



Rapid Classification of Beef Aroma Quality

Key Benefits

Instant analysis of all volatile freshness markers

Minimal sample preparation

Simple operation

Easily configured for multiple products

Industry-proven robust technology ready for the process line



Process-line or laboratory grading of fresh beef aroma is achieved simply and objectively by applying SIFT-MS for instantaneous, direct detection of evolved volatile compounds.

Aroma is an important characteristic in the acceptance of beef by consumers, and preference is often culturally dependent. Certain volatile organic compounds (VOCs) impart favorable or unfavorable characteristics to the aroma, but grading has traditionally been achieved using sensory testing because robust, high-throughput analytical technologies were not available. This application note applies Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) to the detection of VOCs from various New Zealand beef samples. SIFT-MS effectively identifies premium quality carcasses early in the production process.

Figures 1 and 2 show the averaged concentration data for premium and defective-flavored beef samples. These classifications are provided courtesy of an expert sensory panel (trained by Carne Technologies, New Zealand). Premium beef samples are derived from eight prime beef cattle entered in the annual New Zealand "Steak of Origin" (SOO) competition. The defective beef samples are classified as "Bull 3", "Bull 4", "Cow 1", "Cow 2", "R High pH", "R Norm pH", "Rotten", and "QM High pH".

Although the volatile profiles for the various classifications are visually

different (Figures 1 and 2), for rapid screening applications (such as the testing laboratory, or on the process line) classification using multivariate statistical methods is the preferred approach. The statistical model is created based on the instrumental measurements and sensory classifications and then used to rapidly classify test samples. Figure 3 shows the model created from the beef data using the SIMCA algorithm (Infometrix® Pirouette software package). Each colored point represents a replicate measurement. All sensory classifications are very well differentiated via SIFT-MS analysis of the volatile compounds.

This study demonstrates that SIFT-MS is ideally suited to rapid grading of beef aroma quality via emitted VOCs. SIFT-MS effectively discriminates premium quality beef from numerous defective flavors, providing an objective, rapid sensory test that enables many more samples to be screened per day than traditional sensory or instrumental approaches. The Syft Voice200ultra SIFT-MS instrument provides a robust, simple solution for both in-process analysis and off-line analysis (via autosampler integration).

Experimental Method

New Zealand beef steak samples of premium (Steak of Origin, S00) and defective flavor (all other samples) were provided for analysis by Carne Technologies (Cambridge, New Zealand). Carne Technologies carried out the sensory analysis using standardized procedures.

For SIFT-MS analysis, finely diced 20-g samples were placed in one-liter Schott bottles and capped with pierceable septa. Samples were incubated at 60°C for one hour prior to testing.

SIFT-MS Analysis

Instrument	Voice200
Inlet type	High performance
Sample flow	25 sccm
Software	Voice200 & LabSyft
Analysis type	Selected Ion Mode
Reagent ions	H ₃ O ⁺ , NO ⁺ , O ₂ ⁺
Compounds	Methanol, ethanol, acetone, butanone, acetaldehyde, pentanal, ethyl acetate, propyl acetate, ethyl butanoate, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, ammonia, trimethylamine, indole, skatole
Analysis time	30 seconds
Typical LOD	50 pptv

Figure 1. Headspace concentrations of alcohols, ketones, aldehydes, and esters for prime (Steak of Origin) and defective meat samples.

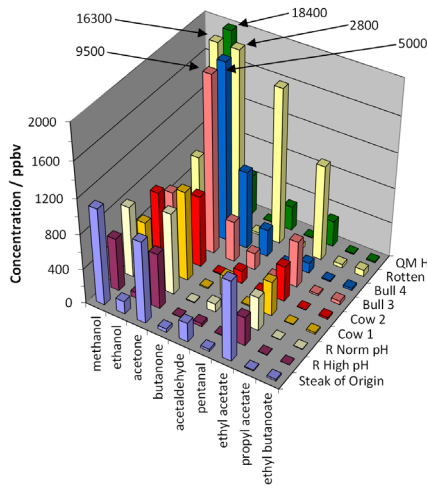


Figure 2. Headspace concentrations of sulfur- and nitrogen-containing compounds for prime (Steak of Origin) and defective meat samples.

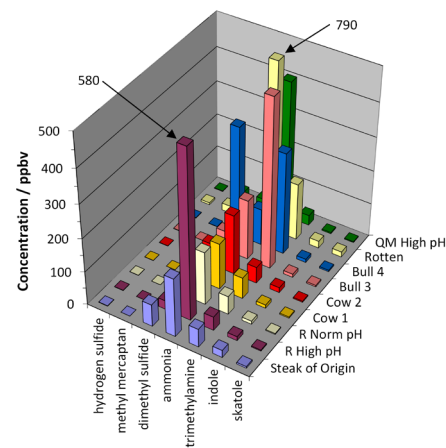
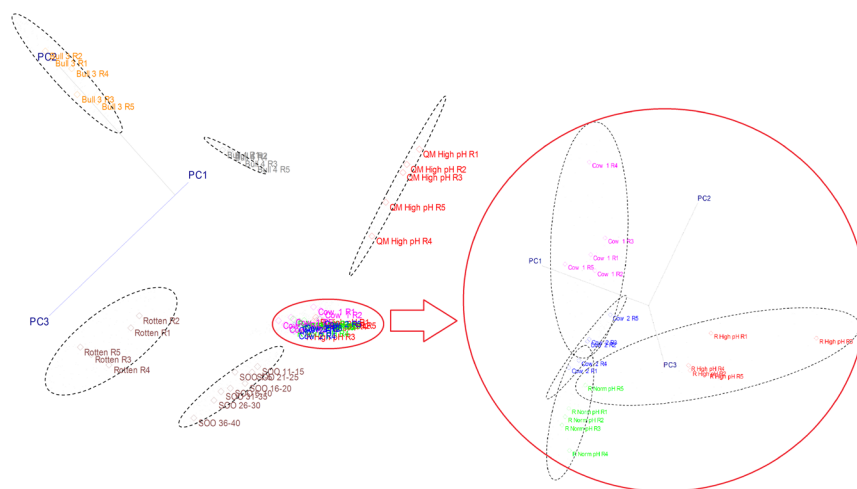


Figure 3. The results of SIMCA multivariate analysis of the headspace concentration data. Each colored point in the class projections graph represents a replicate measurement. The cluttered region of the class projection plot is expanded on the right.



Further Reading

- Syft Brochure *SIFT-MS Technology Overview*
- Syft Brochure *Food, Flavor & Fragrance Solutions*
- Syft Application Note *Instant Evaluation of Beef Freshness*
- Syft Brochure *LabSyft: Laboratory Software for SIFT-MS*

B.J. Prince, et al. (2010), "Application of [SIFT-MS] to real-time atmospheric monitoring", *Rapid Commun. Mass Spectrom.* **24**, 1763.
 V.S. Langford et al. (2012), "Headspace analysis of Italian and New Zealand Parmesan cheeses", *J. Food Sci.* **77**, C719.