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Suppression of boar taint in cryptorchid pigs using a vaccine against the gonadotropin-releasing hormone

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Summary

Thirteen unilaterally cryptorchid Large White pigs, which had been immunized at 4 and 8 weeks of age and a third time at 64 ± 4 kg body weight against the gonadotropin releasing hormone with the vaccine Improvac®, were slaughtered at the age of 170 ± 9 days at a body weight of 102 ± 12 kg. Twelve pigs tested negative in the olfactory test of the salivary gland; their descended testicles were small and their fat androstenone concentration was low compared to normally developed boars of a previous experiment which had been vaccinated twice with Improvac® according the manufacturer's recommendation. One cryptorchid boar, which tested positive in the olfactory test and whose testicular weight and fat androstenone concentration corresponded to values of unvaccinated boars of the same age, obviously had not responded to the vaccination. It is an open question if the vaccination protocol for normal boars is sufficient to prevent boar taint in the majority of cryptorchid pigs, too.

Keywords: cryptorchid, GnRH, vaccine, boar taint, androstenone

Immunisierung von kryptorchiden Ebern gegen das Gonadotropin-releasing Hormon zur Unterdrückung des Ebergeruchs

Dreizehn einseitig kryptorchide Eber der Rasse Schweizer Edelschwein, die im Alter von 4 und 8 Wochen sowie ein drittes Mal im Gewichtsbereich von 64 ± 4 kg mit dem Impfstoff Improvac® gegen das Gonadotropin-releasing Hormon immunisiert worden waren, wurden im Alter von 170 ± 9 Tagen mit einem Körpergewicht von 102 ± 12 kg geschlachtet. Der Speicheldrüsen-Kochtest war bei 12 Tieren negativ. Im Vergleich zu normal entwickelten Ebern einer früheren Untersuchung, welche wie empfohlen zwei Mal mit Improvac® immunisiert worden waren, hatten diese 12 Eber kleine abgestiegene Hoden und eine tiefe Androstenonkonzentration im Fett. Ein Kryporchide, bei dem der Kochtest positiv ausfiel und dessen Hodengewicht und Androstenonkonzentration mit den Werten unvakzinierter Eber gleichen Alters vergleichbar waren, hatte auf die Impfung ungenügend reagiert. Die Frage bleibt offen, ob das Impfprotokoll für normale Eber genügt, um auch bei einem Grossteil der kryptorchiden Eber den Ebergeruch zu unterdrücken.

Schlüsselwörter: Kryptorchide, Eber, Ebergeruch, GnRH, Vakzine

Introduction

Cryptorchidism, the failure of one or both testicles to descend from the abdominal cavity into the scrotum during fetal development, is the most common congenital malformation of pigs. About 0.4 % of the male piglets born in Switzerland are affected by this defect (Hofer, 2012). Similar to the testes located in the scrotum, intra-abdominal testes of sexually mature cryptorchid boars synthesize the pheromone androstenone. Androstenone and the tryptophan degradation products indole and methylindole (scatol), which are produced by the large intestinal microflora, accumulate in fat tissue of sexually mature male pigs and confer an unpleasant odour to the meat. The surgical removal of the abdominal testicle is seldom performed for economic reasons. In order to avoid the risk of boar tainted carcasses, cryptorchid pigs are usually slaughtered before puberty. The immunisation of cryptorchids against the gonadotropin releasing hormone (GnRH), using a GnRH vaccine developed for the immunocastration of boars, should prevent their sexual development and reduce the accumulation of pheromones until they reach the usual slaughter weight of 100 kg. To our knowledge the use of a GnRH vaccine in cryptorchid boars has not been tested. The fact that Gullet et al. (1993) reported a

greater variability in meat aroma and flavour in cryptorchids compared to normally developed boars suggests that the efficacy in cryptorchids of the GnRH vaccination protocol developed for normal boars should not be taken for granted.

When Improvac® got registered for use in Switzerland, cryptorchid piglets born at the farm of the Agroscope Research Institute at Posieux were immunised using this vaccine. In order to minimise the risk of carcass rejection due to boar taint, the cryptorchid animals received 3 doses of the vaccine instead of the 2 doses recommended for normally developed boars. In addition to the sensory test of the heated salivary gland, androstenone, scatol and indole as quantifiable indicators of boar taint were analysed in order to obtain an objective information concerning the efficacy of the immunisation procedure.

Animals, Material and Methods

Thirteen Swiss Large White piglets were diagnosed as unilateral cryptorchids at about one week of age. The descended testicle was not excised. At the age of 4 weeks, the weaned piglets received the first dose of Improvac®, followed by a booster injection 4 weeks later. At the age of about 4 months, when the animals had attained a body weight (BW) of 64 ± 4 kg (mean ± standard deviation), the third dose was administered, and the size of the testicle in the scrotum was visually checked. The recommended dose of 2 ml of the vaccine was injected subcutaneously in the neck of the animals which were physically restrained by an attendant, using a 2 ml syringe and an 1.0 x 15 mm needle. The weaned piglets were raised indoors until they reached a BW of 30 kg and were then kept in a covered yard on straw litter until they were slaughtered. The animals were fed the standard feeds used at the research institute for piglets, growing and fattening animals. The nutrient content of the diets corresponded to the recommended levels for the respective age groups (ALP, 2004).

The animals were slaughtered 40 ± 9 days after the second booster at the age of 170 ± 9 days with a BW of 102 ± 12 kg. Both testicles and a sample of dorsal subcutaneous fat were collected. The testicles without the epididymis were weighed, and androstenone, scatol and indole were analysed in the adipose tissue samples using the method described by Pauly et al. (2008) and Ampuero Kragten et al. (2011). The detection limit was 0.2 µg/g adipose tissue for androstenone and 0.03 µg/g adipose tissue for scatol and indole. At the meat inspection the submaxillary glands were heated in a plastic bag immersed in boiling water for 3 minutes and were subjected to an olfactory test for off-flavour by a person with a high sensitivity to androstenone who had been trained in boar taint detection.

Results

With one exception, the visual examination of the scrotum on the occasion of the third injection at 64 ± 4 kg BW showed that the testicles were small compared to those of intact boars of the same age. Twelve of the 13 slaughtered animals passed the olfactory test, whereas the carcass of the animal having a large scrotal testicle was considered unfit for consumption because boar odour was detected in the heated salivary gland. This animal also had the highest fat androstenone and scatol concentrations, whereas his fat indole concentration was below the detection limit. Data of the 13 boars are shown in Table 1.

Discussion

The mean weight of the descended testicles of the 12 slaughtered animals which had tested negative for boar taint was 2 to 4 times lower than the values reported for boars who had received 2 doses of GnRH vaccine (Oonk et al., 1995; Jaros et al., 2005; Fuchs et al., 2009; Pauly et

Table 1: Characteristics of the vaccinated cryptorchid boars.

Animals n	Slaughtered, olfactory test negative 12	Slaughtered, olfactory test positive 1
Age, days	170 (158–186)[1]	164
Final body weight, kg	102 (73–129)	97
2nd booster-slaughter, days	40 (21–57)	41
Descended testicle, g	34 (13–100)	233
Abdominal testicle, g	9 (7–11)	55
Androstenone, µg/g fat	0.1 (nd–0.3)	0.5
Scatol, µg/g fat	0.02 (nd–0.05)	0.15
Indole, µg/g fat	0.02 (nd–0.03)	nd

nd: not detected; [1]The data of the 12 animals are expressed as arithmetic means and minima-maxima

al, 2009). These 12 cryptorchid pigs also had lower fat androstenone and scatol concentrations than immunocastrated boars of the same genetic background raised and fed under similar conditions (Pauly et al., 2009), suggesting that the vaccination protocol used in the cryptorchids which reduced testicular development to a greater extent than the standard vaccination protocol also prevented the development of boar taint more efficiently. Indole, which contributes less to boar taint than androstenone and scatol (Hansson et al., 1980), was either not detectable or occurred at a concentration which barely exceeded the detection level.

The weight of the descended testicle of the animal which had tested positive in the olfactory test corresponded to the average testicle weight of unvaccinated boars weighing 100 kg (Oonk et al., 1995; Fuchs et al., 2009; Pauly et al, 2009). His adipose tissue androstenone and scatole levels of 0.5 µg/g and 0.15 µg/g respectively, which were barely below the average reported by Pauly et al. (2009) in unvaccinated boars, corresponded to a level which is perceived by androstenone sensitive persons (Weiler et al., 2000).

The exact reason for the insufficient vaccination response of one cryptorchid animal is unknown. The vaccine had been stored as recommended by the producer, and all animals were in good health at the time of the vaccinations. In view of the visually controlled injection into the neck of the immobilized animal, a failure to inject the vaccine can be excluded. Improvac® vaccination failures have been reported before. One of 10 boars vaccinated as piglets mounted an insufficient immune response after two injections, but responded to a third injection (Metz et al., 2002). Seven of 239 twice vaccinated boars (3 %) tested positive in the olfactory test (Fuchs et al., 2009). The rule that no vaccine will provoke a sufficient response in all vaccinated individuals (Heininger et al., 2012) also applies to GnRH vaccines.

Although the present results are based on a small number of animals, they show that vaccinating cryptorchid boars twice before the growing-fattening period, followed by a third injection a few weeks before slaughter, effectively reduces testicle weight and tissue levels of androstenone and scatol in most of the animals. With the exception of one non responding animal, these traits were lower than those observed in a previous study with twice vaccinated boars of the same genetic background (Pauly et al., 2009). It is an open question whether the vaccination protocol recommended for normally developed boars is equally effective in cryptorchid boars.

Suppression de l'odeur de verrat chez des porcs cryptorchides par l'immunisation contre l'hormone gonadolibérine

Treize verrats de la race Grand Porc Blanc ayant une cryptorchidie unilatérale, immunisés contre la gonadolibérine à l'aide du vaccin Improvac® à l'âge de 4 et 8 semaines et une troisième fois à un poids vif de 64 ± 4 kg, ont été abattus à l'âge de 170 ± 9 jours à un poids vif de 102 ± 12 kg. Le test de cuisson de la glande salivaire s'est révélé négatif chez 12 animaux. Ces 12 verrats avaient de petits testicules descendus et une faible concentration d'androsténone dans le tissu adipeux en comparaison à des verrats normalement développés qui, lors d'une étude antérieure, avaient été vaccinés 2 fois selon les recommandations. Un seul verrat cryptorchide a eu une réponse immunitaire insuffisante au vaccin Improvac®, ce qui s'est manifesté par un test de cuisson positif ainsi qu'un poids du testicule descendu et une teneur en androsténone dans le tissu adipeux correspondant aux valeurs observées chez des verrats non immunisés du même âge. La question reste ouverte de savoir si le protocole de vaccination pour verrats normaux est suffisant pour empêcher le développement de l'odeur de verrat chez la plupart des verrats cryptorchides.

Immunizzazione di suini criptorchidi contro l'ormone di rilascio delle gonadotropine per la soppressione dell'odore di verro

Tredici verri criptorchidi unilaterali della razza svizzera Edelschwein, immunizzati con il vaccino Improvac® contro l'ormone di rilascio delle gonadotropine a 4 e a 8 settimane d'età nonché una terza volta al raggiungimento dei 64 ± 4 kg, sono stati macellati all'età di 170 ± 9 giorni con un peso corporeo di 102 ± 12 kg. Per 12 animali il test delle ghiandole salivari è stato negativo. Rispetto ai verri sviluppati normalmente di uno studio precedente, immunizzati, come raccomandato, 2 volte con Improvac®, questi 12 verri avevano piccoli testicoli scesi e una debole concentrazione di androstenone nel tessuto adiposo. Solo un criptorchide, risultato positivo al test, il cui peso dei testicoli e la concentrazione di androstenone erano paragonabili con i valori di verri della stessa età non vaccinati, aveva avuto evidentemente una risposta immunitaria insufficiente alla vaccinazione. Resta aperta la questione se il protocollo di vaccinazione sia sufficiente per un verro normale a sopprimere l'odore di verro anche per la gran parte dei verri criptorchidi.

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