



# TECHNICAL BULLETIN

Pfizer Animal Health

## IMPROVAC®: Consumer Sensory Evaluations

David Hennessy, PhD  
Pfizer Animal Health

### Introduction

Boar taint is an offensive smell frequently detected in pork from some non-castrated (intact) pigs. Androstenone and skatole are regarded as the main contributors to boar taint.<sup>1</sup> High concentrations of androstenone (>1.0 µg/g) and/or skatole (> 0.2 µg/g) are likely to be detected by consumers, particularly those with high sensitivity to androstenone.<sup>2,3</sup> While physical castration is the predominant method of controlling boar taint, it is not without significant costs to production efficiency, animal welfare, and the environment.

Vaccination for the control of boar taint is a relatively new alternative that is gaining increased usage around the world. Vaccination offers the opportunity to raise a more energy-efficient, leaner boar in a more humane and environmentally sustainable manner while still controlling boar taint.

IMPROVAC® is a vaccine that effectively reduces the production and accumulation of both androstenone and skatole in the pig carcass.<sup>4</sup> However, before the use of vaccines such as IMPROVAC can become common practice, they must be proven to reliably produce the same eating quality pork as currently obtained with physical castration. This *Bulletin* reviews some recent sensory studies that compared the sensory attributes, eating quality, and acceptability of pork from pigs vaccinated with IMPROVAC with that from either physical castrates and/or female pigs.

### Sensory Tests

Sensory analysis relies on human senses for evaluating the quality or acceptability of foods. As a result of variations between animals (concentrations of the primary boar-taint compounds), individuals' abilities to detect boar taint, and cultural/culinary habits, the results of sensory studies for boar taint can be quite inconsistent from person to person, country to country, and study to study.<sup>5</sup>

### KEY POINTS

- IMPROVAC is a novel immunological product for the control of boar taint that works solely through the immune system of the pig.
- IMPROVAC is not a hormone and has no hormonal or pharmacological activity.
- IMPROVAC has no oral activity if ingested.
- Numerous multinational sensory studies involving either expert and/or consumer testing panels compared the sensory attributes, eating quality, and acceptability of pork from pigs vaccinated with IMPROVAC with that from either physical castrates and/or female pigs.
- Results from all countries are consistent. Pork from boars vaccinated with IMPROVAC was at least equivalent in sensory quality (odor, flavor, juiciness, tenderness, and overall acceptability) to pork from either female pigs or physically castrated pigs.

Sensory assessments by trained laboratory panels (i.e., expert panels) control and reduce outside bias, making the results more useful for comparison between products being tested. While expert/trained panel assessment is subject to more rigorous controls than consumer panel testing, charac-



Pfizer Animal Health

terization of boar taint is still inherently difficult and influenced by the sensitivity of the panelists, their training, and the methods used to prepare/present the meat samples.<sup>6</sup> Consumer panels, in contrast, lack some of the strict controls and training of expert panels, but nevertheless provide a realistic and standardized assessment of food acceptance.<sup>7</sup>

## South Africa

A study was conducted in South Africa to examine whether pigs vaccinated for boar taint differed from physical castrates or mature boars with regard to the boar odor present in the fat and the meat of the loin.<sup>8</sup> The study involved fat and meat sampled from 25 loin steaks (20 mm thick) from the 3 types of pigs. After cooking, steaks were cut into small cubes for evaluation by 12 panelists with previous experience in sensory evaluation of boar taint. The panel assessed the fat for aroma intensity and boar odor intensity, and the meat for aroma, boar odor, juiciness, tenderness, flavor, and off-flavor characteristics.

Results summarized in Table 1 show that sensory attributes did not significantly differ between physical castrates and vaccinated boars for either the fat or meat samples, but both groups generated significantly ( $P \leq 0.001$ ) better results compared to intact boars. IMPROVAC-vaccinated boar samples were rated as the juiciest and the mature intact boar samples the least juicy ( $P \leq 0.001$ ). In this study, vaccination against boar taint successfully prevented the development of boar odor in the fat and meat from vaccinated boars and resulted in pork of the same sensory quality as that from the physical castrates.

## Philippines

A study was conducted in Manila to assess the sensory acceptability of pork from vaccinated boars with pork from both female and physically castrated pigs.<sup>9,10</sup> Loin steaks (15 mm thick, bone and skin removed) were retrieved from 20 boars vaccinated against boar taint, 20 physical castrates, and 20 female pigs from the same farm. After cooking, the steaks were randomly presented in a blind sequential design to 122 female and 43 male consumers from the Manila area. Participants used a 100-point scale to rate aroma, flavor, after-taste, tenderness, and juiciness.

Results showed no differences in the key sensory attributes between the 3 types of pork (Table 2). Flavor, odor, juici-

**Table 1: Sensory attributes, South Africa (8-pt scale\*).**<sup>8</sup>

| Attribute             | Castrates          | IMPROVAC           | Intact boars       |
|-----------------------|--------------------|--------------------|--------------------|
| <b>Aroma Pork Fat</b> |                    |                    |                    |
| Intensity             | 5.458 <sup>a</sup> | 5.569 <sup>a</sup> | 2.722 <sup>b</sup> |
| Off-flavor            | 2.417 <sup>b</sup> | 2.125 <sup>b</sup> | 6.306 <sup>a</sup> |
| <b>Pork Meat</b>      |                    |                    |                    |
| Aroma                 | 5.569 <sup>a</sup> | 5.542 <sup>a</sup> | 4.486 <sup>b</sup> |
| Boar odor             | 2.236 <sup>b</sup> | 2.319 <sup>b</sup> | 3.556 <sup>a</sup> |
| Juiciness             | 4.847 <sup>b</sup> | 5.181 <sup>a</sup> | 3.778 <sup>c</sup> |
| Tenderness            | 5.556 <sup>a</sup> | 5.944 <sup>a</sup> | 3.417 <sup>b</sup> |
| Overall flavor        | 5.569 <sup>a</sup> | 5.569 <sup>a</sup> | 4.458 <sup>b</sup> |
| Off-flavor            | 1.889 <sup>b</sup> | 1.875 <sup>b</sup> | 3.014 <sup>a</sup> |

\* Sensory assessment used and 8-point category scale, with 1 denoting the least intense condition and 8 the most intense.

<sup>abc</sup> Means in rows with different superscripts are significantly different ( $P \leq 0.001$ ).

**Table 2: Sensory attributes, Philippines (100-pt scale).**<sup>9,10</sup>

| Attribute                        | Castrates | IMPROVAC | Females |
|----------------------------------|-----------|----------|---------|
| Aroma                            | 71.3      | 72.0     | 74.5    |
| Flavor                           | 64.5      | 65.5     | 66.3    |
| After taste                      | 64.4      | 64.6     | 65.7    |
| Tenderness                       | 71.3      | 72.9     | 70.5    |
| Juiciness                        | 68.6      | 69.4     | 66.8    |
| Overall liking                   | 67.5      | 68.8     | 68.5    |
| Androstenone ( $\mu\text{g/g}$ ) | <0.20     | <0.20    | <0.20   |
| Skatole ( $\mu\text{g/g}$ )      | <0.030    | 0.044    | 0.048   |

ness, tenderness, and overall acceptability of pork from the IMPROVAC-vaccinated boars were judged equivalent in eating quality to pork from female and physically castrated pigs.

## Mexico

A study conducted in Mexico compared the sensory acceptability of pork from vaccinated boars with pork from both female and physically castrated pigs.<sup>8</sup> Loin steaks (15 mm



thick, bone/skin removed) from 20 IMPROVAC-vaccinated boars, 20 physical castrates, and 20 female pigs from the same farm were cooked and randomly presented in a blind manner to 130 female consumers from Mexico City.

Consistent with the earlier studies, no differences in the key sensory attributes between the 3 types of pork were detected for flavor, odor, juiciness, tenderness, and overall acceptability (Table 3). Pork from boars vaccinated with IMPROVAC was judged to be equivalent in eating quality to pork from the female and physically castrated pigs. Consumers also ranked samples from the 3 treatments from most desirable to least desirable and stated their intention to purchase pork of that quality. No significant differences were found between samples from the 3 types of pigs.

Results from this study again confirmed that the pork from boars vaccinated with IMPROVAC achieved parity in terms of eating quality with pork from physically castrated pigs and female pigs.

## Chile

The sensory attributes of pork from vaccinated boars was compared to meat from physical castrates by university researchers using both a trained sensory panel and a consumer panel.<sup>8</sup> The trained panel was comprised of 11 female panelists sensitive to both androstenone and skatole, while the consumer panel involved 150 female panelists (18-55 years of age). For each panel, pork loin (10 mm thick, bone out, skin off) from vaccinated boars and physical castrates was cooked and immediately served in a blind random manner.

In both the trained taste panel and the consumer panel, no meaningful differences between samples for any of the sensory attributes were detected (Tables 4 and 5). None of the testers perceived a strong, atypical, or unpleasant smell that could be attributed to boar taint. Small but significant differences ( $P \leq 0.05$ ) were observed for some attributes, with the pork from castrated pigs having a greater acceptability of color while the pork from vaccinated pigs had a higher level of general satisfaction and juiciness.

Results from this study using both a trained panel and a consumer panel re-confirmed that pork from boars vaccinated with IMPROVAC is of equivalent high quality and acceptability as pork currently produced with physical castration.

**Table 3: Sensory attributes, Mexico (100-pt scale).<sup>8</sup>**

| Attribute      | Castrates | IMPROVAC | Females |
|----------------|-----------|----------|---------|
| Aroma          | 69.5      | 71.2     | 70.1    |
| Flavor         | 68.1      | 65.7     | 63.5    |
| After taste    | 56.4      | 55.5     | 51.1    |
| Tenderness     | 75.8      | 75.0     | 69.0    |
| Juiciness      | 75.0      | 70.6     | 71.5    |
| Overall liking | 74.2      | 72.4     | 71.4    |

**Table 4: Sensory attributes, Chile trained panel (7-pt scale\*).<sup>8</sup>**

| Attribute       | Castrates | IMPROVAC |
|-----------------|-----------|----------|
| Color           | 5.76      | 5.90     |
| Appearance      | 5.62      | 5.81     |
| Aroma           | 6.00      | 5.71     |
| Flavor          | 5.90      | 5.60     |
| Texture         | 5.90      | 5.38     |
| Overall quality | 5.69      | 5.61     |

\* Scoring scale 1-7: 1=very bad; 7=very good

**Table 5: Sensory attributes, Chile consumer panel (5- or 7-pt scale\*).<sup>8</sup>**

| Attribute                             | Castrates         | IMPROVAC          |
|---------------------------------------|-------------------|-------------------|
| Appearance acceptability <sup>1</sup> | 5.13              | 4.95              |
| Color acceptability <sup>1</sup>      | 5.14 <sup>a</sup> | 4.84 <sup>b</sup> |
| Color intensity <sup>2</sup>          | 2.67              | 2.72              |
| Aroma acceptability <sup>1</sup>      | 5.26              | 5.16              |
| Aroma intensity <sup>2</sup>          | 2.73              | 2.72              |
| General satisfaction <sup>1</sup>     | 4.84 <sup>a</sup> | 5.16 <sup>b</sup> |
| Flavor acceptability <sup>1</sup>     | 5.11              | 5.29              |
| Flavor intensity <sup>2</sup>         | 2.56              | 2.59              |
| Texture acceptability <sup>1</sup>    | 4.95              | 5.20              |
| Tenderness <sup>2</sup>               | 3.42              | 3.29              |
| Juiciness <sup>2</sup>                | 2.29 <sup>a</sup> | 2.49 <sup>b</sup> |

<sup>1</sup> Scoring scale: from 1 (very bad) to 7 (very good)

<sup>2</sup> Scoring scale: 5-point balanced scale, on which 3 = "just how I like it"

<sup>ab</sup> Means in rows with different superscripts are significantly different ( $P \leq 0.05$ ).



## Brazil

A study was conducted in Brazil to compare the sensory quality and objective meat-quality attributes of pork loin steaks from physically castrated and vaccinated pigs.<sup>11</sup> Results (Table 6) showed that pork from vaccinated pigs contained 11.15% less fat ( $P < 0.05$ ) than physical castrates. The color of the pork from vaccinated boars was slightly darker and more yellowish, but these differences were small and probably not meaningful from a consumer-acceptance perspective.

For the sensory assessment, pork steaks approximately 25 mm thick were cooked and presented in a blind random order to 238 panelists that were frequent consumers of pork. The consumers rated the pork for various sensory attributes against a 9-point scale where 1 indicated extreme dislike and 9 indicated extreme likability.

Results (Table 6) show that odor and taste of the pork from the vaccinated pigs were rated significantly better ( $P < 0.05$ ) than meat from physical castrates, and overall acceptability was also ranked higher, preferred by the majority (66%) of the testers.

## Conclusions

The 5 multinational consumer sensory studies presented here and others not reviewed here from Korea,<sup>12,13</sup> Spain,<sup>14</sup> and Australia<sup>15,16</sup> clearly demonstrate that pork from boars vaccinated with IMPROVAC possesses at least equivalent sensory quality (odor, flavor, juiciness, tenderness, and overall acceptability) to pork from either female or physically cas-

**Table 6: Sensory attributes and meat quality, Brazil consumer panel (9-pt scale\*).**<sup>11</sup>

| Attribute                  | Castrates          | IMPROVAC           |
|----------------------------|--------------------|--------------------|
| <b>Meat-Quality Traits</b> |                    |                    |
| Total fat (g/100g)         | 14.26 <sup>a</sup> | 12.67 <sup>b</sup> |
| Cooking yields (%)         | 28.03              | 30.03              |
| Shear force (kg)           | 4.22               | 4.10               |
| Color - "L" (lightness)    | 44.34 <sup>a</sup> | 42.80 <sup>b</sup> |
| Color - "A" (redness)      | 4.47 <sup>a</sup>  | 2.37 <sup>b</sup>  |
| Color - "B" (yellowness)   | 6.63 <sup>a</sup>  | 11.39 <sup>b</sup> |
| <b>Sensory Traits</b>      |                    |                    |
| Fat odor                   | 6.04 <sup>a</sup>  | 6.75 <sup>b</sup>  |
| Loin odor                  | 6.57 <sup>a</sup>  | 6.97 <sup>b</sup>  |
| Loin taste                 | 6.73 <sup>a</sup>  | 7.19 <sup>b</sup>  |
| Loin overall acceptance    | 7.11 <sup>a</sup>  | 7.45 <sup>b</sup>  |
| Loin preference            | 81 (34%)           | 157 (66%)          |

\* Scoring scale: from 1 (disliked extremely) to 9 (liked extremely)

<sup>ab</sup> Means in rows with different superscripts are significantly different ( $P < 0.05$ ).

trated male pigs. Both expert and consumer panelists were unable to distinguish any negative differences in the eating quality of pork from IMPROVAC-vaccinated boars and pork from physical castrates or female pigs. Small positive differences were noted in some studies. ■

## References

1. Bonneau M. *Livestock Prod Sci* 1982; 9:687-705.
2. Bonneau M, et al. *Livestock Prod Sci* 1992; 32:63-80.
3. Weiler U, et al. *Meat Sci* 2000; 54:297-304.
4. Dunshea FR, et al. *J Anim Sci* 2001; 79:2524-2535.
5. Malmfors B, Lundström K. *Livestock Prod Sci* 1983; 10:187-196.
6. Disjksterhuis GB, et al. *Meat Sci* 2000; 54:261-269.
7. Bond J, Debaq J. *ESOMAR Handbook of Market and Opinion Research*, 4th Edition. 1998.
8. Data on file. Pfizer Inc, New York, NY.
9. Singayan-Fajardo J, et al. *Proc Int Pig Vet Soc* 2006; Denmark.
10. Singayan-Fajardo J, et al. *Proc Asian Pig Vet Soc* 2007; China.
11. Silveira ETF, et al. *Proc 53rd Int Con Meat Sci Tech*, August 2006.
12. Jeong J, et al. *Proc Int Pig Vet Soc* 2008a; South Africa.
13. Jeong J, et al. *Proc Int Pig Vet Soc* 2008b; South Africa.
14. Font i Furnols M, et al. *Meat Sci* (in press) 2008.
15. D'Souza DN, Mullan BP. *Anim Sci* 2003; 77: 67-72.
16. Boghassian V, et al. *Proc 41st Int Cong Meat Sci Tech*, August 1995.



**Pfizer Animal Health**

IMPROVAC® is a registered trademark of Pfizer Inc.  
© 2008 Pfizer Inc. All rights reserved.  
TIM1011

**Improvac**®  
A better way forward