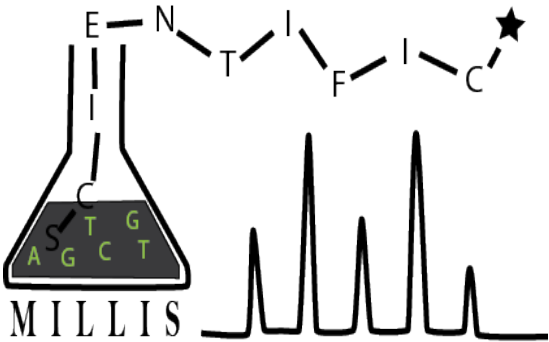


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Analytical Report

| | |
|--------------------|--|
| Title | Vicinal Diketones Profile in Cream and Cookies Flavor Concentrate via GC-MS |
| Report No. | 032017-30 |
| Issue Date | March 20, 2017 |
| Notebook reference | 28-9-01 |
| Contributors: | Alexei Gapeev |
| Quote No. | |
| Requester | Flavorah |

Specific Aim:

The goal is to determine levels of

- Acetoin, Diacetyl and Acetyl Propionyl with reporting cutoff 5 ppm in Cream and Cookies flavor concentrate.

Table 1 lists target compound levels determined pursuant to the protocol described below.

| Sample | Diacetyl | Acetyl Propionyl | Acetoin |
|-------------------|----------|------------------|---------|
| Cream and Cookies | N/D | N/D | N/D |

Table 1: Target compound levels. Concentration units are ppm or N/D, not detected.

Background of the Matter

Diacetyl (2,3-butanedione, CAS 431-03-8) is a volatile liquid with intense buttery flavor occurring naturally in dairy and fermented foods. It is extensively used as a flavoring agent to impart a buttery flavor.

Acetoin (3-Hydroxy-2-butanone, CAS 513-86-0), Acetylpropionyl (2,3-Pentadione, CAS 600-14-6) are related compounds with somewhat similar custard flavor also

used as flavoring agents.

These compounds find use in flavoring compositions designed to impart certain flavors to foodstuffs. They are also common products of fermentation and present in beers, wines and dairy products albeit in low (typically tens of ppb, diketons; several tens ppm, acetaldehyde) levels. When inhaled, these compounds are believed to have deleterious effect on lung function and cause a serious lung disease. Thus it is imperative to have information on levels of these compounds in flavoring compositions designed to be inhaled.

Samples

Sample arrived as clear liquids of varying viscosity and color. 5 ml of submitted material was placed in 40 ml headspace collection vial followed by addition of internal standards (IS). Volatile compounds were collected out of headspace with the aid of 0.5 ml gastight syringe. 0.2 ml of collected headspace was injected at split ratio of 5.

Experimental:

1. GC conditions:

| | |
|---------------------------|----------|
| Injector temperature: | 250 C |
| Initial oven temperature: | 40 C |
| Ramp I | 15 C/min |
| Final temperature I | 200 C |
| Hold II | 3 min |
2. MS parameters

| | |
|-----------------------------|-------------|
| Ionization and ion polarity | EI+ |
| Scan rate | 2 scans/sec |
| Mass range | 35-300 Da |
| Ion source temperature | 180 |
| Transfer line temperature | 220C |
3. GC-MS analysis. Waters/Micromass Quatro GC mass spectrometer interfaced to a Thermo Electron Trace gas chromatograph was utilized for the analysis. 30M 0.32 mm ID DB-624 column was used to separate components. Carrier gas was helium at 2 ml/min.
4. Data treatment.

Isotopically labeled diacetyl (d6), acetylpropionyl (d5) were used as internal standards. Table 1 lists qualifier and quantifier ions for the target compounds. Displayed in Appendix I is the pertinent GC-MS chromatogram.

| RT, min | Compound | Qualifier, m/z | Quantifier, m/z |
|----------------|-----------------|-----------------------|------------------------|
| 3.4 | Diacetyl | 43 | 86 |
| 4.8 | Acetylpropionyl | 43 | 100 |
| 5.5 | Acetoin | 45 | 88 |

Table 2 Retention times and m/z ratios of the target compounds

APPENDIX I

Sample "Cream and Cookie", GC-MS trace

Cream and Cookies
021517_CreamAndCookies

18-Feb-2017 11:49:36
Scan E1+
TIC
1.12e9

