Instrument Comparison between Bran & Leube Auto Analyzer and the Turner Designs Trilogy with Nitrate/Nitrite Module

Background

Concentrations of nitrate in 5 standards, which were processed using Strickland and Parsons (1968) cadmium column reduction method for analysis of reactive nitrate in water, were estimated with a Turner Designs' Trilogy Nitrate/Nitrite Module (P/N: 7200- 074) and a Bran & Leube Auto Analyzer. Instrument estimates were compared in an effort to show that Trilogy is able to estimate nitrate concentrations as accurately as an Auto Analyzer, which is used in most nutrient specific laboratories.

Comparison Data from SFSU Romberg Tiburon Labs (Cadmium Column Reduction Method)

Five standard nitrate concentrations (2, 5, 10, 20, and 40 uM) were prepared from nitrate stock standard by Al Marchi at Romberg Tiburon Labs. The standards were processed by a Bran & Leube Auto Analyzer following an automated method based on the Strickland and Parsons (1968) method for determining reactive nitrate in water, which involves the use of a copper cadmium reduction column. Processed standards resulted in reddish-purple colored solutions. The color of the solutions is directly proportional to the nitrate concentration in the standards. The Absorbance of the solution was measured using two instruments, 1) the Bran & Leube Auto Analyzer and 2) the Turner Designs' Trilogy with Nitrate/Nitrite Module. Standard concentrations per absorbance value for each standard used in the analysis was plotted per instrument. Thus two standard curves were created, a Trilogy standard curve and an Auto Analyzer standard curve. Each curve was regressed using Microsoft Excel and the regression equation from each curve was used to calculate curve-based nitrate estimates per instrument. The curve calculated nitrate estimates for each instrument were compared (Figure 1).
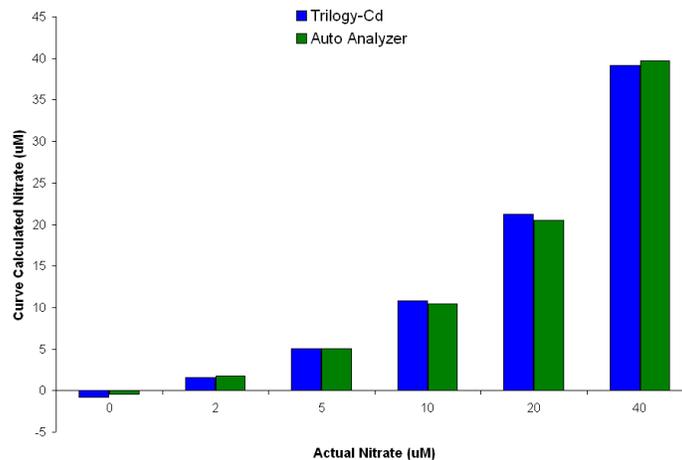

Figure 1: Trilogy (Blue) and Bran & Leube Auto Analyzer (Green) curve calculated estimates from cadmium column reduction method were compared.

Results

Estimated concentrations of 5uM or greater differed by less than 5% of Auto Analyzer concentrations. Estimated concentrations below 5uM differed by less than 10% of Auto Analyzer concentrations. These differences might be a result of cuvette size (i.e. pathlength), shape, and material. The cuvettes used with the Trilogy Nitrate/Nitrite Module were 10x10mm square plastic (methacrylate), which has different optical properties than the smaller glass or quartz cuvette used by the Auto Analyzer. Using quartz or glass cuvettes may increase the accuracy of estimating low concentrations of nitrate.

Method Comparison between Strickland and Parsons (1968) Cadmium Column Reduction Method and LaMotte Test Kit Method

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Background

Nitrate in 5 standards was processed using LaMotte Test Kit Reagents/Methods and concentrations were estimated using a Turner Designs' Trilogy Nitrate/Nitrite Module. Trilogy's nitrate test kit estimates were compared to Auto Analyzer's nitrate estimates to explore accuracy of the test kit method over a typical range of nitrate concentrations.

Comparison Data using SFSU Romberg Tiburon Lab Standards (LaMotte Test Kit Method)

Split samples were taken from Tiburon prepared standards (2, 5, 10, 20, and 40 uM) and frozen at Turner Designs Laboratory for analysis by LaMotte Nitrate Test Kit Method. LaMotte Reagents for nitrate analysis were purchased from Forestry Suppliers. A month after initial freezing of samples, the split samples were thawed to room temperature and processed using LaMotte Nitrate Reagents following LaMotte Test Kit Method. Solutions were analyzed using the Trilogy Nitrate/Nitrite Absorbance Module (P/N: 7200-074). Concentration per absorbance value was plotted for each standard that were processed and analyzed by the LaMotte Test Kit Method. The regression equation from the regression curve was used to calculate curve-based estimates of nitrate as detected by the test kit method. LaMotte Test Kit Method's curve-based estimates were compared to Auto analyzer curve-based estimates (Figure 2).
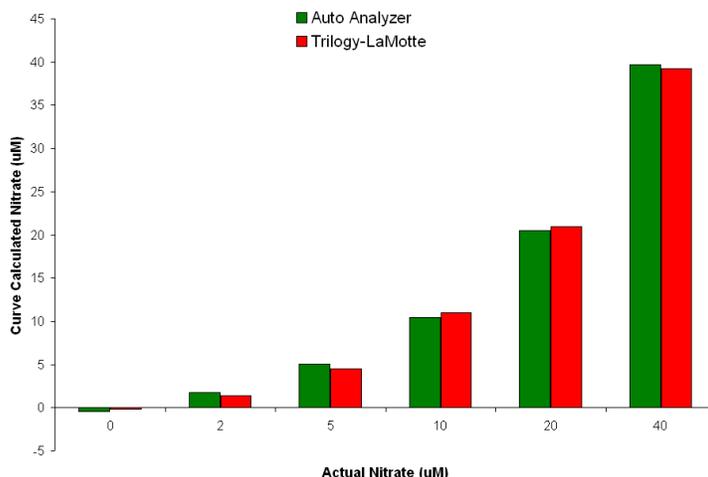

Figure 2: Trilogy calculated concentrations using LaMotte Nitrate Reagents (Red) were compared to Auto Analyzer calculated concentrations (Green).

Results

The cadmium column reduction method is able to detect nitrate concentrations accurately down to 0.5uM. Typically nitrate test kits are used for concentrations greater than 15uM. The LaMotte Test Kit's range is listed as 15uM – 714uM Nitrate/Nitrite. Trilogy's nitrate estimates resulting from LaMotte Test Kit Method were within 2% of the Auto Analyzer estimates that resulted from the cadmium column reduction method, down to 20uM Nitrate, which was expected. However, Trilogy's nitrate estimates down to 5uM were within 10% of Auto Analyzer estimates showing that Trilogy can resolve with greater than 90% accuracy, test kit processed nitrate concentrations down to 5uM. This accuracy may be increased further if glass or quartz cuvettes are used to analyze solutions.

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Summary

The Trilogy can estimate nitrate concentrations from samples that have been processed using Strickland and Parsons (1968) Cadmium Column Reduction Method. Accuracy, precision, and analytical grade materials such as quartz cuvettes and reagents should be utilized if trying to estimate nitrate concentrations near MDL (0.5uM). The upper limit for the cadmium column reduction method is dependent on the ability of the cadmium column to quantitatively reduce nitrate concentrations greater than 40uM, which is the upper limit for the cadmium column reduction method stated by Strickland and Parsons (1968).

The Trilogy can estimate nitrate concentrations for samples that have been processed using LaMotte Test Kit Method. The LaMotte Test Kit Method states an MDL of 0.2ppm (15uM Nitrate) with a detection range of up to 10ppm (714uM). Using the Test Kit Method with the Trilogy's Nitrate/Nitrite Module yields an MDL of 0.04ppm (3uM Nitrate) and a range of up to 14ppm (1000uM). These specifications were determined using varying working standards diluted from stock nitrate standard, which was purchased through from Ricca Chemical Company through Fisher Scientific. All standards were processed using LaMotte Nitrate Test Kit Method.

Trilogy	Using Cadmium Column Reduction Method	Using LaMotte Test Kit Method
MDL	0.5uM (0.007ppm)	3uM (0.04ppm)
Linear Range	0.5–1000uM (0.007-14ppm)	3–1000uM (0.04-14ppm)

Notes:

Calibrating smaller working ranges will increase accuracy and resolution of measurements. A small working range should be used for systems that typically have small variations in nitrate concentrations. If nitrate is highly variable in your system, which spans a large range of concentrations, then the large range should be broken down into smaller working ranges to increase the accuracy of nitrate estimates.

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