

Repeatability of hygiene test systems in measurement of low levels of ATP

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Summary

We have assessed the repeatability of four hygiene test systems (Biotrace Uni-Lite® NG / Clean-Trace®; BioControl Lightning MVP™ / Lightning MVP™ surface sampling device; Neogen AccuPoint™ / AccuPoint™ ATP surface sampler; Charm novaLUM™ / PocketSwab® Plus) with respect to measurement of a low amount (10 fmol) of adenosine 5'-triphosphate (ATP). The Biotrace system was the most repeatable (coefficient of variation [cv] = 7.4%), followed by the BioControl (cv = 38.1%), Charm (cv = 58.7%) and Neogen (cv = 89.4%) systems.

Introduction

Assessment of surface hygiene by measurement of adenosine 5'-triphosphate (ATP) is widespread. Many test systems are available but objective studies of their performance are few. Repeatability and reproducibility are important aspects of their performance. *Repeatability* refers to variation in the measurements attributable to the system (equipment and devices). *Reproducibility* refers to variation in the measurements attributable to the user. Poor repeatability can arise due to many factors, including variability between devices due to manufacturing or storage issues, and inconsistency arising from the instrumentation. As a result, false positives may arise in testing of critical control points, resulting in unnecessary re-cleaning of equipment. False negative results may put product and customers at risk. A high level of repeatability is needed if results are to be put to use in Statistical Process Control, for example in the construction of Run Charts and Control Charts. Here we report on the repeatability of low-level ATP measurements made using four commercially-available ATP hygiene test systems.





Assessment protocol

Four types of luminometers and test devices were obtained *via* different industrial 'Mystery Shoppers'. Test devices from the same manufacturer were from the same batch. Devices were stored at 4 – 8°C and brought to room temperature (controlled at 20°C) for 1 hour before use. Systems were used strictly in accordance with the manufacturers' instructions. Fifty devices of each type were tested with both pure ATP-free water (20 samples each device) and with a 1 nM solution of ATP (30 samples each device). Devices were tested in sequence with the same samples of water and ATP to eliminate any time-dependent effects in the comparison of the systems. Samples (10 µl) were added to the mid section of the swab/sponge bud of each device. Devices were not rotated during the application of the sample. These tests represent near ideal conditions in that variability due to sample pick-up from surfaces and extraction of ATP from live cells are eliminated.

Results

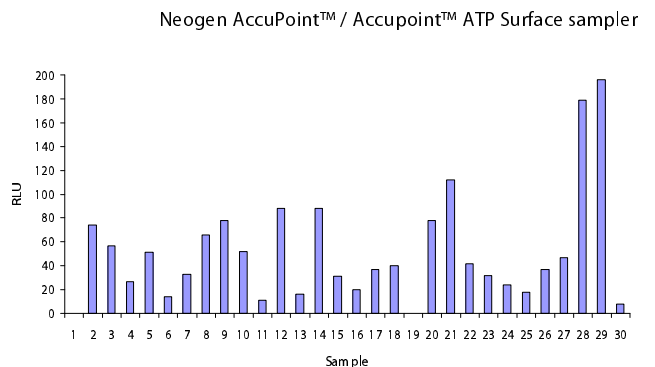
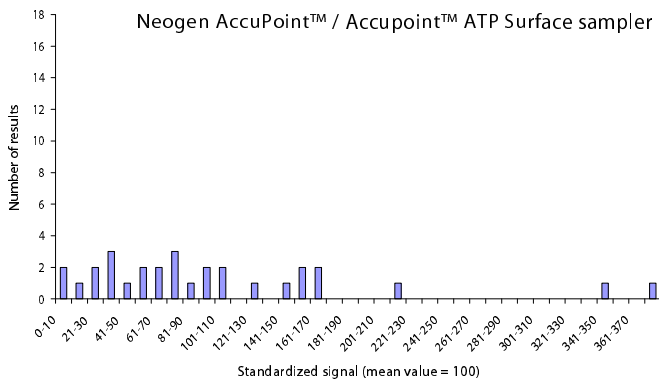
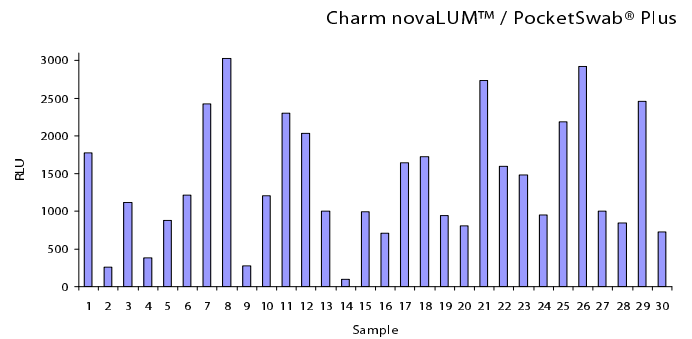
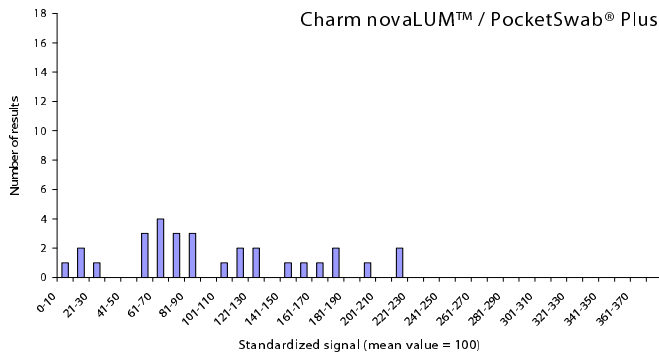
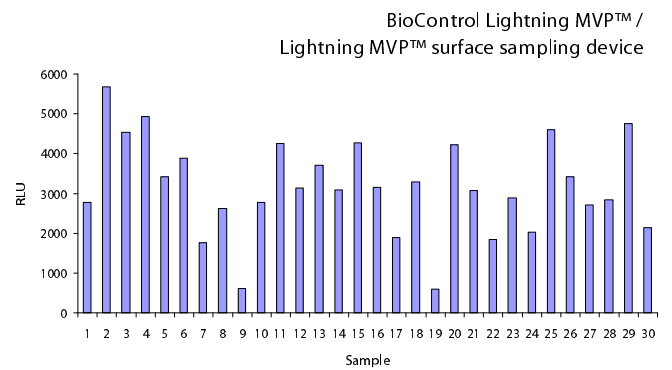
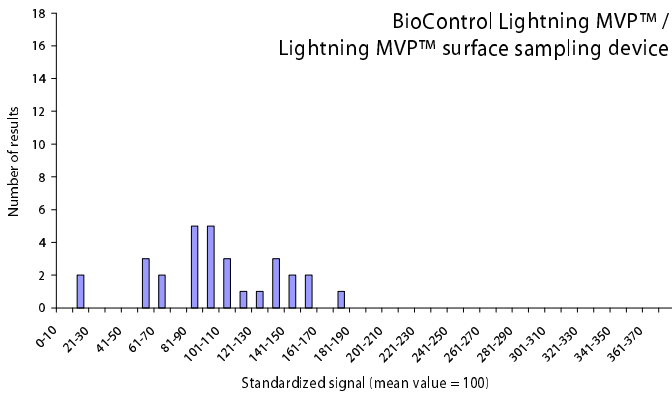
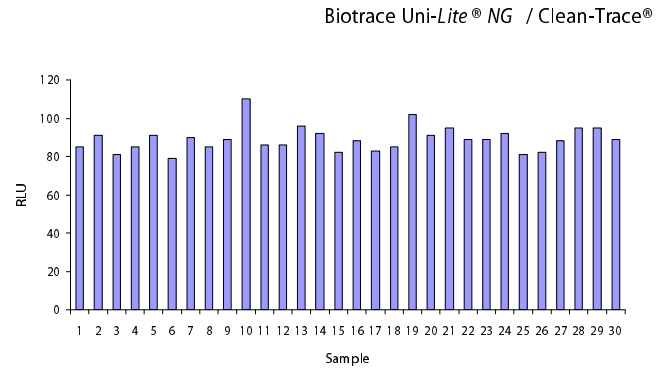
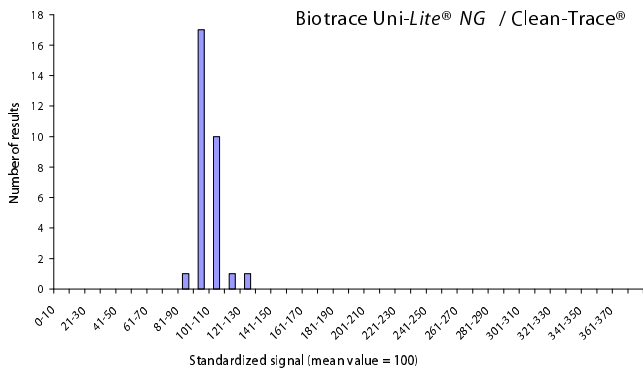
The mean values, together with the coefficients of variation (%), and 95% confidence limits for measurements of 10 fmol of ATP ($n = 30$) are shown in Table 1. The responses differ from system to system since light is measured in 'Relative Light Units' (RLU). As the choice of scale is arbitrary, no advantage is conferred by systems having high or low response values. Figure 1 shows the distribution of the results, presented in the form of frequency histograms and run charts. In the case of the frequency histograms the results were first standardized to provide a common basis for comparison. These results reveal differences in the performance of the different systems. The Biotrace Uni-Lite® NG system, used with Clean-Trace® test devices gave a high degree of repeatability relative to the other systems. In all other cases, results were less repeatable.

Table 1. Repeatability of four hygiene test systems (RLU = Relative Light Unit).

		Measurement of 10 fmol ATP		
		Mean (RLU)	Coefficient of variation (%)	95% confidence interval (RLU)
	Biotrace Uni-Lite® NG / Clean-Trace® - Biotrace International plc, Bridgend UK - www.biotrace.com	89.1	7.4	76.2 – 101.9
	BioControl Lightning MVP™ / Lightning MVP™ surface sampling device - BioControl Systems Inc, Bellevue, USA - www.biocontrolsys.com	3167	38.1	804 – 5529
	Charm novaLUM™ / PocketSwab® Plus - Charm Sciences Inc, Lawrence, USA - www.charm.com	1391	58.7	0 – 2991
	Neogen AccuPoint™ / Accupoint™ ATP Surface samplers - Neogen Corporation, Lansing, USA - www.neogen.com	51.9	89.4	0 – 142.8

♦ Mean results from tests of pure ATP-free water were at least 8-fold lower than those from measurement of 10 fmol ATP in all cases and are not shown.

Figure 1. Frequency histograms and chart of individual results for four hygiene test systems with ATP samples (10 fmol per device). Histograms show distribution of results with respect to standardized results. Bar charts show the spread of individual results in replicate determinations.



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