Breath Acetone as Assessment of Ketoacidotic Status

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Increased concentrations of acetone are generated under metabolic stress of diabetes, exercise, dieting, and bulimia. Acetone is found in the blood and can partition into the lungs where it is exhaled on the breath. Because of Henry's law, the breath concentration is directly correlated with the acetone blood levels. For example, commercial diabetes home testing relies on the blood glucose levels. But, in the hospital and for gestational diabetes, it is the ketone body 3-hydroxybutyrate that is measured in the blood. Acetone, 3-hydroxybutyrate, and acetoacetate are in direct equilibrium and are reaction byproducts. Of the three ketone bodies, acetone is the only one able to partition into the breath. Measure of acetone is a good means to monitor diabetic disregulation.

Toward a portable breath sensor for acetone monitoring, a series of experiments are performed to measure acetone concentration. Here, measurements are done in electrolyte. The adsorption of acetone to a platinum electrode is studied by cyclic voltammetry and square wave voltammetry in 0.5 M sulfuric acid. The adsorption of sulfuric acid to platinum produces the characteristic voltammetric butterfly region. In the presence of acetone, the first hydrogen reduction peak decreases, while the second peak increases due to the reduction of acetone. With varying acetone concentrations, shifts in peak potentials are also observed and are used to generate a calibration plot. Voltammetric responses of 1.0 mM to 1.0 µM acetone are examined. These concentrations fall within the range of acetone concentrations found in the blood, as shown in Table 1.

	Normal Subject	Treated Diabetic	Ketoacidotic Diabetic	*Treat. Diabetic / Normal Subj.*	*Ketoacid. Diabetic / Treat. Diabetic*
Acetone (Me_2O)	0.015 ± 0.005	1.69 ± 0.78	3.26 ± 0.79	110	1.9
Acetoacetate (AcAc)	0.114 ± 0.029	0.306 ± 0.05	2.84 ± 0.40	2.68	9.3
3-Hydroxy-butyrate (3HB)	0.160 ± 0.050	0.810 ± 0.171	8.23 ± 1.48	5.1	10.
pH			7.29 ± 0.01		

Table 1. Plasma Concentrations of Ketone Bodies in Plasma (mM) [1]

Data are shown for differences in peak potential between acetone and blank solutions. From the data, different concentrations of acetone are easily determined.

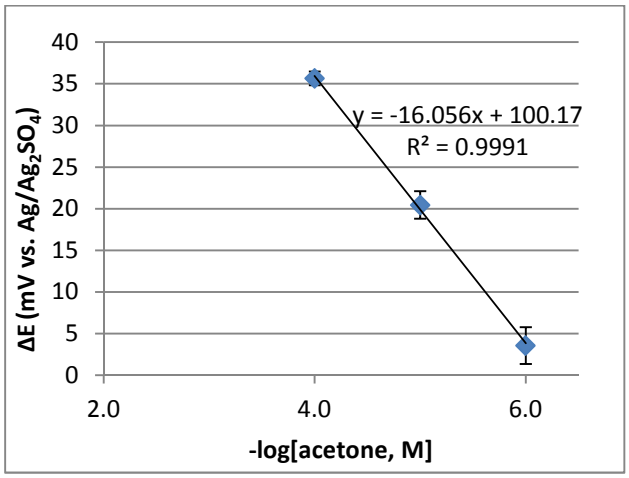

Fig. 1 Peak potential difference vs. –log[acetone, M]

In this presentation, further results from measurements on gas phase samples will be reported, and the method of analysis assessed.

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[1] Perry N. Motsegood, Ph.D. dissertation, University of Iowa, 2012.