EU Reference Centre
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Review on keeping entire male pigs

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The practice of surgical castration raises concerns regarding animal welfare. Raising entire males is an alternative to castration. This EURCAW-Pigs review focuses on key areas in the assessment of animal welfare in entire males and how to minimize welfare problems in this type of production. The development of boar taint is affected by management, housing and feeding, but boar taint is not a focus in this review.

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1 Executive Summary

Male pigs in commercial production systems are often subjected to castration at an early age to prevent the development of undesirable odours and flavours in the meat. However, the practice of surgical castration raises concerns regarding animal welfare. Raising entire or intact males is an alternative to castration. In addition to offering an alternative to an aversive treatment, entire males offer several advantages in terms of improved feed efficiency, reduced feed intake and enhanced protein deposition, and therefore also could be economically advantageous for the farming industry.

Behavioural characteristics of entire males are influenced by sexual hormones and include an increased tendency for activity, aggression and sexual behaviours such as mounting. At puberty, around five to six months of age, depending on the breed, entire males also acquire the ability to extrude the penis from the prepuce. This ability enables penile biting, which is known to occur both under natural and farmed conditions.

Environmental enrichment, encompassing factors such as increased space allowance, access to straw bedding, provision of roughage, or outdoor areas, has been explored as a means to address the welfare concerns of entire males. While enriched housing systems may not necessarily reduce agonistic interactions, they have been shown to decrease the incidence of skin lesions. Offering a well-structured and spacious environment enables pigs to avoid aggressive encounters and mounting behaviours, thereby reducing the risk of injuries. Decreased space allowance is generally known to increase the level of aggression in pigs, however, the specific effects of space allowance and group size on the behaviour of entire males need further investigation.

Housing with females seems advantageous from the point of view of the males, as studies indicate that entire males in single-sex pens have more injuries than males housed with females. Although results are somewhat ambivalent also indicating that group composition does not negatively affect females since entire males seem to direct their behaviours preferably towards other males. Re-grouping, including picking out the fastest growing pigs for slaughter, has a marked negative effect on the level of aggression and therefore should be avoided.

Feeding strategies play an important role in mitigating aggression and ensuring the welfare of pigs. While some studies have reported higher levels of agonistic behaviour during feeding in entire males, other investigations have found no significant effect. The inherent feed efficiency and growth rate of entire males suggest that their nutritional requirements may be relatively easier to meet compared to other pig categories.

In conclusion, as entire males have behavioural characteristics which can lead to injuries, enhancing the welfare of entire males requires attention to key aspects in housing and management. The most important factors seem to be minimizing mixing to ensure a stable social relationships and enrichment of pen environments to satisfy the increased activity level and to create possibilities for avoiding agonistic attacks.

2 Introduction

Male pigs in commercial production systems in most countries are surgically castrated within the first week of life. Castration is carried out to avoid undesirable smell and taste in meat, which can be present in the meat of pubescent and mature male pigs primarily due to the presence of androsterone and skatole (Bonneau, 1982). Early studies showed similarities between cortisol profiles and skatole concentration in faeces and thus suggested a link between stressful environments and development of boar taint (Claus et al., 1994). Castration also limits aggressive and sexual behaviour in male pigs and therefore facilitates handling and housing of the pigs.

Neural, hormonal, metabolic and behavioural evidence of pain persist in castrated pigs for several days. Together with the stress and fear induced by handling during the procedure this has led EFSA to consider surgical castration an important welfare concern. Pain associated with surgical castration can be mitigated using analgesia (intramuscular NSAID's), local anaesthesia (intratesticular procaine, lidocaine or mepivacaine) and general anaesthesia (injectable or inhalable compounds). However, EFSA concluded that "Human and animal safety, the lack of validated protocols, the scarcity of drugs registered in the EU, financial costs and higher workload, are still barriers for a widespread use of drugs for anaesthesia and analgesia during piglet castration, thus preventing pain relief" (EFSA AHAW, 2022). Based on this, raising of entire males or implementation of immunocastration may be better options for protection of animal welfare in male pigs. Entire males have an improved feed efficiency, a lower feed intake and an increased ability to deposit protein rather than fat compared to castrates. Together these beneficial production parameters contribute to a lower N-excretion per animal, a lower climate footprint and improved economy for the farmer (von Borell et al., 2020; Fàbrega, 2021).

Aggression is typically associated with fighting for resources and social regrouping (Giersing & Studnitz, 1996, Coutellier et al., 2007, Peden et al., 2018). Thus, aggression is seen in both sexes and in both castrated and entire males. However, several studies have found a higher level of aggression in entire males compared to castrates or females raised under conventional production conditions (Cronin et al., 2003; Fàbrega et al., 2010; Fredriksen & Hexeberg, 2009; Giersing et al., 2000; Rydhmer et al., 2006).

The current review focuses on key areas in the assessment of animal welfare in entire males and how to minimize welfare problems in this type of production. The development of boar taint is affected by management, housing and feeding, but boar taint is not a focus in this review. Fàbrega (2021) provides a thorough discussion on management in relation to boar taint.

3 Scientific knowledge on the behaviour and physiology of entire male pigs

Due to the effects of male sexual hormones the behaviour of entire males includes more aggressive encounters and more mounting behaviour compared to females and castrates (Fàbrega, 2021; Holinger et al., 2018). In pubertal entire males, testosterone is produced in the testis, and the high levels of testosterone might exert behavioural effects on the animals' level of aggression on sexual behaviour (Rydhmer et al., 2006), although higher levels of aggression and sexual behaviour compared to females and castrates have

also been observed in pre-pubertal entire males (Tallet et al. 2013, Holinger et al. 2015). Studies have shown that an increased level of testosterone is associated with an increased level of skin lesions, suggesting a clear link with aggressive behaviour (Prunier et al., 2013). Onset of puberty is breed dependent but in most breeds occurs at five to six months of age (Almond et al., 2006). Puberty involves growth of reproductive organs and increased spermatogenesis, as well as development of sexual behaviour. The roles of androsterone and skatole in relation to behaviour are less clear than the role of testosterone, but they play a role in dominance and hierarchy formation (Giersing et al., 2000; Zamaratskaia et al., 2005).

Under natural conditions, pigs live in matriarchal family groups. Young males live in so-called bachelor groups and are only loosely associated with these groups. Older males live alone and only interact with other pigs during the mating season (Rydhmer et al., 2006).

3.1 Aggressive behaviour

As reviewed by Thomsen (2015), aggressive behaviour in pigs can be defined as species-specific behaviour associated with threats, pressing, pushing and bites, and is usually directed at the head and shoulder region. Aggression is seen as a trait of individual pigs, meaning that pigs express personality differences in their tendency to show aggressive behaviour (D'Eath, 2004, Turner et al., 2009). The frequency of the behaviour depends on the surroundings of the animals and e.g. regrouping (Peden et al., 2018), limited resources, space allowance per pig, i.e. stocking density and group size have an influence on the occurrence of aggressions (Simonsen, 1990; Turner et al., 2000, Verdon & Rault 2018). Elevated aggression levels can affect the welfare of the animals by resulting in skin lesions (Turner et al., 2006) and/or lameness (Rydhmer et al., 2006), generating pain (Ison et al., 2016), exhaustion (Peden et al., 2019) or negative affective states such as fear (Norscia et al., 2021).

As mentioned above, entire males have an improved feed efficiency compared to castrates. However, a high growth rate has been shown to be associated with high levels of aggression (Rydhmer et al., 2006). In the same study, fast-growing and heavy pigs initiated attacks/aggressive interactions more than slow-growing and light pigs. Thus, the productivity benefits of fast growth may have a downside in terms of aggressive behaviour.

3.2 Sexual behaviour

In the course of puberty, entire males exhibit increased sexual behaviour. Furthermore, in contrast to castrates, they acquire the ability to extrude the penis from the preputium exposing it for potential damage from biting. Penile biting injuries are seen in both domesticated and wild boars. In wild boars it seems to be linked to the mating season (Weiler et al., 2016). Penile biting may thus be seen as a part of the normal behavioural repertoire in boars.

The sexual behaviour of boars under natural conditions includes nosing the genital organ and nosing or lifting the side of the female, mounting and copulation (Zamaratskaia et al., 2005). However, the motivations behind mounting behaviour seem diverse and not entirely sexual or linked with sexual maturity (Boyle & Björklund, 2007; Cronin et al., 2003; Fredriksen et al., 2008; Hintze et al., 2013; Rydhmer et al., 2006). The frequency of mounting is less in females than males (Boyle & Björklund, 2007; Di Martino et al., 2018; Hintze

et al., 2013) and seems to decrease with age (Boyle and Björklund, 2007; Hintze et al., 2013; Holinger et al. 2015) and not to be associated with dominance (Boyle & Björklund, 2007; Hintze et al., 2013). Mounting is observed in different contexts, for instance during a fight, when animals are crowding and while playing with straw and thus might be performed due to general arousal (Hintze et al., 2013). It is recognized as a consistent trait of the individual animal rather than appearing in random outbreaks (Hintze et al., 2013; Prunier et al., 2013). Hintze et al. (2013) found that in particular sexual mounting provoked high-pitched screaming of the recipients indicating a welfare problem. Further, there are varying results as to whether or not mounting was associated with increased lameness and leg health issues (summarised by von Borell et al. (2020)). Early studies indicated that sexual behaviour does not vary by season, but elevated temperatures reduce this behaviour (Hemsworth & Tilbrook, 2007). Accordingly, it has been shown that plasma testosterone and weight of testis at the same age are affected by season with a higher level of hormone and a higher weight of testis in autumn compared to spring, suggesting an accelerated pubertal development with decreasing daylight (Prunier et al., 2013). In the same study, an increased level of skin lesions was seen in the autumn.

Furthermore, the social environment can exert an effect on the sexual behaviour of boars. However, the results are somewhat contradictory. Some studies have shown that boars reared without visual or physical contact with other pigs display less sexual behaviour than boars reared in groups and that isolation from females, especially around puberty, depressed the sexual behaviour of boars (Hemsworth & Tilbrook, 2007). In contrast, Salmon and Edwards (2006) reported more mounting behaviour in pens with entire males where social contact was restricted to other male animals than in pens where entire males had contact with females.

4 Key areas to focus on during welfare inspections and assessing animal welfare indicators

In the housing and management of entire males the increased tendency for aggression and sexual behaviour must be addressed. The scientific evidence supports that four key areas in successful housing of entire males can be identified:

1. Space allowance and group size.
2. Feeding strategies.
3. Enrichment of environment.
4. Group composition.

4.1 Space allowance and group size

A reduced space allowance per pig is generally associated with increased levels of aggression (Simonsen, 1990; Turner et al., 2000). Morrison et al. (2003a) did not verify this association in entire males housed in large groups in a deep-litter system. This study also found no effect of space allowance on the level of sexual behaviour. The enriched housing system could be the reason that no effects were found. Most available studies have compared enriched (increased space, provision of straw/litter and access to outdoor areas) and conventional housing for entire males, thus do not separate the effects of space allowance and enrichment (Prunier et al., 2013; Tallet et al., 2013). The study by Prunier and co-workers (2013) found a reduced level of aggression in castrates in the enriched environment, but no behavioural effect in entire males. Further,

they saw a lower level of skin lesions in enriched pens but a higher level of mounting. In the available study focusing specifically on space allowance (Rydhmer et al., 2006), the authors compared aggressive behaviour in groups of either seven (1.5m^2 per pig) or nine (1.2m^2 per pig) pigs which were provided with the same amount of straw per day, irrespective of group size. They found a higher level of aggression in pens with more space available. Holinger et al. (2015) concluded from their literature study, that although enriched housing systems (increased space allowance, provision of straw/litter, access to outdoor areas) do not necessarily decrease the number of agonistic interactions they seem to reduce the occurrence of skin lesions. They hypothesized that this was possibly because weaker animals have better opportunities to avoid agonistic encounters in a well-structured (see below) and more spacious environment.

Studies using entire males indicate that smaller group sizes (15 pigs/pen) result in lower levels of skin lesions compared to larger group sizes (30 pigs/pen) (Thomsen et al., 2016) and also in a lower level of boar taint (Backus et al., 2016). In the experiments conducted by Backus and co-workers (2016) extra total pen space with comparable pig densities (12 vs. 24 pigs in pen, 1m^2 per pig) did not reduce mounting behaviour and resulted in a higher score for skin lesions.

Because entire males have a higher level of activity, aggression and sexual behaviour than castrated males and females the risk for injuries is also higher. Consequently, the interactive effect of an enriched housing system (space allowance, pen structure/enrichment) becomes particularly important as it allows animals to avoid agonistic encounters and mounting and thereby reduces the risk for injuries. However, the limited scientific literature does not support that an increased space allowance for entire males reduces the level of aggression or sexual behaviour per se. The effect of space allowance and group size on the behaviour of entire males needs further investigation.

4.2 Feeding strategies

Resources of high priority, such as feed, with limited or restrictive access are objects of competition resulting in aggression (Giersing & Studnitz, 1996) and studies have shown that restricted feeding space and few feeders in a pen increase aggression in pens with slaughter/fattening pigs (Botermans et al., 2000; Spoolder et al., 1999).

Some studies have indicated that entire males have a higher level of agonistic behavior at feeding compared to females (Boyle & Björklund, 2007; Rydhmer et al., 2004) but another does not confirm this (Conte et al., 2011).

Morrison and co-workers (2003a) found no effect of restricted feeding space (9 vs. 15 pigs per feeding space) on agonistic behaviour in large groups of entire males housed in a deep litter system when fed ad libitum. In enriched experimental pens (1.6-1.9 m^2 per pig), Backus et al. (2016) also found no effect on skin lesions and mounting behaviour of restricted feeding space (6 vs. 3 pigs per feeder). Again, it must be noted that the studies were conducted in enriched housing systems. In contrast, observational studies in 70 commercial farms within the same project showed that a high ratio of pigs to feeding places and restrictive feeding were associated with more mounting and aggressive behaviour in entire males (Backus et al. 2016). Furthermore, they found that feeding by a long trough, ad libitum feeding, feeding wet by-products, diets with a high level of amino acids, a good hygiene of the feeding and drinking place and sufficient water supply of the drinking system were associated with less sexual and aggressive behaviour and less skin lesions.

As previously mentioned, entire males are characterized by an increased feed efficiency and growth rate compared to castrates and females. Different studies have evaluated the relationship between feeding behaviour and feed efficiency (measured as residual feed intake - the difference between observed and predicted feed intake based on average requirements for growth and maintenance) in slaughter pigs (de Haer et al., 2006; Rauw e al., 2006; von Felde et al., 1996; Young et al., 2011). These studies found that feed efficient pigs had fewer visits to the feeder per day, a lower feed uptake per day and less occupation time per day, indicating that they were less hungry than feed inefficient pigs.

To summarize, studies on feeding behaviour in entire males and whether they need extra feeding space to avoid agonistic encounters are ambivalent. Restrictive access to feed is a well-known risk factor for aggression but taking the increased feed efficiency in entire males into account, their behavioural needs for feed should be easier to meet.

4.3 Enrichment of environment

In scientific studies, enrichment of environment typically includes a mixture of increased space allowance and access to different enriching elements such as straw bedding, roughage or outdoor areas (Bünger et al., 2014; Holinger et al., 2015; Prunier et al., 2013; Tallet et al., 2013; Thomsen et al., 2012). Generally, these studies found relatively low levels of aggression in entire males under enriched conditions but due to the design could not pinpoint which enrichment elements seemed most important. Rooting is recognized as a highly prioritized behaviour in pigs and provision of rooting material such as straw is known to result in a decrease in pen-mate directed behaviour (Studnitz et al., 2007). Enrichment of the environment by provision of straw e.g. decreases nosing other pigs, aggression, ear chewing, licking other pigs, biting other pigs, belly nosing and tail biting (Day et al., 2002; Petersen et al., 1995). Though not conducted in entire males, these results suggest a continuous supply of straw to be a very important element in the enrichment of pens. In a controlled trial with both castrates and entire males, Holinger et al. (2018a) found that access to grass silage reduced pen-mate directed negative behaviour in all pigs but more pronouncedly in entire males.

A few studies directly compare the behaviour of entire males in barren vs. enriched environments (Lyons et al., 1995; Morrison et al., 2003b; Prunier et al., 2013; Tallet et al., 2013). With a fixed space allowance, Lyons et al. (1995) found a lower level of injuries in entire males housed with access to straw compared to housing without straw. In contrast, Morrison et al. (2003b) found a higher incidence of agonistic and sexual behaviours in enriched (1 m^2 per pig, deep litter, 200 pigs per pen) housing compared to conventional housing (0.7 m^2 per pig, concrete/ slatted floor, 45 pigs per pen). Prunier and co-workers (2013) studied skin lesions and mounting behaviour in entire males raised in enriched (2.5m^2 per pig, deep litter, access to outdoor area) vs. conventional (1m^2 per pig, slatted floor) environments. They found that pigs in enriched environments tended to display more mounting behaviour but had significantly less skin lesions than pigs in conventional housing. In line with those results, von Borrell et al. (2020) suggested that the provision of non-slippery flooring in combination with sufficient space allows entire males to perform certain behaviours (e.g. agonistic interactions/fighting, mounting) without risking injuries. Hormonal status (measured in terms of plasma testosterone, oestradiol-17β, fat androsterone and skatole, and weight of testes) did not differ between the housing systems (Prunier et al. 2013). Thus, the behavioural effects do not seem to be elicited through an effect on the sexual development. In a parallel study during the same trial as Prunier et al. (2013), Tallet et al. (2013) studied agonistic behaviours and found no significant difference in agonistic behaviour between

entire males housed in enriched vs. conventional pens. In both castrates and entire males, they found a decrease in agonistic behaviour over time (from three to five months of age). Vermeer and co-workers studied the effect of straw vs. rubber in the lying area, an extra feeder in the pen, feeding sugar beet pellets and the presence of a dummy to mount (Vermeer et al., 2010). They found that straw and an additional feeder did not reduce mounting behaviour and that sugar beet pulp pellets did not reduce skin lesions, lameness or mounting behaviour. The dummy had no effect on skin lesions or mounting behaviour but resulted in less lameness. The author concluded that the dummy served as a barrier more than as a mounting device. Backus et al. (2016) investigated the effect of a hiding wall in the pen on the behaviour of entire males. They did not find any reduction in mounting behaviour or skin lesion score by a hiding wall. In a meta-analysis on environmental factors affecting the behaviour of pigs, Averos and co-workers (2010) found that the percentage of time engaged in negative social behaviours (aggressive behaviours, including biting, pushing, as well as redirected explorative behaviours, such as belly nosing, sucking, tail-biting, perceived as negative by the recipient) decreased in the presence of solid floors and in the presence of point-source objects (defined as enrichment material not covering the whole resting area). In the absence of bedding, they found that percentage of time engaged in negative social behaviours increased with group size, but not when bedding was present.

To conclude, enrichment of pens allows entire males to show their naturally increased aggressive and sexual behaviour while decreasing the risk for negative welfare effects such as skin lesions and lameness.

4.4 Group composition

The sex composition in pens can affect the level of aggression in pens. A study by Boyle and Björklund (2007) indicated more sexual behaviour in mixed-sex groups and single-sex groups with entire males as well as more aggressive interactions and lesions in entire male groups. Similarly, Rydhmer et al. (2006) found a tendency for females raised in single-sex pens to have a lower level of aggression compared to entire males raised alone or in mixed-sex pens at 90 kg of weight. However, at 115 kg of weight, no differences in levels of aggression were seen. Females generally initiated fewer aggressions than entire males, explaining why females in single-sex pens received fewer attacks than females in mixed-sex pens. There was no significant difference in received attacks between entire males in single-sex pens and entire males in mixed-sex pens (Rydhmer et al., 2006). Further, twice as many males as females were lame or had other problems related to legs or claws. The highest occurrence of leg problems was seen in single-sex pens with entire males. In these pens, 18% of pigs had leg problems compared to 4% and 7% of females in pens with mixed sexes and only females, respectively. Entire males in mixed-sex pens had leg problems in 12% of cases (Rydhmer et al., 2006). In the same study, males in single-sex pens showed the same level of mounting behaviour as males in mixed pens. These results indicate that lameness was not a result of mounting behaviour but rather aggressive behaviour. Furthermore, the study found no significant relationships between the frequency of mounting or being mounted, on the one hand, and leg problems or aggressive behaviour, on the other. Thus, no link between sexual and aggressive behaviour was found. In contrast, the study did find significant associations between mounting behaviour and bite wounds and scratches. The occurrence of bite wounds was significantly higher in pens with entire males only compared to mixed sex pens. Another study compared single-sex groups with entire males, mixed-sex groups with entire males and females and mixed-sex groups with castrates and females (Holinger et al., 2015). In this study, they found no significant difference between

mixed-sex and single-sex pens with entire males on agonistic or sexual behaviour. They concluded that welfare of female pigs was not impaired when penned together with entire males compared to when penned together with castrates in terms of skin lesions and received aggressive behaviour. Pigs in the entire male groups had higher lesion scores than those in mixed-sex groups. In contrast to this, Weiler et al. (2016) found that raising entire males in mixed-sex groups led to a 1.5 times higher number of penile injuries compared to raising in single-sex groups.

Different studies have found that grouping pigs according to weight results in longer fights and more frequent biting compared to grouping with some variation in weight (Andersen et al., 2000; Rushen, 1987; Schmolke et al., 2004). In enriched pens (1.6-1.9 m^2 per pig), Backus et al. (2016) found no effect of regrouping strategy (litters housed together versus single-sex pens with males) on skin lesions. Rydhmer and co-workers (2013) found that entire males reared in intact groups and being socialised prior to weaning showed less aggression and had fewer skin lesions compared to unfamiliar pigs in regrouped groups. Fredriksen et al. (2008) investigated the effect of raising entire males with littermates in Farrow-to Finish (FTF) pens compared to mixing litters with entire males at 25 kg. They found that rearing entire male pigs in sibling groups reduced aggressive behaviour. In contrast, Fàbrega et al. (2013) found no significant effect on sexual or agonistic behaviour between groups mixed at weaning and groups reared without mixing from weaning to finish with socialisation with different litters prior to weaning. In entire males mixed with females, it was found that although an additional regrouping according to weight at the start of the finishing period (week 10) resulted in a more homogenous group composition (weight and carcass weight) at 21 weeks, it also led to considerable increases in aggressive behaviour during the 2-day post regrouping period (O'Connell et al., 2005). In contrast to these findings, a study of entire organic males found no effect of regrouping of pigs at 30 kg on the occurrence of skin lesions (Thomsen, 2015), perhaps indicating that the extra space and rooting material provided in the organic systems counteract the negative effects of a disturbed hierarchy. In heterogenous groups, Conte (2010) did not find an effect of weight variation on levels of aggression or mounting behaviour in groups of entire males with either low or high weight variation. However, a regrouping that consisted of disturbing the hierarchy by taking out the fastest growing pigs for slaughter (split marketing) increased the level of aggression in the study by Rydhmer et al. (2006). This was irrespective of the groups' sex composition. Similarly, results by Boyle and Björklund (2007) showed that split marketing resulted in higher lesion scores in single-sex entire male groups. In contrast though, (Bünger et al. (2015) did not find an increase in aggressive behaviour in single-sex male groups after split marketing.

As a conclusion, scientific literature supports that a stable group composition is important when keeping entire males. However, rearing of litters without any mixing is difficult to implement in current housing systems and thus requires significant changes to be implemented. Mixing entire males with females is beneficial for the males, although from the point of view of the females, single-sex housing would be preferred.

4.5 Animal- and resource-based indicators

Animal- and resource-based indicators can help to identify welfare issues in entire males and these indicators can be used to facilitate welfare inspections on farms. As explained above, some indicators (space allowance and feeding space) need more research and currently cannot be directly linked with compromised welfare in entire males. Based on current knowledge, we suggest to use **skin lesions**, **lameness** and **lack of appropriate**

enrichment as indicators during inspection. Penile injuries are also mentioned in the literature as indicators of fighting among entire males, but these injuries should not be expected to be detectable during on-farm inspection (Weiler et al., 2016).

5 Minimising welfare problems: improved practices

As entire males are affected by sexual hormones and therefore have an increased tendency for aggression and mounting, it is important to focus on how to minimize negative welfare consequences of these behaviours during raising. Holinger and co-workers (2018b) did not find behavioural or physiological indications for an increased baseline level of chronic stress in entire males compared to castrates in an experimental setup up. They found, however, an increased behavioural stress response to a chronic intermittent social stressor (confrontations with unfamiliar pigs and repeated short separations) in entire males. Furthermore, they found a higher motivation to perform manipulations, such as belly nosing, tail and ear manipulations, in entire males. Access to grass silage reduced manipulation behaviour in all pigs but more pronounced in entire males. The authors concluded that provision of rooting material could be one way to adapt housing system to managing entire males in accordance with their behaviour and motivations (Holinger et al., 2018).

As already mentioned, most studies on the effect of enrichment of pen-environment on the behaviour of entire males, did not separate the effects of increased space and enrichment with bedding, rooting material and in some cases access to outdoor areas. Because increased space provides better opportunities for receiver of aggression and mounting to escape, it can be recommended to increase space allowance for entire males, and to combine it with environmental enrichments, including creating functional areas within the pen. Explicitly, to avoid leg problems and lameness as a consequence of aggressive attacks or mounting, non-slippery flooring should be provided.

Stable social relationships in pens are important in order to keep the level of aggression as low as possible. Studies indicate that keeping entire males in single-sex pens increases the level of leg problems (Rydhmer et al., 2006), and that mixed-sex pens are recommendable. Taken together, these results suggest that raising of entire males in farrow-to-finish or weaning-to-finish pens is beneficial to their welfare. Such stable group compositions have also been shown to reduce the negative effects on the level of aggression when disturbing the hierarchy by taking out the fastest growing pigs for slaughter (Fàbrega et al. 2013). Therefore, management procedures including regrouping need rethinking, especially when raising entire males. Immunocastration is an active immunisation against Gonadotropin Releasing Hormone (GNRH). The procedure offers an alternative to keeping males entire which diminishes the disadvantages in terms of aggressive and sexual behaviour as well as boar taint. Immunization against GNRH leads to an interruption of the hormone cascade that controls the synthesis of testosterone and androstenone in the testes (Borell et al., 2020). The method is recommend by EFSA as a better alternative than castration with analgesia and raising of entire males (EFSA AHAW, 2022). Drawbacks of immunocastration include occasional non-responders to immunisation, potential handling stress during vaccination (large animals are handled), and painful reaction at the injection site in some animals. Furthermore, although the procedure reduces aggressive and mounting behaviour, it does not eliminate the occurrence of penile injuries (Bonneau &

Weiler, 2019; Borell et al., 2020). In addition to the information provided by EFSA (2022) and Fàbrega (2021) on alternatives to surgical pig castration and its consequences, the EU Commission compiled further material on reducing boar taint, immunocastration and meat marketing (https://food.ec.europa.eu/animals/animal-welfare/animal-welfare-practice/animal-welfare-farm/pigs/alternatives-pig-castration/en).

6 Legal requirements

Council Directive 2008/120/EC of 18 December 2008 regulates legal requirements laying down minimum standards for the protection of pigs. There are no specific regulations on housing and managing of entire males.

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7 References and review papers for further reading

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EU Reference Centre for Animal Welfare *Pigs*

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- pig welfare policy workers;
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