

PIG PRODUCTION



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Layout: Lene Kruse Kessler, Grafica-design

Cover photo: LandbrugsMedierne

Print: Hørdum & Engelbreth

Paper: 115 gram G-print

Publisher: SEGES Publishing
Agro Food Park 15
8200 Aarhus N
Denmark

T +45 8740 5501
E forlag@seges.dk
W seges.dk/forlag

ISBN: 978-87-93050-37-2

1st edition, 2016

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1 Pigs as Domestic Animals

The family of pigs came into existence in Asia approximately 40 million years ago. It is divided into five genera which together have 19 existing species. The domestic pig belongs to the genus Sus which came into being approximately five million years ago.

Pigs are found in nature in Europe, Africa and Asia, and the feral pig is one of the most widely distributed mammals on Earth. In Denmark the feral pig was extinguished around the year 1800, but in recent years a smaller number have returned to Denmark from Germany.

The pig was one of the first animals to be tamed by humans. It happened about 9,000 years ago in the eastern part of Turkey and almost simultaneously in China. Probably, primeval hunters killed a feral sow and took her piglets with them home. In Denmark remnants of bone and pig's teeth have been found in dung heaps from the kitchens of the Neolithic period, and the findings are at least 5,000 years old.

Development and Adaptation of Pigs

In prehistoric Denmark, domestic pigs lived in relative freedom in and around the small villages where they foraged in nature and dung heaps.

From the middle of the eighteen-hundreds, pigs were fed cereals and waste products from the dairies. The surplus of whey and skimmed milk from the production of butter was excellent pig feed. During the 1860es and 1870es, the first slaughterhouses were built resulting in an increasing export of meat rather than live animals. Especially the export of bacon to England had a big impact on Danish pig production in the first half of the nineteen-hundreds.

The first years after the Second World War there were approximately 200,000 farms with pig production in Denmark. The farms were mixed and produced yearly

12-13 finishers on average and only very few herds produced more than 100 finishers per year.

In the late 1950es new housing systems emerged, and the farrowing pen with a farrowing rail became common. In the 1960es specialization increased and the herds became bigger. Slatted floors were introduced in the 1970es and prevailed in the 1980es. In 2014 there were 3,626 pig herds in Denmark, and the average size of the sow herds was about 700 sows. The average size of the finisher herds was about 6,800 finishers in 2014.

In Denmark, applied breeding for certain characteristics has only existed the latest 200 years even though we have kept pigs for several thousand years. That means that the behaviour of domestic pigs has generally not changed a lot compared to that of the feral pigs. The biggest differences between the domestic and the feral pig are therefore not in the behaviour but in the appearance, growth and reproductive results.

Designations for Pigs

The designation depends on age, gender and stage in the reproductive cycle.

Boar: A male animal

Sow: A female animal that has given birth

Castrate: A castrated boar

Young female: A female pig (2-8 months) that hasn't been mated yet

Gilt: A female pig that is inseminated or mated for the first time but still has not farrowed

Piglet: From birth to weaning

Weaner: From weaning to 30 kg

Finisher: From 30 to 110 kg

Nursing sow: A sow taking care of piglets that she hasn't given birth to herself

First parity sow: A sow that has had her first litter

Second parity sow: A sow that has had her second litter and so on.

Pig Senses

The sense of smell (olfactory sense) is the most important sense of the pig and together with the very sensitive and flexible snout it makes the pig very efficient when searching for and sorting food in the ground.

All studies indicate that the pig experiences the world through its snout. To keep a pig occupied it is therefore better to give it something to rub the tip of the snout on rather than something to look at or listen to. Feral pigs eat by moving the snout to

and fro and pulverize the food with the lower lip, the teeth and tongue. Domestic pigs eat the same way and have the same need for rooting.

The pig's sense of hearing is good and sounds are very important in the way pigs communicate with each other. A sow and her litter can recognize each other on sound and smell and so can finishers within a group. Pigs can also distinguish humans through sight, sound and smell.

The eyes are small and the sight of the pig is not very good. The pig has a restricted colour vision and is near-sighted.

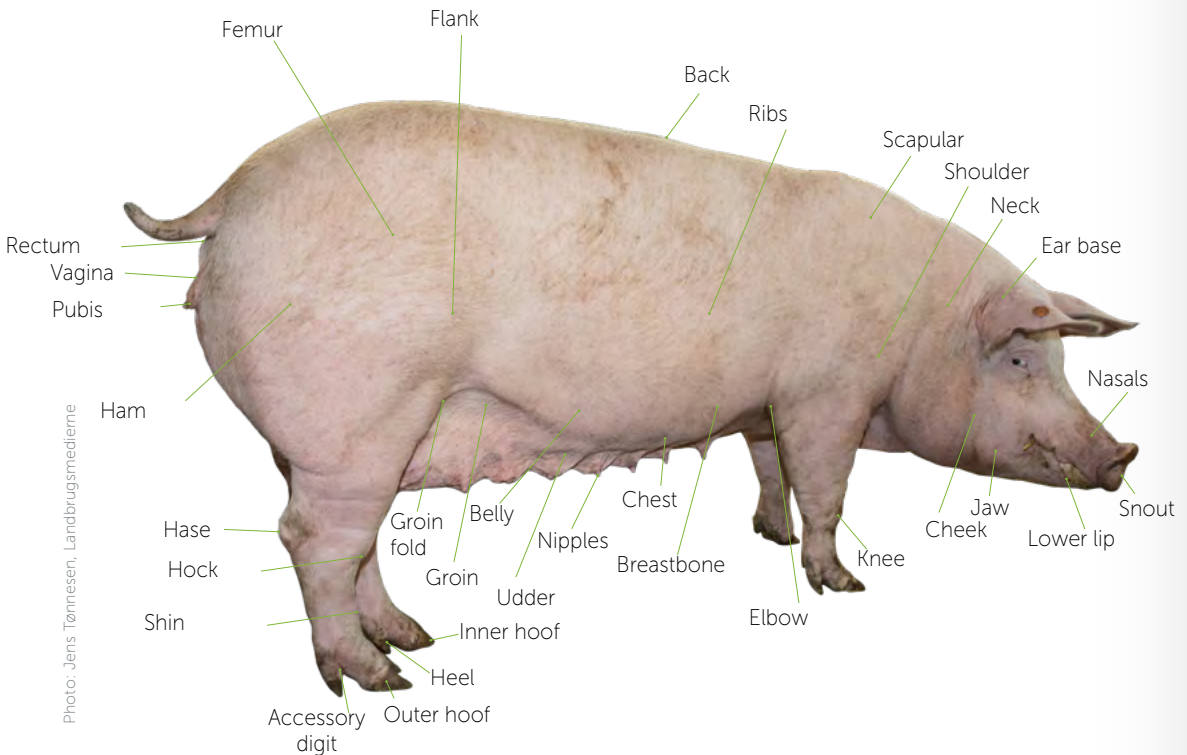


Photo: Jens Tønnesen, Landbrugsmedierne

1.4. In many ways the inner anatomy of the pig is similar to that of humans. Pigs are thus used as experimental animals when studying operational techniques, healing, cardiac surgery, diabetes research and they are used as donors in organ transplantation.



1.17. *The former English Prime Minister, Winston Churchill, once said: "Dogs look up to us, cats look down on us, but pigs regard us as equals".*

Then the behaviour in the flock is observed and finally the individual animal.

Pigs in production systems have poor chances of adapting to emerging situations. The sows, for example, cannot move in an ordinary farrowing pen or run very far away in the gestation unit. Thus it is important that the routines are well-known and handling of the pigs is predictable so as to stress the animals as little as possible.

The connection between production results and the pattern of reaction of the staff has been studied. The animals in the best herds are characterized by low timidity, willingness to approach humans, short escape distance, ease of handling and quietness in the proximity of humans. The staff act in a firm, safe and predictable manner. They handle the animals frequently just as they often speak to and touch the pigs, especially in stressful situations.

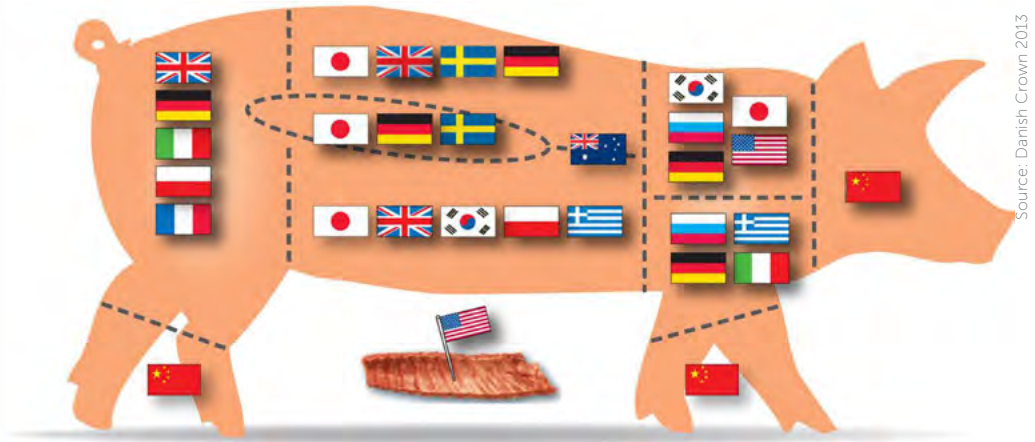
2. Pig Production in Denmark

In Denmark, approximately one million sows yearly produce roughly 30 million piglets i.e. they produce about 30 pigs per year sow. Danish pig production is important for Danish economics and helps to create jobs. Every day about 4,500 tonnes of pork is produced in Denmark, and in 2014 the value of the Danish export of pork was approximately 30 billion kroner. The slaughterhouse sector alone employs 6,900 people, in addition to this there are employees at the farms, in the advisory service and in the processing industry.

The number of farms is decreasing, and the farms are continuously increasing in size and efficiency. The big herds are getting even bigger and the workflow is rationalized. At the same time investments are made in technical facilities which reduce physically hard work and minimize time consumption per produced pig.

In a modern pig herd you spend about eight hours to take care of a year sow and her litters, 4.5 minutes per weaner from 7-30 kg and 9.5 minutes to take care of a finisher from 30-100 kg.

The production systems and the workflow are continuously developed to improve and streamline production



Source: Danish Crown 2013

2.6. Danish pork is exported to the whole world. But different cuts are demanded in different countries.

Export of Pork and Live Animals

Danish pig producers are among the best in the world when it comes to breeding, quality, food safety, animal welfare and traceability which is a major reason why Denmark is among the world's largest exporters of pork. One of the challenges to Danish pig production is to get the farmers to send their finishers to Danish slaughterhouses. This is partly due to the fact that Danish weaners are attractive. Like all other products, pigs are sold at the best paying markets. This means that many weaners are sold for export. During the last ten years, the amount of weaners that leave the country has increased significantly and today constitutes a large part of the weaners produced in Denmark.

The majority of live pigs for export are made up of weaned 30 kg pigs; in 2014 it amounted to 10.5 million weaners. The export of piglets of 0-15 kg is somewhat smaller as there is not the same demand; in 2014 just under 0.4 million were exported. The majority of exported weaners are sold to German and Polish pig producers. German pig producers buy approximately 60 percent of the exported weaners and Polish pig producers about 30 percent.

Danish producers are generally good at sorting and producing uniform animals that reach the agreed weight. The reason that Danish weaners are attractive is that the health level is well controlled. At the same time, a number of sow herds have reached a size which enables them to deliver 600-700 weaners at a time. This minimizes transportation costs and means that one producer alone can fill up a truck.

4. Gestation Unit

The gestation period is the period from insemination till the onset of farrowing. On average a sow is gestant 116-117 days. In a popular term she is gestant three months, three weeks and three days.

In the gestation unit supervision is crucial. All animals must be supervised on a daily basis for instance while providing bedding when it is possible to check that all animals are able to get up.

During the daily supervision it is important to assess the condition of the sows and check for signs of heat.

Development of the Foetus

Sows and gilts can be transferred to the gestation unit just after insemination. Typically, however, they are transferred four weeks after insemination when they have been proved gestant by scanning. Usually they stay in the gestation unit until a week before expected farrowing. All sows in Denmark must be loose in the gestation unit.

Within the first ten days after fertilization, the embryos are distributed to both uterine horns. Around day 11 the foetus starts a drastic growth in length and during day 12-14 each foetus measures about one meter in length and becomes like a piece of very thin sewing thread. Then the foetuses disperse in the uterus. This helps ensuring that each foetus gets the needed space to build its own placenta. As gestation progresses, the uterine horns grow in length from about one and a half to two metres each. Every foetus ends up having about 30 cm of uterine horn.

Day	
1	Ovulation and fertilization
10-13	Foetal bladders grow and disperse in the uterine horns.
13	The sow realizes that she is gestant
10-14	The female hormone, oestrogen, is produced. If there are not at least two foetal bladders in each of the two uterine horns, the sow will return to oestrus
14-15	Uterus and foetal membranes establish contact (implantation)
15	Increased active hyperaemia in the areas of contact
16	The heart of the foetus starts to beat
20	The placenta develops
30	The organs of the foetus develop
35	The foetus is 4 cm long and weighs 4.9 grams
42	The length of the foetus is 12.5 cm and it weighs 22 grams
63	Cranial, vertebra and costal ossification begins
116	The piglet is born



17-18 days old, 5 mm.



18-19 days old, 7,5 mm.



24 days old, 15 mm.



28 days old, 20 mm.

4.1. The development of the embryo/foetus from ovulation to birth.

7. Finishing Unit



Weaners are typically transferred from the weaner unit to the finishing unit when they are 11-12 weeks old and weigh about 30 kg. There is, however, some variation in weight which can easily vary from 22 to 38 kg in weaners of the same age.

Finishing pigs stay in the finishing unit until delivered for slaughter when they are five to six months old and weigh 95-110 kg.

From 30-110 kg, finishing pigs averagely grow more than 900 grams per day. In the finishing unit focus is on optimizing environment and climate, hence enabling the animals to grow and utilize the feed in the best possible way.

Transfer to the Finishing Unit

Weaners are transferred to the finishing unit in batches or continuously, as and when they reach a certain size.

Batch operation allows emptying and washing of an entire section in one operation which is not possible with continuous transfer of new animals into the unit.

Routines in the Finishing Unit

The finishing unit must be inspected at least once a day – also in the weekends. Troughs and dispensers must be checked and all animals must get up. The best time to check the animals is in their active period in the morning and in the afternoon. Animals showing signs of disease or abnormal behaviour must be marked and decision must be made whether they should be treated and moved to a hospital pen.



Photo: Jens Tønnesen, LandbrugsMedierne

7.1. All finishing pigs must stand up at the daily inspection.

8. Outdoor Pig Production



Pig production takes place not only in houses and pens; pork may also be produced in the open. There is a distinction between free-range production and organic production. Free-range production is conventional production where farrowing takes place in the open, and where gestant sows and finishing pigs are either in indoor loose housing with access to outdoor exercise area or in pens on the field. Organic production differs from free-range production in that feed must be organic, and in a number of areas it is an expanded version of the concept of free-range pigs. In 2014, Free-range Ltd. slaughtered 108,000 organic pigs and 112,000 free-range pigs. There is an increasing demand for organic pork, and SEGES Pig Research Center expects the production to double toward 2020.

In outdoor pig production the animals have the same breeding background as indoor produced pigs, but the housing systems and routines are somewhat different. There may be many reasons for producing outdoor pigs; for some farmers it is the ambition to supply a demanded special product, to others it is the wish for a healthy working environment and to others again, it is the lower investment requirements that count. To a greater extent, keeping outdoor sows is based on the terms of the animals, and it provides the animals with greater opportunity for pursuing their natural behaviour.

Housing Conditions

Land for Production

The optimum soil condition for outdoor herds is a sandy soil, or sandy loam. It is important that the area is well drained, preferably coarse sand, fine sand or coarse and clayey sand, as a tractor will be used year round.

Before land is used for outdoor sows, a wear-proof growth of grass must be es-

tablished. Grass utilizes animal manure and also helps to drain the soil surface and thus keep the huts dry. It is recommended also to establish windbreaks because they offer good protection against wind and sun.

In the open, maximum stocking density is 2.8 animal units (AU) per ha when pigs are kept on the land for a maximum of 12 consecutive months, and a nitrogen consuming crop subsequently is grown for at least 12 months before pigs again are kept on the land.

8.1. *Clay soils and low-lying areas are not suitable for outdoor pig production. They will give humidity problems in the huts and make daily operation of machinery difficult.*



9. Pig Breeding



Denmark is world champion in pig breeding. The Danish breeding system DanAvl is a unique and very efficient system which ensures that pig producers always breed on the best genes. The Danish breeding system, along with good production management, helps ensure that Danish pig production holds on to the leading position in the world.

DanAvl has existed since the end of the 19th century and is managed by SEGES Pig Research Centre. DanAvl has a board that consists partly of representatives of pig producer associations in Denmark and of the associations "Danske Slagterier" (Danish Slaughterhouses), "Dansk Landbrug" (Danish Farmers Association), "Danske Svineproducenter" (Danish Pig Producers), and partly of pig producers, who have joined of their own volition.

All parties involved in the DanAvl system are obliged to adhere to common rules that are established by SEGES Pig Research Center. Outside of the pure breeding, the people involved in the DanAvl system also perform activities related to marketing, sales and distribution of breeding material.

Parties involved in the DanAvl system:

- Genetic management
 - SEGES Pig Research Center
- Artificial insemination companies
- Distributors
- Multiplier herds
- Nucleus herds.

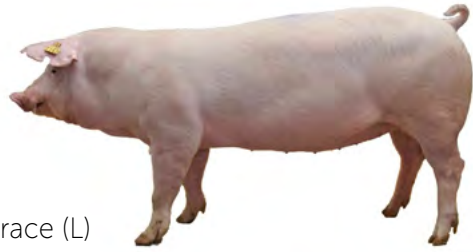
Breeds

DanAvl uses three breeds in the breeding program: Landrace (L), Yorkshire (Y) and Duroc (D). When abbreviating cross-breeds, the male breed is always mentioned first. The designation LY thus indicates an offspring from a Landrace boar and a Yorkshire sow, and L(YL) is the offspring from a Landrace boar and a YL sow.

Due to high fertility, litter performance and excellent maternal qualities of the Landrace, the sows are used as dams of YL young females which together with LY young females are the most suitable hybrid sows for producing finishing pigs.

Yorkshire, like Landrace, is used as dam of LY young females. It is also the most suitable breed in relation to production traits. Danish Yorkshire has a high meat percentage, high daily gain, low feed conversion ratio and a good meat quality. In addition, Yorkshire has good litter performance and maternal qualities.

Duroc originates from the United States and Canada and was imported in 1977-1979. Subsequently, it was used as a sire line for cross-breeding. Since then, Danish Duroc has been improved, especially regarding meat percentage and daily gain. Duroc produces fast-growing finishers with a low feed conversion ratio and a high meat percentage.



Landrace (L)

White breed with long, narrow and light head with large drooping ears. The body is long with a light front and full hindquarters. Landrace is used as a dam line. Very high litter performance and excellent maternal qualities make Landrace sows very suitable for dams of YL hybrid sows. Crossed with Yorkshire or zig-zag crossbreed sows, Landrace boars are used for production of hybrid sows.



Yorkshire (Y)

White breed with short and broad head and protruding ears. The body is medium long, low and the shoulder region is a little heavy. Yorkshire is used as dam line. This makes the sows of this breed suitable as dams of LY hybrid sows. Crossed with Landrace and zig-zag crossbreed sows, Yorkshire boars are used for production of hybrid sows.



Duroc (D)

The breed is chestnut brown, and the colour varies from totally blond to almost black. It has a short, broad and heavy head with small drooping ears. The body is short and broad with a little coarse front and full hindquarters. Duroc is used as a sire line and has a particularly high daily gain and an excellent feed conversion ratio. Duroc boars are of great economic value in the production of finishing pigs and are thus used for that.

In addition to that, Duroc produces carcasses with good meat and eating quality. Today, DanAvl has the largest population of pure-bred Duroc in Europe.

9.1. Landrace, Duroc and Yorkshire are the three prevailing breeds in Danish pig breeding.

Photo: SEGES Pig Research Center

10. Health



Healthy pigs thrive and provide the best results. In consideration of animal ethics, the outside world focuses on the use and handling of antibiotics in pig production. Moreover, there is a growing interest in the quality of the produced meat. In addition, owners of and staff in production units have a personal interest in conducting a responsible handling of veterinary medicine for the sake of the working environment and their own safety.

However, it is not possible to completely avoid diseases and injured animals. It is important to know how to react in a particular situation in relation to both preventing and treating sick and injured animals.

This chapter is about how to keep animals healthy, how to prevent disease and how to treat disease and injuries.

The Healthy Pig

A sound and healthy pig is active, curious and has a good appetite. It grows and develops well and is cheaper to produce than a sick pig that requires both time and money for treatment.

All pigs must be inspected minimum once a day. To detect sick animals in time, it is crucial to know the look of a healthy pig.

10.2. Normal values for resting pigs. Sows have a small increase in temperature after farrowing.

Pigs	Temperature, °C	Respiratory rate/min.	Pulse/min.
Piglets	39.5	52	200
Finishing pigs	39.3	25	90
Sows, young females	38.8	13	70
Older breeding stock	38.3	13	70
Variation	+/- 0.3	+/-5	+/-10

Source: Poul Bækbo

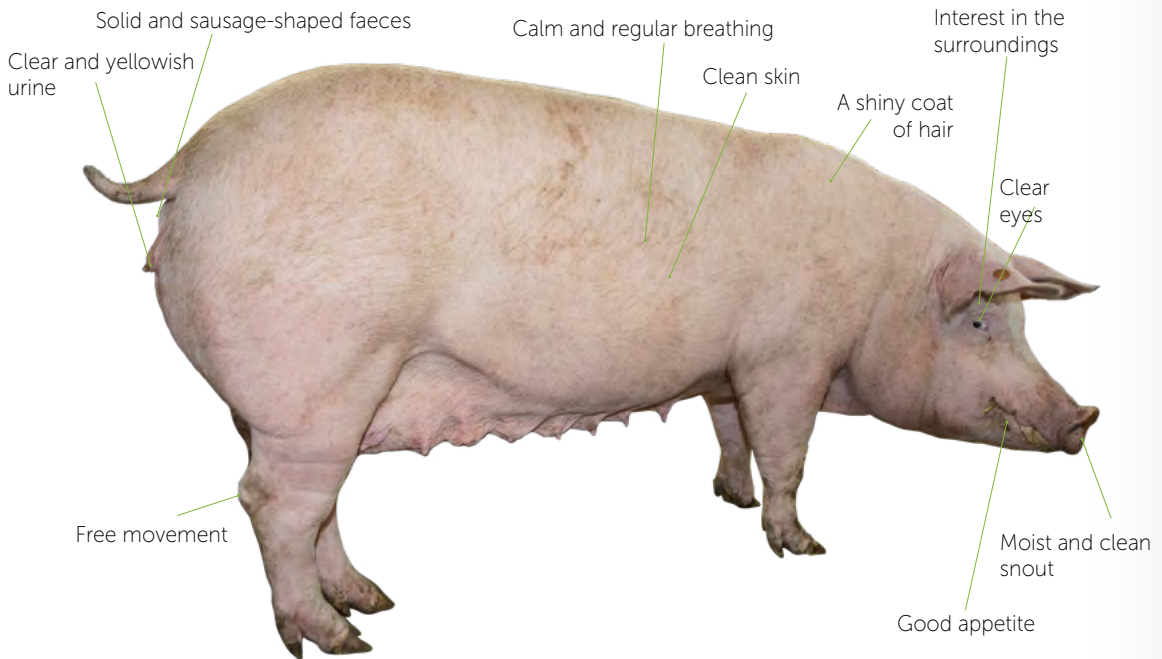


Photo: Jens Tønnesen/Dansk Landbrugs Medier

10.1. Observation points, showing how the pig is. If disease is suspected, temperature is checked as fever is often the first sign of infection. A sow will, however, often have a rise in temperature around farrowing without signs of disease.

11. Feeding

Feed must cover the pigs' needs for nutrients for production of meat, foetuses or milk. Moreover, feeding should help ensure the health and welfare of the pig, the economy of the producer and the environment.

Feed accounts for approximately 80 percent of the expenses for producing a finishing pig. Feed conversion and daily gain are two of the major factors determining if the production is profitable or not. It is, thus, crucial to have control over practical feeding, contents of nutrients in the feed and feed hygiene in the herd.

Feeding Behaviour and Appetite

Pigs are gregarious animals and prefer to eat together. In nature, they spend a long time searching for food and are generally very motivated to feed and drink.

Until they weigh 50-60 kg, feed intake is physically regulated i.e. the capacity of the intestinal system determines how much they eat. Above 60 kg, they are, to a greater extent, regulated metabolically, i.e. the content of nutrients in the blood regulates the feed intake. Pigs with a great genetic ability to converse feed can eat several feed units before the chemical regulation reduces the feed intake.

Energy

Human intake of energy is usually measured in kilojoules (kJ) or kilocalories (kcal). A man between 19-30 years old, weighing 80 kg, with sedentary work and regular physical activity in his spare time needs about 14,000 kJ or 3,340 kcal a day. Energy for pigs is measured in feed units, abbreviated to FU_{gp} for growing pigs and FU_{sow} for sows. One feed unit for growing pigs equals 7,375 kJ, and one feed unit for sows equals 7,700 kJ. A grown man, then, needs about two feed units a day.

If pigs have a higher energy intake than energy consumption they will gain weight. This weight increase can be deposited as fat or as protein (meat, foetuses or milk).

Conversions

Dry feed:

From FU_{gp} into kg:

A feed mixture contains 110 FU_{gp} per 100 kg

How many kg per FU_{gp} is that?

$$100 \text{ kg}/110 \text{ FU}_{gp} = 0.91 \text{ kg}/\text{FU}_{gp}$$

From kg into FU_{gp}:

A feed mixture weighs 98 kg per 100 FU_{gp}

How many FU_{gp} per kg is that?

$$100 \text{ FU}_{gp}/98 \text{ kg} = 102 \text{ FU}_{gp}/\text{kg}$$

Liquid feed:

From litre into FU_{gp}:

3 litre liquid feed contains 1.2 FU_{gp}

How many litre per FU_{gp} is that?

$$3 \text{ litre}/1.2 \text{ FU}_{gp} = 2.5 \text{ litre}/\text{FU}_{gp}$$

From FU_{gp} into litres:

The volume of 1 FU_{gp} liquid feed is 2.8 litre

How many FU_{gp} per litre is that?

$$1 \text{ FU}_{gp}/2.8 \text{ litre} = 0.36 \text{ FU}_{gp}/\text{litre}$$

Feed dispenser:

From FU_{gp} into lines:

The feed dispenser is filled to four lines and the contents are weighed (outside the dispenser). It weighs 3.6 kg and the mixture contains 98 FU_{sow} per 100 kg

How many FU_{sow} per line?

$$3.6 \text{ kg} \times 0.98 \text{ FU}_{sow} \text{ per kg}/\text{four lines} = 0.88 \text{ FU}_{sow}/\text{line}$$

One kg daily gain costs 3.2 feed units. Sows have a greater natural daily gain in the first litters than in the subsequent litters. An

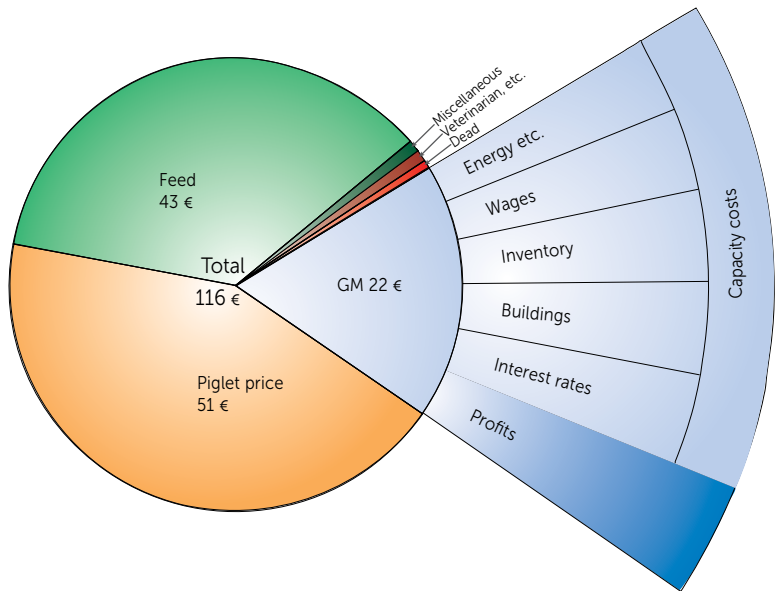
12. Economy and Key Figures



Good production results require knowledge, systematics, planning and overview. If this is followed by a high breeding level and good production facilities, it is possible to ensure greater earnings, better production results and greater job satisfaction.

To everybody who works professionally with pig production it is important to monitor herd performance. Various IT applications can help keep track and calculate relevant key figures in production. In Denmark, recording and management software like WinPig.NET is widely used.

12.13. The calculation of gross margin for finishing pigs, GM. Gross margin must cover expenses for buildings, inventory, energy and wages.



12.14. The concept 'animal units' is used in the calculation of the size of a pig production from the nitrogen that the animals produce in the faeces and urine. One animal unit (AU) is equivalent to 100 kg nitrogen.

Type of animal	Unit	Number of animals for one AU
Sows with piglets (four weeks ~ 7.2 kg	1 year sow	4.4
Weaners from 7.2 to 32 kg	1 produced animal	208
Finishers from 32 to 107 kg	1 produced animal	39



Source: Anker Weber

12.15. Slurry is liquid manure consisting of urine and faeces. One year sow produces 5.25 tonnes, a weaner 0.11 ton and a finisher 0.49 ton of slurry. Slurry contains several nutrients which must be preserved until the slurry can be spread on the fields. From faeces it is potassium, phosphorous and magnesium, and from urine it is nitrogen, for example in the form of ammonia. Nutrients which are not absorbed by plants may be leached and constitute a threat to the environment, just as pig units and slurry spreading can cause odour problems. The environmental impact from sow production is often smaller than from finishing units. Approximately 70 percent of the smell from an integrated production originates from the finishing units.