BREATH Analysis

Analyzing Volatiles in Human Breath

Chemicals in the blood will equilibrate with inhaled air in a similar fashion to that of O2 and CO2. Concentrations in breath can be correlated to blood concentrations, making breath analysis an ideal means for simple screening applications. The non-invasive sampling process (see Page 30) makes breath collection inherently safe and easy allowing field collection of samples can be performed by non-clinical personnel. The following uses for breath analysis have been demonstrated:

- Analysis of exogenous chemicals to determine extent of exposure in occupational monitoring
- Analysis of endogenous products of metabolism to screen for various diseases
- Analysis of volatile drugs of abuse or their metabolic breakdown products

Exposure Monitoring

Breath samples were collected before and after exposure to 0.05 to 0.20 PPM level compounds during an 8 hour work day. Compounds were clearly visible in the breath after the 8 hour shift. Other compounds present are derived from both exogenous and endogenous sources. Exposure levels were 10 to 100 times below current OSHA PEL's for each compound. Higher concentration exposures may produce levels that can be monitored for several days after exposure. This technique does not require "any" prior planning, making it ideal for unexpected exposure episodes (emergency response). It also does not assume exposure through inhalation, treating respirative and dermal exposure equally. Monitoring of more unique compounds may have forensic applications, such as in the detection of volatiles found in illegal drug manufacturing laboratories.

Monitoring Metabolic Breakdown Products for Clinical Diagnosis

Analysis of volatile chemicals in breath can be a powerful tool for clinical diagnosis. The relative concentration of "chemical markers" in breath can be used to diagnose several diseases in their earliest and most treatable stages. Many tests are also currently performed using isotopically labeled (13C) fats or carbohydrates to determine whether the expected concentration of the isotopes show up in metabolites, including CO2. Some of the markers and their corresponding disease or conditions are as follows:

High Acetone - Indicates poorly regulated glucose levels caused by uncontrolled diabetes.

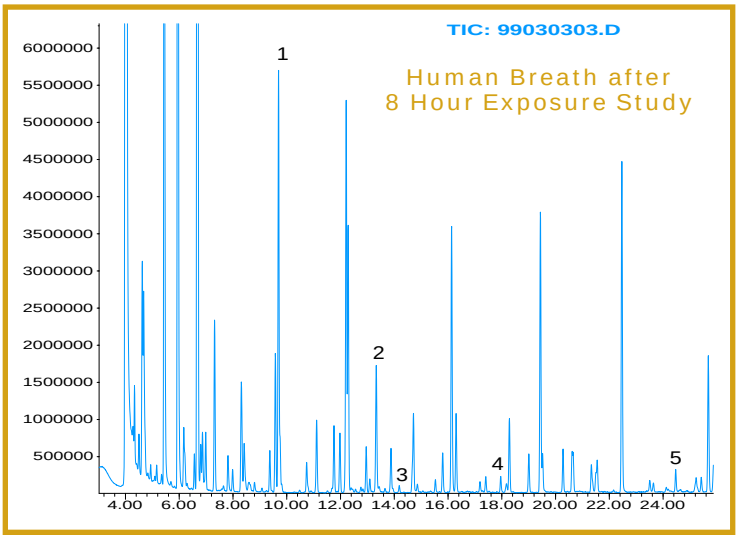
High Pentane - Increased oxygen free-radicals in damaged cells. Elevated in patients with acute myocardial infarction, arthritis or multiple sclerosis. Also elevated in schizophrenic patients.

Acetone, MEK, n-propanol, tolualdehyde and oxepanone - Elevated in patients with lung cancer.

High Ethane - May indicate deficiency in vitamin E or trace metals such as selenium and copper.

$C^{13}O2$ - Produced after ingesting 13C labeled urea when peptic ulcer causing *Helicobacter* bacteria are present.

- Low production after 13C labeled trigliceride ingestion indicates pancreatic disorders.
- Low production after labeled galactose injection indicates liver damage (cirrhosis, hepatitis).



Inlet: 7100A/7032A
System Configurations: A, B, C, D (Pg. 57)
Sample Collection: 0.4L MiniCan (29-MC400L)
Sample Volume: 100cc
Matrix Management: MP&T
Column: HP1, 60m, 0.32mm ID, 1um film
Carrier: He, 1.5 ccm constant flow
Oven Temp: 35°C 5 min, 6°C/min to 150°C
15°C/min to 220°C, 4min hold
GCMS: Agilent 6890/5973N
MS Operation: 33-270 amu, 3.1Hz, EI,
EM=0 Rel.
Tune: BFB
Compounds:

1. Hexane
2. 1,4-Dioxane
3. Methyl Methacrylate
4. n–Butyl Acetate
5. 1,3,5-Trimethyl Benzene