Annual report 2000

The National Committee
for Pig Production

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Preface

In 2000, the price finally moved towards an acceptable level and peaked preliminarily at DKK 10.10 in midsummer. Thereby more than 2 years of recession had finally come to an end and many pig producers again started developing their herd.

Environmental approvals

Unfortunately, it has turned out that the approval procedures with VVM (assessment of impact on environment) have delayed many good and interesting projects.

For a dynamic business as pig production where stagnation equals recession it is impeding if the individual herd cannot adjust to technical and financial developments. If the new production systems with loose sows, batch operation, 7 kg's production, multisite, all in/all out, WTF etc. are to gain foothold, efficient and uniform procedures in the local authorities are necessary.

Image

Society's acceptance is among the crucial factors for further development. Anybody familiar with the facts of Danish pig production know that it is a dynamic and exciting business with good jobs, and fortunately these positive messages are becoming increasingly visible.

Many journalists, politicians, civil servants and scientists know that it is not idle talk when we claim Danish pig production to be leading when it comes to animal welfare, environment, the fight against Salmonella, and the consumption of antibiotics. A number of important, yet traditionally critical interest groups approve of the effort.

Changes in production

Within the last year alone we can point towards changes such as the voluntary cessation of growth promoters, consistent handling of Salmonella and a decent increase in the number of loose sows and UK production.

We have had a fairly long period of time to develop and prepare for systems for loose sows as opposed to eg. Sweden and England. There, legislation was passed without any technical foundation and the latest figures from the Swedish summer count show a decline in the pig population of 9% compared to the previous year and the situation is similar in England.

Effort areas

It is the National Committee's ambition that Danish pig production should be leading on the soft parameters but we must not progress so fast that we lose our efficiency and competitiveness. In the years to come, we will aim at further developing production systems such as WTF and housing units for weaners and finishers that meet new legislative requirements. However, we will also aim at gaining the necessary knowledge regarding feeding, health and immunity management that together with efficient breeding will raise the necessary finance.

In many sow herds it is possible to raise the genetic level considerably by using AI and improved selection of young sows. Thus the initiative of nucleus management in production herds has been hugely successful. Producers of finishers should make demands to weaners' genetics in the same way as demands are made to health status.

2000 was the year when it became obvious that the eradication strategy for Salmonella DT 104 was untenable. Still more herds are discovered and it is now a great challenge to find the right model for handling this zoonosis.

Thank you for this year

As is apparent from this annual report, the National Committee has an extensive test programme. This is only possible thanks to our cooperation with the many pig producers supplying herds, the companies dealing in housing units and feed and others contributing positively, and the governmental research institutions and laboratories often involved in the projects. We thank these cooperators, our employees and the basic organizations behind the National Committee for Pig Production for yet another eventful year with many new challenges.

Yours sincerely,

The National Committee for Pig Production

Lindhart Nielsen / Orla Grøn Pedersen

The National Committee for Pig Production

Chairman, farmer
Lindhart Bryder Nielsen,
Løgstør,
Elected at the annual meeting

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

Farmer Ole Kappel,
Hurup,
Elected at the annual meeting

Farmer Jørgen Pedersen,
Ringkøbing,
Elected by the Danish Bacon and Meat Council

Farmer Per Højgaard Andersen,
Odder,
Elected by the Danish Bacon and Meat Council

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Snedsted,
Elected by The Danish Family Farmers' Association

Smallholder Aksel Andersen,
Bogense,
Elected by The National Council for Pigs of the Danish Family Farmers' Association

Farmer Boye Tambour,
Søllested,
Elected by Danish Pig Producers' Association

Director Orla Grøn Pedersen,
The National Committee for Pig Production

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Budget and activities

Organisation and budget of the Committee

The National Committee is founded by four basic organisations: Danish Bacon and Meat Council, Danish Farmers' Union, the Danish Family Farmers' Association and Danish Pig Producers' Association. Besides representatives from these organizations, the Committee consists of freely elected pig producers elected at the annual meeting and members elected by the local pig production committees.

The Committee safeguards tasks of development and information within Danish pig production and has for the financial year 2000/2001 a total net budget of DKK 89.4 m. There has been a slight expansion of the budget corresponding to the development in inflation thus facilitating the implementation of projects.

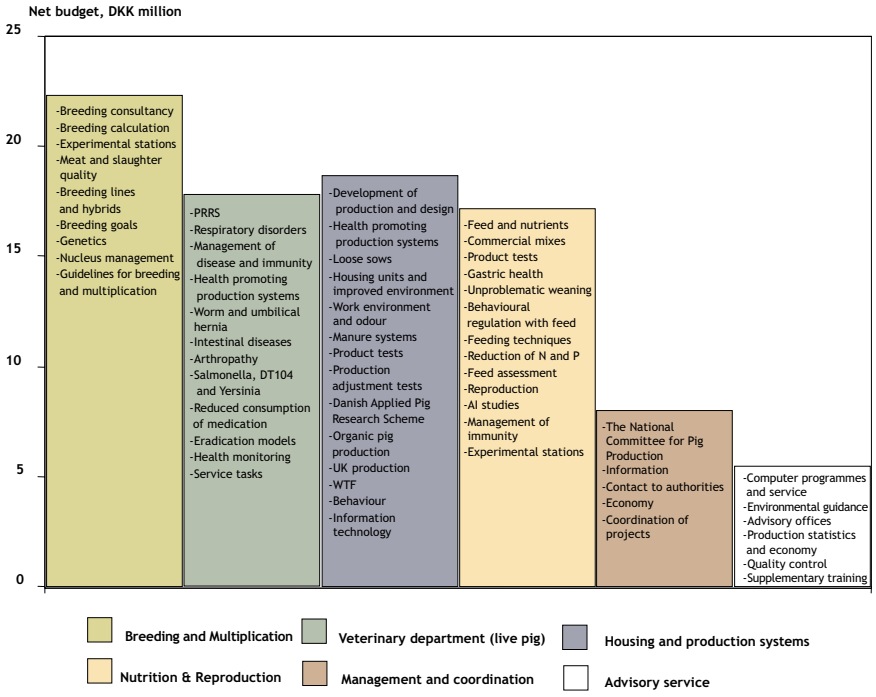
Work in the Committee is primarily financed via the Pig Levy Fund and the Per Mille Levy Fund, but is also subsidized by basic organizations and public funds. Furthermore, there is a considerable own earning from actual services such as veterinary advice and laboratory studies, information material and meetings, companies contributing to tests, etc.

Strategy and new pro-jects of the Committee

For years, the activities in the Committee have been affected by demands and requests from society. Efforts concerning animal welfare, Salmonella, environment, abolition of growth promoters, etc. have been successful. Danish pig production occupies a leading position in these areas, and we have reached this without jeopardizing our efficiency. Pigs per year sow, daily gain and feed consumption are not surpassed by any other country with a large pig production.

To ensure efficiency further, the entire budget expansion was basically made in this effort area. When adopting the budget for the coming year, the Committee decided to initiate the following new projects:

- Zoonosis diagnostics
- Intervention against Yersinia and Toxoplasma
- Salmonella infection dynamics
- Optimum work procedure and work rationalization
- WTF (weaning to finish in same pen)
- Weaning of large, healthy and uniform pigs
- Unproblematic weaning in weaner units
- Lawsonia (regional enteritis and dysentery)
- Dissemination
- Disease problems, injuries and abnormal behaviour in loose sows
- Tail biting
- Longevity
- Cloning of F4-coli-gene
- Heredity to disabilities
- Injection injuries



The National Committee for Pig Production - effort areas

	DKK million 2000	2001
Product safety	4.8	5.2
Product quality	3.5	2.9
Environment and work environment	5.7	5.7
Efficiency and breeding	20.2	23.4
Housing systems	15.6	15.1
Health	18.4	17.6
Professional alert, information and advisory service	18.9	19.6
The Na. Comm. for Pig Production	87.1	89.4

Prognosis for production systems until 2010

Work with developing new housing systems will remain a high priority in the coming year. The aim is to develop housing systems meeting increased requirements to animal welfare, but where building costs, labour and efficiency are at least level with the production systems still allowed in the rest of the world.

To ensure the best possible relation between new projects initiated and the production systems expected to be dominant in the next 5-10 years, the National Committee has made a comprehensive analysis of the need for new knowledge. In this connection, an estimate for structure development was made.

The number of pig herds is halved approx. every 10 year, and in 2010 we expect approx. 7,000 herds to be left. The number of herds with sow units drops slightly more than the number of finisher herds. The integrated systems with housing units divided into sections are expected to dominate in many years to come, but in the long run they will be replaced by multisite systems.

Multisite generally fits the Agricultural Holdings Act that limits the possibilities of increasing herd size to more than approx. 250 animal units (au) on each premise. Together with increased requirements of disease management, this causes the production to be increasingly specialised at herds producing weaned pigs, wea-ners or finishers. Relatively large sow herds will be established containing at least 500 sows that will often produce their own young sows.

Batch operation in sow herds combined with sectioned operation from farrow to slaughter is expected to be predominant in the future due to advantages in health and labour. However, batch operation involves tight management as individual housing units must be filled with a certain number of pigs at a time and emptied at certain points. Quality requirements for pigs are also higher than at continuous operation as all pigs must reach slaughter weight and be transferred before the production period stipulated in advance. This will contribute to a still wider cooperation between sow units and producers of finishers.

Development in herd structure (prognosis)

	Herd size		
	2000	2005	2010
Number of sows, thousands	1.050	1.100	1.100
Number of herds with sows and finishers	6.500	4.600	2.800
Number of herds with sows alone	2.000	1.800	1.800
Number of sows per herd	125	275	350
Number of herds with 500+ sows	300	400	800
Share of herds with 500+ sows, %	14	18	35

Development in herd types (prognosis)

	Herd size		
	2000	2005	2010
Sows alone, %	8	20	40
Sows and weaners, %	40	35	25
Number of herds with sows, weaners and finishers	52	45	35

Development in housing types (prognosis)

	Herd size		
	2000	2005	2010
Multisite, % of produced	10	40	80
Loose gestant sows incl. outdoor, %	30	60	90
Lose nursing sows incl. outdoor, %	8	10	15
Share of purchased young sows, %	50	40	25

Productivity

Development

In 1999 the sow population peaked preliminarily at 1,080,000 sows. In 2000 this is expected to drop to 1,060,000 which is slightly below the 1998 level. In 1999 22.5 million finishers were produced and according to the prognosis this will decrease to 22.3 million in 2000.

Results in herds with efficiency control

Sows

In sow units productivity still rises by approx. 0.1 pigs per year sow. The explanation is a rise in the number of liveborn of 0.2 and in the number of weaned per litter of 0.1. Less positive is the fact that more pigs die pre-weaning, and sadly this is also seen post-weaning. Overall the figures for daily gain and more dead pigs post-weaning indicate that the abolition of growth promoters has not been unproblematic for all herds.

The difference between the 25% best and 25% poorest herds shows that the best with 24.6 pigs/year sow have more than 5 pigs more per year sow than the poorest. Post-weaning both gain and mortality are considerably better with 420 g daily gain against 400 g for the poorest 25% of the herds.

Finishers

The increase in gain continues while feed consumption has dropped to the 1997 level. Lean meat percentage has increased slightly as has unfortunately the percentage with deduction.

The difference between the 25% best and 25% poorest is distinct at feed conversion where the best reached 2.71 against 3.07 FUp/kg gain for the poorest. This also applies to gram daily gain where the figures are 868 g against 732 g.

Development in pig production

Year	1995	1996	1997	1998***	1999	2000*
Sows, 1000	984	980	1040	1070	1080	1060
Produced, million **	20.2	20.1	21.1	23.0	22.5	22.3
Slaughter weight	74.6	75.2	76.0	77.2	76.6	76.5
Lean meat percentage	59.9	59.8	59.9	60.0	60.0	60.0

* Prognosis
** Incl. export of living animals and sows, boars, young females etc.
*** 53 weeks

Sows and weaners

Year	1997 All	1998 All	1999 Alle	1999 Poorest 25%	1999 Best 25%
Weight per delivered pig, kg	29.1	30.0	29.4	30.8	28.6
Feed per produced pig, FUp	97.1	99.4	106	129	84
Produced pigs per year sow, no.	21.9	22.2	22.3	19.4	24.6
Litters per year sow	2.26	2.26	2.25	2.15	2.3
Year sows	195	225	223	178	265
1st parity litter, %	21.0	20.9	21.6	21.7	21.1
Liveborn per litter, no.	11.3	11.5	11.7	11.3	12.1
Stillborn per litter, no.	1.0	1.0	1.1	1.1	1.0
Weaned per litter, no.	10.0	10.2	10.3	9.6	10.8
Age on weaning, days	29	29	29	32	28
Weight on weaning, kg	7.3	7.2	7.2	7.5	7.0
Dead post-weaning, %	2.8	2.9	3.6	5.6	2.3
Daily gain post-weaning, g	419	427	407	400	420
Age at 30 kg, days	82.8	82.9	85.3	89.8	81.7
Non-productive days per litter	17.0	16.9	17.0	22.8	12.9

Finishers

Year	1997 All	1998 All	1999 Alle	Poorest 25%	Best 25%
Produced pigs, no.	2.681	3.005	2.991	2.627	3.413
Daily gain, g	778	786	798	732	868
Feed per kg gain, FUp	2.89	2.91	2.89	3.07	2.71
Weight on penning, kg	30.6	31.7	31.0	30.4	32.3
Average slaughter weight, kg	76.0	77.1	76.6	78.0	75.7
Average lean meat percentage	59.9	59.9	60.0	59.9	60.1
Dead and rejected, %	3.24	3.38	3.58	5.23	2.35
Incidence of pleurisy rec. at slaughter	20.5	15.4	15.6	18.8	12.0
Total including deduction, %	5.5	6.6	7.3	8.7	6.3

Economy

Development

In 1998 and 1999, economy in Danish pig production was the poorest for many years. In 2000 it looks slightly brighter with an expected price incl. bonus payment of DKK 10. All costs having been paid, a total result of DKK 23 per pig is expected.

Analysis of accounts

Many herds have production accounts drawn up. Here the accounts incl. all earnings, expenses and work hours used are divided into sow unit and finishers.

Results for both sow units and finishers show yet another year with a loss due to the very low price in 1999.

Sow units

Results do not reveal great production progress, however they do reveal a decent decrease in feed costs from DKK 3,417 to DKK 3,182 mainly because a feed unit has become DKK 0.09 cheaper. The price was slightly higher in 1998, ie the price of a weaner was approx. DKK20 higher than in 1999. However, the total result of DKK 2,214 is considerably higher mainly as expenses for both maintenance, depreciation and not least yield increased compared to 1998. The calculation has been made with 7% in yield of buildings, inventory and herd.

Finishers

Being DKK -90, the result for finishers is basically the same as last year. Gross margin rose by DKK 7 mainly because the price of feed has dropped by DKK 0.11/FUp and feed efficiency has risen by 0.05 FUp per kg gain. Capacity expenses, esp. labour and yield, however, have increased so that overall the result is as negative as in 1998.

Barometer for Danish pig production for new building

Year	1996	1997	1998	1999	2000*
Price incl. bonus payment, DKK/kg	11.39	11.70	8.32	8.02	10.0
Average feed price, DKK/FUp	1.38	1.37	1.32	1.21	1.19
GM per pig from farrow to slaughter, DKK	360	383	152	159	310
Capacity expenses, DKK	114	118	123	127	125
Finance expenses, DKK	180	187	180	180	162
Result per pig, DKK	66	78	-151	-148	23

* Prognosis

Average of production accounts for pig herds with sow units and herds with finisher units

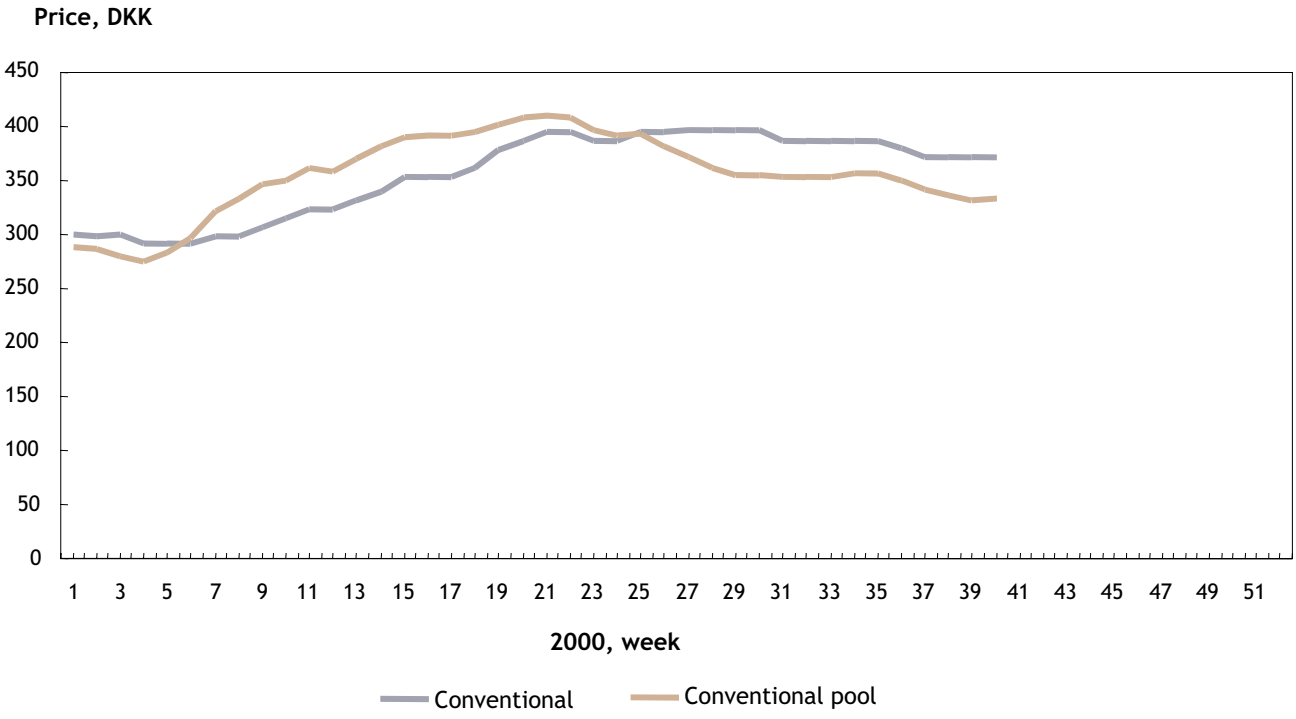
	Sow units		Finishers	
	1998	1999	1998	1999
Number of properties	173	153	160	151
Number of year sows	203	214		
Produced pigs per year sow	22.4	22.4		
Produced finishers			2.697	2.801
Weight, kg per produced weaner	29	30		
Gain, kg per finishers			71	71
FUp per produced weaner	107	107		
FUp per kg gain			2.95	2.90
Price, DKK per produced pig	291	272	639	601
Price, DKK per FUp	1.42	1.33	1.19	1.08
Gross profit, DKK	6.562	6.133	334	313
Feed expenses, DKK	3.417	3.182	249	222
Veterinarian and medication, DKK	267	278	4	3
Other expenses, DKK	233	250	4	3
Gross margin, FKK	2.645	2.429	78	85
Maintenance, DKK	209	232	14	13
Energy, DKK	219	226	7	8
Labour, DKK	1.959	1.879	68	71
Depreciation, buildings/inventory, DKK	814	940	34	33
Yield, buildings/inventory	779	1.138	35	41
Yield, herd	221	228	8	9
Result per year sow/finisher, DKK	-1.556	-2.214	-88	-90

Source: The National Department of Farm Accounting and Management

Sale of weaners and breeding animals

10-11 million weaners are sold annually, the majority of them in pig circles that follows the estimated weaner price or a combination of this and the pool price. In spring 2000, pool price was approx. DKK 40 higher than the estimated weaner price until the situation as usual chan-ged in mid-May, and since then pool pigs have been equally lower. On average there has been no difference in the first three quarters of 2000.

UK production, PRRS, Salmonella, batch operation and all in/all out production make still larger demands to the intermediaries of the cooperation between buyer and seller. Lately, the National Committee has focused on the pigs' genetic level. Numerous tests have shown that pigs' genetic levels are significant, and there may easily be a genetic difference of DKK 5-25 per pig. When buying weaners one should know the sow keeper's recruitment strategy. With AI and nucleus management or AI and purchased young females there is no need for concern. However, if young females are selected among finishers, and home produced boars are used there is need for concern, and alarm bells should ring for producers of finishers.



Sale of animals from breeding and multiplier herds

Breed	Health status	Female animals 97/98	98/99	99/00	Boars 97/98	98/99	99/00
Landrace	SPF, etc.	9.444	8.538	7.833	720	429	460
	Conventional	1.291	632	258	134	76	64
Large white	SPF, etc.	5.306	3.617	3.256	1.524	1.030	649
	Conventional	601	228	572	124	104	109
Duroc	SPF, etc.	567	462	210	2.546	2.047	2.030
	Conventional	0	0	3	67	50	78
Hampshire	SPF, etc.	37	20	82	76	47	17
	Conventional	0	0	0	3	3	23
Purebred animals, total	SPF, etc.	15.354	12.637	11.381	4.866	3.533	3.156
	Conventional	1.892	860	833	328	233	274
Cross-bred animals, total	SPF, etc.	205.453	190.493	156.264	6.324	4.946	3.840
	Conventional	30.147	20.122	30.251	909	627	443

SPF, etc. contains sale from herds with SPF-, MS-, SKD-/SKM status and sale via S.E.A. and caesarean incision animals.

Breeding progress

Table 1 shows annual breeding progress in 1996-1999 for each breed and the average of this period for all four breeds. The pre-sent breeding target with the characteristics daily gain from 0-30 kg, pH and slaughter loss has applied since the beginning of 1998.

Slaughter loss is still in a very weak, unfavourable development seen as an average over four years, but has been reduced ie. improved in 1999. Thus the characteristic develops in the right direction. pH has improved on average by 0.006 units contributing by DKK 0.30 to the value of breeding progress. The characteristic's development varies slightly between the breeds but has on average increased slightly as can be seen from the table.

Weaner gain from 0-30 kg has increased slightly. The pigmented breeds contribute positively while the white ones pull in the wrong direction. As the characteristic is represented in both breeding goals, the white breeds are also expected to contribute positively in the years to come.

Breeding progress is of great financial importance. As an average of all breeds, gross margin per finisher has improved by DKK 9.27 per year on average of the period 1996-1999.

Table 1. Breeding progress in the last four years, stated per year and breed. Average progress per year has been calculated for each breed and as an average of all four breeds.

Breed	year	Gain (30-100 kg) g/day	Feed conversion FUp/kg gain	Lean meat %	Slaughter loss kg	Pigs born per litter no.	Gain (0-30 kg) g/day	Strength points	pH
Duroc	1996	25.8	-0.04	0.11	0.10	-	4.3	0.01	0.003
	1997	21.1	-0.03	0.04	0.01	-	1.3	0.01	-0.001
	1998	24.3	-0.04	0.13	0.17	-	2.2	0.04	0.002
	1999	15.0	-0.04	0.26	-0.02	-	2.2	0.03	0.011
Average	4 år	21.6	-0.04	0.14	0.07		2.5	0.02	0.003
Hampshire	1996	21.9	-0.03	0.24	-0.01	-	0.7	0.01	0.002
	1997	20.3	-0.04	0.12	0.11	-	1.6	0.02	0.001
	1998	19.7	-0.03	0.12	-0.05	-	3.7	0.04	0.003
	1999	19.1	-0.02	0.00	-0.11	-	3.7	0.02	-0.001
Average	4 år	20.3	-0.03	0.12	-0.02		2.4	0.02	0.001
Landrace	1996	15.4	-0.03	-0.01	-	0.40	4.7	0.04	0.005
	1997	18.9	-0.02	-0.17	-	0.56	-0.2	0.05	-0.004
	1998	18.0	-0.02	-0.02	-	0.55	-4.0	0.09	0.010
	1999	14.4	-0.02	0.04	-	0.40	-1.8	0.09	0.002
Average	4 år	16.7	-0.02	-0.04		0.48	-0.3	0.07	0.003
Large white	1996	16.8	-0.02	0.02	-	0.23	-0.8	0.08	0.090
	1997	10.3	-0.01	-0.03	-	0.16	-2.4	0.10	0.110
	1998	14.0	-0.01	0.00	-	0.21	0.0	0.07	-0.120
	1999	11.6	-0.01	-0.01	-	0.19	0.3	0.04	-0.100
Average	4 år	13.2	-0.01	0.00		0.20	-0.7	0.07	0.000
Average four breeds	4 år	18.0	-0.025	0.06	0.013	0.34	1.0	0.045	0.006

Production level

In both the herd test and the test at Experimental station Bøgildgård, the breeding animals achieved production results at a high level compared to the production results achieved in production of finishers. The high production result may be explained by high standards for management, hygiene and feed quality. Furthermore it is important to use ad libitum feeding and that the stocking density is fairly low.

Tables 1-4 show the production results achieved at Bøgildgård and in the breeding herds in 1999.

Table 1. Average production results, achieved by boars at Experimental station Bøgildgård, 1999.

Breed	Number	Gain (30-100 kg) (g/day)	Feed conversion (FUp/kg gain)	Lean meat (%)	pH in loin (units)	pH in ham (units)	Slaughter loss (kg)
Duroc	1.234	961	2.37	59.7	5.57	5.68	26.4
Hampshire	785	884	2.42	62.5	5.45	5.47	23.6
Landrace	1.010	966	2.44	60.8	5.52	5.66	24.9
Large white	1.003	959	2.37	61.2	5.53	5.61	24.2
Total	4.032	-	-	-	-	-	-

Table 2. Average production results, achieved by boars in the breeding herds in 1999.

Breed	Number	Gain (0-30 kg (g/day)	Gain (30-100 kg) (g/day)	Lean meat (%)	Strength (points)
Duroc	8.715	382	977	59.1	3.11
Hampshire	1.215	367	859	61.4	3.07
Landrace	13.120	390	957	61.4	3.00
Large white	11.727	376	954	61.0	3.19
Total	34.777	-	-	-	-

Table 3. Average production results, achieved by young sows in the breeding herds in 1999

Breed	Number	Gain (0-30 kg (g/day)	Gain (30-100 kg) (g/day)	Lean meat (%)	Strength (points)
Duroc	9.923	380	930	59.1	3.16
Hampshire	1.937	370	825	61.4	3.12
Landrace	18.534	391	927	61.5	3.18
Large white	14.547	378	922	60.9	3.32
Total	44.941	-	-	-	-

Table 4. Litter size for purebred litters produced in the breeding herds in 1999.

Maternal breed	Litter size (purebred litters in breeding)	Gilt percentage
Duroc	9.85	68.5
Hampshire	8.32	59.4
Landrace	13.28	63.2
Large white	11.56	57.4

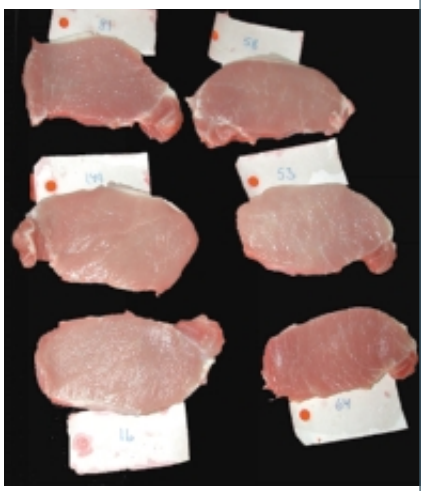
Meat quality

Heredity of meat colour

Calculations have been made of meat colour's heredity and relation to performance traits of Landrace, Large white and Duroc. Meat colour was measured with Minolta CR300 equipment measuring brightness (L*), redness (a*) and yellowness (b*) on a chop that had been oxidized for approx. 1 hour. Meat colour was also determined subjectively (Jap) according to the JPSC Scale.

The calculated heredities differed only slightly between the three breeds. Table 1 shows the values for Landrace. The heredity of Jap, L*, b* is moderate while a* value has a high heredity. The genetic connections between colour measures and performance traits are very low and in several cases with different signs. The conclusion of this test is that selection for meat colour is possible and that selection for the performance traits daily gain, feed conversion and lean meat content does not affect meat colour negatively.

The project is conducted with aid from The Directorate for Food, Fisheries and Agro Business under the FØTEK-II programme.



Breeding for daily gain, feed conversion and lean meat percentage does not affect meat colour negatively.

Table 1. Heredity (fat, the diagonal) and genetic connections for colour measures for Landrace.

		Colour	L*	a*	b*
Colour		0.33	-0.91	0.55	-0.20
Minolta	L*		0.25	-0.18	0.50
	a*			0.58	0.68
	b*				0.23

Table 2. Genetic connections between meat colour measures and performance traits.

Perfomance traits	Colour measures	Breed Landrace	Large white	Duroc
Daily gain	Sub. JPCS scale	-0.04	0.08	0.07
Lean meat percentage	Sub. JPCS scale	0.00	-0.04	0.07
Feed conversion	Sub. JPCS scale	-0.03	-0.08	-0.04
Daily gain	a*	-0.10	-0.30	0.06
Lean meat percentage	a*	-0.03	0.15	-0.07
Feed conversion	a*	-0.04	-0.09	0.16
Daily gain	L*	0.12	-0.21	0.15
Lean meat %	L*	-0.16	0.21	-0.26
Feed conversion	L*	-0.02	-0.06	0.08

Does breeding work for ultimate pH

Impact of ultimate pH, daily gain and lean meat content was studied in 2,297 DD(LY) finishers that were offspring from 59 Duroc boars and 233 LY/YL sows. The 59 Duroc boars were selected so that the spread in breeding values for ultimate pH was as large as possible. Only sows without the halothane gene were used for production of test pigs.

The test pigs were slaughtered at usual slaughter weight and one week's delivery was divided equally between Danish Crown's branches in Bjerringbro and Horsens.

The day after slaughter the following meat quality parameters were registered: pH in loin, ham, neck and tenderloin and drip loss in loin. Drip loss was also determined in part of the carcasses with a container method from the Danish Meat Research Institute.

The only significant difference found between the two slaughterhouses for the measurements of meat quality was pH in loin, which was 0.03 units higher in the pigs slaughtered at Danish Crown in Bjerringbro.

Table 1 on page 12 shows the impact of breeding for ultimate pH in the individual muscles. Impact of pH tended to be highest when the pigs were slaughtered at Danish Crown in Bjerringbro. Only impact of pH in ham revealed a significant difference.

Impact of daily gain and lean meat content was studied. It was determined to 92% and 208%, respectively.

Meat quality

Performance test of meat quality

The possibility of making a performance test of the meat quality traits meat colour, ultimate pH and content of IMF has been studied as part of the project aided by FØTEK-II "Optimising meat colour, drip loss and eating quality in pork".

The Dept. of Animal Product Quality at the Danish Institute of Agricultural Sciences has made analyses of contents of glycogen, glycerol and myoglobin on muscle biopsies collected from living test pigs at Bøgildgård. Ultimate pH in loin and ham and meat colour in loin was measured in the slaughtered test pigs. The Dept. for Breeding and Multiplication made calculations of heredity and genetic connections of meat quality measures and performance traits, respectively. Hampshire was excluded from the calculations as the breed houses the RN-gene that affects the glycogen content and thereby the meat quality measures.

The test revealed a relatively high heredity for glycogen content (h2 =0.37) while heredity for myoglobin content (h2 = 0.19) and glycerol content (h2 = 0.14) was somewhat lower.

Genetic connections between myo-globin and meat colour measures for Minolta L*, a* and b* and the JPCS scale were -0.56, 0.69, 0.15 and 1.0, respectively.

It can thus be concluded that myoglobin content is a good measure for meat's brightness (L*), redness (a*) and subjectively assessed meat colour according to the JPCS scale.

Table 2 shows the genetic connections between glycogen content and glycerol content and pH in loin and ham, respectively.

Genetic connections between glycogen content and glycerol content and pH in loin and ham are relatively high, and they are all significant.

pH in pork may be improved by selecting for lower content of glycogen and higher content of glycerol. No feasibility study has yet been made. This will determine whether performance test for meat quality should be included in work with breeding.

Tests show that breeding for ultimate pH works!

Table 1. Impact of ultimate pH for test pigs

	Impact in percent Bjerringbro	Horsens	Average Bjerringbro - Horsens
pH in loin	66 ± 20	56 ± 18	62 ± 18
pH in ham	96 ± 24	50 ± 24	72 ± 22
pH in necj	168 ± 52	92 ± 50	130 ± 46
pH in tenderloin	60 ± 26	76 ± 26	68 ± 22

Table 2. Genetic connections between content of glycogen, glycerol and pH, respectively

	pH in loin	pH in ham
Glycogen content	-0.54	-0.33
Glycerol content	0.25	0.59

Research and development

KerneStyring®
(nucleus management)

In 2000 the number of participating production herds has risen to more than 200. Thus as expected there is both interest in and need for management in terms of breeding in the herds that have chosen closed operation. The Dept. for Breeding & Multiplication estimates, though, that the number of herds able to take advantage of KerneStyring® is far higher than the pre-sent 200 herds as only 50% of the need for young sows in Danish pig production is annually covered by purchase, ie. 200-250,000 young sows are produced annually without any management of their genetic background.

The basis of KerneStyring® is well-documented, as the producer's possibility of optimising his breeding strategy via KerneStyring® is based on tools also used in the multiplier herds. The herd's breeding sows are registered in a pig breeding data base. On the basis of the herd ow-ner's report on influx and transfer of breeding animals and services and farrowings, a weekly index is calculated of the production herd's re-ported sows. The index level of the breeding animals can be seen from the breeding report and the management lists available at www.danavl.dk.

Present experiences with KerneStyring® show:

The quality of LY/YL and zig-zag young sows in nucleus management herds using name and/or special semen may approach the average level in the multiplier herds. However, for most herds reaching that will require many years' effort. Several conditions impede competition with multiplier herds such as the number of purebred sows in the herd and the index level of the boars used. Table 1 shows the index level in the nucleus management herds.

Table 1. Average index level in the herds practising KerneStyring®, August 2000

	Purebred nucleus		Zig-zag-herd
	Landrace	Large White	
Average female index	83	91	83
Average YL/LY litter index	95	95	-
Average zig-zag litter index	-	-	97
Average sow index at purebred service	100	104	-
Average boar index at purebred service	126	125	-
Average sow index at cross-bred service	89	95	-
Average boar index at cross-bred service	122	119	-
Average sow index at zig-zag service	-	-	92
Average boar index at zig-zag service	-	-	122

KerneStyring® for boars in the participating herds' production of finishers has shown that it is very difficult to produce own boars of a high breeding quality in a nucleus herd. Home produced Duroc boars are typically approx. 30 index points below the index level for Duroc se-men from A.I. stations. In terms of breeding, this corresponds to a financial loss of DKK80-100 per litter.

KerneStyring® is a dynamic management tool to be developed continuously. The agenda comprises electronic transfer of data from ef-ficiency control programmes, nucleus management of several recruitment strategies (eg. (YD)L sows), inclusion of litter size in the index calculation for zig-zag sows, quality declaration of weaners in terms of breeding (finisher index) and new key figures for management reports.

Removal of the RN-allele

The Hampshire breed has a gene found in the versions (alleles) rn^+ and RN^-. Pigs with genotype RN^-rn^+ and RN^-RN^- have abnormally low pH after slaughter causing greater drip loss, less profit from processing and larger slice loss unless phosphates are added during processing.

Therefore it is desirable to remove the allele gene from Hampshire which is the only breed housing the allele. The allele can be removed by cross-breeding other breeds without the allele or by selecting within the Hampshire breed. Thorough considerations opted for selecting within Hampshire by using a DNA test recently made available.

The allele is removed as follows:

- Hampshire index is adjusted for RN^- status
- From November 1 1999, RN^-RN^- boars are no longer transferred to AI
- From November 1 2000, only rn^+rn^+ boars are transferred to AI.

Requirements are also made to the production of HD boars. As of April 1 2000, Hampshires with genotype rn^+rn^+ or RN^-rn^+ are to be used. As of April 1 2001, requirements to genotype rn^+rn^+ will be tightened.

Research and development

The RN allele is removed from Hampshire

Sows' longevity

Presently there is great attention to sows' longevity. The genetic development in sows' longevity and bone strength has been questioned. It has been noted that heavy selection for higher lean meat percentage and daily gain has influenced sows' longevity negatively.

Presently no results can verify or reject this claim. It is anyhow important to follow the genetic and phenotypic development and to examine the possibilities for improving longevity and leg strength through breeding efforts.

Since 1995, all performance tested animals have had their strength assessed in connection with scanning. The results are part of breeding and thus already now regard is made to leg strength. However, knowledge lacks on the genetic variation of longevity, of the relation between strength and longevity, and of the relation between performance traits and longevity. Therefore a test has been initiated to collect and analyse data material that may answer the above questions.

However, longevity cannot be registered in breeding and multiplier herds as removal of purebred animals primarily takes place on the basis of breeding index. The registrations must therefore be made on LY sows in production herds. Origin, lit-ter size, cause and time of removal are registered. Furthermore, on penning, strength assessment of the sows must be carried out according to the same guidelines as in breeding herds.

The collection period runs 3-4 years before test results may be computed. The study supplies knowledge of the genetic variation for longevity and the relation between traits in breeding goal and longevity. Thus an improved basis is provided for assessing how breeding affects the sows' longevity.

Breeding for health

Development within DNA technology has presented new opportunities. Studies can now be carried out that may identify genes with large effect on financially important traits. It is possible to conduct a complete scanning of the pig's genes in order to identify genes influencing traits defined by few genes and traits affec-ted by many genes. This is called a genome scan.

The Dept. for Breeding & Multiplication has initiated a project to study whether single genes exist that greatly influence disease resistance, traits for production and meat quality. The project is divided into two phases, the first one consisting of data collection and analyses. The collection of data takes place in three production herds where there is a certain prevalence of pneumonia.

For production of test pigs, 10 specially selected Duroc A.I. boars and LY/YL sows free of the halothane gene are used. Each Duroc boar must have 1,000 offspring. In the first 24 hours each single pig is marked with an individual number for identifying the pig's origin.

It is extremely important that a litter is observed from farrow to slaughter. The pigs must have completely identical environmental exposure as the test of whether there are single genes with a great effect, is conducted within a litter.

The test pigs' weight at birth, weaning and transfer to finisher unit is registered at individual animal level, ie. the pigs' gain in various weight intervals can be calculated. All treatments for diseases carried out on test pigs are registered from farrow to slaughter or death, and furthermore deformities, umbilical hernia, etc. are registered. An autopsy will

be performed on pigs that die before slaughter.

When the largest pig in the litter weighs approx. 115 kg, all test pigs are slaughtered. At the slaughterhouse they are marked individually, and an Extended Health Control (EHC) is made on the plucks. Furthermore KC-lean meat percentage, slaughter weight, and the meat qua-lity traits meat colour, ultimate pH and drip loss are registered. The test pigs are slaughtered in July 2000 to August 2001.

If the results from phase 1 indicate that there is a difference in the frequency of disease, gain or in meat quality in litters from different boars, the second phase is carried out. In this phase a test is made of the genome of the approx. 10,000 test pigs and their parents.

The project is carried out in coop-eration with the Dept. of Animal Breeding and Genetics at the Danish Institute of Agricultural studies, the Dept. of Clinical Studies at the Royal Veterinary and Agricultural University, and the Veterinary Dept. of the National Committee for Pig Production.

Sow tests at Grønhøj

The project at Grønhøj concerning comparison of different recruitment strategies in the sow unit is well on the way. The idea is to test the sow combinations YL-,(YD)L- and zig-zag sows, and calcu-

On the basis of disease registrations from approx. 10,000 test pigs, it is examined whether single genes exist that have a great influence on disease resistance.

late their efficiency in the same environment. The test will run for some years, and will produce a total of 1,000 litters of each combination. The zig-zag sows that have presently had litter results are primarily L(LY) sows. Table 1 shows the preliminary results. No conclusions can yet be made of the test.

Table 1. Number of litters and average number of born pigs in the first six litters

Breed	1st litter		2nd litter		3rd litter		4th litter		5th litter		6th litter	
	Number	Av. born	Number	Av. born	Number	Av. born	Number	Av. born				
LL	145	11.37	108	12.46	76	12.48	50	12.90	38	13.61	21	13.43
(YD)L	175	12.02	129	13.07	94	14.18	36	14.03	5	15.20	-	-
YL	210	11.83	149	12.89	108	14.12	51	15.04	16	13.81	-	-
Zig-zag	30	12.10	14	12.57	1	14.00	-	-	-	-	-	-

Artificial insemination (AI)

Sale of semen

In total, approx. 45% of all services takes place with AI. The figures have been computed from a population of 1,100,000 sows. In 1999/2000, DanBred's AI stations sold 2,670,759 semen doses, which is an increase of approx. 8% compared to the previous year.

Dilution of semen

The final stage of a test of the semen diluent Androhep is now finished with the final inseminations. Semen collected Friday and diluted with Androhep or EDTA is compared to mixed semen collected Monday and diluted with EDTA. The semen is dispatched at the same time on Monday for use that day or the day after. Reproduction results show no significant difference so far.

Antibiotics for semen

Antibiotics are added to the semen to reduce the risk of transferring bacteria on sale of semen. A herd test with a new antibiotics combination is finished with the final inseminations.

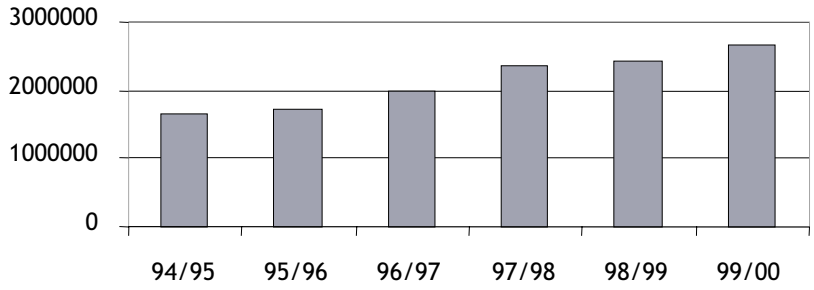
Durability and concentra-tion of semen

A test of the relation between the semen's age and concentration concerning production results has been initiated. Sperm cell concentrations from 1.5 bn to 3.0 bn motile cells are used either as 24 or 48 hours old semen on the first insemination.

Large white semen's process and storage tempera-ture

Previous results have shown that large white semen used for large white sows gives a significantly higher return rate than large white semen used for Landrace sows. The reason for this has not been established, but one hypothesis is that large white semen is more sensitive towards changes in temperature. A test has been initiated where the temperature is measured from the semen leaves the AI station and until it is used in the herd.

Semen sale the last 6 years from DanBred's AI stations



Catheter gel's effect on semen

Six Danish and foreign catheter gels have been tested in a laboratory test to establish whether they have a damaging effect on semen expressed as motility of sperm cells. It is concluded that except one – "Katetergel" (Hatting AI) – all gels were damaging to sperm cells.

Internal AI versus processed semen

A test has been initiated to see whether there is any difference in re-production results when using processed semen compared to using semen collected in the herd. Both "types" of semen are tested in the same herds.

Determination of vitality and concentration of sperm cells

A new method for determining the concentration of sperm cells has been developed in cooperation with the Royal Danish Veterinary and Agricultural University and the Federation of Danish A.I. Societies supported by the Directorate for Food, Fisheries and Agro Business. Preliminary results with correlation to total born pigs per litter look very promising. The method is at present patented and the AI stations are expected to implement it in the years to come.

Feeding loose, gestant sows

In many herds, feeding according to appetite has removed aggressive behaviour of loose, gestant sows. The feeding principle may be employed in three ways:

- Complete diets with roughage.
- High-fibre dry feedstuff ad libitum.
- Feeding with concentrated feed and roughage ad libitum.

It is important that the feeding principle covers the sows' basic need for nutrients so that nutritional restrictions do not reduce production results. In two periods in particular, nutritional restrictions affect production results: the first 3-4 weeks after service (number of pigs born) and the last 2 weeks before farrowing (the pigs' birth weight). Furthermore, young females/gilts must be given the necessary energy to grow to become well-functioning sows.

Use of high-fibre dry feedstuff or complete diets with roughage is only recommended for gestant sows in solid groups as it there is possible to supply extra feed in critical periods.

Free access to roughage supplemented with an addition of concentrated feed in feeding stalls or feed dispensers may also be used in sections with dynamic groups.

Complete diets with roughage

A test of different feedstuffs – whole-crop silage and sugar beet waste has been carried out. Furthermore a number of herds in which the sows were fed corn silage or pectin feed were observed.

It is important that the feed is homogeneously mixed to ensure a uniform intake of nutrients and that the roughage has a low energy content. So far pectin feed seems to meet these requirements the best.

High-fibre dry feedstuff ad libitum

A test of high-fibre dry feedstuff is carried out in three herds. The sows fed ad libitum are fed two different gestation mixes: one mix with a.o. 30% sugar beet pellets in the first three weeks after service and two weeks before expected farrowing, and a mix with a.o. 50% sugar beet pellets in the intervening period. In the nursing period the sows are fed a mix with 10% sugar beet pellets. With this concept the sows are supplied fibres during the entire reproduction cycle and it is assumed that the content of starch is sufficient to ensure implementation of embryos and their growth in the last part of the gestation period.

The sows are fed via single space dispensers. The first measurements of the feed consumption show that the sows eat approx. 2.9 FUp per day of the mix containing 50% sugar beet pellets. It is important to be aware that the sows' feed intake can only be controlled via the feed's composition of high-fibre feedstuffs and via the dispenser's shape and adjustment. The dispenser used has been adjusted so that it is almost closed. The sows have to work a long time to get sufficient feed.

Feeding with concen-trated feed and roughage ad libitum

A test is carried out of feeding via ESF supplemented with free access to roughage in the form of pectin feed. Approx. 1.6 FUp via ESF is given per sow per day and furthermore the sows eat approx. 10 kg pectin feed.

The sows are very calm when employing this feeding principle but we do not have sufficient data to express the effect on productivity.

When using ad libitum feeding for gestant sows, two gestation mixes should be used. The sows should be housed in solid groups and there should be 10-12 sows per dispenser.

Efficient service

Stimulation and reproduction results

Stimulation to standing heat and during insemination help excrete the hormone oxytocin from the hypophysis that via the bloodstream is transported to the uterus and here increases the uterus' muscle contractions thus improving the semen's transport to the oviducts where fertilization takes place. Increasing oxytocin in the bloodstream is estimated to increase litter size through facilitated semen transport.

A study of the connection between sexual stimulation and reproduction results has been initiated. The first part of the test showing a connection between different degrees of stimulation and oxytocin level in the blood, is finished. In the control group, oxytocin levels are measured in sows provoked by mating by boars. As is apparent from the figure showing oxytocin level in the bloodstream at low and high stimulation, high stimulation at heat control and during insemination will also result in a high oxytocin level. On the basis of these preliminary results, it is recommended to perform high stimulation at heat control and insemination of sows.

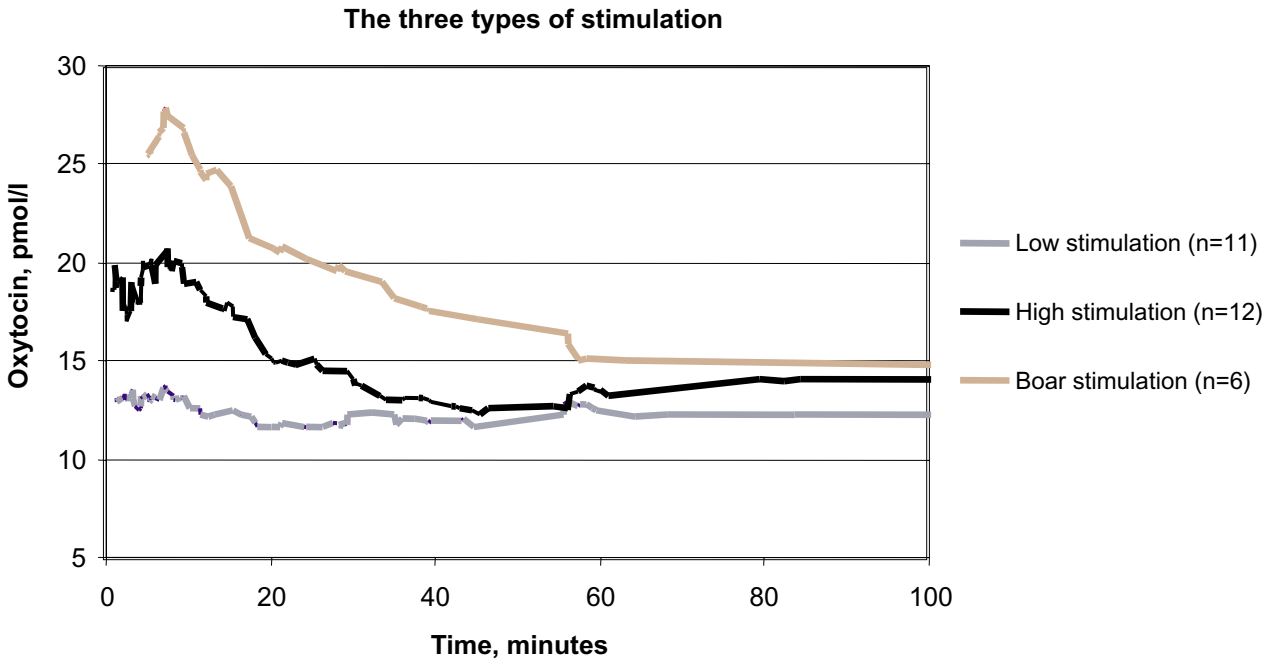
In the second part of the test, which is finished in the herd, it is studied how long time may pass between sexual stimulation and the actual insemination. Ie. for how long high oxytocin level can be maintained and not least when it is again possible to stimulate after the first stimulation. Before the results of this test, the recommendation is 20-30 minutes.

Surprise effect of boar

Swedish experience shows that a good effect is achieved on the sows' standing heat by the boar not being visibly present for the sows' entire stay in the service unit. The sows can hear and smell, but not see the boar during the last days before the expected service. The theory is that upon appearance on the expected day of service, the boar increases the sexual stimulation via the surprise effect and thereby also releases the sow's standing heat. A test has been initiated to establish the connection between surprise effect of boar and reproduction results.

Rest after insemination

It seems important to have rest after insemination. The sow's physiology makes it natural to recommend that the sows as a minimum be housed individually and thus can take "a rest" before being brought back to the others. Today, it is recommended that sows must have a rest period of 20 minutes after insemination, but this is not yet documented nor is it known whether a rest is necessary. A test has been initiated to establish how various lengths of rest affect reproduction results.



Gestation control

The purpose of gestation control is to reduce the number of non-productive days in the herd. Furthermore it should be easier to step in quickly when mistakes happen. Finally, gestation control show when problems can arise so the reason may be established.

After servicing a block of sows most of them are gestant while the rest may already be declared dry at 3 weeks. Less than 1% of all serviced sows absorbs or aborts later than that. A good gestation test is thus able to divide sows into those dry and those gestant at the earliest opportunity and with the greatest accuracy possible.

Cyclic and acyclic re-breeders

Dry sows will often show heat with intervals of 3 weeks. This can be observed in loose housing systems, but may be difficult to see in tethered sows. However, up to half of the dry sows does not reach heat. This may be due to boar contact and energy allocation in the farrowing unit being insufficient to motivate the sow to reach heat again. These sows must be found during gestation control and after having been removed to the service unit they will reach heat 4-5 days later.

Control with boar

The 3-week control with boar is the earliest efficient test. It is misleading to mention 21-days control as the sows should be checked daily from day 19 to day 26. Regardless of the system, the boar will find max. 30% of the dry sows. The remaining show too weak signs of heat, are not cyclic or have not reached heat at control. The sows found dry at the 3-week control can be re-bred immediately thus saving many non-productive days. It takes approx. 2 minutes daily per sow to let the boar perform a thorough test. Thus in terms of time this method is fairly expensive.

Gestation test using ultra-sound tester

The one-dimensional ultra-sound tester costs between DKK 2,500- 3,500. It sends a sound wave through the sow and if this wave encounters fluid it is thrown back to the tester, which makes a sound or light signal. As such, the tester seems easy to use, but it takes practice to place the tester correctly and to test in the correct angle in the animal. If testing on the bladder, dry animals will react as gestant. If testing next to the uterus, gestant animals will react as dry. Thus it is crucial to follow the instructions closely and make thorough notes thereby facilitating comparison of the test results with the final farrowing result. Up to three sows can be tested per minute.

The gestation testers in the Danish market have been tested twice. The methods used were not quite identical thereby making it impossible to compare the results directly.

Doppler testers

The Doppler testers are very popular in other pig producing countries, but not quite so in Denmark. An ultra-sound is sent through the animal, but instead of receiving all echoes, the tester reacts only to moving subjects. At first, the bloodstream in the uterus artery will be found and that may be confused with the sound of other arteries, but later the fast pulse of the embryo heart can be found. As the embryo heart cannot be confused with other sounds from the sow, a positive diagnosis is very efficient. In two tests the Doppler testers have provided poorer results than ultra-sound testers. This may be due to the fact that it is more difficult to learn how to use Doppler testers. Approx. 3 sows can be examined per minute.

Scanners

The two-dimensional scanners also employ ultra-sound, but here the result is shown as a picture on a screen in two dimensions, just as on TV. It is possible to see what is being tested thus avoiding testing a wrong area of the sow, and you get a detailed picture of what is being measured thus most of the time eliminating sources of error. The results will as such be very certain. As the test is performed on a living animal and as the sharpness of the picture is limited, errors may still occur. They may be prevented by experience. Four scanners

Gestation control

have been tested. All of them could be used for gestation control from day 24 after the first service. The certainty differed when non-experienced persons used the scanners and the differences were due to especially the picture's sharpness on the individual scanners. The difference in handling and the weight of the individual scanner should be considered before purchase. The price of a usable scanner varies from DKK38,000 to DKK58,000.

Rectal examination

Marking the sow's uterus arteries through the rectum performs the gestation control. This method, too, requires thorough instruction. You are then certain of examining the correct vein, and if you wait until day 35 after service, you will also be very certain of the result. The method takes up to 3 minutes per sow.

Selecting gestation test

Control with boar should be carried out regardless of which test follows. There is no doubt that a two-dimensional scanner or a rectal examination are the most certain tests to use. The former is expensive and the latter takes time. If excluding these two tests, a gestation control with a one-dimensional ultra-sound tester should be performed to avoid too many sudden surprises. However, with the one-dimensional ultra-sound tester one should keep a close eye on the animals so that any errors are observed. Furthermore, a list should be made of definitely dry, definitely gestant and doubtful results so that at the end of the day one's own abilities are improved.

Tables:

Results of testing gestation testers. Calculated on the basis of number of correct answers. Options for answer were "dry" "gestant" or "uncertain". "Uncertain" thus yields the same value as a wrong answer. Only results for test persons.

Table 1. Test of simple ultra-sound testers and Doppler on sows day 32 and 39. 1989

Tester	*All-test*	*HK drægtighedstester*	*Ultrasonomatic U76 B*	*Pregtone I*	*Unitest*	*Medata doppler*
Certainty on gestant sows	*96*	*99*	*95*	*99*	*98*	*88*
Certainty on dry sows	*70*	*61*	*56*	*88*	*69*	*88*

Table 2. Test of simple gestation testers and Doppler on sows day 28 and 58. 2000

Tester	*Draminski*	*Pregtone I*	*Pregtone II*	*Sonograder*	*Unitron doppler*
Certainty on gestant sows	*92*	*96*	*94*	*90*	*96*
Certainty on dry sows	*65*	*68*	*69*	*72*	*58*

Tabel 3. Test af todimensionale ultralydsskannere dag 24 og 54. 2000

Scanner	*Pie Medical 50S Tringa*	*Smart Scan A1*	*TM 18*	*US 45*
Certainty on gestant sows	*84*	*88*	*95*	*99*
Certainty on dry sows	*71*	*89*	*100*	*100*

Feeding weaners

Fermented liquid feed

A test was carried out of fermented liquid feed for weaners (6-12 weeks) in one herd. It was concluded that fermentation of complete diets for weaners reduces production results and can therefore not be recommended.

In the first part of the test, a normal weaner mix was used containing synthetic amino acids. The mix was fermented at approx. 20° Celsius. Fresh feed was given once a day and 25-50% of the mix was left in the tank. The results showed that gain and feed conversion were reduced compared to not-fermented or partly fermented liquid feed. Analyses of the feed showed that the added synthetic amino acids disappeared during fermentation which is a significant reason for the reduction of production results.

In the second half of the test a weaner mix without synthetic amino acids was used, but the feed was composed so that it met the standards for amino acids. Analyses of the feed revealed that the contents of protein, energy and amino acids and vitamins A, E, B1 and K3 had not changed significantly during fermentation. However, a higher content of biogenic amines was found after fermentation. Biogenic amines may be damaging to the pigs.

Compensatory growth

Pigs' ability to compensatory growth has been tested. The aim was to see whether pigs given 7.8 g digestible lysine per FUp and 130 g digestible crude protein per FUp from weaning to slaughter could achieve the same production results as pigs fed according to standards.

In both the control and the test group, three feed mixes were given from weaning to slaughter. Preliminary results indicate that the production value for the entire period (7-100 kg) was significantly reduced when the contents of protein and amino acids were reduced in the weaner period. The pigs were not able to recover a weight difference of 3.3 kg on transfer from weaner unit, and it consequently took them a week longer to reach the same slaughter weight.

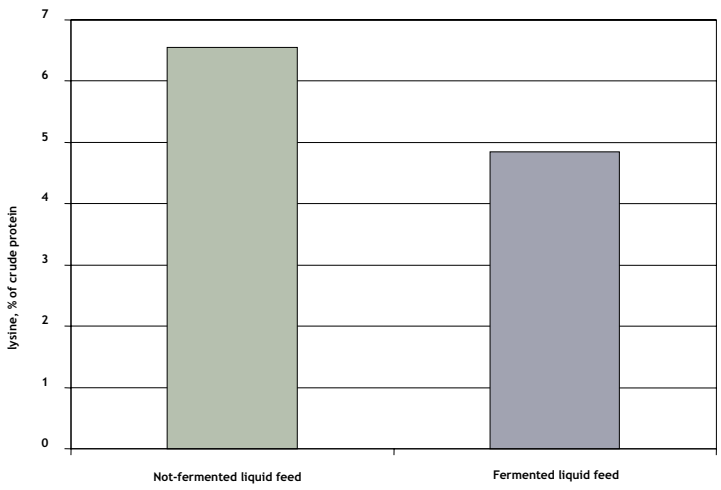
The under-supply of protein also caused a significantly reduced feed conversion in the weaner period. However, the pigs compensated for this in the finisher period so that total feed conversion (7-100 kg) was level with the control group. The lean meat percentage for finishers was not affected. The number of diarrhoea treatments was not affected in the test group, however, it must be noted that the test was carried out in a herd with a good health status.

Rapeseed

For years it has been natural for home mixers to use the sometimescheap rapeseed.

A test has been carried out of feed for weaners added 4, 6 and 8% rapeseed, respectively, as partial replacement for soybean meal and fat. The addition of rapeseed was compared to a control group with animal fat and a control group with vegetable fat. All feed mixes were produced as meal feed and were not heat-treated. Analyses of the rapeseed used revealed a high content of glycosinolates: 31.6 micro mol/g.

The pigs given 4, 6 or 8% rapeseed in the feed had a production value that was level with each other but significantly lower than the control group.



Synthetic lysine disappears during fermentation of liquid feed

Rapeseed in feed for weaners reduces production results.

Commercial mixes

During the last six years the National Committee has tested commercial mixes for weaners and finisher. The mixes were bought via the pig producers and without the knowledge of the feedstuff companies. The aim is to obtain knowledge of the mixes' production economy and thereby achieve a quality improvement of the mixes sold to Danish pig producers

Weaners

A test of commercial mixes sold in Western Jutland for weaners was carried out (Report 443). Three starter diets were tested and they were compared to each other and to a control mix. These diets are used for weaned pigs in the age 4-6 weeks. In the last part of the weaner period (6-10 weeks of age) control feed was used in all four groups. The following diets were tested:

- Flat Deck LA from A-ONE Feed Supplements Ltd.
- Vitesse 1 Pellets from Vivet
- Multiwean Denmark Pellets from 3S

In the age 4-6 weeks the pigs fed Flat Deck LA, Vitesse 1 Pellets and Multiwean achieved an increased feed intake and an approx. 25% higher daily gain than the pigs fed the control feed. Feeding with Vitesse 1 Pellets furthermore resulted in a 9% lower feed consumption compared to feeding with the control feed in the period 4-6 weeks.

The result for the entire test period showed no difference between the control group and the groups fed commercial mixes. There was no difference in the frequency of diarrhoea treatments or the number of dead and culled pigs. Despite improved production results when using Flat Deck LA, Vitesse 1 Pellets and Multiwean the first two weeks post-weaning, this was not enough to pay an excess price for these mixes.

A test of commercial mixes bought in Southern Jutland for weaners was carried out (Report 482). The test produced the following index calculated on the basis of the production value:

Control . . . . . .100(b)
Organica Avanti/Promax
KFK . . . . . .103 (bc)
Grisette acid UK/StartpillerLT AC
UK DLG . . . . . .111 (c)
Top Start/Go Start UK
Brdr.Ewers . . . . . .110 (bc)
MP Super starter/Alternativ II
M.Perregaard . . . . . .103 (bc)
Gysse Startpiller with Biopro
Skærbæk Lokalforening . . . .86 (a)
(Different letter = significantly different production value)

DLG's mixes caused a significantly higher production value than the control mix. The feed from Skærbæk Lokalforening gave a significantly lower production value than the other mixes. The frequency of diarrhoea treatments was significantly lower when using the feed from Skærbæk Lokalforening compared to the control group and the group fed feed from DLG.

It is possible to achieve an improved production value by choosing the right feed mix

Finishers

A test of finisher feed bought in the Eastern part of Denmark was carried out (Report 483). Five commercial mixes were bought resulting in the following index numbers for production value:

Control . . . . . .100 (a,b,c)
Mondeo UK (DLG) . . . . . .101 (b,c)
Bacona Korn (KFK) . . . . . .104 (c)
Svinefoder Antonia (ØA) . . . .96 (a,b,c)
SPF-Medio (RA) . . . . . .92 (a)
Antón 106 (BAF) . . . . . .94 (a,b)
(Different letter = significantly different production value)

None of the mixes deviated significantly from the control mix. Feeding with the mix from DLG caused a significantly higher production value compared to the mix from Roskilde Andel. Feeding with the mix from KFK caused a significantly higher production value compared to the mixes from Roskilde Andel and Bornholms Andels Foderstofforretning. There was no difference between the other mixes. There was no difference in treatment frequency for diarrhoea and the number of dead or culled pigs.

Commercial products

In the last years, the National Committee has carried out tests of commercial products for weaners. In total, more than 100 tests of products have by now been carried out for weaners and finishers on behalf of companies. On the basis of the cessation of growth promoters for weaners there is a need for alternatives. Respectively 23 and 9 tests of products for weaners and finishers have been carried out in the last year.

The table shows the results of the last year's tests. In the tests with weaners four products showed a positive effect and three products tended to show a positive effect on the production value. One product tended to affect the production value negatively. Again, acid products showed the best effect on productivity. Only benzoic acid had a reducing effect on diarrhoea.

Besides the usual tests, a test of different doses of lactic acid (0.7-1.4 and 2.8%) and formic acid (0.7 and 1.4%) has been carried out (Report no. 469). Surprisingly, it showed no effect on production value. The microbiological studies showed, however, that an addition of acid resulted in reduced pH in the gastro-intestinal tract and an increased production of organic acids in the digestive tract. Addition of 2.8% lactic acid caused a reduction in the population of Coliform bacteria in the digestive tract. No products for finishers have shown an effect on the production value.

*Commercial products for weaners tested during the last year. Effect on production value stated in relation to the control group. *= tendency, ***= significant difference. Index values may only be compared within the test (same report no.).*

Company	Product name	Type of product	Dosage 1	Index based on 5-years prices (94-99)	Rep.no.
Roche	Cylactin	Lactic acid bact.	120g/tonne	102	441
			80 g/tonne	106	441
Ringsted og Semler	Euroacid LFPA	Mixed acid	4l/tonne	107	441
	Greenacid LBF	Mixed acid	4l/tonne	109*	441
Orffa	Enterogurad	Plant extract	1.0/0.5 kg/tonne	105	441
Kemira	Bolifor FA2000L	Mixed acid	3 kg/tonne	106	461
			7 kg/tonne	104	461
DLG	XS44	Olligossachride	0.30/0.15kg/tonne	100	461
DLG	FU01	Aroma	0.40 kg/tonne	99	465
DAKA	Blosol A922	Blood meal	30 kg/tonne	95 Negative *	465
Natura Vet	Endosan/EndosanD3	Herb product	3/4.5 kg/tonne	103*	465
Lucta	Luctacid HC	Mixed acid	2 kg/tonne	101	474
			3 kg/tonne	107	474
Agro Korn	Master Cid 90	Mixed acid	5 kg/tonne	96	474
Norsk Hydro	Aciform	Mixed acid	0.6/0.5 kg/tonne	107*	477
			1.2/1.0 kg/tonne	110***	477
Den lokale andel	Liprot SG9 4	Lysine analog	43/39 kg/tonne	96	477
BMI	Profeed	Fructo olligosacc.	5 kg/tonne	105	477
Valio	Valiomix 108CFU/g	Lactic acid bact.	5 g/pig/day	98	487
Tests:	Lactic acid	Pure acid (100%)	0.7%	99	469
pure			14 %	106	469
acids/acid salts			2,8%	102	469
	Formic acid	Pure acid (100%)	0.7%	107	469
			1,4%	105	469
	Calcium formiate	Acid salt	1.25%	106*	445
	Sorbic acid	Pure acid	2.0%/0	111***	445
	Lactic and formic acid	Pure acids	0.7 + 0.7%	110***	490
	nzoic acid	Pure acid	2.0/1.0%	120***	490

1) On stating two doses, the first one states the dose in Diet 1 (4-6 weeks of age) and the other the dose in Diet 2 (6-10 weeks of age). 2) Blood meal used as replacement for fishmeal. 3) Meal feed compared to control meal feed. 4) Liprot SG9 replaced synthetic lysine in the mix.

*Commercial products for finishers tested during the last year. Effect on production value stated compared to a control group. *= tendency ***=significant difference. Index values may only be compared within the same test (same Report no.).*

Company	Product name	Type of product	Dose	Index based on 5 years prices (94-99)	Rep.No.
Akzo Nobel	Crina HC	Essential oils	75 g/tonne	103	439
			150 g/tonne	102	439
Mycogonesis	Trøffel Aroma	Aroma	0.5 g/tonne	97	450
			1.0 g/tonne	94	450
			1.5 g/tonne	101	450
Optivite	Genex	Mixed acids	2.0 kg/tonne	98	450
BASF	Luprocid	Mixed acids	5.0 kg/tonne	95	473
	Luprocid+Natuphos1	Mixed acids + enzyme	5.0 kg/tonne + 650 FTU	101	473
	Luprocid1	Mixed acids	5.0 kg/tonne	95	473

1) Content of Ca and P reduced by 1.0 and 1.2g/kg feed, respectively.

New standards for livestock manure and new animal units

Data are being collected to revise the standards for livestock manure. The new standards have three purposes:

- The best possible basis for manure planning.
- As data basis for establishing new animal units (au) when an au as of 1 August 2002 is defined as 100 kg nitrogen ex slurry tank and when there will be a maximum limit of 140 kg N per ha from pig manure.
- As data basis for evaluating Action Plan for the Aquatic Environment II where the prerequisite is a 10% reduction of the content of nitrogen in livestock manure before 2002.

The National Committee has collected data from the feedstuff industry and from the Plant Directorate's control of feed concerning the feed's composition from October 1999 to April 2000. On the basis of this, the feed's average contents of nitrogen and phosphorus for sows, weaners and finishers have been calculated. Furthermore, a Danish average has been calculated for productivity in pig herds on the basis of herds with efficiency control. The average numbers for weight intervals, feed consumption and the feed's content are used for calculating N ex animal, and the final standards for N ex slurry tank are calculated by deducting the normal evaporation from housing unit and slurry tank.

Evaporation is smallest at partially slatted floor, medium at fully slatted floor and largest at systems with deep litter and solid manure. The table shows the calculation of nitrogen ex slurry tank for partially slatted floor. In other manure systems there will be more pigs per 100 kg N ex slurry tank, but it has not yet been decided how to define an au in relation to the various evaporation figures.

Data basis for manure standards, partially slatted floor

Group	For year sow *	For weaner	For finisher
Weight interval	Til fravænning	7.2-30 kg	30-100 kg
Crude protein, g/FUp	149.8	164.3	158.2
FUp per pig/sow	1.342	47	202
N-intake, kg	32.18	1.235	5.113
N-deposited in the pigs, kg	5.46	0.593	1.960
N-ex animal kg	26.72	0.642	3.153
Evaporation, kg	2.27	0.076	0.436
N-ex slurry tank, Kg	24.45	0.57	2.72
Number per 100 kg N	4.09	175	36.8
Number at 140 kg N/ha	5.73	245	51.5
Number per au until 2002	4.62	136	30
Number per 1.7 au/ha (until 2002)	7.85	231	51

* Inclusive boar units and young females from approx. 100 kg

Preliminary figures indicate a tightening of the requirements for sows with pigs for weaning while there may be slightly more pigs per au and per ha for weaners and finishers.

Leucine and protein con-tent

It is desired to reduce the content of protein in weaner feed out of consideration for the pigs' health and to minimize the nitrogen content in pig manure. In practice the possibilities for a protein reduction are limited by the standard for leucine as this is too expensive to add as a free amino acid. It is also uncertain whether there might be a lack of non-essential amino acids if protein content decreases considerably.

Thus a test was carried out of wea-ner feed with 135 and 150 g digestible crude protein per FUp. At both protein levels, three leucine levels were tested corresponding to 85, 100 and 115% of the standard. Thus there were six groups in the test.

The test comprised weaners in the weight interval 7-23 kg. The feed was added free amino acids so the contents of all essential amino acids (except leucine) were above the standard in all six feed mixes.

There was no significant difference in production value between the two crude protein levels. Production value tended to be slightly lower at a leucine level of 85% of the standard. However, the decrease in productivity was smaller than expected if the original standard was correct.

The result indicates that it might not be possible to lower the leucine standard for weaners. The results also showed that pigs could grow normally even though there is only 135 g digestible crude protein per FUp if free amino acids are supplemented so that all standards are met. The addition of amino acids, however, makes the feed considerably more expensive.

Environmentally correct feeding

Ammoniac evaporation

Tests have been initiated to examine the possibilities re. feeding that may reduce ammoniac evaporation. It is well known that minimizing feed's content of protein by adding amino acids reduces the content of nitrogen in the manure and thereby reduces ammoniac evaporation. If the content of nitrogen in slurry drops by 10%, ammoniac evaporation will decrease by at least the same, according to foreign studies.

Another option is to try changing the feed mix so that pH in slurry decreases. Thereby a larger part of the ammonia (NH_3) is bound as ammonium (NH_4^+).

Normally, the majority of the pigs' calcium need is covered by adding chalk. Chalk is very basic, and it is therefore an obvious idea to examine whether addition of calcium through other sources than chalk can reduce pH in the manure. Tests have been initiated with calcium formiate and calcium chloride instead of chalk.

Replacing chalk with other sources of calcium means that the feed's acid binding capacity decreases which might benefit the pigs' digestion of protein. It is therefore possible that the excess price of alternative calcium sources can be paid by slightly improved production results.

Preliminary results indicate that only calcium chloride significantly affects pH. It is discovered that use of calcium chloride lowers pH in urine by approx. 1.2 pH units from approx. 6.2 to 5.0. However, in slurry the effect is only approx. 0.3 pH units as the sour urine is partly neutralized by the undigested mineral salts and protein from faeces. In Dutch lab tests, a decrease of 0.3 pH units in slurry lowered ammoniac evaporation by 10-20%. There are no figures yet on the effect of calcium chloride on production results.

Even though calcium formiate has no significant effect on pH in slurry, it can still be an interesting source of calcium as it has shown a significantly positive effect on the production results of weaners. Preliminary results also indicate a positive effect on finishers fed pelleted feed while calcium formiate

An on going test indicate that gestant sows need only 1.5 g digestible phosphorus per FUp.

Environmentally correct feeding

apparently has no effect when using home mixed feed.

Reduction of phosphorus content in sow feed

In sow herds, livestock manure contains considerably more phosphorus than plants need if manure is used from 1.7 animal units per ha. Also, theoretical calculations show that gestant sows' need for phosphorus is considerably below the present stan-dards. Therefore a test has been in-itiated in four sow herds where the content of digestible phosphorus has been reduced to 1.5 g in the gestation period. This is compared to a control block with 2.2 g digestible phosphorus. Both control and test sows are fed 2.7 g digestible phos-phorus in the nursing and dry periods.

Furthermore, in two of the herds the effect of two phosphorus levels in the young sows' feed in the entire period from weaning to first service is studied.

Presently, approx. 3,000 sows have been included in both test and control blocks. Of these, approx. half of the litters have been by sows that have had their first parity after the start of the test and thus have been affected by a long-term effect.

Reproduction results in the form of born and weaned pigs do not differ between the blocks, and preliminary figures indicate no negative effect on longevity. The test continues for one more year to assess the effect of feeding young sows and to get sufficient sows that have lived their entire lives with reduced phosphorus allocation.

Furthermore, digestibility tests have been initiated with some of the test mixes to assess whether actual content of digestible phosphorus of the feed mixes corresponds to the calculated content.

New calcium standards

A literature study has been carried out to assess whether leg problems in practice may have been caused by lack of calcium or phosphorus. Test results and theoretical calculations of the need indicate that phosphorus standards were sufficient. However, tests measuring calcium digestibility indicated that the calcium standards were nearly at a minimum for sows and weaners.

A too high addition of calcium also has disadvantages in the form of lower digestibility of phosphorus and a too high acid binding capacity. The latter means that calcium from chalk binds part of the gastric juice that especially for newly weaned pigs may hinder digestion of protein.

This is the reason why the calcium standard is lower in diet 1 (4-6 weeks) than in diet 2 (6-10 weeks). The table shows the new calcium standards.

Weight, kg	Calcium/FUp
6-9	7.0
9-30	8.5
20-45	8.0
30-45	7.5
25-100	7.0
65-100	6.5
Gestant sows	7.0
Nursing sows	8.0

Weaners can grow normally on only 135 g digestible crude protein per FUp if all standards for amino acids are met.

Salmonella

Feed is an important factor in the fight against a salmonella problem in the individual herd. The last year's activities concerning a reduction of Salmonella on herd level have thus been focused on the feed's effect.

Feed texture in meal feed

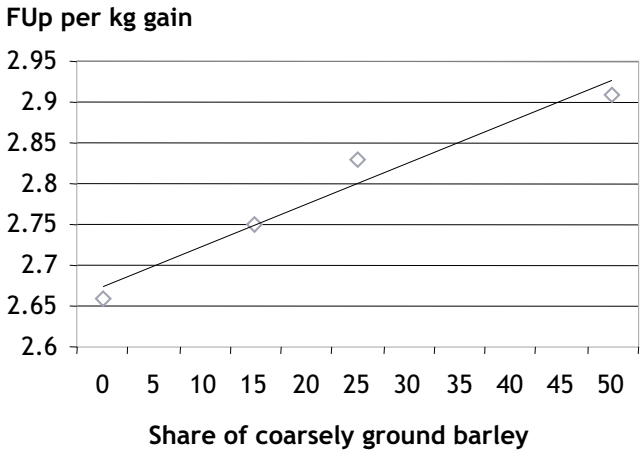
The effect of increasing content of coarsely ground barley in meal feed has been studied. The amount of barley was identical in the mixes; the only variation being the relationship between finely and coarsely ground barley.

Production economy decreased with increasing content of coarsely ground barley. However, the results showed that the larger the share of coarsely ground barley, the better the pigs' gastro-intestinal health. A high addition of coarsely ground barley must therefore be expected to have a protective effect on bacteria such as Salmonella.

Barley:wheat

The importance of the barley:wheat relationship in pelleted feed for finishers has been studied. Preliminary figures reveal that feed added barley reduces the number of salmonella positive pigs. The production results were otherwise not affected by the barley:wheat relationship in the mixes in this test.

Preliminary figures show that barley in feed reduces Salmonella prevalence



Feed conversion deteriorates with increasing amount of coarsely ground barley in meal feed

Commercial products

Two products and one feed mix for finishers have been tested. Due to very few salmonella positive pigs, it was not possible to elucidate the various mixes' effect on Salmonella. Preliminary figures reveal that meal feed and an addition to pelleted feed of the acid products Formi®LHS (1%) from Norsk Hydro and ACID ONE (2%) from DLG affected the gastro-intestinal health positively, ie. an ecosystem where salmonella bacteria are expected to have poor growth conditions. Expandat (DLG) did not affect the gastro-intestinal health as positively. Meal feed and Expandat provided a considerably poorer production economy primarily due to a poorer feed conversion, which was among others due to a large feed waste despite regular adjustment of the feed dispensers.

Salmonella-reducing feed for weaners

The effect of the feed's form (meal or pellets) and of addition of acid (0 or 2.8% lactic acid) has been studied. Preliminary figures show that addition of acid reduces the number of salmonella positive faecal samples and at the same time improves pigs' production results.

Preliminary figures show that 2.8% lactic acid added to the feed reduces Salmonella and increases productivity for weaners (7-30 kg

	Pellets	Meal	Pellets + 2.8% lactic acid	Meal + 2.8% lactic acid
Daily gain, g	461	478	491	507
FUp per kg gain	1.55	1.54	1.55	1.51
Salmonella positive faecal samples, %	7	5	3	3

Status on combating Salmonella

Combating Salmonella in primary production

The fight against Salmonella in primary production continued in 1999. The positive trend from 1998 continued in 1999 as shown in figure 1. Similarly, the number of sero-positive meat juice samples is very low.

The requirement of a bacteriological survey of Salmonella prevalence in all types of pig herds with Salmonella problems is now an integrated part of the Salmonella surveillance, and may be used in the advisory work.

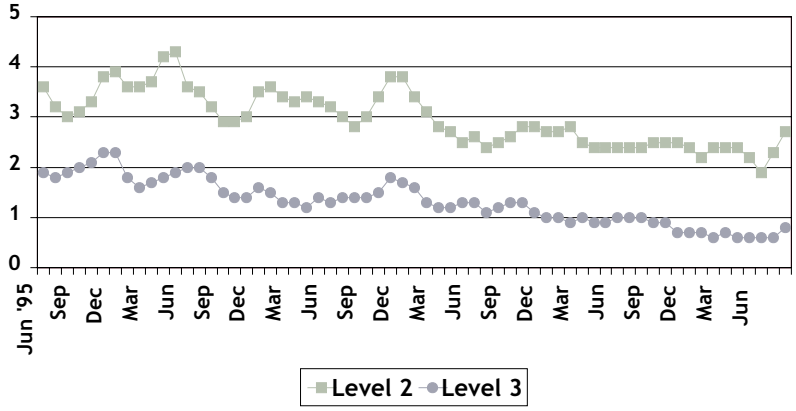
The Danish Bacon and Meat Council introduced a slaughter penalty for Salmonella in September 1998. In October 1998, the rules for this were tightened. Now all level 3 herds are imposed penalties from their first month in level 3. Thereby yet another step has been taken towards letting the individual producer pay a larger part of the slaughterhouse's – and thereby the community's – actual costs for special slaughtering of pigs from level 3 herds.

Too many herds have repeatedly been ordered advice without for various reasons managing to reduce Salmonella prevalence. Part of these herds is now advised by the advisory body. In 1999 75 herds were appointed to the advisory body. The majority of these herds are after six months placed in level 1. Overall the conclusion is that the effort is successful as tools and knowledge are available that might contribute to solve Salmonella problems in the majority of the problem herds.

Salmonella and weaners

A test has been carried out in 69 sow herds of risk factors of Salmonella prevalence among weaners. It was discovered that using not-heat treated meal feed for sows considerably reduces the risk of finding Salmonella bacteria among weaners. No Salmonella was found among the weaners in herds using liquid feed for sows, however, the protective effect of liquid feed was not significant as the test only comprised 6 herds. It was not possible to determine if using not-heat treated meal feed for weaners had a protective effect, but this is now being studied by the National Committee.

Serological Salmonella monitoring
Distribution in percentage of level 2 and 3 herds
June 1995 up to an including August 2000



Salmonella positive weaners and finishers

If positive faecal samples were found among the weaners, the risk of finding positive meat juice samples in the buyers' finishers was three times higher. If the buyer used not-heat treated meal feed the risk was lower, but the effect of meal feed could not quite eliminate effect of receiving weaners from positive sow herds.

Declaration of herds selling weaners

On the basis of these results, the National Committee has drawn up a declaration system for herds selling weaners. Status on the individual herd will be available in the zoonosis register just as the status on finisher herds.

Monitoring finished goods at slaughterhouse

Prevalence of Salmonella in fresh pig meat has for years been approx. 1%. Internationally, this is very low. It is, however, dissatisfactory that the decreasing prevalence of sero-positive meat juice samples seen in finisher herds is not reflected in a correspondingly lower Salmonella prevalence in the samples collected from the finished goods at the slaughterhouse. One explanation may be that the present monitoring of finished goods is not sufficiently sensitive to register a minor drop when the prevalence of positive samples is so low. Together with the agreement with the authorities on halving prevalence of Salmonella in fresh pig meat at the end of 2001, this was the reason why the Danish Bacon and Meat Council at year-end 1999 initiated a number of studies to reduce prevalence of Salmonella in pig meat.

Four measures were recommended: controlled transport and housing, removal of entire head with the tongue, decontamination of the carcass, and using meal

feed in problem herds. In autumn 2000, the industry will assess the use of these measures.

In august 1999, a study was initiated to elucidate if a USA-swab method was a more appropriate tool for monitoring prevalence of Salmonella in fresh meat than the present monitoring of finished goods. Advantages of the USA swab method are that it is easily standardized, it is directly comparable between slaughterhouses and can be used in all kinds of slaughterhouses, the samples are collected close to the slaughterline and are related to herds and finally that the method is internationally recognized. In spring 2000, it was decided that monitoring of Salmonella prevalence in fresh meat will take place via the USA swab method from next year.

DT 104 status

In autumn 1996, the Danish Veterinary Laboratory (DLV) started examining Salmonella samples for prevalence of DT 104.

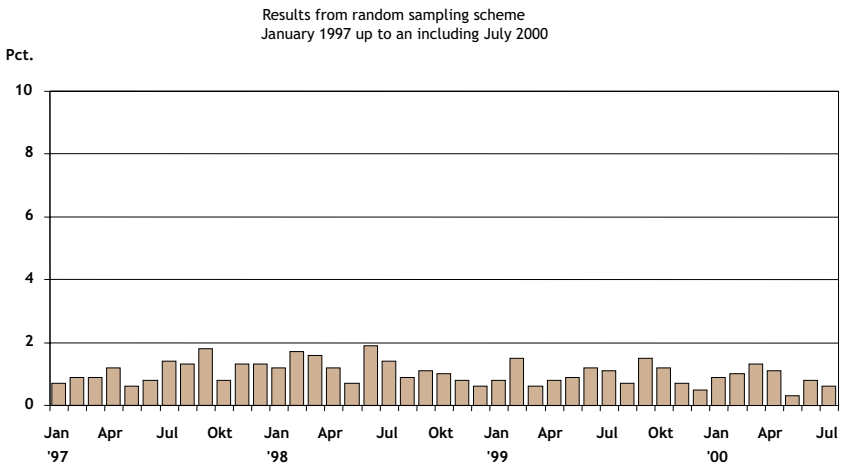
December 6, 1996 DVL diagnosed multiresistant DT 104 on Salmonella isolated form a large integrated sow and finisher herd in Salling thus becoming the first recognized Danish DT 104 herd. Subsequently, it has turned out that DT 104 for certain has been present in Denmark since September 1991 when a recently established sow herd had a clinical case of DT 104.

Thereafter and up until August 2000, DT 104 has been found in 65 livestock herds with pigs.

Since September 1999, unusually many DT 104 herds have been discovered. 25 new herds have been discovered in the first seven months of 2000. DT 104 is now found everywhere in Denmark with the exception of Bornholm, Lolland-Falster and Northern Jutland.

The reason for the increased prevalence in pig herds is unknown. It is highly likely that infection of DT 104 has been exchanged from other herds, primarily via sales of pigs or secondarily via infection from other animals such as cattle, sheep, horses, poultry, rodents and wild birds. Subsequently it must be assumed that DT 104 is now subclinically present in a wider animal reservoir in Denmark, and that eradication is impossible.

The eradication strategy has been used up to and including herd no. 59. Then, as a test, a reduction strategy is introduced intending to combat DT 104 in the herd without slaughtering the animals. Throughout the year intense negotiations have taken place with the authorities on new handling options, partly for DT 104 and partly for slaughter of DT 104 pigs. The aim is unchanged maintenance of a very high food safety but with a more appropriate handling at herd level as well as at the slaughterhouse.



Salmonella in fresh pig meat (includes coarse carvings, fine cuttings and diced meat)

Post-weaning enteritis

Altered feeding may reduce consumption of medication

Restrictive feeding

The aim of the test was to see if restrictive feeding might reduce post-weaning mortality, and assess the importance of restrictive feeding to production results. Four times daily in the first 14 days post-weaning, the restrictively fed pigs were given so much feed that they had eaten it all in 15 minutes.

Restrictive feeding resulted in a significant reduction in the number of treatments for diarrhoea, but mortality was not reduced. The restrictively fed pigs in one herd achieved the same production result as the control pigs. In the other herd where the test period was shorter, the restrictively fed pigs managed poorer than the control pigs.

Protective diets

The effect of feeding with two different protective diets in the farrowing unit and the first two weeks post-weaning has been tested in three herds selected due to high mortality caused by E. coli. The protective diets were each compared to the herds' regular weaner diets used for ad lib feeding.

The first protective diet tested was pelleted and consisted of ingredients with good flavour and high digestibility, and added 1% lactic acid. The calculated contents of energy and nutrients in this diet and the control feed were basically similar. Overall, the test revealed that this type of protective diet with a high content of flaked oats, skimmed milk powder, fish meal, soy protein concentrate, lactic acid and without soy bean meal reduced the number diarrhoea treatments. Mortality and production result were not affected.

The other protective diet tested differed from the control feed by: a) it was expanded (heat-treated, but not pelleted), b) it contained ingredients rich on fibre, and c) energy content was considerably lower (1.07 FUp/kg). The contents of other ana-lysed nutrients were basically similar in this diet and the control diet. Overall, the test revealed that this type of protective diet based on barley, wheat, soy bean meal, fish meal and wheat bran caused a significant-ly lower gain most likely due to under-supply of essential amino acids and energy. Mortality and the number of diarrhoea treatments were not affected.

Overall, the tests reveal that by altering feed as the only preventive measure it is possible to reduce the number of diarrhoea treatments. Despite the achieved reduction, treatment level remained too high, and the problem is not yet solved. Restrictive feeding and feeding with protective diets as tested have not reduced mortality significantly.

Optimization tests

Presently, tests have been carried out in three out of ten planned herds that have experienced deteriorated health and productivity after removing growth promoters from the feed for weaners. The aim is to see whether optimising production conditions as much as possible may reduce the problems.

Preliminary results from present tests indicate that it is difficult to achieve the same productivity by optimising production conditions as when using a growth promoter in the feed. However, as opposed to doing nothing, it does seem possible to im-prove production results and health to some extent.

Table 1. Results from test of restrictive feeding and feeding with protective diets

	Restrictive				Protective diet 1		Protective diet 2	
	Herd A		Herd B					
	control	test	control	test	control	test	control	test.
Dead, total	6.0	5.0	2.7	1.6	6.6	6.0	4.2	3.4
Dead, diarrhoea	4.4	4.5	1.8	0.9	-	-	-	-
Dead + culled	-	-	-	-	11.2	11.1	9.4	7.3
% treated for diarrhoea	292 a	231 b	657 a	420 b	434 a	373 b	135	148
FUp per pig per day	0.34	0.27	0.63	0.56	0.60	0.59	0.64 a	0.59 b
Daily gain, g	157	120	304	281	324	323	338 a	315 b
FUp per kg gain	2.19	2.24	2.10	2.00	1.89	1.85	1.77	1.81
Production value, DKK per pig	12.6 a	9.7 b	30.0	30.7	31.9	32.6	40.8 a	35.4 b

a,b: different letters denote significant differences between groups

Mycoplasma arthritis

Mycoplasma arthritis is a great problem in many finisher herds and in many young breeding animals. It often causes severe lameness, often at the hindquarters whereby the pig refuses to stand up.

With one-sided lameness the animal moves with little or no support on the affected leg. Pigs with double lameness may have a brief and pricking movement where lameness is difficult to observe.

Ill pigs may be treated with antibiotics by injection, but they may house the organism in the pharynx for lifetime. It is not estimated to be realistic to eradicate herds medically for this infection.

Widely distributed

Many Danish herds house the Mycoplasma hyosynoviae organism even though outbreaks are not seen. 104 randomly chosen Danish herds have been tested for anti bodies in the blood against M. hyosynoviae by an analysis developed by the Danish Veterinary Laboratory (DVL). Totally, 2,059 finishers were tested; 26% of these were seropositive. 72 herds (69%) had one or more seropositive samples. There was a wide range in the number of positive samples in these herds (figure 1). Totally, 9 herds had one positive sample, while only one herd had 20 seropositive samples out of 20.

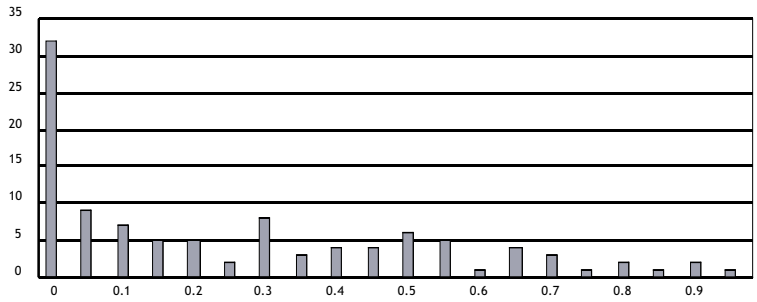


Figure 1. Prevalence of seropositive samples in104 herds

Diagnostics

Mycoplasma arthritis is diagnosed by culture at DVL. Under the National Committee, thorough diagnostic examinations have been carried out in five finisher herds with a high prevalence of lameness. Mycoplasma arthritis was by far the most common diagnosis while one case of infection of Streptococcus suis type 2 and a few cases of ostechondrosis were found. Mycoplasma arthritis was diagnosed in four of the herds while neither bacteria nor Mycoplasma were found in the last herd as the cause of lameness. In each herd, 10 acutely lame pigs were selected for examination. Nearly all of them were lame at the hindquarters, only few were also lame at the forelegs. The pigs were put down and an autopsy was performed at the Danish Bacon and Meat Council laboratory in Kjellerup. All the pigs suffered from ar-thritis. Half of the pigs from one herd (no. 5) suffered from severe ostechondrosis lesions in the articular cartilage. M. hyosynoviae was cultivated from synovia on 30 out of 50 pigs (table 1). When cultivating from blood, the organism was found in the generalization phase in 14 out of 50 pigs. In this phase, the mycoplasma organism is spread to the joints.

Immunity

The National Committee participates in a science project under the Research Centre for the Management of Animal Production and Health in co-operation with the Royal Veterinary and Agricultural University and DVL. The pig's immunity in relation to M. hyosynoviae infection is examined in this project. Experimental studies will elucidate whether weaners younger than 12 weeks have an age-specific resistance against developing disease or whether immunity received from the colostrums determines whether weaners develop Mycoplasma arthritis.

Table 1. Cultivation of M. hyosynoviae synovia and blood from 50 lame finishers

Herd no.	Synovia	Blood
1	10	7
2	-	-
3	10	3
4	6	2
5	4	2
Total	30/50	14/50

Finisher with acute lameness and swelling of hock joints.

PMWS - is the disease prevalent in Denmark?

In cooperation with the Danish Veterinary Laboratory and the Danish Veterinary Institute for Virus Research, the National Committee has initiated a study to elucidate if the disease PMWS is prevalent in Denmark.

PCV2 the cause of PMWS?
The disease PMWS – postweaning multisystemic wasting syndrome - has in the past years been observed in large parts of the world such as USA, Canada, Spain, Holland, Germany, Italy, Ireland, England and France. The disease primarily affects weaned pigs in the age 6-16 weeks with symptoms dominated by unthriving and weight loss. Furthermore, one or more of the following symptoms may be observed: difficulties breathing, diarrhoea, ulcers and icterus. The cause of the disease is not yet established, but it is thought that porcine circovirus type 2 (PCV2) may be involved in developing the disease. However, PCV2 may also be isolated from herds without PMWS symptoms. Furthermore, PCV2 has been related to other sufferings such as miscarriages and a specific skin and kidney suffering. However, discovery of PCV2 in a herd does not mean that symptoms of PMWS will develop at a later point in time.

Symptoms
The symptoms vary from herd to herd as does the intensity of an outbreak. Often 5-10% of the pigs in the age group in question are affected by the disease and the majority of these die. The symptoms are unspecific and can easily be confused with other sufferings such as ulcer, pneumonia, regional enteritis and E.coli diarrhoea.

During an autopsy, pneumonia and enlarged lymph nodes are seen especially in the groin and in the connection to intestines and lungs. Liver and kidney lesions may be observed. At a microscopy, different lesions typical for the disease can be seen.

Diagnosis
It may be difficult to diagnose PMWS, and the diagnosis must be based on both clinical symptoms and an autopsy. Other known diseases must also be ruled out.

The study in Denmark
Presently, herds with clinical symptoms of PMWS are visited with 1-2 months interval. A thorough clinical examination of the herd is made, as is some laboratory diagnostics. In June 2000 the herds have been vi-sited once, and the first laboratory results are available.

The clinical picture varies greatly and it is not similar to experiences from abroad. The final results of the laboratory studies are not yet available, but it seems that in all the tested herds, antibodies against PCV2 can be found. So far, PCV2 virus has been isolated from one herd.

Future studies
During summer 2000, a test is initiated to elucidate the dynamic of PCV2 within a herd. A group of pigs is observed from farrow to slaughter, blood samples are collected from these pigs and some of them are put down at different stages of their lives. It should thereby be possible to follow the pigs' antibody development and determine time of infection. The test is carried out in several herds to see whether the time of infection is the same in all herds. If after the first test it is inconclusive whether PMWS is prevalent in Denmark, further tests are made to investigate this.
It is expected that during winter 2000 a national screening will be initiated of PCV2 to test the spread of this.

Conclusion
The preliminary conclusion is that PCV2 is prevalent in Denmark, and that antibodies can be found in many herds. It is not yet clear if the disease PMWS is prevalent in Denmark. The study will be finished in autumn 2000.

It still requires great work to define the problems surrounding PMWS as we still lack final proof that PCV2 is the primary cause of PMWS.

Lawsonia

Regional enteritis

Regional enteritis has been known that last 20-30 years, but only a few years ago it was discovered that the bacterium *Lawsonia intracellularis* is the central cause of the disease. Regional enteritis is the common name for four different types of the same disease that may be prevalent in the pig's small intestine.

The disease in the housing unit

Normally, a greyish, pulpy diarrhoea is seen in pigs already 3-4 weeks post-weaning. Only few pigs die, but feed conversion and gain is reduced. Most pigs will recover in 4-6 weeks. In many pigs the disease will develop causing these pigs to become chronically unthriving and thin. Some pigs become so extremely thin that they have to be put down. The bloody form of the disease, the regional enteritis, is a suddenly occurred disease resulting in death without any previous symptoms.

Prevalence of Lawsonia

To get an idea of how wide spread *Lawsonia* is in Denmark, the National Committee and the Danish Veterinary Laboratory (DVL) have examined 79 randomly chosen finisher herds. At the time of visiting, none of the herds had problems with diarrhoea. Despite this, approx. 93% of the examined herds were infected with *Lawsonia*. In each herd, typically approx. 30% of the pigs were infected. Thus it seems that the *Lawsonia* bacterium is very wide spread in Danish pig production, and at the same time it must be concluded that *Lawsonia* far from always causes diarrhoea problems.

In that examination, the herds were also tested for other bacteria that may influence development of diarrhoea. The familiar bacterium causing dysentery was only found in approx. 3% of the herds while one of the spirochaetae ascribed a certain importance *(Brachyspira pilosicoli)* was found in approx. 20% of the herds.

Many bacteria in the same herd

Furthermore, the test showed that fairly many herds are infected with several diarrhoea viruses. Thus 30 herds (40%) were infected with two viruses, 15 herds (19%) infected with 3 viruses, 5 herds (6%) infected with 4 viruses and 1 herd infected with 5 viruses.

The individual viruses appeared in many different combinations without any clear pattern. Thus nothing indicated that prevalence of other viruses increased the risk of the herd being infected with *Lawsonia*.

What increases the risk of Lawsonia?

In the test, information was also gathered on housing and management conditions, feeding, use of growth promoters, etc. A lower prevalence of *Lawsonia* was found in herds using consistent batch operation (as opposed to continuous operation) and home mixed and/or pelleted feed (as opposed to purchased/pelleted feed). The importance of consistent batch operation and home mixed feed corresponds well with several tests on Salmonella. It did not affect the prevalence of *Lawsonia* whether the herds used growth promoters. This corresponds well with experiences from the period when growth promoters were removed from finisher feed. Generally very few problems were observed with diarrhoea in finisher units.

The future

Several questions on *Lawsonia* and regional enteritis remain unanswered. How the infection is spread in the individual herd (disease dynamics), what housing sections are especially exposed,

how long *Lawsonia* is discharged from an infected animal and to which degree the pigs' productivity is affected (gain and feed conversion). Answers to these central questions are sought in an ongoing study in cooperation between the National Committee and DVL. The answers may help assess how large the financial importance of *Lawsonia* is and establish the basis for measures limiting infection and disease in infected herds.

Loose sows – injuries and preventive measures

Systems exist today for group housed, loose sows where it has been attempted to adjust the lay out and feeding principle to the individual pig producer. Thus it is the responsibility of the individual producer that his housing system works optimum re. production and in particular welfare. It may be a difficult balance as the present in-door loose systems are based either on a stable group composition at the expense of space or on good space at the expense of stability in group composition. With this type of production, various problems may arise that did not exist when the sows were housed individually. These problems are often seen in relation to the social strain, aggression and fear among the animals. One should thus be aware that inappropriate-/incorrect use of an otherwise good housing system might immediately cause increasing injuries in sows.

Acute injuries cannot be completely avoided when sows are gathered in larger or smaller groups, as ranking is determined via internal fights resulting in scratches, wounds, hoof injuries, tendency to slip and lameness, etc. Also, a damp floor environment with low pH as a result of accumu-lation of urine and manure predisposes to poorer horn quality and thereby easier access for infections to the hoof after an injury.

At lameness the animal avoids supporting fully on the affected leg. If more than one leg is affected, leg position is standing under with both fore and hind legs. When moving, the animal has varying degrees of avoiding support and it often has a short and mincing walk or a swinging movement in lower back and back.

Constant supervision during the animals' active periods is a requirement if the loose housing systems are to work satisfactory. It is thereby ensured that injuries are seen and treated in time and if necessary the animal can be removed from the group and housed in a relief pen. There is always a need for relief pens and the floor in these should be deep litter as most reasons for a sow being isolated are problems making the animal want to lie down for longer periods than usual.

It requires more of the sow's motor function when it has to move to get feed. The hooves must be okay if the sow is to be able to move freely in the farrowing unit. Torn off hooves-/accessory digits, tendency to slip and insecure walk on smooth slatted floors are often consequences of lacking hoof wear/-hoof care.

Overgrown hooves are the primary cause of varying degrees of lameness in sows as they give rise to changed strain of the hoof, joint and tendons. Overgrown hooves are also disposed to pressure marks in the heel region and at the root of the accessory digit. Besides acute tenderness in legs, these pressure marks cause increased blood supply to that area and thereby an increased growth. Thus the condition is self-increasing. Leg and hoof injuries reduce the sows' longevity thus causing them to be slaughtered or put down before intended.

Thus the National Committee has initiated a study to elucidate if by regular hoof care of loose sows there might be a production economic gain in the form of increased litter weight at weaning and improved longevity in sows. Also the importance in terms of welfare of hoof care is assessed, and a detailed registration will be made of injuries in loose sows.

Overgrown hooves and accessory digits.

The sow is tethered and elevated to work height.

The hind leg is tethered.

Cutting accessory digit by cutting machine

Health at multisite production

The multisite concept is a type of production involving housing units for sows, weaners and finishers being located at geographically separated premises so that only one or few age groups are in the same building. As there are not weaned pigs and finishers at the property of the sow unit, the sow unit is not affected by infections from young stock. It is assumed that infection pressure in the sow unit will therefore be low and that the risk of the sows infecting the piglets is reduced. In time, the sow unit may be able to cleanse itself of certain viruses.

The National Committee has carried out experimental studies of infection transfer between sows and offspring and has made studies of the health conditions in Danish multisite systems. The studies were carried out in cooperation with the Research Centre for the Management of Animal Production and Health.

Experimental studies

The study comprised sows bought from conventional herds and their offspring. Already at the age of 10 days two viruses were found in the piglets; Lawsonia and Actinobacillus pleuropneunomonia. Also PRRS virus and Haemophilus parasuis (bacterium causing Glässer) were transferred pre-weaning. Despite the transfer of viruses, there were only few disease problems in the pigs, and at slaughter no disease lesions were found in the lungs. Thus disease is not necessarily the result when the pigs at weaning carry viruses to the weaner unit.

Herd studies

Transfer of viruses and health conditions were studied in seven multisite systems. Each system consisted of a sow herd with adjoining weaner premise and finisher premise. The number of age groups per building varied from 1-8 in the weaner units and 1-12 in the finisher units. All in/all out operation was carried out at section level. Four out of seven sow herds were infected with PRRS, while six herds were infected with mycoplasmal pneumonia and pleuropneumonia.

Experiences from the study showed that in the weaner period, multisite operation had obvious advantages such as low mortality (1.8%) and low prevalence of respiratory disorders. However, the pigs were often infected with Lawsonia, joint-mycoplasma and streptococci already before weaning and it must be expected that these bacteria will be transferred to finisher production.

In the finisher period it was observed that approx. 3/4 of the studied finisher units were infected by pleuropneumonia with a high prevalence of lung lesions as a consequence. Only approx. half of the units were infected with mycoplasmal pneumonia. It was impossible to conclude whether the prevalence of respiratory disorders in the finishers was due to infections from animals in adjacent finisher sections or whether the animals were already infected at weaning. PRRS studies revealed that it was possible to wean PRRS free pigs from PRRS infected sow units. Large part of the units were, however, infected with PRRS after transfer to the fini-sher unit – probably due to infection from other sections in the herd. Mortality among the finishers was generally low.

Variations between herds

There were variations between the herds in prevalence of infection of respiratory disorders thus indicating that factors specific for the herd in question have affected the prevalence of infection. Such factors may be age at weaning, the number of age groups in the same weaner unit or finisher unit, and the sow unit's status re. excretion of viruses. It is also likely that development of disease is not only dependent on whether the animals are infected but also on other conditions such as environmental conditions and the pigs' immunity status. This study did not comprise enough herds to be able to assess to which degree factors specific for the herd in question have affected the results. That will be elucidated in an ongoing study.

FTF and WTF

What is it and is it the future?

The study

In cooperation with national research institutes, the National Committee has carried out a study assessing the potential of health and production when housing pigs either from farrow to finish in the same pen (FTF) at the same premise or in the same pen from weaning to finish (WTF) combined with transfer at weaning to another premise than the sow unit.

Good health

The study revealed that overall the pigs in the WTF system suffered neither from mycoplasmal pneumonia nor pleuropneumonia at slaughter (see table). This should be compared to pigs produced in the same herd in a traditionally sectioned course with weaner units and fini-sher units (control pigs). Among these pigs, 39% suffered from mycoplasmal pneumonia and 64% from chronic adhesive pleurisy. The FTF pigs also had a very low prevalence of mycoplasmal pneumonia (4%) while the prevalence of pleuropneumonia was level with or above the level of the control pigs. The scope of mycoplasmal pneumonia in the individual pig was considerably lower for both the FTF and the WTF pigs compared to the control pigs. Furthermore, blood samp-les revealed that the WTF pigs were not in-fected with AP2 (pleuropneumonia) or mycoplasma. The results indicate that an efficient discontinuation of infection was achieved by moving the pigs to another premise than the sow unit at weaning.

High level of productivity

Compared to the control pigs, productivity was significantly better for FTF pigs and in particular for WTF pigs. For more on this, please see the National Committee's annual report from 1999. On the basis of improved productivity, calculations made by the Danish Institute of Agricultural and Fisheries Economics show that production according to FTF or WTF is fully competitive with the traditional finisher production.

The future way of production?

The most significant improvement of health and productivity was achieved with the pigs in the WTF system. Removal to another premise at weaning resulted in a discontinuation of infection com-pared to the respiratory disorders found in the sow unit. WTF pigs did generally not suffer from mycoplasmal pneumonia or pleuropneumonia. Thus it is estimated that the reasons for the high productivity in these pigs must be freedom of disease, the minimum strain of the pigs at litter production and only one removal.

Pigs in the FTF system showed the same low prevalence of mycoplasmal pneumonia as pigs in the WTF system. How-ever, prevalence of pleuropneumonia was very high for FTF pigs. This is pro-bably why it took these pigs approx. one week longer to reach slaughter weight than the WTF pigs. Though the FTF pigs were not tail docked there was a very low prevalence of tail biting that may be ascribed to the stable ranking among litter siblings.

The pigs have great potential

In particular, the study shows pigs' very large growth potential - a potential that is expressed when the pigs are offered conditions that take into consideration a high degree of health and a low degree of strain of these.

N.B.: This study has been carried out in the public research project: Respiratory disorders in pigs: The influence of production system on health, infection pressure and production economy.

Prevalence of pigs with various lung lesions at slaughter (extended health control)

	Control	FTF	WTF
Number of blocks	*6*	*6*	*4*
Number of pigs	*185*	*236*	*121*
Mycoplasmal pneumonia, % of the pigs	*39a*	*4b*	*2b*
Mycoplasmal pneumonia - scope of mycoplasmal pneumonia among animals with			
mycoplasmal pneumonia (lesions in lung tissue, %)	*8.7c*	*4.4d*	*2.3d*
Pleuropneumonia, % of the pigs	*2a*	*20b*	*0a*
Chronic adhesive pleurisy, % of the pigs	*64a*	*72a*	*1b*

a, b Average with different initial letters is significantly different ($p<0.0001$).
c, d Average with different initial letters is significantly different ($p<0.02$).
e,f Average with different initial letters is significantly different ($p<0.006$).

WTF

Expectations on good production results and little work effort in cleaning and removal have increased the interest in building housing units where the pigs stay in the same pen from weaning to finish (WTF). The greatest challenge in establi-shing pens is to adjust the feeding system to pigs weighing 7-100 kg.

Production results

The first established WTF systems have now been used 1-2 years. Production results vary and are dependent on farm management and the quality of the penned pigs. The results are important to how long a stay is required in the housing unit or how high a slaughter weight may be achieved. To ensure that the pigs reach the optimum slaughter weight and that there is time for cleaning and drying the housing unit, a 20-week stay per block at a weaning age of 4 weeks should be designed. If production is planned according to increased stocking density in the beginning of the growth period, removing the smallest pigs may reduce the stay.

Feeding principle

Pens with partially slatted floor and a large part solid floor suit dry feeding better as the floor's tilt together with liquid feeding in a long trough will cause a great level difference between the upper and the lower end of the trough. Solid floor in one third of the pen and a combination of slatted floor and drained floor gives the lowest trough height.

Liquid feeding

The National Committee conducts tests with different types of troughs in pens with restrictive liquid feeding and trough in one side of the pen. Preliminary results are:

WTF pen with restrictive liquid feeding.

- Low feed waste even if the pigs step into the trough, if the feed amount is adjusted to appetite
- W-shaped troughs require uniform stocking density on both sides of the double trough up to slaughter as the same feed amount is dosed in both halves
- Feeding tube must be 5 cm from the trough's bottom to avoid blockage
- Closed fittings above the trough reduce the risk of the pigs fouling in the trough
- To ease newly weaned pigs' access to the trough and provide sufficient space when they have reached slaughter weight, the trough should have the same depth as one for finishers and the height should be 14-16 cm.

Dry feeding

The National Committee has initiated a functional test of 6 brands of tube dispensers marketed for WTF production. Preliminary experiences with the dispensers are:

- Newly weaned pigs step into all dispensers, regardless of type
- The trough works best if feed and water are separated
- Deep troughs under the nipple drinker provide a risk that tainted feed accumulates in the nipple drinker so the pigs cannot get fresh water
- It is very important that WTF dispensers can dose both small and large feed amounts as feed intake is multiplied during growth period.

Two tube dispensers per pen

With group sizes of 30-35 pigs per pen in the first part of the growth period, preliminary results indicate that gain becomes 30-40 g higher if two tube dispensers are used as opposed to one. The same increase in gain is seen if a simple weaner dispenser is used in combination with a simple finisher dispenser.

Preliminary production results in the WTF herds participating in The Danish Applied Pig Research Scheme. The high weight on penning is due to the fact that several herds have had pigs delivered from outdoor sow units

Herd	1	2	3	4
Number of produced	956	276	2312	1978
Weight on penning, kg	8.3	10.5	9.2	7.8
Slaughter weight, kg	81.3	73.9	72.0	72.8
Number of feeding days*	115	151	128	139
Daily gain, g	782	599	703	651

* adjusted for weight on penning and on slaughter.

Multisite

Networking

Networking between pig producers is still relatively new in Denmark. In the USA networking has been known and used for several years for improving efficiency in pig production. Networking is a necessary, organizational part of using a multisite system that often comprises several herds and owners. The essence of networking is that pig producers at the different stages jointly plan production so that everybody profits as much as possible.

When a sow keeper decides to establish a division of production with sow units at one premise and weaners at another, he also accepts to conduct a strict batch operation. This is the basis for making the multisite system and the various housing units and herds work appropriately.

Networking typically comprises a large sow unit together with several producers of finishers buying weaners from the sow unit in question. The network idea should begin already when the sow keeper divides his production into sow units at one premise and weaners at another premise.

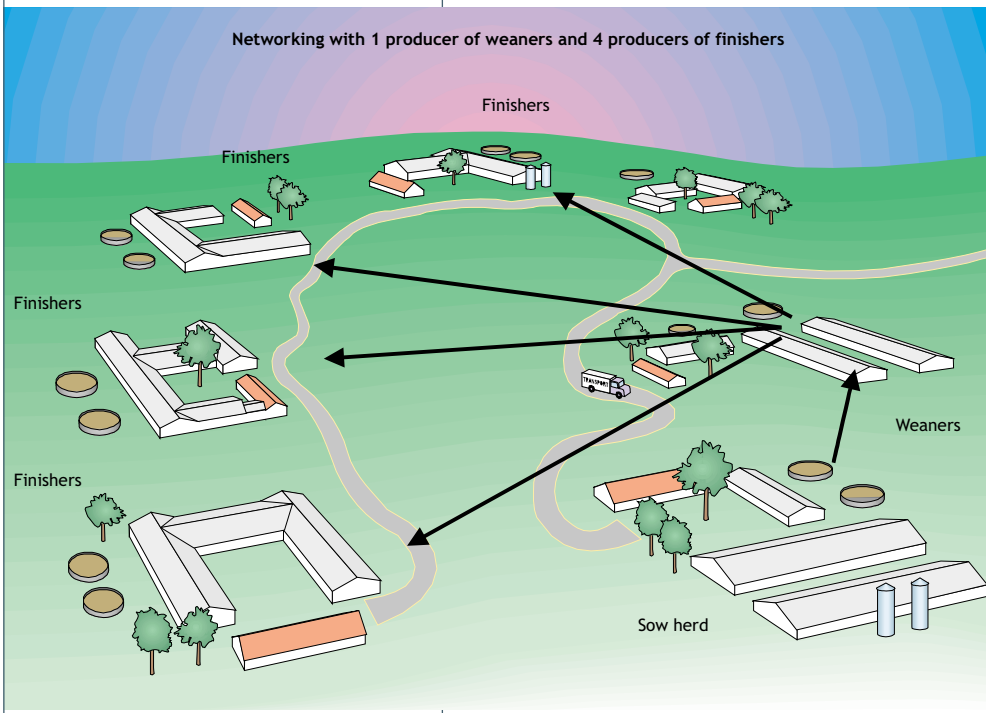
Considerations

There are many considerations at the beginning of networking. First it is necessary to decide who is to be the central point in the network. Usually this will be the sow keeper as he controls services, farrowings, weanings and deliveries of weaners to several of the herds in the network. Organisationally, it is easy to get started by hiring weaner intermediaries and/or pig advisors to be in charge of notices of meetings, agendas and perhaps function as secretary for the herds in the network.

It is important to establish which batch operation system to use in the sow herd. Block intervals and the size of sow units are crucial to how many pigs can be expected to be delivered at a time. Furthermore it is important to agree upon how to commission the sow herd and how the delivery structure is expected to be in the period in question. Here it is obviously important that the sow keeper informs the other producers of any deviations from the agreed deliveries. One tool for this is drawing up delivery plans that in due time state how many pigs are expected to be delivered at a given point in time. It is also important to agree upon who delivers the pigs to the individual producers of finishers and what requirements are made to the animals. So far there has not been great focus on quality requirements to the animals, but it is important to agree upon matters concerning weight spread and settlement, including value of pigs with hernia, etc.

What networking may comprise

- Agreement on delivery and prices
- Harmonization of financial risks
- Regular meetings
- Discussion of efficiency reports
- Exchange of experiences
- Joint purchase of feed
- Joint advisor and veterinarian
- Investment plan



Batch operation

Batch operation implies the sows being divided into batches with a number, letter or colour that is the same for each batch. By changing production systems from a continuous week operation system to batch operation, production management becomes the keyword in maintaining a good utilization of the housing system. Batch operation does not have the same options for moving the pigs within in the housing system to have optimum use of the housing capacity.

Why batch operation

Production of finishers will increasingly be based on all in/all out production which increases efficiency considerably in the finisher unit. With labour saving, gross margin is increased by DKK 20-40 per finisher. The producer of weaners, though, has increased costs in batch operation system as it takes 5-10% more farrowing pens and 10-15% more weaner space. Increased interest and depreciation is approx. DKK 5-6 per 30 kg weaner. However, a labour saving of 5-10% corresponds to this expense.

Batch operation systems

There are in principle 40-50 different batch operation systems, but many either has poor pen utilization or are difficult to handle. The figure shows the most used systems. Systems with 7, 8, and 12 batches normally have 4 weeks weaning age. The system with 11 batches always has 5 weeks, and the system with 7 batches may also be used with 5 weeks weaning age.

If production is based on WTF, the number of WTF batches must correspond to the number of weaner and finisher units. With a system with 5 weeks weaning, the number of WTF batches may be lower than the listed number of weaner and finisher units.

Housing system for batch operation

To deliver the agreed number of pigs, the weaner unit must have the right capacity. Normally there is great variation in pigs' size in batch operation which is why it must be possible to sort them. To avoid a virus being spread in the herd, the pigs should be mixed as little as possible post-weaning. Yet it is often necessary to put together a batch from two sections when they are moved from the finisher unit or sold. Test results show that for various reasons 15-20% of the weaners in a section are 5-10 kg smaller than average when the section is emptied. If the interval between the batches is 2 weeks or more, there should buffer sections for excess pigs. If the interval is less than 2 weeks, one can "take from the top" of the following section.

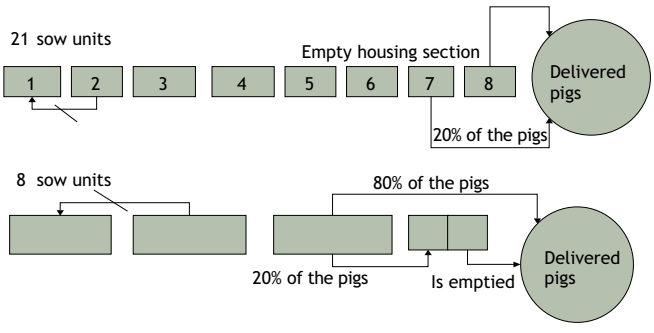
Management of batch operation

The crucial prerequisite for managing a batch operation system is to have the correct amount of sows for farrowing in each batch. Due to variations in liveborn and mortality in the nursing period, the number of weaned pigs per batch will vary even with the same number of farrowings per batch. Large sow units (20+ sows) result in less variation in the number of sows per farrowing batch. If the farrowing batches are smaller, relatively large movements in the number of weaned pigs per batch must be expected. To manage a batch operation system, various conditions must be defined:

Batch operation systems

No. of batches	Interval between batches, weeks	No. of batches Far.	Wea.	Fin.
7	3-3-3-3-3-3-3	2	3	4
8	3-2-3-3-2-3-3-2	2	3	5
11	2-2-2-2-2-2-2-2-2-2-2	3	3	8
12	2-2-2-1-2-2-2-1-2-2-2-1	3	4	8

- No. of pigs per batch
- No. of sows for farrowing
- No. of sows and young females to be served per farrowing batch
- Farrowing percentage should be 85+. If lower, there will be great variation in no. of sows per batch.
- No. of farrowing pens must be adjusted to the batch operation system that requires more farrowing pens than continuous operation.
- Fixed strategy for litter equalization. Pigs are often weaned outside the usual weaning days when using nursing sows. These pigs are recommended to stay in the farrowing unit until the usual day of weaning. Alternatively they may be weaned in buffer section.
- Determine when a farrowing batch starts and ends. There will often be sow and esp. gilts where it has to be decided to which farrowing unit they belong.
- Determine strategy for standardizing no. of pigs per batch at sale, both no. of pigs and weight spread.
- A.I. must be incorporated.



Pens for weaners and finishers

Slatted floor for finishers

Interest has increased in using partially slatted floor in finisher pens. New legislation also requires at least 1/3 of the floor to be solid or drained in finisher pens in new housing sections.

In finisher pens with partially slatted floor, traditional concrete slatted floor is used in the dung area. It could be expected that slatted floors with a wider open space as eg. metal gratings might affect pen hygiene positively. In finisher pens with 1/3 slatted floor, the Danish Applied Pig Research Scheme has tested 3 metal slatted floors against a concrete slatted floor.

In the test period no difference was observed in pen hygiene or cleaning of the pens.

On the basis of an overall assessment of price and function, concrete slatted floors are more attractive.

Group sizes in finisher pens

The Danish Applied Pig Research Scheme has initiated a study of group sizes. Production, pen function and labour conditions are studied in finisher pens comprising three group sizes with approx. 20, 40 or 80 pigs per pen as are two different types of floors, 1/3 solid floor and 2/3 solid floor, respectively with covered area. Normally, group size is 15-20 pigs per pen in the finisher period. By increasing group size and thereby pen size it is possible to give the individual pigs more space which is positive from a welfare point of view.

Preliminary results indicate that daily gain is reduced when group size is increased from 20 to 40 pigs per pen. Consequently, time spent on monitoring and delivery increases.

Experience from the herds shows that the pens with 2/3 solid floor are most dirty, and that the number of dirty pens depends on temperature strategy and the pigs' size. To limit the risk of dirt, it is important to have a housing temperature 3-4 degrees lower than in a housing unit with fully slatted floor.

In previous tests both weaner housing and finisher housing were equipped with fully slatted floor. Increased space combined with solid floor in the lying area must be expected to increase the risk of dirtying the area esp. when the pigs are little and occupy a limited area of the pen.

The following floor types have been tested in finisher pens with partially slatted floor

Floor type	Beam breadth	Slit mm	Company
Tribar	15	15	Egebjerg/Nooyen
Cast iron	10	10	Ikadan
Cast iron	12	10*	Ikadan
Concrete	63	22	P.Beton

* every 5 slit is 20 mm

The tribar grating with welded flat bar is not interesting in Denmark.

The cast iron floor has a 12 mm platform and 12 mm slit, however every 5 slit is 20 mm.

Product test of tube dispensers for weaners

The first paid product test of dispensers has been carried out. The test comprised the following dispensers:

- TUBE-O-MAT, Esbjerg Maskinfabrik
- Faaborg 3-i-1, L-Frandsen
- AP-Swing MIDI, Agro Products
- Trio-Feeder Mini, Durofarm
- StarFeeder K-Flex, W. Domino

Preliminary production results with different group sizes

Group, number of pigs per pen	20	40	80
Number of batches	34	31	31
Number of produced	594	1.098	2.146
Daily gain (adjusted for weight on penning)	906	896	876
Weight on penning	28.5	30.0	30.4
Slaughter weight	75.7	76.3	76.4
Feeding days	78	76	77
Dead	2.0	1.0	1.5

There was no significant difference between the dispensers re. production value. There was a tendency (p=0.06) to lower production value at AP-Swing Midi from Agro Products compared to Faaborg 3-I-1 from L. Frandsen.

Number of batches	9	9	9	9	9
No. of produced pigs	303	303	310	306	311
Weight on penning, kg	7.3	7.3	7.4	7.4	7.4
Weight on transfer, kg	15.5	15.6	15.0	15.0	15.4
Daily gain, g	289	296	273	271	286
Feed consumption per day, FUp/day	0.52	0.51	0.49	0.48	0.53
Feed conversion, FUp/kg gain	1.80	1.74	1.79	1.77	1.86
Production value at 5 years prices, DKK/pig	32.2	33.6	29.9	30.4	30.5
Index	100	104	93	95	95

Function value for each dispenser was weighed together in a function index constructed so that the points most important to production economy or the pigs' ability to use the dispenser were weighed highest. The dispenser Trio-Feeder Mini only obtained one out of four stars (assessment = poor) while the remaining dispensers obtained three stars (assessment = good).

	TUBE-O-MAT	Faaborg 3-i-1	AP-Swing Midi	Trio-Feeder Mini	Star Feeder K-flex
Feed waste	* * * *	* * * *	* * * *	* * * *	* * * *
Adjustability	* * * *	* * * *	* * *	* *	* * *
Easy to use	* * * *	* * * *	* * * *	* * * *	* * * *
Bridging	* * * *	* * * *	* * *	* * * *	* * *
Caking	* * *	* * *	* * *	* *	* * *
Easy to clean	* * *	* * *	* * *	*	* * *
Work environment	* * * *	* * * *	* * *	* *	* * * *
Durability and wear	* * * *	* * * *	* * * *	* * * *	* * * *
Function index	* * *	* * *	* * *	*	* * *

*=poor, **=less good, ***=good, ****very good

Occupational material

From July 1, 2005, weaners, breeding animals and finishers must have access to straw or other material that may meet their need for occupational and root material. A test has been initiated to find the most appropriate material, and the requirements are:

- The pigs must use the material
- The material reduces/eliminates inappropriate behaviour
- Costs for method/material must be low
- The method must be practically easy to handle

The test comprises a.o. hemp robe, cosh/hose, alfalfa hay, sliced barley straw, wood beam, seed grass straw (red fescue). The various grass, straw and hay are allocated in a straw dispenser while the remaining root material is slung in an adjustable chain. The test takes place in a weaner herd and a finisher herd, respectively, under the Quality Marking Scheme where tail docking is not allowed.

None of the used materials significantly reduce the prevalence of in-appropriate behaviour. However, slinging a rope in pens with suddenly arisen tail biting/aggression may dampen aggression or divert attention. Furthermore, it is recommended to switch between various types of material to maintain the pigs' interest.

Preliminary results from the test

1. The material must be easily accessible
2. Pigs lose interest if the materials are soiled in manure
3. Novelty value is of great importance to the pigs
4. Straw dispensers must have a trough to limit waste, and it must be placed above the solid floor in the activity area opposite the feed dispenser
5. Straw dispensers should be cleansed between each batch
6. The rope should be organically soluble

Loose sows

As more loose housing systems have been established, problems have arisen in many cases with productivity, animal welfare and use of resources. This increases the need for methods and tools for analysing ty-pical problems and finding solutions.

When planning, it is important to decide on a number of general conditions before focusing on the actual arrangements. For instance, decisions must be made on production safety, handling of straw and manure and other matters concerning management. Subsequently, actual arrangements re. strong and weak sides of the entire housing system must be analysed.

In service and farrowing sections, housing conditions and management must meet specific demands in different periods of the sows' cycles. Eg. various demands are made to group-ings, heat, service, implantation of embryos and gestation.

From weaning to service, focus should be on the following:

- Space so that ranking may be established within the first days of penning
- Possibility to sort the pigs to protect small and/or weak sows
- Space for sows that in pre-heat mount other sows
- Escape route, eg. as crates
- Floor must be non-skid
- Good boar contact for all sows

In the implantation period, focus should be on the following:

- Space for creating ranking when re-grouping the sows
- Ensure nutrients supply to the individual sow
- Access to stimuli
- Large space and good possibilities for moving between the various areas of the pen
- Non-skid floors

In the farrowing and nursing period, focus should be on the following:

- Isolation from other sows
- The sows should be able to adjust to the farrowing environment
- It must be possible for the piglets to escape the sow when she lies down
- Space for nursing

	Weaning	Service	4 weeks after service	Farrowing
Crates	X		X	
Individual pens	X		X	
Group with crate	X		X	X
Group with joint crate			X	X
Trickle, sorting			(X)	X
ESF-bedding			X	X
ESF-"nest boxes"			(X)	X
Ad lib.				X
Ad lid. two-mixes			(X)	X
Floor feeding				X
Liquid feeding, trough				X

Service unit

Bedding material and manure handling

A finished pilot test of bedding material in service units with individual pens reveals that consumption is 800-1000 kg per place unit regardless of bedding type. A new test will elucidate whether bowl depth and bedding technique are important to the consumption of straw and shavings and to the sows' litter results and farrowing percentage.

Product	Consumption (kg/place unit)	Price (DKK/place unit)*
Hemp	650	1430-2010
Rape straw	800	350
Shavings	900	540-1350
Wheat straw	1000	400-500
Wood flour	1100	1050

* Calculated from recommended prices, excl. vat.

Når strøelsesmængde og pris tages i betragtning, vurderes rapshalm at være det bedste strøelsesmateriale efterfulgt af spåner og halm

Over-sættelse mangler

Observations from a current test indicate that sows in groups in the service unit should be housed on deep litter to avoid leg and hoof injuries and to avoid tendencies to slip when the sows mount each other.

Experiences with insemination pen
Experiences were gathered from an insemination pen in service units with loose sows in 4 Swedish herds.

An insemination pen is a pen to which sows are moved at heat control and insemination. The pen is established adjacent to a boar pen. When the sows have had boar contact for 3-4 days immediately post-weaning, the boar is isolated and the sows do not see him until heat control and insemination (surprise effect) in the insemination pen. The sows are moved to the insemination pen individually or 2-3 at a time.

The sows' farrowing percentage averaged 88, and is thereby better than the Danish average of 84. The number of liveborn per litter averaged 11.6 against 11.7 in Denmark. The number of total born pigs averaged 12.3 and is thereby 0.5 pigs per litter lower than in Denmark. The lower number of total born pigs per litter in Sweden is most likely due to breeding material or management of body condition.

The advantage in arranging the service unit with insemination pens is a systematic heat control and less manual labour in relation to stimulating the sows until they elicit standing reflex.

Gestation unit

Experiences
In three different housing systems with loose, gestant sows, experiences were gathered re. feeding, management and arrangement: trickle feeding (8 herds) where the sows stay at the feeding place due to slow allocation of feed; one feeding stall per sow (5 herds) where the sow closes behind her and is protected when she enters the stall; and electronic sow feeding (ESF) with "little" nest boxes (6 herds) where the sows are fed one at a time in electronic feed dispensers and where the laying area is equipped with small separate lairs (approx. 2 m deep and 4-6 m wide).

General experiences:
- Gilts should be housed individually to avoid strain in fights for ranking and feed.
- The animals should be monitored daily in periods of both rest and activity to catch as many signals from the animals as possible.
- Very aggressive sows and sows suffering from eg. lameness and poor body condition should be removed from the group.
- There should be extra space for sows that cannot manage in the group.
- Straw or other root materials reduce aggression level and is also a legislative demand.
- When allocating straw, manure canals should be established with cables or a recirculated waste flushing system.
- With vague ventilation, large demands are made to design and siting of insulants.
- There will always be an initial phase for both staff and animals. Loose housing systems involve many new management elements, eg. feed control, removal of sows that cannot manage in the system. These elements are often the cau-se of several of the problems in pens with loose housing.

Trickle feeding
At feeding, it is important that the pen is calm, ie. only few changes of place so the sows in the groups are ensured a uniform feed intake. Calm is ensured if:

- The number of open feed boxes equals the number of sows in the pen
- Feed dose is higher than normal in the days after penning
- High-fibre feedstuffs are added to the feed, eg. beet pellets (max. 20%)
- Sows are penned in pens with 6-12 sows per pen in solid groups

In pens with trickle feeding the best control of feed allocation is achieved if the sows are sorted so that small-/thin sows and large sows are in different pens. Feed dose may be increased in pens with small/thin sows so the feed ration is adjusted.

The possibilities for monitoring the sows are good due to the small pens and it is relatively easy to train sows and gilts in the trickle system.

If the insemination pen is correctly located and equipped, moving the sows is easy. Time spent was 6-8 minutes per insemination incl. removal and heat control. In a traditional service unit it takes 5-7 minutes from the catheter is placed till the sow has received the semen.

Loose sows

One feeding stall per sow

Compared to pens with joint feeding stalls where at feeding the sows are let out to the stalls and after feeding back into the pen, one feeding stall per sow has a number of advantages. There is permanent access to the feeding stall so the sows can take refuge in the stall or cool down at the concrete/slatted floor. Labour is reduced considerably, when this is reduced for feeding and inspection eg. on weekends. However, in many tasks, the amount of work is almost identical in the two arrangements. It is possible to establish smaller pens without increasing the amount of work. A week batch is thus sorted into large and small/thin sows.

Other experiences:

- Solid groups are recommended to ensure an adjusted feed ration.
- Thin sows should be given supplementing feed.
- The stalls should be locked while the sows eat.
- Due to safety reasons, feeding stalls should have a front exit as it is easier to get a sow out forwards if by accident two sows are in the same feeding stall.
- It is easy to train sows and gilts to use the feeding stalls.

A new test will decide which siting of the slatted floor is most appropriate in pens with one feeding stall per sow.

ESF and "little" nest boxes

All alley areas and areas in front of the feed dispensers are equipped with slatted floors. Experience shows that relatively many sows had leg or hoof injuries most likely due to the large areas with slatted floors. Sows' walk and hooves should thus be examined thoroughly before the sows are penned in loose housing systems. Also, all slatted floors should be sprinkled to ensure a non-skid floor.

Other experiences:

- Sows may be housed in large pens with dynamic groups.
- Labour for supplying straw and handling manure is at a minimum.
- If the housing unit is not filled, individual nest boxes should be closed thereby reducing the risk of dirt in the laying area.
- The initial phase with ESF is often more demanding than in the other feeding principles because of the work with training the sows.

Ab libitum feeding

12 ad lib dispensers for loose gestant sows have been tested re. feed waste, adjustability, handling, bridging, caking, cleaning, work environment, durability and wear.

Recommended designs of dispensers for sows:

- The trough must be 40 cm deep so the sow's head is above the trough.
- Trough breadth must as a minimum be 35 cm corresponding to the breadth of the sow's head.
- For dispensers with head/shoulder separation trough breadth must be 45 cm corresponding to the sow's shoulder breadth.
- Trough height should be 26 cm.

There were generally big problems with the dispensers' function and durability. Several were not designed for sows. The sows got abrasions on head and knees. The dispensers also broke easily.

Training and separation areas may be a help re. electronic sow feeding. However, there is also a risk that these auxiliary devices lead to serious accidents with dead and injured sows. Feed dispensers with separation equipment must thus be equipped with safety devices to avoid too many sows being led into a separation area.

Loose, nursing sows

Danish experience shows that piglets from loose nursing sows weigh more at weaning than piglets from sows in crates. However, loose housing is often connected to increased piglet mortality and increased use of space and labour.

Farrowing pens differ from other pens by having to meet two categories of animals: sow and piglet. The farrowing pen is also the setting for several phases in the lives of sows and pigs in which it can be difficult to tend to both sow and pigs at the same time as their needs may be conflicting.

In the last year several new pen systems have been tested and assessed in production herds.

Swiss farrowing pen

Results show a high weight on weaning of 79.5 kg per litter at 26 days, but also a high piglet mortality of 23%. The pen worked well regarding hygiene and consumption of labour. Due to the high piglet mortality the pen cannot as such be recommended. However, mortality may be reduced by increased knowledge of the causes. Another test has thus been initiated to elucidate these matters.

The VIP farrowing pen, Ikadan. Tilting balls protect the pigs from being crushed to death, but apart from that the sow may move freely. The pen occupies approx. the same area as the usual farrowing pen and has fully slatted floor

Other types of pens

In several types of pens, dirt in the pen and high piglet mortality within the first days post-weaning have been registered. So far, positive observations have been made with the Combi-pen from a.o. Egebjerg Maskinfabrik in which the sow can be housed in a crate for a short period.

Outdoor sow herds

Individual or joint farrowing paddocks

Financial consequences of using individual farrowing paddocks and joint farrowing paddocks are analysed in a test based on piglet mortality, amount of labour and weight on weaning.

Total mortality was reduced from 19.2 to 17% by using individual pens while mortality among liveborn until weaning was reduced from 13.5 to 11.9%. It also caused a reduction in feed consumption of 0.4 kg feed per kg weaned pig while weight on weaning was increased by 0.3 kg per pig. In a herd with 100 year sows, the improved production in individual farro-wing paddocks will mean a financial gain of approx. DKK 20,000. Depending on whether there are feed dispensers in the joint paddocks, in the same herd there will be excess labour of 109 or 38 hours corresponding to an expense of DKK1 4,000 or 5,000.

Frost-free water

In cooperation with the company Columbus Aqua, the Danish Applied Pig Research Scheme has developed a removable, frost-free water system for outdoor production. The system is based on re-circulation in regular PEL pipes buried or ploughed in 10-15 cm depth. Furthermore, the company has developed a water trough that is also frost-free. The system has been tested in two relatively mild winters.

Danish Swiss farrowing pen with large covered creep area, slatted floor and clearance rails.

Individual paddocks require more work and larger investments in fences, water troughs and dispensers.

Ventilation

Special requirements to ventilation are made by housing sections for loose, gestant sows: extent of deep litter, carcass' degree of insulation, radiant heat from not-insulated roof surfaces and pen size are some of the factors to consider.

Deep litter
A deep litter mat produces both heat and humidity. On the basis of Danish stan-dards for livestock manure, deep litter is estimated to yield approx. twice as much humidity as a gestant sow while heat production is approx. 2/3 that of a gestant sow. In particular, the great production and emission of humidity of deep litter greatly influence how a housing section for loose, gestant sows should be ventilated.

Deep litter in the entire pen
In systems where all manure is handled as deep litter, typically 800-1000 kg straw is used annually per place unit. Here production of humidity will be so big that a very large production of air all year round is necessary to remove humidity production even if the housing section is insulated.

Acc. to common dimensioning basis, maximum air production of approx. 100 m^3/hour per gestant sow is the aim to maintain an acceptable temperature in the summer. However, such "small" air production is not sufficient to remove humidity production in the winter when sometimes 300-350 m^3 /hour/place unit must be ventilated to remove humidity. Only natural ventilation with gaps in walls and ridge can in practice be used for this type of housing. Even if natural ventilation as other ventilation systems is designed to manage 100 m^3/hour/ place unit at calm days, air production will most of the time be many times bigger due to wind influence. As such housing temperature will follow the temperature outdoor. The installation of water must therefore be made frost-proof.

Deep litter in lying area
In these housing units, typically 300-400 kg straw per place unit are used annually. Production of heat and humidity from deep litter is estimated to be approx. 1/3 of deep litter in an entire pen.

Natural ventilation is also used in not-insulated buildings to achieve sufficient air production to remove humidity production and prevent too much condensation. In insulated housing sections it is possible to maintain a temperature of up to 10 degrees above outdoor temperature in the winter thereby actually keeping the housing section frost-free. This type of housing should be ventilated with managed natural ventilation where gaps in walls and ridge are adjustable. Mechanical ventilation may be used.

Nest boxes – straw as root material
This type of housing should be insulated as there is no deep litter to compensate for a low housing temperature. Housing may be designed traditionally as no regard needs to be made to emission of heat and humidity from bedding. It will, however, often be relevant to consider humid, solid floor and slatted floor. The aim is to have a constant temperature all year and the housing unit should thus be ventilated mechanically or with managed natural ventilation.

Selecting ventilation in gestation units in relation to the extent of deep litter and the housing unit's degree of insulation

Type of housing unit	Annual concumption of straw kg/place unit	Insulation degree	Housing temperature	Ventilation
Nest box	Approx.. 50 kg	Insulated	Constant	Mechanical managed natural ventilation
		Not-insulated	÷	÷
Deep litter in lying area	300-400 kg	Insulated	Up to 10 degrees above outdore temperature	Managed natural ventilation Evt. mechanical
		Not-insulated	Follow outdoor temperature	Natural ventilation
Deep litter in the entire pen	800-1000 kg	Insulated	Follow outdoor temperature	Natural ventilation
		Not-insulated	Follow outdoor temperature	Natural ventilation

Pen size

Which ventilation system may be used in gestation units depends on the number of sows in the group. In connection with the climatic-technical studies under the Danish Applied Pig Research Scheme, several examples have been observed where diffuse ventilation in units with big pens does not work optimum.

Diffuse air intake

Diffuse air intake is characterized by the inlet air merely ”oozing” into the unit. Thus the air let in does not have an impact as opposed to ventilation systems where the air is distributed via air jets. In diffusely ventilated units air distribution is primarily decided by rising air currents from the sows’ heat production. Many animals in one area of the unit will cause a great heat production and a heavy, rising air current that will ”press” the cold air let in to areas without heat production. In units with big pens this may cause very distinct differences in temperature.

Diffuse air intake can therefore not be recommended for service/gestation units with loose sows unless the unit is equipped with relatively small pens and has a uniform stocking density in the housing unit.

Radiant heat

In not-insulated buildings radiant heat from roof surface may increase the pigs’ heat exposure significantly on sunny summer days; a heat exposure that cannot be reduced by ventilation.

Globe measurings

To assess the importance of radiant heat, measurings have been made with a globe thermometer, which is a dull black sphere with a diameter of 15 cm where the temperature inside the sphere is registered. The measurings were made in a finisher unit with a unit that was not insulated and a unit where roof surface was insulated with 35 mm cement bonded fibreboards of 35 mm with an insulation trait corresponding to approx. two cm mineral wool. The globe measurings revealed that the pigs in the not-insulated unit were exposed to distinct heat radiation on sunny summer days. The globe temperature was up to 3 degrees higher than housing temperature. However, the temperature in the globe is not a direct expression of how warm it feels like in the housing unit. It will, actually, feel like the temperature increase is approx. double what is registered in the globe. Ie. a temperature three degrees higher in the globe will feel like an approx. six degrees higher housing temperature.

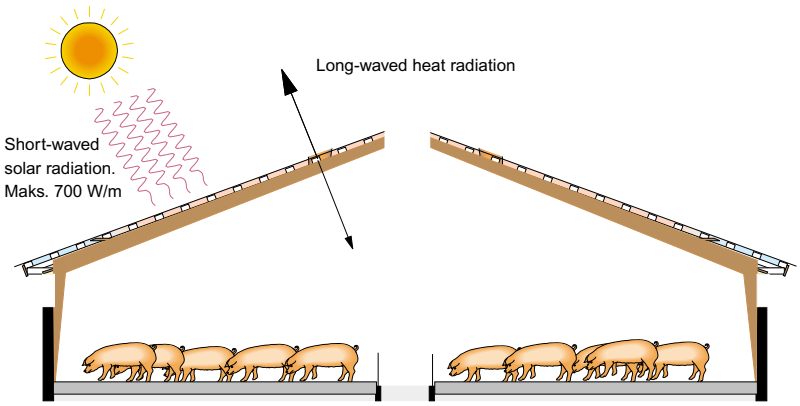
Asymmetrical radiation

Asymmetrical radiation, ie. different surface temperatures on different building surfaces might feel uncomfortable to humans. In particular, a ”hot” ceiling will feel uncomfortable. A ceiling surface 20 degrees hotter than the other surfaces will be considered uncomfortable by 8 out of 10 human beings.

The difference in radiant heat between the not-insulated and the slightly insulated surface will be clearly felt on sunny summer days. Despite the same housing temperature, the not-insulated unit will feel much hotter than the ”chilly”, slightly insulated unit.

Elimination of radiant heat

Radiant heat from the roof surface may be limited by choosing light and shiny roof slabs, but the best solution is insulation of the roof surface. Already at an insulation degree cor-responding to approx. 2 mm mineral wool, radiant heat will practically be eliminated. If the housing unit should at the same time be secured against condensation, a construction with an insulation degree corresponding to at least 5 cm mineral wool is recommended.



The sun adds energy to the roof surface in the form of short- waved heat radiation. Some of that energy is emitted in the form of heat radiation towards the housing unit. On sunny summer days, the roof surface may be more than 30 degrees hotter than the housing temperature.

External environment

Odour

In early summer of this year, odour from livestock production was in the public eye particularly concerning spreading of slurry. The cause of odour is primarily ascribed to the unusually warm and dry early summer.

Regulation for livestock manure contains provisions for how close to neighbouring buildings housing units may be erected. Yet increasingly more pig producers encounter local authorities that in practice require larger distance. Thus, on the basis of the Environmental Protection Act, the local authorities may establish limit values for odour that renders present distance requirements insufficient to ensure the surrounding environment against "not insignificant nuisance".

Thinning the air is a possibility

In factory plants with high chimneys it is estimated that pollution around the factory at a given point is reduced to 1/4 if chimney height is doubled. This effect can probably not be estimated for pig units as the housing units contribute to pulling ventilation outlet air towards the ground.

To elucidate the possibilities of relieving any odour problems, the Danish Applied Pig Research Scheme conducts a project based on a 1400 m^2 large finisher unit. A number of tests have been conducted under different meteorological conditions and with different heights of exhaust pipe. The project will be finished towards the end of 2000. The following has been observed in the tests: Traditional design of exhaust pipe which is approx. 70 cm above ridge, has the effect that outlet air is pulled towards the ground in the lee side of the building. This causes a reduced thinning of the odour and thereby an increased strain of odour of the surroundings.

As expected, odour concentration drops with increasing height of exhaust pipe not least because in many periods no odour can be measured as the "plume of smoke" remains in the air and is gradually mixed with the atmosphere. However, more or less frequent impacts of plumes of smo-ke occur that press the plume of smoke towards the ground thereby causing nuisances. The frequency of these impacts depends on the height of the exhaust pipe as well as of the turbulence in the atmosphere.

Ammonia

Atmospheric fallout of nitrogen compounds may be a problem in forests, common, heaths and raised bogs that lack nutrients. If the tolerance limit for nitrogen is exceeded it will alter vegetation. Atmospheric nitrogen fallout is primarily due to ammoniac evaporation from agriculture and nitrogen filters made from burning fossil fuel.

Distance requirements according to the order on livestock manure.

Area	Number of AU 15-120	120-250
Rural zone	50	50
Future urban zone and summer cottage area	100	100
Existing urban zone and summer cottage area	100	300

Action plan

A new action plan for reducing ammoniac evaporation from agriculture will be made in Parliament in 2000/01. The National Environmental Research Institute and the Danish Institute of Agricultural Sciences have so far drawn up four technical reviews describing the environmental consequences of atmospheric nitrogen fallout, development in nitrogen fallout, techno-logical possibilities for a reduction and a financial assessment.

Nitrogen fallout

Acc. to the four reviews, nitrogen fallout in Denmark has dropped significantly from approx. 21 kg nitrogen per ha per year in the mid-80s to approx. 15 kg in 1996. Total nitrogen fallout in Danish rural areas was in 1996 calculated to be 67,300 ton-nes. Of this, nitrogen filter constitutes 35% while ammonia from Danish agriculture constitutes 51%. Danish pig production constitutes 18% of the total fallout.

Effort areas

To reduce ammonia and odour emission from housing units, a four-year development project has been initiated in cooperation with Reseacrh centre Bygholm, DIAS and the Department of Farm Buildings and Machinery. The aim is to develop simple and cheap techniques to reduce evaporation of ammonia and odour.

So far tests are conducted of V-shaped slurry containers and different designs of floor construction in finisher herds with drained floor.

Work environment

It is important to include the work environment on establishment and renovation of housing units and when instructing new employees.

Feed barn

A study has shown that with renovation of feed barns it was possible to reduce dust concentration by 50-85%.

In order to avoid high concentrations of dust, all assemblings must be tight and self-cleansing filters should be chosen over flour bags.

Regarding dust it is an advantage to use bigbags or liquid minerals rather than manually pouring supplementary feed from sacks in intake pits. When using bigbags one must make sure to sling it properly without any risk of it tipping over or falling down, and it will be an advantage to be able to move the sacks with a craneway. So far, liquid minerals may only be used as an exemption.

Sack hoist so the back is not strained.

When grinding grain, noise level was reduced from approx. 97 to approx. 94 dB(A) after changing grinders. To put this into perspective, it should be noted that a change of 6 dB(A) corresponds to halving the level of sound pressure, and that the limit value for noise during a working day is 85 dB(A).

In areas where the electricity tariff varies during the day, more companies install feeding plants thus facilitating night work. This is also an advantage as producers are not annoyed by noise.

Outdoor production in the summer

A gathering of experiences has been initiated of work environment on outdoor production. Two herds are observed for one week in July and November, respectively. On the basis of registrations made during the summer, the following conclusions can be made:

- The noise level is very low, however, breathing masks should still be used on castration of pigs in farrowing huts, removal of piglets from farrowing paddocks to weaner units, vaccination and sorting pigs in an open weaner unit, and when catching and treating sows outdoor.
- Large part of the working hours is spent on a tractor or a 4-wheeled motorbike. The body is exposed to many twists when driver looks backwards. Furthermore, there is a risk of accidents when getting on and off the vehicle with the engine running. The aim should be to use comfortable vehicles and ensure a plane driving surface so that vibrations are minimized.
- Knees are strained on outdoor production and it is therefore an advantage to use pants with knee caps. It is also an advantage to use huts where the roof can be lifted.
- Castration is one of the most dangerous tasks and it should be carried out by experienced persons as there is a risk that the sow may attack.

Inspection in farrowing paddocks.

On outdoor production, large part of the work takes place on a tractor or ATV.

Bolt pistol

Many accidents with a bolt pistol occur due to poor instruction, and therefore the following advice may be given:

- Students using a bolt pistol for the first time should receive detailed instructions.
- The animal must at all times be tethered with a snout break.
- The bolt pistol should be loaded only immediately before use.
- The firing pin should be pulled only immediately before firing as the pistol may fire if dropped.
- The pistol must never be pointed towards people.
- Do not shoot before the pig stands still and pulls backwards in the snout break.
- After use, clean the bolt pistol and store it cleaned.
- Repairs of the bolt pistol should be made by experts.

Legislation and specialised production

Legislation on indoor production of weaners, breeding pigs and finishers came into force on July 1 2000. For buildings taken into use before that date, the law does not apply until July 1 2015. A bill has also been drawn up on outdoor pig units expected to come into force on March 1 2001. This law concerns animal protection aspects, but environmental demands to outdoor production have been stipulated in a revised edition of the Byggeblad (environmental protection legislation).

Common EU rules on organic pig production have now been adopted esp. influencing accommodation of the production plant and feeding.

Production of UK pigs has increased as more pig producers establish loose housing systems.

Law on weaners and finishers

The law bans establishment of pens with fully slatted floors. In pens for weaners and finishers, at least 1/3 of the required minimum area must have solid or drained floor or a combination. In weaner-only pens this applies to half of the required pen area. The drained floor must not have more than 10% opening space. Sprinkling plants must be installed for pigs weighing more than 20 kg so they can cool down. No requirements are made to bedding in pens; however, from no later than July 1 2005 pigs in new housing units must have access to occupational or root material.

Law on outdoor pig units

The prepared bill esp. makes demands to space in the huts, pigs' possibilities for regulating temperature and defines matters on water supply. The bill also makes demands to size of outdoor areas with environmentally approved floor placed adjacent to removable huts, tents etc. The law is expected to come into force on March 1 2001 but with a five year transition period on some of the demands.

Byggeblad

No great changes are planned for outdoor sow units in the Byggeblad. However, demands will be tightened to removal of feed and water troughs and huts to minimize excise pollution with nutrients.

Tooth clipping is no longer allowed, but teeth may if necessary be polished within the first four days after farrowing.

Production of UK pigs

Approx. 1,750 producers have now been approved for production of UK pigs. They deliver approx. 63,000 pigs per week corresponding to 1% of the production. In 2000, approved UK pigs are settled with an additional price of DKK 0.40 per kg. For the two subsequent years an additional price of min. DKK0.30 per kg is guaranteed.
The main demands to the producers are that meat-and-bone meal is not used in the herds and that the sows must be loose in the period outside the farrowing unit. As more production safe service units are developed for loose sows, more producers will choose letting the sows be loose in this period to meet UK demands.

A group representing the three slaughter companies, The National Committee and Danish Bacon and Meat Council is responsible for production rules and control meeting demands made from the UK market. Contract on production of UK pigs is made with the slaughter company. These producers must be ready to receive visits from the UK to verify that the contract terms are met.

Common EU rules on organic pig production

The future for Danish organic pig production is a great challenge with the adoption of common EU rules for organic livestock production. Requirements of 2.3 m^2 pen area per 100 kg pig and 100% organic feed in 5 years will make organic pig meat so expensive that it is doubtful whe-ther consumers will buy it. There is also a risk of a significant reduction in meat quality.

Management in organic pig herds

The Dept. of Pig Production works on a project to develop advisory tools for organic pig producers. In cooperation with local advisors, 3 farmers are visited once every month for 1 1/2 years with the aim of advising and showing how organic pig production may be run in practice. Experiences are systematized so they can be transferred to other herds. Results from the project will be shown continuously at: www.lr.dk.

Production economy

Production costs abroad

Interest is increasing in comparing the competitiveness of Danish pig production in primary production to the countries we compete with globally. The exchange rate is a year's average.

The table shows production costs per kg carcass in chosen countries.

Canada has the lowest production costs and some of the world's lowest feed costs. The abolition of the support scheme The Great Western Transportation Act has greatly influenced feed prices.

Ireland has low labour costs and a good efficiency.

Spain has very low labour costs and very low building costs.

The USA has low costs for feed, building and labour.

Holland has increasing costs for environment.

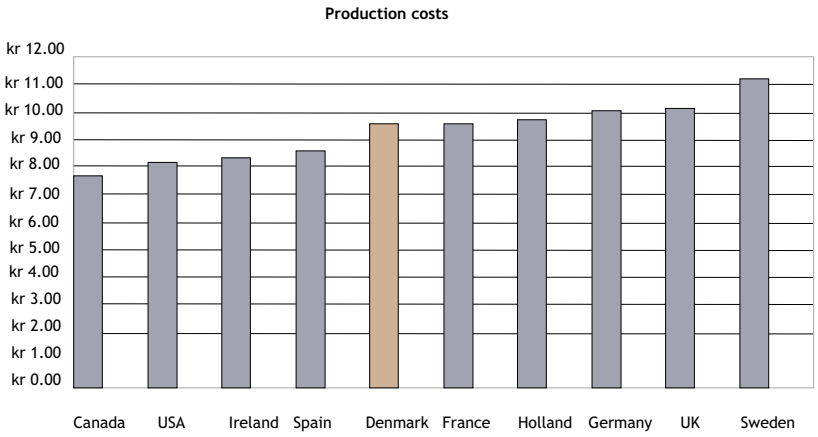
France has costs level with Denmark, but a lower efficiency.

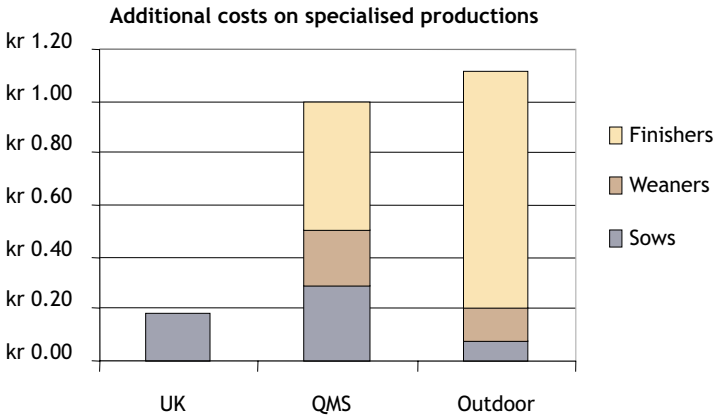
Germany has high costs for medication and the highest slaughter weight.

The UK has high feed costs and high labour costs. Labour costs are influenced greatly by efficiency in pig production: both produced pigs and time spent influence these costs.

Sweden has high costs for building housing units and the highest labour costs.

What makes Denmark competitive in terms of production economy is the high efficiency and that affects all costs positively. However, competitiveness is hampered by high financial costs and high labour costs.





Additional costs at specialised productions

Additional costs per kg carcass for different productions have been calculated and compared to traditional pig production.

Additional costs for UK production are found in the sow unit where the requirement to loose pregnant sows is central.

Combined with a boar contract, there may be advantages of the higher lean meat percentage in boars.

The calculation does not include costs for check visits.

Additional costs at QMS production (Quality Marking Scheme) have been divided equally from 0-30 kg and 30 kg till slaughter. In particular the 30% larger space requirement for finishers increases additional costs.

On outdoor production, outdoor space for finishers and more time spent are important additional costs.

Organic pig production

Development in organic pig production has been great in the last five years, however it seems to stagnate with the adoption of common EU rules for organic livestock production.

The cause of this stagnation is probably the increased requirements to feeding and housing.

Feeding

With the adoption of the common EU rules on organic livestock production, possibilities are limited for composing optimum feed mixes for pigs. These limits will generally affect protein supply to pigs.

Danish legislation has so far allowed using up to 25% (% of FUp) conventional feed, some free amino acids and GMO-free soybean meal. This was changed as of August 24 2000 so that until 2005 it is only allowed to use 20% conventional feed (% of DM of products of agricultural origin) while free amino acids and soybean meal are no longer allowed. After 2005 the entire feed mix must be organic.

To elucidate the problems, The National Committee in cooperation with the Danish Institute of Agricultural Sciences and the Meat Re-search Institute has attempted to optimise feed supply to organic pigs by initiating a study of feeding with lupin as protein source, and through studies of green rib mix (rib-harvested triticale, barley/pea and lupin) as energy rich roughage.

Housing

Re. housing conditions, the EU rules lay down space requirements for the individual animal groups. Danish rules are framework rules with a recommendation on space requirements. Comparing the Danish recommendation to the EU requirements, the following difference is observed:

- In Denmark it is recommended that an organic pig of 100 kg have min. 0.5m^2 lying area, min. 0.5m^2 outdoor area and a total area of 1.3m^2.
- In the EU rules an organic pig of 100 kg must have min. 1.3m^2 in-door area and min. 1.0m2 out-door area, ie. 2.3m^2 per 100 kg pig.

Denmark has by now many experiences with housing systems and they are the basis of the Danish recommendations. A requirement of 2.3m^2 total area will cause increased costs for producers; partly set-up costs and partly labour costs for cleaning.

Economy

Export to England, in particular, has really got going thereby stabilising the market and settlement.

Future organic production (EU rules), however, requires increased settlement approx. 100% above the conventional. This will most likely mean that consumers will have to pay DKK 150-200 per kg in the shops. This may have severe consequences for the export/market in the future.

Optimising organic finisher units

The Danish Applied Pig Research Scheme has conducted a study in an organic finisher unit with the aim of optimising pen function and reducing labour in pens with access to outdoor areas (1.3m^2/100 kg pig).

The finisher unit was equipped with an outdoor run and a scraper system for cleaning the solid floor. The pens in the indoor area were fitted with removable equipment facilitating variation of the pen's area between 21m^2 and 36m^2.

Use of mechanical delta scrapers in the outdoor area is a considerable labour reduction. The plant should run 1-2 a week as a minimum.

Pen function very much depends on access facilities between indoor and outdoor areas and therefore there has to be clear passage.

Flexible housing equipment gives way to the pressure of the deep litter mat.

Production	Conventional	Present organic rules	Common EU-organic rules
Break-even price, incl. bonus payment, DKK/kg	kr. 9.50	kr. 15.80	kr. 18.80
(Increase in per cent compared to conventional)	(0)	(60.1)	(97.9)

Management and IT

FarmWatch® and Integrated Farm Management System - Pigs

FarmWatch® - a new tool for monitoring weaners and finishers in batch operation.

FarmWatch® is a newly developed programme for monitoring weaner and finisher production in sectioned operation. The programme is developed by the National Committee and is marketed via The Danish Agricultural Advisory Centre. As of June 15 2000 FarmWatch® is released for sale in version 1.0.0.

FarmWatch® automatically registers water consumption in each housing unit once every hour. Studies reveal that pigs' drinking pattern changes up to a day before they fall ill. When FarmWatch® detects the pigs drinking more or less water than expected, the programme sends a warning to the herd manager. The early warning enables taking care of the pigs at the right time.

Experience shows that warning is only given in due time if water consumption is registered once every hour. It is no help registering water consumption eg. once a day as diarrhoea problems often arise within few hours. FarmWatch® combines hourly registration of water consumption with a sophisticated mathematic model for warning. The model is individually adjusted and is thus superior to other systems for monitoring via water consumption. It varies from herd to herd when a certain change in water consumption signals impending disease. With FarmWatch® it is therefore possible to set the warning limit individually for each of the units based on the herd manager's experiences. Ie. only pigs that are actually falling ill will be treated. "Noise" in the form of fake alarms will be separated.

Treatment of the right pigs at the optimum time results in a smaller medication bill.

For instance, a herd that has 1,200 sows and has used FarmWatch® for more than a year, has been treating diarrhoea more accurately. This herd has observed that diarrhoea quite often occurs in weaners within 2-3 days post-weaning. Before the herd implemented FarmWatch® it was difficult to find the right time for medicating. Now the individual monitor-warning is used which is typically triggered up to 24 hours before the pigs are visibly ill. When the curve of water consumption is back to normal, treatment is stopped immediately. By using FarmWatch® the consumption of medication has been reduced considerably in this herd.

Nucleus management and IFMS

By the end of this year, the Integrated Farm Management System is expected to be supplemented by a breeding modulus for pigs called AMOS. In relation to the nucleus management herds, it can handle a number of tasks re. registration and reporting to the pig breeding database.

All reports to the data base must contain an unambiguous ID number of each breeding animal. AMOS can automatically assign ID numbers for newly born piglets that are later expected to participate in breeding. When ID numbers have been assigned, AMOS automatically creates the necessary reports to the data-base. This is also the case when entering new breeding animals, performing services, reporting farrowings and departures. It is then the user's responsibility to send the reports via the Internet to the data base.

AMOS also contains a number of facilities designed for breeding and multiplier herds. There is a price and sales index and options for managing the home test. Finally there is an address index that all herd owners may use.

FarmWatch® - a European novelty at Agromek 2000.

Informationsmateriale

Pjecer/foldere

- Info Svin, Svinefaglig database, brochure
- 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"
- "Værd at vide om veterinærmedicin"

Skilte

- Adgang forbudt - grisene må ikke fodres, inkl. bekendtgørelse + indhegningsfolder
- Adgang forbudt - uden ejerens tilladelse

Andet materiale

- Dansk svineproduktion efter 2. verdenskrig 1945- 1995
- Svinepasseren II. Arbejdstilrettelæggelse og pasning af svinebesætningen
- CHECKLISTE - 900 gram dagligtilvækst
- Årsberetning 2000, Landsudvalget for Svin
- Engelsk Årsberetning 2000, Landsudvalget for Svin
- Årsberetning 1999, Avl og Opformering,
- Kongresbog 2000 fra Kongres for Svineproducenter
- Grundlaget for den beregnede smågrisenotering
- Svinefaglig ordbog Dansk/engels – Engelsk/dansk

Abonnementer

Info Svin, Svinefaglig database
Uge- eller Månedsudsendelse, fagligt materiale

Bestilling

Internetadressen:
http://www.danskeslagterier.dk/lu/info/Index.htm
Telefax nr.: 3313 4712
Tlf.: 3373 2556, Merete Klingert
E-post: mkl@danskeslagterier.dk

Reported results October 1999 – October 2000

Experiences published since the annual report 1999

No. 0001: Gestation units with and without insulated roof surface (Jan. 2000)
No. 0002: Pit ventilation in finisher units with vacuum plants (Mar. 2000)
No. 0003: Lay out and management of finisher units (Mar. 2000)
No. 0004: Proving Mycoplasma hyosonyviae organisms in blood as a tool for diagnosing Mycoplasma arthritis (Mar. 2000)
No. 0005: Experiences with cessation of AGP for finishers (May 2000)
No. 0006: Gestation units with loose sows fed via trickle (July 2000)
No. 0007: Swedish service units with group housed sows and insemination pen (Aug 2000)
No. 0008: Insulated versus non-insulated two-climate housing for finishers – cold and heat radiation (Aug. 2000)
No. 0009: The Perstrup housing unit – finisher unit with solid floor (Aug. 2000)
No. 0010: Gestation units with loose sows housed in pens with one feeding stall per sow (Aug. 2000)
No. 0011: Segregation of dry feedstuff (Sep. 2000)

Reports published since the annual report 1999

No. 443: Com. mixes for weaners sold in West. Jutland (Nov. 1999)
No. 444: Feed with 60% pulpetter for gestant sows housed in solid groups (Nov. 1999)
No. 445: Calcium formiate and sorbic acid for weaners (Nov. 1999)
No. 446: Heredity of meat colour and relation to production traits (Nov. 1999)
No. 447: Does breeding for ultima-te pH work (Nov. 1999)
No. 448: Analysis of return rates for Yorkshire AI boars (Nov. 1999)
No. 449: Prevalence of disease lesions in thoracic cavity organs and liver in Danish finishers. Status 1994 & 1998 (Nov. 1999)
No. 450: Com. products for finishers – Truffle Feed Addtive and Genex (Dec. 1999)
No. 451: Time of grouping for sows in dynamic groups (Dec. 1999)
No. 452: Optimised, sectioned management – Prod. results and slaughter check (Dec. 1999)
No. 453: Testing strategies for litter equalization (Dec. 1999)
No. 454: Comparison of simple dry feed dispenser and tube dispenser for weaners/no. of weaners per tube dispenser (Jan. 2000)
No. 455: Assessment of conformation in Duroc. Heredity of and relation between 4 diff. assessments of con-formation in performance tested Duroc (Dec. 1999)
No. 456: Comparison of litter size in LY sows served by HD and YD crossbreds, respectively (Dec. 1999)
No. 457: Design of slurry containers in farrowing units (Dec. 1999)
No. 458: Low-pressure oil ejecting system in a farrowing unit and a finisher unit (Dec. 1999)
No. 459: Wheat rib-mix for finishers (Jan. 2000)
No. 460: Restrictive feeding for preventing diarrhoea and mortality caused by E.Coli (Jan. 2000)
No. 461: Com. products for weaners: Bolifor FA2000L and XS44 (Jan. 2000)
No. 462: Extended registration of disease prevalence in lungs, heart and liver (Jan. 2000)
No. 463: Increasing amounts of extracted rapeseed for finishers (Feb. 2000)
No. 464: Testing Regumate (Feb. 2000)
No. 465: Com. products for weaners – FU01, blood products and Endosan (Feb. 2000)
No. 466: Importance of Salmonella positive faecal samples of the weaner supplier for prevalence of positive meat juice samples in buyer herds (Feb. 2000)
No. 467: Reduced protein content in feed for growing-finishing pigs (Feb. 2000)
No. 468: Vaccination with Porcilis App against pleuropneumonia in finishers (Mar. 2000)
No. 469: Different doses of organic acids for weaned piglets (April 2000)
No. 470: Protective diets for prevention of post-weaning enteritis and mortality caused by E.coli (Aug. 2000)
No. 471: 3-phase feeding of finishers with differentiated phosphorus standard (May 2000)
No. 472: Productivity in multisite systems (May 2000)
No. 473: Com. products for finishers – Luprocid and Natu-phos (July 2000)
No. 474: Com. products for weaned piglets – Luctacid HC, Luctacid Piglets and Mastercid 90 (June 2000)
No. 475: The effect of grinding and pelleting on the production results and stomach health of finishers (July 2000)
No. 476: Effect of catheter gel on semen (July 2000)
No. 477: Com. products for piglets – Aci-Form, Liprot SG 9 and Profeed (July 2000)
No. 478: Treatment with serum for the odema disease toxin VT2E in herds with Eschericia coli 013 (July 2000)
No. 479: Increasing content of rapeseed in feed for piglets (July 2000)
No. 480: Comparison of individual and joint farrowing paddocks for nursing sows outdoors (July 2000)
No. 481: Traditional, sectioned housing versus housing in the same pen from farrow to finish or from weaning to finish (Aug. 2000)
No. 482: Com. mixes for weaners sold in Southern Jutland (Aug. 2000)
No. 483: Com. mixes for finishers sold in Eastern Denmark (Aug. 2000)
No. 484: Comparison of trickle feeding and floor feeding for gestant sows in solid groups (Aug. 2000)
No. 485: Product test of tube feeders for weaners (Aug. 2000)
No. 486: Testing gestation testers and scanners (Aug. 2000)
No. 487: Com. products for piglets – Valiomix (Aug. 2000)
No. 488: Effect of Tylosin and the feed's protein content on prevalence of diarrhoea in finishers (Sep. 2000)

Subject index

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