Characterisation of Novel Technology for Boar Taint Detection

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Abstract – Boar taint is the term given to pork meat which has an unfavorable taste or aroma, studies have found that several compounds in porcine adipose tissue are responsible for this trait. Adipose tissue samples from a wide range of pigs were analysed via the novel technology and the well-established gas chromatographic validation method. This preliminary study demonstrates that the novel technology correlates well with the traditional GC technique. The novel technology is advantageous compared to traditional methods in its rapidity, portability, and cost-effectiveness. This technology could ultimately help to prevent consumer dissatisfaction by identifying tainted meat on-line in abattoirs, allowing the carcasses to be sorted for use as prime cuts or alternative food products.

Key Words – Adipose tissue, androstenone, skatole.

I. INTRODUCTION

Boar taint is the term given to the unfavourable flavour and aroma sometimes experienced with pork meat. This is due to the accumulation of several naturally occurring compounds in pig adipose tissue. The prevalence of these compounds is linked with age, level of sexual maturity, gender, diet and breed. The two primary compounds responsible for boar taint are skatole and androstenone; both are fat-soluble resulting in a greater accumulation in adipose tissue compared with muscle tissue. Skatole (3-methylindole) is produced in the gut as a breakdown product of the amino acid tryptophan [1] [2]; the levels of this compound can be reduced with dietary manipulation. Androstenone (5α-androst-16-en-3-one) is a pheromone produced by the Leydig cells in the testes by entire male pigs [3]; therefore, castration can be used as a preventative measure. However, surgical castration has ethical implications which have recently been raised by the European Union resulting in the implementation of a voluntary ban on the surgical castration of pigs by 2018 for EU countries (European Declaration on Alternatives to Surgical Castration of Pigs, SANCO, 2010). The European Union is the second largest pig producer in the world and many of its countries do not routinely castrate their pigs. The planned 2018 ban will likely result in a greater demand for a robust analytical system to determine whether a carcass is tainted with levels of the boar taint compounds above the accepted threshold for that country. The generally accepted threshold levels at which consumers would negatively react to meat from entire males are 0.5 ppm [4] or 1.0 ppm [5] for androstenone and 0.20 ppm [6] or 0.25 ppm [5] for skatole. There are often differences in the consumer acceptance of boar taint compounds because personal perception can vary [7] [8], this has been linked to human genetic variation [9] and gives rise to different thresholds between countries. Currently, there is no EU approved method to measure boar taint online in abattoirs [10]. Therefore, there is a real industry requirement for technology which can rapidly detect taint compounds with high specificity and sensitivity without sample preparation.

II. MATERIALS AND METHODS

To validate our novel technology subcutaneous adipose tissue samples were analysed by both a well-established analytical technique, gas chromatography (GC), and the novel technology (Fig. 1). A Perkin Elmer Clarus 580 gas chromatograph linked to a flame ionisation detector (FID) was used for androstenone determination. This GC method required a non-polar cross-linked and bonded dimethyl-polysiloxane stationary phase (capillary column), hydrogen carrier gas and a temperature programme. The determination of skatole was performed using the same GC linked to a nitrogen phosphorous detector (NPD). This GC method required a high polarity bonded polyethylene glycol phase (capillary column), helium carrier gas and a temperature programme. The standards 5α-androst-16-en-3-one, 5α-androstan-3α-ol-17-one, 3-methyl-indole and 5-methyl-indole were obtained from Sigma Aldrich (Dorset, UK). Standards were prepared by dissolving the required mass in a known volume of methanol. The sample preparation of adipose tissue for analysis via GC methods involved two separate procedures for the two analytes of interest. Microwave radiation is initially used to release the lipid phase from

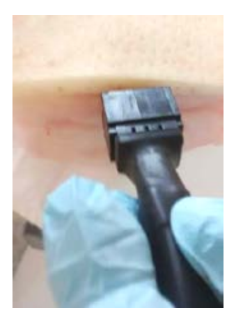

Figure 1. Direct analysis of adipose tissue with novel technology.

adipocytes, which was then subjected to solvent extraction, sonication, and centrifugation. The procedure for skatole has an additional solvent exchange step. An internal standard is finally added to the prepared sample (androsterone and 5-methylindole) and a 1 µl injection volume is used for GC analysis.

III. RESULTS AND DISCUSSION

Our gas chromatographic methods used an internal standard for quantification which allows for peak size compensation from sample introduction errors [11]. Our preliminary studies demonstrate that the levels of androstenone and skatole determined by GC correlate well with that determined by the novel technology. The novel method is rapid, achieving results for both compounds in under a minute compared to hours with the traditional method. The GC method requires labour intensive sample preparation with solvent extraction making it unsuitable for on-line measurements. The rapid novel technology is portable and does not require sample preparation making it suitable for direct measurement on-line.

IV. CONCLUSION

Following our successful preliminary study of frozen and fresh adipose tissue, further studies into the investigation of boar taint variation with regards to pig breed and age are underway. Additionally, the next phase of this project will analyse carcasses on-line in abattoirs which will be the final step before commercialization.

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