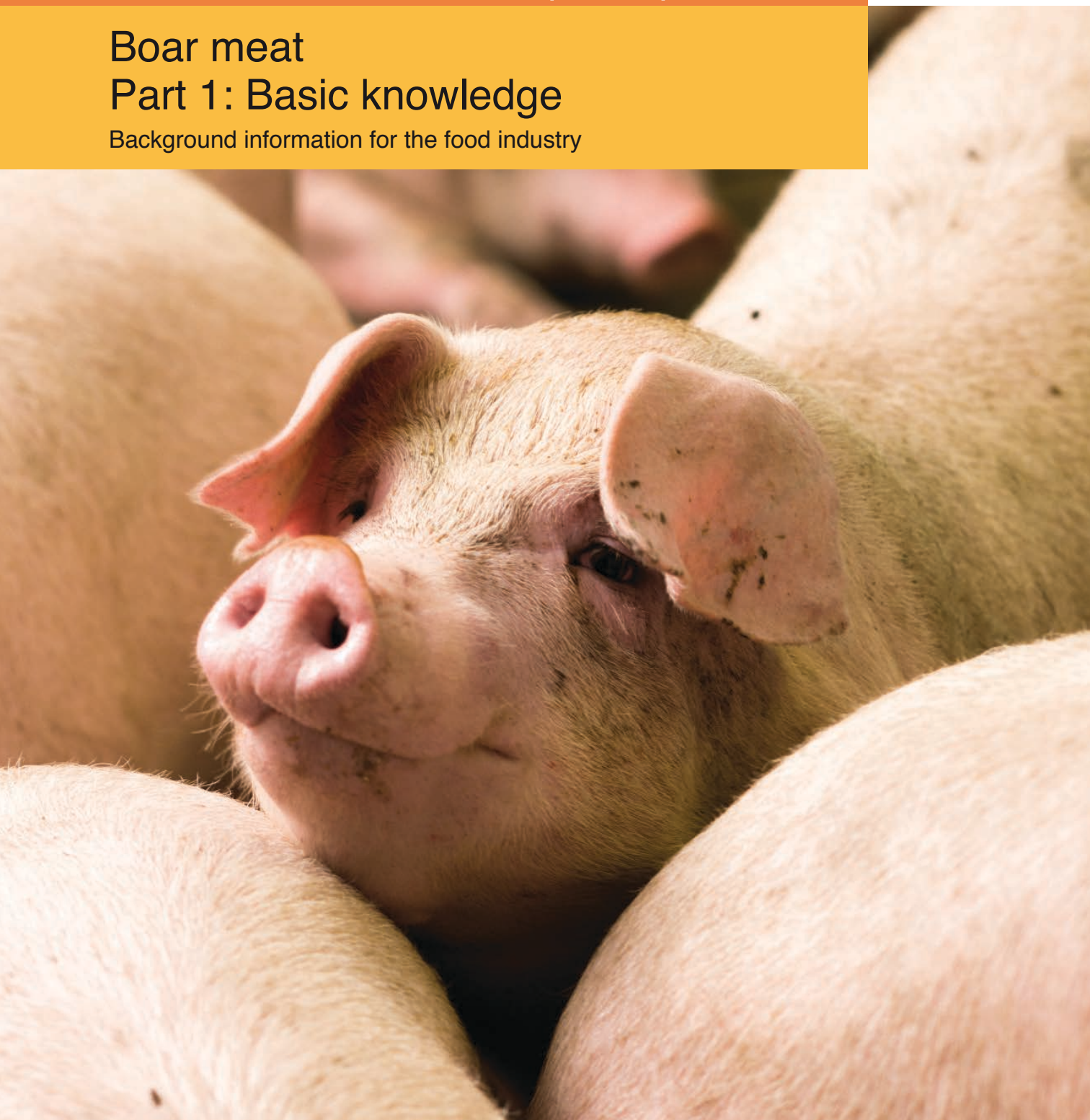


DLG Expert report 8/2016

**Boar meat**  
**Part 1: Basic knowledge**  
Background information for the food industry



## 1. Introduction

On 1 January 2019, the statutory ban on the castration of piglets without anaesthesia comes into force in Germany. Already in September 2008, in the so-called “Düsseldorfer Erklärung” the German Farmers’ Association (DBV), the Meat Industry Association (VDF), as well as the German Retail Trade Federation (HDE) spoke out in favour of a common approach aiming to stop the castration of piglets without anaesthesia as soon as possible (DBV/VDF/HDE 2008). Since then, all male piglets are only castrated with the use of analgesics.

With the European Declaration on alternatives to surgical castration in pigs, the 2010 actors in the pork sector voluntarily committed themselves to stopping surgical castration of male piglets by 2018 for animal welfare reasons. Notwithstanding the legal deadlines, in the meantime almost all the well-known large customers in the German food retail trade – including discounters – have imposed tougher animal welfare standards – and already from 2017 no longer want to sell meat from castrated pigs or those castrated without anaesthesia. With this, there is the risk of possible, gender-specific taints of the meat occurring.

## 2. Boar taint

The unpleasant odour and taste variations in the meat of uncastrated male pigs are known as boar taint. The main components of boar taint are androstenone and skatole. While skatole is formed in the large intestine as a bacterial metabolite from tryptophan and is found in all pigs, androstenone forms together with the sex hormones in the testes and is therefore sex-specific. Both compounds are stored in the fatty tissue of boars and bring about a urine-like or faecal-like odour and taste during preparation, especially when warming the meat, or in the pork products. Individuals perceive boar taint very differently as unpleasant and repulsive.

Whether and how the consumer perceives the boar taint and taste is dependent on the individual odour sensitivity, the concentration of boar taint components and how the pork or meat product has been prepared. Approx. 20 – 30 % of the European population perceive androstenone, while at the same time, the differences in the ability to perceive the



androstenedione are genetically defined, but are also regional, and both gender- and age-dependent. In contrast, skatole is recognised by almost all consumers. Boar taint is not present in all slaughtered boars. However, male piglets are routinely castrated within their first year of life so that the testes can no longer produce hormones and the gender-specific odour compounds (androstenedione).

The future ban on piglet castration (without anaesthesia) represents a huge challenge for the entire pork production chain – from meat producers to the processing industry. With a complete ban on surgical castration, besides the questions relevant to animal welfare, the focus is on the demand for sufficient consumer protection from odour-tainted meat.

### 3. Alternatives to castration without anaesthetics

In Germany, the following are considered alternatives to castration without anaesthesia: Castration with anaesthesia (general anaesthetics/analgesia, cf. Fig. 1) as well as foregoing the conventional castration with vaccination or boar fattening. These alternatives are briefly presented below.

#### 3.1. Castration with anaesthesia

##### 3.1.1. Castration with narcosis

During surgical castration under (general) anaesthesia, the intervention is performed under full analgesia. Such anaesthesia must be performed in Germany by a veterinarian in accordance with § 5 of the Protection of Animals Act, as doing so affects the cognitive ability and sensibility of the piglet. This method is relatively time intensive and is therefore connected with considerable costs.

The active ingredients ketamine and azaperone are approved for use in pigs, and they can be used combined as an injected anaesthesia for piglet castration. The anaesthetic is safe and effective, however, has a longer emergence stage (3 to 4 hours). Thus, there is increased risk of hypothermia and crushing. Furthermore, the lost suckling behaviour at the maternal sow can have a negative effect on the vitality of the piglet. The costs, arising from the medications and presence of a veterinarian, are given as approximately 2 euros per animal.

Another possibility for castrating piglets under general anaesthetic is represented by inhalation narcosis with short-acting isoflurane. The advantage of this anaesthesia is the rapid recovery of the piglet (only approx. 2 minutes post-anaesthesia sleep), so that there is no fear of the piglet cooling off or of disturbance of the suckling behaviour. The isoflurane anaesthesia does however involve higher costs (approx. 2 to 6 euros per piglet) as considerably more equipment (anaesthetic apparatus) is required. The piglets must also be administered an additional analgesic prior to the intervention as postoperative pain relief. Isoflurane is as yet not approved for use in pigs, however rededication within veterinarian law is possible under specific conditions with a minimum withdrawal period of 28 days for edible tissue.

For completeness, local anaesthesia should also be mentioned – the corresponding medications only affect analgesia and not the cognitive ability and sensibility unlike the methods mentioned above, and therefore their application does not require a veterinarian (see § 5 Section 1 Sentence 4 Animal Welfare Act). The possibility of castration under local anaesthesia is, however, out of the question as an alternative to the previous practice from a scientific point of view, as injection neither in the testes nor the scrotum or spermatic cord leads to a reduction in the pain-induced stress reaction during castration. The external (topical) use of (freeze) sprays or creams also does not lead to the required reduction in the castration pain.

##### 3.1.2. Castration with analgesia

According to the Animal Welfare Act, the farmer could carry out analgesia during the castration of the piglets, in the same manner as topical application, if the pain is relieved only during and after the operation and the perception of the animals is not affected. The prerequisite for this is the use of a veterinary drug, which is approved for the pain reduction during this operation according to pharmaceutical laws. Despite intensive research, the required active ingredient that is suitable for

effective pain reduction of the animals, is well tolerated and can be applied by the farmer himself, has not been found yet. At present, scientists also do not see any evidence indicating the possibility of developing such pain reducing active ingredients. According to the latest research, the requirement for reliable stress and pain relief is also not fulfilled when using pain-relieving opioids (butorphanol) – even when combined with a painkiller (meloxicam). Therefore, anaesthesia by the farmer is currently impossible for purely legal reasons.

### 3.2. Vaccination against boar taint

A further alternative for surgical piglet castration is represented by the vaccination against boar taint - also known as immunocastration, where the production of sex hormones is suppressed (Improvac®, Zoetis Deutschland GmbH). The active ingredient itself does not have a hormonal effect. As with any other vaccination, antibodies are formed. These antibodies produced by the pig are directed against a bodies' own messenger substance (GnRH), which controls the formation of sex hormones and androstenone. If these are missing, be it through castration or vaccination, skatole production is also indirectly suppressed, which is in parts responsible for the boar taint. Furthermore, the typical boar behaviour is reduced, i.e. mounting each other and fighting for ranks, which often leads to injuries in unvaccinated boars. The application in boars requires two doses, the first one at an age of 8 weeks and the second one at least four weeks after the first injection and four to six weeks before the planned slaughter date. While the immune system produces relatively few antibodies after the first vaccination and does not influence the testicle function, the second vaccination causes a sufficient immune response in the animal (booster effect). To avoid the boars producing boar taint, all the animals must be vaccinated correctly, i.e. twice. The costs for the complete vaccination are quoted as being 3.50 to 5 euros.

The vaccination effect is temporary (reversible), meaning that if sufficient quantities of antibodies are no longer produced, the testicles once again begin to develop to full function and size so that boar taint reappears. If the slaughter date is planned for more than 10 weeks after the second dose, a third dose should therefore be applied four to six weeks before the planned slaughter date.

The animals grow up as intact boars (including the better feed utilisation and the leaner meat production) up until the start of the

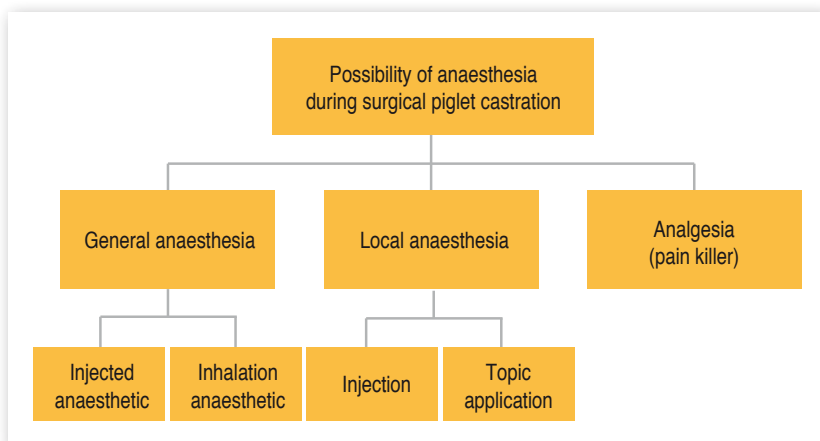


Fig. 1: Analgesia

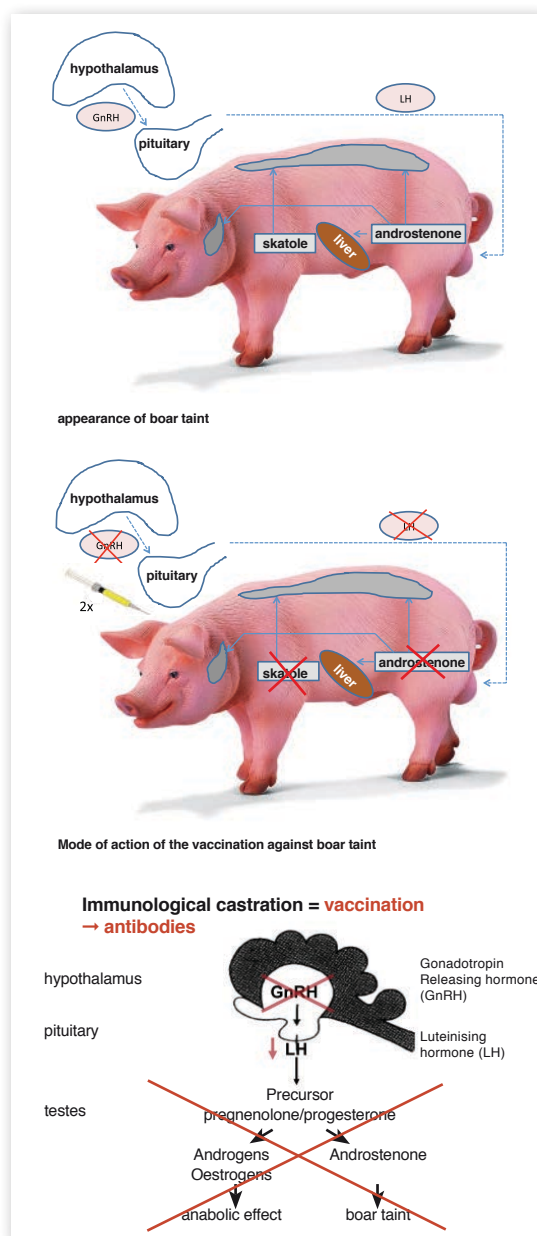


Fig. 2: Schematic diagram of the mode of action of the immunisation

effect of the second vaccination and there are no effects on the physical appearance and the behaviour of the animals. Only later, the animals quieten down considerably and act comparable to castrated animals.

During an accidental self injection of the animal keeper, the same processes are started as in the pigs. Therefore, use of a safety injector is legally prescribed. The vaccination does not leave residues in the meat and is absolutely harmless for consumption. Since 2009, the vaccination is approved EU-wide and has already been successfully in use globally for a longer time span. "The immunocastration is the only procedure that cuts out the function of the testicles without harming the animal – besides the prick for the vaccination", applauds Prof. Ulrike Weiler, University of Hohenheim regarding the advantages of the vaccination. Therefore, the procedure is also accepted by animal activists and is also used in eco-farming.

### 3.3. Boar fattening

In the last few years, several projects have been brought forward regarding fattening of uncastrated male pigs and thus fully doing away with castration. These have shown that fattening boars is an alternative, which seems particularly attractive due to advantages in the fattening and slaughter performance of the boars and can be realised if certain aspects of management and animal keeping are adhered to.

However, "pure" boar fattening naturally carries with it known and unsolved problems: the already described boar taint and the so-called boar behaviour. At the latest when boars enter puberty, there is an increase in social conflicts, rank fights and mounting each other. This rise in aggressive behaviour, which mainly is a problem for low ranking boars, can then lead to animal protection problems (injuries of the limbs, the skin and the penises). There are increased occurrences of ranking fights when the groups are sorted anew and when the animals are transported to the slaughterhouse, which is why keeping the groups as stable as possible and short transport times are recommended. In mixed sex groups, there is also the risk of pregnancy and with it the slaughtering of early pregnancy female fattening pigs.

Suitable measures can be taken to reduce the proportion of tainted carcasses through suitable husbandry measures (feeding, hygiene) when selecting race and breed (boar lines with low taint frequency):

- **Breeding measures**

Breeding programmes geared towards the reduction of boar taint risk can reduce the proportion of boars with taint. However, the breeding measures towards boars with low boar taint do not necessarily reduce the species typical boar behaviour. "Low taint" boars continue to fight for rank and mount each other. Therefore, severe injuries are also possible in these animals.

- **Feeding measures**

Boars have an increased ability to form protein (and with it particular feed requirements), lower fat formation and an approx. 3-5 % higher amount of muscle mass. When compared with hogs, boars demonstrate lower feed requirement (by 0.3-0.4 kg lower per kg gain), but have a more pronounced reaction to feeding deficiencies than female fattening pigs. To avoid competition situations, and guarantee the necessary feed uptake, boars require more feeding troughs than castrates and should be able eat as much as they want (ad libitum rather than rationed feeding). In contrary to androstenone, the skatole concentration in the fat of the carcass can be reduced using suitable feeding measures, e.g. by utilising inulin, raw potato starch or blue lupins.

- **Holding and management measures**

Besides feeding, stress also has a large influence on the tainting of boar carcasses. Boars need space so they can evade each other during rank fights. Injured animals have particularly high skatole concentrations. During transport to and waiting periods at the slaughterhouse, young boars require increased attention: recent studies found that the transport time has an influence on the androstenone concentration, while skatole is influenced considerably by the waiting time during slaughter. Slaughter before sexual maturity, as is common for instance in Great Britain, also minimises the tainting risk.

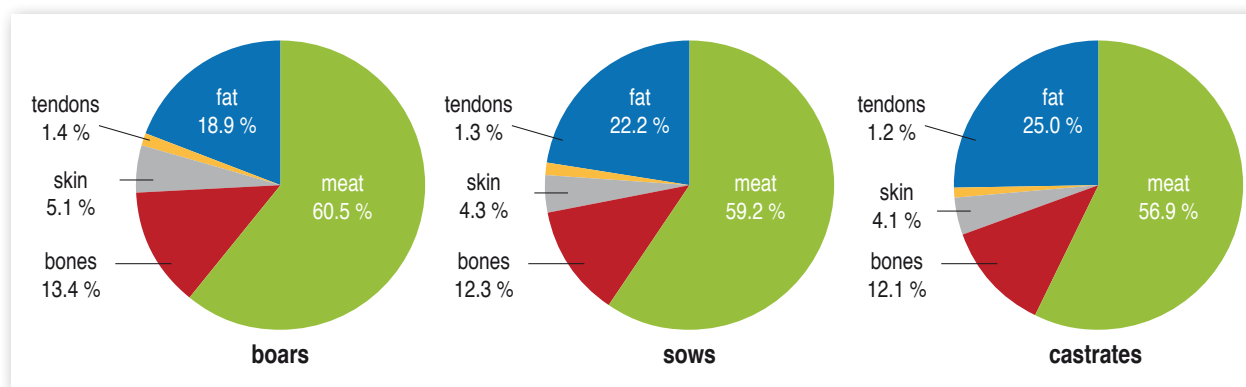


Fig. 3: Composition of the boar carcass in comparison to sows and castrates, mean values of the manual rough cutting (Boars:Sows:Castrates n=79:79:83; Bauer and Judas, 2014).

### 3.4. Slaughter quality of boars

(Article by Dr. Aneka Bauer,  
Max Rubner-Institut, Kulmbach)

The characteristics and the tissue composition of the slaughter carcass and of the individual carcass parts differ between boars, castrates and female fattening pigs (sows) (Bauer and Judas, 2014). Boar carcasses have a higher proportion of muscle with lower degree of stored fat (Fig.3). Sows are usually in a mid-position, while the carcasses of castrates show the lowest amounts of meat and the highest amounts of fat. In this comparison, the boars also show the highest amount of bone, skin and tendons. This tissue composition is also reflected, when the valuable carcass parts are analysed (Fig. 4). The muscle-fat ratio is the deciding factor for the carcass value, and is the base for the official quality class grading.

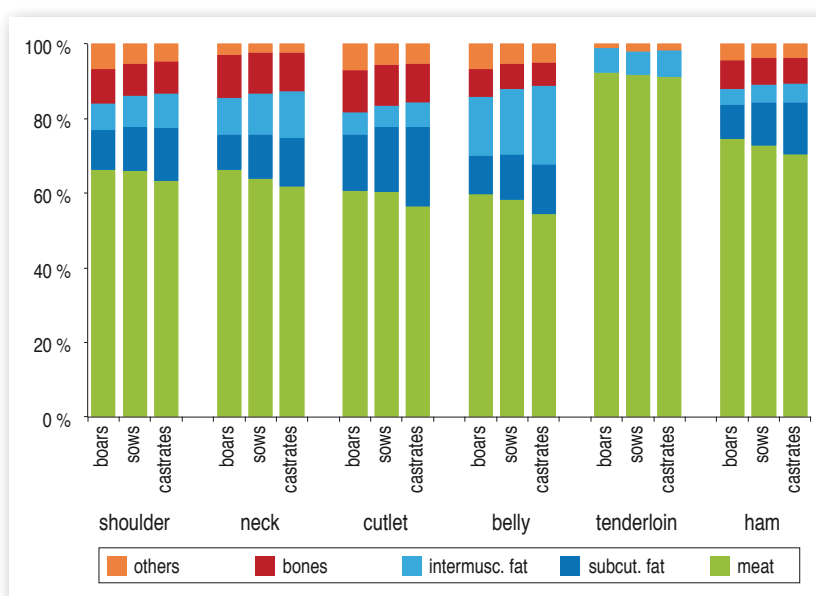


Fig. 4: Rough cut composition (%) of the main parts shoulder, neck (with fat), cutlet (with back fat), belly, tenderloin and ham differentiated according to sex (Boars:Sows:Castrates n= 79:79:83; Bauer and Judas, 2014).

There is a different fatty acid composition for the lower total fat content of the boar carcass, moving towards a higher content of polyunsaturated fatty acids (PUFA) of the tissues. This is mainly of interest for the processing of the raw materials to sausage products, as a high PUFA content results in a softer consistency and a lower oxidation stability of the fat.

## 4. Recognising taints

According to the guidelines for meat and meat products, "boar meat with tainting is not suitable for sale". Therefore, to fulfil the quality requirements of the customers and to ensure that no tainted pork is brought into circulation, it will be necessary in the future to regularly check for sexual odour at the slaughterhouses, when abstaining from the castration of the piglets. Carcasses with "prominent" sexual odour must be safely detected and be disposed of according to Regulation (EC) 854/2004 Annex I Section II Chapter V No.1 as unfit for consumption. To distinguish between light and

prominent sexual odour, a sensory test must be carried out according to Annex 4 No. 6 of the General Food Hygiene Directive (AVV Lmh).

The Working Group Meat and Poultry Hygiene and specific professional questions about food of animal origin (AFFL) of the State Working Group Consumer Protection (LAV) has decided on a number of resolutions in the last few years, which can be reviewed in the Professional Information System Consumer Protection and Food Safety (FIS-VL).

The decision concerning the fitness for consumption of pork is in the hands of the official slaughter animal and meat inspection. The precondition for a comparable procedure during the decision-making involves special training of the respective testers (official veterinary surgeons, official technical assistants, slaughterhouse-own personnel), in particular for determining the specific sexual odour (androstenone). This demand is also followed in the CA-guideline “slaughter and cutting”, revised 2012, which contains the newly included framework conditions for the detection of tainted boar carcasses.

#### 4.1. Tester training

The future ban on piglet castration (without anaesthesia) represents a huge challenge for the entire pork production chain. In order to fulfil the requirements of the consumers regarding taint-free pork, all participants in the process must do everything possible to bring taint-free quality meat to the market and thus also in the future secure the image and acceptance of pork.

As long as there are no suitable instrumental sensors (e.g. “electronic nose”) on the market for detecting tainting, the focus in quality control is also on the human sensory system, where the human nose identifies meat with boar taint (human nose method). Naturally, not all employees are suitable for the reliable detection of tainting. For the odour test, therefore, only suitably trained personnel can be used. The repeatability and the consistency between the testers can be further increased using suitable training measures for the standardisation of the human sensory detection of boar taint.

#### 4.2. Perception

While skatole is perceived by nearly everybody, there is a wide range of variability in the individual perception of androstenone. On the one hand, around 25 – 30 % of consumers are highly sensitive, on the other hand, 7 – 75 % even demonstrate anosmia concerning androstenone (Havlicek et al. 2010), which means that the people cannot perceive androstenone at all, or only in very high concentrations.

Studies show that women are more sensitive to androstenone than men. Anosmia also occurs more often in men than women (Müller 2011). Further parameters, such as cultural background, experience as well as meat temperature and the degree of processing also influence the perception. In the literature, the following values are found for the human ortho-nasal perception of both substances:

- |                        |                           |
|------------------------|---------------------------|
| • Skatole              | • Androstenone            |
| – exogenous: 0.15 µg/g | – exogenous: 0.2-1.0 µg/g |
| – in fat: 0.5 µg/g     | – in fat: 0.5-2.0 µg/g    |
|                        | (Mörlein 2009)            |



Fig. 5: The DLG academy offers training in the area of sensory testing of boar meat. For this, special sniffing sticks were also developed. These are odour samples of skatole and androstenone, which can be used during employee screenings.

### 4.3. Test characteristic “foreign odour” in the DLG test

Every year, the DLG Test Center Foods tests products from almost every food area, including fresh meat. The DLG food tests provide the user with neutral and independent results concerning the quality of the food. The food sensory analysis is one of the most important pillars in the evaluation of food quality and is also regularly used by the authorities for quality control and assurance of foods. Sensory analysis of food (colour, appearance, consistency, odour and taste) is at the centre point of the DLG product tests. The sensory analysis is performed by qualified experts from the DLG pool of testers using the DLG 5-point scheme.

Boar meat is itself absolutely harmless from a health point of view, however such taints represent a severe quality defect. The increased occurrence of taints has led during the DLG quality tests of recent years to the test characteristic “odour” being added to the missing terminology of the DLG 5-point scheme®. At the same time, the DLG expanded the qualification test for their experts to cover the sensory competence for boar taint. The sensory experts who are able to reliably recognised androstenone and skatole can be used specifically for the quality tests.

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The literature referred to can be obtained from the authors.

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