PE1.03 The effect of vaccinating male pigs with improvac on growth performance and carcase quality. 65.00

S Andrews (1) stuart.andrews@pfizer.com, Ernst Lohner(2), H Schrade (3), I Horst (1)
(1)Pfizer Animal Health, United Kingdom
(2)Schweinegesundheitsdienst, Baden-Wuerttemberg, Germany
(3)Bildungs-und-Wissenszentrum, Boxberg, Germany

Abstract—The main objective of the study was to evaluate the benefits of using the anti-GnRF vaccine Improvac on growth performance and carcase quality of male pigs, fed either a normal barrow diet or an optimised diet with higher levels of protein, lysine and energy, compared with physical castration. Two hundred and sixty-seven pigs were randomly allocated to three treatment groups: T01, T02 and T03. Piglets in T01 were physically castrated at the start of the study and pigs in T02 (normal diet) and T03 (optimised diet) were vaccinated with Improvac at 11–12 and 20–21 weeks of age. All pigs were slaughtered 4–6 weeks after second vaccination. Vaccination with Improvac provided significant benefits in growth performance and carcase quality, compared with physical castration, although these benefits did not appear to be improved by offering vaccinated pigs an optimised diet. Body weights were comparable between all groups at weaning and at slaughter. Although the average daily gain of both vaccinated groups was generally lower than castrated pigs from weaning until second vaccination, Improvac had a significant benefit on average daily gain between second vaccination and both cut-off and slaughter (increases of 182–223 g/day, T02; 144–188 g/day, T03), respectively. Of particular economic importance was the improved feed conversion ratio of the vaccinates (8.5–9%, T02; 11–11.5%, T03) compared with the castrated pigs for the whole fattening period. Although not statistically significant, the FCR of vaccinated pigs offered the optimised diet (T03) was numerically better than vaccinated pigs offered the normal diet (T02) for the whole fattening period. There was no significant difference in mean carcase weight between vaccinated pigs (86.8 kg, T02; 86.5 kg, T03) and castrated pigs (89.6 kg), although the dressing percentage of the vaccinated pigs (T02 and T03 both 76.7%) was significantly lower (1.9 percentage points) than castrated pigs. There were, however, significant improvements in the quality of the carcases from the vaccinated pigs compared with the castrated pigs including: a higher percentage of carcases graded "E" as part of the EUROP classification (94%, T02; 92%, T03 compared with 73%, T01), higher percentage of lean meat (60% T02 and T03 compared with 58% T01), a reduction in back fat thickness (1.8 cm, T02; 1.9 cm, T03 compared with 2.1 cm, T01) and higher percentage of valuable parts of the carcase, including cutlet, ham and shoulder (58% T02 and T03 compared with 57% T01). Meat quality parameters of pH, conductivity, drip loss and colour showed no difference between groups. Carcases of the castrated pigs (T01) and vaccinated pigs fed a normal diet (T02) were negative for boar taint as determined using cooking and melting sensory tests; two of the vaccinated pigs fed an optimised diet (T03) tested positive. These samples were, however, negative for boar taint using HPLC with levels of androstenone, skatole and indole in belly-fat well below recognised threshold levels and in most cases undetectable.

S.J. Andrews is with Pfizer Animal Health, Sandwich, Kent, UK (phone: +44(0)1304644593; fax:+44(0)0134656257; e-mail: stuart.andrews@pfizer.com). E. Lohner is with Schweinegesundheitsdienst, Baden-Wuerttemberg, Germany (e-mail: author@lamar.colostate.edu). H. Schrade is with Bildungs-und Wissenszentrum, Boxberg, Germany (e-mail: author@nrim.go.jp) I. Horst is with Pfizer Animal Health, Berlin, Germany (e-mail: author@nrim.go.jp.

Index Terms—boar taint, carcase quality, castration, GnRF vaccination, Improvac.

I. INTRODUCTION

The anti-gonadotrophin-releasing-factor (GnRF) vaccine Improvac™ (Pfizer Animal Health) for the control of boar taint in male pigs has recently been introduced into the global market as a welfare friendly alternative to physical castration. It is currently (April 2009) registered in 23 countries. The vaccine acts via the hypothalmic-pituitary-gonad axis and suppresses testicular function through the induction of antibodies against GnRF.

It has been shown in a number of studies to have beneficial effects on growth performance and carcase quality [1,2]. The results from previous studies consider national production systems and may not be directly relevant to all parts of the global swine industry. This study was conducted to evaluate the benefits of using Improvac in male pigs, fed either a normal barrow diet or an optimised diet, raised on a commercial research farm in southern Germany, and compare with physical castration.

II. MATERIALS AND METHODS

Two hundred and sixty-seven male piglets farrowed from a Baden Wurttemberg line, were enrolled on the study in four batches, each three weeks apart, and randomly allocated, as per a randomised complete block design with blocking based on order of enrolment, within each batch, to three treatment groups: T01 (n=89), T02 (n=88) and T03 (n=90).

Eighty-nine piglets in group T01 were physically castrated by cutting the spermatic cords and removing the testicles at the start of the study; 78 pigs in T02 and 86 pigs in T03 (the number then remaining in these two groups) were vaccinated with Improvac at 11–12 and 20–21 weeks of age. The first vaccination was given on entry into the fattening unit. The date of the second vaccination was calculated retrospectively from the desired slaughter age, being given 4–6 weeks prior to slaughter and nine weeks after the first vaccination. Pigs were weaned when 22–30 days of age and moved into a nursery unit. On moving into the fattening unit, when 11–12 weeks of age, pigs were blocked on weight, such that within each enrolment batch, pigs of a similar weight were housed together by treatment group. They were not moved from their allocated pen until the end of the study. All pigs in T01 and T02 were fed a typical barrow diet, those in T03 an optimised diet with higher levels of protein (17.3% raw protein), lysine (1.03% lysine) and energy (13.4 MJ ME/kg) during the first half of the fattening phase (30–90 kg live weight). All treatment groups received the same diet for the second half of the fattening period (90–115 kg live weight). The impact of Improvac vaccination, and diet, on a number of parameters were examined including: bodyweight and bodyweight gain, feed consumption and feed conversion ratio (FCR), and carcase composition and quality. Other parameters were also examined which shall be the subject of a separate publication. Each batch of pigs was slaughtered in three lots, at weekly intervals, as they reached slaughter weight, commencing when pigs were 24–25 weeks of age and continuing until they were 26–27 weeks of age.

Following slaughter a subjective sensory cooking and melting test for boar taint was performed for all pigs in accordance the German Administrative Regulation on Food Hygiene. Belly fat samples from pigs with a positive sensory test were tested for the presence of androstenone, skatole, indole and testosterone using high performance liquid chromatography. The primary efficacy variables were the average daily gain and feed conversion ratio. All treatment differences were assessed at the two-sided 5% level of significance. Prior to moving pigs to the fattening unit the pig was the experimental unit and after that point, pen was the experimental unit. With regard to carcase parameters, with the exception of the EUROP grades, slaughter performance, meat quality and meat content were analysed by calculating descriptive statistics for the continuous data and frequency distributions for the categorical data for the criteria measured and collected at the slaughterhouse. EUROP grades were analysed using generalised linear mixed model with treatment as a fixed effect. The random effects were block and pen within block. Frequency distributions of each categorical carcase variable were calculated for each treatment.

III. RESULTS AND DISCUSSION

Body weights were comparable between castrated and vaccinated pigs and between the two vaccinated groups of pigs at weaning and at slaughter. Although the average daily gain of both groups of vaccinated pigs were generally lower than the castrated pigs from weaning until second vaccination (similar results have been reported by Fuchs et al [3]), Improvac had a significant benefit on average daily gain, 182 g/day (T02), $P=0.0013$; 144 g/day (T03), $P=0.0068$; between the time of second vaccination and cut-off (when first pigs from each batch were slaughtered), and 223 g/day (T02), $P<0.0001$; 188 g/day (T03), $P<0.0001$; between the time of second vaccination and slaughter.

Similar results have been reported [1,2,3] as has the observation that following second vaccination the social and feeding behaviour of vaccinated pigs changes to being similar to physically castrated pigs [4]. Over the whole fattening period, from entry into the fattening unit to both cut-off and slaughter, the FCR of the vaccinated pigs was significantly better (8.5–11.5%) than the castrated pigs.

For the period between entry into the fattening unit and cut-off the FCRs for T01, T02 and T03 were 2.93, 2.68 and 2.61, respectively ($P<0.0001$ for each vaccinated group of pigs compared with castrated pigs). For the period between entry into the fattening unit and slaughter the FCRs for T01, T02 and T03 were 2.96, 2.69 and 2.62, respectively ($P<0.0001$ for each vaccinated group of pigs compared with castrated pigs). This economically significant benefit of using Improvac has been consistently shown in many studies [5,6]. Although not statistically significant, values for FCR were numerically better for vaccinated pigs offered the optimised diet (T03) compared to vaccinated pigs offered the normal diet (T02) for the whole fattening period and would likely be economically significant for the farmer. There were no significant differences in mean carcase weight between vaccinated pigs (86.8 kg, T02; 86.5 kg, T03) and castrated pigs (89.6 kg), $P=0.491$ (Table 1), or values in pH, electrical conductivity, meat colour or drip loss (Table 2), although the dressing percentage of the vaccinated pigs (T02 and T03 both 76.7%) was significantly lower (1.9 percentage points) than castrated pigs ($P<0.001$)(Table 1). Dunshea et al and Fuchs et al [1,7] also reported higher dressing percentages in physically castrated pigs compared with either Improvac vaccinated pigs or boars. Moreover, a higher dressing percentage was also found in female fattening pigs compared with Improvac vaccinated pigs by Oliver et al [8], and Andersson et al [9] found lower dressing percentage in entire males compared with physical castrates and females.

Andersson et al [9] suggested the additional weight of genitalia as a possible reason for the lower dressing percentage in entire male pigs compared with physical castrates and females. Differences in feed intake and gut fill between Improvac vaccinated males and entire males were given as possible reasons by Dunshea et al [1]. There were, however, significant improvements in the quality of carcases from vaccinated pigs compared with castrated pigs, for example: the percentage of carcases graded “E” as part of the EUROP classification (93.5%, T02; 91.6%, T03 compared with 73.3%, T01; $P=0.002$) (Table 3); also supported by results of Fuchs et al [7], percentage of lean meat (59.8%, T02; 59.5%, T03 compared with 57.7%, T01; $P=0.021$), improvements in back fat thickness (1.80 cm, T02; 1.86 cm, T03 compared with 2.13 cm, T01; $P=0.001$), [1,10] and percentage of valuable parts of meat, including cutlet, ham and shoulder (58.3%, T02; 58.1%, T03 compared with 56.7%, T01; $P=0.021$). These improvements in carcase quality are well substantiated and support results of other studies [7,10,11, 12].

All of the castrated pigs (T01) and vaccinated pigs fed a normal diet (T02) were negative for boar taint as determined using the subjective cooking and melting sensory tests; three percent (n=2) of the vaccinated pigs fed an optimised diet (T03) were positive although further chemical analysis using high performance liquid chromatography (HPLC) confirmed that levels of androstenone, skatole and indole in belly-fat from these pigs were below recognised threshold levels [13,14].

IV. CONCLUSION

Vaccination with Improvac provided benefits in growth performance and carcase quality, compared with physical castration, although additional statistically significant benefits were not seen by offering pigs an optimised diet. Of particular economic importance was the improved FCR of the vaccinated pigs (8.5–11.5%) compared with castrated pigs for the whole fattening period. There was also a numerical improvement in FCR of vaccinated pigs offered an optimised diet compared to those offered a normal diet. There were no significant differences in mean carcase weight between vaccinated pigs (regardless of diet) and the castrated pigs, although the dressing percentage of the vaccinated pigs was lower than the castrated pigs.

However, there were significant improvements in the quality of the carcases from the vaccinated pigs compared with the castrated pigs, including a higher percentage of pigs graded “E” in the EUROP classification, higher percentage of lean meat, a reduction in back fat thickness and higher percentage of valuable parts of the carcase, including cutlet, ham and shoulder. Carcases of the castrated pigs and vaccinated pigs fed a normal diet were negative for boar taint as determined using cooking and melting sensory tests; two of the vaccinated pigs fed an optimised diet were positive. These samples were, however, negative for boar taint using HPLC with levels of androstenone, skatole and indole in belly-fat below recognised threshold levels.

ACKNOWLEDGEMENT

The authors thank the following: from Pfizer Animal Health, Nicola Clamp and A. Shanks for data management and Fiona Brock for statistical analysis of the data; from LSZ, Boxberg, Dr. B. Zacharias (statistical analysis of carcase data), Dr. Julia Grimm (veterinary supervision) and Barbara Hahn, Dr. P. Grün, Dr. K. Winterhalder and G. Lenkner for technical assistance.

REFERENCES

[1] Dunshea, F.R., Colantoni, C., Howard, K., McCauley, I., Jackson, P., Long, K.A., Lopaticki, S., Nugent, E.A., Simons, J.A., Walker, J. & Hennessy, D.P. (2001). Vaccination of boars with a GnRH vaccine (Improvac™) eliminates boar taint and increases growth performance. Journal of Animal Science, 79, 2524–2535.

[2] Zamaratskaia, G., Andersson, H.K., Chen, G., Andersson, K., Madej, A. & Lundström, K. (2008). Effect of a gonadotropin-releasing hormone vaccine (Improvac™) on steroid hormones, boar taint compounds and performance in entire male pigs. Reproduction in Domestic Animals, 43, 351–359.

[3] Fuchs, T., Nathues, H., Koehrmann, A., Andrews, S., Brock, F., Klein, G. & grosse Beilage, E. (2009). The Veterinary Journal. In press.

[4] Cronin, G.M., Dunshea, F.R., Butler, K.L., McCauley, I., Barnett, J.L. & Hemsworth, P.H. (2003). The effects of immuno- and surgical-castration on the behaviour and consequently growth of group-housed, male finisher pigs. Applied Animal Behaviour Science, 81, 111–126.

[5] Xue, J.L., Dial, G.D. & Pettigrew, J.E. (1997). Performance, carcass, and meat quality advantages of boars over barrows: A literature review. Swine Health and Production, 5, 21–28.

[6] Turkstra, J.A., Zengt, X.Y., van Diepent, J.T., Jongbloed, A.E., Oonk, H.B., Van de Wielt, D.F. & Meloen, E.H. (2002). Performance of male pigs immunised against GnRH is related to the time of onset of biological response. Journal of Animal Science, 80, 2953–2959.

[7] Fuchs, T., Nathues, H., Koehrmann, A., Andrews, S., Brock, F., Sudhaus, N., Klein, G. & grosse Beilage, E. (2009). A comparison of the carcase characteristics of pigs vaccinated with Improvac™ with physically castrated pigs. Meat Science. In preparation.

[8] Oliver, W.T., McCauley, I., Harrell, R.J., Suster, D., Kerton, D.J. & Dunshea, F.R. (2003). A gonadotropin-releasing factor vaccine (Improvac™) and porcine somatotropin have synergistic and additive effects on growth performance in group-housed boars and gilts. Journal of Animal Science, 81, 1959–1966.

[9] Andersson, K., Schaub, A., Andersson, K., Lundström, K., Thomke, S. & Hansson, I. (1997). The effects of feeding system, lysine level and gilt contact on performance, skatole levels and economy of entire male pigs. Livestock Production Science, 51, 131–140.

[10] Hennessy, D.P., Bernal, G. & Hodge, A. (2006). Growth performance and carcase quality in male pigs given the boar taint vaccine Improvac® compared to physical castrates. In Proceedings of the 19th International Pig Veterinary Society Congress, Copenhagen, Denmark. Abstract No. O.62–04.

[11] Jaros, P., Bürgi, E., Stärk, K.D.C., Claus, R., Hennessy, D. & Thun, R. (2005). Effect of active immunization against GnRH on androstenone concentration, growth performance and carcase quality in intact male pigs. Livestock Production Science, 92, 31–38.

[12] Schmoll, F., Kauffold, J., Pfützner, A., Baumgartner, J., Brock, F., Grodzycki, M. & Andrews, S. (2009). Growth performance and carcass traits of surgically castrated and Improvac™ vaccinated boars raised in Germany. Swine Health and Production. In preparation.

[13] Bonneau, M. (1997). Boar taint in entire pigs, a review. CAB Abstracts, 18:15N–18N.

[14] Andresen, Ø. (2006). Boar taint related compounds: androstenone/skatole/other substances. Acta Veterinaria Scandinavica, 48 (Suppl I):S5

Table 1. LS Mean values for whole carcase weight, dressing percentage, back fat thickness, lean meat percentage, valuable parts percentage, belly points, fat cutlet area, meat cutlet area, meat in belly and meat yield.

	LS Mean (Standard Error)		
Carcase Variable	**T01**	**T02**	**T03**
Carcase weight (kg)	89.6 (1.97)	86.8 (1.97)	86.5 (1.96)
Dressing Percentage (%)	78.6 (0.24)	76.7 (0.24)	76.7 (0.23)
Back Fat (cm)	2.13 (0.06)	1.80 (0.06)	1.86 (0.05)
Lean Meat (%)	57.7 (0.53)	59.8 (0.52)	59.5 (0.52)
Valuable Parts (%)	56.7 (0.40)	58.3 (0.40)	58.1 (0.40)
Belly Points	5.8 (0.29)	7.3 (0.29)	7.2 (0.29)
Fat Cutlet (cm^2)	16.3 (0.54)	13.3 (0.54)	13.6 (0.53)
Meat Cutlet (cm^2)	53.2 (0.96)	53.4 (0.95)	52.6 (0.93)
Meat in Belly (Grub), (%)	58.1 (0.50)	61.3 (0.50)	61.0 (0.49)
Meat Yield (Bonn 04), (%)	59.0 (0.42)	61.4 (0.42)	60.9 (0.42)

Table 2. Mean values for pH, electrical conductivity values, meat colour and drip loss.

	LS Mean (Standard Error)		
Carcase Variable	**T01**	**T02**	**T03**
pH, 45 min (cutlet)	6.1 (0.03)	6.1 (0.03)	6.1 (0.03)
pH, 24 hr (cutlet)	5.5 (0.01)	5.5 (0.01)	5.5 (0.01)
Electrical Conductivity, 24 hr mS (cutlet)	4.6 (0.25)	4.3 (0.24)	4.2 (0.24)
pH, 45 min (ham)	6.2 (0.05)	6.3 (0.05)	6.3 (0.04)
pH, 24 hr (ham)	5.6 (0.02)	5.7 (0.02)	5.6 (0.02)
Electrical Conductivity, 24 hr mS (ham)	2.9 (0.25)	2.7 (0.24)	3.0 (0.24)
Meat Colour (reflection) (%)	69.8 (0.98)	68.5 (0.97)	69.3 (0.96)
Drip Loss (%)	2.43 (0.20)	2.66 (0.20)	2.61 (0.19)

Table 3. Carcase quality parameters.

EUROP Grade	Percentage of Pigs (Number of Pigs)		
	T01	T02	T03
E	73.3 (55)	93.5 (72)	91.6 (76)
U	21.3 (16)	6.5 (5)	8.4 (7)
R	5.3 (4)	0.0 (0)	0.0 (0)
O	0.0 (0)	0.0 (0)	0.0 (0)
P	0.0 (0)	0.0 (0)	0.0 (0)