# Q-OLOR: strategies for obtaining pork free of boar taint

## Summary

The use of alternatives to surgical castration in the production of pork and when assessing boar taint in the slaughterhouse enables consumers' needs to be met with no consequences for the pork sector, for meat producers, or for exports. Action has been taken at various levels to achieve this objective, and to provide pork that is improved in sensory terms, and free of unpleasant smells and tastes. First, work was undertaken at the farm level, by applying immunocastration, one of the alternatives to surgical castration (and to the production of boars). Several procedures for applying the vaccine were studied, and its effect on production yields, meat and carcass quality and in terms of eliminating the sensory problem of boar taint was assessed. Second, work was done on the other alternative to surgical castration, which is the production of untreated boars, involving assessment of the possibility of indirect selection based on the boars' level of aggressiveness, and direct selection based on genetic markers of boar taint in order to reduce the number carcasses with the highest probability of this problem occurring. The relationship between pigs' aggressiveness and the presence of boar taint in the meat was also determined. Finally, because both alternatives may entail a minimal risk of boar taint, it is necessary to ensure that the carcasses with the problem are detected, in order to separate them and send them to markets where boar taint is not a problem, or to apply masking strategies to reduce it. Accordingly, action was taken to determine the level of boar taint using a non-invasive sensor that could potentially be automated and included in the slaughter line.

## Objectives

The overall objective of the project was to assess alternatives to surgical castration that ensure the production of high quality pork free of boar taint:

1. Determine the best immunocastration procedure (time of the first and second dose of the vaccine) for boars.
2. Determine the effect of indirect selection, using indicators of the pigs' aggressiveness to reduce boar taint in males, and classify them in terms of their risk of boar taint.
3. Confirm whether direct selection based on the genetic markers described in the literature can help identify animals with boar taint problems.
4. Assessment of a laser sensor based on Raman technology for non-destructive detection of boar taint.

## Description of the actions carried out in the project

<u>Action 1: Immunocastration procedures to achieve good carcass quality, maximum meat infiltration and meat free of boar taint.</u>

Three batches containing 48 pigs each with three different genetic profiles were studied in this action (batches 1, 2 and 3). There were 3 treatments for each batch, one of boars (UB), one involving late immunocastration (8 and 4 weeks before slaughter) (T1) and one involving early immunocastration (13 and 8 weeks before slaughter) (T2). The animals were bred on the Monells experimental farm and slaughtered under commercial conditions. The parameters for production and carcass and meat quality were monitored. The boar taint of the fat was assessed using the human nose method.

This action studied a fourth batch of pigs (batch 4, n = 579), with the same genetic profile, divided into 4 groups depending on the different treatments applied: untreated boars (UB), surgically castrated boars, boars undergoing late immunocastration (8 and 4 weeks before slaughter) (T1) and boars undergoing early immunocastration (11 and 4 weeks before slaughter) (T2). The animals were bred on a commercial farm and also slaughtered under commercial conditions. The parameters for production and carcass and meat quality were monitored. The boar taint of the fat was assessed with the human nose method.

Action 2: Genetic selection of untreated boars and effects on boar taint levels.

This action was carried out on with two different genetic profiles on two commercial farms. Three markers were selected for each one, based on an analysis of the allelic and genotype frequencies obtained for 7 markers related to boar taint in the literature. The markers selected were FMO5, CYP21 and CYP2e1 for farm 1, and FMO5, CYP21 and SDR9C7 for farm 2. At this point, the most suitable boars for mating were selected, and 211 male piglets from farm 1 and 152 from farm 2 were finally identified. The animals were bred and slaughtered under commercial conditions. The characteristics of the carcasses and the lesions on the carcass were evaluated in the slaughterhouse, and a fat sample was obtained to evaluate the boar taint using the human nose method.

Action 3: Determination of boar taint in carcasses of boars and immunocastrated male pigs with a Raman sensor.

In first phase of this action, a Raman sensor was used to obtain the spectra from 50 fat samples with chemically analysed androstenone and skatole levels, and the level of boar taint was evaluated using the human nose method. The samples used came from action 1 in the project and a fat bank from other projects. A model was produced to predict androstenone and skatole levels, and models were made to classify samples as positive or negative for boar taint considering both the levels of the two compounds responsible for this taint and classification by the human nose method. In the second phase, the prediction models were validated by expanding the number of samples analysed with 60 samples from action 2 and various sample classification criteria were tested, in an attempt to focus the analysis on conditions that are more similar to the real measurement conditions.

## Final results and practical recommendations

Action 1: Immunocastration procedures

The results show that both late and early immunocastration affects the production parameters, although this effect was not the same in all the batches analysed. In general, there were few differences between the treatments in average daily weight gain in the overall fattening period. The daily growth rate either did not differ or tended to be lower in untreated boars than in early immunocastrates (T2), and the effect in late immunocastrates (T1) was more variable depending on the batch. Finally, the untreated boars generally had a lower conversion rate than both the early and late immunocastrated animals.

As for the carcass quality parameters, immunocastration led to a greater variability of the carcasses treated, which increased as the immunocastration time increased. In general, the carcasses of early and late immunocastrated animals were fatter and less lean than those of the boars. However, no differences were observed in the fattening of the carcasses between UB, T1 and T2 in batch 2 and batch 4. The meat quality parameters were not affected by the different immunocastration procedures.

The results of the human nose method show that both late and early immunocastration eliminate boar taint, although it is still slightly noticeable in a small number of animals, which are mainly those undergoing early immunocastration.

Action 2: Genetic selection

Classification of boar taint with the human nose method related the genotypes of the genetic markers studied, either individually or in combination, to the level of boar taint. The results show that although it is difficult to find a marker that allows a large percentage of animals without boar taint to be obtained individually, the combination of markers provides between 82% and 95% of pigs that are negative for boar taint. The effect of the carcass characteristics and the genotype of the various markers from the animal studied and its parents on the presence of boar taint were studied. The most influential factors were found to be the percentage of lean meat in the carcass, the thickness of dorsal fat and lesions on the skin of the carcass. The fatter the animals, the greater the presence of boar taint, and the more lesions on the skin of the carcass, the lower the percentage of animals with a negative boar taint, or the greater the presence of boar taint. Some genotypes of the genetic markers for boar taint studied were also found to be related to the pigs' aggressiveness, indicating that genes associated with some of the genetic markers could affect physiological mechanisms common to the manifestation of aggression and the presence of boar taint.

Action 3: The Raman sensor

The Raman sensor provides a fat classification model according to the presence or absence of boar taint based on the levels of androstenone and skatole obtained by chemical analysis, with an error margin of 25%. This error is around 28-40% in the validation phase. It also enabled a classification of fat (with/without boar taint) according to the level of boar taint evaluated with the human nose method, with a similar margin of error (34-38%). However, the prediction of androstenone and skatole levels with the Raman sensor is of limited accuracy. The human nose method and the Raman sensor can classify samples as positive or negative for boar taint with similar margins of error.

## Conclusions

The results for the evaluation of boar taint with the human nose method show that immunocastration is effective in eliminating or reducing boar taint. Late immunocastration is slightly more effective than early immunocastration. Immunocastration generally increases fattening, but this effect depends on the genetics used. It is therefore important to study the effect of immunocastration on the productive and quality characteristics of the carcass depending on the genetics to be worked with.

Genetic markers and the measures of aggression and carcass characteristics can potentially predict the presence of boar taint in carcasses.

The Raman sensor classifies fat according to the presence/absence of boar taint. However, whether the classification error is acceptable needs consideration. The use of other non-invasive technologies that are quicker than the Raman sensor such as NIRS could be attempted for online boar taint classification.

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## Subject area(s) of application

☒ Livestock farming and animal welfare

☒ Genetic resources

## Geographical area(s) of application

**PROVINCE(S):** BARCELONA, GIRONA
**REGION(S):** El BAGES, OSONA and LA SELVA

## Dissemination of the project: publications, seminars, multimedia, etc. (State links)

Presentation of the Ordinary General Assembly of INNOVACC, on 21 June 2021. See page 51 of the following link:
https://www.innovacc.cat/wp-content/uploads/2021/07/210621-Presentaci%C3%B3_AG_INNOVACC_lq.pdf
Presentation of the project by S. Batallé at the National Rural Network seminar on "Virtual exchange between operational groups and innovative projects on the subject of genetic improvement of livestock'' organised by the Ministry of Agriculture, Fisheries and Food.

## Project website

https://www.innovacc.cat/2021/08/10/estrategies-per-obtenir-carn-de-porc-lliure-dolor-sexual-q-olor-3/

## More information on the project

| PROJECT DATES | TOTAL BUDGET |
|---|---|
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