Simple, Instant Detection of Fish Oil Oxidation

Key Benefits

Instant detection of all volatile oxidation markers

Minimal sample preparation

Simple operation

Easily configured for multiple products

Industry-proven robust technology ready for the process line

Process-line or laboratory detection of fish oil oxidation is achieved extremely simply by applying SIFT-MS for instantaneous, direct detection of volatile oxidation markers.

Edible oils rich in unsaturated fatty acids offer health benefits, but they are susceptible to autoxidation that affects consumer acceptance and shortens product shelf-life. Generally, greater unsaturation in the fatty acid chain means more extensive autoxidation will occur in a given time period.

Volatile aldehydes, ketones, and saturated and unsaturated hydrocarbons are formed during autoxidation. In addition to compromising flavor, they provide sensitive indicators of oxidative status for instrumental measurement. In general, propanal has been utilized as the most significant marker for fish oils. This application note demonstrates how easily autoxidation products can be detected in the headspace of fish oil using Selected Ion Flow Tube Mass Spectrometry (SIFT-MS).

Figure 1 shows the propanal concentration measured for fish oil samples and blanks over a four-day period. The "Day 0" measurements were made one hour after the samples were prepared (i.e. on the freshly cut capsules) and reveal a significant concentration of propanal in the fresh oil (22 ppbv).

Other volatile oxidation products are shown in Figure 2. The very volatile markers that dominate the headspace – acetaldehyde, acetone and ethanol – are extremely significant. These compounds are not reported using traditional methods such as GC/MS, whereas they are detected readily with SIFT-MS. The data in Figures 1 and 2 also demonstrate the selectivity of SIFT-MS. The NO^+ reagent ion resolves isomeric acetone and propanal in real-time by detecting ion products that occur at m/z 88 and 57, respectively.

The data presented here show that SIFT-MS very effectively detects early autoxidation of fish oil *via* traditional (e.g. propanal) and non-traditional marker compounds (acetaldehyde, acetone and ethanol). The simple detection of these polar, low-molecular-weight compounds with SIFT-MS arises from the unique application of ultra-soft chemical ionization and direct headspace sampling in SIFT-MS.

The rapid, highly sensitive analysis provided by SIFT-MS is ideal for high-throughput quality assurance of fish and other edible oils. In fact, SIFT-MS enables objective, rapid sensory testing of oxidation to be applied on the process line or off-line in the laboratory via autosampler integration.

Experimental Method

In this study, five 1-mL fish oil capsules ("Giant Eagle" brand, USA) were placed in duplicate wide-mouthed sample jars. Capsules were opened inside the jars, and the contents allowed to drain. Jars were capped immediately (trapping laboratory air) and left on a laboratory bench at ambient temperature (12 to 25°C) for the duration of the tests.

SIFT-MS Analysis

Instrument	Voice200
Inlet type	High performance
Sample flow	25 sccm
Software	Voice200 & LabSyft
Analysis type	Selected Ion Mode
Reagent ions	H_3O^+, NO^+, O_2^+
Compounds	Acetaldehyde, propanal, hexanal, pentenals, hexenals, nonenals, hexadienal, heptadienal, nonadienal, decadienal, acetone, pentenones, methanol, ethanol, propanol, pentanols
Analysis time	45 seconds
Typical LOD	50 pptv

Figure 1. The propanal concentration as measured using the NO^+ reagent ion. The concentration in the blank was always less than 4 ppbv.

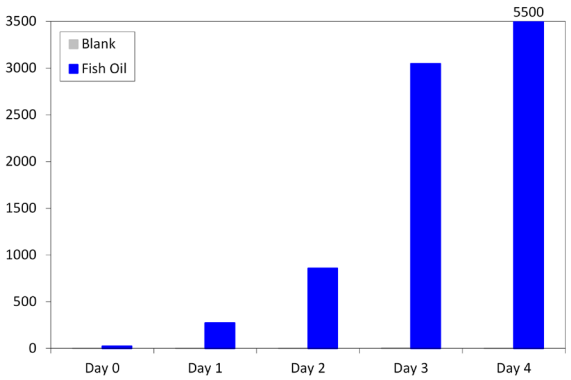
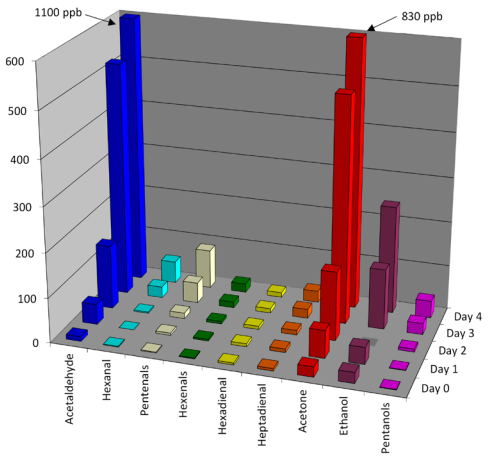


Figure 2. Additional volatile oxidation markers detected and quantified from fish oil headspace.



Further Reading

Syft Brochure *SIFT-MS Technology Overview*

Syft Brochure *Food, Flavor & Fragrance Solutions*

Syft white paper *A New Method for the Early Detection of Edible Oil Oxidation*

Syft Brochure *LabSyft: Laboratory Software for SIFT-MS Applications*

B.M. Davis & M.J. McEwan (2007), "Determination of Olive Oil Oxidative Status by Selected Ion Flow Tube Mass Spectrometry", *J. Agric. Food Chem.* **55**, 3334.

V.S. Langford, et al. (2012), "Headspace analysis of Italian and New Zealand Parmesan cheeses", *J. Food Sci.* **77**, C719.

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