QUINTRON

Application Note #3

Long-Term Storage of Wet and Dry Patient Breath Samples in QuinTron Sample Holding Bags

Abstract

If long-term storage is needed, QuinTron recommends storing dried patient breath samples in sample holding bags (QT00842-P). Samples stored in 'wet' holding bags show an increase in hydrogen concentration over time compared to 'dry' samples.

Introduction

When bacteria digest (or ferment) food substances, they produce acids, water and gases. The major gases produced by bacteria include, primarily, hydrogen (H_2), methane (CH_4), carbon dioxide (CO_2) and small concentrations of aromatic gases.[1] These gases are absorbed into the blood circulating near the site of digestion and are carried to lungs, where they are equilibrated with the air in the alveoli. When a patient exhales, gases contained in alveolar air can be captured and measured.

QuinTron manufactures instruments and accessories which are designed to capture and analyze the contents of a patient's breath sample. Specifically, our instrumentation measures concentrations of breath hydrogen (H_2) and methane (CH_4) in parts per million (ppm) and the percentage of exhaled carbon dioxide (CO_2). In the GaSampler collection system, patients exhale into a collection bag (QT00844-P, QT00834-P, QT00841-P, or QT00830-P) which holds the alveolar air sample until it is ready to be analyzed. Samples in the collection bags must be analyzed within a matter of hours. If this is not possible, the sample should be transferred to a sample holding bag.

QuinTron sample holding bags (QT00842-P) are made of a proprietary aluminum foil-laminate. Hydrogen, being the smallest element, can easily diffuse through many materials; one exception to this being metal foils due to their low permeability rating. However, this means water vapor is also trapped inside the bag with the other sampled gases. It is known that bacterial growth is exacerbated by the presence of water vapor. Since hydrogen and possibly methane are contained in the sample holding bag while being exposed to water vapor for a long period of time (up to two weeks or longer), a study was undertaken to determine if the water vapor had any effect on the concentrations of H_2 and CH_4. Previous studies demonstrated that the holding bags can adequately hold a sample for a prolonged period of time without significant losses in H_2, CH_4 and CO_2 concentration (QuinTron Application Notes #1 & 2).

Materials/Method

Sixteen alveolar air samples were collected in a 750mL sample collection bag (QT00841-P) using the GaSampler collection system from random volunteers attending a trade show. Volunteers for this study were not required to fast and did not ingest a sugar or substrate. Each sample was divided into two holding bags; one where the sample was dried by passing it through a sample drying tube into the holding bag (dry sample), and the other was transferred into the holding bag (wet sample) without the use of the sample drying tube. The samples were then shipped back to QuinTron for analysis.

NOTE: The sample drying tube (QT01135-K) contains 10/20 mesh indicating Drierite desiccating material. Indicating Drierite is made up of anhydrous calcium sulfate and cobalt chloride and is used to remove water vapor from the sample while preserving the H_2, CH_4 and CO_2 concentrations. Fresh Drierite in the sample drying tube must be conditioned with at least 60 mL of QuinGas before the sample is injected through it to make sure it does not absorb CO_2.

The H_2, CH_4 and CO_2 concentrations of each sample were measured on a BreathTracker SC twice. The samples were measured on the day they were received and again 14 days later. Two weeks is the maximum recommended holding time that patient breath samples should be stored in sample holding bags.

Results

Tables 1 and 2 show the initial measured concentrations of the Uncorrected H_2 and CH_4 values (Table 1) and Corrected H_2 and CH_4 values (Table 2). The left side of Table 1 shows the range of H_2 values (uncorrected for CO_2) for ‘dry’ samples (Column 1) and ‘wet’ samples (Column 2). The right side shows the range of CH_4 values for ‘dry’ and ‘wet’ samples. In addition, the average values of ‘dry’ and ‘wet’ samples are also shown in the second row of this table. In the third row, the ‘dry’ samples are compared to the ‘wet’ samples for both H_2 (left) and CH_4 (right).

Table 1: Initial Uncorrected H_2 and CH_4 Concentrations

H_2 (ppm)		Measured 10/20/2008	CH_4 (ppm)	
Dry	Wet		Dry	Wet
0-26	0-29	**Range**	0-34	0-34
8.69	12.75	**Average**	3.94	3.88
	+4.06	**Dry vs. Wet**		-0.06

Table 2 shows the same parameters for H_2 and CH_4 as Table 1 but corrected for dilutions using the CO_2 concentration (see the BreathTracker SC manual for an explanation of the CO_2 Correction Factor).

Table 2: Initial Corrected H_2 and CH_4 Concentrations

H_2 (ppm)		Measured 10/20/2008	CH_4 (ppm)	
Dry	Wet		Dry	Wet
0-43	0-47	**Range**	0-50	0-49
13.75	20.94	**Average**	6.06	5.94
	+7.19	**Dry vs. Wet**		-0.12

The initial measurements show that there is already a discrepancy between the dry and wet H_2 samples. When comparing the average H_2 values, the wet samples are 4.06ppm (uncorrected data) and 7.19ppm (corrected data) higher than the dry samples. This discrepancy in the H_2 baseline values could be due to the fact that the samples had to be shipped back to QuinTron for analysis and therefore, a few days passed between the sample being taken and it being analyzed.

There is no discernable difference between initial measured concentrations of either the uncorrected or corrected wet and dry CH_4 samples.

Tables 3 and 4 show the same parameters (range and average values) for H_2 and CH_4 two weeks after the initial concentrations were measured.

Table 3: Uncorrected H_2 and CH_4 Concentrations Measured After 14 Days

H_2 (ppm)		Measured 11/03/2008	CH_4 (ppm)	
Dry	**Wet**		**Dry**	**Wet**
3-22	8-30	**Range**	0-34	0-35
8.81	15.69	**Average**	4.00	3.88
	+6.88	**Dry vs. Wet**		-0.12

Table 4: Corrected H_2 and CH_4 Concentrations Measured After 14 Days

H_2 (ppm)		Measured 11/03/2008	CH_4 (ppm)	
Dry	**Wet**		**Dry**	**Wet**
4-39	14-50	**Range**	0-51	0-51
15.25	27	**Average**	6.38	6.125
	+11.75	**Dry vs. Wet**		-0.26

Once again, there is no discernable difference between either the uncorrected or corrected wet and dry CH_4 samples measured two weeks after the initial samples were tested.

Comparing the average H_2 values, the wet samples are 6.88ppm (uncorrected data) and 11.75ppm (corrected data) higher than the dry samples. This is an increase of 2.82ppm and 4.56ppm respectively when compared to the initial measured concentrations as seen in Tables 5 and 6. Tables 5 and 6 also show a comparison of the average values for ‘dry’ and ‘wet’ samples for uncorrected and corrected data

Table 5: Comparison of Uncorrected Values

H_2 (ppm)			CH_4 (ppm)	
Dry	**Wet**		**Dry**	**Wet**
	+2.82	**Dry vs. Wet Values Compared to Table 1**		-0.06
+0.12	+2.94	**Average Values Compared to Table 1**	+0.06	0.00

Table 6: Comparison of Corrected Values

H_2 (ppm)			CH_4 (ppm)	
Dry	**Wet**		**Dry**	**Wet**
	+4.56	**Dry vs. Wet Values Compared to Table 2**		-0.14
+1.5	+6.06	**Average Values Compared to Table 2**	+0.32	+0.19

While the exact mechanism responsible for the increase in H_2 in the 'wet' samples is unknown, it is clear that the 'dry' samples average value has increased 0.12ppm (uncorrected) or 1.5ppm (corrected) while the 'wet' samples have increased 2.94ppm (uncorrected) or 6.06 (corrected). The concentration of CO_2 was measured each time to confirm the validity of each sample. The average CO_2 concentration slightly decreased (less than 0.3% for both wet and dry samples) over time.

Conclusion

Drying the sample appears to slow the effect of water vapor on the hydrogen concentration. After the two week measurement, it was observed that the increase of hydrogen in the 'wet' samples was four times greater when compared to the 'dry' samples (corrected data). QuinTron recommends using a sample drying tube to dry a patient's breath sample if it has to be stored in a holding bag.

For further information on the history and science of breath-testing, sample protocols and collection techniques please reference Breath-Tests & Gastroenterology, 1998 edition, written by Lyle Hamilton Ph.D. or request information from QuinTron directly.

References

1. Bond, J.H., Levitt, M.D. Quantitative measurement of lactose absorption. Gastroenterol. 1976; 70(6):1058-62