

Preface

Costs and image

The year 1999 will be remembered for its disastrous economy and a substantial improvement of the image of pig production.

Earnings and the sympathy of society may be interconnected. But we choose to believe that the real reason is the targeted efforts of the pig producers concerning animal welfare, *Salmonella* control, elimination of growth promoters and environmental considerations.

But such efforts are costly. The added cost in relation to Community legislation is 0.52 DKK/kg of pigmeat. We probably cannot recover that through higher prices, but it is necessary in order to ensure the acceptance of society and thus the possibility of future pig production in Denmark. Moreover, it will contribute to ensuring access to the markets of the future.

But the soft parameters must not be introduced at the cost of productivity. Large gains can still be achieved by better management, breeding, feeding, reproduction and health. We must use modern technology such as IT and genetic engineering to ensure this. The ultimate challenge will be to develop and choose production systems where animal welfare considerations do not negatively affect production reliability, labour required, etc.

Economic situation

The recession slumped in February 1999 with a slaughter price of 6 DKK/kg, and half of all pig farmers are really hard pressed financially. In this situation it is important that each pig producer analyses the situation with his advisers and decides on a long-term solution.

Luckily, lenders - banks and mortgage institutions - have shown

great professionalism and have kept their cool.

Scale economies and cooperation

In the coming years, the National Committee will focus even more on the development of different production systems and models of co-operation adapted to Danish conditions. Health-promoting production systems - batch operation, all in/all out and multisite - are the future, and they must be used despite the Farming Act. At the same time, economies of scale must be exploited.

Development of pens for weaners and finishers

Future legislation will demand partially slatted flooring, showering and messing material, and the optimum feasible solutions must be found.

We must also carefully consider the promising WTS system (Weaning to slaughter), where piglets are moved from the sows at weaning and remain in the same pen until slaughter.

Good stockmanship and animal welfare

Conversion to loose sows is a giant challenge for sow units. UK production and quality mark production have moved the focus to conditions in the individual herd. Good stockmanship is the key word. The National Committee encourages herd owners to regard it as positive when veterinaries and consultants point to things to be corrected.

Antibiotics consumption declining

Danish pig producers can rightly be proud of the drop in antibiotics consumption. Since 1994, the consumption has more than halved. Growth promoters have been eliminated from finisher feed, and from 1 January 2000 it will not be used in weaner feed either.

The impression of the National Committee is that many pig herds can manage with fewer visits by the vet, and the recording procedures concerning drug consumption can be much simplified.

GMO feed

The advantages of using genetic engineering seem at first sight so large that it will be hard to avoid genetically modified soybean and other GMO products in pig feed. At the same time, the National Committee finds that if consumers want a GMO-free pig, we must be able to deliver the goods.

Feed quality and traceability

The experience from the dioxin scandal points toward the creation of even better systems for ensuring traceability from soil to table, but some way still remains before there is a trail between a cut of meat found in a supermarket and the pig from which it derives and the food given to this pig.

Thank you for this year

With the above extract of the events and challenges of 1999, The National Committee for Pig Production wishes to take this opportunity to thank everybody who is working to ensure a future for Danish pig production. We hold the qualifications although there are also obstacles and hard competition ahead.

We are not the only country to want large exports of pigmeat.

THE NATIONAL COMMITTEE FOR PIG PRODUCTION

Lindhart B. Nielsen / Orla Grøn Pedersen

The National Committee for Pig Production



Lindhart Bryder Nielsen, chairman, farmer, Løgstør. Elected by the general assembly



Hans Peter Steffensen, vice-chairman, farmer, Sønderborg. Elected by Region 2 (South and Southern Jutland and Funen)



Ole Kappel, farmer, Hurup. Elected by the general assembly



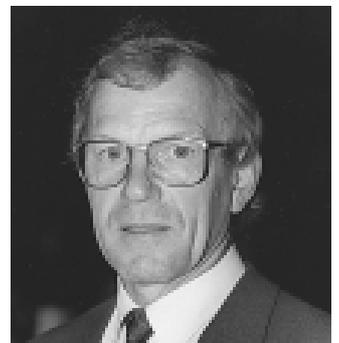
Jørgen Pedersen, farmer, Ringkøbing. Elected by the Federation of Danish Pig Producers and Slaughterhouses



Per Højgaard Andersen, farmer, Odder. Elected by the Federation of Danish Pig Producers and Slaughterhouses



Lars Erik Hornemann Jensen, farmer, Gudbjerg. Elected by the Danish Farmers' Union



Karsten Vig Jensen, farmer, Jyderup. Elected by Region 1 (eastern islands)



Frede Hansen, farmer, Roslev. Elected by Region 3 (North and Central Jutland)



Søren Hansen, smallholder, Snedsted. Elected by the Danish Family Farmers' Association



Aksel Andersen, smallholder, Bogense. Elected by the National Pig Council of the Danish Family Farmers' Association



Carsten Lind Pedersen, farmer, Brædstrup. Elected by the National Union of Danish Pig Farmers



Orla Grøn Pedersen, Director, National Committee for Pig Breeding, Health and Production

List of Contents

Contents	page
National Committee for Pig Breeding, Health and Production	2
Table of Contents	3
Budget and activities	4-5
Productivity	6
Economy	7
Sales of live pigs	8
Genetic improvement	9
Production level	10
Meat quality	11
Nucleus management	12
Research and development	13-15
Animal welfare legislation - UK production	16
Health-promoting production systems	17
Weaner and finisher pens	18
Layout of WTS housing	19
Loose sows	20-23
Product trial	24
Organic pig production	25
Ventilation	26
Working environment	27
Ammonia	28
Feeding of loose sows	29
Artificial insemination	30
Litter equalisation	31
Fermented liquid feed	32
Phase feeding for finishers	33
Feeding of finishers	34-35
Feed without growth promoters	36-37
Progress report on <i>Salmonella</i> control	38-40
PRRS partial eradication	41-42
<i>Lawsonia</i> - porcine intestinal adenomatosis	43
Pathological changes in lungs and liver in finishers	44
Research on <i>Streptococcus suis</i>	45
Umbilical hernia	46
Health insurance	47
Integrated Farm Management System - Pigs	48
Productive Pig Farms	49
Production monitoring	50
Batch operating system	51
Environment	52
Further training and information material	53
The information strategy of the National Committee	54
Reports of studies and experiences 1998 - 1999	55
Index	56

STATISTICS

BREEDING

HOUSING

REPRODUCTION

NUTRITION

HEALTH

MANAGEMENT & IT

INFORMATION

INDEX

Budget and activities

The National Committee for Pig Production was set up by four basic organisations: The Federation of Danish Pig Producers and Slaughterhouses, the Danish Farmers' Union, the Danish Family Farmers' Associations and the National Union of Danish Pig Farmers. In addition to representatives from these organisations, the National Committee consists of pig producers elected at the annual general meeting, and members elected by local pig production committees.

The National Committee concentrates on development and information within Danish pig production. The many and varied activities of the National Committee have some overall objectives:

Financing

For the financial year 1999/2000, the National Committee has a total net budget of DKK 87.2m used to carry out upwards of 100 pig-related projects.

The work of the National Committee is mainly financed through the Pig Levy Fund, the Per Mille Levy Fund, subsidies from the basic organisations and public funds. Additionally, considerable own earnings are obtained for specific services and through optimisation of the operation of experimental stations.

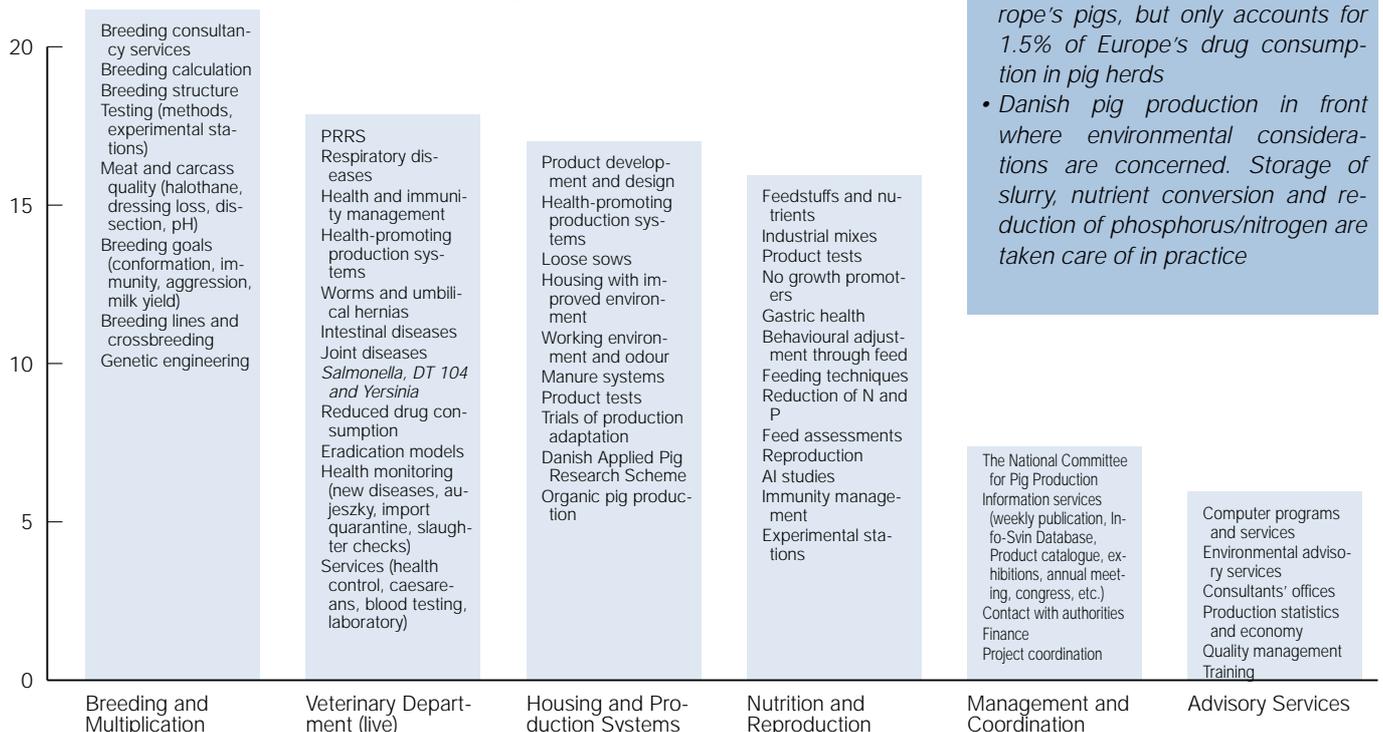
Strategy for the future

Long ago, Danish pig production got the message that changes are necessary to keep the right to produce pigs in Denmark. Despite this focus on so-called 'soft values', Danish pig production has maintained its leading position as the country having the highest efficiency in the primary sector, low labour consumption and reasonable building costs.

Danish pig production is up front

- The world's largest exporter of pork
- Top efficiency. Pigs per year sow, daily gain, etc., not surpassed by other countries with large pig production
- Loose gestating sows - about 25% of production converted to this type of production. All investments in new housing based on new legislation
- 12% of production observes UK requirements
- Denmark and Sweden the only countries in Europe with an action plan for Salmonella
- Denmark the only country with a plan for eliminating multiresistant Salmonella DT 104
- No use of growth promoters for finishers - and before the end of the year also eliminated from weaner feed
- Animal welfare an important part of the R&D of the National Committee
- We can satisfy purchasers' requirements of traceability and branded productions
- Denmark produces 10% of Europe's pigs, but only accounts for 1.5% of Europe's drug consumption in pig herds
- Danish pig production in front where environmental considerations are concerned. Storage of slurry, nutrient conversion and reduction of phosphorus/nitrogen are taken care of in practice

Net budget, DKKm



Distribution of net budget for National Committee departments and their main work areas. The most important function of the National Committee is the development of the professional basis for Danish pig production. This is done by ranking resources by priority in the main areas of breeding, nutrition, reproduction, housing, production systems, health, information and advisory services.

National Committee - fields of work

	DKKm	1997/1998	1998/1999	1999/2000
Production safety		4.1	5.1	4.8
Product quality		2.7	3.5	3.5
Environment and working environment		3.9	5.8	5.7
Efficiency and breeding		19.6	18.5	20.2
Housing systems		11.8	16.9	15.6
Health		16.4	18.2	18.4
Professional preparedness, information and advisory services		23.8	19.3	18.9
National Committee		84.4	87.8	87.1

We must not jeopardise this position in the future, and the National Committee has therefore formulated a Two-way Strategy for Danish pig production. We must secure a leading position in the soft areas, but not so fast that we cannot keep the level of costs down.

Activities under the National Committee

These years, the work of developing housing systems for the future have high priority. The goal is to develop housing for all groups of animals that satisfy increased demands for animal welfare. At the same time, the systems developed must have building costs, labour consumption and efficiency at least on a level with the production systems developed during the 1980s. In most places in the world apart from North European countries like Denmark, Sweden, Britain and the Netherlands, the technological development and efficiency above all determine the design of production systems. Danish pig production must prepare to match competition from Southern Europe, USA, Asia, etc., where large units, fully slatted flooring, no use of straw and tethered sows are universally accepted.

During the past year, the National Committee has strengthened its professional preparedness in relation to the recession. The National Committee has encouraged all pig producers to carry out a service check-up of the collaboration with the local advisers and work out a strategy for the future of their herd.

Some of the other specialist challenges that the National Committee ranks high in coming years are:

- No-problem weaning and elimination of growth promoters
- exploitation of biotechnology in breeding, e.g., for better health and immunity
- more advice and information on genetic improvement in production herds
- health-promoting production systems, such as batch operation, all in/all out production
- reduction of respiratory diseases in finisher housing
- future handling of PRRS
- design of pens from weaning to slaughter (WTS)
- pen design in weaner housing and finisher housing
- models of collaboration to exploit large-scale economies

New projects 1999/2000

Before implementation of new projects, their utility value is thoroughly discussed by the National Committee. The new projects are correlated with on-going projects and account for about 30% of studies and development activities.

*Gene for scatole
Elimination of RN gene in Hampshire (pH)
Breeding for behaviour / aggressiveness
Semen quality - Large White
Infection-safe transfer of genes (embryo technique)*

Feeding and eating quality

*Reduction of ammonia evaporation
Acid/base-balanced feed
Feeding strategy at high daily gain*

Increased weaner weight

*70 weaned pigs per sow life
No-problem weaning
Working environment in housing for sow mating*

*Loose sows:
Grouping, manure handling, vulva bites, health problems, mating units*

*Weaner and finisher housing:
messing material
pen environment, weaning to slaughter (WTS)*

IT management systems

*Salmonella in weaner production
Welfare assessment of diseases
Interaction between respiratory diseases*

Vaccination against exudative epidermitis

Risk factors of high drug consumption

Importance of worms for morbidity and productivity

Umbilical hernia

Productivity

Development

The sow population continues to rise, and thus also the finisher production. In 1998 with 53 weeks, the production came to 23.0 million animals, up 9% on the previous year. A continued rise to 23.4 million animals produced in 1999 is anticipated.

Performance in herds with efficiency control

Sows

Productivity this year rose by 0.3 pigs per year sow while the feed consumption per pig produced rose by 2.3 FUs. This rise is substantially due to the fact that on average the pigs leave at a higher weight, 30 kg, a rise of 0.9 kg compared with the previous year. Mortality has risen, also resulting in a small increase in feed consumption.

The difference between the best and the poorest herds is 5 pigs per year sow. The explanation is especially the non-productive days, differing between 21.7 days and 12.0 days. At the same time slightly below one pig per litter less is weaned in the poorest herds.

Finishers

The period shows a fine increase in daily gain. FUs per kg of gain rose in 1998, where previous years have seen a fall. Some of the rise can be explained by the fact that both weaners at entry and finishers at slaughter have grown bigger by 1.1 kg.

The difference between the best and the poorest herds is marked in terms of FUs per kg of gain, the best herds using 0.4 FUs less per kg of gain, and the finishers growing by 142 g more per day.

Development in Danish pig production

Year	1994	1995	1996	1997	1998***	1999*
Sows, 1000 animals	995	984	980	1040	1070	1100
Production, millions **	20.5	20.2	20.1	21.1	23.0	23.4
Slaughter weight, kg	74.1	74.6	75.2	76.0	77.2	76.0
Lean meat content, %	59.8	59.9	59.8	59.9	60.0	60.0

* Prognosis

** Incl. exports of live animals as well as sows, boars, gilts, etc.

*** 53 weeks

Production performance in sow units with efficiency control

Year	1996	1997	1998		
	all	all	all	poorest 25% best 25%	
Weight per outgoing pig, kg	29.1	29.1	30.0	31.6	29.1
Feed per pig produced, FUs*	97.6	97.1	99.4	111.0	89.1
Pigs produced per year sow	21.7	21.9	22.2	19.9	24.8
Litters per year sow	2.27	2.26	2.26	2.17	2.34
Year sows, total	183	195	225	185	240
1st parity litters, %	20.5	21.0	20.0	22.2	19.6
Liveborn per litter	11.2	11.3	11.5	11.2	12.0
Stillborn per litter	0.9	1.0	1.0	1.0	1.0
Weaned per litter	9.9	10.0	10.2	9.6	10.8
Age at weaning, days	29	29	29	31	28
Weight at weaning, kg	7.2	7.3	7.2	7.5	7.0
Deaths after weaning, %	2.8	2.8	2.9	3.9	1.8
Daily gain after weaning, g	420	419	427	426	436
Age at 30 kg, days	83.0	82.8	82.9	85.5	79.9
Non-productive days per litter	16.7	16.7	16.9	21.7	12.0

* Feed for gilts not included

Production performance in finisher units with efficiency control

Year	1996	1997	1998		
	all	all	all	poorest 25% best 25%	
Pigs produced, total	2632	2681	3005	2952	3062
Daily gain, g	762	778	786	718	860
Feed per kg of gain, FUs	2.93	2.89	2.91	3.12	2.71
Weight at entry, kg	30.4	30.6	31.7	31.3	32.8
Average slaughter weight, kg	75.4	76.0	77.1	78.7	76.4
Average lean meat content, %	59.9	59.9	59.9	59.7	60.0
Dead and culled, %	3.15	3.24	3.38	4.82	2.19
Chronic adhesive pleurisy, %	19.6	20.5	15.4	17.4	12.6
Total with allowances, %	4.9	5.5	6.6	7.5	5.8

Economy

Development

The economy of Danish pig production in 1998 was the poorest for many years, and unfortunately 1999 shows no prospects of improving. For new buildings, both 1998 and 1999 show losses of DKK 151 and 132 per pig, respectively, when all costs are paid.

Analysis of accounts

A number of farms have so-called 'Production accounts' prepared. Such accounts break down all income, costs and working time by sow units and finishers.

Sow units

For sow units, the profit can roughly be divided by 2 when comparing the 1997 gross margin of DKK 5220 with the DKK 2645 from 1998. Above all, this large drop is due to the price of the pigs produced, which has dropped by DKK 129. The positive points include an increase in production per year sow of 0.6 pigs and a resulting small drop in feed prices and thus feed costs. However, the end result remains a drop from a profit of DKK 923 to a loss of DKK 1,556 per year sow.

Finishers

Finisher units had a balanced economy in 1997, but 1998 shows a loss of DKK 88 per finisher when all is paid. The gross margin dropped from DKK 177 to DKK 78, noticeably due to a drop in the price per pig produced of DKK 247, caused by the large drop in slaughter prices. A positive point also here is that 0.02 FUs less per kg of gain is used, that feed prices have fallen by DKK 10 per pig, and that capacity costs have largely remained stable.

Barometer for Danish pig production in new buildings

Year	1995	1996	1997	1998	1999*
Price, incl. corrective paym., DKK/kg	10.40	11.39	11.70	8.32	8.25
Average feed price, DKK/FUs	1.38	1.38	1.37	1.32	1.20
Gross margin per pig, birth to slaughter, DKK	291	360	383	152	172
Capacity costs, DKK	108	114	118	123	126
Financial expenses, DKK	177	180	187	180	178
Result per pig, DKK	6	66	78	-151	-132

* Prognosis

Average production accounts for farms with sow herds and farms with finisher herds

	Sow herds		Finisher herds	
	1997	1998	1997	1998
Total farms	259	173	288	160
Total year sows	194	203		
Pigs produced per year sow	21.8	22.4		
Finishers produced			2671	2697
Weight per weaner produced, kg	29	29		
Gain per finisher, kg			69	71
FUs per weaner produced	107	107		
FUs per kg of gain			2.97	2.95
Price per pig produced, DKK	420	291	886	639
Price, DKK/FUs	1.51	1.42	1.26	1.19
Gross profit, DKK	9292	6562	440	334
Feed costs, DKK	3542	3417	259	249
Veterinary and drugs, DKK	291	267	4	4
Other costs, DKK	239	233	3	4
Gross margin, DKK	5220	2645	174	78
Maintenance, DKK	268	209	16	14
Energy, DKK	200	219	8	7
Labour, DKK	1922	1959	70	68
Depreciation, build./equipm., DKK	749	814	32	34
Interest, buildings/equipment	866	779	39	35
Interest, herd	292	221	11	8
Result per year sow/finisher, DKK	923	-1556	-2	-88

Source: Department of Farm Accounting and Management of the Danish Farmers' Union

Sales of live animals

Breeding stock

Sales of breeding stock have fallen in the period under review. This is attributable to the low slaughter price, which has made most pig producers hold back on costs. The reason why sales did not fall more, after all, is that many producers have utilised the low prices for replacement of their herds at a higher health level. That is why sales of conventional breeding stock have suffered the largest drop expressed in percentages.

Of sales of purebred gilts of white breeds, Landrace gains an ever-increasing share, now at 70%. This is mainly because Landrace sows produce larger litters than Large White. Boar sales in white breeds have also dropped somewhat. The reason for this development is probably that the proportion of AI services in multiplier herds has risen considerably. This has happened in step with the new increased focus on the index level of multiplier herds, both of own purebred nucleus and of the sales animals.

Weaner sales

The National Committee has analysed the development in weaner sales from 1992 to 1998. During this period, the total weaner production rose by 3.9 million from 18.3 to 22.2 million. Of the 3.9 million extra weaners, sow unit farmers themselves established finisher places for producing 2.3 million finishers, while 0.6 million found space through expansion of the pure finisher herds, and finally exports rose by 1 million weaners per year.

Market prices are highly influenced by the German market and fluctuate substantially more than the calculated price. In 1998, the difference between the calculated price and the market price was up to DKK 100, while 1999 has seen dif-

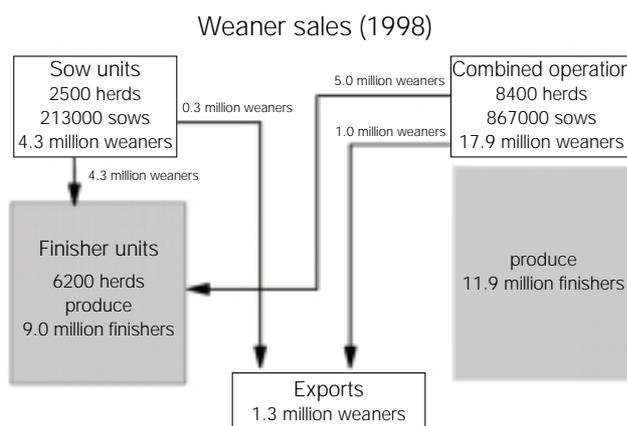
Sales of animals from the breeding and multiplier herds of DanBred

Breed	Health status	Females			Boars		
		96/97	97/98	98/99	96/97	97/98	98/99
Land-race	SPF, etc.	6,754	9,444	8,538	763	720	429
	Conv.	832	1,291	632	88	134	76
Large White	SPF, etc.	4,321	5,306	3,617	1,473	1,524	1,030
	Conv.	884	601	228	294	124	104
Duroc	SPF, etc.	323	567	462	2,136	2,546	2,047
	Conv.	0	0	0	12	67	50
Hampshire	SPF, etc.	2	37	20	94	76	47
	Conv.	7	0	0	28	3	3
Purebred pigs, total	SPF, etc.	11,400	15,354	12,637	4,466	4,866	3,533
	Conv.	1,723	1,892	860	422	328	233
Hybrids total	SPF, etc.	179,704	205,453	190,493	5,814	6,324	4,946
	Conv.	32,407	30,147	20,122	1,029	909	627

Sales figures were calculated from 1 April to 31 March for the relevant years and comprise all DanBreed herds, i.e. herds subject to contract with The National Committee for Pig Production. "SPF, etc." includes sales figures from SPF-selskabet, S.E.A. and animals delivered by a caesarean.

ferences of DKK 30 to 40. For the first three quarters of 1999, the pool price was DKK 20 on average below the calculated price, typical for a recession. Seen over several years, the difference between the prices is extremely limited, and if the parties of a weaner agreement are otherwise satisfied, it would be a pity if a short-term market imbalance made the collaboration collapse.

On the cessation of the national price fixing on 1 October, the Committee for the Calculated Weaner Price decided that in future the calculation will be based on the price of DANISH CROWN. When the prices of Steff-Houlberg and Tican deviate from that of DANISH CROWN, the effect thereof on the weaner price will be stated.



Genetic improvement

The table below shows the annual genetic improvement for 1996 to 1999 for each breed as well as the average of the period for each breed and for all four breeds. In 1998, three new traits were included in connection with a revision of the breeding goal. These traits are dressing loss, pH and daily gain for the interval 0-30 kg. Dressing loss saw an unfavourable development,

as genetic improvement should preferably be negative and thus reduce the loss. pH is unchanged, while weaner gain saw a faint, favourable development in pigmented breeds, but unfavourable development in white breeds. Large White and especially Landrace litter sizes experience a very strong improvement due to the large number of sows in breeding. This has hap-

pened despite a substantial reduction of the economic weighting.

As an average of the last 4 years, genetic improvement has resulted in an annual improvement of the gross margin of DKK 10.92 per year. When adjusted for penetration from breeding to production, the value is DKK 9.15 per year.

Genetic improvement 1996-1999

Breed	Year	Daily gain (0-30 kg) g/day	Daily gain (30-100 kg) g/day	Feed conv. FUs/kg of gain	Lean meat content, %	Dressing loss, kg	Litter size, number	Conformation, points	pH, unit
Duroc	98/99	2.0	24.3	-0.04	0.20	-0.05		0.05	0.002
	97/98	1.4	21.1	-0.04	0.13	0.16		0.01	-0.001
	96/97	4.3	25.9	-0.04	0.04	0.01		0.01	0.002
	95/96	3.1	26.6	-0.04	0.11	0.10		0.04	-0.001
Average	4 years	2.7	24.5	-0.04	0.12	0.06		0.03	0.001
Hampshire	98/99	3.6	20.2	-0.04	0.11	-0.03		0.03	0.003
	97/98	1.7	20.6	-0.04	0.12	0.11		0.03	0.001
	96/97	0.7	12.0	-0.03	0.24	-0.01		0.01	0.002
	95/96	1.6	11.8	-0.03	0.24	0.05		0.02	-0.001
Average	4 years	1.9	16.2	-0.04	0.18	0.03		0.02	0.001
Landrace	98/99	-4.0	19.3	-0.02	-0.02		0.55	0.09	0.010
	97/98	-0.2	15.6	-0.01	-0.17		0.58	0.05	-0.004
	96/97	-3.2	28.0	-0.03	0.00		0.41	0.04	0.005
	95/96	2.3	19.1	-0.03	0.05		0.23	0.00	-0.002
Average	4 years	-1.3	20.5	-0.02	-0.04		0.44	0.05	0.002
Large White	98/99	-0.1	13.9	-0.01	0.01		0.18	0.10	-0.002
	97/98	-2.4	10.1	-0.01	0.00		0.15	0.07	0.002
	96/97	-0.8	16.8	-0.02	-0.03		0.23	0.05	0.001
	95/96	1.5	15.6	-0.02	0.02		0.44	-0.04	0.006
Average	4 years	-0.5	14.1	-0.02	0.00		0.25	0.05	0.002
Avg (4 breeds)	4 years	0.7	18.8	-0.03	0.07		0.35	0.04	0.002

Litter size only comprises Landrace and Large White

Production level

In both herd tests and the test at Bøgildgård test station, breeding animals perform on a high level compared with the production performance achieved in finisher pro-

duction. This high production performance is attributable to high standards of management, hygiene and feed quality. Another point of importance is the ad lib. feeding

used, and stocking rates are relatively low. The following tables show the production performance achieved by Bøgildgård and breeding herds in 1998, respectively.

Bøgildgård test station – average production performance for boars tested in 1998

	Pigs, number	Daily gain (30-100 kg) g/day	Feed conversion, FUs/kg of gain	Lean meat content, %	pH in loin, units	pH in ham units	Dressing loss, kg
Duroc	1,341	915	2.41	59.6	5.59	5.71	25.5
Hampshire	692	847	2.48	62.0	5.45	5.52	24.0
Landrace	1,044	939	2.48	60.6	5.55	5.68	25.2
Large White	1,038	924	2.40	61.1	5.58	5.65	24.5
Total	4,115						

Breeding herds – average production performance for boars tested in 1998

	Pigs, number	Daily gain (0-30 kg) g/day	Daily gain (30-100 kg) g/day	Lean meat content, %	Conformation, points
Duroc	8,358	384	964	59.0	3.1
Hampshire	1,501	374	839	61.1	3.2
Landrace	16,756	394	943	61.4	3.0
Large White	12,620	378	938	60.9	3.2
Total	39,235				

Breeding herds – average production performance for sows tested in 1998

	Pigs, number	Daily gain (0-30 kg) g/day	Daily gain (30-100 kg) g/day	Lean meat content, %	Conformation, points
Duroc	9,612	383	916	59.0	3.2
Hampshire	2,244	379	802	61.2	3.2
Landrace	23,000	395	915	61.4	3.2
Large White	14,693	379	905	60.8	3.4
Total	49,579				

Litter size

Production performance for litter size has been calculated for purebred litters (total number of pigs born per litter) born to breeding herds in 1998. Note that the proportion of gilts is very high in these litters.

Litter size of purebred litters produced in breeding herds in 1998

Maternal breed	Litter size (purebred litters in breeding)	Percentage of gilts
Duroc	10.1	67.5
Hampshire	8.5	65
Landrace	13.0	64.5
Large White	11.4	63.8

Meat quality

Does breeding work for ultimate pH

Ultimate pH in pigmeat is a very important meat quality parameter of importance, i.a., to the water-binding capacity, meat colour and processing and slice yields. Ultimate pH in meat has a heritability of about 0.20 and a genetic variance of 0.07, and the trait is included in the breeding goal for all breeds. The slaughterhouse sector estimates that at the moment ultimate pH is the most important quality parameter after the problem of PSE has been solved by removal of the halothane gene.

To examine whether breeding for ultimate pH works, offspring of Duroc boars with high and low breeding values for ultimate pH are produced. The test pigs are produced in a herd under the project 'Breeding control and development'. The same registrations are made as for breeding herds.

About 2,500 D(LY) crossbred pigs are produced, half of them by a sire with a high breeding value and the other half by a sire with a low breeding value for ultimate pH. The test pigs are fed ad lib. with a traditional feed mix. The test pigs fast for about 18 hours before slaughter. To examine whether breeding value for ultimate pH interacts with the place of slaughter, test pigs are slaughtered at Danish Crown's units in Horsens and in Bjerringbro. The data registered are daily gain from 30 to 100 kg, classification centre measure for lean meat content, ultimate pH in loin and M.semimembranosus and meat colour in loin. The experiment finishes at the end of 1999.

Glycogen content and ultimate pH

	Glycogen content μ mol/g		pH in loin		pH in M.semimembranosus	
	Average	Variance	Average	Variance	Average	Variance
Landrace	87.2	11.2	5.53	0.10	5.66	0.14
Large White	85.3	11.9	5.60	0.14	5.68	0.19
Duroc	88.0	11.8	5.61	0.13	5.70	0.11
Hampshire	143.7	20.8	5.48	0.08	5.52	0.08

Performance testing for meat quality

The possibility of performance testing for the meat quality traits of meat colour, ultimate pH and content of intramuscular fat is being examined as part of the FØTEK II-subsidised project 'Optimisation of meat colour, drip loss and eating quality in pigmeat'.

Muscle biopsies have been sampled from about 2,000 purebred test pigs at Bøgildgård. These muscle biopsies are analysed by the Danish Institute of Agricultural Sciences for myoglobin, of importance to meat colour, and for glycogen, which affects ultimate pH. An analysis is also made for glycerol, a measure of the IMF content in the meat. All analyses for glycogen content

have been concluded, while a few myoglobin analyses are still pending. The glycerol analyses were made in spring 1999. The table shows the glycogen content in the loin of the four breeds.

It appears from the table that Hampshire differs substantially from the other breeds concerning glycogen content. The glycogen content of Hampshire is about 57μ mol/g higher, and the variance is far greater. The high glycogen content of Hampshire is due to a special gene in this breed, the RN gene, that results in a high energy content (glycogen) in the muscles. A high energy content provides a basis for a large pH drop in the process transforming muscle into meat. The Hampshire breed also appears to have the lowest pH values in both loin and M.semimembranosus.



Hampshire has a high glycogen content due to the RN gene.

Nucleus management

During the first six months of 1999, the National Committee launched a programme for nucleus management. It enables producers with a closed herd to obtain knowledge of the genetic level of the herd, allowing them to plan and follow the optimum breeding strategy. As expected, the interest in this unique breeding tool is great. At 1 August 1999, 65 production herds totalling about 30,000 production sows had established cooperation, and the figure increases continuously.

The nucleus management programme of the National Committee makes it possible to optimise breeding work in production herds with an in-house production of breeding stock based both on a purebred nucleus and on an alternating breeding strategy. The breeding sows are created in the Pig Breeding Database as so-called zig-zag bred sows resulting from an alternating breeding strategy or as purebred nucleus sows. On the basis of the herd owners' registration and reports of additions and disposals of breeding stock as well as services and farrowings, weekly breeding reports and management lists are prepared and made available via DanBred's home page (www.danavl.dk) on the Internet.

The information from the breeding reports and the management lists allows the herd owner to optimise the genetic level of the herd by continuous selection of the highest indexing animals for further breeding. Typically, the index level of the purebred matings of the nucleus is raised by 15-25 index points, equalling two years' genetic improvement. Furthermore, after implementation of the nucleus breed-



Many producers are interested in participating in the nucleus management programme of DanBred.

ing programme of the National Committee, the best production herds can produce LY/YL gilts averaging index levels of more than 100 index points. This is on a level with an average multiplier herd. The financial gain from improving the genetic level of the herd is considerable. An improvement of the genetic level by 15 index points results in an increase of the value of the life production of a gilt by about DKK 300.

Formerly it was impossible - or at best difficult - for production herds to keep track of the index level of the purebred sows of the nucleus or the zig-zag bred sows used for further breeding. Therefore the

breeding material has been selected on the basis of other criteria. This often means that the herd cannot keep up in terms of index. With the launching of the nucleus management programme of the National Committee, all production herds - also the closed ones - can optimise their breeding level.

Producers interested in participating in the nucleus management programme of the National Committee can contact their local production consultant or the Dept. of Breeding and Multiplication of the National Committee under the Federation of Danish Pig Producers and Slaughterhouses.

Research and development

Number of litters and average number of pigs born in the first three litters

Breed	Number of litters, parity 1	Average born, parity 1	Number of litters, parity 2	Average born, parity 2	Number of litters, parity 3	Average born, parity 3
LL	94	10.86	73	12.00	52	12.37
(YD)L	98	12.20	32	13.09	7	15.29
YL	118	11.55	57	13.53	14	14.14

Sow experiments at Grønhøj

At Grønhøj test station, the project of comparing different recruiting strategies in sow herds is well on its way. The purpose is to test the sow combinations YL and (YD)L and zig-zag bred sows and to calculate their efficiency in the same environment. The experiment runs over several years, and about 1,000 litters of each combination must be produced. The above table shows preliminary litter results, but contains no results from the alternating breeding combination as it has not come this far yet.

The sows of the three experimental lines are mated with YD boars to assess production traits and the incidence of black spots when a specific boar breed is used.

Danish and French Large White

This experiment was started by semen imports from France as from January 1996. The results of comparing the production traits in YL offspring sired by Danish and French Large White boars, respectively, have already been reported. That part of the experiment showed a large difference in production



At Grønhøj, three sow combinations with 1,000 litters each will show the difference in the same environment.

economy of about 28 DKK/pig (average for sows and castrates) in favour of the hybrids by a Danish sire.

The experiment also includes litter size in YL offspring of the two types of Large White boars. This part of the experiment was carried out in collaboration with 57 production herds, which have purchased YL gilts of the two types from the breeding and multiplier herds that participated in the import of French Large White semen. The report on this part of the experiment is being written. The study on litter size comprises 1198 YL pigs, 468 of

which were by a French sire. The table shows the litter size results for parities 1-3 for the two types of hybrids.

When the difference between YL sows with Danish and French sires is adjusted for environmental effects and differences in the breeding value for liveborn pigs per litter of the Landrace dam, the difference between Danish and French Large White is only 0.01-0.03 liveborn pigs per litter in favour of sows with a Danish sire. Differences of the same order for the total number of pigs born per litter have been found.

Number of litters, total number born and number of liveborn

	Danish Large White sire			French Large White sire		
	Number of litters	Total number born	Number of liveborn	Number of litters	Total number born	Number of liveborn
Parity 1	730	11.5	10.8	468	11.3	10.6
Parity 2	644	12.7	11.9	406	12.8	12.0
Parity 3	426	13.2	12.3	285	13.6	12.5

Research and development



The difference in fertility is minimal in the experiment comparing Danish and French Large White.

The result depends on the statistical model chosen, but regardless of model the variance has been calculated at 0.14. In other words, the difference between the two types of YLs should have been 0.28 pigs per litter to be statistically significant. Thus, assessed on parity 1-3 results, the difference between the two types of YLs is minimal.

The influence of the breeding value for liveborn pigs per litter of the YL sow's dam for both total number born and liveborn per litter has been found to be 0.32-0.35 with a variance of 0.12. At full penetration for this trait, the influence is expected to be at 0.50. No difference has been found in the penetration of the litter size trait in the different parities.

In the experiment, YL sows with a French sire tended to have a development in litter size with increasing parity more favourable than that of the purely Danish sows. This fact has also been examined using different statistical models, but the analyses gave no clear answer to this question.

Analyses of the proportion of sows culled between parities 1 and 2 and between parities 2 and 3 show that the culling rate for the two types of hybrids did not differ. However, the number of liveborn pigs in the preceding litter was found to affect the chance that the sow produces another litter.

The study recorded both liveborn and stillborn pigs per litter. It was thus possible to analyse differences on the effect of the sire's country of origin on the proportion of stillborn pigs per litter. The analysis showed no significant differences between countries, nor regarding the sows' dam or sire or the dam's breeding value for liveborn pigs per litter. A significant effect of parity, litter size and herd was found. However, the importance of parity is not very great.

Osteochondrosis

Bøgildgård test station has carried out a comprehensive study of the joint disease osteochondrosis together with the Danish Institute of Agricultural Sciences. Through a three-year period, all performance-tested Landrace and Large White boars have been anaesthetised and X-rayed at the end of the testing

period. Two cases of osteochondrosis were assessed in the elbow joint, one in the foreknee, one in the knee joint, and two in the hock joint. The right and left sides were assessed independently. Moreover, the exterior of the animals was thoroughly assessed.

The results, which appear from the table, showed that Landrace has a greater incidence of osteochondrosis than Large White, and that the highest incidence of osteochondrosis is in the knee joint. It turned out that osteochondrosis is moderately heritable.

Genetically, however, osteochondrosis in different joints is not the same disease, as the genetic correlations are rather low. Correlations between incidence of osteochondrosis and assessment of the exterior were assessed in the form of genetic correlations. Generally, the correlations are small. The highest



More than 4,000 boars have been anaesthetised and X-rayed.

correlation was found between the assessment of splayed hind legs and osteochondrosis in knee joints in Landrace, the correlation being 0.56. The corresponding figure for Large White is 0.31.

This means that selection away from turned out hind legs will reduce the incidence of osteochondrosis in knee joints. In Yorkshire, the incidence of osteochondrosis in the elbow joint was correlated with buck kneed forelegs, turned out forelegs and stiff locomotion. Selection to avoid these traits will thus reduce the incidence of osteochondrosis. In Landrace, on the other hand, osteochondrosis in the elbow joint will hardly be affected by selection according to an assessment of the exterior.

The weak genetic correlations between osteochondrosis in other joints and the exterior assessments mean that reduction of the incidence of osteochondrosis in these joints necessitates X-raying or possibly incision. So the incidence of osteochondrosis in these joints cannot be improved by selection based on the exterior assessment.

Reduction of osteochondrosis may be desirable for several different reasons. One reason may be a pre-

Genetic correlations between the sum of osteochondrosis scores and the individual production traits as well as an index of the production traits

Breed	Daily gain	Feed conversion	Lean meat content	Index*
Large White	0.24	-0.04	-0.08	0.11
Landrace	0.34	0.09	-0.07	0.04

Index = (0.14 * daily gain - 95 * feed conversion + 7.5 * lean meat content)

sumed correlation between osteochondrosis and longevity. A newly started project is now studying whether osteochondrosis leads to reduced longevity. Another reason may be consideration of animal ethics. The weak correlations with exterior assessments, especially with locomotion, however, seem to indicate that the pigs are not highly bothered by the osteochondrosis. It will now be possible to study this in more detail in the newly started project, which evaluates the long-term effect.

The correlation between osteochondrosis and the production traits of daily gain, feed conversion and lean meat content has also been studied. The sum of changes in all joints examined has been used as an aggregate measure of osteochondrosis. The results of this part of the study are shown in the table.

It appears that daily gain is positively correlated with osteochondrosis, which is unfavourable. Lean meat content is negatively correlated, which is favourable. The correlation with feed conversion is favourable in Large White and unfavourable in Landrace. The correlation to an index of daily gain, feed conversion and lean meat content has also been calculated, showing for both breeds a very weak unfavourable correlation.

For that reason, a selection for improved production traits is estimated to have a very weak negative effect on the incidence of osteochondrosis. However, the exterior assessment, today included in the overall breeding index, will counter with a weak positive effect. Therefore, osteochondrosis will hardly become worse as a consequence of genetic improvement.

Breakdown of osteochondrosis score into joints and breeds

Joint	Breed	Breakdown of scores in per cent					Heritability h ²
		1	1.5-2	2.5-3	3.5-4	4.5-5	
Elbow	Large White	83.5	14.3	1.4	0.5	0.3	0.09
First joint	Landrace	71.6	19.3	5.5	2.6	0.9	0.25
Elbow	Large White	57.2	31.5	9.5	1.7	0.1	0.23
Second joint	Landrace	57.3	27.5	10.6	4.3	0.3	0.35
Foreknee	Large White	67.1	21.0	7.6	2.8	1.4	0.12
	Landrace	35.5	36.1	21.5	5.4	1.5	0.33
Knee	Large White	44.2	33.6	18.5	3.5	0.2	0.32
	Landrace	16.2	38.6	37.3	7.7	0.2	0.31
Hock	Large White	86.2	11.2	2.4	0.3	0.0	0.14
First joint	Landrace	45.5	39.0	13.5	1.9	0.1	0.39
Hock	Large White	93.8	5.1	1.0	0.1	0.1	0.08
Second joint	Landrace	81.2	14.1	4.4	0.3	0.1	0.16

Animal welfare legislation - UK production

In general, Denmark observes Community law concerning animal protection. A national act on indoor keeping of sows and gilts has applied from 1 January 1999. Under the Act, gestating sows must be loose at least 4 weeks after service until at most 7 days before expected farrowing. In spring 1999 a bill on the keeping of weaners and finishers was published. The Danish Parliament will debate the Bill this autumn. Branded pigs for the UK market have now been produced for 2 years. During this period, information has been collected on the ranking of requirements in the UK and how to observe them.

Act on loose sows

The Act, which applies to buildings commissioned after 1 January 1999, has caused some construal problems. The National Committee has clarified the most important problems in a memorandum 'Construal of the Act on indoor keeping of gestating sows and gilts'. However, only the courts can clarify the doubts in the final instance. For buildings commissioned before 1 January 1999, the Act applies from 1 January 2014.

The most important problems have been:

- *Area requirements for gilts?*

The area requirement for finishers over 110 kg applies ~ 1 sq.m. per pig. They must also be able to lie down/get up unhindered.

- *Definition of area requirement?*

The area freely available to the sow is included in the total area. The solid-floor area can include freely accessible eating/resting stalls of an internal minimum width of 60 cm and solid floor, if the stalls can be bedded.

- *Nowhere may the pen be narrower than 3 m.*

The requirement applies to all passages where sows move between feeding and lying areas, except between two opposite pen divisions if the sows can escape to both sides.

Bill on indoor keeping of pigs

The proposed date of entry into force of the Act is 1 July 2000. For buildings commissioned before then, the Act will only apply as from 1 July 2015.

The Bill provides as follows:

- *In pens for weaners and finishers, at least one half or one third, respectively, of the required minimum area must have a solid or drained floor or a combination thereof. A drained floor means a floor with a maximum of 10% aperture area. Conventional concrete slatted flooring has an aperture area of about 20%.*
- *Pens with pigs above 20 kg must have a showering system or similar arrangement for adjusting the body temperature of the pigs.*
- *The pigs must have access to straw or other occupational or messing material. It is proposed that this requirement only becomes effective from 1 July 2005, as development of suitable materials/allocation methods is needed.*

Amendments of the Ministerial Order on castration, tail docking and tooth clipping are proposed to take effect on 1 July 2000 as follows:

- *Piglets may be castrated without anaesthesia within the first 7 days of life.*
- *Tail docking is still not allowed as a routine measure, but if necessary, it must be done within the first 4 days of life, and not more than half the tail may be removed.*
- *No clipping of teeth is allowed. Where removal of tooth tips is needed, the teeth must be polished within the first four days of life.*

Observance of the Animal Protection Act does not in itself guarantee optimum welfare, health and productivity of the animals. Functional requirements must be met, but supervision and control of the animals

are essential conditions for ensuring animal welfare.

Production of UK pigs

In 1999, about 2000 suppliers are approved for production of UK pigs and thus entitled to the supplement for the finishers that satisfy the criteria therefor.

Approval as a producer of UK pigs requires loose sows from weaning until entry in the farrowing house. Since the UK only receives parts of the pig - mainly loin portions - about 35% of the production is taken up. About 15% of sows are loose at present as stated.

Pigs for the UK market are paid by 0.40 DKK/kg above the current price in 1999. A supplement of at least 0.30 DKK/kg is guaranteed for the next two years. The supplement presupposes a slaughter weight between 67 and 80 kg and a minimum lean meat content of 58%.

The supplement for production of UK pigs must be seen as a compensation for the risk of lower productivity because the sows have to be loose - also in the service unit. Also as compensation for documentation.

To obtain the maximum supplement, producers must be careful with both delivery weight and lean meat content. So far only about two thirds of pigs delivered have been approved for the UK market.

The pig industry is responsible for meeting production rules and control procedures required by the UK market. Rules and supporting material for producers have been drafted, and about 50 advisers have been trained to approve and control the herds. The UK producers are controlled by the National Committee in cooperation with the Danish Agricultural Advisory Centre. This ensures that the documentation satisfies both UK requirements and Community norms. Where serious defects are disclosed with the producer, the supplement lapses. Since the British importers also make control visits to the herds, it is crucial for exports that the pig producers fulfil the UK contract.

Health-promoting production systems

Sectioning

Studies carried out by state research institutions and the Danish Applied Pig Research Scheme show that an essential condition for controlling respiratory diseases is the construction of sectioned housing for all in/all out and/or multisite operation.

Apart from the layout, the way of using the housing is essential to obtain good disease control and efficiency. Studies of multisite systems have shown that it often takes a long time, often up to 1.5 years, to run in batch operation. Both during the running-in period and afterwards, the number of pigs produced may vary greatly. This makes it difficult to practice all in/all out operation in the weaner sections designed for the purpose, and thus to obtain a health gain.

The most important condition for making all in/all out operation work is to dimension and manage batch operation so that the weaner sections are filled with the same number of animals every time. Therefore, all in/all out operation must be planned already at the time of service. The point is to serve the number of sows and gilts that corresponds to the number of pigs expected to be weaned at a given time. It is also important to be aware of seasonal biological varia-

Preliminary results from a comparison of traditional sectioned operation with an FTS and a WTS system

	Control	FTS	WTS
Batches, number	5	5	3
Pigs, number	567	601	652
Daily gain, 7-25 kg	433	498	466
Daily gain, 25-200 kg	798	858	986
Days from weaning to slaughter	133	124	117
Chronic adhesive pleurisy, %	33	34	2
Mortality between weaning and slaughter, %	4.2	4.9	2.0

tions in returns-to-service, culling, litter size and mortality, which may affect the number of weaned pigs. Therefore it is advantageous to use the results from the efficiency control as part of the planning of service and gilt recruitment.

FTS and WTS

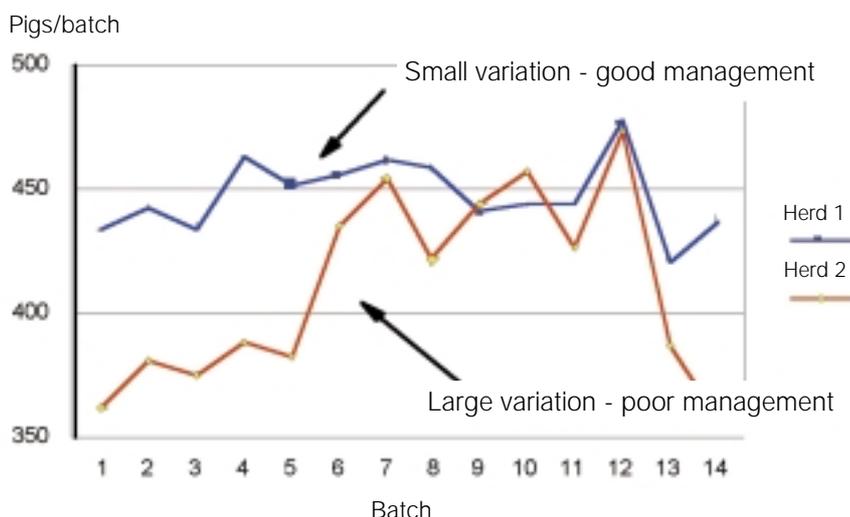
The resistance of pigs to diseases is reduced by stress influences such as moving and mixing with other pigs. This is the reason for a comparison of a system with housing of the pigs in the same pen from farrow to slaughter (FTS) with a traditional system where the pigs are moved and mixed at weaning and at transfer to finisher housing. The comparison also includes a WTS system located at another site without other pigs. The pigs are transferred to the WTS system at weaning and are penned by litters until slaughter. Preliminary analyses

show the best results in terms of health and production with the WTS system. This is probably the effect of both interruption of infection at weaning and litterwise penning, which involves less stress.

It should be emphasised that conditions for pigs in the WTS system were better concerning stocking rate, composition of groups as well as factors of infection than in the WTS systems being constructed. Therefore, the results of the study only reflect the performance of pigs of the same genetic material under differing housing conditions.

Interest in the WTS system is increasing. This is due, not least, to economic calculations showing the competitiveness of this form of housing compared with a traditional production system with weaner and finisher houses. The most important reasons for this are reduced labour for moving pigs and washing housing, lower transport costs and finally a slightly higher production level.

The WTS system is expected to be established in two versions. One model is based on the same size and composition of the group during the entire growth period. The other model has twice the number of pigs in the 7-30 kg range compared with the remaining period. Studies have been initiated to illustrate the implications of the two production methods for performance and production economy.



Weaner and finisher pens

Drained floor

A new bill on housing of weaners and finishers defines a drained floor as a floor having a maximum aperture area of 10%. This means that the percentage proportion of slots and/or holes must not exceed 10% of the floor area in the relevant part of the pen. The Bill has no specific requirements of slat or slot widths.

Drained floors can be designed with slots, round holes or a combination thereof. The drained floor is to give pigs a comfortable lying area and allow distribution of bedding while contributing to efficient removal of any liquid from the lying area. Whether drained flooring can also be kept free of manure is as yet unclarified. It is also unclarified what slat and slot widths can be recommended.

A trial has been initiated of different types of drained flooring with 10%



Traditionally, concrete slatted flooring for finishers has an aperture area of about 20%. A drained floor with an aperture area of 10% can be designed with slats or holes.

aperture area in finisher pens with restricted wet feeding, covering of lying areas and showering of the dunging area.

Future trials will clarify how to design the drained floor in relation to pen function and leg and hoof health.

Slatted floors for weaners

A product trial has been carried out of 6 types of traditional slatted flooring of different designs in controlled-climate pens with one-third slatted floor. The floors were compared in relation to pen function, dung fall-through, skid-proof function, damage to the pigs, daily gain and durability.

No pens with messing were observed during the trial period.

No serious lesions of the legs and hoofs of the pigs were recorded for the different floor types.

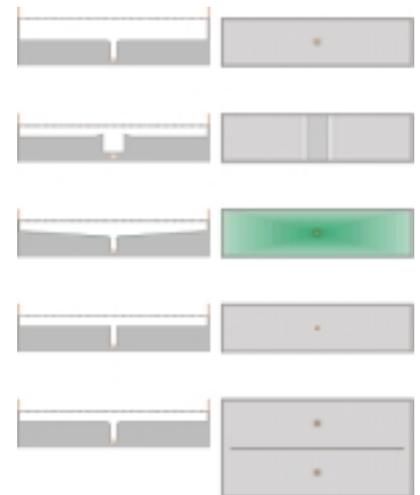
Slurry systems in finisher housing

A trial of 5 different designs of slurry pits in a finisher house showed that a system with stemming edges and sump was the only system to work without problems during the trial period.

The second-best system was a traditional system with a 60 cm deep flat-bottomed pit, while a slurry sys-

tem constructed with communicating pits worked so badly that the slurry often required addition of water to run out.

The trial did not disclose whether the sump or the stemming edges were the reason for the good function. This question will be clarified in another trial of the design of slurry pigs in finisher housing with partially slatted flooring.



5 tested slurry pits:
 (1) System with 1.2 m deep slurry pit.
 (2) System with sump and stemming edges.
 (3) System with 3% incline of slurry pit towards outlet.
 (4) Traditional system with 60 cm deep slurry pit, dimensions 13.0x2.1 m.
 (5) System with slurry pits communicating pairwise, the plugs being pulled alternately.

Types of slatted flooring for weaners in two-climate pens with one-third slatted floor

Floor type slat/slot width, mm	Tri-bar slats 10/10	Plastic 10/10	Cast iron 10/10	Cast iron/ plastic 10/10	Cast iron 12/12	Plastic 38/15
Cleanliness of pigs	****	****	****	****	****	****
Dung fall-through	***	***	***	***	***	****
Skid-proof function	***	**	***	***	****	***
Pen function	***	***	***	***	***	***

**** = excellent *** = good ** = inferior * = poor

Layout of WTS housing

New studies are to clarify how to design feed allocation and flooring as well as the other pen equipment to accommodate a pig in the weight range 7 to 100 kg. Especially feeding is difficult due to the enormous development undergone by the pig from weaning to slaughter. A preliminary recommendation, whether feeders or long troughs are used, is a height from floor to edge of trough not exceeding 13-14 cm. The trough sides in long troughs for, e.g., restricted wet feeding must be rather steep, making it easier for the pigs to reach the trough bottom without stepping into the trough. However, supplementary feeding in a movable long trough or on the floor for the first two weeks will be suitable to make allowance for the smallest pigs and to ensure sufficient eating places in general.

To satisfy the pigs' need for heating, the pens must be designed with a controlled environment system, i.e., at least one third of solid floor combined with floor heating and a cover. So far, concrete slatted flooring with a slat width of about 50 mm and a slot width of 16 mm is recommended. In pens with two thirds solid floor, the concrete slatted floor should have a slat width of 70-80 mm and a slot width of 20 mm.



Layout of a WTS pen.

The pigs' body dimensions increase rather faster in the weight range 7-30 kg than during the finishing period, making it difficult to design feeders and troughs for WTS pens

	Weight		
	7 kg	30 kg	100 kg
Shoulder width, cm	11	19	30
Height, cm	30	46	67
Length, cm	48	83	130
Hoof width, cm	1.8	3.0	4.4

Finisher pens with restricted wet feeding and partially slatted flooring

The new proposal for a Bill on the layout of weaner and finisher housing points to a certain proportion of solid or drained floor with a maximum aperture area of 10% in future housing. At cessation of the use of growth promoters, restricted wet feeding may have a positive influence on gastric health, feed conversion, lean meat percentage and monitoring of the pigs in the pen. Traditionally, pens with restricted wet feeding have been designed with fully slatted flooring due to the risk of messing. To be able to use wet feeding in future, it is important that also pens with partially slatted flooring can function without messing.

Therefore, the Danish Applied Pig Research Scheme is conducting studies concerning pen function and weight distribution in finisher housing with restricted wet feeding and one third and two thirds, respectively, of solid flooring. The trial includes different designs of feeder tubes, equipment above the trough and trough types to clarify their influence on messing in the pens.



Layout of finisher pen with restricted wet feeding and partially slatted floor.

Preliminary results from a trial of different troughs and feeding methods in connection with restricted allocation of wet feed to finishers

- Four feeder tubes rather than two ensure rapid and more even distribution of the pigs at the trough.
- Closed equipment above the trough results in fewer changes of place during feed intake than open equipment.
- Round-bottomed troughs and troughs with an acute-angle bottom ensure rapid distribution of feed and are easier for the pigs to keep clean than flat-bottomed troughs with steep sides.
- Nipple valves above the trough result in spillage of water, contributing to dilution and slower distribution of the feed in the trough.
- The trough bottom must be at the same level as the top point of the solid lying area.

Loose sows

The Act on indoor keeping of gestating sows and gilts became effective on 1 January 1999. The main feature is that gestating sows and gilts must be loose from at least 4 weeks after service until at most 7 days before expected farrowing. For loose gestating sows, requirements include a specific area, possibility of temperature adjustment and bedding.

For producers with a UK contract production, the sows must be loose during the entire period from weaning until farrowing.

Problems in relation to loose housing

When establishing loose housing it is important to be aware that the demands on management have substantially changed. To obtain the same production reliability and avoid problems of animal welfare, demands on supervision and intervention are higher compared with crate systems. There are sows, for example, that cannot cope in a group. These sows must be removed and housed individually.

Where sows are fed ad lib. or fed restrictively in a situation of competition, the sows risk getting different amounts of feed. Sow body condition must therefore receive greater attention at these feeding principles.

The stockman also has to note the sows' movements in the pen to avoid leg and hoof injuries. Floors must be skid-proof and liquid manure must be diverted from the pen floor. Slips and lesions are a risk on greasy and slippery floors.

Vulva biting may arise in situations where sudden changes occur in the pen. The changes may be increased stocking rate, lack of feed supply, or a move to the farrowing house later than one week before farrowing.



To avoid serious hoof injuries it may be necessary in some cases to dock the sows' accessory digits. Docking can be performed in the farrowing house. Note that the cut must have a forward inclination.



Service unit fitted with eating/insemination stalls.

Service unit

Loose sows in the service unit can be housed in several ways, either individually or in a group. Results from a trial in two herds show that reproduction results become significantly lower when sows are housed in a group rather than individually in a pen. The group sows were fed via ad lib. feeders. Competition for the feed and the consequent aggressiveness may have caused poorer performance. Furthermore, sows coming on heat will mount other sows, which is especially stressful to low-ranking sows.

In service units with sows housed in a group with permanent access to eating/insemination stalls there will be no competition at feeding, and sows can seek towards the stalls when the bunt order is being established or when the sows mount each other. The Danish Applied Pig Research Scheme has just initiated a trial to clarify whether sows housed in a group with permanent access to eating/insemination stalls can obtain reproduction results at a level with systems having sows penned individually.

Preliminary results from a trial in which the sows were housed individually or in a group for the period from weaning until after service. Group sows were fed via ad lib. feeders

	Herd 1		Herd 2	
	Individual	Group	Individual	Group
Service unit housing	Individual	Group	Individual	Group
Litters produced, No.	332	349	223	233
Pigs born per litter, total No. *)	13.2	12.9	13.1	12.8
Farrowing percentage	88	89	83	85

*) Liveborn + stillborn

*Requirements of service unit with eating/insemination stalls**Dimensions of stall*

- Minimum length 1.90 m measured from back edge of trough to back edge of stall
- Minimum width 0.60 m excluding tubular partition (total width 0.65 m)
- Sow must be accessible and inseminator must be able to stand beside the sow

The pen

- Boar contact in the pen itself and in front of eating/insemination stalls
- Possibly slatted flooring in eating/insemination stalls
- Minimum width of area behind eating/insemination stalls of 4 m
- Skid-proof floor in area behind eating/insemination stalls

Stimulation of sow the day before expected service.

- fist punches in the flank
- holds and lifts in the knee/groin folds
- fist punches under genital opening
- cross holds/clasping holds
- riding test
- insemination at 'standing' oestrus



At insemination, the stockman must:

- sit/lie down on the sow facing backwards
- use the free hand to hold and lift the knee/groin folds
- stimulate the area around the sow's fore-end/shoulder with foot/lower leg

Gestation unit

Subsidised by the Danish Directorate of Development and Fisheries, eight herds have gathered experiences over a 2-year period on reproduction results, culling reasons and operating conditions. The sows were housed in either dynamic or stable groups. Five herds used electronic sow feeding, two herds used trickle feeding and in one herd the sows were fed in common eating stalls.

Bedding materials and manure handling

There is increased interest in restricting labour and consumption of bedding material in service units with eating/insemination stalls. A trial has therefore been initiated to clarify whether a floor design with slatted and solid flooring rather than deep litter bedding can improve hygiene and reduce labour without any negative influence on sows and performance.

In housing with loose individual penning, the composting possibilities, consumption and handling of bedding materials are being studied. The study includes the following materials:

- Wood dust
- Shavings
- Wood pellets
- Hemp
- Rape straw
- Shredded wheat straw

At individual penning it is possible to reduce bedding consumption, number of bedding distributions and mucking-out by using saw dust/shavings rather than straw.

Oestrus detection and stimulation

Stimulating for and detection of pre-oestrus and 'standing' heat are important. A move to the service unit stimulates oestrus. Moreover it is important that the sows can smell, hear and see the boar in the service unit. Oestrus is also stimulated by shoving and mounting by other sows - mainly in the last two days before expected oestrus. A trial has been initiated to clarify the effect of manual sow stimulation during oestrus and insemination on reproduction results.

In a sow, the level of the hormone oxytocin is high for about 20-30 minutes after stimulation and then drops. The hormone helps to trans-

port the semen up into the womb. It is only possible to increase the oxytocin level by stimulation again after 30-60 minutes. Therefore, serving of group-housed sows requires careful planning so that all sows are served when the oxytocin level is high. A new study will clarify the optimum interval between two stimulations for 'standing' heat.

Sow physiology makes it natural to recommend individual penning of the sow at least in connection with insemination, allowing her a 'rest' before she is returned to the group. Today, a 20-minute period of rest after insemination is recommended for the sow, but this has not been documented, and it is not yet known whether a rest is necessary. Another trial seeks to clarify this point.

Loose sows

Reproduction results:

- After the running-in period, 26 pigs more per year sow were weaned in two herds, and three herds had more than a total of 13 pigs born per litter.
- On average the eight herds weaned 23.4 pigs per year sow after the running-in period. Compared with the running-in period of about 6 months, this was an improvement of 1.4 weaned pig per year sow.

Reasons for removal:

- The most frequent reason for removal were leg injuries, accounting for 1-10% of sows entered during the running-in period and 1-5% in the subsequent period.
- There is a higher risk of leg injuries in the running-in period when older sows are moved to a loose housing system.

Operating conditions, etc.:

- Gilts were never moved to the loose housing system until 4 weeks after service.
- There was a need for separate housing of gilts/young sows and older sows.
- The oldest sows were assessed as the most aggressive ones.
- It was important that sows with minor infirmities such as poor legs were rapidly removed from the group, as they were more exposed to aggression and actual attacks.
- At ESF it was considered an advantage with a permanent pen for training of young sows or gilts.
- Both ESF and eating stalls provided a good possibility of controlling feed allocation.
- Trickle feeding provided a better possibility of controlling feed allocation in small stable groups than in large dynamic groups where sows were not sorted by size.
- In all herds, the sows were calm and confident towards people.
- When straw was distributed in the pens, a wire-type cleaner or other scraping system under slatted flooring was needed.

Common eating stalls

Experience has been gathered from 6 gestation houses with loose sows housed in pens with common eating stalls. The experience showed that the labour required for feeding varies much between herds. In all herds, the work of feeding was combined with other tasks, either in the gestation house or in other housing units to minimise waste time.

Feeding - common eating stalls, experience

- possibility of manual allocation of feed to skinny/small sows
- sows are only let out of pen when all troughs are filled
- eating stalls should have front exit
- stalls should be lockable when sows have left so they cannot re-enter
- automatic gate opening from pen to corridor at eating stalls

Slatted flooring

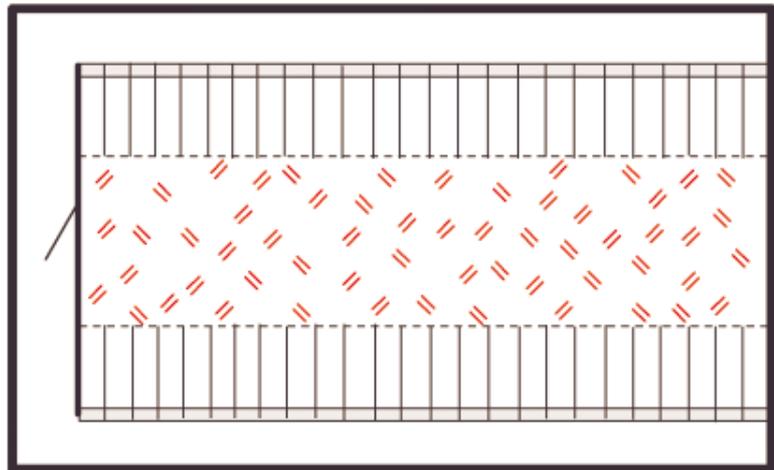
The statutory requirements of allocation of bedding and messing material lead to a need for rational manure systems. Simple arrangements where the manure is removed from a dunging area by a

mini loader or the like have proved to work well. But extra labour is often needed both for handling of straw and solid manure. Automatic scraping systems have been tried, but the sows risk getting caught between scraper and equipment.

New slatted flooring with a larger slat and slot width (294/36, 143/22 mm) is being tested to improve pen hygiene and reduce labour without negatively affecting the sows. In pens with a straw-littered lying area and dunging area, the larger slat and slot widths function satisfactorily so far. It is important, however, to keep slats free of manure to avoid slippery floors.

Showering

Showering - or a similar arrangement to cool the sows in the summer - has been statutory since 1 January 1999 in new buildings for gestating sows and gilts. Especially highly pregnant sows produce much heat and need cooling in the summer. The need is intensified if roughage is given. In addition to cooling of the sows, showering will also help keep any slatted flooring clean so it becomes skid-proof.



A layout with one eating stall per sow requires 20% more area and costs 25% more per pen place than a layout with common eating stalls. On the other hand, labour for feeding is reduced. The saved labour can almost cover the increased investment.

Basically, showering takes place in the dunging area. The pigman must ensure that the showering system is set for optimum function. Short-time showers at frequent intervals should be preferred to long-term showers at long intervals. The shower duration should be adapted to pen layout, group size and season.

Loose nursing sows

Swiss farrowing pen

The Swiss farrowing pen has been further developed on a number of points to adapt it to Danish production conditions. Adaptations include slatted flooring in the dunging area, and the creep has been adapted to the large litters.

The sows generally keep the lying area clean, and offhand the pen seems to function well. Too many piglets die, however (about 20%). To reduce excess piglet mortality, further studies have been initiated together with behavioural researchers of the Royal Veterinary and Agricultural University and the Danish Institute of Agricultural Sciences.

New pen types

The companies Ikadan and Agro Products have launched new farrowing pens for loose nursing sows. The characteristic feature of the pens is that they only require slightly more space than conventional farrowing crates and can be fitted into conventional farrowing houses.

The new farrowing pen from Ikadan has fully slatted flooring and a diagonal partition between two pens. The sow can move around in the pen, and the piglets are protected from the sow by plastic balls mounted on a flexible stand. The piglets also have access to a corner with a heating pad. The Agro Prod-



The sow can be tethered in the crate when farrowing.

ucts pen is based on a conventional farrowing crate. The sow is loose, but controlled by rails. The sow area is divided into a lying area and an eating area. The pen has slatted flooring in the areas where the sow dungs, and the piglets have an area protecting them from the sow.

An on-going trial compares the above pens and a larger loose housing pen from Egebjerg with conventional farrowing crates.

Outdoor sows

Of the different systems for loose nursing sows, the outdoor system must be characterised as a reliable system. So much knowledge is now available that well-qualified advice in this field can be offered. There are thus examples of outdoor sow herds with a performance fully on a level with the best indoor herds.

Piglet mortality

Average total mortality in free range herds is at 18% and thus does not deviate from indoor production with a total mortality of 19%. On the other hand, free range herds vary greatly - from 11 to 26%.

To reduce piglet mortality, the Danish Applied Pig Research Scheme is conducting a study of two different paddock systems - single and common farrowing paddocks. The study especially focuses on mortality, weaning weight, feed consumption and labour.

Management

Experiences on the use of electronic identification (ID) have been collected. The experiences indicate that electronic ID is an excellent management tool allowing timesavings in data recording.

The price of electronic ID is about DKK 10,000 for the hand terminal and about DKK 100 per ear tag. PCs and management program must be added.



Based on experience collected by the theme group for outdoor sows the following straw allocation is recommended: 50 kg of straw before farrowing followed by 5 kg 2-8 times during the nursing period.

Product trial

The Danish Applied Pig Research Scheme conducts product trials, mainly of feeders, but also troughs and slatted flooring are tested.

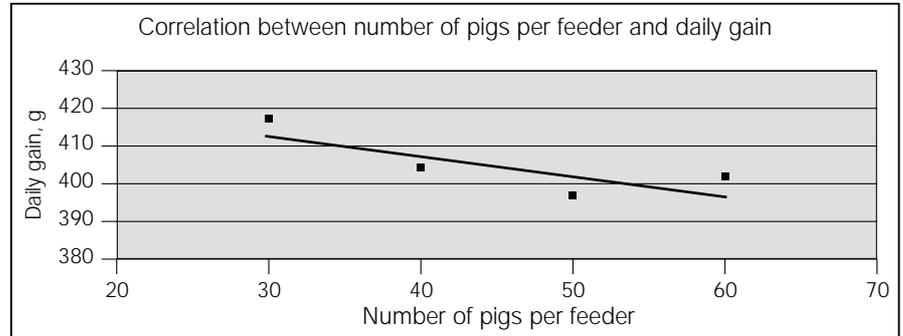
A novelty is an offer to firms to have their feeders tested in future against payment. At the same time, the product test is extended to include performance too. The trial will thus become similar to the trials of feed-stuffs conducted for several years by the Department of Nutrition and Reproduction. The first trial includes five firms distributing tube feeders for weaners - Agro Products, Durofarm, Egebjerg, Faaborg and Wagner Domino.

Trial of principles for feeders for weaners

The performance of weaners fed via a simple dry feeder and a tube feeder, respectively, was studied in two herds. The trial showed no difference regarding daily gain and feed consumption.

Weaners per tube feeder

The performance from a trial of tube feeders in one herd, where the number of pigs per feeder varied from 30 to 60 pigs, showed a significantly higher gain at the low number of pigs per feeder. It should be noted that the feeder used had a relatively small output on drinking nipples. The general recommendation will therefore be about 30 weaners per tube feeder with a supplementary water supply. The increased gain occurring at 30



pigs rather than 50 pigs per weaner can pay interest on and write off an investment of DKK 112 per pen place (10 years and 7%).

Ad lib. feeders for loose gestating sows

Provisional experience with ad lib. feeders for loose gestating sows shows great problems of durability and feed waste. A product trial of ad lib. feeders for loose gestating sows has therefore been initiated. The feeders are assessed in relation to: feed waste, caking, adjustment, cleaning, durability and learning.

Feeders for free range sows

A product trial of six feeders for free range nursing sows has been completed.

The feeders were all intended for common farrowing paddocks. The feeders were assessed in relation to: feed waste, caking, adjustment, cleaning, durability, learning, ease of handling and filling.

The result of the product trial shows that the feeders can be divided into roughly 3 categories:

Good ones:

*Frilandsso - 4 from Domino
Feeder from BK-teknik
Feeder from JODI-inventar*

Medium ones:

Creeb and Nut feeder from Sal-linghytten

Poor ones:

*Feeder from TP-hytten
Feeder from A-hytten, Atlantik*

Production results from trial of feeders for weaners

Feeder	Simple dry feeder	Tube feeder
Batches, No.	12	12
Pigs produced, No.	644	649
Daily gain, g ¹⁾	403	396
Feed intake per day, FUs	0.68	0.68
Feed consumption, FUs/kg of gain	1.71	1.72

¹⁾ Adjusted for weight at entry



It must be easy to fill the feeders with feed and move them around in the paddocks.

Organic pig production

The number of organically produced finishers has more than doubled every year since 1995. In 1998, the number was about 45,000 organic finishers, about 0.2% of the total Danish pig production. The number of organic finishers produced is expected to reach about 75,000 head at the end of 1999.

Production systems

Results/experience from a development project on organic pig production shows that this form of production is practicable on a major scale under current rules. The development project is conducted in 4 real herds with 60-280 year sows.

Sow units

Free range sows directly comply with the rules of organic production. Compared with conventional free range production, however, some areas attract particular attention.

Breeding stock: In organic production, good slaughter quality (lean meat content/loin fat) is vital to the economy. The foundation of good slaughter quality is laid above all through the choice of good breeding stock.

7-week weaning: Despite very large litters, 7-week weaning does not cause especially skinny sows. The average body condition score after weaning is satisfactory for the 4 herds studied.

Roughage: Roughage can cover up to 80% of the energy requirement of gestating sows. The amount depends on the type of roughage fed and its quality, among other things. It should be possible to mix the roughage with a concentrate to take into account any fluctuating quality. Gestating sows can crop between 0.7 and 1.2 FUs/day during the growing season.

Reproduction: Outdoor mating may work well, but requires more management. It is recommended to establish an indoor service unit.

Finishers

When the organic pig is over 8 weeks old, it must be housed. The building must have an outdoor run and free access to roughage. Alternatively, the finishers can be pastured.

Free range finishers: For small herds, this may be a fine solution, but the form of production demands much land, feed and work.

Houses with runs: The functioning of houses with runs differs greatly. Experience shows that the pigs deposit about 90% of their manure in the run, but the risk that the pigs dung in the corners of the inside area is nevertheless great. Adaptation of the indoor area to the size of the pigs, use of showering systems in the run and frequent cleaning of the run seem to improve the functioning of the housing systems.

Roughage: The most frequently used feeding principle is ready-made feed with separate allocation of roughage. According to this principle, roughage amounts to 3-5% of the total energy intake of the finishers. Experiments of increasing the roughage intake of the finishers by means of a mixer cart have results in excessive feed waste so far. However, a complete feed mix with concentrate and boiled ensiled potatoes has proved appropriate.

Sources of protein: Organic growing of protein sources (peas/rape/lupine) remains very difficult. So far, the production has been based on soybean meal imports, but it becomes more difficult to get soybean meal guaranteed to be genetically non-modified.

<i>Sow units:</i>		
<i>Period</i>	28.06.97-31.03.99	
<i>1st parity litters, %</i>	34	
<i>Liveborn/litter, No.</i>	11	
<i>Weaned/litter, No.</i>	9.4	
<i>Died during nursing, %</i>	14.7	
<i>Weaning weight, kg</i>	14.0	
<i>Non-productive days/litter</i>	31	
<i>Farrowing rate, %</i>	74	
<i>Litters/year sow, No.</i>	1.91	
<i>Weaned pigs/year sow, No.</i>	17.0	
<i>Feed consumption/pig, FUs</i>	24	
<i>Feed consumption/year sow, FUs</i>	1905	
<i>Finishers:</i>		
<i>Period</i>	28.06.97-31.03.99	
<i>Weight at entry, kg</i>	29.8	
<i>Average slaughter weight, kg</i>	82.2	
<i>Feed days/pig produced</i>	97	
<i>Daily gain, g</i>	813	
<i>Feed/kg of gain, FUs</i>	3.24	
<i>Feed/pig produced, FUs</i>	241	
<i>Roughage thereof per pig produced, FUs</i>	8	
<i>Average lean meat content, %</i>	58.2	
<i>Chronic adhesive pleurisy, %</i>	11.0	
<i>Total with allowances, %</i>	5.6	
<i>Dead and culled, %</i>	5.8	
<i>Performance of 4 organic pig herds participating in the project</i>		
<i>Costs per finisher produced, DKK</i>		
<i>Production system</i>	<i>Conv.</i>	<i>Org.</i>
<i>Feed costs</i>	376	740
<i>Vet. costs</i>	20	15
<i>Energy and straw</i>	20	67
<i>Misc./Breeding costs</i>	36	25
<i>Land rent</i>	-	9
<i>Labour</i>	101	185
<i>Maintenance, etc.</i>	26	29
<i>Interest</i>	70	75
<i>Depreciation</i>	105	77
<i>Total costs/pig</i>	754	1222
<i>Cost/kg of pigmeat</i>	9.99	14.70

Ventilation

The climate has been recorded in two gestation houses with common eating stalls. A non-insulated house with natural ventilation and a house with an insulated roof surface and adjustable natural ventilation. The houses were part of the project Shell Structure Design under the National Department of Farm Buildings and Machinery.

Temperature

In the non-insulated house, the temperature varied in step with the outside temperature. In the winter, the house had periods of frost measuring down to -7°C.

In the insulated house, the temperature was on average 6° higher than the outside temperature during winter, but the temperature difference varied much during the 24 hours. It was thus possible to keep the insulated house frost-free by limiting ventilation. In periods the difference between inside and outside was up to 17°C. The disadvantage of limiting ventilation so much was, however, that the air might become too heavy in the morning before airing.

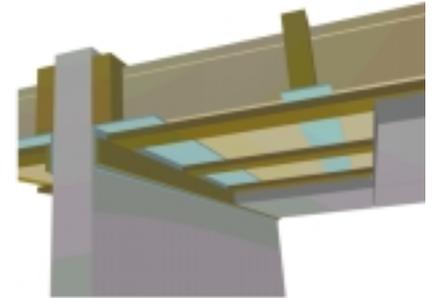
During the summer, the insulated roof surface meant that the house was substantially cooler on sunny

days. In the house with the insulated roof surface, the temperature was normally less than half a degree above the outside temperature at full open ventilation.

The non-insulated roof surface also resulted in further heat strain on the sows from higher house temperatures and radiant heat. Thus, roofing panel temperatures of up to 41°C and up to 15°C above house temperature were measured. The amount of heat transferred depends on type and colour of the roofing panels. The most frequently used roofing panels normally transfer between 50 and 200 W to the house per sq.m. of house at the most sunny and calm times. This is a lot when the sows' own heat production is only 60-70 W per sq.m. of house.

Generally, insulation of gestation houses results in the following advantages:

- frost-free house possible
- lower feed consumption
- reduced consumption of bedding
- no extra heat/cold strains on animals through radiation from roof surface
- no condensation problems
- generally drier corridor areas, etc.



It is important to pass the section partition up through the mineral wool to prevent air from passing between sections. The membrane must lie on the lagging up against the mineral wool to prevent condensation.

Diffuse air intake

The air must be taken in via the mineral wool and not via leaks in the diffuse ceiling. Therefore, measures must be taken to prevent mice and rats from settling in the insulation material. Cracks between beams and insulation are also a problem because the beam distance may vary because the beams 'warp', etc. It is therefore important to place the beams as accurately as possible and make the insulation material 1-2 cm wider than the average beam distance.

Period		Insulated roof surface			Non-insulated roof surface				
		Outside	House	House ÷ outside	Outside	House	Roof	House ÷ outside	Roof ÷ house
		°C	°C	°C	°C	°C	°C	°C	°C
Summer	Average	15.8	17.1	1.3	14.8	17.1	16.5	2.5	÷0.5
05.8.1998-	Standard	3.1	2.6	1.2	3.6	3.5	6.5	1.1	3.5
31.8.1998	Minimum	7.2	11.5	÷1.4	6.9	9.3	5.9	÷2.2	÷5.4
	Maximum	25.4	26.1	7.1	27.1	27.8	41.4	7.0	15.5
Winter	Average	3.4	9.2	5.8	2.6	4.5	2.5	1.9	÷2.0
16.12.1998-	Standard	3.4	2.2	2.5	3.5	3.1	3.4	1.3	1.2
29.01.1999	Minimum	÷8.0	1.3	÷1.7	÷9.8	÷7.1	÷11.0	÷1.0	÷7.9
	Maximum	10.5	16.0	17.0	9.2	12.4	9.2	8.7	1.7

Working environment

In future years, the straw consumption of Danish pig production will rise, as the new quality mark scheme and several other branded productions require allocation of straw to the pigs.

Most pig producers can accept using masks when spreading straw in the pens or filling the straw dispensers as this task takes a relatively short time.

Normally, the use of straw in deep litter houses does not result in a higher dust level because a higher air exchange is accepted in deep litter houses and because stocking density is lower.

However, pigs given straw in partially slatted flooring houses whirl up more dust in the house, resulting in a permanently higher dust level. This requires development of new methods to bind straw dust, for one reason because very few pig producers want to wear a dust mask all day.

Addition of lignin to straw

One method of reducing dust release from straw might be the use of lignin. Lignin is a natural component of wood and a waste product from paper production and is sprayed on, i.a., dirt roads in Sweden to bind dust.

A pilot project recently concluded showed that addition of a 39% solution of lignin to shredded straw provided a 90% reduction of the tendency to dust, and a 70 and 85% reduction, respectively, of the content of endotoxins and fungus spores in the released dust.

Lignin-treated straw stored in plastic for one month, however, gave rise to increased fungus spore concentration. On-going studies will show whether storage without plastic wrapping and the use of another type of lignin can prevent spore formation during storage.

Based on the pilot project it will be decided whether a commercial plant for treating straw with lignin is to be developed.

Oil spraying in farrowing house

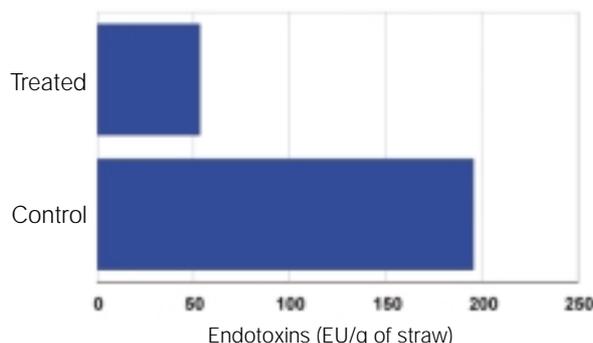
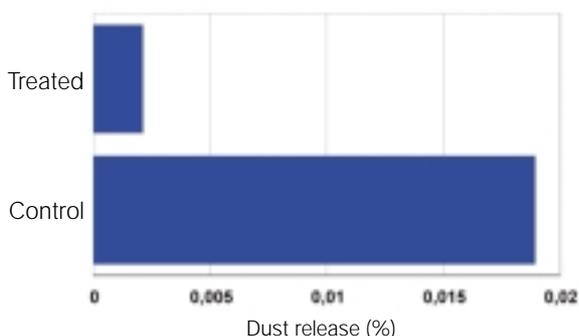
Low-pressure and high-pressure spraying systems have been tested in a farrowing house with 6 identical sections. The systems were started 3 days after the sows had farrowed, and 8 g of oil per sow was sprayed out daily.

In 19 batches, the dust and ammonia concentrations were measured twice a week. The measurements showed that the total and respirable dust concentrations were reduced

by 33 and 39%, respectively, with the low-pressure system, while the trial of the high-pressure system is not yet concluded. However, preliminary results show that it is extremely important that the pig producers and their staff do not enter the house during and right after spraying, as the liquid particles sprayed out are respirable. Pig producers who have installed high-pressure oil spraying systems in houses where staff are working most of the day are encouraged to adjust the control so that oil is only sprayed outside work hours and during lunch breaks.



Low-pressure oil spraying system in farrowing house. When the tubing is mounted over the slatted flooring and the nozzles are mounted above the pen partition at every second pen, any drips will not bother animals or humans.



Release of dust and endotoxins partly from shredded straw (control) and partly from shredded straw that has passed a dust separator and subsequently been treated with lignin.

Ammonia

With a view to improving air quality and reducing ammonia evaporation, four different designs of slurry pits were tested in a farrowing house fitted with diffuse air intake and pit ventilation.

The trial showed that the ammonia concentration in the house was markedly lower at partially slatted flooring compared with fully slatted flooring. The ammonia concentration in fully slatted flooring housing could be reduced by either an inclined bottom under the sow or a divided pit. Concerning ammonia evaporation from the house, the difference between the different designs was not so pronounced as for ammonia concentration measured inside the house.

The trial also showed that in all systems the ammonia concentration was significantly higher measured in the pit ventilation channel than in the house. Pit ventilation had the relatively largest effect at partially slatted flooring and high fan output.

Fully slatted flooring with an inclined bottom below the sow caused so much manure to heap up that it increased the summer problem of flies considerably. Therefore, this design is not recommendable.

Odour

As part of the efforts to reduce the odour level around pig housing, wind tunnel tests have been conducted with a pig house model. The purpose of the tests is to find out how to dimension ventilation outlets so the pig odour does not bother neighbours.

The model tests indicate that the combination of the conventionally low outlet height and low air velocity of ventilation outlets results in insufficient dilution of the air outside the houses and therefore, under special circumstances, odour nuisances for the neighbours. To find

Design of slurry pit	Change in NH ₃ conc. compared to change in CO ₂ conc.	
	NH ₃ -conc. inside house ppm per 1000 ppm CO ₂	NH ₃ -conc. in pit ventilation ppm pr. 1000 ppm CO ₂
Partially slatted flooring	2.2a	3.7d
Fully slatted flooring	6.3b	7.6e
Fully slatted flooring	6.7b	8.0e
Inclined bottom	3.7c	5.6f
Divided pit	4.5c	7.1e

a, b and c: significant difference ($p < 0.05$)

d, e and f: significant difference ($p < 0.05$)

solutions, wind tunnel tests have been conducted so far with the following test setups:

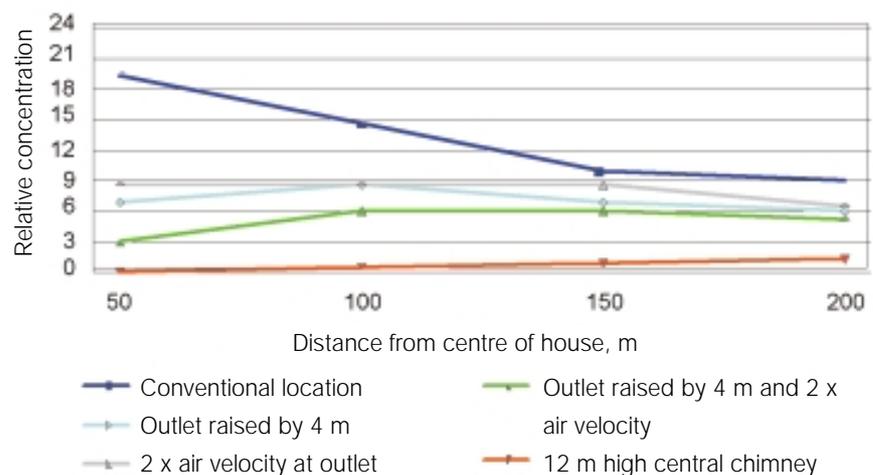
- (1) Conventional ventilation outlet (70 cm above ridge)
- (2) 12 m high central chimney
- (3) as (1), but with double air velocity (10 m/s)
- (4) 4 m increase of all outlets
- (5) combination of (3) and (4).

Preliminary results from the model tests showed that a model of a 12 m high central chimney resulted in

the relatively highest dilution. The other test setups also resulted in improved dilution compared with conventional ventilation outlets.

The results of the wind tunnel tests will later be compared with full-scale tests illustrating the effect of different solutions by means of tracer gas and artificial smoke. These results are not yet available. Furthermore, the extra costs of using the solutions found must be calculated.

Model tests in wind tunnel



Model tests conducted in a wind tunnel indicate that increased dilution of the house air discharged can be obtained by increased height and/or air velocity of the ventilation outlets.

Feeding of loose sows

Feeding with feed mixes rich in fibre once a day or ad lib. has limited or eliminated aggressive behaviour in the loose gestating sows of many herds. In addition to the fibre content and composition, it is important that the fibre-rich feed mixes also cover the basic needs of the sows for nutrients so that nutrient limitations do not reduce performance.

Nutrient limitations

During two periods in particular, nutrient limitations will affect sow performance. These periods are the first 3-4 weeks after service (affecting number of pigs born) and the last 2 weeks before farrowing (affecting piglet birthweight). Moreover, young sows/gilts must have the requisite amount of energy for growth if they are to become well-functioning sows.

Two trials of feed mixes with large amounts of soluble fibres (complete feed with liquid sugar beet waste and dry feed with 60% Pulpetter) allocated during the entire gestation period both showed that the feed entailed a reduction in litter size as well as birthweight. These negative results were due to the insufficient focus on the starch and fibre content in the feed mixes.

A trial with increasing amounts of sugar beet waste (35, 45 and 55%) and a gathering of experience in 27 herds that had fed the sows ad lib. over a long period showed that allocation of large amounts of sugar beet waste during gestation made the sows more calm, and their appetite during the subsequent nursing period was increased. The sows thus suffered a smaller weight loss during nursing.

Stable or dynamic groups

Based on trial results and experience gained, it is recommended mainly to use ad lib. feeding for gestating sows in stable groups, as it makes it easier to take the above

factors into account. At ad lib. feeding in dynamic groups it is recommended not to transfer the sows to loose housing less than 3-4 weeks after service and to move them to the farrowing house or elsewhere 2 weeks before expected farrowing.

Feed composition and change

Based on trial results and present knowledge in the field, the following feed strategy and composition of mixes are recommended for feeding fibre-rich feed mixes during gestation:

Nursing mix: Used for nursing and empty sows and young sows. Must be optimised according to the norms for nutrients for nursing sows and should contain 10-15% sugar beet pellets.

Transition mixes: Used for the first about 3 weeks after service and the last 2 weeks before farrowing, and for gilts and thin sows. Must be optimised according to the norms for nutrients for gestating sows and must contain grain so that each animal gets 200-300 g of starch every day. Moreover, a content of about 25% sugar beet pellets is recommended. The rest of the feed mix

should contain feedstuffs with a large content of insoluble fibres, such as oats, hulls, green meal, etc. Possibly a feed mix consisting of about 1/3 nursing mix and 2/3 ad lib. feed mix can be used.

Ad lib. feed mix: used from about the 4th to the 14th week of gestation for sows of normal body condition. Must be optimised according to the norms for nutrients for gestating sows and must contain grain so that each animal receives 150-200 g of starch per day. Moreover a content of up to 50% sugar beet pellets is recommended. The rest of the feed mix should consist of feedstuffs with a large content of insoluble fibres, such as oats, hulls, green meal, etc.

Future and on-going trials

The recommended composition of feed mixes and times for changing between mixes will be tested during the coming year. Also, a combination feeding will be tested in which the sows receive a basic ration consisting of concentrated feed fed via an electronic feed dispenser and roughage freely available to the sows.

Performance

Group	Ordinary gestation feed	Fibre-rich gestation feed with large amounts of wet sugar beet waste
Feeding strategy	Restricted	Ad lib.
Litter, No.	962	940
Total pigs born, No.	12.2a	11.7b
Weak pigs born per litter	0.6	0.8
Birthweight/pig, kg	1.54a	1.43b
Dead before weaning, %	10.7	12.2
Litter weight at weaning, kg	73.3	72.6
Gestation period, days	117a	116b
MMA treatment, %	7.4	4.5
Farrowing rate, %	86.1	86.0

a and b in the same row means significant difference ($p < 0.05$)

Artificial insemination

Semen sales

Semen sales from the AI stations of DanBred are increasing again. In 1998/1999, 2,439,033 semen portions were sold, an increase of 3.5% on the previous year. As the sow population has risen similar, the increase means that about 40% of all services are made with purchased semen - which is at the same level as the previous year. The proportion of internal AI rose during the period, and it is estimated that at present about 600,000 semen doses are produced in the herds, a rise of about 40% on the previous year, so that semen collected in the herds is now used for about 9% of all services. Altogether, about 49% of all services are made by AI.

Semen dilution

The last phase of a study of the long-life diluent Androhep is on-going. Mixed Duroc semen collected on Fridays and diluted with Androhep or EDTA is compared with mixed semen collected on Mondays and diluted with EDTA. The semen is shipped at the same time on Mondays for use on the same and the next day. EDTA is the diluent conventionally used.

Reproduction results (farrowing rate and total number born per litter) so far do not differ significantly between the two diluents or according to the collection time. Conclusion of the study is expected at the beginning of 2000.

Antibiotics for semen

To eliminate the risk of transmission of pathogenic bacteria at sales of semen, antibiotics are added to the semen. Denmark at present permits the use of neomycin sulphate or an antibiotics combination of streptomycin, penicillin, lincomycin and spectinomycin (or a corresponding combination with the same effect).

A herd trial with a new antibiotics combination of gentamicin and amoxycillin has been started after laboratory studies showed that the combination is effective against all generally occurring bacteria in boar semen - including Salmonella DT 104 - and that the antibiotics combination does not harm the acrosomal apical ridge and motility of sperm cells. The result of the trial is expected at the beginning of 2000.

Semen longevity and concentration

Previous studies under the Danish Applied Pig Research Scheme showed a significant increase in the number of liveborn pigs per litter at an increase in the sperm count from 2.0 billion to 4.0 billion motile sperm cells - however, 48-hour old semen was used at the first insemination (Notice 8, 15 November 1990). A follow-up on this study of day-old semen could not prove the result (Notice 229, 6 May 1992). Therefore, a new study aiming to clarify the effect of semen age and concentration on reproduction re-

sults in the same study has been initiated. Sperm cell concentrations ranging from 1.5 billion to 3.0 billion motile sperm cells are used as day-old semen or 48-hour old semen - at the first insemination. The results are expected at the end of 2000.

Boar culling according to return-to-service rates

Reported service data from breeding and multiplier herds are now processed routinely in a computer program that calculates the return-to-service rates for the individual herds and boars. The program thus prepares monthly surveys of boars with significantly higher return-to-service rates than average. These surveys are used to cull such boars from the AI stations. The program at present includes data for Large White and Landrace boars.

Semen sales in the past years from the AI stations of DanBred

	Semen portions, No.
93/94	1,605,188
94/95	1,645,151
95/96	1,728,017
96/97	1,979,781
97/98	2,358,423
98/99	2,439,033

Litter size standardization

It is necessary to adjust the litter size right after farrowing because a large number of the sows have more piglets than they have functional teats for (Figure 1). Excess piglets are moved to sows with spare functional teats (perhaps a foster sow) to ensure that all piglets get sufficient milk.

Later during nursing, a few piglets of the litter often turn out to do poorly. There are three possible reasons, with pertaining solutions.

- The piglet has no genetics for growing faster. Little can be done about it.
- The piglet is ill and requires treatment and possibly a feed supplement until it can drink again on its own.
- The piglet receives insufficient milk and is therefore moved to a sow with milk.

Finally, piglet sizes often vary at weaning. The stockman can choose to:

- wean all piglets and risk that the weakest piglets die in the controlled-climate house.
- move the weakest piglets to younger litters, thereby transmitting disease to next week's batches.

Correct litter equalisation after farrowing

The sow only lets down small amounts of milk at each nursing, so it is important that each piglet has an accessible teat. The bunt order is important for each piglet quickly to find its teat and suckle before another piglet drinks the milk or the sow moves. The teat order is

established during the first days after farrowing, and once the teat order is established, no new piglets should be moved to the sow. This would result in new fights to get these piglets established in the order (Figure 2).

There are two theories for litter size standardization

- to standardise the individual litters to a uniform piglet weight.
- to move as few piglets as possible. Some difference in size means that fights for power are quickly decided.

The latter strategy saves time and creates the least possible infectious contact between litters, as only superfluous piglets being moved. An on-going trial indicates that the weaning weights at the two strategies do not differ (Table 1).

Moves and use of foster sows at different numbers of piglets per litter

Foster sows command pen space in return for expected better gain and survival. A herd with a litter size of 11.4 liveborn piglets has the following need (see Figure 1):

- at 12 piglets per litter, on average 7 piglets need to be moved from 3 litters per 10 farrowings. Normally, no foster sows are needed.
- at 11 piglets per litter, on average 10 piglets need to be moved from 5 litters per 10 farrowings. On average, 1/2 foster sow is needed per 10 farrowings.
- at 10 piglets per litter, on average 19 piglets need to be moved from 7 litters per 10 farrowings. On average 1 1/2 foster sow per 10 farrowings are needed.

Table 1: Effect of standardising the litter to only large, medium or small pigs versus moving the pigs as little as possible (data from 2 herds)

Group	Complete standardisation	Least possible moving of pigs
Litters, No.	220	270
Liveborn pigs/litter	11.3	11.4
Number at weaning	10.0	10.2
Weaning weight/pig, kg	6.2 (+/- 1.1)	6.2 (+/- 1.2)



Runs

It costs about 600 g per piglet to replace a runt with another piglet later than day 2 after birth (Figure 2). If the alternative is that the runt dies, the risk of a lower weaning weight is acceptable, but otherwise moving of piglets after 2 days should be avoided unless they are placed with a foster sow after day 2.

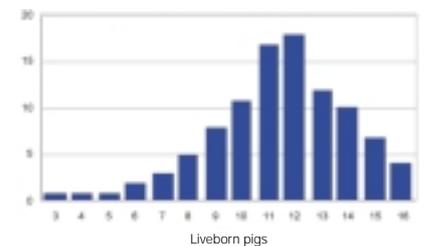


Figure 1. Distribution of litter sizes in herd with 11.4 liveborn piglets.

Effect of age at moving of pigs (853)



Figure 2. Effect of age on weaning weight at moving of piglets.

Piglets moved at most 24 hours after birth manage just as well as pigs not moved.



Fermented liquid feed

In recent years, interest concerning fermented liquid feed has been increasing, as it is assumed to have a beneficial effect on pig health and welfare. However, preliminary results show that it may result in decreasing performance if the course of fermentation is not optimum.

Previously, the advantage of liquid feeding was that of being a feeding method where cheap liquid raw materials could be used, such as whey, brewer's yeast, food waste. After the decision to eliminate antibiotic growth promoters from feed, fermented liquid feed has received more focus as a possibility of ensuring good gastrointestinal health in the pigs. Projects have therefore been initiated to clarify how, in practice, it is possible to obtain and control well-functioning fermentation of liquid feed for both weaners and finishing pigs.

Weaners

Danish and foreign laboratory studies on fermented liquid feed for weaners have promised well concerning the gastrointestinal flora, daily gain and feed intake of the pigs. The beneficial effect of fermented liquid feed is assumed to be due, mainly, to a high content of lactic acid bacteria producing lactic acid, which makes the pH fall.

These studies indicate that the pH in fermented liquid feed should be between 4.0 and 4.5. The temperature of the liquid feed should be around 20°C for an optimum fermentation process. Lower temperatures inhibit fermentation.

In an on-going trial of fermented liquid feed for weaners in one herd, it has been found, contrary to expectations, that fermented liquid feed may negatively affect the pigs' feed intake and daily gain if the fermentation process is not optimum. The fermented liquid feed was pro-



Future trials will show how to obtain optimum control of the fermentation of liquid feed.

duced for this trial by filling fresh feed into the tank once a day after the last feeding and by having a residual amount in the tank of about 50% of the mix. There was also a residual amount in the tubing of about 20% of the feed amount in the tank after filling. The temperature of the liquid feed averaged 19°C, and the pH was 3.9.

The fermented liquid feed was tested for pigs aged 6-12 weeks. Compared with pigs receiving non-fermented liquid feed (pH 5.3), feed intake was 19% poorer and daily gain 27% poorer.

The poor feed intake may be caused by excessive acidity of the feed (pH too low), but another hypothesis is that the fermentation has caused the formation of other flavours than acids that may have a negative influence on feed intake. The fermentation also caused a reduction of the lysine content of about 25%, probably because the microorganisms degraded synthetic lysine added to the feed.

These results show that it is important to be able to control the fermentation. As yet it is not clear how to obtain this in practice, but future studies will clarify this. Matters of

potential importance to fermentation are choice of raw materials, content of synthetic amino acids, soaking time, residual amount and temperature of the liquid feed. Until these factors have been clarified, it is recommended to be careful with fermentation of liquid feed for weaners, especially when the mixes used have a high content of synthetic amino acids.

Growers-finishers

A trial of fermented liquid feed for finishers has been planned. The trial is to clarify how fermented liquid feed can be produced based on home-mixed feed and purchased industrial feed. Another object of study is whether a positive effect can be obtained by fermenting only part of the feed components of home-mixed feed.

The trial is part of a development project carried out together with Big Dutchman, Funki, Skiold Datamix, Biotechnological Institute and the Danish Institute of Agricultural Sciences.

Phase feeding for finishers

With phase feeding, the feed is adapted to the average need of the pigs over short growth ranges (phases), such as 30-49 kg, 50-69 kg and 70-100 kg. The prevailing strategy in Denmark is feeding with one mix for finishers in the growth range 30-100 kg (called single mix below). It is adapted to the average need of the pigs over the growth range 30-100 kg. As the need for, i.a., amino acids per FUs is greatest when the pigs are small, they will be undersupplied in the first part and oversupplied in the last part of the growth range. This applies both to phase feeding and to the single mix.

It is not known whether the pigs can compensate for the undersupply when they get to the last part of a growth range. If this ability for compensatory nutrient conversion is sufficiently good - and trial results seem to indicate this - phase feeding is in principle unnecessary from an economic point of view.

A trial has been carried out of 3-phase feeding according to the recommended norms compared with the single mix. In relation to the single mix, this type of phase feeding gives about 4% less nitrogen discharge and about 6% less phosphorus discharge provided feed conversion does not change.

The trial, which was carried out in three herds with dry feed, showed no significant difference on production economy.

The current average feed price for the three herds was DKK 107 for the single mix and DKK 106 per 100 FUs as a weighted average of the three phase feeding mixes. A requirement of low crude protein content in the final mix and thus greater consumption of free amino

acids contributes to the small price difference. The same raw materials were used in all three mixes within a herd. No doubt, it is possible to save money on the final mix by using cheaper raw materials, but performance might also be negatively affected.

Based on the trial it is recommended to use phase feeding only where no extra investment is required, such as for liquid feed and multisite, unless special circumstances (such as problems of diarrhoea) favour phase feeding.

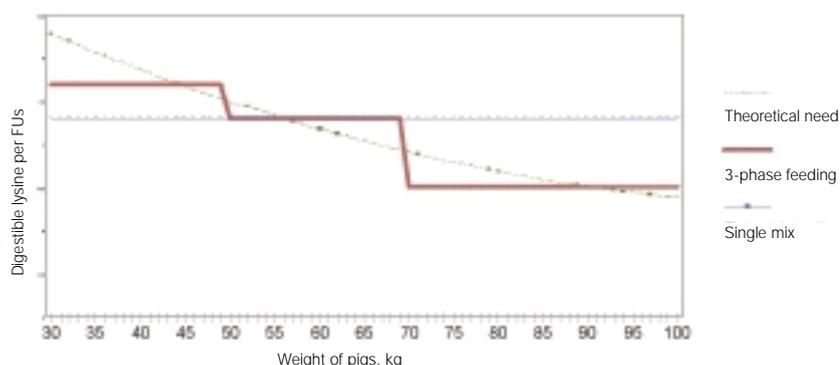
A minor study has also been performed of using ground wheat exclusively as the only feed for finishers from about 75 kg (Experience

No. 9811). This piece of advice was given to pig producers for a period by some consultants outside the farming associations. The background was the large drop in settlement prices.

The final mix (wheat) constituted about 42% of the feed consumption. The use of 3-phase feeding with wheat as the "final mix" resulted in a drastic deterioration of performance (122 g of daily gain less, extra feed consumption of 0.53 FUs per kg of gain and the lean meat content fell by 2.9 percentage points). Although there were savings of about DKK 0.19 per FUs across the entire growth period, still about 60% of the gross margin was lost!

Effect of 3-phase feeding against single mix

	Single mix	3-phase feeding
Distribution of phase feeding mixes		Start: 23.8 pct. Middle: 30.0 pct. End: 46.2 pct.
Repeats (finishers produced), No.	127 (2,466)	122 (2,394)
Daily gain, g	870	875
FUs/kg of gain (provisional figures)	2.80	2.79
Lean meat content, %	60.3	60.0
Production value/pen place/year, Index	100	100



Feeding of finishers

Liquid vitamins and minerals

Liquid feed with a liquid vitamin pre-mix including phytase, micromineral pre-mix and phosphoric acid was tested in one finisher herd (Report No. 425). The liquid pre-mixes were added direct in the mixing tank. The trial included the following groups

- Liquid feed with dry vitamin and micromineral pre-mix and phosphorus - 100% of norm (control)
- Liquid feed with liquid vitamin/phytase pre-mix (80% of norm and 100 FTU per kg of dry feed, respectively) and liquid micromineral pre-mix and phosphoric acid (63-97% of norm).

Use of the two different types and levels of vitamin/micromineral pre-mixes for finishers in the weight range 40-100 kg did not result in any difference in production value.

Nor was there any difference between the content of vitamins and microminerals in liquid feed sampled at the mixing tank compared with the mineral content in liquid feed sampled at the most remote nipple. It was found that use of a liquid micromineral pre-mix resulted in more homogeneous feed mixes meaning that the dosing of liquid pre-mix was more accurate/homogeneous than when a dry pre-mix was used.

The conclusion was that liquid pre-mixes with vitamins, phytase and minerals added direct to the mixing tank at a reduced dosage compared with the norm can replace an ordinarily used dry vitamin/micromineral pre-mix and phosphorus.

The trial was carried out together with LEO AGRO and Big Dutch-



Feed waste from three different feeders was determined by placing the feeders on a collection tray. The feed waste varied between 0.6 and 1.9% of the amount of feed allotted. The waste depends very much on feeder type and management, such as adjustment of feeders.

man, which supplied all vitamin and mineral pre-mixes and the dosing equipment used, respectively.

Feed waste from dry feeders

The amount of feed waste was determined for three different types of feeders (Report No. 435): a simple feeder (SK 70, Egebjerg), a single-space feeder (Groba, Diplommat) and a tube feeder (MaxiMat, Echberg). The feed waste was collected in trays placed under the feeders. The trays covered 21% of the total pen area.

The feed waste compared with feed consumption was greatest when the pigs were small (1.3% at 30 kg), and decreased with the age of the pigs (0.8 and 0.7% at 55 and 90 kg, respectively).

The feed waste varied between 0.6 and 1.9% of the amount of feed allotted. At an average weight of 30 kg, the pigs spilled 1.9% of the feed when fed from SK 70, which was more feed than when they were fed from a Groba or a MaxiMat, where they spilled 1.1 and 1.0%, respectively. At 55 and 90 kg, there was no difference in feed waste from the different feeders. There was no difference in feed waste between Groba and MaxiMat regardless of the pigs' age/weight.

Effect of energy in the weight range 55-100 kg

	Females		Castrates	
FUs/kg	1.13	1.02	1.13	1.02
Daily gain/g	956	860	1073	977
FUs/kg of gain	2.94	2.96	2.95	2.95
Lean meat content	59.7	60.1	57.3	58.6

Effect of lysine in the weight range 55-100 kg

	Females		Castrates	
Digestible lysine g/FUs	6.8	5.8	6.8	5.8
Daily gain/g	909	907	1028	1022
FUs/kg of gain	2.92	2.98	2.91	2.99
Lean meat content	60.1	59.6	57.7	58.1

Rapeseed meal

In terms of price, rapeseed meal will almost always be an attractive alternative to soybean meal as a source of protein in finisher feed. But rapeseed meal contains substances that may inhibit growth. In a study, rapeseed meal was given in increasing amounts to finishers. The study showed a decrease of the production value with increasing amounts of rapeseed meal in finisher feed. This is due to decreasing daily gain and increasing feed consumption.

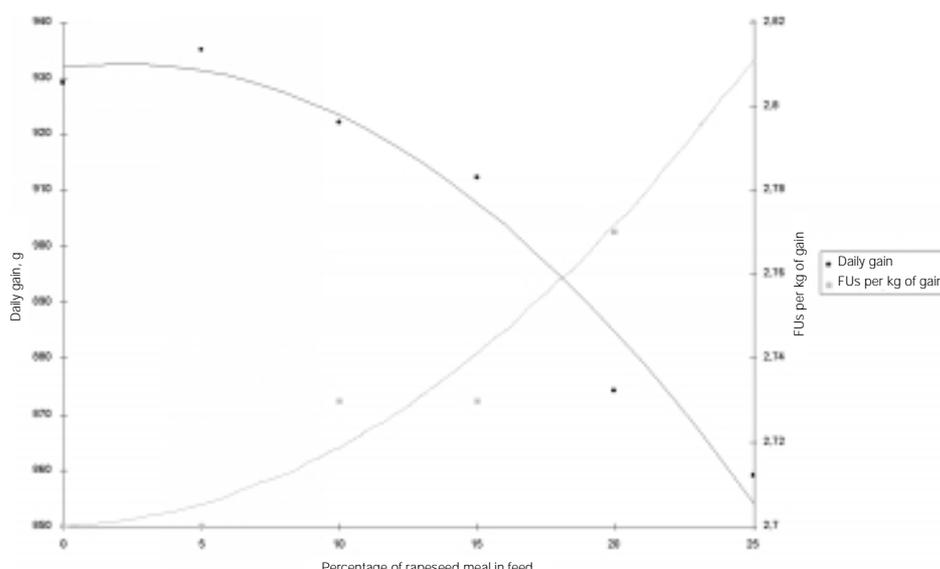
Use of a certain amount of rapeseed meal in finisher feed must thus be based on a lower feed price that can balance the lower productivity.

Energy and protein at gender-divided finishing

Herds with a good health status may have problems with a too low lean meat content when feeding ad lib. during the last part of the finishing period, especially for castrates. In several branded productions, the pigs only obtain a bonus if the lean meat content is above 57% - it is thus of great economic importance to get as many as possible above this limit. A trial has been carried out with gender-divided finishing of the pigs, testing at the same time two energy levels and two protein levels in the range from about 55 kg until slaughter at about 100 kg. The results appear from the table.

The results show that a lower energy content decrease daily gain and increase lean meat content. The effect on lean meat content was largest for the castrated pigs. The effect of the amino acid level was small, but the highest level yielded the best feed conversion. The trial

does not give rise to a general recommendation for gender-divided finishing, but in some herds it might be relevant to divide genders and give castrates a special mix with a lower energy content the last month before slaughter.



Feed without growth promoters

The consumption of antibiotic growth promoters for pigs dropped by 54 per cent from 1998 to 1999 because 99.9 per cent of pig producers supplying the Danish cooperative slaughterhouses concluded a voluntary agreement to cease the use of growth promoters for pigs of +35 kg. The agreement took effect on 1 March 1998. This agreement has thus been a success in reducing the consumption of antibiotic growth promoters. An action plan has now been initiated to stop the use of antibiotic growth promoters for weaners at the turn of the year 1999-2000, eliminating antibiotic growth promoters from Danish pig production.

Elimination of growth promoters from feed may result in a higher incidence of diarrhoea and poorer production results. Several trials have therefore been conducted to illustrate the scope of problems caused by elimination of growth promoters from feed and to find alternatives to antibiotic growth promoters.

Ceased use of tylosin for growers-finishers

Ceased use of the growth promoter tylosin for finishers was studied in five herds. Different effects of the use of tylosin were found in the individual herds. Four of the herds exhibited a positive effect on the gross margin of 3-4 per cent, while the fifth herd exhibited a negative effect of 13 per cent. A negative effect of tylosin was also found previously in a single herd in a trial including four herds. (report No. 100 from the *Danish Applied Pig Research Scheme*, 1986).

In two of the herds, tylosin had a positive effect on manure consistency, abnormal manure being

found in fewer pens especially during the first two weeks after entry in the growers-finisher house. The other three herds showed no clear effect of tylosin on manure consistency.

The Danish Veterinary Laboratory tested manure samples for *Lawsonia intracellularis*, which may cause enteritis. Preliminary reports show that tylosin reduces the number of pigs infected by *Lawsonia intracellularis*, especially during the first three weeks of entry in the finisher house.

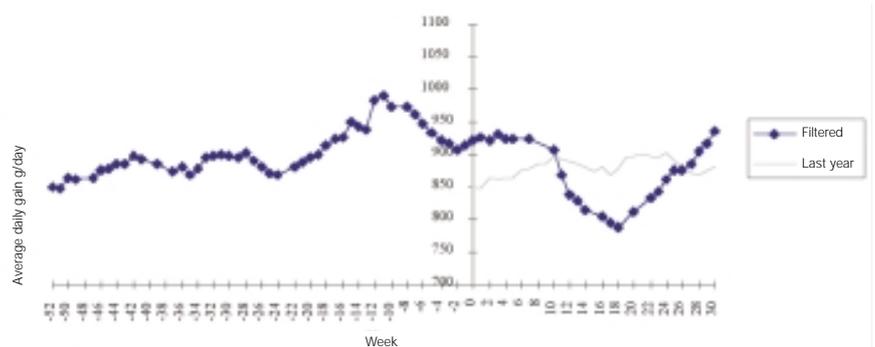
The Danish Veterinary Laboratory also tested manure and blood samples for *Salmonella*. Preliminary reports show that tylosin apparently has no demonstrable effect on *Salmonella*.

Gathering of experience

Experiences have been gathered from 62 growers-finisher herds that have ceased the use of growth promoters. Most of the participating

herds (about 65 per cent) experienced no problems of reduced daily gain or increased incidence of diarrhoea caused by eliminating growth promoters from the feed. About 25 per cent of the herds experienced a temporary drop in average daily gain at cessation of growth promoters, presumably due to a temporary microbial imbalance in the gastrointestinal tract of the pigs. About 10 per cent of participating herds saw persistent problems of diarrhoea and/or reduced daily gain, presumably due to elimination of antibiotic growth promoters from the feed.

Thus, elimination of antibiotic growth promoters in feed for growers-finishers generally caused no problems for most of the herds participating in the gathering of experience. More studies have been initiated to illustrate whether the use of growth promoters for weaners can be stopped just as easily.



About 25 per cent of the growers-finisher herds experienced a temporary drop in daily gain on elimination of growth promoters from the feed, presumably due to a temporary microbial imbalance in the gastro-intestinal tract of the pigs. The figure shows an example of a gain graph for one herd. The graph is compared with a corresponding gain graph from last year. The herd ceased the use of growth promoters on 1 March 1998 (week 0).

Product trial

During the past year, a total of 23 commercial products for weaners and finishers have been tested as alternatives to antibiotic growth promoters. This totals almost 70 products that have been tested by the National Committee.

Which products work?

The tables show the products tested during the past year.

Four out of 16 products tested for weaners had a positive effect on production value. One product (Ecosan), however, increased the number of treatments for diarrhoea. The other products with a positive effect on production value contained organic acids.

Results again confirm that acid products appear to have a good effect on weaners.

For finishers a total of seven products were tested, of which one plant extract (new-add-II) produced a significantly higher production value compared to the control group.

None of the products for weaners or finishers were able to reduce the number of treatments for diarrhoea significantly.

Commercial products for weaners tested during the past year. Effect on production value and number of treatments for diarrhoea compared with a control group. Only significant differences ($p < 0.05$) are stated

Company	Name of product (dose, %) ¹⁾	Effect on prod. value	Diarrhoea treatment	Notice No.
Chemvet	Zoo-lac (0.05)	-	-	407
BASF	Luprocid (0.6)	Better	-	409
BASF	Luprocid (0.6) + Natuphos (0.013)	Better	-	409
BASF	Natuphos (0.013)	-	-	409
Int. de Premezclas	Ecosan-premix (12.0+4.0+1.5) ²⁾	Better	More	411
The local co-op	Fructomix (0.03)	-	-	411
Beifa	BEP (0.1)	-	-	411
Medipharm	Lactiferm (0.08/0.02)	-	-	416
Superfos	Lafeed 80 (2.0/1.0)	Better	-	428
CO&S	Igalac (1.5)	-	-	433
den lokale andel	Bokashi F (1.0)	-	-	433
LAH	ToyoCerin (0.1)	-	-	436
LAH	Carniking (0.006/0.004)	-	-	436
LAH	Toyocerin (1.0)+ Carniking (0.006/0.004)	-	-	436
Øta-kompagniet	Fresta F (0.05)	-	-	436
Natura Vet	Endosan Fravænningspulver (0.3/-) + Endosan D (-/0.45)	-	-	436

¹⁾ When two doses are stated, the first dose is for the weaning feed (age 4-6 weeks) and the second dose is for the end feed (age 6-10 weeks).

²⁾ Three different pre-mixes were used during the trial period.

Commercial products for finishers tested during the past year. Effect on production value and number of treatments for diarrhoea compared with a control group. Only significant differences ($p < 0.05$) are stated

Company	Name of product (dose, %) ¹⁾	Effect on prod. value	Diarrhoea treatment	Notice No.
Nutriscan	Bact-acid (0,3/0,25)	-	-	402
Nutriscan	Modificeret Bact-acid (0,3/0,25)	-	-	402
The local co-op	LA-Mix (0,5)	-	-	415
The local co-op	Biofos (0,05)	-	-	419
The local co-op	new-add-II (0,2)	Better	-	419
Øta-kompagniet	Aromex (0,03)	-	-	431
Alltech	Bio-mos (0,1)	-	-	431

¹⁾ Where two doses are stated, the first dose is for the weight range 30-55 kg and the second dose is for the weight range 55-100 kg.

Progress report on *Salmonella* control

The incidence of the multi-resistant *Salmonella Typhimurium* DT 104 has characterised the *Salmonella* debate to a high degree this last year - some times to such an extent that the general efforts of the pig industry against other types of *Salmonella* seem forced to the background. However, this is far from the case, as the efforts against ordinary *Salmonella* types have continued at undiminished strength.

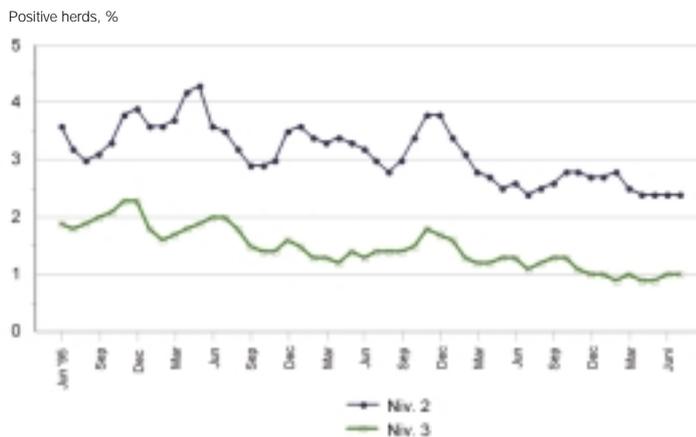
Primary production control

The proportion of finisher herds requiring guidance, i.e. Level 2 and 3 herds, has been steadily falling over the past year. For the first time since the start of monitoring, the proportion of Level 2 herds was stable below 3%, and the proportion of Level 3 herds was below 1% for the first time. The incidence of *Salmonella*-positive herds has halved since 1994, which was also confirmed by the national screening for DT 104, mentioned separately on the next page.

Every month thus sees 150-170 Level 3 herds for special slaughter with subsequent microbiological studies of swab tests from the carcasses. If 25% or more of the samples test *Salmonella*-positive, the entire lot must be heat treated or salted, resulting in considerable costs for the slaughterhouse.

The vast majority of the finisher herds in Denmark (75%) has only been at Level 1 since monitoring started in 1995. Of the remaining 25% of the herds that have been designated for Level 2 or 3, 75% of them have only received 1 or 2 orders to procure guidance, which

Serological *Salmonella* monitoring
Percentage breakdown of Level 2 and 3 herds
June 1995 - July 1999



must be considered absolutely satisfactory. On the other hand it is not satisfactory that 14% of the herds with *Salmonella* problems have had more than 4 orders on *Salmonella* control. Thus, about 20 herds have received 8 orders since 1995. These few herds have cost a lot of money for the pig industry and will continue to do so unless a special effort is made to solve the *Salmonella* problems.

Guidance corps

To reduce the number of Level 3 herds with repeated *Salmonella* orders, the National Committee established a special *Salmonella* guidance corps in the autumn of 1998. The corps consists of 5 pig production consultants and 5 pig veterinarians and are deployed to Level 3 herds with 4 or more *Salmonella* orders within the past 3 years. The pig producer pays all expenses in connection with the guidance. Since establishment of the corps in October 1998 and until July 1999,

77 finisher herds have been designated for the guidance corps.

Slaughter deduction

From October 1999, finishers from Level 3 herds will have the following percentages deducted from the slaughter value:

Period at Level 3	Percentage of slaughter value per finisher delivered
First 3 months	3%
4-6 months	6%
7- months	9%

When the herd again gains a lower level, it must be out of Level 3 for 12 consecutive months, otherwise the deduction system counts on from the latest position at Level 3.

Breakdown of finisher herds by *Salmonella* Levels 1, 2 and 3 in May 1999

Period	Level 1		Level 2		Level 3		Total
	Number	%	Number	%	Number	%	
May 99	15,551	96.6	406	2.5	147	0.9	16,104

Processed goods monitoring at slaughterhouse

Every month about 2,200 pieces of fresh pigmeat and offal are tested for *Salmonella*.

In 1998, *Salmonella* findings averaged 1.2% of the fresh pigmeat, which is at the same level as the preceding 3 years since the start of the *Salmonella* action plan.

The pig industry has agreed with the Minister for Food to reduce the incidence of *Salmonella* in fresh pigmeat to a stable incidence of less than 1% at the end of 1999 and less than 0.5% at the end of 2001. Attempts are made to achieve this by continued efforts, both in the primary production and in the slaughterhouse sector.

Recent years' activities concerning reduction of *Salmonella* at herd level have concentrated on the effect of feed and the importance of weaner status at transfer to finisher housing.

Heat treatment and pelleting

A trial (Notice No. 426) has been performed aiming to clarify the effect of degree of grinding, pelleting and expansion on the proportion of *Salmonella*-positive finishers. Moreover the effect on performance and gastrointestinal health was examined. The trial showed that:

- pelleted food resulted in a higher incidence of *Salmonella* than non-pelleted food
- finely ground feed resulted in a higher incidence of *Salmonella* than coarsely ground feed
- meal feed resulted in the best microbial ecosystem in the pigs' gastrointestinal system

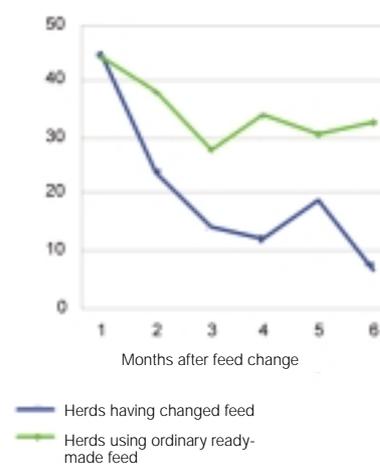
- meal feed and the expanded feed resulted in the best gastric health, whereas finely ground pellets resulted in the poorest gastric health
- finely ground pellets resulted in the best production value, whereas non-pelleted feed resulted in the poorest production value.

Altogether the trial showed that the feed mixes that reduced the incidence of *Salmonella* and/or had a positive effect on the microbial ecosystem affected performance negatively.

Ready-made feed with partial heat treatment

The effect of changing the feed from pelleted ready-made feed to feed where part of the grain is not heat treated and pelleted was studied. The analysis included 14 test and 20 control herds all having problems with *Salmonella*.

Feed where part of the grain was not heat treated and pelleted reduced the incidence of *Salmonella*. Not all test herds reached *Salmonella* Level 1 after 6 months, which indicates that *Salmonella* problems cannot always be solved via feed changes alone.



Use of feed where part of the grain is not heat treated reduces the incidence of *Salmonella*.

No one type of feed ensures both the lowest incidence of *Salmonella* and the best production economy at the same time

Group	Fine pellets	Coarse pellets	Cold-pressed pellets	Expanded feed	Meal feed	Partially heat-treated feed
<i>Salmonella</i>						
Positive, %	12.9	5.6	8.6	4.6	2.8	4.6
Production value						
GM/pen place/year, DKK 379a	315b	318b	241c	253c	270c	
Index	100	83	84	63	67	71

a, b, c: Different letters indicate significant difference

Progress report on *Salmonella* control

Correlation between Salmonella status of selling and buying herds depending on buyer's feed source

Buyer's feed source	Positive meat juice samples of seller, %	Buyer herds at Level 3, %
Ready-made feed	Over 10%	26%
Ready-made feed	Under 10%	5%
Home-mixed	Over 10%	4%
Home-mixed	Under 10%	0%

Importance of weaners for Salmonella level of finishers

The importance of purchasing weaners from *Salmonella*-infected herds has been studied. The study included data from the meat juice monitoring in 371 herds that both sold weaners and produced finishers.

If the selling herd had more than 10% positive meat juice samples among its own finishers over a one-year period, then the buying herd had a 7 times greater risk of being at Level 3 (more than 33% positive samples). The effect of purchase penetrated most in herds using ready-made feed, but the effect was also visible among home-mixing herds (see table).

A study is now being initiated to clarify the *Salmonella* status of weaners and study the importance for *Salmonella* status in the subsequent finisher period.

Blood sampling of sows

A small study found a correlation in sow herds between incidence of *Salmonella* in pen floor samples in the weaner house and positive blood samples from the sows. Based on these preliminary results, a study is being made in further 50 herds to confirm this correlation.

Eradication of the first 15 DT 104 herds

In spring 1997, the pig industry decided to eradicate the first 15 herds infected with the multi-resistant *Salmonella Typhimurium* DT 104. All 15 herds have now been successfully eradicated, 11 continue as pig producers with the same production as before eradication, while 4 chose to stop their pig production. The herds that stopped were all very small herds where pig production was either more of a hobby or a small part of the entire farm. The conclusion is that the pig industry now has a reasonably safe method of eradicating the DT 104 infection from a pig herd.

How many DT 104-infected herds does Denmark have?

To maintain an eradication strategy against DT 104, the number of infected herds must be low, partly because eradication is expensive, DKK 100,000 to 5 million depending on herd size, partly because it must be feasible in practice.

It is known from the *Salmonella* monitoring, both in primary production and at slaughterhouses, that the incidence of DT 104 is extreme-

ly low. Thus, until July 1999, only 28 DT 104 pig herds have been found, numbering 16 pure pig herds and 12 combined cattle and pig herds. Moreover, DT 104 has been demonstrated in 2 pure cattle herds near Brædstrup in Jutland.

To obtain a very high degree of certainty of the number of DT 104-infected herds, the Minister for Food, together with the pig and cattle industry, decided in summer 1998 to screen the pig and cattle herds of Denmark. On the pig side, all 366 breeding and multiplier herds, 305 weaner producing herds and 1,962 finisher herds were screened for DT 104. The screening was carried out in the period from July 1998 to March 1999. DT 104 was only found in 1 finisher herd, an incidence of DT 104 of 0.05% of the finisher herds of Denmark. The screening thus confirmed the prior opinion that the DT 104 incidence is very low.

Eradication strategy continues

Based on the screening result, the National Committee and the Federation of Danish Pig Producers and Slaughterhouses decided to continue the eradication strategy for the moment. In spring 1999, new guidelines were drafted for DT 104 eradication aid, according to which the pig industry in principle compensates for operating loss while the pig producer pays the costs of cleaning, disinfecting and any alteration of housing.

PRRS partial eradication

In a project with local advisers, the National Committee has monitored a number of PRRS-positive sow and finisher herds from 1997 to 1999. Results and experience have been gathered concerning check-up and eradication possibilities for PRRS, and on this basis follow some general directions:

The acute phase of infection

PRRS infection of the PRRS-free herd may cause problems of still-born and weak piglets in sow units. Especially infection during gestation or farrowing housing periods seems to cause problems. In piglets and weaners, problems of controlling the bacterial infections present may arise. PRRS-infected herds will usually re-stabilise to normal productivity in 1-6 months. Due to immunity developed in the herd, the stable sow population weans PRRS-negative pigs.

Persistent problems in the herd may be due to inappropriate layout of the unit or entry of susceptible breeding animals which are persistently infected at a problematic time. Operational changes and building alterations are necessary in such cases.

Strategy

PRRS has probably come to stay, but spreads at varying speeds between regions and over time. Based on the observations of recent years, the risk of infection of the herd must be assessed at between 4 and 8% a year.

Planning of the future development of a herd is important, and the herd owner should assess sources of infection together with his advisers.

Overall there is a choice between 2 strategies: (1) Keeping the herd infected and stable or (2) eradicating the herd. If (1) is chosen, the stable positive sow population will be protected against new infection, but requires special housing layout and herd operation. Layout requirements may be further tightened depending on whether the goal of the herd is merely acceptable productivity in the sow unit or exploitation of the fact that the stable sows wean negative pigs. If (2) is chosen, the eradicated herd will be susceptible to new infection from outside with pertaining production loss.

The infected and stable herd

Chronically infected sows

Chronically PRRS-infected sows typically achieve productivity corresponding to that prior to infection. Recruitment of PRRS-positive gilts is the key to persistently protected positive sows without production losses. With chronically infected sows, infection of sow to piglets is limited. The most important spread of infection is made in grower sections where weaned negative pigs meet continuous operation.

Sow units recruiting positive gilts infected at the age of 2 to 5 months can usually enter these gilts in the unit around service time without any problems.

Consistently sectioned herds and weaner-selling sow units may experience the paradox of finding it difficult to maintain a PRRS infection among the gilts. Purchase of positive gilts from a supplier herd with the same PRRS status is an alternative possibility that should be upgraded. Breeding stock-selling herds with continuous operation in grower sections can produce PRRS-positive gilts more easily.

PRRS-positive stabilised sow unit

The herd can exploit the fact that the stable positive sows wean non-infected pigs. The goal will be positive sows with protection and exploitation of the negative weaned pigs in the finishing unit. The sows should be housed completely separately from the grower units. The separation may consist of sectioning, separate houses or multisite systems.

Positive gilts as well as gilts infected in own grower units should only be entered in the sow unit after a quarantine period of 8 weeks. This model requires a corresponding age spread of 8 weeks of gilts at quarantining. Alternatively, two quarantine sections can be used with monthly entry and emptying every 8 weeks.

The experience from stable sow units is that they can recruit positive gilts and still wean negative pigs over periods of several months to years. Weaned pigs can be kept negative through the controlled-climate and finishing periods when they are sectioned and run as an all in/all out batch operation. The consequences, should a positive weekly batch of weaned pigs occur, can furthermore be expected to be limited to the grower sections.

PRRS partial eradication

Partial eradication of herd

The genes of the herd can be saved and the operating loss reduced through partial eradication rather than total eradication. A partially eradicated herd weans negative pigs and enters negative breeding stock. After a check-up period, such a herd can be declared PRRS-free by partial eradication with sero-positive sows in the herd.

Results from the partial eradication project

The partial eradication project has monitored partial eradication attempts in 23 sow herds and 8 finisher herds. 18 eradication attempts of 23 sow units were considered successful, and 5 eradication attempts of sow units failed. 22 are completely concluded. 6 of 8 finisher herds succeeded, and all are completed.

Most of the eradication attempts in sow units were carried out as 'Swiss' eradications (eradication model for mycoplasma hyopneumonia) and included several respiratory diseases to obtain the greatest possible gain from the eradication attempt. A few of the herds monitored eradicated PRRS purely by gilt recruitment, building alterations or operational changes.

Partial eradication of sow herds

The process consisting in first stabilising the sows after a natural through-infection of the sows and unidirectional weaning of pigs away from the sows were carried out. Gilt recruitment was stopped or PRRS-positive gilts entered, either own replacements or positive purchases. Negative gilts were immunised in grower sections or the quarantine itself. Quarantining after infection lasted for at least 2 months.

As persistent weaning of PRRS-free pigs is the basis for a successful partial eradication attempt, this was checked by blood samples. The eradication attempt has good chances of success if it is possible persistently over a check-up period of 3 months to produce weaned pigs (10-12 weeks old) without antibodies and demonstrate a falling antibody level in the sows. In herds with poor sectioning so that piglets and newly weaned pigs must be deemed to meet PRRS infection, blood samples cannot be assessed. An alternative solution in these cases was emptying the herd of weaned pigs and growers over a period of 3 months before the time of eradication.

The actual eradication procedure consisted in emptying grower and finisher sections over a period of up to 2-3 months. Poorly sectioned herds emptied grower sections earlier than well-sectioned herds. The time of eradication comprised a period of 1-2 weeks where the herd was empty of weaned pigs and possibly also piglets (farrowing stop). The last positive breeding animals were also entered in the sow unit at the time of eradication.

After the time of eradication, PRRS-negative breeding stock was recruited, either purchased or own replacements after the time of eradication. During the project, the check-up consisted in using the negative breeding animals entered and weaned pigs older than 3 months as test animals. Test animals must be available in all sections of the herd and keep PRRS-free during the check-up period of one year.

PRRS is a virus infection in pigs. The infection settles in the respiratory system, but can also settle in other organs with resulting excretion as a manure-transmitted or sexually transmitted infection. After infection, the pigs can carry the PRRS infection for periods of varying lengths.

Partial eradication of finisher herds

Partial eradication of finisher units has also been carried out. At consistent batch operation, PRRS can be partially eradicated out of a sectioned finisher herd when sections of negative pigs entered are separate and infection from the older PRRS-positive sections is avoided. It is vital that the sections can be filled, cared for and emptied without direct contact or joint ventilation with the infected sections. The eradication attempts are considered a success if the finisher herds can be kept negative over an emptying cycle of 3 months after removal of the last positive section.

Lawsonia - porcine intestinal adenomatosis

Porcine intestinal adenomatosis (PIA) has been known for the past 20-30 years, but only a few years ago *Lawsonia* was found to be the central cause of the disease. PIA is an overall term for 4 different forms of the same disease that may occur in the pig's small intestine.

Studies show that *Lawsonia* is widespread in Danish pig herds (over 90% are infected). Not all infected herds experience problems of disease, but an estimated 20-30% of herds experience varying degrees of problems every year.

Disease in the pigg house

Normally, a greyish, mushy diarrhoea is seen in pigs already 3-4 weeks after weaning. Few pigs die, but feed conversion and daily gain are reduced. Most pigs will recover in 4-6 weeks. In some pigs the disease will develop and make them chronically unthrifty and emaciated. Some pigs become so emaciated that they have to be destroyed. The bloody variety of the disease, proliferative hemorrhagic enteropathy, presents as a sudden fatal disease without prior symptoms.

Development of the disease

A new study has looked at development and infection factors of *Lawsonia*. The study showed that about half the pigs infected with a large amount of *Lawsonia* developed diarrhoea 2 weeks after the infection - a diarrhoea that lasted for 1-2 weeks. Pigs infected with a small amount of *Lawsonia* got no diarrhoea. Upwards of half the pigs excreted *Lawsonia* in the manure from 2 weeks up to 10 weeks after their

infection. This means that a pig infected at weaning can pass on the infection to both growing and finishing units relatively unnoticed. Since the disease need not become visible although the pigs are infected, it can also easily spread between herds through sales of animals.

Studies indicate that feed composition and feeding strategy, heat, cold and mixing of pigs are contributory reasons for development of the disease in pigs infected with *Lawsonia*.

Lawsonia in the environment

How long *Lawsonia* can survive in the environment is not known with certainty. Some studies indicate that the bacteria can survive for up to 2 weeks outside the pig. Several other animals have a regional intestinal infection similar to that of the pig. Also here, *Lawsonia* bacteria are thought to be the cause. *Lawsonia* bacteria, largely the same ones as those of the pig, have been demonstrated in rabbits, ferrets, horses and roes abroad. Whether other animals play a part in spreading *Lawsonia* from herd to herd is as yet unknown.

How to diagnose the disease

New examining methods have just been developed for showing the bacteria in a manure sample. The Danish Veterinary Laboratory is trying to develop a method of blood sampling examination (serological method). The disease can also be diagnosed with certainty by post-mortem examination of a pig with typical symptoms.

Treatment and prevention

Some antibiotics have a good effect on the bacteria (Aureosup, Lincospectin, Tiamutin, Tylan). Studies show that medicated feed can prevent development of disease and reduction in daily gain and prevent or reduce excretion of the bacteria. Unfortunately these studies were completed just after medication was eliminated from the feed. Therefore, any long-term effect has not been discovered. Eradication of the disease has not been tried on a large scale. The National Committee is working at present on developing and testing different eradication programmes.

The future

Many questions on *Lawsonia* and PIA still remain unanswered. An attempt is made to answer some of them in a large Danish study of finisher herds soon to be completed.

In cooperation between the Danish Veterinary Laboratory and the National Committee, just over 80 finisher herds selected at random were examined. Many factors were recorded in the herds concerning feeding, use of growth promoters, housing system, type of operation, use of antibiotics and cleaning and disinfection. An analysis of these factors has been initiated. It is hoped that this study can point to the factors that increase the risk of an outbreak of disease and low productivity in herds infected with *Lawsonia*. The result of the study will be available during the autumn of 1999.

Pathological changes in lungs and liver in finishers

In 1994 and 1998, the Federation of Danish Pig Producers and Slaughterhouses carried out an extended examination of 20,000 finishers to clarify the scope of lung, heart and liver changes in Danish finishers. The study took place at 4 large slaughterhouses, 3 in Jutland and 1 on Zealand. The study was planned so that the pigs examined represented the entire finisher production to the extent possible.

Due to their infectious cause, most lung changes were attributable to after-effects of mycoplasma hyopneumonia and pleuropneumonia.

Mycoplasma hyopneumonia

The incidence of mycoplasma hyopneumonia dropped strongly from 1994 to 1998 (from about 40% to 25%). The reduced incidence of mycoplasma hyopneumonia is probably the result of the last years' information campaign concerning the health advantages of batch operation and sectioning, especially in large herds. Another factor that may have reduced the mycoplasma hyopneumonia problem is increased use of a vaccine against mycoplasma hyopneumonia in 1998 compared with 1994. For mycoplasma hyopneumonia, the effect

of the mycoplasma-reducing measures initiated apparently far exceeded the effect of increased herd sizes from 1994 to 1998.

Pleuropneumonia

Lung changes following pleuropneumonia (mainly chronic adhesive pleurisy at the top and back of the lung) occurred at an almost unchanged incidence in the two study years, 28% in 1994 and 27% in 1998. That no downward trend for pleuropneumonia was found might be connected with a simultaneous increase in the average herd size. For, as also shown by the study, the incidence of pneumonia rose with increasing numbers of pigs for slaughter, especially in case of pleuropneumonia.

Compared with the slaughterhouses in Jutland, there was a clearly lower incidence of lung changes in pigs delivered to the slaughterhouse on Zealand. The difference was less marked in 1998 than in 1994, though. This may be connected with the fact that during the period the difference in herd sizes in the catchment areas of the slaughterhouses diminished.

Pleurisy

The incidence of pleurisy declined slightly during the period. This is remarkable, as the incidence of pleural changes recorded at slaughter by the meat control, which is also an expression of pleurisy, rose from 19 to 23% for the same pigs.

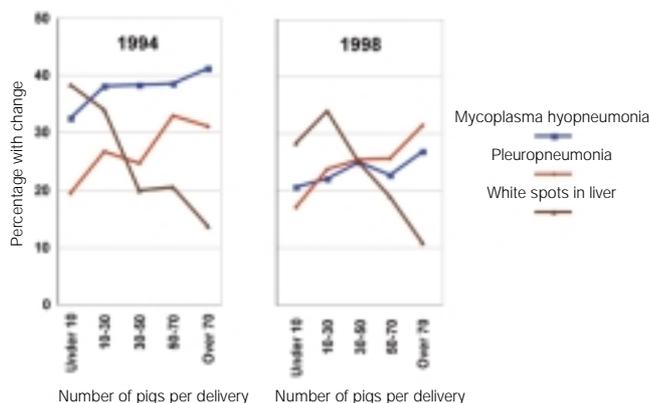
White spots in liver

The incidence of white spots in the liver was slightly lower in 1998 than in 1994. Compared with volume of deliveries, the incidence notably decreased with increasing herd deliveries. The lower predisposition for white spots in large herds is no doubt attributable to the widespread use of slatted flooring. This reduces the pigs' possibility of absorbing infective worms' eggs.

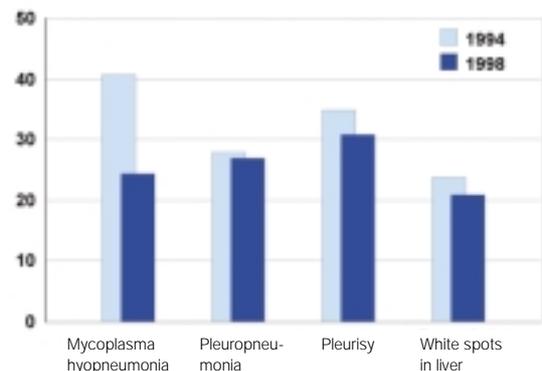
Successful study

This study for the first time provides data to show, by virtue of objective and detailed recording of disease, the percentage of finishers affected at slaughter by sequelae in lungs and liver after respiratory infections and attacks by worms. The study also shows the way health has developed during the past 4 years.

Pneumonia and white spots in finishers in relation to volume of deliveries to slaughterhouse



Percentage of finishers with mycoplasma hyopneumonia, pleuropneumonia, pleurisy and white spots in liver



Research on *Streptococcus suis*

The National Committee and the Danish Veterinary Laboratory initiated a research project in December 1996 on *Streptococcus suis*. *S. suis* isolates are continuously collected from Danish pig herds for the project.

Rapid and certain identification of S. Suis with new method

Project researchers have developed a new DNA method for determining rapidly and with certainty whether *S. suis* is present in a sample. The method, which is a PCR test (Polymerase Chain Reaction), tests for all *S. suis* serotypes except the serotypes 32 and 34. Future work will examine whether yet another PCR test can be developed for detecting only *S. suis* serotype 2. *S. suis* serotype 2 is the prevailing serotype in Denmark.

Common signs of disease and antibiotics resistance

During the project, Danish *S. suis* serotype 2 isolates were thoroughly characterised. The results indicate a potential connection between bacterial type and disease caused, as one of the prevailing types almost exclusively derived from pigs with cerebrospinal meningitis, while the other prevailing type was connected with pneumonia, infection of the heart valve or blood poisoning.

S. suis serotype 2 strains from pigs with cerebrospinal meningitis were resistant to sulfamethazaxol, while strains from pigs with pneumonia, infection of the heart valve or blood poisoning were resistant to tetracyclin. Two types represented 58% of all examined bacterial isolates. The intention is to examine whether the connection between bacterial type and disease can be proved by experimental infections in pigs with *S. suis* strains.

Serum treatment against S. suis serotype 2

Researchers are working to produce an antiserum for treatment and prevention of *S. suis* disease in pigs. By injection in pigs, a serum can give short-term protection against disease caused by *S. suis* serotype 2. Such *S. suis* antiserum is expected to be tested experimentally on pigs during 1999, and depending on results it may be tested in herds with *S. suis* problems, typically cerebrospinal meningitis.

Serum treatment of pigs with bacterial infections is already known from treatment of enterotoxemia and oedema disease.

New efficient cultivation method

A new method being developed will allow cultivation of *S. suis* from even very low concentrations. So far the method has been tested with good results; it is based on an immunomagnetic technique for isolation of *S. suis*. Magnetic balls with antibodies are mixed with a sample containing *S. suis* bacteria. The bacteria will combine with the antibodies. By means of a magnet the balls on which the bacteria are caught can be separated from the remaining sample contents.

Streptococcus suis is found worldwide in countries with intensive pig production. In Denmark especially *S. suis* type 2 prevails and manifests itself in infected pigs as blood poisoning, cerebrospinal meningitis, infection in the heart valve and arthritis in weaned pigs and finishers. In rare cases, people are infected with *S. suis*., usually in the form of meningitis in people in contact with pigs.

The Danish Veterinary Laboratory is also working on other diagnostic methods and monitoring of resistance in *S. suis*. Moreover, the National Committee is cooperating with the Royal Veterinary and Agricultural University on a PhD project concerning more basic research on how streptococci cause disease when the pig is infected. In Denmark, research concerning *S. suis* in pigs have been modest for many years, but the last years' activities have shown that it is possible rapidly to contribute with new knowledge. It should be mentioned, finally, that *S. suis* infections are seen in man very rarely, usually as meningitis in persons in contact with pigs.

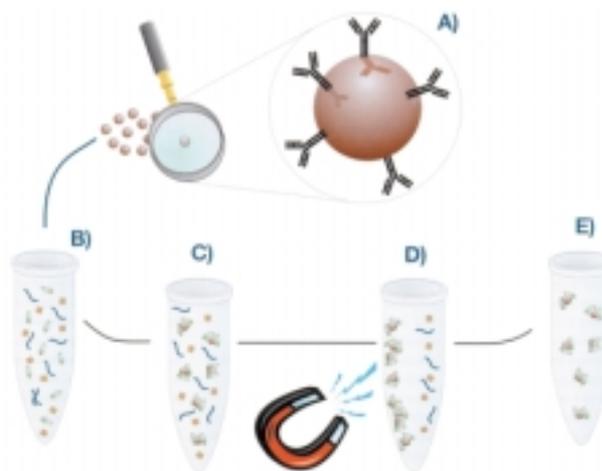


Illustration of principle of immunomagnetic separation of bacteria.

A: Purified polyclonal antibodies aimed at a specific type of bacteria are bound to magnetic latex particles. B: The magnetic latex particles carrying antibodies are added to a heterogeneous sample containing bacteria. C: The bacteria are bound to the magnetic latex particles via the antibodies. D: By means of a magnet the bacteria are retained in the test tube while undesired impurities are washed away. E: After washing, the bacteria and the latex particles are suspended, and the bacteria can be isolated by cultivation in, e.g., an agar dish.

Umbilical hernia

Is the incidence of umbilical hernia rising?

Recordings of umbilical hernia by the routine meat control seem to have risen over the past 10 years. In 1988 umbilical hernia was recorded in about 0.5% of the slaughtered animals. From 1996 and onwards, this proportion has risen to over 1%. Reports from practice seem to support the fact that some herds have experienced a rise in the incidence of umbilical hernia. In a small inquiry the incidence was between 1 and 10% of the pigs.

Nature and consequences of umbilical hernia

Umbilical hernia is characterised by a too wide umbilical ring, which permits intestines and omentum to bulge out under the skin. Whether the hernia bothers the pig depends on the size and on any complications. An umbilical hernia with complications develops if peritonitis occurs. The most serious complications are strangulation of the hernia or rupture of the hernial sac. In both cases the pig goes into shock and dies.

Causes of umbilical hernia

There is only very sparse information on the causes of umbilical hernia and in real fact none from Denmark. The condition is assumed to be congenital or acquired through omphalitis. Umbilical hernia often occurs in families, i.e., many pigs by one particular sow or boar are seen with umbilical hernia. Today, some researchers believe that umbilical hernia in the pig is inherited polygenetically, i.e., that many genes contribute. Others believe, however, that the heredity may be more simple.

Prevention

In this country, prevention seems to be aimed mainly at the possible infectious cause, i.e. omphalitis. Several herds have initiated various forms of prevention. Typically they are:

- increased hygiene in the farrowing crate
- treatment with antibiotics in the first days of life
- wiping of the navel with iodine immediately upon birth
- application of a plaster to the navel

In some herds, this form of prevention is used for all piglets, while other herds only take action with the pigs suffering from omphalitis. No studies show the effect of these preventive measures. Reports from practice state that the prevention seems effective in some herds and with no particular effect in others.

Future studies

The available knowledge unfortunately does not allow us to point to the factors most important to the development of umbilical hernia. Since our knowledge on effective prevention of umbilical hernia is thus limited, the National Committee will initiate studies on umbilical hernia. These studies will help shed light on the causes of umbilical hernia and on how best to prevent the disease.



Health insurance

Together with the insurance broker firm of Bonnor, Marsch & McLennan, the National Committee has thoroughly illuminated the possibilities of establishing a general health insurance for Danish pig production.

The reasons for this are the relatively large resources expended by the community up through the 1990s on handling diseases like oedema disease, PRRS, *Salmonella* and *Salmonella DT 104* as well as the fact that the German insurance company R + V Forsikring has pulled out of the Danish market.

The insurable losses from disease vary between DKK 5-40 per pig per year from the best case to the worst case. The costs and thus the insurance premium are also connected to desires/requirements of eradication in connection with the various diseases.

Undesired diseases

For the serious undesired diseases there are public and industry schemes that cover both destruction (herd value) and operating loss. On the other hand, loss in connection with sales restrictions is only covered if the pig industry controls diseases without the assistance of the veterinary authorities.

In case of serious outbreaks of disease in Denmark, preparedness and handling of the control are expected to be so efficient that they will keep the costs of control down at a reasonable level.

Catastrophy protection where the public and the pig industry cover the first DKK 400 million and an insurance company covers from DKK 400 to 800 million was assessed at an insurance premium of about DKK 2 per pig, if there was any insurance company interested at all. Cover of quite new unknown diseases are very difficult to reinsure.

Zoonoses

Zoonoses are diseases that can be transmitted from animals to people. They do not result in any production loss in the herd, but may involve

slaughter deductions, sales restrictions and eradication requirements (*Salmonella DT 104*). This makes it an insurable loss easy to document. The main problem is that restrictions and thus the financial loss change in step with decisions by public authorities, the pig industry or the individual slaughterhouse.

The premium for a *Salmonella DT 104* insurance with a deductible of DKK 25,000 for the individual herd and a maximum total cover of DKK 100 million was assessed at DKK 25-35 million.

Production diseases

Insurance companies are pleased to take on the role of administrator of insurance schemes provided that pig producers bear a large part of the risk in the form of a high deductible and a pool from the pig industry. Moreover the scheme must be generally subscribed to so that not only high-risk herds take out insurance. Indirectly, this requirement also hinders the establishment of special insurance for breeding and multiplier herds as well as SPF

Handling of diseases

Disease	Community legislation	Act on Livestock Diseases	Public destruction compensation	Control by industry
Foot and mouth disease	YES	YES(A)	YES	NO
Swine fever (classic and African)	YES	YES(A)	YES	NO
Swine vesicular disease	YES	YES(A)	YES?	NO
Teschen disease	YES	YES(A)	YES?	NO
Brucellosis <i>Brucella suis</i>	YES	YES(A)	YES?	NO
Transmissible gastro-enteritis	NO	YES	NO	YES
Aujeszky's disease	YES	YES	NO	YES
Trichinosis <i>Trichinella spiralis</i>	NO	YES	NO	YES
<i>Salmonella (Cholerae-suis DT 104)</i>	NO	YES	NO	YES
<i>Salmonella</i> (known in DK)	NO	YES	NO	NO
PRRS	NO	YES	NO	NO
Epidemic diarrhoea	NO	NO	NO	YES
<i>Yersinia enterocolitica</i> t.09*	NO	NO	NO	YES/NO

(A) Immediate national importance (for exports).

* Cross reaction for brucellosis makes it undesired in the breeding system.

herds. The administration costs were assessed at about 20% of turnover.

Conclusion

Based on the reports from the insurance companies, the National Committee and the Federation of Danish Pig Producers and Slaughterhouses concluded that the most expedient financial cover and handling of diseases were those in use at present:

- Undesired diseases are handled jointly by authorities and the industry based on existing schemes.
- Zoonoses are handled from case to case, and to the extent the professional tools of control and reduction are present, as much as possible of the slaughter cost is to be charged back to and paid by the individual producer. Where eradication is required, such as *DT 104*, common funds should still be applied.
- Production diseases and SPF diseases are the individual pig producer's risk.

Integrated Farm Management System - Pigs

In March 1999, part of the Integrated Farm Management System - Pigs (IFMS) in a Windows 95 version was shipped to all existing customers.

At that time, the program had been in operation at 4 pig production offices since the autumn of 1998. These 4 offices have done a great job of using the program in their daily work and thus discovering errors and inexpedient features, which inures to the benefit of everybody else.

Production Plan

In the March shipment, the planning part was missing. In the dos version of IFMS - Pigs, this module was called Technical Budget. In the Windows version, the module has been renamed Production Plan, because this is where the production is planned.

In Production Plan, the farmer decides the assumptions and determines the efficiency for a given production. The program then calculates the week-by-week production volume and the financial results.

The following planning tasks can be performed

- Establishment of production
- Change of production
- Phasing out of production

Production Plan has undergone professional reassessment, and several new facilities have been incorporated. Among them are:

- Batch operation
- Eradication/partial eradication
- Change of production
- Better handling of prices

Batch operation

The new Production Plan enables batch operation to be planned. It is possible freely to choose batch interval, and the various batch intervals can be combined, such as 3-week batch operation for sows and

weaners, and 6-week batch operation for finishers.

A new concept has also been introduced: 'production line'. This new facility enables the farmer to transfer pigs to the same finisher house from different weaner houses.

Eradication

It has become easier to plan eradication because it is now possible to make plans with overlapping establishment and phasing out periods, as often occurs in practice.

Partial eradication or medicinal eradication can be used to plan eradication for, e.g., mycoplasmal pneumonia. The program allows the user to change services per week, introduce a stop to services for a period, or the gestating animals can be sold.

Change of production

When a change of the existing production is planned, it is important to use the existing production as the starting point. If production data are

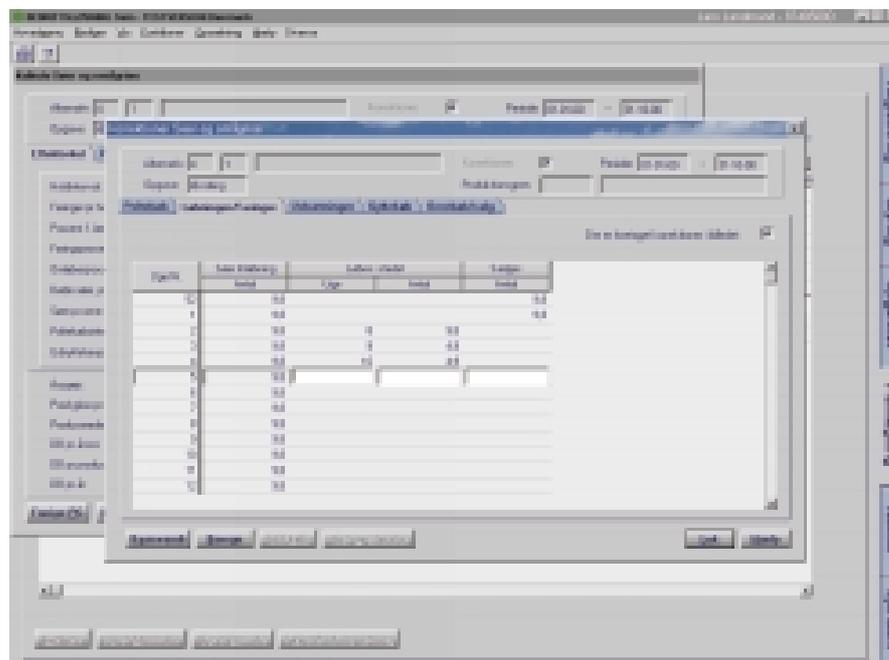
already recorded in the program, such data can be transferred to Production Plan and be used as the starting point for more accurate planning.

Better handling of prices

Substantial factors of planning are feed and slaughter prices. If the user expects feed prices to change within the next year, the program can take account of monthly price changes.

Based on a slaughter price entered, the program can now calculate prices for the individual animal groups, because there is a correlation between the slaughter price and the price of a 30 kg pig. The program also takes into account health supplements.

Altogether, the Production Plan program is a considerable improvement on the old Technical Budget. How good the improvements are can only be experienced by active use of the program.



Productive Pig Farms

The project 'Productive Pig Farms' aims to uncover the factors able to increase productivity in the short term in pig farms and alleviate costs in the long term.

The project has therefore included many different actions, some of which follow below:

Service check-up

As with the car, it is a good idea to give the farm a check-up once in a while. A service check-up is an advisory offer under which a pig production consultant and a financial consultant together visit and go over the farm. The visit will typically comprise a tour of the housing and a review of production and economy.

The results of a service check-up will differ widely from farm to farm. Some will get a list of specific items where action can be taken, such as feed price and refinancing of loans. Others have to make a more drastic change of operations, such as getting a machine pool to tend the fields, or expanding production. The strength of a service check-up is that the farm is reviewed by two professional advisers who can point to things that can improve, or talk about what is to happen in the long term - it all depends on the situation on the farm.

Crisis management

In January, briefing meetings were held on advising pig producers during a recession. An offshoot of these meetings was local meetings with banks. The banks have been informed of the influence of the crisis on pig producers' economy and increased need for available funds.

Sharing of farm management experience

Across the country a number of groups have been established for sharing their experiences on farm management. The groups meet 3-4 times a year. A financial adviser participates in the meeting and plans it

together with the host. The financial advisers meet once a year to share their experiences and pass on those of general application.

Renting of animal housing

Guidelines have been drafted on the renting of housing. They briefly describe the most important legislation and many of the practical details to be agreed.

Check lists for herd visits

Based on several herd visits, a large number of check lists have been prepared. With these in hand it is easier for the consultants to cover all angles when discussing various subjects.

Count your steps

Is the work in the piggery planned in the best way, and is the working environment o.k. in relation to the statutory working place assessment that all farms with employees must have made before the end of 2000? These two elements are included in a new advisory offer. Emphasis is on efficient and good utilisation of the working time spent in the piggery combined with a good working environment.

Stocktaking weights of animals and feed for Production Reports

An analysis of the types of error most important for the key figures

of the Production Report shows that most of the typing errors resulting in reconciliation errors for the herd or items on the error list, such as a missing weaning, mean very little compared to errors in stocktaking weight or a weighing error on feed.

IFMS - Pigs can itself calculate both the number and weight of pigs for stocktaking, but this requires accurate weights for the pigs entering and leaving the house during the period.

For sow units of 210 year sows, an assessment error of 2.5 kg per pig at stocktaking results in a change of about 50 pigs produced per quarter, about 1 pig produced per year sow.

Weighing errors for feed typically occur because not all grinding/mixing equipment is in good condition, and an error of 10-20% on the scales of the equipment is not uncommon. This may greatly affect both the Production Report and feed composition.

A weighing error of 10% on grain and soybean meal may mean 13 FUs extra per pig produced. At 4,000 pigs produced per year this corresponds to about DKK 57,000 extra in feed costs.



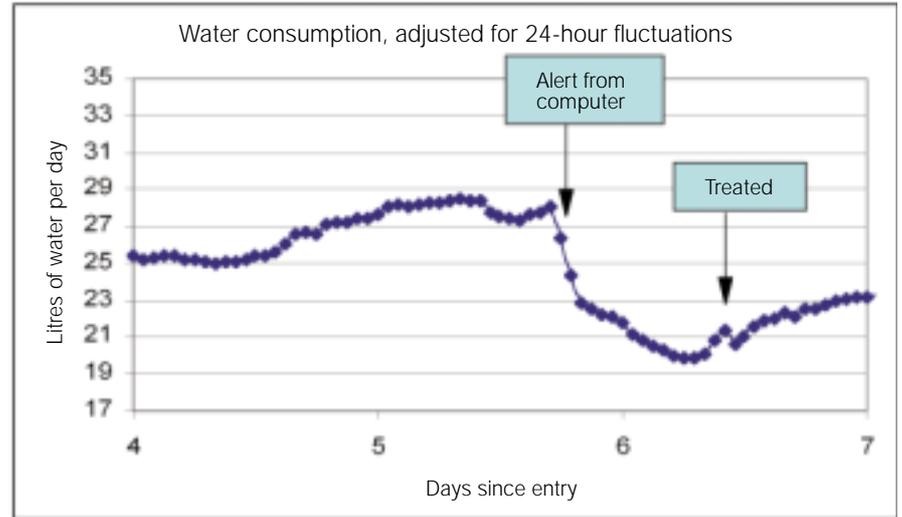
Production monitoring

Monitoring via water consumption

Studies performed by the National Committee show that the drinking behaviour of pigs is closely connected with their welfare. On this basis a prototype for intensive monitoring of the water consumption of weaners and finishers in all in/all out production has been developed.

Via flowmeters, the program continuously records the water consumption at section level, and a mathematical model analyses the pigs' drinking pattern. When the drinking pattern changes compared to expectation, the computer alerts the manager. Provisional studies indicate that, e.g., outbreaks of diarrhoea are discovered by the computer 12-24 hours before any visible symptoms occur.

External factors like temperature fluctuations, change of feed or moving of pigs can affect drinking behaviour. Therefore, the program has an electronic log and a module



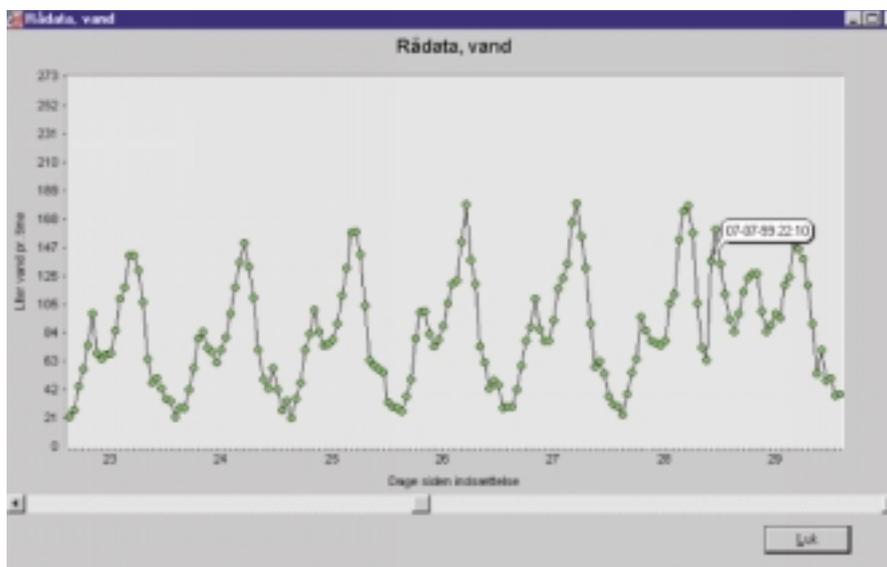
Water consumption for a group of weaners 4-7 days after weaning, adjusted for 24-hour fluctuations. The manager found diarrhoea on the 6th day at 10 a.m. However, the computer discovered the problem already on the 5th day at 5 p.m. (the manager had no access to the computer).

for automatic recording of the climate. A comparison of water consumption, log and climatic records can often explain changes not due to disease.

Electronic data collection

All data exchange between electronic equipment and PC must be done via a network in the piggery. The network standard chosen for this purpose is P-Net, which is also used by the IFMS - Pigs.

To a high degree, future software for production management will be based on electronically collected data. It is therefore important that the industry works towards a common standard for electronic data communications.



The computer monitors the pigs' drinking pattern. To the right in the figure, a change in drinking behaviour due to problems of dispensing feed can be seen. The program gives an alert on this within 1-2 hours.

Batch operating systems

Batch operation can be performed with any number of batches. Normally, the number of batches will be between 7 and 14. If the sows' cycle divided by number of sow batches is an integer, the interval between sow batches will be constant, e.g., 21 weeks divided by 7 batches. Thus, only batch operating systems with 2-week operation and weaning at 5 weeks as well as 3-week operation and weaning at 4 weeks always have the same interval between sow batches. In all other batch operating systems the intervals between sow batches differ. The table shows, for example, that at 8 batches and weaning at 4 weeks the interval between batches alternates between 2 and 3 weeks. This means that some batch operating systems cannot use a fixed weaning weekday.

Farrowing batches, No.	Active sows, No.	Interval between batches, weeks	Weaning days	Batches in farrowing house, No.	Weaner batches, No.	Finisher batches, No.
7	210	always 3	Wed.	2	3	4
8	240	3-2-3-3-2-3-3-2	Wed.	2	3	5
9	270	2.5-2-2.5-2.5-2-2.5-2.5-2.5	Thu./Mon./Thu.	2	3	6
10	300	2-2-2-2-2-2-2-2-3	Wed.	3	4	6
11*	330	always 2	Wed.	3	3	7
12	360	2-2-2-1-2-2-2-1-2-2-2-1	Wed.	3	4	8
13	390	1-2-2-1-2-2-1-2-2-1-2-2-1	Wed.	4	5	8
14	420	always 1.5	Mon./Thu.	4	5	9

*) 5-week weaning age

The table shows the number of active sows in the herd when each farrowing batch has 30 sows. The non-active sows are the ones culled or re-served. The table also shows the interval in weeks between batches, proposed weaning days and a proposal for the number of batches in the farrowing, weaner and finisher houses, respectively. If a WTS system is chosen, the weaner and finisher batches must be added together.

Effect of herd size

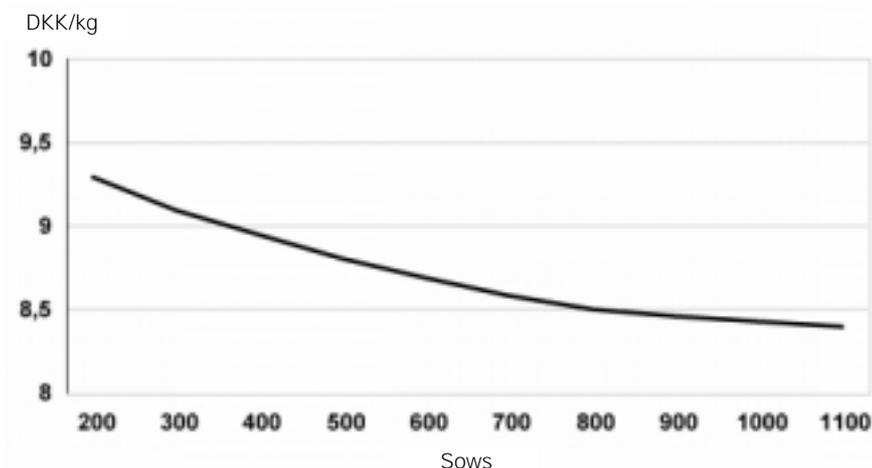
The figure shows the effect of herd size on production costs. The comparison presupposes the same efficiency regardless of herd size.

The effect of herd size is thus exclusively attributable to differences in investment, labour and feed prices.

Herd size has a much larger influence on costs per kg of meat than the batch operating system chosen. When the number of sows is increased from 220 to 650, costs per kg of pigmeat are reduced by about 0.70 DKK/kg. An increase of sows to 1100 yields further savings of 0.15 DKK/kg.

In herds of less than 500 sows, production costs are slightly lower in batch operating systems with 8 and 12 batches than 21 batches. The larger the herds, the more competitive is weekly operation compared with 2-3 weeks between sow batches.

Cost per kg of pigmeat



Environment

Green Accounts

The Danish Agricultural Advisory Centre is developing a set of 'green accounts'.

Objectives

The objectives of green accounts are especially:

- Better utilisation of resources and environmental management on each farm
- Documentation of environmental matters to the public
- In the long term possibly to replace some of the present environmental requirements

Contents

Green accounts for a farm include the following:

- nutrient accounts (N, P and K)
- pesticide accounts
- energy and water consumption
- reference values
- text giving type of property, area, production, environmental approvals, waste handling, natural values, etc.

Key figures and ratios

The key figures and ratios of the green accounts will be the excess nutrients per hectare and the pesticide consumption.

The program itself

During the first part of 1999, a prototype of the green accounts was tested on about 20 farms. The experience from this will be incorporated into the final computer version to be released in 2000.

Experience shows that it takes some time to do the first green accounts of a farm, but the following years are expected to be a bit easier. Pig farms with efficiency control are well on their way, as they already have the most important information for the nutrient accounts. But experience also shows that it is difficult to interpret the green accounts as the key figures and ratios

depend very much on type of operation, especially choice of crops, type of soil and number of animal units per hectare. To assess a farmer's performance it is necessary to be able to compare with reference values for corresponding types of farm.

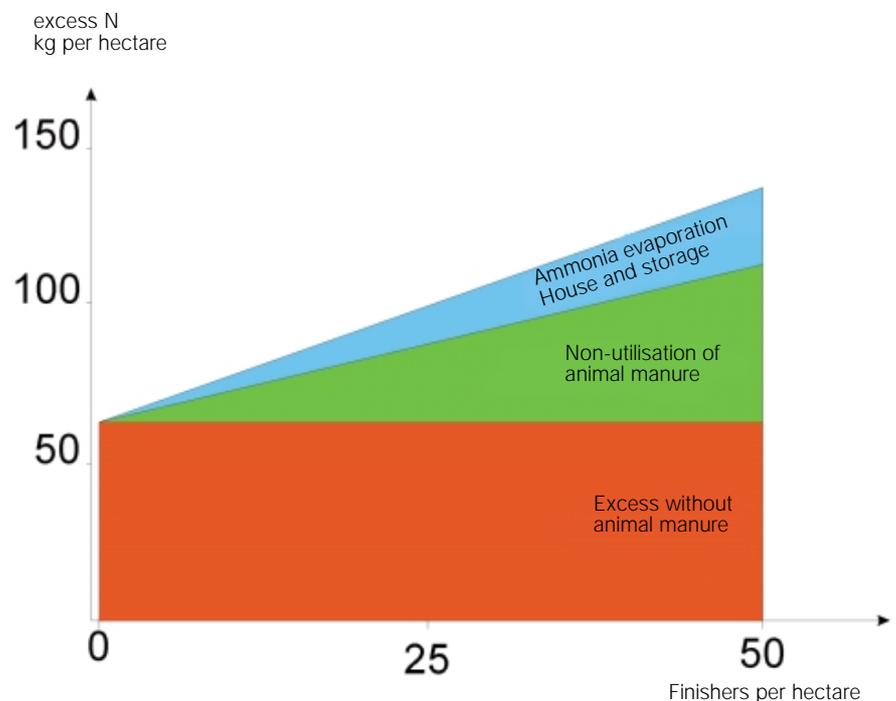
Nutrients according to need

Based on the Action Plan for the Aquatic Environment II and the reduced nitrogen quota for the fields, the Danish Agricultural Advisory Centre has prepared campaigning material on the optimum utilisation of nutrients in both fields and housing.

Better utilisation of manure

The main theme of the campaign is the possibilities of better utilisation of animal manure and commercial fertilisers. But the campaign also focuses on the possibilities of reducing the N content in animal manure, partly to observe the requirement of a maximum of 140 kg of N per hectare (year 2002), partly because the excess N per hectare drops when a smaller amount of the N allocation derives from animal manure.

The campaign started in winter 1999 as 3-day courses and is repeated in the course season 1999/2000 as 3-day courses as well as being included in other courses.



The number of pigs per hectare is of great importance to the excess of N

Further training and information material

The campaign 1999/2000

For the course season 1999/2000, the National Committee has coordinated the publication of updated teaching material for two topical course subjects.

The course *Management of finisher production - '2.5 FUs per kg of gain'* - addresses farmers and farmhands. It contains a proposed programme and subjects for two-day courses emphasising feeding and production management, respectively.

The course *Health management and medication* is an update of the previous diploma course. The course addresses pig producers, farmhands and students at agricultural colleges. It comprises 3 one-day courses emphasising legislation and diagnostics, preparations and their handling as well as health management and injection technique, respectively. Active participation and practical examples are emphasised. A group of consultants and veterinaries are available as teachers of the courses, which are arranged by the local pig production committees.

Further training of advisers

After a considerable decrease in 1998 in adviser participation in further training, attendance to such training was good during the first half of 1999 in the fields of feed, feeding technology and housing technology, etc.

The topicality, quality and contents of the courses have been strengthened by involving the specialist expertise from the theme groups under the National Committee. The theme groups now participate in both the User Group for Further Training and the planning of courses offered.

INFORMATIONSMATERIALE fra Landsudvalget for Svin - pr. 17. august 1999

<i>Info Svin</i>	Svinefaglig database,
<i>Pjecer</i>	FOKUS PÅ-pjecer inden for , avl, reproduktion, fodring, stalde og produktionssystemer og sundhed og sygdom "Sådan anvendes boltpistol" "Anbefalinger for indhegning af svin på friland"
<i>Skilte</i>	Adgang forbudt - grisene må ikke fodres, inkl. bekendtgørelse + indhegningsfolder Adgang forbudt - uden ejerens tilladelse
<i>Abonnement på fagligt materiale:</i>	Ugeudsendelse, kr. 1.500,- pr. år Månedsudsendelse, kr. 1.000,- pr. år
<i>Kampagnemateriale</i>	2,5 FEs pr. kg tilvækst, 1999. Sundhed i centrum 1996/97. Styr på bedriften' 1994. Kursus i medicinanvendelse og injektionsteknik.
<i>Svineordbog</i>	Dansk/engelsk - engelsk/dansk,
<i>Redegørelse vedrørende prrs i Danmark 1991-96</i>	
<i>Grundlaget for den beregnede smågrisenotering</i>	
<i>Dansk svineproduktion efter 2. verdenskrig 1945- 1995</i>	
<i>Arbejds miljø i svinestalde, kr. 100</i>	Omhandler: Støv, Ammoniak, Svovlbrinte, Mikroorganismer og Giftstoffer, Ånde-drætsværn, Støj, Ergonomi,
<i>Økologisk svineproduktion</i>	Udredningsprojekt vedrørende Primærproduktion, (Rapport nr. 9 - juli 1996)
<i>Udendørs sohold</i>	(Rapport nr. 6, december 1995) + andet materiale vedr. udendørs sohold,
<i>Grovfoder til svin</i>	(Rapport nr. 12 - januar 1998)
<i>Svinepasseren II</i>	Arbejdstilrettelæggelse og pasning af svinebesætningen, (marts 1994)
<i>CHECKLISTE - 900 gram dagligt ilvækst</i>	
<i>ÅRSBERETNING 1998, Landsudvalget for Svin</i>	
<i>ENGELSK ÅRSBERETNING 1998, Landsudvalget for Svin</i>	
<i>ÅRSBERETNING 1998, Avl og Opformering,</i>	

Ovennævnte informationsmateriale kan bestilles på Internet-adressen:
<http://www.ds-data.dk/lu/info/Index.htm>

An organisational change with compulsory advance enrolment for each course has enabled the courses to be targeted to the participants' needs and thus made the training efficient.

The information strategy of the National Committee

In future years, access to new knowledge and technology will be vital for Danish pig production to be able to maintain and possibly expand its present market share in the global competition.

The staff of specialists employed by the National Committee covers largely all specialist areas of Danish pig production. This staff reports results from their own and foreign experiments on a current basis.

The National Committee will continue to improve and develop its electronic information systems to give users even easier access to specialist information on pigs. The goal is access to all relevant specialist information from a joint list of options even if several databases are involved.

At present, the National Committee has gathered all specialist information on the CD-ROM Info Svin so that a simple search will very quickly give the user all the information needed in a given situation. In addition, the National Committee has developed several tools on the Internet that make it easier for the individual pig producer to use the Internet for daily work.

Many of these databases or home pages are free of charge, while access to, e.g., Info Svin or Landbrugsinfo of the Danish Agricultural Advisory Centre requires subscription.

The following describes the databases or home pages that the National Committee has been involved in developing.

The National Committee on the Internet - www.lu.dk

On this home page you find the latest news on the professional and political work of the National Committee. There is also a description of the structure of the National Committee and information on its specialist areas. In addition to ordering thematic booklets, etc., you can also find information on on-going projects, the General Assembly and Congress for Pig Producers as well as a list of names and addresses of local advisory centre staff. There is also an index with links to pig-related pages in Denmark and abroad.

The home page of the National Committee is an integral part of the home page of the Federation of Danish Pig Producers and Slaughterhouses, where you can find the current slaughter prices, statistics of Danish pig production, pork recipes, etc.

DanBred - www.danavl.dk

As a unique tool it is possible under 'Avl og Opformering' to see AI lists where you can search absolutely current indices for all the AI boars of DanBred. It is thus also possible at any time to find the current index of your own breeding stock purchased from a DanBred herd. Pure-bred animals are entered by their 9-digit ID. For hybrids, the sire's and dam's IDs are entered, and the index of the animal itself is then the average of the parents' current indices.

Database with legislative information - www.lr.dk

The Danish Agricultural Advisory Centre has established 'Regelinfo', which is a database of legislation

on agriculture. The National Committee participates in this work, being responsible for acts and orders related to Danish pig production. The new generation of Info Svin will have direct reference to acts or orders from the individual specialist fields.

Produktkatalog Svin - www.produktkatalog.dk

Produktkatalog Svin is a work of reference on the Internet. Firms selling products and services can advertise here by entering information on each product supported by pictures and a short description of the firm. Produktkatalog Svin is linked with Info Svin and is therefore available both on the Internet and on the Info Svin CD-ROM. This means that it is now possible to exploit all the results and experiences of Info Svin when large or small investments are to be made. Produktkatalog Svin has been developed by the National Committee.

Markedspladsen Svin - www.markedspladsen.produktkatalog.dk

At the beginning of 1999, the National Committee launched the new Internet service 'Markedspladsen Svin'. On Markedspladsen Svin it is possible free of charge to insert advertisements or search for something needed in a given situation. Weaner sales is one of the frequently used areas, but the second-hand, property and job markets are three other popular areas.

It is thus easy for the individual to insert classified advertisements when he/she wants either to sell or buy weaners or second-hand equipment or the like.

Afrapporterede resultater oktober 1998 - oktober 1999

Meddelelser

- Nr. 404: Flydende vitaminforblandinger sprøjtet på pelleteret færdigfoder til slagtesvin. (Oktober 1998).
- Nr. 405: Delvis sektionering kontra fuld sektionering af slagtesvinestalde. (November 1998).
- Nr. 406: Gramineers ANF-koncept til smågrise. (November 1998).
- Nr. 407: ZOOLAC® i foder og vand til smågrise. (November 1998).
- Nr. 408: 3-Fasefodring af slagtesvin med skrabet slutblanding. (December 1998).
- Nr. 409: Firmaprodukter til smågrise - Alimet, Luprocid og Natuphos. (Januar 1999).
- Nr. 410: Gramineers ANF-koncept til slagtesvin. (Januar 1999).
- Nr. 411: Firmaprodukter til smågrise, Ingaso Ecosan Mini, Medi og Maxi, Fructomix og BEP. (Februar 1999).
- Nr. 412: Trivsels- og motivationsundersøgelse blandt ansatte i større svinebesætninger. (Februar 1999).
- Nr. 413: Jernpasta og flydende jern til pattegrise. (Februar 1999).
- Nr. 414: Spaltegulve til smågrise. (Februar 1999).
- Nr. 415: Firmaprodukter til slagtesvin - LA-MIX, norsk fuldfoderblanding og en dansk fuldfoderblanding. (Februar 1999).
- Nr. 416: Firmaprodukter til smågrise - mælkesyrebakterier, Lactiferm. (Februar 1999).
- Nr. 417: Resultater af salmonellaovervågningen opgjort på besætningsstyper. (Februar 1999).
- Nr. 418: Sammenligning af simpel tørfodringsautomat, enkelt-dyrsautomat og rørfodringsautomat til slagtesvin. (Februar 1999).
- Nr. 419: Firmaprodukter til slagtesvin - New-Add-II og Bio-Fos. (Marts 1999).
- Nr. 420: Elektronisk overvågning af produktionen i stalde med alt-ind alt-ud produktion. (Marts 1999).
- Nr. 421: Fuldfoder med sukkerroeaffald til løsgående drægtige søer - indendørs. (April 1999).
- Nr. 422: Uisolerede toklimastalde til smågrise. (Marts 1999).
- Nr. 423: Firmablandinger til slagtesvin - solgt i region Nordvestjylland. (Marts 1999).
- Nr. 424: Ad libitum fodring af individuelt opstaldede, drægtige søer. (April 1999).
- Nr. 425: Flydende vitamin/Fytase- og mineralforblandinger i vådfoder til slagtesvin. (April 1999).
- Nr. 426: Effekt af ekspanderingsgrad, pelleting og formalingsgrad på salmonella, produktionsresultater og mave-tarmsundhed hos slagtesvin samt på fytaseaktivitet og vitaminstabilitet i foder. (April 1999).
- Nr. 427: Firmablandinger til slagtesvin - solgt i region Østjylland. (Maj 1999).
- Nr. 428: Firmaprodukter til smågrise - mælkesyre, Lafeed 80. (Maj 1999).
- Nr. 429: Slagtesvindets sammensætning. (Maj 1999).
- Nr. 430: Forskellige foderstrategier til drægtige søer samt disses effekt på afkommet. (Juni 1999).
- Nr. 431: Firmaprodukter til slagtesvin - Agromex og Bio-Mos. (Juli 1999).
- Nr. 432: Effekt af myresyre i drikkevand på forekomst af salmonella hos slagtesvin. (Juli 1999).
- Nr. 433: Firmaprodukter og foder til smågrise - Igalac, FUT og Bkashi F. (Juli 1999).
- Nr. 434: Adfærdsregulerende foder med 40 pct. pulpetter til individuelt opstaldede drægtige søer. (August 1999).
- Nr. 435: Foderspild fra tørfoderautomater. (August 1999).
- Nr. 436: Firmaprodukter til smågrise - Toycerin, Carniking, Fresta F og Endosan. (August 1999).
- Nr. 437: Tilsætning af uorganisk og organisk kobber til smågrise. (August 1999).
- Nr. 438: Projekt fransk Yorkshire - delrapport II. Sammenligning af kuldstorelse og holdbarhed hos to typer YL-søer. (September 1999).
- Nr. 439: Crina HC i foder til slagtesvin. (September 1999).
- Nr. 440: Fodring af smågrise efter vægt. (September 1999).
- Nr. 441: Firmaprodukter til smågrise - Cylactin, Euroacid LFPA, Greenacid LBF og Enteroguard. (September 1999).
- Nr. 442: Effekt af foderets indhold af kalcium på Salmonella, foderets syrebindingskapacitet og produktionsresultater hos slagtesvin. (Oktober 1999).

Erfaringer

- Nr. 9809: Drikkekrug til løsgående søer. (November 1998).
- Nr. 9810: Drikkekopper til løsgående søer. (November 1998).
- Nr. 9811: Tre-fasefodring af slagtesvin med hvede som "slutblanding". (December 1998).
- Nr. 9901: Løbeafdeling med flokopsstaldede søer og æde-/insemineringsbokse. (Januar 1999).
- Nr. 9902: Produkttest af rørfodringsautomat til smågrise. (Januar 1999).
- Nr. 9903: Ad libitum fodring af løsgående, drægtige søer. (April 1999).
- Nr. 9904: Gyllesystemer - Funktion og luftkvalitet. (April 1999).
- Nr. 9905: Filtrerende hjelme/hætter med batteridreven hjælpemotor. (Maj 1999).
- Nr. 9906: Strategi for flytning og sammenblanding af smågrise. (Juni 1999).
- Nr. 9907: Anvendelse af HP-massa i fuldfoder til drægtige søer. (Juni 1999).
- Nr. 9908: Forsøg på reduktion af multi-resistent Salmonella Typhimurium DT 104 i fire svinebesætninger. (Juni 1999).
- Nr. 9909: Drægtighedsstalder med løsgående søer opstaldet i stier med fælles ædebokse. (Juni 1999).
- Nr. 9910: Overbrusningsanlæg i svinestalde - en oversigt over nytteværdi, funktion og brug. (August 1999).
- Nr. 9911: Produkttest af foderautomater til diegivende søer på fri-land. (August 1999).
- Nr. 9912: Spaltegulve til smågrise i toklimastier med delvist spaltegulv. (September 1999).
- Nr. 9913: Vurdering af fejmaskiner. (Oktober 1999).

Acids	37	Durofarm	24	Landbrugsinfo	54	Produktkatalog Svin	54
Action Plan for the Aquatic Environment II	52	Dust and ammonia	27	Landrace	8, 14, 15, 30	Protein	35
Ad lib.	24, 29	Dust level	27	Large White	8, 9, 14, 15, 30	PRRS	4, 5, 41, 42
Agro Products	23, 24	Eating stalls	22	<i>Lawsonia</i>	36, 43	PRRS-positive	41
Al	8, 30	Echberg	34	Lean meat content	35	Pulpetter	29
Air intake	26	EDTA	30	Lignin	27	Quarantine period	42
Air quality	28	Efficiency Control	6	Liquid feed	33, 34	Rapeseed meal	35
All in/all out	4, 5, 50	Egebjerg	23, 24	Liquid feeding	19	Ready-made feed	39
Alltech	37	Electronic data collection	50	Litter size	13	Recruiting strategies for sow units	13
Alternating breeding strategy	13	Electronic sow feeding	21	Loose gestating sows	4, 5, 24	Reproduction result	30
Amino acid	33, 35	Endotoxins	27	Loose nursing sows	23	Respiratory diseases	17
Ammonia	27	Environment	52	Loose sows	20	Respiratory infection	44
Analysis of accounts	7	Eradication	40, 43, 48	Lysine	35	Restricted liquid feeding	19
Androhep	30	ESF	21, 22	Løven Agro	34	Roughage	25, 29
Animal ethics	15	Experience-sharing groups	49	Manure handling	21	Royal Veterinary and Agricultural University	23, 45
Animal Protection Act	16	Exterior assessment	15	Markedspladsen Svin	55	Run	25
Animal welfare	4, 5, 20	Faaborg	24	Meat juice samples	39	Runts	31
Antibiotic growth promoters	32, 36	Farrowing crate	46	Meat quality	11	<i>Salmonella</i>	36, 38, 40
Antibiotics	43, 46	Feed composition	29	Medication	53	<i>Salmonella</i> action plan	38
Antibiotics for semen	30	Feed consumption	24	Medipharm	37	<i>Salmonella Typhimurium</i>	38, 40
Area requirements	16	Feed intake	32	Messing material	16, 22	Screening	38, 40
Automatic recording of climate	50	Feed mixes	29, 34	Minerals	34	Sectioning	17, 41
BASF	37	Feed price	33	Monitoring of processed goods	38	Semen dilution	30
Batch operation	48, 51	Feed waste	24, 34	Multiplier herd	13	Semen sales	30
Bedding materials	21	Feeders	24, 34	Multisite	17, 33, 41	Serum treatment	45
Beifa	37	Final mix	33	Mycoplasma hyopneumonia	44	Shell house design	26
Big Dutchman	32, 34	Finishers	6, 7, 9, 16, 32, 25,	National Dept. of Farm Buildings and Machinery	26	Showering	16, 22
Biotechnological Institute	32	Foster sows	31	New buildings	7	Skjold Datamix	32
Blood samples	39	Free range	25	Nucleus management program	13	Slatted flooring	18, 19, 22, 23, 27
Branded pigs	16	FTS	17	Nutrient accounts	52	Slaughter deduction	38
Branded productions	4, 5	Fully slatted flooring	19, 23	Nutrient utilisation	4, 5	Slurry systems	18
Breeding reports	13	Funki	32	Nutriscan	37	Sows	6
Breeding stock	8, 13, 25	Further training	53	Odour	28	Sow units	7, 25, 41
Breeding value for litter size	14	FUS	6	Oil spraying	27	Stocktaking weight	49
Børgildgård	9, 10	FØTEK	11	Omphalitis	46	Strategy	4, 5
Castration	16	Gastrointestinal health	39	Organic acids	37	<i>Streptococcus suis</i>	45
Cerebrospinal meningitis	45	Genetic level	13	Outdoor sows	23	Superfos	37
Chemvet	37	Gestating sows	16, 20	Oxytocin	21	Swiss eradications	42
Climatic recording	26, 50	Gestation unit	21	Partial eradication	42	Swiss farrowing pen	23
CO&S	37	Grønhøj	13	Partially slatted flooring	28	Tail docking	16
Community legislation	16	Gross margin	7, 9, 33	Pelleting	39	The local co-op	37
Concrete slatted flooring	19	Growth ranges	33	Performance	6, 10, 24, 25, 29, 32, 36, 39	Tooth clipping	16
Costs	7, 25	Guidance corps	38	Pesticide accounts	52	Trickle feeding	22
Crisis management	49	Hampshire	8, 12	pH	9, 12, 32	Two-way strategy	4, 5
Daily gain	7, 17, 9	Health	4, 5	Phase feeding	33	Tylosin	36
DanBred	8, 14, 30	Health management and medication	53	Phosphoric acid	34	UK production	20
Danish Applied Pig Research Scheme	17, 24	Heat detection	21	Piglet mortality	23	Ultimate pH	11
Danish Institute of Agricultural Sciences	11, 13, 32	Heat treatment	39	Piglets	31, 41	Umbilical hernia	46
Danish Veterinary Laboratory	36, 43	Herd size	51	Pit extraction	28	Vitamins	34
Data collection	50	Hoof injuries	20	Pleurisy	44	Vulva bites	20
Database	13	Housing temperature	26	Pleuropneumonia	44	Wagner Domino	24
Deep litter	21, 27	Hygiene	46	Porcine intestinal adenomatosis	43	Weaners	16, 24, 32
Diarrhoea	33, 36, 43	Ikadan	23	Production accounts	7	Weaning	25, 31
Diffuse air intake	26	IMF	11	Production loss	41	White spots in liver	44
Diplomat	34	Information strategy	54	Production monitoring	50	Windows 95	48
Disease control	17	Injection technique	53	Production Plan	48	Working place assessment	49
Disinfection	40	Int. de Premezclas	37	Production reliability	20	WTS	4, 5, 17, 19
Drained floor	16, 18	Integrated Farm Management System - Pigs	48, 49, 50	Production report	49	Øta-kompagniet	37
DT 104	4, 5, 38, 40	Internet	13, 54	Production systems	4, 5		
Dunging area	18, 22	Lactic acid bacteria	32	Production traits	13, 15		
Duroc	8, 9, 30	LAH	37	Productive Pig Farms	49		