VOLATILE COMPOUNDS RESPONSIBLE FOR THE FISHY OFF-FLAVOUR IN BEEF WITH ENHANCED HEALTHFUL FATTY ACIDS

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I. INTRODUCTION

There have been many attempts to increase n-3 fatty acids (FA) in beef due to their health benefits and their presence in ruminant animals [1]. However, when polyunsaturated fatty acids are too abundant, oxidation can result in a shorter shelf life and negative flavours or off-flavours in cooked meat. Vahmani et al. [2] improved the profile of health favourable FA (n-3, vaccenic and rumenic) in beef by feeding co-extruded flaxseed (flaxseed, peas, and alfalfa) before alfalfa-grass hay. However, this beef enriched with healthful FA resulted in tougher steaks with lower beef flavour and greater off-flavour intensity, presenting a fishy off-flavour to an extent that might be detectable by consumers [3]. The aim of this study was to characterize the volatile compounds responsible for the fishy off-flavour found in beef with health enhanced FA profiles.

II. MATERIALS AND METHODS

Twelve 2.5-cm steaks enriched with healthful FA presenting a fishy off-flavour according to trained panellists (Fishy) [3], and 11 steaks from commercial cattle (Non-fishy) collected from the caudal end of the *longissimus thoracis* were frozen at -20 °C. Upon thawing at 4 °C for 24 h, steaks were cooked to a final internal temperature of 71 °C [3]. Stir bar sorptive extraction (SBSE) coupled with thermal desorption-gas chromatography-mass spectrometry (TD-GC-MS) was used for identification and quantification of volatile flavour compounds in grilled beef samples as described in Ruan et al. [4]. Partial least squares discriminant analysis (PLS-DA) based on volatile compounds was applied to classify steaks into presence or absence of fishy off-flavour (Fishy and Non-fishy, respectively).

III. RESULTS AND DISCUSSION

The PLS-DA including only two factors identified two clusters: the first group included Fishy samples and the second cluster Non-fishy samples. Hence, a clear separation between Fishy and Non-fishy was observed based on the volatile compounds.

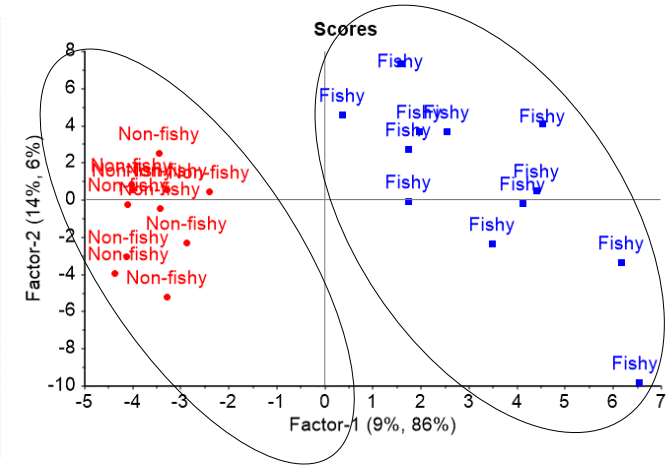

Figure 1. Score plot based on factor 1 and 2 from the partial least squares discriminant analysis using the volatile compounds to classify steaks based on the presence or absence of fishy off-flavour.

As shown in Fig. 2, 17 volatile compounds significantly ($P < 0.05$) contributed to the presence of fishy off-flavour. Among these, 14 compounds were positioned on the right quadrants near the fishy off-flavour, hence being positively correlated with the presence of this off-flavour. Compounds produced by autoxidation of linolenic acid, such as (E,E)-2,4-Heptadienal and heptanal, and 2-undecanone and pentadecane have been described as major contributors to fishy odour [5,6]. To our knowledge, the other 10 compounds have not been independently related to fishy off-flavour, although they might have contributed to this off-flavour when their odour was mixed with others in a complex beef sample.

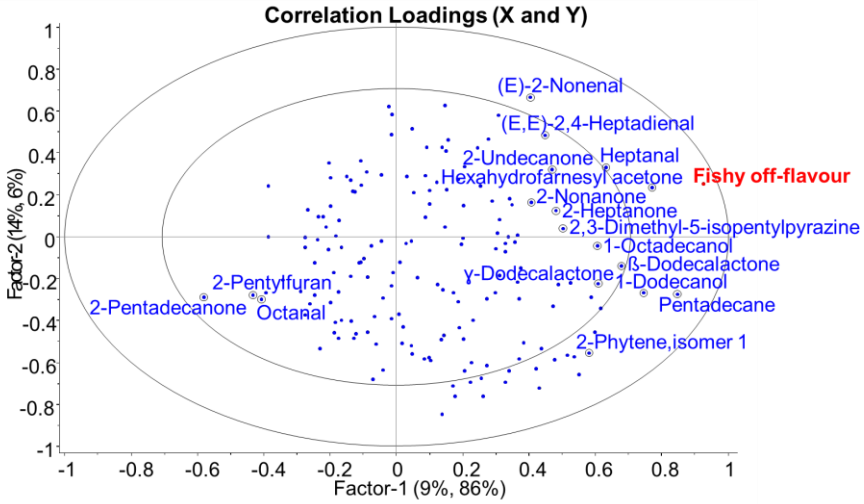

Figure 2. Correlation loading plot from the partial least squares discriminant analysis showing the volatile compounds positively and negatively correlated with the presence of fishy off-flavour. Circled (•) volatile compounds were significant at $P < 0.05$.

IV. CONCLUSION

A variety of compounds appears to have contributed towards the fishy off-flavour found in beef with enhanced healthful FA. Fishy off-flavour is a complex sensory phenomenon, and further research to confirm the contribution of those volatile compounds not previously related to this off-flavour is warranted.

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