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Immunocastration of male pigs – situation today

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Abstract

Immunological castration of male pigs is an attractive alternative to surgical castration and nowadays is increasingly used in many countries to reduce boar taint and improve pork quality. Moreover, immunocastrated pigs showed reduced sexual and aggressive behaviour compared to entire male pigs, thus improving animal welfare. Carcass and meat quality parameters generally do not differ between immunocastrated and surgically castrated male pigs.

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1. Introduction

The history of surgical castration of male pigs dates back to 4000-3000 BC. Surgical castration is used to reduce aggressive behavior and produce taint-free meat by prevention of skatole and androstenone accumulation in fat. Nowadays, surgical castration is regarded as a stressful intervention with negative effects on animal health and welfare. Additionally, raising entire male pigs is more profitable because of leaner carcasses and improved feed conversion. The higher protein content in carcasses from entire males might indicate nutritional advantages of this meat compared to that from castrates. On the other hand, entire male pigs express their natural behavior including attempting to mate and fight which negatively affects animal welfare and causes difficulties in management.

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Alternative ways of rearing male pigs are being evaluated to address issues of boar taint and aggressive behavior. Active immunization against gonadotropin-releasing hormone (GnRH; also referred to as luteinizing hormone-releasing hormone, LHRH), so called immunocastration, is an attractive alternative to surgical castration. The use of immunocastration of pigs is increasing, with approximately 1.3 mill pigs being vaccinated worldwide every month using Improvac. In Scandinavia, however, there is no systematic use of immunocastration, even though its use has been approved (N Wuyts, Zoetis, personal communication, 19/05-2015).

This review provides an update of recent progress in the field of improving pig welfare by the means of immunocastration.

2. Aim and principles of immunocastration

The aim of immunocastration is to deactivate testicular functions by neutralization of the hormones of the hypothalamic-pituitary-gonadal axis. Basically, this involves vaccination of animals against either the pituitary luteinizing hormone (LH) or the hypothalamic gonadotropin-releasing hormone (GnRH), both are key hormones that regulate reproductive function. GnRH vaccination involves the injection of GnRH analog conjugated to a foreign protein and combined with an adjuvant, to initiate transient formation of anti-GnRH antibodies that can bind and inhibit the action of endogenous GnRH. Improvac, the vaccine against boar taint, developed in Australia and produced by Zoetis (formerly Pfizer Ltd., formerly CSL Limited, Parkville, Victoria, Australia), is approved in over 60 countries worldwide and has been in commercial use in the EU since 2009.

3. Quality of meat from immunocastrated pigs

3.1. Boar taint levels

Both androstenone and skatole are reduced in tissues from immunocastrated pigs to the levels found in surgically castrated pigs. Androstenone production is suppressed as a consequence of suppressed testicular development. The decrease in intestine-originated skatole is most likely due to increased hepatic metabolism and subsequent clearance in the absence of testicular steroids, particularly androstenone and oestrogens^{1,2}.

3.2. Carcass and meat characteristics

Generally, carcass-quality parameters did not differ between entire, surgically castrated and immunocastrated male pigs^{3,4}. Minor differences were found for dressing percentage (lower for immunocastrates) and lean meat content (highest in entire male pigs and lowest in surgically castrated pigs). Fuchs et al.⁵ observed leaner bellies from immunocastrated than surgically castrated pigs, although in another study no differences between immunocastrated and surgically castrated pigs were found⁶.

Studies investigating meat quality parameters in immunocastrated pigs also showed conflicting results. Aluwé et al.⁷ observed lower ultimate pH and higher cooking loss in meat from entire male pigs compared to immunocastrated. However, for the majority of meat quality parameters, there were no significant differences between immunocastrated and surgically castrated pigs⁷.

Generally, it can be concluded that carcass and meat characteristics are comparable between immunocastrated and surgically castrated pigs.

4. Animal health and welfare

From a welfare perspective the procedure of injecting the vaccine is obviously less harmful to the pig compared to surgical castration without anesthetics or analgesics. On the other hand, immunocastrated pigs behave as entire male pigs until after administration of the second vaccine and thus display increased aggressive behavior^{4,8}. However, after the second vaccination, aggressive behavior and mounting are reduced to the level of surgically castrated pigs⁹.

The injection of the vaccine is a systemic event leading to disturbance in the hormonal homeostasis of the animal, thus adverse effects could be expected in other tissues apart from the testis. One previous study suggested that immunization against GnRH caused tissue damage to the hypothalamus¹⁰. However, this was not confirmed in a later study¹¹.

5. Practical considerations

5.1. Number of injections

According to the manufacturer's recommendation, two doses must be given at an interval of at least 4 weeks. The first dose serves to prime the immune system and results in only a small increase in anti-GnRH antibodies, whereas after the second dose, a strong antibody response causes temporary suppression of testicular function^{3,12,13}. However, if non-respondent pigs are detected (larger testicle size or prolonged sexual behavior), an additional dose might be applied¹⁴. Additionally, for heavy male pigs (slaughtered at 14 months of age) a three-dose vaccination regimen might be required¹⁵ to ensure efficient inactivation of endogenous GnRH and elimination of boar taint.

5.2. Age at immunocastration

According to the manufacture of Improvac (Zoetis), the first injection should be given at week 17-18 or earlier, while the second should be administered at 21-22 weeks old if the pigs are slaughtered at 26 weeks old. The motivation to perform immunocastration in the finisher phase is to utilise the full growth potential of the entire male pigs until the second injection. However, a number of studies have been conducted using alternative vaccinations schemes. A study conducted by Brunius et. al.¹⁶ showed equal levels of androstenone and skatole in pigs vaccinated at week 10 and 14 compared to pigs vaccinated at week 16 and 20, as well as surgical castrated pigs. Moreover it has been shown that 2 weeks following the 2nd vaccination, the skatole levels are below sensory threshold and did not decrease further during the following 8 weeks¹⁷. In fact, it has been documented that the effect of immunocastration lasts for up to 22 weeks following the second injection¹³.

5.3. Tools for assessing the effectiveness of immunocastration

Several studies have shown that the effect of immunocastration is very consistent among individuals. However, there are cases where non-responders (0-3%) have been reported^{17,18,19}, both in small and large scale studies. The cause of pigs not properly responding to the vaccine has been ascribed to the health status of the pigs or the fact that some pigs are cryptorchids or simply escape vaccination in a commercial production setup. This argues for the development of good tools to assess the effectiveness of immunocastration e.g. at the slaughterhouse. A reliable method is the evaluation of the boar taint compounds e.g. by chemical analysis; however non-invasive methods are desired in relation to economical and practical issues. The size and weight of the testis and bulbourethral glands has been shown to significantly decrease with successful immunocastration. However, the size and weight of reproductive organs may not be a reliable indicator of a response to vaccination because of overlap in the distributions between successfully immunocastrated and entire male pigs³. It was suggested that measuring seminal vesicles weight may be a better tool to identify non-responders²⁰. Moreover, behavioral observations like high rates of mounting could also be warning signs used at the farm to detect possible non-responders.

6. Conclusion

Immunological castration is an attractive alternative to surgical castration as it efficiently reduce boar taint and aggression to the levels of that in castrated male pigs. However, there is only minor if any performance advantages compared to surgically castrated pigs.

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