PE1.09 Efficacy of Improvac® for controlling boar taint in heavy male pigs under commercial field conditions in Italy 90.00

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***Abstract*—The standard, two-dose vaccination regime for the anti-GnRF vaccine Improvac® requires the second dose to be given 4 to 6 weeks prior to slaughter. This may not be satisfactory in heavy pig production systems in which a second dose may be required earlier to control unacceptable male behaviour. Two alternative regimes were therefore investigated: a two-dose regime with vaccine administered at 10–11 and 26–27 weeks of age, and a three-dose regime in which an additional dose was given 10 weeks later at age 36–37 weeks. Pigs were slaughtered at age 42–43 weeks in both cases, 16 weeks after the second dose and 6 weeks after the third dose. A group of barrows was also included. Serum titres of antibodies against GnRF and testosterone concentrations were measured in all pigs at each vaccination, 14 days after the third vaccination, and at slaughter. Samples of subcutaneous fat collected at slaughter were assayed for androstenone and skatole—the major compounds responsible for boar taint. Testosterone concentrations were well controlled in both groups of vaccinated pigs 10 weeks after the second vaccination. At slaughter the two-dose regime did not fully control boar taint: antibody titres were low, testosterone had risen and 8% pigs had high androstenone concentrations in fat (>1000 ng/g) indicative of potential boar taint; a further 8% had moderately high concentrations (500–1000 ng/g). In pigs given a third dose, there was a strong anamnestic response and the concentrations of testosterone and taint compounds at slaughter were low. These results suggest that a three dose vaccination regime may be the most appropriate in heavy pig production.**

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***Index Terms*—boar taint, heavy pigs, Improvac, GnRH vaccine**

I. INTRODUCTION

THE anti-gonadotrophin releasing factor vaccine Improvac is becoming widely used around the world as an alternative to physical castration of male piglets for the management of boar taint. The vaccine is given as a course of two doses, the second resulting in an immune response that temporarily reduces testicular activity, a process sometimes referred to as immunological castration. In most countries, the directions for vaccine use specify that the second dose should be given 4 to 6 weeks before slaughter. This timing ensures freedom from boar taint but allows pigs to spend most of their fattening period as functional males, with corresponding benefits in growth performance. Importantly, as the testicular suppression also reduces testosterone production, typical entire male behaviours such as aggression and mounting are also reduced, thus removing a potential management problem in the late fattening period. In the commercial systems where Improvac is currently used, pigs are usually given their second dose before age 24 weeks and the dosing regime works well.

In Italy and some other countries, many pigs are reared to heavy weights for the production of specialist ham products and not slaughtered until a minimum age of 9 months. Application of the standard Improvac dosing regime in such circumstances would require administration of the second dose at around age 36 weeks—well past the point at which undesirable male behaviour can become evident. If the second dose is given earlier, either the recommended

interval between dosing and slaughter must be extended, or a third dose must be given to adequately control boar taint. Although published work has suggested that the vaccine may work for at least 10 weeks after the second vaccination [4] or perhaps even longer [8], the studies are small and cannot be considered definitive.

This paper describes a study designed to test both an extended 2-dose regime and a 3-dose regime under Italian field conditions.

II. MATERIALS AND METHODS

The study was run on a commercial farm typical of the Italian heavy pig industry. 240 male piglets were randomly allocated at age 0–4 days to three treatment groups: physical castration in the first week of life (T1), vaccination with a minimum potency batch of Improvac on three occasions, at 10–11 and 26–27 and 36–37 weeks of age (T2), and vaccination with the same batch of Improvac on two occasions, at 10–11 and 26–27 weeks of age (T3). Pigs were slaughtered at age 42–43 weeks, 6 weeks after the third dose was given to group T2 and 16 weeks after the second dose was given to group T3. 46 pigs in group T1, 45 in T2 and 49 in group T3 completed the study. The remaining pigs were withdrawn because of ill health or died.

Blood samples were taken from pigs in all groups at the time of the first, second and third vaccinations, 14 days after the third vaccination and at slaughter. Serum titres of antibodies against GnRF were measured by ELISA and serum testosterone concentrations by HPLC with mass spectrometric detection. Samples of subcutaneous belly fat were taken from all pigs at slaughter and assayed for androstenone and skatole—the two compounds primarily associated with boar taint. Androstenone concentrations in fat were measured using HPLC with mass spectrometric detection; skatole was measured using HPLC with fluorescent detection.

III. RESULTS AND DISCUSSION

At the time pigs in group T2 were given their third dose of Improvac, the least squares mean titre of antibody against GnRF was only slightly elevated from levels at the time of second vaccination in groups T2 (96 U/ml compared with 49.9 U/ml) and T3 (114 U/ml compared with 74 U/ml). However, following the third vaccination, there was a 6-fold increase in least squares mean antibody titre among pigs in group T2 from 96 U/ml at the time of third vaccination to 571 U/ml two weeks later, which subsequently declined to 224 U/ml at slaughter.

Among barrows, least squares mean serum testosterone concentration remained below 0.4 ng/ml throughout the study. At the time of second vaccination, least squares mean serum testosterone concentration was 1.73 ng/ml in group T2 and 2.15 ng/ml in group T3. When pigs in group T2 were vaccinated for third time, 43% (23/53) pigs in group T2 and 46% (25/56) pigs in group T3 had a serum testosterone concentration <0.1 ng/ml and the least squares mean concentrations among pigs with a concentration ≥ 0.01 ng/ml were 0.78 ng/ml (T2) and 0.47 ng/ml (T3), which were still considerably lower than those seen 10 weeks before.

However, at slaughter, only 13% (7/54) pigs in group T3 had a serum testosterone concentration <0.1 ng/ml compared with 71% (37/52) pigs in group T2 and the least squares mean concentrations of pigs with a concentration ≥ 0.01 ng/ml had risen to 2.36 ng/ml among pigs in group T3. but declined to 0.18 ng/ml among pigs in T2.

The concentrations of androstenone and skatole in the fat of groups T1, T2 and T3 are shown in Tables 1, 2 and 3 respectively. The most critical assessment of efficacy is the distribution of pigs by risk categories. For androstenone, a concentration of 1000 ng/g has been suggested as a limit above which boar taint may be detected by consumers [5]. Other authors, however, have suggested a lower limit of 500 ng/g [2, 3]. For skatole 200 ng/g has been suggested as a meaningful figure [1, 5]. Samples high in both compounds are considered at greatest risk.

All barrows had low belly fat concentrations of androstenone and skatole, with the exception of one pig which had an androstenone concentration of 1891 ng/g and was also moderately high in skatole. High concentrations of boar taint compounds in apparently physically castrated pigs were also found in a random survey conducted in the United States [6]. Incomplete castration, undetected cryptorchidism and intersex are all possible explanations.

Excellent control of boar taint was achieved in all pigs given three doses of Improvac. All pigs in this group had low concentrations of both androstenone and skatole.

In contrast, 8% (4/49) of the pigs that only received 2 doses of vaccine had androstenone concentrations of over 1000 ng/g, and a further 8% (4/49) had concentrations between 500 and 1000, indicating that testicular function, and androstenone production, had resumed in at least some of the pigs

in group T3 by slaughter 16 weeks after the second vaccination. These results suggest that a two-dose regimen, with a 16-week gap between second vaccination and slaughter, would not be satisfactory for commercial use.

All groups in this study had low concentrations of skatole. Without an entire boar group as a negative control it is impossible to be sure whether this reflects efficacy in the two vaccine groups or simply the absence of a skatole problem on the farm. Unlike androstenone, skatole concentrations are only indirectly influenced by sexual status and also depend on management factors such as nutrition and hygiene.

IV. CONCLUSION

In heavy pig production systems, the recommended, two-dose Improvac vaccination regime is unlikely to be satisfactory, as delaying the second dose, and the consequent decline in testosterone, until 4 to 6 weeks prior to slaughter may result in unacceptable behavioural problems within groups of older male pigs. Results from this study indicate that a two-dose regime with a 16-week gap between vaccination and slaughter is not effective in controlling boar taint to an acceptable level. However, the administration of a booster dose, 10 weeks after the previous dose and 6 weeks prior to slaughter, gave full efficacy. Further work is therefore proposed to elaborate an effective and practicable 3-dose vaccination approach for heavy pigs.

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Table 1. Distribution of surgically castrated pigs (T1) by belly fat concentration of androstenone and skatole.

Skatole Concentration (ng/g)	Androstenone Concentration (ng/g) Percentage of Pigs (Number of Pigs)		
	<500	**500–1000**	**>1000**
<100	97.8 (45)	0.0 (0)	0.0 (0)
100–200	0.0 (0)	0.0 (0)	2.2 (1)
>200	0.0 (0)	0.0 (0)	0.0 (0)

Table 2. Distribution of pigs vaccinated with Improvac three times (T2) by belly fat concentration of androstenone and skatole.

Skatole Concentration (ng/g)	Androstenone Concentration (ng/g) Percentage of Pigs (Number of Pigs)		
	<500	**500–1000**	**>1000**
<100	100 (45)	0.0 (0)	0.0 (0)
100–200	0.0 (0)	0.0 (0)	0.0 (0)
>200	0.0 (0)	0.0 (0)	0.0 (0)

Table 3. Distribution of pigs vaccinated with Improvac twice (T3) by belly fat concentration of androstenone and skatole.

Skatole Concentration (ng/g)	Androstenone Concentration (ng/g) Percentage of Pigs (Number of Pigs)		
	<500	**500–1000**	**>1000**
<100	81.6 (40)	8.2 (4)	8.2 (4)
100–200	2.0 (1)	0.0 (0)	2.2 (1)
>200	0.0 (0)	0.0 (0)	0.0 (0)