

in ammonia, but no reduction in odour. Since then, the company has further developed the system and also considered different methods for chemical oxidation to reduce odour. The company decided on hydrogen peroxide, and a system was set up in the same herd in which the first acidification system was tested. The acidification system was also updated to the latest version with load cells, improved pumps and valves, a large process tank with backwash through 315 mm slurry pipes and a separate valve well.

A one-year trial period revealed a stable operation of the acidification system and a 70-80% reduction in ammonia. Likewise, pH was constantly 1.5-2 units lower in the sections with acidified slurry compared with the control sections with untreated slurry. Odour was measured over 14 days and the results revealed no significant odour reduction.

It is well-known from literature that



*Behind the acidification system, the process tank can be seen and on top of that is a pallet tank containing a 30% hydrogen peroxide solution.*

heavy chemical oxidation can reduce odour, but the addition of hydrogen peroxide, as in this trial, did not result in a significant and stable odour reduction. Infarm A/S is not planning on finishing the development of the system for adding hydrogen peroxide to acidified slurry.

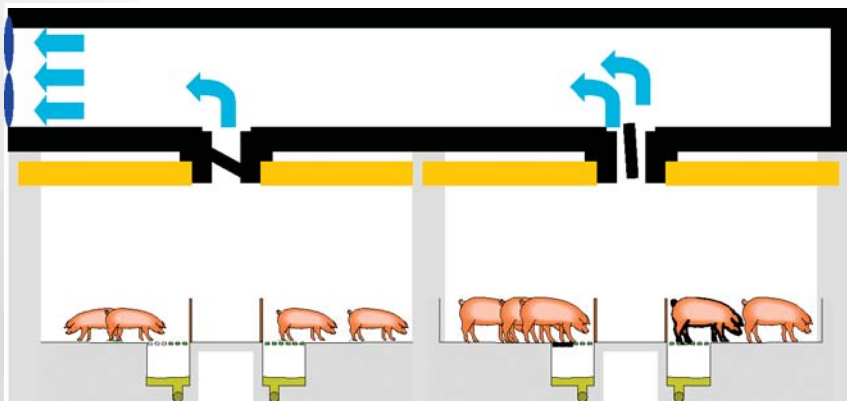
### Ozone treatment

Odour from pig facilities originates from the manure and it would open up perspectives if a method was found that could make the slurry inside the facilities odour-free. The company BIO-AQUA A/S has just finished a series of pilot trials at DSP's experimental station Grønhøj. The trials were conducted under lab-like conditions and showed that it is possible to:

- Reduce odour from slurry measured olfactometrically by more than 95%
- Decompose hydrogen sulphide completely
- Decompose phenols and indoles
- Decompose volatile fatty acids

However, during the treatment, pH in the slurry increased from 7 to approx. 9, which means that measures must be taken to avoid unnecessary high ammonia emissions. The lab studies also revealed that it is possible to add too much ozone to the slurry as an overdose increased the numbers of ketones and aldehydes.

A system is now being constructed for an entire housing facility in order to assess the possibilities of treating slurry with ozone.



*The lowest consumption of energy is obtained when the exhaust output of the central system is adjusted so that the draught control in the section with the greatest need for ventilation is always open.*





# Minimising protein and phosphorus in the feed

## Minimising ammonia emission

When the feed's protein content is reduced, the ammonium content in the urine drops and pH in the slurry drops slightly. It is thereby possible to significantly reduce the ammonia emission. When the protein content is reduced, more free amino acids are utilized, and it is possible to obtain the same daily gain if all amino acid standards are met.

Replacing protein with amino acids is free as long as you only need to add three amino acids. If you need to reduce the protein content further, you can still choose to meet all amino acid standards, but this will make the feed more expensive. Another possibility is to combine a low protein content with feeding slightly below the amino acid standards whereby the feed becomes cheaper. These two strategies were studied for weaners and finishers.

## Low-protein feed for weaners

In the weaner trial, a diet extremely low on protein – but with the addition of all ten essential amino acids – was compared with a normal weaner diet to which only five amino acids were added.

The trial feed included approx. 2% less protein than the control feed. In addition to ammonia, odour was measured by way of olfactometry.

The trial showed a clear effect of the trial diet on the ammonia emission. The ammonia emission was on average 48% lower when the trial feed was used compared with the control feed. However, there was no effect on odour. In practice, the addition of ten amino acids is unrealistically expensive, but the trial does illustrate the potential in minimising protein.

## Low-protein feed for finishers

In the finisher trial, the effect of four levels of protein was studied. The

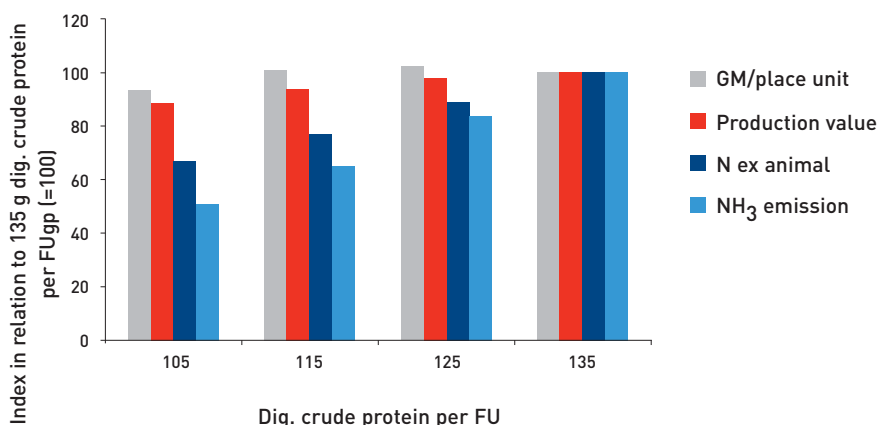


Figure 1. Effect of the content of digestible crude protein on the productivity, economy, N in manure and ammonia emission.

reduction in the protein content was accompanied by a corresponding reduction in the content of essential amino acids. However, with the lowest protein level (105 g), additional lysine, methionine and threonine were added so that these amino acids were at the same level as with 115 g digestible crude protein.

The trial comprised nine trial groups. Figure 1 shows the preliminary results from four trial groups in which the pigs were not phase fed.

Figure 1 shows that the highest productivity was obtained with the highest protein content, but the best economy was obtained with 125 g digestible crude protein. If the protein content was reduced to 115 g per FUgp, there was a minimal reduction in gross margin, but a significant reduction was obtained in nitrogen content in manure and thereby in the ammonia emission. The ammonia emission was not measured in this trial, but on the basis of other trials it was estimated at 1.5 x reduction in nitrogen discharge ex animal.

The preliminary conclusion is that a significant reduction in ammonia

emission is possible by reducing the feed's protein content and that this is financially realistic for finishers.

## Phosphorus for weaners

Minimisation of the phosphorus content in pig feed requires the addition of the enzyme phytase, as phytase releases plant phosphorus bound in phytate. The phosphorus digestibility is then increased so the pigs can manage on less phosphorus. A trial investigated how much phosphorus is necessary in weaner feed when phytase is added (see trial report no. 751). The trial included six trial groups of which five were given the amount of phytase normally used, while the dose was doubled in group 1. The trial results are shown in table 1.

The weaners had a normal productivity with 5.2 g total phosphorus when a normal dose of phytase was added, whereas they were able manage with 4.7 g phosphorus per FUgp when phytase was doubled. With a double dose of phytase, the feed is slightly more expensive.

On the basis of this trial, the phosphorus standard for weaners from 9 to 30 kg was reduced to 3.0 g digestible phosphorus, which corresponds to 5.2 and 4.9 g total phosphorus per FUgp with a normal dose of phytase and a double, respectively. With a double dose of phytase there will be approx. 3 kg phosphorus less per ha at 1.4 LU per ha. This will cost approx. DKK 0.25 per weaner or DKK 50-70 per ha.

Table 1. Production results for weaners depending on the phosphorus level in feed to which phytase was added.

| Group                   | 1     | 2   | 3   | 4   | 5   | 6   |
|-------------------------|-------|-----|-----|-----|-----|-----|
| Phytase, FYT/kg added   | 1,500 | 750 | 750 | 750 | 750 | 750 |
| Phosphorus, g/FUgp      | 4.7   | 4.7 | 5.2 | 5.7 | 5.9 | 6.4 |
| Daily gain, g           | 592   | 539 | 584 | 571 | 577 | 565 |
| Production value, index | 100   | 87  | 100 | 96  | 96  | 96  |



# Service and gestation facilities

The production units are getting bigger, and bigger units require a safe and efficient production system. Housing facilities must also meet the statutory requirements and at the same time be production-safe and benefit the welfare of the animals.

## Time spent in service facilities

Measurements of the time spent in gestation facilities have demonstrated that not only the design but also the work method influences the time consumption. The Danish Applied Pig Research Scheme therefore made a corresponding pilot study that demonstrated the time consumption in service facilities with different designs. Each staff member carried a chip that registered every time they walked in and out of the service facility.

Time was measured in three different types of service facilities. Here, the sows were housed either in stalls, in groups with one feeding and insemination stall per sow or in groups with an insemination pen.

Figure 1 shows the total number of employees needed in the service facilities in the five herds for service and allocation of straw/mucking out. In herds 1 and 2, the sows were housed in stalls, in 3 and 4 in groups with one feeding and insemination stall per sow, and in 5 in groups with an insemination pen. Deep litter was used in herds 3, 4 and 5. The herd sizes were standardised to 500 sows/year. One employee = 1,654 hours/year (excluding holidays and weekends).

The results show that the time spent did not increase when the sows were housed in groups with one feeding and insemination stall per sow compared with sows housed in stalls. However, more time was spent in the service facility when the sows were housed in groups with an insemination pen.

In the herds with one feeding and insemination stall per sow approx. 2.5 minutes were spent per service, while 6.8 minutes were spent per service in the herd with insemination pens.

Several factors influenced the time consumption in the service facility;

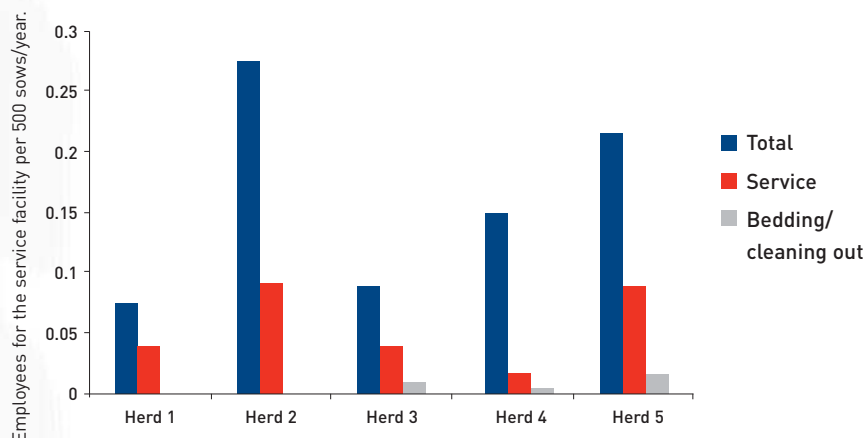


Figure 1. Time spent in three different types of service facilities. Herds 1 and 2 house the sows in stalls, herds 3 and 4 in groups with one feeding and insemination stall per sow, and herd 5 in groups with an insemination pen.

particularly the allocation of straw and cleaning out are heavy tasks in terms of time.

## Relief pens

Experiences from trial herds have shown that the use of relief pens can reduce the number of dead and destroyed sows. It is essential to agree upon a strategy with the vet for the use of relief pens and treatment to obtain optimum utilization of the relief pens.

In many herds, too much time passes before the sows are moved to a relief pen and that reduces the effect of the

relief pens. A daily inspection of the sows ensures that weak sows are moved to a relief pen immediately. When weak sows are moved immediately, the treatment period is shortened, and the sows can quickly be returned to the gestation pen.

The relief pens must be placed as close to the gestation pen as possible, and inspection alleys and gates must be designed to facilitate moving of the sows.

In two herds with ESF the effect of placing the relief pens inside the



A sow should be moved to a relief pen if she is apathetic and shows signs of disease; has sore legs, lies and sits for long periods at a time; is unthrifty and has no appetite; has serious injuries such as hoof abscesses, shoulder ulcers, torn dewclaws, vulva bites.

### Basic statutory requirements for design of relief pens:

- Always have an empty relief pen ready for use
- House no more than 3 sows per relief pen
- There must be min. 2.8 m<sup>2</sup> per sow, but the pen must be min. 3.5 m<sup>2</sup>
- Two thirds of the total minimum area must have soft bedding, for instance straw or a rubber mat
- There must be a cooling facility (for instance a dry and cool concrete floor) and heat (for instance cover or heat lamp)

gestation pens is being studied. Preliminary experiences show that it is very easy to move sows to and from the relief pen.

### Product trial of ESF

Six brands of feed stations (ESF) are sold on the Danish market, and a trial is currently evaluating and describing these feed stations.

These feed stations are marketed by:

- ACO Funki A/S
- Agro Products A/S
- Big Dutchman A/S
- Bopil A/S
- KJ Klimateknik A/S
- Skiold –Echberg A/S

The trial evaluates:

- Construction of the station
- Access for the sow
- Design of the trough and eating position of the sow
- Dosage of feed (accuracy)

- Exit for the sow
- Separation (safety)
- Ear tags (brands)
- Communication (AgroSoft / Integrated Farm Management System)
- Software (user friendliness)
- Instruction and follow-up from the vendor
- Durability and wear

The trial is expected to finish in the autumn 2006.

### The Opti pen

The Opti pen is a new pen concept for gestating sows with individual feeding and bedding on a drained floor.

Pens with one feeding and resting stall per sow require a lot of space. There was therefore a need for developing new types of pens with individual feeding in which the total area and the overall costs per place unit are competitive with ESF.

The Opti pen has a row of feeding and resting stalls with slatted floor behind (see figure 2). In continuation of the slatted floor, a lowered area with drained floor constitutes a well-bedded lying area. This area also functions as feeding place for the rest of the sows. There is a wire-type barn cleaner beneath the slatted floor and the lying area.

At feeding time, one third of the sows eat from a long trough. As individual feeding is not employed, the sows are not transferred to the Opti pen until four weeks after service. This non-controlled feeding is a consequence of the reduced total area compared with pens that have one feeding and resting stall per sow. Despite the fact that not all sows in



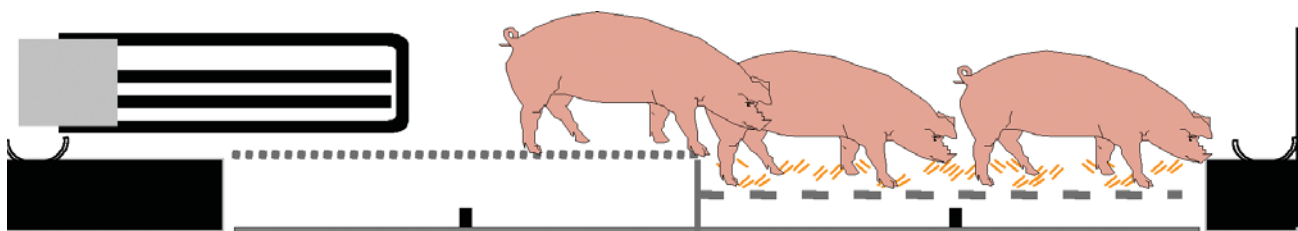
*In the Opti pen, the bedding is kept dry in the lowered lying area with drained floor.*

the pen are fed individually, there were no problems with the sows' body condition.

The Opti pen is being studied in one herd, and it is considered as a possible future alternative to T pens with one feeding and resting stall per sow. The aim of the pen is to reduce the overall area used and at the same time ensure that the sows have a well-bedded lying area.

The preliminary experiences with the Opti pen are positive. Slightly more straw is used than in regular T pens (approx. 150 kg straw/place unit/year), but future interventions are intended to reduce the consumption of straw.

A wire-type barn cleaner is established in the facility for handling of slurry. This works satisfactorily. However, problems occurred with handling of slurry in the crossing between the cross channel and the ante tank. These problems are partly solved by having a fixed strategy for the use of wire-type barn cleaners and back-flush.



*Figure 2. Cross-section of floor design of an Opti pen (principle sketch). In one side of the pen is the lowered lying area with permanent bedding (lowered max. 20 cm).*

# Farrowing facilities

The increasing litter size and the increasing litter weight require an increasing milk production. This, among many other elements in the farrowing facility, brings attention to the sows' comfort in the farrowing pen to ensure that the sows have optimum possibilities for a high intake of feed and water.

## Space used by the sow

The space used by sows for getting up and lying down was studied. The aim was to establish the space used by sows housed in two different sizes of farrowing stalls and housed loose. On the basis of the investigation, the recommended dimensions on farrowing stalls are maintained; i.e. 65 cm wide by the standard and adjustable to 90 cm by the back gate of the stall, and 210 cm long from the back end of the trough to the back gate (see trial report no. 733).

## Dimensions of farrowing stalls and farrowing pens

A trial demonstrated that the current recommendation for sizes of farrowing stalls and farrowing pen results in higher litter weight at weaning compared with the previously recommended far-

rowing stall and pen that were smaller. A farrowing stall with the dimensions mentioned above was placed in a pen measuring 180 cm in width and 270 cm in length. Litter weight increased with 9, 10, 11 and 12 piglets per litter (see trial report no. 739).

However, the trial also revealed poorer hygiene in the large pens with the large farrowing stalls. In this trial, the width by the back gate was increased from 65 cm to 90 cm on day 4 after farrowing. This sudden and great change in space for the sow increased piglet mortality. The farrowing stall should therefore be adjusted individually, and if necessary gradually, according to the sow's size.

## Hygiene on solid floor

Farrowing pens should have solid floor under the sow to reduce the risk of shoulder wounds and to increase the utilization of the statutory rooting and enrichment material. Solid floor under the pigs ensures a warm and draught-free environment. Some producers experience no problems with hygiene on the solid floor. Others see it as a great problem that increases labour and constitutes a risk of transmission of diseases between pens and sections. Mess often occurs along the pen sides opposite the creep area.

With the new recommendations for size of farrowing pens and stalls, the width of the pen is typically increased from 150-160 cm to 170-180 cm. As

stalls and pens have become bigger, reports of increased mess along the pen partition have multiplied. A project aimed at preventing the piglets from dunging in the wrong places has been initiated under the Danish Applied Pig Research Scheme. The preliminary analyses indicate that the pen width in itself, for instance 160 cm versus 180 cm, or the distance from the standard to the pen wall are not the decisive factors.

## Cooling of lactating sows

The sows can get too hot, especially in the summer, and experience shows that this affects their feed intake and increases the mess with water and feed residue. A trial is investigating cooling by way of water atomization with high pressure and additional air intake from ceiling inlets. The trial was conducted in a herd with diffusely ventilated farrowing facilities. The aim is to improve the hygiene around the trough, reduce the risk of shoulder wounds and increase the sow's appetite in the summer.

Temperature measurements in the housing facility show that under outdoor temperatures of approx. 27°C, the housing temperature can be reduced by approx. 4°C in the sow's activity area in sections with cooling compared with sections without cooling. The trial is not yet finished, and it is unclear whether an effect on feed intake has been achieved. There do not seem to be great differences in pen hygiene regardless of cooling.

**Until trials have established the elements needed in design and operation of the farrowing pen to "prevent" the pigs from dunging on the solid floor, the below recommendations still apply:**

- The corner and the long side opposite the creep area and the area under the trough are shielded/filled with concrete.
- Open pen partitions, for instance pipes, in the top part of the pen partitions if these are higher than approx. 50 cm to enable air change in the pen.
- Gradient on the floor down towards the slatted floor.
- Heat lamp (100 W).
- Floor heat in the creep area.
- Water and feed supply placed in the same side as the creep area.
- Make demands to the quality of the concrete.



*It is still recommended to have an area filled with concrete between the pen side and the floor in order to reduce the risk of mess on the solid floor.*

Future activities related to cooling of sows in farrowing pens will centre around floor cooling.

**Loose lactating sows**

Loose housing of sows in the lactation period is excellent welfare for the sows, but mortality among the piglets can be high and working conditions are considerably different from traditional farrowing pen. A great effort is being made these years to find methods that can reduce mortality.

**Tilted lying walls**

In two production herds with loose lactating sows, DSP compared piglet mortality and the sows' choice of lying area in farrowing pens that had been used for a number of years before the trial. A tilted lying wall was installed in approx. half of the pens.

It was concluded that the tilted lying walls did not reduce piglet mortality. This may be due to the fact that in only half of the cases did the sows lie with their back against the tilted lying

wall. This indicated that the lying wall in itself did not influence the sow's location. However, tilted lying walls are still included in DSP's future research as other studies have shown that walls can reduce the risk of the sow crushing the piglets.

**Trial of four proto types**

Based on results from a joint venture project between the Royal Veterinary and Agricultural University, the Danish Institute of Agricultural Sciences and DSP, four types of pens were selected for comparison. The four pen types varied in terms of size, length/width ratio, location of the creep area and per cent solid floor in the pen.

**Type 1: Narrow T pen**

This type of pen has solid floor in approx. two thirds of the pen. The pen is called a "narrow T pen" and it is expected that the sow lies with her back along the creep area or the opposite pen side and her head against the slatted floor where the pen partitions are open.

**Type 2: Wide T pen**

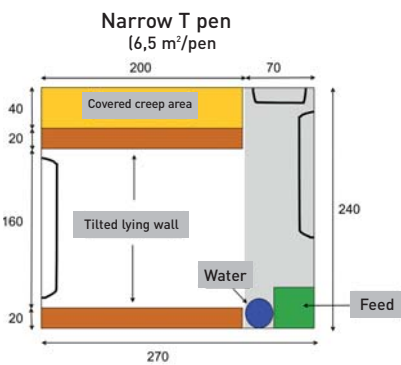
This pen is designed as the narrow T pen but has a wider solid floor, which makes room for three tilted lying walls versus two in the narrow T pen.

**Type 3: F pen**

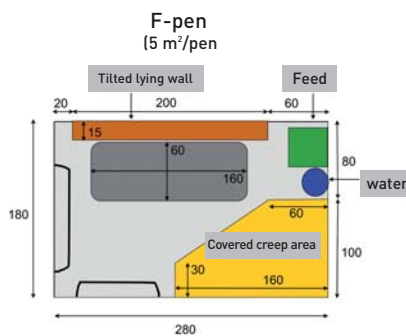
This pen has fully slatted floor, hence the name F pen. A board is placed on the slatted floor to "establish" solid floor under the sow's shoulders if she lies with her back against the tilted lying wall. The sow is expected to lie primarily with her back against the tilted lying wall.

**Type 4: O pen**

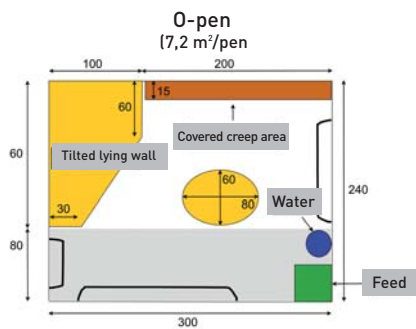
This pen has solid floor in approx. two thirds of the pen and slatted floor in the remaining third. There is a ring in the middle of the pen that is expected to partly provide safety to the piglets in the sow's usual activity area and partly function as a zone divider of the pen for the sow. The sow is expected to primarily lie with her back against the tilted lying wall.



Rough drawing of T pen



Rough drawing of F pen



Rough drawing of O pen



Photo of narrow T pen



Photo of F pen



Photo of O pen

# Weaner and finisher facilities

One of the great challenges in designing and managing facilities with partially slatted floors is to ensure that the solid floors are clean and comfortable. This is essential for the animals' welfare, the surrounding environment and for the reduction of labour in the facility. Design and management of large pens are also being investigated more closely to find methods for reducing the workload.

## The production efficient weaner and finisher facility

To achieve good production results, it

### Recommended design of weaner facilities:

- Pens measuring e.g. 2.2 m x 4.4 m with 2/3 solid floor, 1/3 concrete slatted floor/cast iron grating
- Tripartite cover with front bent downwards
- Partially open pen partitions (45 cm closed, 30 cm open)
- Tube feeders with water, two feed pipelines
- Supplemental water from drinking bowl, two pipelines
- Diffuse ventilation with automatic draught control in the exhaust
- Solid floor in inspection alleys
- Room and floor heat
- Sprinkling pipeline with nozzles bent downwards
- Soaking pipeline

### Recommended design of finisher facilities:

- Pens measuring e.g. 2.4 m x 4.8 m with 1/3 solid floor, 2/3 concrete slatted floor
- Tripartite cover with front bent downwards
- Partially open pen partitions (60 cm closed, 40 cm open)
- Liquid feeding in long trough
- Supplemental water from drinking bowl
- Diffuse ventilation with automatic draught control in the exhaust
- Solid floor in inspection alleys
- Room and floor heat
- Sprinkling pipeline with nozzles bent downwards
- Soaking pipeline

is essential to have a strategy for the production and an action plan for the management from the beginning. The challenge lies in combining high levels of efficiency, health and working environment with factors such as environment, neighbours and animal welfare. Regardless of which facility is chosen, it is important that it is designed on the basis of the existing knowledge to obtain the best functionality and productivity in the facility.

At the Agromek conferences in 2005 and in 2006, Danish Pig Production (DSP) presented a model of a production efficient finisher facility. The recommendations are based on trials and studies including climate-technical studies.

## Design and quality of floors in finisher pens

In co-operation with the Danish Institute of Agricultural Sciences (DIAS) and various floor manufacturers, DSP participates in a joint venture project on floor design in finisher pens. The project is supported by the Danish Directorate for Food, Fisheries and Agri Business and aims at establishing physical, thermal and biological requirements for design and quality of floors.

To be able to select relevant types of floors for the herd trial, DIAS investigated factors such as lying behaviour, non-skid properties, shock absorption and movement for a number of floors nominated by the participating companies. The floors yielding the best results were selected for investigation under production conditions. A total of eight different floor combinations are included in the investigation. The pens have 1/3 solid floor, 1/3 drained floor and 1/3 slatted floor.

### Floor types

Two floor types are being investigated in the lying area: a concrete floor with pre-fabricated floor elements from Perstrup Beton Industri A/S and a soft floor consisting of 40 mm bonded foam with a top layer of 2 mm rubber mat.

In the activity area, two different types of drained floor are being investigated: a traditional, drained floor made

of concrete and a drained floor in which plastic granulate is embedded in the floor surface to alter its thermal conductivity. Both floors are delivered by Sunds Alfa Beton A/S. In the dunging area, three different floor types are being investigated: a plastic floor with sand embedded in the surface from Ikadan A/S; a cast iron floor with abrasive traces from ACO Funki A/S, and finally a "bristle" concrete slatted floor from Sunds Alfa



Pen with cast iron floor with abrasive traces in dunging area.



Pen with bristle concrete slatted floor in the dunging area.

Beton A/S. On a bristle concrete slatted floor, the surface has been brushed with a broom before hardening. These three types were primarily chosen on the basis of a desire to obtain good non-skid properties.

### Surface treatment

In co-operation with the National Centre, Building and Technique, the Danish Applied Pig Research Scheme is investigating different products for surface treatment of floors.

The investigation includes products from eight different companies:

- Bent Møller proofing
- Fosroc strong plaster and fluat
- TC nano surface enhancement
- Vesla VespoX, epoxy proofing, epoxy with dyna grip and epoxy with quartz sand
- Degussa lascoat fluat and epoxy with quartz sand
- DeLaval epoxy with dyna grip

The investigation will evaluate factors such as the individual products' ability to protect the concrete, the products' shelf-life and price, and non-skid properties, cleaning of the floors, and the leg health of the animals.

The above factors have now been under evaluation for one and a half year, and incipient corrosion is seen on the surface of the untreated floors,



*Design of the pens in which the floor surface is treated.*

i.e. the surface has become rugged. This is also seen on a few of the treated floors where epoxy products have not been used. Furthermore, preliminary results indicate that it takes longer to wash the untreated floors than the treated floors.

#### **Solid floor with no mess**

Many of the investigations made by DSP in terms of climate and environment are commissioned to finisher facilities with mess problems. The problems are particularly great in warm periods and particularly in facilities with partially solid floors, closed pen partitions and diffuse ventilation. These investigations show that the problems occur when it is impossible to mix the air sufficiently in the pigs' activity zone. This reduces the air

quality: the concentrations of carbon dioxide and ammonia increase as do the temperatures, and moist may form, which makes the pigs move away from the warm/bad air, "turn the pen around" and dung on the solid floor. Unfortunately, faeces in the pigs' lying area results in increased odour and ammonia concentrations in the facility and thereby increased emissions to the surrounding environment.

Experiences from the climate investigations and a current trial show that more open pen partitions increase the mixing of air and the air change in the pens. This improves the ventilation efficiency (how fast contamination is eliminated from the room) in the pigs' activity zone. For most of the year it is thus possible to guarantee a good pen function if partially open pen partitions are used and if efficient temperature and sprinkling strategies are chosen.

However, on very warm days in diffusely ventilated facilities it may be difficult to prevent the pigs from dunging on the solid floor, even when heavy sprinkling is applied. High temperatures in the animals' lying area also affect the pigs negatively in the form of heat stress.

In the last years, additional air intake, typically in the form of ceiling inlets, has gained increasing ground when investments are made in ventilation systems. When the diffuse ceiling is combined with ceiling inlets, it is possible to lead the air directly into the pens or to the inspection alley, and the increased air speed will ensure extra cooling to the pigs. Unfortunately, the use of additional air intake does not always come without problems. The inlets can have different degrees of opening, and thereby different output, and they do not always close when they are supposed to. It is therefore difficult to manage the air optimally with this type of ventilation and avoid draught in the pens, particular during sudden drops in outdoor temperatures.

New methods for cooling of finishers are therefore being developed and investigated.

Increased ventilation efficiency in pigs' lying areas through air nozzles

The effect of taking in part of the ventilation air closer to the pigs' activity zone is being investigated in a finisher facility in which the pens measure 5.0 m x 2.4 m and are designed with partially slatted floors, cover and diffuse ventilation. The additional air intake takes place through nozzles through the inner third of the cover. The air intake is regulated so that the nozzles do not open until a given facility tem-



*Supplemental air intake through nozzles under the cover.*

perature is reached. The preliminary results show that it is possible to reduce the temperature under the cover and create slightly higher air speeds on the inlet air without causing draught nuisances for the pigs. The preliminary results also indicate that the number of pens with mess problems can be reduced by increasing the ventilation efficiency.

Increased ventilation efficiency in pigs' lying areas through ceiling fans DSP is investigating whether it is pos-



*Ceiling fan installed above a finisher pen.*

# Weaner and finisher facilities

sible to increase the ventilation efficiency in a diffusely ventilated facility through ceiling fans. The ceiling fans are installed 1.5 m from the back wall of the pen above every other pen partition. The fans are automatically adjusted via temperature sensors or manually and have ten different speeds.

The preliminary results show that it is possible to improve the ventilation efficiency in the pigs' lying area and to reduce the mess in the pens considerably by using a ceiling fan.

## Floor cooling

This project is conducted in a WTF herd in two of four sections. Each section has floor heat that is laid out with two loops per row of pens. A cooling system is hooked to the system via an additional mixing loop, and a three-way tap makes it possible to



7 kW cooling system for floor cooling.

switch between heating and cooling. A Danfoss valve regulates the temperature in the loop and a circulating pump distributes the water in the pipeline at section level. It is possible to shut off the heat and distribute the excess heat from the large pigs to the small pigs.

The preliminary results do not indicate that it is possible to cool the floor sufficiently to avoid mess on the solid floor with this trial design.

## Large pens for finishers

In co-operation with DIAS, DSP is investigating the concept of large pens for finishers. Factors such as

pen function, pig behaviour, production results and slaughter weight will be analysed.

The trial includes two herds with 2 x 350 and 270 place units, respectively,

### The principle of large pens and sorting scales is interesting because it makes it possible to

- Evaluate gain on an on-going basis
- Optimise slaughter weight
- Practise phase feeding
- Reduce labour in connection with delivery for slaughter and wash

and with sorting scales from Howema and Skiold Nederland, respectively. In both herds, the pens are equipped with separate feeding areas which means that the pigs pass the sorting scales to get from the lying/activity area to the feeding area. The pigs return to the pen through one-way gates.

In design, the sorting scales look like each other with load cells placed under the bottom of the scales. Each time a pig passes through the scales,



View of a large pen.

its weight is recorded and stored on a computer.

The daily weighing provides information on the average gain and weight spread in the group. It also makes it easier to practise accurate phase feeding based on the basis of the pigs' weight instead of over time.

## Preliminary experiences

The preliminary experiences show

- A good pen function in which the pigs lie in the lying area and dung in the dunging area. Quiet among the pigs.
- It is easy to get around in the large pen due to significantly less equipment, but difficult to move individual pigs.
- A great work relief in automatic weighing of the pigs before departure to the slaughterhouse.
- The daily gain is approx. 100 g below the normal level of the herd and the feed conversion approx. 0.05 to 0.1 FUGp per kg gain above.
- Mortality is higher than normally in the herd.
- Pigs delivered for slaughter through sorting scales are classified better in terms of weight compared with basis related to the normal level of the herd.

The production results correspond with experiences seen in the US and in previous DSP investigations with large pens for weaners.

The production results and the classifications are primarily based on results from the herd using the scales from Skiold Nederland. These scales had from the beginning of the investigation been developed the most, which resulted in fewer initial problems.

## The future

On the basis of the preliminary production results from the large pens, it can be concluded that we lack sufficient knowledge to be able to recommend the system on equal terms with the traditional housing systems for finishers.

Further investigations of large pens will concern establishment of the amount of work involved for daily and periodic tasks in and around the large pen. Furthermore, projects will focus on how the feed conversion and the daily gain can be improved. It will be investigated whether more feeding points for the smallest pigs can help increase the daily gain.



# Welfare and legislation

## Welfare campaign 2006

The focal point of the welfare campaign in 2006 was reduction of mortality among sows, weaners and finishers. The long-term objective is to reduce mortality in all herds (see table 1).

Table 1. DSP's long-term objectives for mortality in all herds.

| Animal category | Mortality       |
|-----------------|-----------------|
| Sows            | 8% of sows/year |
| Piglets         | 10 %            |
| Weaners         | 1 %             |
| Finishers       | 1.5 %           |

There are several benefits in reducing mortality: improved animal welfare, greater job satisfaction and a better economy.

The financial benefits can be calculated in several ways and with different prerequisites, but there will generally be good economy in reducing mortality.

Every death or destruction corresponds to a loss of minimum DKK 2,000 per sow.

Every time mortality is reduced by 1 percentage point in the weaner facility, it corresponds to a profit of DKK 3.2 per produced pig.

Every time mortality is reduced by 1 percentage point in the WTF facility, it corresponds to a profit of DKK 4.9 per produced pig.

Every time mortality is reduced by 1 percentage point in the finisher facility, it corresponds to a profit of DKK 6.6 per produced finisher.

As part of the effort to reduce mortality, DSP sent two sets of information material directly to the pig producers. The material consisted partly of background material and partly of material that could be used immediately in the facilities. The first publication in February 2006 was aimed at sow facilities and included information on:

- Growth and correct selection of gilts
- Correct selection of sows for further production

- Prevention of gastric problems
- Prevention of leg and hoof problems

The second publication in April 2006 was aimed at weaner and finisher producers and included information on:

- Inspection
- Useful recording
- Certain diagnosis
- Tail biting
- Hernia
- Gastro-intestinal diseases
- Respiratory diseases
- The use of hospital pens

The welfare campaign will continue in 2007 and will focus on, among other things, piglet mortality.



Information material on sows.

Political focus on animal welfare  
Animal welfare has been on the political agenda several times in the past year, and in December 2005 the government and Dansk Folkeparti reached a compromise on an action plan for improving animal welfare. Among other things, the action plan includes animal welfare in the publicly approved agreements on health advice in the herds. At the same time, requirement for self-inspection programmes for animal welfare are introduced in the herds.

Danish Pig Production is co-operating with the Danish Veterinary and Food Administration on drawing up a self-

inspection programme for use in the herds.

The self-inspection programme consists of two parts:

- Veterinary check of the self-inspection in the herd
- Self-inspection of the herd

At least once a year, a vet must check the self-inspection programme of the herd. This could be either the herd vet, a vet from the pig industry or one of the vets from the Regional Veterinary and Food Administration.

During the self-inspection of the herd, the herd owner will implement procedures in the daily tending to the animals that will ensure that the animal welfare regulations are met and that relevant recordings are made that can document that the self-inspection is implemented and is working according to plan.

Each Industry code/procedure contains four main areas:

- Description of good animal welfare practice based on legislation and recommendations.
- Self-inspection points and frequency of the self-inspection in the herd.
- Recording and documentation.
- Corrective action and advice if mistakes are detected during the self-inspection.

It may be necessary to adapt the individual Industry code/procedure to the conditions of the herd.

## Results of 5% inspections

In 2005 (2004), 647 (824) inspections were made in pig herds. These inspections led to 1053 (1833) injunctions. Forty-six (47) pig producers were reported to the police.

In 2004, lack of rooting and enrichment material was a major problem. This improved significantly in 2005. Significantly fewer injunctions were granted, but unfortunately the number of reports to the police increased.

Unfortunately, the results show that some producers do not tend sufficiently to sick and injured animals. DSP



now sets aside even more resources to solve this problem.

On January 1, 2005, a new order came into force requiring specially designed hospital pens in all herds. The change in statutory requirements was clearly reflected in the 2005 results, which showed that one fifth of the injunctions were caused by the new legislation coming into effect with only 1.5 months' notice.

Inevitably, due to the short time horizon some producers did not manage to set up the statutory hospital pens in time. Now two years after the order commenced, DSP therefore expects the problem to be considerably reduced.

In 2004, problems were detected with bleeding of animals after stunning with a captive bolt pistol. The 2005 results indicated improvements even though some producers still do not bleed their animals. The herd vets are hereby encouraged to step in and give advice. Bleeding is a necessary, but unpleasant, part of a successful destruction procedure. The animals must be bled as described in the campaign material published by DSP, which was sent to all pig producers in the summer 2005.

### **Instruction on rooting materials**

In the summer of 2005, the Danish Minister of Justice promised that an instruction would be prepared on the allocation of rooting and enrichment materials, and this is now available.

For the first time, the instruction distinguishes between rooting and enrichment materials in a way that makes it possible for some materials to meet both requirements and others only the one requirement. For instance, rope that is not placed on the floor is enrichment material but not rooting material. It is also new that some types of feed allocation can meet the requirement for rooting material. In that case, enrichment materials must be provided.

In as far as which materials meet the statutory requirement, the Ministry of Justice maintains the requirements

already in place for natural materials, etc.

### **Feeding that regulates satiety**

For a period of time, the inspectors of the Danish Veterinary and Food Administration have focused on feeding that regulates satiety of gestating sows. It was the belief of the



*Feeders where the pigs have to work for small amounts of feed at a time can meet the requirement for rooting material but not enrichment material.*

Administration that when gilts and sows do not have access to straw, they must be given feed containing max. 85 FUsow/100 kg in order to fulfil the statutory requirements.

At the request of the Danish Institute of Agricultural Sciences, the Veterinary and Food Administration analysed this interpretation, and the result was that there is no documentation for using a limit of exactly 85 FUsow/100 kg feed or for setting another limit. The Veterinary and Food Administration has therefore decided not to employ limits for FUsow/100 kg feed at the welfare inspections.

### **The demonstration project "welfare"**

Supported by the Directorate for Food, Fisheries and Agri Business, DSP has completed a series of activities aimed at disseminating the knowledge of welfare-promoting solutions in pig production. The aim is to encourage pig producers to work towards an effi-

cient production and at the same time respect the welfare of the individual animal.

Therefore, various measures were implemented in five sow herds and four weaner/finisher herds to demonstrate how the number of cullings and destructions due to welfare reasons or disease can be reduced.

In the demonstration herds, it was attempted to increase the longevity of sows, particularly in systems with electronic sow feeding (ESF). Measures were introduced in areas such as introduction of gilts to ESF and correct use of hospital and relief pens. For weaners and finishers, improvements demonstrated how to reduce tail biting through optimisation of ventilation, allocation of straw and the use of hospital pens.

The results and experiences from the herds are included in the preparation of an ESF and tail biting manual and in guidelines for correct use of hospital and relief pens. The entire material will be available at [www.infosvin.dk](http://www.infosvin.dk).

# Satiety and gastric health

## Introduction

Several projects have been conducted with the aim of clarifying which dietary measures are able to enhance the satiety and gastric health of sows.

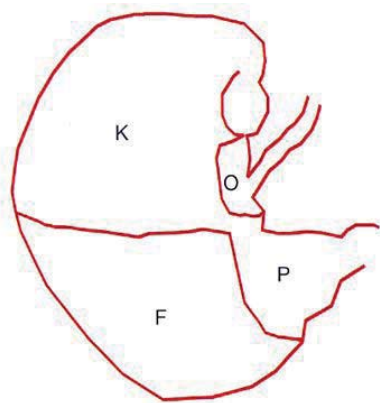
## Satiety in sows

A joint research project is being conducted in co-operation with the Danish Institute for Agricultural Sciences supported by the Directorate for Food, Fisheries and Agri Business that will clarify the importance of feed composition on the sows' total satiety periods. The project was initiated on April 1, 2006, and therefore no preliminary results are available yet. Below are Danish Pig Production's current recommendations for feeding of gestating sows in facilities that are not based on bedding:

- Diet with 103 FU<sub>sow</sub> per 100 kg.
- Use barley as the only cereal.
- Wheat can also be used in combination with 30% oats, 20% sugar beet pellets or 10% green meal.

## Gastric health in sows and young females

Analyses of gastric health in pigs are based on changes in the white part of the mucosa immediately after the mouth of the oesophagus. The white part of the stomach does not produce mucus for protection of the mucosa. Therefore, gastric juice produced in the lower part of the stomach may "flush" up on the white part and cause changes. The gastric juice can only reach the white part if the gastric content is thin. Therefore, all measures making the



Drawing of a stomach. "O" denotes the white part of the stomach.

gastric content more viscous will benefit the gastric health of the pig.

A gastric content of viscous texture is primarily obtained through a coarse feed texture and through the addition of soluble fibre to the feed. A high fibre content is also expected to generally stimulate the function of the stomach. In February 2006, all sow keepers in Denmark received the campaign material on increased welfare among sows and young females. This material included fact sheets on gastric health describing the measures currently recommended for maintaining a healthy stomach. The material is available in Danish at [www.infosvin.dk](http://www.infosvin.dk).

## Insoluble and soluble fibres

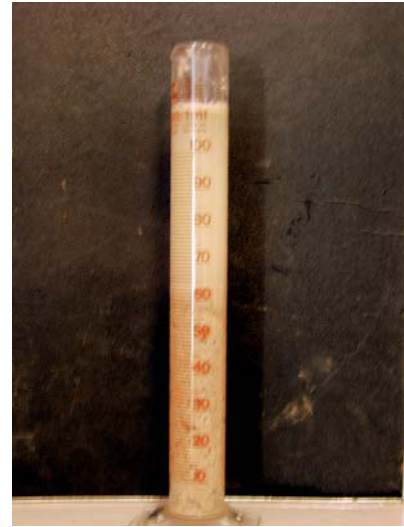
The feed's content of insoluble and soluble fibres is called dietary fibre and is stated in grams per kg dry matter. The soluble fibres are capable of binding 15 times as much water as the insoluble ones. The amount of dietary fibres helps determine the texture of the gastric content: the more soluble fibre, the thicker the texture. The current recommendation is that 20-25% of the dietary fibre should be soluble fibre.

## Texture of the gastric content

The feed's influence on the texture of the gastric content was studied in a trial (report no. 0512). Various high-fibre feed-stuffs were given to the sows for 14 days before slaughter and the texture of the gastric content was examined max. three hours after the last feeding. The results revealed that diets containing 15% oats, 10% sugar beet pellets or 10% pectin fibre all resulted in a thicker texture of the gastric content compared with the control diet.

As a result, a trial was initiated in two herds in which 10% sugar beet pellets (increased amount of fibre) or 20% rolled oats (coarser texture as oats were added after pelleting), respectively, were added to the gestation diet. The lactation feed remained unchanged.

Stomachs from all slaughtered sows from the two herds were examined in a before and after period. The results showed that the addition of 10% sugar



Volumetric flask showing the texture of the gastric content (sediment).



Healthy stomach (index 0).

beet pellets significantly improved the gastric health in the sows. The effect could probably have been greater had the lactation diet also been changed (trial report no. 757).

## The use of acid inhibitors

A trial investigated the use of a natural acid inhibitor (0.6% sodium bicarbonate) in gestation feed (trial report no. 721). The trial comprised two herds, and the results showed an improvement in gastric health in one of the herds, but not in the other. It was concluded that sodium bicarbonate in sow diets is not a suitable method for improving the gastric health.

## Gilts and gastric health

At experimental station Grønshøj, a high-fibre diet for gilts is currently being compared with a control diet

# Satiety and gastric health

given from 30 kg until slaughter at approx. 120 kg.

The gilt diet contains 70 g extra dietary fibre per kg. So far, approx. 150 stomachs have been examined in each group, and the preliminary results indicate that the gastric health improves in the trial group already after three weeks.

Financial support has been granted from the Directorate for Food, Fisheries and Agri Business (EU funds) for demonstrating that know-how from the finisher area can improve gastric health in sows and gilts. Nine sow herds were included and here the following interventions were implemented in diets for the gilt period, the gestation period and the lactation period to improve the gastric health:

1. Meal feed vs pellets for sows
2. 15% pectin fibre for gestating sows and 5% pectin fibre for lactating sows
3. 20% sugar beet pellets for gestating sows and 10% sugar beet pellets for lactating sows
4. 10% green meal for gestating sows and 5% green meal for lactating sows
5. The use of coarsely ground feed in the first part of the lactation period
6. 10% pectin fibre for gilts from approx. 60 kg until service

|                            |   |
|----------------------------|---|
| Group 1 (positive control) | Finely ground heat-treated and pelleted feed                  |
| Group 2 (negative control) | As group 1, but coarsely ground meal feed                     |
| Group 3                    | As group 1, but with access to straw from straw dispenser     |
| Group 4                    | As group 1, but with the inclusion of approx. 10% cut straw   |
| Group 5                    | As group 1, but with the inclusion of 10% pectin              |
| Group 6                    | As group 1, but with the inclusion of 10% fibremin (sphagnum) |
| Group 7                    | As group 1, but with the inclusion of 10% green meal          |
| Group 8                    | As group 1, but with the inclusion of 10% oats                |
| Group 9                    | As group 1, but with the inclusion of 10% Arbocel®            |

The results will be published at the end of 2006.

### Gastric health in finishers

The effect of feed on the texture of the gastric content in finishers was investigated in a trial (trial report no. 757).

The effect of nine different diets on the pH of the gastric content, dry matter percentage and sedimentation was studied. The stomachs were also evaluated on a scale from 0 to 10 for the degree of gastric changes.

The nine diets were based on a control diet in which the grain consisted of wheat. The groups included in the trial are shown in the table.

In each group, finishers in two pens were given the trial feed from approx. 78 kg until slaughter. In each group, 20-26 pigs were slaughtered.

As expected, feeding with coarsely ground meal feed resulted in a more coherent gastric content, and significantly fewer pigs in this group had gastric changes.

This trial indicates that it is possible to reduce the prevalence of severe gastric changes in finishers by feeding with coarsely ground meal feed for 3-5 weeks (see figure 1).

None of the diets resulted in significantly more sediment, more dry matter in the gastric content or a lower gastric index compared with the negative control group given finely ground pelleted feed. However, the pigs given sphagnum had a significantly lower dry matter content and more pigs suffered from gastric changes compared with the positive and the negative control group.

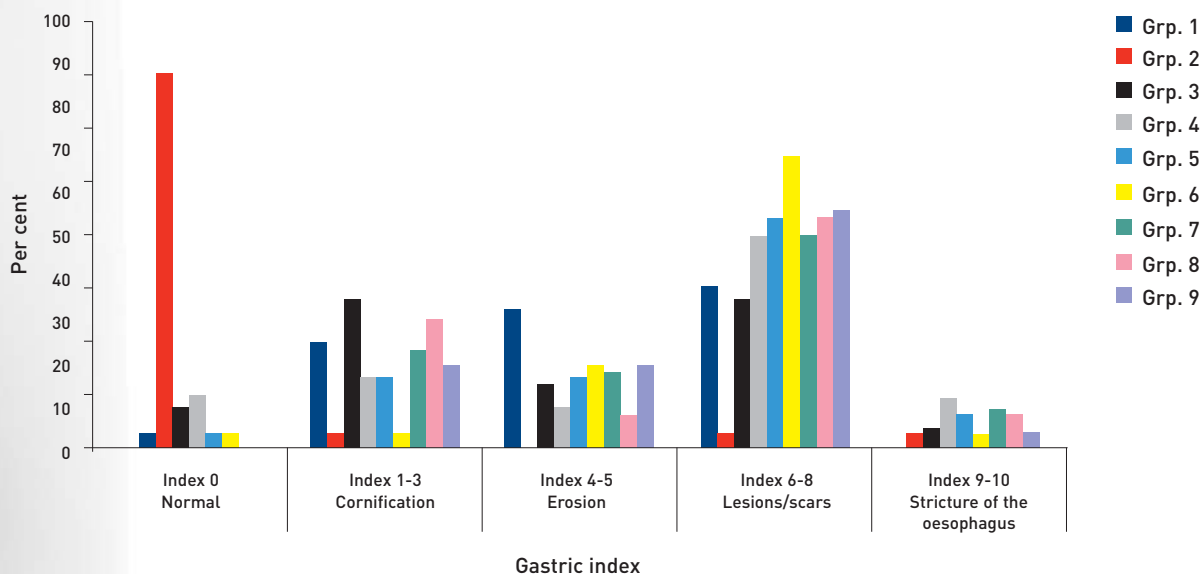


Figure 1. Percentage of pigs within a group with the listed gastric index.

# Prevention of shoulder ulcers

## Prevention rather than cure

Over the last years, the interest in shoulder ulcers has increased and many measures have been initiated to solve the problem. It is, for instance, important to keep focusing on prevention. Prevention is first and foremost obtained through feeding and through avoiding risk sows.

### How to prevent shoulder ulcers:

- Manage the body condition of gestating sows
- Maintain a good body condition in the farrowing facility
- Avoid old sows
- Avoid sows with scars on their shoulder
- Avoid lame sows
- Have mats ready for risk sows

## Management of body condition – also in the farrowing facility

Management of body condition in the gestation facility is the first place to start. However, managing body condition in the farrowing facility is more important than previously assumed. From humans we know that diets rich in protein and energy have a protective effect on pressure ulcers and improve the healing of ulcers. Similar conditions may also apply to sows.

## Old sows and scars

Old sows manage badly in relation to shoulder ulcers. It is therefore important to consider the sow's age when selecting sows due for culling. A sow that has suffered from shoulder ulcers before has a greater risk of getting an ulcer again. Sows with scars on their shoulders have twice the risk of getting shoulder ulcers. It is an advantage to provide such sows with a mat.

## Poor legs

A study made by the Royal Veterinary and Agricultural University showed that lame sows were at a 16 times greater risk of developing shoulder ulcers. Sows with bad legs must therefore be given extra attention and care.

## Once the damage is done

If the sow develops a shoulder ulcer

despite preventive interventions, treatment must be initiated immediately. The pressure on the shoulder must be relieved and the ulcer must be treated.

The best solution is to provide relief in a pen with soft bedding, but placing mats in the sow's pen is also a solution.

## Mats immediately

Based on practical experiences, DSP recommends that the producer has a number of mats ready permanently in a couple of pens in each section and the risk sows can then be transferred to these pens. You thereby avoid moving the mats too much and labour is saved. It is at the same time ensured that the sow has a mat already at incipient shoulder ulcer.

## Do mats work?

We have sparse knowledge of the effect of mats. An American study including 46 sows found a positive effect of mats on the healing of shoulder ulcers.

DSP is currently finishing a comprehensive study on the importance of mats to the healing of shoulder ulcers. The study comprises approx. 300 sows from three different herds. Half the sows are given a mat, and emollient is applied twice a day until the ulcer has healed. The other half receives no treatment (control). The area and the severity of the ulcers are

recorded during this process.

The first results are expected to be available in the autumn 2006, and the remaining results are expected at the end of the year. Among other things, it will be assessed if mats are able to protect the sows against shoulder ulcers during the subsequent parity.

## Moisturizing plasters

In a pilot study, DSP studied the effect of four different bandage types for local treatment of shoulder ulcers. The study included both products for humans (angel skin, liquid spray and hydro colloid bandages) and specially developed plasters for sows. The specially developed plasters were developed in an innovative co-operation between DSP and the company Anicare.

During the study, the sows were inspected every day, and the plasters were tested for adhesiveness, durability, elasticity, transparency and effect on infection of the ulcer.

Plasters for humans were unsuitable for sows due to poor adhesiveness and durability. Despite some variation, the specially developed plasters had a good adhesiveness and a significantly better durability. However, infection of the ulcer, particularly during warm periods, caused problems. The use of plaster can therefore not be recommended until this problem is solved.



Risk sows should lie on mats.



# Tail biting

In co-operation with the Danish Institute of Agricultural Sciences, DSP has studied tail biting in detail to pinpoint and eliminate possible causes. Various interventions against tail biting and temporary elimination of acute tail biting were investigated.

## Elimination of acute tail biting

The pig producer may need tools that can stop tail biting from developing while the actual causes are being found and eliminated.

Rope, straw and feeding with carbohydrate-rich feed in which soybean meal is replaced with grain were investigated in three herds. These materials were given for 14 days only at incipient tail biting (reddening/scratches).

Changes in feed composition did not have a uniform effect on tail biting.

Straw and rope generally stopped the development of the tail biting and were able to prevent new cases of tail biting while given. Rope seemed more efficient than straw, probably because the straw quickly passed through the slatted floor as the pens did not have solid floor.

The trial also showed that the development of tail biting could be stopped simply by pinpointing the causes of tail biting in the herd and by the staff becoming aware of the problem and of the indications of incipient tail biting.

## Interventions against tail biting

The causes that trigger tail biting in a herd must be detected and eliminated as quickly as possible for welfare and financial reasons. In a trial under the above co-operation, interventions were made against tail biting in 18 herds. Unfortunately, three of the herds were excluded from the trial.

The interventions were selected on the basis of detailed analyses of welfare and climate, among other things, in the individual herds.

Many different factors were found and evaluated as triggering tail biting. Two to three relevant interventions were made in each herd.

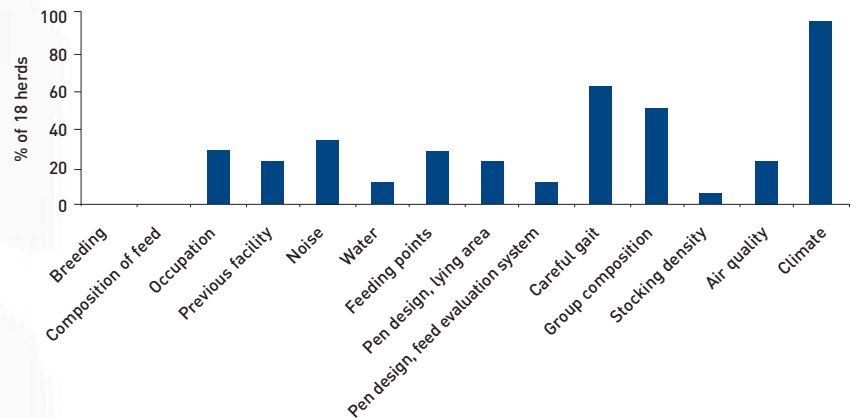


Figure 1. Factors triggering tail biting. In this trial it was attempted to eliminate these factors.

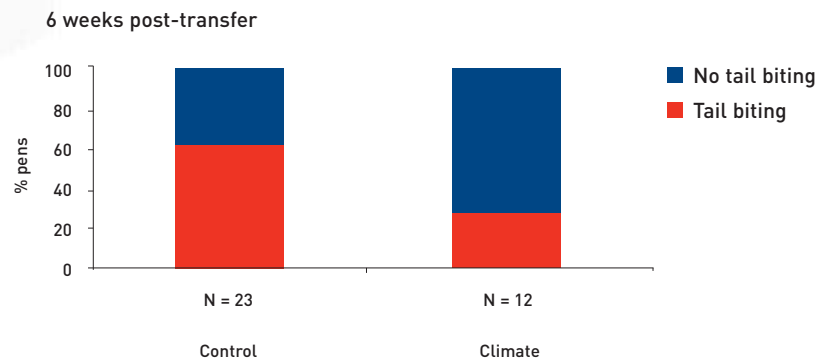


Figure 2. Example of effect of interventions. Slurry curtains were installed, inspection alley covered and temperature strategy changed in a herd where outbreaks were normally seen six weeks after transfer to the pen.

In most herds, climate factors such as heat and draught were evaluated as being possible causes of tail biting. Careful gait and sorting of animals (for instance according to sex or size) were also pinpointed in many herds as triggering tail biting.

Careful gait can trigger tail biting because a pig with sore legs does not move away when its tail is being bitten. In terms of sorting pigs, small pigs may have learned that they can chase other pigs away from, for instance, the feed by biting their tails, thereby getting a place by the feed trough.

In 13 of the 15 herds, the interventions generally had a positive effect on the prevalence of tail biting. In three herds, the interventions had a highly positive effect. In these herds, the following were changed:

- Allocation of straw, slurry curtains, cover of inspection alley, changed temperature strategy.
- Surface treatment of the floor in farrowing pens, intact litters in weaner pens, floor heat, straw board, bedding, curtain in front of creep area.
- Intact litters in finisher pens.

The efficiency of an intervention depends on whether the intervention eliminates an essential factor and whether other factors are so influential that the effect of the intervention becomes insignificant. The latter is often the reason why tail biting problems are difficult to solve.



# Reduction of finisher mortality



Lab studies provide a good basis for solving problems with excessive mortality.

## Excessive mortality

Excessive mortality constitutes a welfare problem and an unexploited economic potential in many herds. For each percentage point reduction in mortality, the gross margin per produced finisher increases by DKK 6.60.

To solve this problem, DSP is conducting a demonstration project that consists of two parts:

1. Risk factors for excessive mortality are analysed on the basis of data that have already been collected.
2. Relevant DSP employees and representatives from the local advisory service visit a number of producers that have experienced a high mortality for a long period of time.

During the visits, herd conditions will be analysed and diagnoses made among the pigs will be analysed by way of blood samples, autopsies and lab examinations of destroyed or dead pigs with typical symptoms. These factors constitute the basis for finding solutions to the problems in the herd. The financial potential in reducing

mortality will be analysed in the individual herd, and often a general improvement in productivity will be evaluated.

## Problems and interventions

In several of the herds visited so far, problems have been detected with PRRS and/or PMWS. Other typical findings include pneumonia, pleuropneumonia and Lawsonia.

Based on analyses, financially sensible proposals for improvements are made – typically changes in operation - to stabilise the virus infections in the herds.

Handling of PMWS in the weaner facility is thoroughly described in the PMWS manual. However, it is not quite as well-known how to handle the disease in the finisher facility.

In herds with PMWS in the finisher facility, the interventions were typically aimed at other infections such as PRRS, pneumonia and pleuropneumonia.

Below are examples of the interventions in the herds:

- All finisher facilities were emptied and separate weaning facilities were established for the smallest pigs.
- Staff with an interest in tending to finishers was hired.
- Sows were vaccinated against PMWS.
- Separate premises were built for immunisation and stabilisation of gilts against PRRS.

Proposals for complete depopulation in one of the herds were to be considered in connection with an extension of the herd. Subsequently, however, it turned out that a change in diets stabilised the herd despite the fact that the pigs suffered from all diseases imaginable.

## Preliminary experiences

The virus infection seemed to play a major part in several of herds. The aim was to stabilise the PRRS infection in the sow unit so that pigs leaving the weaner facility would be PRRS-free. It is still too early to evaluate the effect of the improvements. The project has so far demonstrated that it is possible with existing know-how to pinpoint causes for the excessive mortality in several of the herds.

In herds with more than one vet attached, we had positive experiences with reaching a joint understanding of the problems in the herd and agreeing on solutions. Agreement between all advisors seems to be an important prerequisite for initiating and completing all the necessary changes of the operation of a herd.

To improve the economy in more finisher herds, another demonstration project has been initiated with the aim of increasing the gross margin by DKK 25 per finisher through improvements in production.



# Antibiotics and resistance

## Concern for the use of antibiotics

The use of antibiotics for treatment of sick animals may result in zoonotic bacteria developing resistance to the antibiotic in question. If this happens, it might become difficult to treat humans infected with the resistant bacteria originating from farm animals.

## Tylosin is out

In an attempt to mitigate this risk, the Danish Veterinary and Food Administration decided to remove macrolides (including Tylosin) from the list of antibiotics recommended for treatment of diarrhoea in pigs in 2006. The decision was based on information on a high prevalence of macrolide-resistant *Campylobacter* in pigs, wide-spread use of macrolides in pig production, and new reports of serious cases of human infections with macrolide-resistant *Campylobacter*.

## Risk assessment completed

The pig sector has assessed the risk associated with humans becoming infected with macrolide-resistant *Campylobacter* originating from Danish pig production. The assessment demonstrated that only a small percentage of the exposure of Danes originates from Danish pork (3.6%). The majority of the exposure is caused by imported meat, poultry or pork (88.7%).

## Official data

The assessment was based on data from official EU reports and Danish reports describing the prevalence of *Campylobacter* (which is a zoonosis) and in particular the prevalence of macrolide-resistant *Campylobacter* in pigs, poultry and meat from these animals. The analysis also included information on origin of the meat and consumer habits in Denmark.

## Natural occurrence in pigs

The assessment revealed that *Campylobacter* is naturally occurring in the gut of most pigs and that 23% of the *Campylobacter* bacteria from Danish pigs are resistant to macrolides, including Tylosin. This resistance is probably the result of the use of macrolides in Danish pig production; in 2004, approx. 13 tonnes macrolides were used for a production of 23 million finishers and an export of 2 million weaners.

Is there a direct correlation between the prevalence in live pigs and the prevalence in pork? Or, put differently, is it correct to assume that a high prevalence in live pigs equals a high prevalence in pork?

## Few bacteria in pork

The assessment revealed that the prevalence of *Campylobacter* in pork in the retail link is low – generally less than 10%. The prevalence is particularly low in Danish pork (0.2%). This is due to the wide-spread use of blast-chilling and a high level of hygiene.

## More bacteria in poultry meat

*Campylobacter* is frequently found in poultry meat: 20-40% in most EU member states. There are two different types of *Campylobacter* in poultry: *jejuni* and *coli*. In Danish poultry meat, the prevalence of resistance to macrolides is low for *Campylobacter jejuni* (0-3%), while it is moderate for *Campylobacter coli* (approx. 12%). Pigs primarily have *Campylobacter coli*.

## Assumptions

There are no data for macrolide-resistance in pork as it is a wide-spread view that *Campylobacter* is primarily related to poultry meat. It was therefore assumed that the prevalence of resistance in *Campylobacter* in pork is the same as for live pigs – 23% for Denmark.

## The majority is imported

A simulation model showed that the majority of the exposure of Danes in the form of macrolide-resistant *Campylobacter* originates from imported meat (88.7%). Only 3.6% of the exposure

could be explained by treatment with macrolides in Danish pig production.

## Consequences?

According to a recently published Danish study, the risk of severe disease or fatal outcomes among humans due to infection with macrolide-resistant *Campylobacter* compared to sensitive *Campylobacter* was increased. However, the observed increased risk only applied to very old patients who suffered from concurrent serious diseases. Moreover, the severe disease or fatal outcome occurred weeks to months after the initial infection with *Campylobacter*. The severity of the consequences was therefore assessed as low for children and medium for older people. The human health risk connected to veterinary use of macrolides in Danish pig production seems therefore to be low. This is primarily due to the fact that Danish pork is accountable for a very small part of the overall infections in humans.

## Dialogue with authorities

In the spring 2006, the sector presented the risk assessment at a public meeting. DVFA subsequently asked the Danish Institute for Food and Veterinary Research to evaluate this risk assessment. DVFA has received the scientific report containing the risk assessment from the sector, and the authorities' peer review of the assessment is expected in the autumn 2006. It is our hope that the risk assessment may initiate a new dialogue between the authorities and the sector with the aim of constructively co-operating on the use of antibiotics and resistance.



Few humans become infected with macrolide-resistant *Campylobacter* from Danish pork.



# Vaccination and economy

## Vaccination

The purpose of vaccinating pigs is to improve the health in the herd. Benefits include the elimination of the risk of specific infections and/or the reduction of the losses caused by the infection. However, the benefits should always be greater than the costs of the vaccination. Some of the considerations you need to make before deciding on a specific vaccination strategy are described below. Additionally, the development of a new vaccine is briefly described.

## Pneumonia and PRRS

Pneumonia in finishers caused by *Mycoplasma hyopneumoniae* is the most common form of pneumonia in Danish pig production, and it is believed that the disease is present in most conventional herds. The disease is chronic and many pigs carry *M. hyopneumoniae* without showing signs of disease. The disease is important to the producer because it causes reduced weight gain and increased feed conversion.

PRRS (Porcine Reproductive and Respiratory Syndrome) is also common among finishers. Additional infections such as *Mycoplasma hyopneumoniae* and *Actinobacillus pleuropneumoniae* can be very difficult or impossible to control when the pigs in a herd are infected with PRRS.

## Clinical trial

Severe clinical disease problems are often seen when infections with pneumonia and PRRS are present simultaneously, and it is therefore important to develop a vaccine against both infections.

Danish Pig Production has therefore tested a combination vaccine in three herds against *Mycoplasma hyopneumoniae* and PRRS in co-operation with the medicine company Intervet Danmark A/S. The vaccine was tested in three groups: placebo + placebo, placebo + mycoplasma, and placebo + PRRS. Data from the trial are currently being analysed, and the results will be published at the end of 2006.

## Vaccination and economy

To assess the effect of a vaccine one

may look at, for instance, the daily weight gain and the degree of pathological changes in the lungs before and after a vaccination strategy has been implemented.

Table 1 provides an outline of the most important input parameters for cost-benefit assessments of a vaccination strategy. In the particular example it can be seen that, in theory, the annual surplus will be DKK 19,870 if the vaccine is used. The calculations are based on key-herd figures, such as the number of sows, the number of weaned pigs/litter and the number of litters per sow per year. These figures are readily obtained from the production reports in the herd.

The costs of the vaccination and the amount of antibiotics used for the age group in question are also known. Labour costs and the hourly wages can be estimated in co-operation with the producer.

Additionally, the calculations require some estimates that are somewhat uncertain but at the same time decisive to the final results, e.g. the number of pigs that are affected by the disease in the herd, the expected change in daily weight gain in vaccinated versus

non-vaccinated pigs, the expected change in mortality and the expected change in the number of sick pigs that need to be treated with antibiotics. Information from vaccination trials, for instance recordings of daily weight gain and frequency of lung changes, should, of course, always be included in the considerations before deciding upon a specific vaccination strategy. However, it is equally as important to have good recording procedures in the herd, so that the advisor can make a qualified estimate of the expected effect of the vaccine on, for instance, mortality. Good recording procedures before and after a vaccinating strategy has been implemented are also a prerequisite for evaluating whether any change has occurred. Finally, it is a natural prerequisite that the veterinarian has made a thorough diagnostic work-up regarding the actual cause of the disease and the extent of the disease in the herd.

## Conclusion

The decision on whether to vaccinate or not must be assessed on the basis of the existing information in the herd and on the expected effect of the vaccine. Danish Pig Production is currently working on developing tools to assist in making such assessments.

Table 1. Necessary input values for assessing the cost-benefits of a vaccination strategy in a herd

|   |           |
|---|-----------|
| Recordings  |           |
| Number of sows  | 300       |
| Weaned pigs/litter  | 11        |
| Litters/year  | 2.3       |
| % sick pigs before vaccination  | 50        |
| % sick pigs receiving antibiotic treatment before vaccination (treated compared with total number of finishers) | 25        |
| Vaccination costs per finisher, DKK   | 8         |
| Labour connected to vaccination, minutes/finisher   | 1         |
| Increased daily gain, g/day/pig – all pigs, healthy and sick  | 50        |
| Change in mortality, percentage points  | 1         |
| Reduction in the number of sick pigs, %   | 75        |
| Price of antibiotic treatment, DKK/treated pig  | 2         |
| Labour connected to antibiotic treatment, minutes/treated pig   | 1         |
| Economy   |           |
| Vaccination costs, DKK/pig  | 10.50     |
| Value of increased daily gain, DKK/pig  | 6.77      |
| Value of reduced mortality, DKK/pig   | 5.50      |
| Costs saved for treatment, DKK/pigs   | 0.84      |
| Calculated surplus, DKK/finisher  | 2.62      |
| Calculated surplus, DKK/year  | 19,780.00 |



# Financial potential in depopulation

In the past year, DSP has focused on two activities: depopulating for pneumonia by way of quinolones and evaluating the financial consequences of national depopulation for certain diseases.

## Pleuropneumonia

Medical depopulation of herds with antibiotics has proven to be extremely difficult. However, depopulation trials made years ago with medication, particularly quinolones, indicated a relatively high success rate. Due to a possible risk of development of antibiotic resistance, the use of quinolones is currently subject to restrictions that make it impossible to use them for depopulation purposes.

With permission from the authorities, DSP has initiated a depopulation trial in three sow herds with a quinolone drug (Marbocyl). The project will demonstrate whether an undesired increase in resistance occurs after medicating and whether depopulation is successful. If the results are positive, the idea is that they can constitute the basis of considering possible future approval for using quinolones for depopulation purposes.

## Cost-benefit analysis of national depopulation

A study investigated the basis for depopulating all the herds in the country for loss-inflicting diseases and the potential financial benefits associated with this. The study compared complete depopulation with so-called medical partial depopulation.

## Background for national depopulation

In Denmark, we have a fairly large nucleus of breeding and multiplier herds with SPF status from which replacement stock can be recruited after depopulation. At the same time, the strong development in structure towards still fewer herds will probably result in these herds being placed far away from each other. This will reduce the risk of herds infecting each other through airborne transmission.

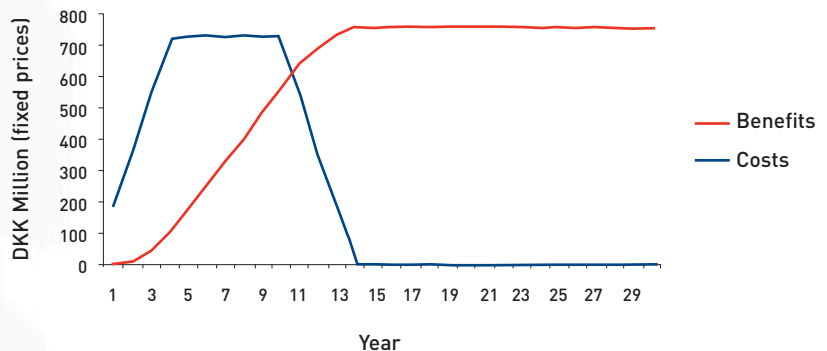


Figure 1. Costs and benefits over 30 years for national total depopulation.

## Relevant diseases

The most relevant diseases are the ones for which, under Danish conditions, experiences have been obtained with depopulation and declaration of freedom. The scenario with total depopulation at national level included: mycoplasma pneumonia, pleuropneumonia, PRRS, dysentery, rhinitis, mange and lice. The scenario with national partial depopulation comprised the same diseases except pleuropneumonia and rhinitis, as the probability for successful depopulation for these two diseases is too low.

## Costs and benefits of national depopulation

The financial benefits of total depopulation and partial depopulation were estimated on the basis of assumptions on the average changes in daily gain, feed conversion, mortality and the number of pigs weaned per sow. The costs included lost production in the non-productive period, costs for cleaning and disinfection, loss on culled animals, purchase of replacement stock and costs for advisory services. The partial depopulation scenario also included medication costs.

The costs of handling the depopulation programmes at national level were not estimated.

Figure 1 shows the distribution of the annual costs and profits at national level over a 30-year-period in the scenario with total depopulation.

## Is it worth it?

For both scenarios, it is possible to determine the present values of the stream of costs and benefits and the total "net profit" (net present value) over a number of years.

Table 1 shows that over a 15-year-period neither of the two scenarios are worth it, but for longer time horizons they are both profitable (20 and 30 years). Furthermore, the ratio between the total discounted benefits and the total discounted costs (B/C ratio) may say something about the benefit per invested Krone. Table 1 shows that national partial depopulation is apparently a marginally more cost-efficient strategy compared with national total depopulation.

Table 1. Net present value (stated in DKK million) and Benefit/Cost (B/C) ratio at 2.5% real interest rate.

|  | Total depopulation | Partial depopulation |
|--|--------------------|----------------------|
| Net present value 15 years (DKK million) | -1,662             | -842                 |
| Net present value 20 years (DKK million) | 825                | 671                  |
| Net present value 30 years (DKK million) | 4,965              | 3,191                |
| B/C ratio 20 years                       | 1.1                | 1.2                  |
| B/C ratio 30 years                       | 1.8                | 1.9                  |



# Worms and weaner diarrhoea

## Importance of worms for pig productivity

The effect of worm infections on daily gain and feed conversion in finishers was investigated in two herds. The pigs in both herds had a moderate prevalence of roundworm measured as 10-33% livers with white spots at slaughter.

The pigs were treated with either dewormer (Flubenol© vet, 5 mg/kg body weight) or a placebo (lactose) upon transfer to the finisher facility (30 kg) and five weeks later (60 kg). The dewormer and the placebo were mixed in the feed (liquid feed) and administered for five consecutive days.

Treatment with dewormer at 30 kg and 60 kg prevented shedding of worm eggs in the faeces (0%) compared with the placebo group (18.2%), but had no effect on the prevalence of white spots in the liver at slaughter (table 1).

Table 1. Effect of treatment with Flubenol or placebo on the productivity.

|                | Flubenol | Placebo |
|----------------|----------|---------|
| Number of pigs | 1947     | 1985    |
| Daily gain, g  | 837      | 836     |
| FU/kg gain     | 2.83     | 2.82    |
| Lean meat %    | 60.9     | 60.9    |
| Worm spots     | 27.7     | 24.8    |

Treatment with dewormer had no effect on daily gain, feed conversion

or lean meat percentage (table 1). However, in one herd, diarrhoea problems tended to enhance the effect of worms on productivity.

Treatment against worms had no effect on mortality or the number of disease recordings.

The conclusion from this trial is therefore that treatment against worms has no effect on productivity or disease frequency in finishers.

Acid and zinc in the weaner facility  
The effect of including 2.5% acid and 2.5% acid + 2,500 ppm zinc in the diet the first 14 days of the weaner period was investigated in one herd. Three groups were included in the trial totalling 3,000 pigs. The addition of 2.5% acid consisted of 0.5% benzoic acid, 1% lactic acid and 1% formic acid. The pigs in the herd had documented problems with post-weaning diarrhoea caused by E-coli O138 or O149 and Lawsonia diarrhoea towards the end of the weaner period.

### Preliminary figures

The inclusion of 2.5% acid resulted in a 22% reduction in treatments and in a 27% reduction in mortality. The combination of 2.5% acid and zinc resulted in a 90% reduction in treatments and a 54% reduction in mortality. The effects were significant, and the results are shown in table 2.

Table 2. Effect of acid and zinc on mortality and treatments for diarrhoea.

| Group       | Treatments /pig | Mortality, % |
|-------------|-----------------|--------------|
| Control     | 8.9             | 2.6          |
| Acid        | 6.9             | 1.9          |
| Acid + zinc | 0.9             | 1.2          |

There was no effect on daily gain or feed conversion.

The results are shown in table 3.

Table 3. Effect of acid and zinc on productivity.

| Group       | Daily gain g/day | Feed conversion, FUgp/kg |
|-------------|------------------|--------------------------|
| Control     | 415              | 1.96                     |
| Acid        | 410              | 1.95                     |
| Acid + zinc | 406              | 1.98                     |

The majority of the diarrhoea treatments (75%) took place the first three weeks post-weaning and must be attributed to the E. coli infection in the herd.

The addition of 2.5% acid and 2,500 ppm zinc to the weaner diet for two weeks efficiently reduced the number of cases of diarrhoea requiring treatment in the entire weaner period (figure 1), and most treatments took place immediately post-weaning.

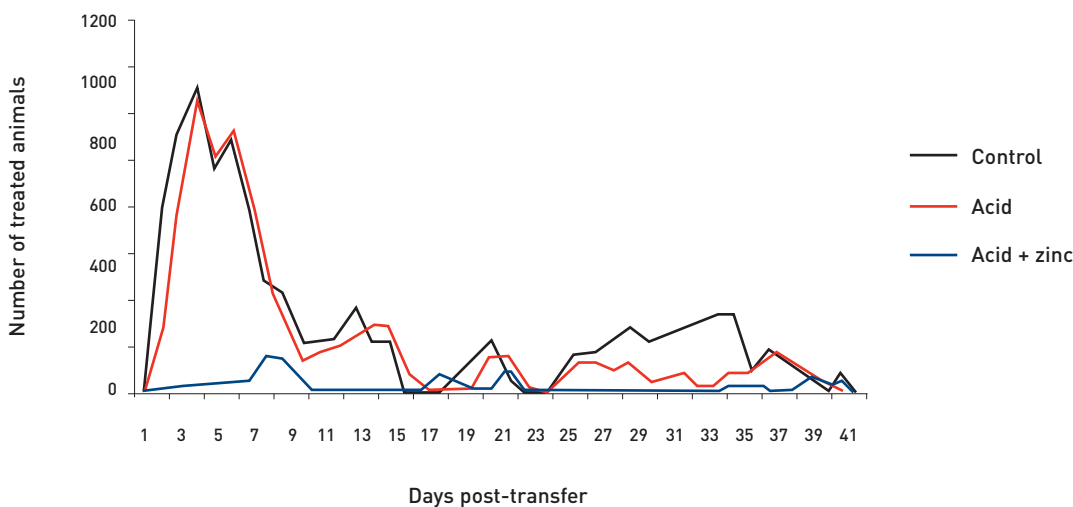


Figure 1. Number of pigs treated in the weaner period in the three trial groups.



PMWS is still causing huge losses in many of the herds suffering from the disease. Lab studies made at the Danish Institute for Food and Veterinary Research (DFVR) show that the number of new herd outbreaks has dropped over the last couple of years. However, the actual spread of PMWS is uncertain, as many vets are now familiar with the disease and perhaps therefore do not submit dead pigs for lab examinations.

In the past year, DSP's activities have centred around finding ways to prevent PMWS and gaining a better understanding of the causes triggering PMWS.

### Acetylsalicylic acid

Acetylsalicylic acid (ASS) is a drug that subdues inflammation, fever and pain.

Based on promising reports from practice, ASS was studied as a feed drug in one sow herd suffering from PMWS. The trial included approx. 1,600 weaners divided among 52 pens – one half was given ASS in their feed from day 13 to day 22 post-weaning, the other half was the control group.

The trial showed no differences in mortality in the weaner facility (5.3% and 6% in the ASS group and the control group, respectively). However, the prevalence of diarrhoea requiring treatment was significantly reduced (12.1% in the ASS group and 18.9% in the control group). For more information, see trial report no. 753.

### Risk factors for PMWS

It is by now generally accepted that the development of PMWS require Circovirus type 2 (PCV 2). However, investigations have shown that herd-related factors such as operation and management and other bacterial infections and virus infections also influence the risk of developing PMWS.

On the basis of data collected from 74 herds with PMWS and 74 herds without PMWS, it was possible to pinpoint a number of factors that increase or reduce the risk of PMWS.

In herds where the weaners had anti-

bodies against PRRS (particularly the American type – PRRS-Vac.), there was an increased risk of PMWS. This corresponds with findings in foreign investigations.

The results also showed that SPF herds had a lower risk of getting PMWS. This was particularly due to quarantine of purchased animals, that visitors complied with visitation rules, and that visitors changed clothes and boots before entering the herds. The risk was also reduced if the weaners were weaned away from the facility and if a transfer facility was available for the finishers. Overall, a good infection protection reduces the risk of PMWS.

### Research in the EU

In 2005, a comprehensive co-operation was initiated in the EU on PMWS in which DSP participates together with 15 other parties, including DFVR and the Royal Veterinary and Agricultural University. The main priority in this co-operation is to establish the causes of PMWS and prevent the disease from developing.

### Spread of infection

In 2005 it was investigated whether sick pigs can infect healthy ones with PMWS. Pigs from four PMWS herds and from two healthy herds were mixed in empty, clean sections at experimental station Kronjyden. Pigs from herds without PMWS were housed either in the same pen as sick pigs, in an adjacent pen or in a pen two meters away from pigs from PMWS herds.

Fourteen pigs from herds without PMWS developed PMWS after direct or indirect mixing with clinically sick pigs from PMWS herds. Of these 14, ten were housed in pens with sick pigs, three in pens next to sick pigs and one was housed in a pen two meters away from sick pigs. In this trial, pigs housed up to two meters away from sick pigs were infected.

It therefore seems that PMWS is able to transmit through the air. To further analyse this, DSP initiated another infection trial. Two containers were connected with a pipe to determine the

amount of air transferred between the containers. Sick pigs from herds with PMWS were mixed with healthy pigs in container A. Only healthy pigs were housed in container B. Unfortunately, the trial did not confirm that PMWS is contagious as no healthy pigs in container A were infected even though they were housed with sick pigs, and therefore no infection was transferred to container B.

### Why do some pigs get sick?

To investigate why some pigs develop PMWS and others do not, an investigation was initiated in 12 PMWS herds. In each herd, ten sows were selected and their pigs were ear-tagged and followed from birth until approx. 30 kg. Blood samples were collected from the ten sows in the first week of the piglets' lives and from all the ear-tagged piglets in their first week of life, close to weaning, in their sixth week of life, ninth week of life and at destruction. The pigs were at the same time assessed for disease signs and samples were collected from the nasal cavity and from the rectum. The pigs were weighed at farrowing, close to weaning and at the post-mortem.

When the pigs started showing signs of PMWS, both sick pigs and healthy pen mates were destroyed. All destroyed pigs were submitted for a post-mortem at the Laboratory in Kjellerup and were further examined at DFVR. All the samples have now been collected and they are currently being analysed and the results are being statistically analysed.

### The future

In the autumn 2006, a trial was initiated of Circovac, the only one of the three PMWS vaccines allowed on the Danish market. The first results from current investigations will furthermore be published in the autumn 2006.

New results from Danish investigations will be published at DSP's web, [www.dansksvineproduktion.dk](http://www.dansksvineproduktion.dk), and results from the EU project will be available from [www.PCVD.org](http://www.PCVD.org) (in English, but with central elements in Danish).

# IT management

Danish Pig Production works on making the daily management in the pig facilities easier through the use of IT.

## Data standards

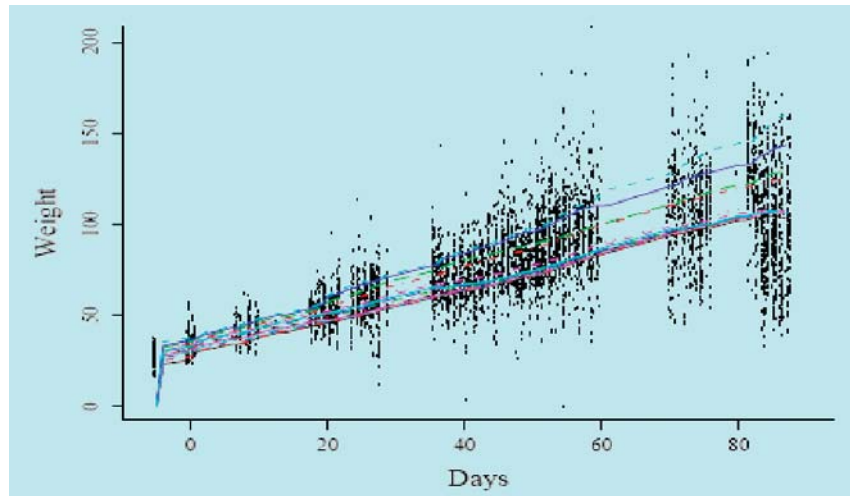
A modern and efficient pig facility is filled with electronics such as feed computers, PCs, PDAs, climate computers, electronic devices that manage sprinkling systems or heat lamps, etc. Every time a new device is introduced into the facility, it is often necessary to enter data in several systems to make it all work. DSP has decided to make this process more efficient.

In the project "Joint data platform", a group has been established with representatives from 26 companies selling electronics to the Danish pig sector. These companies co-operate on creating joint IT standards. With joint IT standards, all electronic units in a herd will be able to exchange data. For the pig producer, this means that double entries such as dead pigs, dates for transfer to service or transfer to the gestation facility will only have to be entered once versus two and three times today. Furthermore, it will be possible to collect all input in a terminal or telephone, should the producer so desire. The project will also open up for communication between, for instance, a feeding system and a ventilation system. Several companies are expected to be able to optimise feeding and climate through exchange of data.

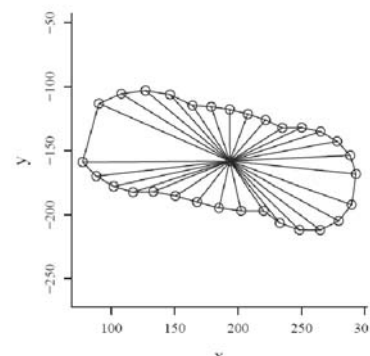
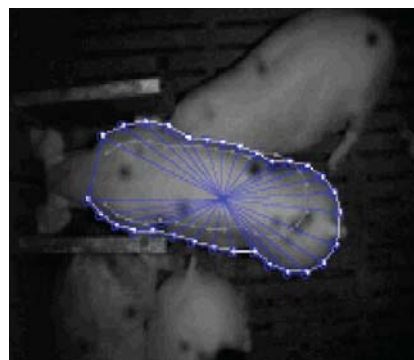


*In this example, data are transmitted to the ventilation system and the feeding system in one process.*

The data standards will be the direct consequence of this work and they will not be directly visible to the pig producer. In an investment situation, it is therefore essential to ask the merchant of



*Calculated weight based on individual images (the black dots) and estimated growth curves for a group of finishers in the weight interval 30 to 100 kg.*



*The edge around the pig's body is automatically found, and the area is calculated by dividing the area into a number of triangles.*

the equipment whether the products support the "Joint data platform".

## PIGVISION

Today, information on the pigs' weight is primarily obtained through manual weighing.

However, this task is heavy and difficult and as a consequence daily weighings for recording of gain are often out of the question, and weighing out for transport to the slaughterhouse is often only done randomly. As a result, too many animals outside the financially optimum weight interval are transported to the slaughterhouse.

In co-operation with the Danish Technical University, DSP has obtained positive results from using computer vision for determining the

weight of finishers. The study was based on a trial design that produced digital images of pigs in a pen while at the same time the pigs were weighed as a control measure once a day.

In the above system, the weight is determined by locating the edge of the pig's back and the area is subsequently calculated.

This means that the pig producer will obtain two management parameters from this system:

- Current growth curve showing the gain of the pen.
- Number of pigs ready for slaughter at pen level.

Currently, further development of the system is being considered.

# New users for the Minigris every week

The Minigris from Danish Pig Production and the Danish Agricultural Advisory Service, the National Centre, has been now available for approx. 1 1/2 years. Every week, new users discover the programme for handheld computers made for recording of activities in pig facilities.

Since the launch of the programme in June 2005, the users of the Minigris have been a particular focal point.

In order for the producer to benefit from the Minigris from day one, we have installed the Minigris for the producers that have bought the programme. On the basis of the experiences obtained through this work, we have developed a new installation programme for the Minigris so that the agricultural centres are also able to install the programme for the producers. To further help our clients in their use of the new programme, we have doubled the number of staff members on our hotline. The results have come in the form of satisfied users and new clients every week.

In the future, computers will communicate with each other in the pig facility

In Europe, Danish Pig Production works on developing a standard for data communication in the pig facility. In popular terms this means that, for instance, feeding systems, ventilation systems and pocket computers will be able to communicate with each other in the future. For the producer, this means that he can adjust all installations from his pocket computer.

There is today particular focus on creating a practical value for Danish pig producers through technology, and this is therefore being intensively studied.

Currently, the National Centre, Pigs, is testing some of the functions in two herds in co-operation with three suppliers.

- With Bopil we are able to see the planned amount of feed and adjust it. This means that the producer can see the planned feed consumption and from the Minigris adjust this, and he can also access the key figures of each animal.
- We can transmit the number of pigs to SKOV's climate computer and to Big Dutchman's feeding computer.

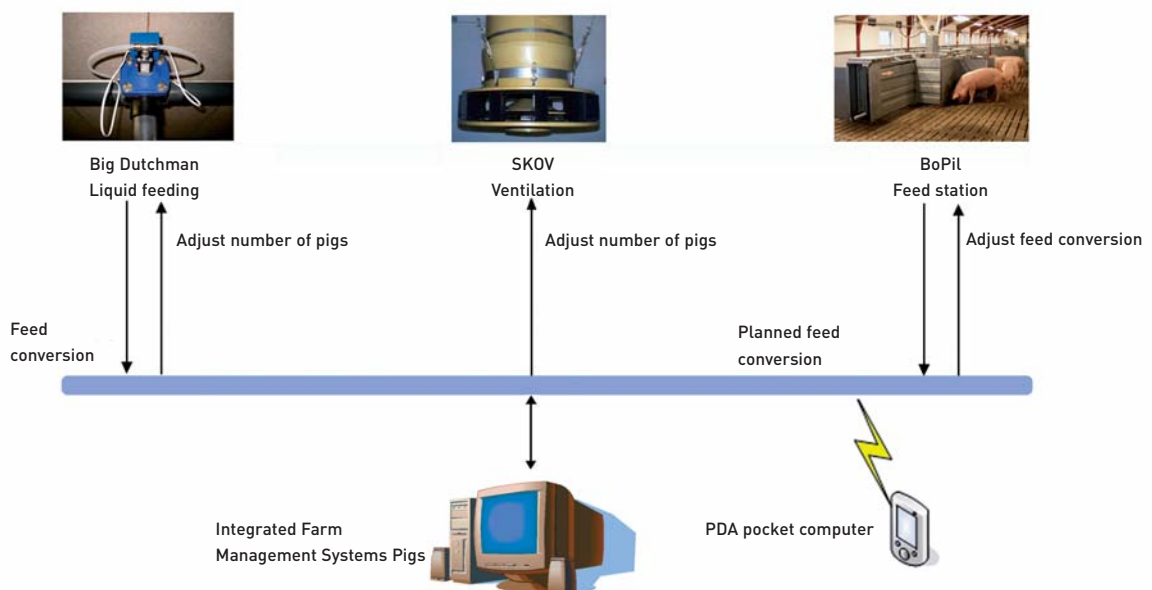
The producer can thereby adjust the number of pigs once and for all for all three systems.

- The actual amount of feed used is daily transmitted from Big Dutchman's feeding computer to the DLBR Sow unit analysis. The producer will thereby not have to enter the feed consumption when making his calculations. It will furthermore be possible for him to compare the feed consumption with other key figures for individual periods.

It is an ambitious project because it involves many suppliers. We expect that Danish pig producers will be able to benefit from the first functions at the beginning of 2007. In co-operation with Bopil, SKOV and Big Dutchman, we furthermore expect the number of functions included in the new standard will be further developed before the standard is ISO certified, hopefully in 2009.

The recording tasks of the pig producer will be eased when the standard is completed and the various suppliers in the pig sector have incorporated it into their solutions.

## Data communication in the facility



# Development

The agreement between the pig advisory offices and Danish Pig Production on joint development of management tools is now in its second year.

This agreement will ensure that new knowledge is implemented in the pig facilities. This will make it easier for Danish farmers to create and maintain a competitive development of Danish pig production.

The basis of the development in 2006 was also found in the fact that regardless of our position in the Danish pig sector, we are all in the same boat.

## The development is suffering from growing pains

In 2005, Danish Pig Production applied for – and was granted – EU funds of which “Demonstration projects on animal welfare” naturally becomes part of the development. The activity level and the range of efficient management tools for primary production will therefore be more comprehensive than initially planned.

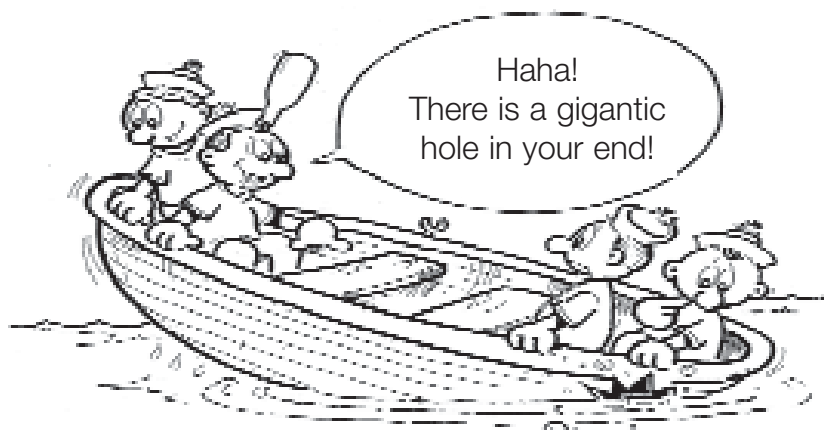
Development and implementation  
In 2006, the activities included six projects. Three projects concerned development of guidelines for tail biting, liquid feeding and gestation facilities. The remaining three concerned implementation and operation of tools already developed: Guidelines for Farrowing Facilities, Growth management, and Feed Evaluation Tools.

### Tail biting manual

Tail biting is a problem in many herds. In most cases, tail biting is an indication of imbalances in the production system. The tail biting manual will make it easier for both producers and advisors to reduce the problem. The new manual will be ready for implementation at the end of 2006.

### Liquid feeding manual

Feed efficiency is stagnating and this is particularly seen in facilities with liquid feed. It is, however, possible to obtain a low feed conversion with restrictive feeding. The liquid feeding manual will be available from the local advisors in the spring 2007 and



will make it easier for producers and advisors to obtain maximum functionality of the individual systems.

### Manual for Electronic Sow Feeding

Gestation facilities for group-housed sows and management of these are still being developed. There is a great need for tools that can enhance the producer's possibilities for practicing good management to ensure that weak sows get the necessary treatment. The manual for gestation facilities with electronic sow feeding will be available at the end of 2006. Manuals for gestation facilities will be further developed during 2007.

### Guidelines for Farrowing Facilities

Traditionally, routines and work processes in most herds have only been partially written down. We have by far managed with oral traditions from herd manager to herd manager and with practical instructions from employee to employee.

With the Guidelines for Farrowing Facilities, know-how and practical experiences from the farrowing facilities have been collected in one place in a so far unprecedented scale and quality. The Guidelines are now finished and are being implemented. They consist of four parts:

1. A checklist that in details provide information on pig weight and on environment in the facilities on a day-to-day basis.
2. A log that provides each animal with a history.

3. A workplan, which is indispensable when new employees or substitutes are introduced into the facility.
4. Twenty-three fact sheets that step by step describe good practice for the most important routines in the farrowing facility. They clarify how things are (should be) done in the facility.

However, regardless of how excellent the Guidelines may be, they do not necessarily result in improvements in the facility. It is essential that the pig producer, the staff in the farrowing facility and the advisor together decide on how to use the Guidelines. Weak points in the system must be detected, the Guidelines adjusted, and clear agreements made on who does what, when and who makes the follow-up.

Out of regard to the non-Danish speaking staff working in the facilities, the Guidelines have been translated into English. The Guidelines will also be available in Russian at the end of 2006.

### Growth management

Growth management was launched in 2005 and it is a checklist with practical day-to-day instructions concerning tending to weaners and finishers. It was highly sought after in 2006, not least thanks to the advice linked to it and the close follow-up.

### Feed Evaluation Tool

When buying feed, it is important to



ensure that you do not buy "a pig in a poke". With the Feed Evaluation Tool, the feed advisor can make a qualified estimate of what should be paid for the diets. The estimate is based on information on the diet's composition, nutrient content, additives and price of the ingredients, etc.

## Career Start

The fight for the best employees will increase in the coming years as the classes are small. Newly qualified people want certainty that they will be helped to a good start in their job. To be able to attract good and committed advisors, the Danish Agricultural Advisory Service has developed a concept called "Career Start" to ensure that new colleagues are well received.

This project aims at ensuring that new employees get an organised and systematic introduction to their tasks to enable them to quickly create results and feel comfortable in their position.

The central element in Career Start is a personal education plan. This plan establishes how the new employee will obtain qualifications to solve the tasks he/she will be working with.

The education plan is made in co-operation with the new employee, his/her immediate director and an advisor from the Danish Agricultural Advisory Service, the National Centre. It provides an outline of how to develop the qualifications of the new employee. The advisor from the National Centre will call – and participate in – follow-up meetings after two and six months' employment and start up work groups for newly hired, as required. At the follow-up meetings it is assured that the goals are reached.

Career Start is a national project and is implemented in all sectors. The majority of the local advisory offices have signed up for the project.

## Ecology

The National Special Advisory Service for Outdoor and Organic Production has been active for 1 1/2 years.

The positive development on the mar-

ket for ecology has increased the attention to the production, and in the first six months the Advisory Service has been busy in helping clients convert their production. This is the first conversion wave in several years. Primarily conventional outdoor producers choose to convert their production, but conversions are also seen among new ecologists.

## Project tasks

The project "Housing of organic finishers - how?" is part of the National Advisory Service. A task force consisting of production and construction advisors visited six herds with a total of eight housing systems and investigated pros and cons of these systems. The results were presented at a workshop for a group of producers, advisors and the Danish Animal Welfare Society.

The event bore fruit. Applications are now being made for funds to continue the work on the area.

The National Advisory Service also participates in a project on roughage.

## Organic feeding

Organic feeding is huge scientific challenge as it is not allowed to use ingredients such as soybean meal and synthetic amino acids.

In the past year, a political agreement was reached on a gradual phasing out of the few remaining parts of conventional feed. Practice is already close to the goal, but the last 5% is the hardest part. By the end of 2011, the entire feed ration must be organic.



# Published results: 2005-2006

## Reports:

- No. 26: Danish pig production in the right direction
- No. 27: Boar importance for litter size
- No. 28: Feeding in relation to odour from pig facilities
- No. 29: Costs in international pig production 2004
- No. 30: The Danish Feed Evaluation System for pig feed
  
- No. 0510: Design of free space in pens for gestating sows with one feeding and resting stall per sow – "U pen"
- No. 0511: Changes in health, productivity and management five years after the introduction of multisite operation
- No. 0512: Feed's influence on the texture of the gastric content in sows
- No. 0513: Development of alarms in connection with separation (ESF)
- No. 0601: Local treatment of shoulder ulcer with moisturizing plasters

## Trial reports:

- No. 714: Campylobacter in finishers – from herd to carcass
- No. 715: Commercial products for weaners: Feed ADD-s
- No. 716: Commercial products for finishers: Feed ADD-s
- No. 717: 2 vs 1 bn sperm cells in semen doses
- No. 718: Product test of lime as disinfectant
- No. 719: Sources of fat for weaners
- No. 720: Sectioned management in the farrowing facility
- No. 721: Effect of feed with sodium bicarbonate on gastric health in sows
- No. 722: Weaning after 29 days vs 35 days (II) – effect on weaners
- No. 723: Different storage temperatures for semen doses: 13, 17, 21 and 24°C
- No. 724: Influence of inulin in feed on odour and ammonia emissions from finishers
- No. 725: Fermented grain for weaners
- No. 726: Correlation between herd conditions and PMWS outbreaks – preliminary results

- No. 727: Reduction of odour and ammonia with the Oldenburg biofilter, Agrofilter GmbH
- No. 728: Fermented grain for weaners
- No. 729: Weaner diets from Hamlet Protein
- No. 730: Digestibility of phosphorus in phosphoric acid and mono calcium phosphate
- No. 731: Variations in feed value in sorts of winter wheat, spring barley and winter barley cultivated in Denmark
- No. 732: Additional milk for piglets
- No. 733: Sows' movements when standing up and lying down in different farrowing pens
- No. 734: Comparison of one vs two services per sow per heat
- No. 735: Post-cervical insemination with reduced numbers of sperm cells
- No. 736: Colostrum for the smallest piglets
- No. 737: Finisher facility with biological air purification from SKOV A/S
- No. 738: Benzoic acid in finisher feed – effect on ammonia and odour emissions
- No. 739: Effect of dimensions of two farrowing pens on weaning weight
- No. 740: Effect of feed's protein content and composition on daily gain and post-weaning diarrhoea
- No. 741: Feeding of gilts in the growth period
- No. 742: Standards for odour emissions from Danish pig facilities in the summer
- No. 743: Wheat protein C\*HYPROW for weaners
- No. 744: Three vitamin concepts for weaners
- No. 745: Commercial diets for weaners purchased at Funen in the winter 2005/06
- No. 746: PMWS is still infectious
- No. 747: Topfeed feeding concept for weaners (8-35 kg)
- No. 748: Moving the nurse sow
- No. 749: Glutamine and glutamic acid for weaners
- No. 750: Weaning after 28 days vs 35 days (III) – effect on weaners

- No. 751: Total phosphorus level when using phytase in purchased weaner feed
- No. 752: Effect of weaning age, composition of diet 1 and feed intake on diarrhoea and daily gain in weaners
- No. 753: Acetylsalicylic acid for weaners as adjuvant treatment in a PMWS herd
- No. 754: Importance of worms for productivity and disease in finishers
- No. 755: Tilted lying walls in pens for loose lactating sows

### Note:

You can sign up for "News from Danish Pig Production" (only available in Danish) at [www.dansk-svineproduktion.dk](http://www.dansk-svineproduktion.dk) and receive an e-mail with links to the latest publications. The Info Svin database is available at [www.infosvin.dk](http://www.infosvin.dk).



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