Boar Taint: Off Odor in Cooked Pork from Intact Male Pigs

Meat from male pigs can have an unpleasant aroma when cooked, technically known as boar taint. While these naturally developing odors are completely safe, research shows that a high proportion of consumers, especially women, can easily detect them,1,2 making their control a necessity to protect the quality experience of eating pork.

- As intact3 male pigs sexually mature, they can develop two naturally occurring compounds that can create an unpleasant smell in pork when it is cooked.
  - Androstenone and skatole are compounds that over time can accumulate in the fatty tissue of some male pigs. They are released when the pork is cooked, causing the unpleasant aroma.
  - This odor occurs mainly, but not exclusively, in mature intact male pigs. Depending on age, breed and environment, 50 percent or more of all intact male pigs produce pork that has a strong to moderate off odor when cooked.4
  - These odors do not represent a food safety concern, but need to be controlled to ensure a high quality eating experience.
  - Boar taint is prohibited by food quality regulations in most countries.

- Consumers rarely experience this unpleasant smell because farmers have controlled it for centuries with physical castration.
  - More than 95 percent of the world’s male pig population is physically castrated (testes removed).
  - Male pigs are physically castrated in their early days of life.
  - Physical castration is a long-standing, traditional practice used to control the unpleasant aromas and reduce pig injuries through behavioral control (less aggression and fighting).

Two naturally occurring compounds, androstenone and skatole, are responsible for causing the unpleasant aromas in pork from male pigs.

- These can accumulate in fatty tissue of some male pigs.
- These compounds are released when pork is cooked, causing the unpleasant aroma, technically known as boar taint.
- The natural off odors create no food safety issue, but pose a threat to the eating/cooking experience.

Androstenone
Skatole
There are a few alternatives to physical castration, but in some countries societal pressures have caused farmers to look for other options:

- Pigs sent to market before puberty have reduced off odor, but this limits the pig’s total value and creates inefficiencies. There is also a risk that a pig will mature early and develop the off-odor compounds.
- Specially formulated diets can reduce skatole levels, but is ineffective at reducing androstenone.
- Breeding of only female pigs has been explored and used in cattle breeding. But the technique is still under research and no economic or practical solution exists for pigs yet.
- Genetic-assisted markers are being researched to breed pigs with a lowered probability for boar taint; however it may take years for this technology to be developed for practical use in pig production.

Now U.S. farmers have a safe and effective immunological solution to reduce off odors in pork, called IMPROVEST®.

- It’s a protein compound that works like an immunization to protect against off odors. IMPROVEST is an FDA-approved immunological castration product that reduces boar taint. It uses the pig’s own immune system to temporarily create the same effect as physical castration, but much later in a pig’s life.
- IMPROVEST is as effective as physical castration at managing the unpleasant aroma.5
- It enables the production of pork with the same high quality (free from unpleasant aromas) as consumers enjoy today.5
- The U.S. Food and Drug Administration has determined that meat from pigs given IMPROVEST is safe to eat.5 Regulatory authorities in more than 60 countries, including the European Union and Japan, have reached the same conclusion for the related global brand, IMPROVAC®.
- By eliminating the need for physical castration, the animals grow to their full intact male potential, with all the inherent advantages, until the second dose. They eat less feed while creating more pork.6,7

Important safety information
Special care should be taken to avoid accidental self-injection during administration of IMPROVEST. Accidental self-injection could negatively affect reproductive physiology of both men and women. Therefore, pregnant women should not administer IMPROVEST and women of childbearing age, as well as men, should exercise extreme caution when administering the product. There is no risk, however, of these effects on an individual that consumes pork from pigs given IMPROVEST. Pigs should not be sent to market prior to three weeks after the second dose to allow adequate time for reduction in the compounds responsible for off odor in pork. Marketing pigs given IMPROVEST more than 10 weeks after the second dose may increase the risk of off odor in pork. IMPROVEST should not be used with female pigs, barrows or male pigs intended for breeding.

3. Refers to pigs that are not physically castrated, but were reared with their testicles in place or “intact.”

For more information, go to: www.highqualitypork.com
IMPROVEST®
(Gonadotropin Releasing Factor Analog-Diphtheria Toxoid Conjugate, 0.2 mg/mL)
Sterile Solution for Injection

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION: IMPROVEST is a sterile solution containing Gonadotropin Releasing Factor Analog-Diphtheria Toxoid Conjugate. Each mL contains 0.2 mg Gonadotropin Releasing Factor Analog-Diphtheria Toxoid Conjugate, 150 mg of diethylaminoethyl-dextran hydrochloride, 1 mg chlorocresol, sodium hydroxide as needed to adjust pH and water for injection.

INDICATIONS FOR USE: IMPROVEST is indicated for the temporary immunological castration (suppression of testicular function) and reduction of boar taint in intact male pigs intended for slaughter.

DOSAGE AND ADMINISTRATION: IMPROVEST should be administered via subcutaneous injection into the post auricular region of the neck. A safety injector should be used, preferably one which has a dual safety system providing both a needle guard and a mechanism to prevent accidental operation of the trigger. Each intact male pig should receive two 2-mL doses of IMPROVEST. The first dose should be administered no earlier than 9 weeks of age. The second dose should be administered at least 4 weeks after the first dose. Pigs should be slaughtered no earlier than 3 weeks and no later than 10 weeks after the second dose. In case of misdosing, the animal should be re-dosed immediately.

CONTRAINDICATIONS: Do not use IMPROVEST in intact male pigs intended for breeding because of the disruption of reproductive function. Not approved for use in female pigs and barrows.

WARNINGS:
WITHDRAWAL PERIODS: No withdrawal period is required when used according to labeling.

For not Human Use. Keep Out of Reach of Children.

USER SAFETY WARNINGS:
Warning for person administering IMPROVEST: Accidental self injection could affect reproductive physiology of both men and women and may adversely affect pregnancy. Pregnant women should not administer this product. Women of childbearing age should exercise extreme caution when handling this product. Special care should be taken to avoid accidental self injection and needle stick injury when administering the product. Protective clothing including, but not limited to, safety glasses and gloves should be worn. Use a safety injector, preferably one which has a dual safety system providing both a needle guard and a mechanism to prevent accidental operation of the trigger. In case of eye contact, rinse immediately with copious amounts of water. In case of skin contact, wash immediately with soap and water. The product should be stored safely out of the reach of children. As a reminder, it is the prescribing veterinarian’s responsibility to inform drug administrators of the user safety warnings associated with IMPROVEST.

Advice to the user in the event of accidental self injection: In the event of accidental self injection, wash the injury thoroughly with clean running water. Seek prompt medical attention and take the package leaflet with you. Do not administer the product, and/or any other product with a similar action, in the future.

Advice to the physician: Accidental self injection could affect reproductive physiology of both men and women and may adversely affect pregnancy. If self injection with IMPROVEST is suspected, reproductive physiology should be monitored by assay of testosterone or estrogen levels (as appropriate). The risk of a physiological effect is greater after a second or subsequent accidental injection than after a first injection. The patient should be advised not to administer IMPROVEST, and/or any other product with a similar action, in the future.

For customer service, to report suspected adverse reactions or to obtain a copy of the Material Safety Data Sheet (MSDS) call 1-888-963-9471.

PRECAUTIONS: Subcutaneous injection in intact male pigs can cause a transient local injection site reaction that may result in trim loss at slaughter.

ADVERSE REACTIONS: The field study observations from field effectiveness studies were consistent with the observations made during the target animal safety studies of transient inflammation at the injection sites. IMPROVEST did not cause unusual clinical signs or an unexpected frequency or severity of injection site reactions. Adverse events, as reported, were not uniquely attributable to IMPROVEST.

TARGET ANIMAL SAFETY:
Margin of Safety: The safety of two doses of IMPROVEST was evaluated in intact male swine. Thirty 9-week old intact boars received two subcutaneous doses of IMPROVEST in the same location 14 days apart. The boars received one of three treatments: Saline Control (12-mL), IMPROVEST at the intended dose (2-mL, 1X), or IMPROVEST at 6 times the intended dose (12-mL, 6X). Boars were clinically monitored daily. In addition, observation and measurement of injection sites, body weight, quantitative feed consumption, hematology, and clinical chemistry analyses were also obtained. A complete postmortem examination was conducted on each boar 14 days after the second injection. IMPROVEST, administered subcutaneously at the label dose (2-mL) resulted in mild transient injection site reactions at the 1X dose and caused clinical signs of systemic inflammation at 6X the intended dose. The signs of inflammation included depression, stiffness of the neck lasting up to five days, reduction in feed intake, and lower body weights. Multiple swollen joints and associated lameness, which may be signs of systemic inflammation, were observed in one 6X boar. Evaluation of blood work revealed increased white blood cell counts (eosinophilia and neutrophilia); slight increases in total serum protein (above normal reference range in 50% of the 6X boars) and globulin (above the normal reference range in 40% of the 6X boars); and slight decreases in serum albumin in 6X boars. Injection sites for the 6X boars showed clinically detectable firmness persisting in all animals for 14 days after the second injection. Pain and sensitivity at the injection site persisted for up to five days, and erythema and heat were more prominent in the 6X boars than in the 1X boars. Mild to moderate chronic inflammation and discoloration in the subcutaneous tissues at the injection site were observed. In all IMPROVEST treated boars, atrophy of testes, prostate, and bulbourethral glands were observed as expected consequences associated with the intended effect of the drug. At the label 2-mL dose, IMPROVEST may cause transient injection site inflammation.

Injection Site Safety: Injection site safety was evaluated following the injection of IMPROVEST into healthy 17-week old boars. The treated boars received two 2-mL doses of IMPROVEST into the same injection site location 28 days apart, while the control boars received saline. Daily monitoring included clinical evaluation and observation and measurement of injection sites. Two days after the second injection, postmortem observations of injection sites were conducted. All clinical signs of observable injection site swelling were resolved within 24 hours, and pain on palpation resolved by 48 hours post-injection. Firmness persisted for up to 11 days after the first injection in 10% of boars. Gross injection site alterations consisted of subcutaneous edema with tan or red discoloration. Two 2-mL injections of IMPROVEST, administered 28 days apart into the same location resulted in transient injection site reactions following each injection and resulted in discoloration of tissue at the injection site which was observable approximately 48 hours after the second injection.

Field Safety: During the conduct of the nine location field effectiveness study, IMPROVEST did not cause unusual clinical signs or an unexpected frequency or severity of injection site reactions. The field safety observations from this study were consistent with the observations made during the target animal safety studies of transient inflammation at the injection sites. Adverse events, as reported, were not uniquely attributable to IMPROVEST.

EFFECTIVENESS: IMPROVEST is an injectable sterile solution containing an incomplete analog of natural gonadotropin releasing factor (GnRF) conjugated to diphtheria toxoid in an adjuvanted formulation. Immunization with a two dose regimen of IMPROVEST, with a four week interval between doses, stimulates the pig’s immune system to produce antibodies which can neutralize its own GnRF. Pigs given an initial dose of IMPROVEST are immunologically primed but do not produce sufficient antibodies to have any physiological effect. Following receipt of the second dose, the pig’s immune system responds with a strong antibody response. These antibodies bind to and neutralize circulating GnRF in the bloodstream. Neutralization of GnRF blocks the hypothalamic-pituitary-gonadal endocrine axis, thereby suppressing testicular function, including both sex hormone production and reproductive capability, thereby providing temporary immunological castration in these injected boars.

Evidence of temporary immunological castration was provided in a series of studies showing that within 1-2 weeks after the second injection of IMPROVEST, anti-GnRF antibody levels increase significantly. With this rise in anti-GnRF antibodies, the levels of gonadal sex hormones were substantially reduced, the size of the testes, and spermatogenesis suppressed, as was the expression of typical male behaviors (aggression and sexual, e.g., mounting). Full immunological castration was demonstrated to last from 3 to 10 weeks after the second dose.

IMPROVEST injected boars will start to return to full reproductive function at a variable period after this time, as evidenced by increases in male sex hormones, testicle size, and intact male behavior. IMPROVEST should not be used in boars intended for breeding purposes.

Evidence to assess the acceptability of pork from IMPROVEST treated pigs was provided through a series of consumer taste panels using consumers deemed sensitive to the taste of “tainted” meat. The presence of boar taint was evaluated on the basis of pork aroma and flavor and not by chemical analysis. Four consumer taste panel studies were conducted to demonstrate the difference of pork generated from IMPROVEST treated boars and intact boars. A surgically castrated male group was not evaluated during these studies. In these four studies, 787 sensitive consumers evaluated cooked pork loin samples from IMPROVEST treated and intact boars. These pigs were raised to market weight, injected with IMPROVEST as per product labelling and slaughtered 3 to 10 weeks after receipt of the second IMPROVEST injection. The consumers found the aroma and flavor of pork from the IMPROVEST injected pigs to be more acceptable than from the intact boars in all four studies.

STORAGE INFORMATION: Store under refrigeration at 2°-8°C (36°-46°F). Once broached, product may be stored under refrigeration for 28 days. Store bottles in carton until used. Protect from light. Protect from freezing.

HOW SUPPLIED: IMPROVEST is available in the following package sizes: 20 mL bottle, 100 mL bottle, 250 mL bottle, 500 mL bottle.

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Zoetis Inc.
Kalamazoo, MI 49007
PA005383
Improvast®

(Gonadotropin Releasing Factor Analog-Diphtheria Toxoid Conjugate, 0.2mg/mL)