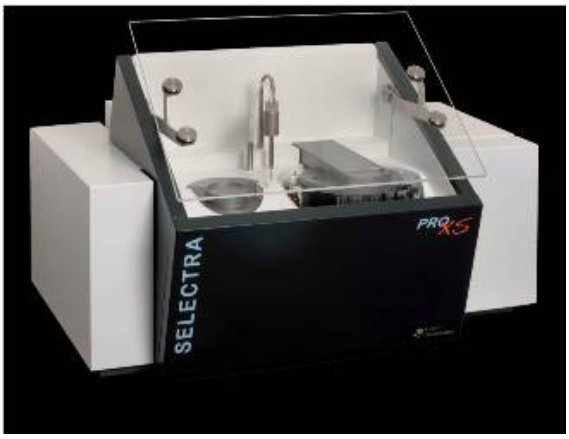
December 2012

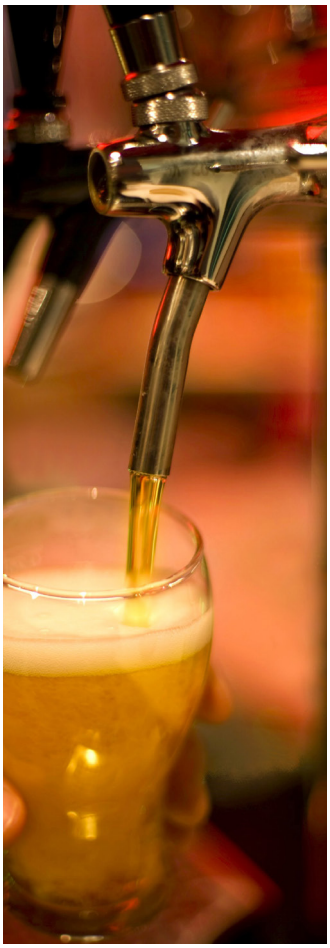
# Instrument Assessment Report

Campden BRI
food and drink innovation

# ELITech UK Ltd

## Assessment of the ELITech Selectra Pro XS Beer Analyser



## Executive Summary

We have trialled the ELITech Selectra Pro XS Analyser to establish whether we believe that it could have the potential for analysing a number of important beer, wine and cider quality parameters.

In our work with the Selectra Pro XS we found that:

- The instrument was easy to use and there was a good level of technical support
- The software package was logical and user friendly.
- Maintenance and cleaning of the system was quick and straightforward
- Compared to traditional methods, the Selectra Pro XS was fast and less reliant on operator skills.

Our assessment of the ability of the Selectra Pro XS to analyse for colour and alcohol content in beers, ciders and wines showed that the test instrument gave comparable results to the reference instruments used in this study. The results suggested that colour measurement using the Selectra Pro XS was more precise than alcohol measurement and both were well within acceptable tolerances for such an instrument.

Accuracy of the Selectra Pro XS Analyser with regard to declared ABV values was comparable to the reference instrument and could potentially be improved further if more developmental work on the methodology is undertaken.

## Background

ELITech UK Ltd are in development of a photometric based system that determines important quality parameters for beer and other alcoholic beverages including colour, alcohol, pH and total sugars. The quick and accurate analysis requires no sample preparation except for prior degassing in the case of carbonated samples.

In this evaluation the ELITech instrument has been tested against another make of spectrophotometer for measurement of colour and against the official gas chromatography method for measurement of alcohol. The results were then compared for accuracy and precision.

## Evaluation

Detailed instructions were provided for the instrument and the training at installation was sufficient for analysts experienced in use of spectrophotometers. The instrument requires only a power supply and a supply of de-ionised (or distilled) water. The setting up is straightforward. The instrument is controlled through a simple on-screen menu and the included software has the capacity to store several methods. Results for colour and alcohol can be obtained with appropriate programming of methods. Once methods have been set the instrument can be started with minimal keystrokes.

Initial calibration and subsequent calibration checks were done with reference materials. The manual provided included details for troubleshooting, though no major problems were encountered during the evaluation. The only maintenance required was the cleaning of the sample and reagent needles and this was easily achieved using the programmable options for cleaning (which also include a full system clean). No build-up of sample components was apparent during the evaluation.

## Sample analysis

Ten samples of a commercially available canned beer were analysed for alcohol and colour using the Selectra Pro XS Analyser. This was then repeated for ten samples of the same brand of commercially available cider and ten samples of the same brand of commercially available wine.

Tables 1-3 summarise the mean and precision data for the analysis of colour and alcohol of the ten samples of beer, wine and cider using the Selectra Pro XS Analyser, together with the declared ABV values for the samples. The precision of the instrument, as expressed in the standard deviations of the ten replicates showed that precision was greatest for colour measurement with the wine analysis showing the least precision. Precision with regards to alcohol was good with the results for cider and wine showing less precision compared to the results for the beer analysis. Accuracy of the instrument with regards to agreement with the declared values of ABV was good for all sample types (the actual ABV must not differ from the declared ABV by more +/-0.5% for beers less than 5.5%, +/-1.0% for beers greater than 5.5%, +/-1.0% for ciders and +/-0.5% for wines). It must be noted that the sample volume measured was not optimal for this evaluation and further investigation into optimising the method may result in better accuracy and precision of the analyses.

**Table 1** Summary of analysis results for 10 samples of a single brand of beer

| Beer | Alcohol ABV (%) | Beer | Colour EBC units |
|---|---|---|---|
| 4 | 3.90 | 2 | 8.28 |
| 4 | 3.90 | 2 | 8.27 |
| 4 | 3.90 | 2 | 8.30 |
| 4 | 3.88 | 2 | 8.27 |
| 4 | 3.91 | 2 | 8.29 |
| 4 | 3.94 | 2 | 8.30 |
| 4 | 3.92 | 2 | 8.20 |
| 4 | 3.90 | 2 | 8.20 |
| 4 | 3.98 | 2 | 8.20 |
| 4 | 4.02 | 2 | 8.33 |
| **Mean** | **3.93** | | **8.26** |
| **SD** | **0.044** | | **0.047** |
| **95% Confidence Interval for Mean** | **3.89, 3.96** | | **8.23, 8.30** |
| **Declared ABV (%)** | **3.8** | | |

**Table 2** Summary of analysis results for 10 samples of a single brand of cider

| Cider | Alcohol ABV (%) | Colour EBC units |
|---|---|---|
| 3 | 4.29 | 7.22 |
| 3 | 4.29 | 7.23 |
| 3 | 4.36 | 7.20 |
| 3 | 4.40 | 7.23 |
| 3 | 4.40 | 7.25 |
| 3 | 4.49 | 7.30 |
| 3 | 4.37 | 7.20 |
| 3 | 4.34 | 7.20 |
| 3 | 4.40 | 7.10 |
| 3 | 4.10 | 7.25 |
| **Mean** | **4.34** | **7.22** |
| **SD** | **0.104** | **0.052** |
| **95% Confidence Interval for Mean** | **4.27, 4.42** | **7.18, 7.25** |
| **Declared ABV (%)** | **4.5** | |

**Table 3** Summary of analysis results for 10 samples of a single brand of wine

| Wine | Alcohol ABV (%) | Colour EBC units |
|---|---|---|
| 2 | 10.00 | 7.50 |
| 2 | 10.05 | 7.48 |
| 2 | 9.96 | 7.40 |
| 2 | 10.03 | 7.42 |
| 2 | 9.91 | 7.45 |
| 2 | 9.93 | 7.30 |
| 2 | 9.95 | 7.40 |
| 2 | 9.97 | 7.50 |
| 2 | 9.63 | 7.60 |
| 2 | 9.84 | 7.47 |
| **Mean** | **9.93** | **7.45** |
| **SD** | **0.120** | **0.080** |
| **95% Confidence Interval for Mean** | **9.84, 10.01** | **7.39, 7.51** |
| **Declared ABV (%)** | **10** | |

To establish robustness over a range of alcohol and colour values, six small pack beer samples, six small pack cider samples and nine wines (three red, three white and three rosé) were analysed in duplicate for colour and alcohol content.

Tables 4-6 summarise the mean and precision data for the duplicate analyses of the beer, cider and wine samples using the Selectra Pro XS and reference instruments, together with the assigned values for the samples used in the tests.

**Table 4** Summary of analysis results for 6 brands of beer

| | | Declared | Elitech | | | Campden BRI | | | |
|---|---|---|---|---|---|---|---|---|---|
| Analysis | Beer | | Mean | Std Dev | SE Mean | Mean | Std Dev | SE Mean | *p-value* |
| Colour | 1 | | 6.16 | 0.042 | 0.030 | 6.84 | 0.085 | 0.060 | ***0.063*** |
| (EBC) | 2 | | 8.29 | 0.021 | 0.015 | 8.88 | 0.106 | 0.075 | ***0.082*** |
| | 3 | | 148.78 | 0.530 | 0.037 | 158.13 | 0.530 | 0.037 | ***0.003*** |
| | 4 | | 25.35 | 0.071 | 0.050 | 26.54 | 0.127 | 0.090 | ***0.055*** |
| | 5 | | 10.48 | 0.113 | 0.080 | 11.48 | 0.071 | 0.050 | ***0.060*** |
| | 6 | | 12.56 | 0.007 | 0.005 | 13.55 | 0.071 | 0.050 | ***0.032*** |
| ABV | 1 | < 0.05 | 0.03 | 0.007 | 0.005 | 0.02 | 0.007 | 0.005 | ***0.293*** |
| (% v/v) | 2 | 2 | 2.03 | 0.000 | 0.000 | 2.01 | 0.015 | 0.009 | ***0.118*** |
| | 3 | 2.8 | 2.99 | 0.000 | 0.000 | 2.93 | 0.021 | 0.012 | ***0.042*** |
| | 4 | 3.8 | 3.90 | 0.042 | 0.030 | 3.92 | 0.006 | 0.003 | ***0.581*** |
| | 5 | 5 | 5.17 | 0.014 | 0.010 | 5.08 | 0.025 | 0.015 | ***0.034*** |
| | 6 | 9 | 9.01 | 0.085 | 0.060 | 8.83 | 0.012 | 0.007 | ***0.210*** |

Accuracy of the instrument with regards to agreement with the declared values of ABV was comparable to that of the reference instrument. The standard deviations of the duplicate samples showed that the precision of the test instrument to both reference instruments was similar, and overall the precision of the Selectra Pro XS proved better than that of the reference instruments and was well within acceptable tolerances for such an instrument. Statistical analysis using the two-sample t-test and the one-way ANOVA test suggested that in the majority of cases and based on current data there is no statistically significant evidence (p-value >0.05) for a difference in both colour and alcohol measurements when using the Selectra Pro XS versus reference instrument. Agreement of colour between the two instruments was better than that of alcohol but optimisation of the methodology should help rectify this.

**Table 5** Summary of analysis results for 6 brands of cider

| | | Declared | Elitech | | | Campden BRI | | | |
|---|---|---|---|---|---|---|---|---|---|
| Analysis | Cider | | Mean | Std Dev | SE Mean | Mean | Std Dev | SE Mean | *p-value* |
| Colour | 1 | | 0.92 | 0.028 | 0.020 | 1.00 | 0.035 | 0.025 | ***0.229*** |
| (EBC) | 2 | | 4.08 | 0.028 | 0.020 | 4.26 | 0.021 | 0.015 | ***0.086*** |
| | 3 | | 7.21 | 0.007 | 0.005 | 7.18 | 0.035 | 0.025 | ***0.448*** |
| | 4 | | 8.60 | 0.283 | 0.200 | 9.31 | 0.035 | 0.025 | ***0.177*** |
| | 5 | | 6.68 | 0.177 | 0.130 | 7.05 | 0.071 | 0.050 | ***0.219*** |
| | 6 | | 8.15 | 0.028 | 0.020 | 8.78 | 0.035 | 0.025 | ***0.033*** |
| ABV | 1 | < 0.05 | 0.00 | 0.000 | 0.000 | 0.06 | 0.007 | 0.005 | ***0.058*** |
| (% v/v) | 2 | 3.5 | 3.42 | 0.057 | 0.040 | 3.60 | 0.035 | 0.020 | ***0.155*** |
| | 3 | 4.5 | 4.35 | 0.014 | 0.010 | 4.59 | 0.000 | 0.000 | ***0.027*** |
| | 4 | 6 | 5.83 | 0.092 | 0.065 | 6.00 | 0.006 | 0.003 | ***0.231*** |
| | 5 | 7.5 | 7.15 | 0.014 | 0.010 | 7.51 | 0.021 | 0.012 | ***0.002*** |
| | 6 | 8.4 | 7.95 | 0.007 | 0.005 | 8.25 | 0.025 | 0.015 | ***0.003*** |

**Table 6** Summary of analysis results for 9 brands of wine

| | | Declared | Elitech | | | Campden BRI | | | |
|---|---|---|---|---|---|---|---|---|---|
| Analysis | Wine* | | Mean | Std Dev | SE Mean | Mean | Std Dev | SE Mean | *p-value* |
| Colour | 1 | | 1.32 | 0.042 | 0.030 | 1.44 | 0.085 | 0.060 | ***0.325*** |
| (EBC) | 2 | | 1.49 | 0.021 | 0.015 | 1.60 | 0.071 | 0.050 | ***0.271*** |
| | 3 | | 1.28 | 0.035 | 0.025 | 1.46 | 0.050 | 0.035 | ***0.142*** |
| | 4 | | 7.45 | 0.071 | 0.050 | 7.17 | 0.092 | 0.065 | ***0.178*** |
| | 5 | | 6.68 | 0.106 | 0.075 | 6.00 | 0.071 | 0.050 | ***0.085*** |
| | 6 | | 17.27 | 0.000 | 0.000 | 15.81 | 0.092 | 0.065 | ***0.028*** |
| | 7 | | 81.69 | 0.262 | 0.190 | 76.63 | 0.530 | 0.370 | ***0.052*** |
| | 8 | | 65.74 | 0.233 | 0.170 | 61.25 | 0.354 | 0.025 | ***0.042*** |
| | 9 | | 123.00 | 0.000 | 0.000 | 111.25 | 0.707 | 0.500 | ***0.027*** |
| ABV | 1 | 8.5 | 8.64 | 0.021 | 0.015 | 8.69 | 0.076 | 0.044 | ***0.337*** |
| (% v/v) | 2 | 10 | 9.94 | 0.028 | 0.020 | 10.03 | 0.046 | 0.026 | ***0.113*** |
| | 3 | 13 | 12.98 | 0.219 | 0.160 | 13.03 | 0.087 | 0.050 | ***0.793*** |
| | 4 | 10 | 10.27 | 0.078 | 0.055 | 10.11 | 0.025 | 0.015 | ***0.228*** |
| | 5 | 11 | 11.09 | 0.099 | 0.070 | 11.15 | 0.035 | 0.020 | ***0.561*** |
| | 6 | 13 | 13.02 | 0.106 | 0.075 | 12.83 | 0.119 | 0.069 | ***0.206*** |
| | 7 | 12 | 12.01 | 0.050 | 0.035 | 12.33 | 0.095 | 0.055 | ***0.038*** |
| | 8 | 13 | 13.25 | 0.007 | 0.005 | 13.23 | 0.029 | 0.017 | ***0.572*** |
| | 9 | 14 | 13.67 | 0.064 | 0.045 | 14.17 | 0.069 | 0.040 | ***0.014*** |

*Wines 1-3 = white, 4-6 = rosé and 7-9 = red

## Summary

The ELITech Selectra Pro XS Beer Analyser has been shown to give comparable performance in the measurement of colour and alcohol to established instruments. Analysis of ten replicates of the same brand of sample showed that the instrument had greatest precision in analysing beer samples but was poorer in analysing wine samples. The results showed that colour measurement using the Selectra Pro XS was more precise than alcohol measurement. Accuracy of the Selectra Pro XS with regards to agreement with the declared ABV was similar to that of the reference instrument. Both accuracy and precision could potentially be improved further by optimising the methodologies. Precision values for both alcohol and colour for beer are well within the tolerances expected for spectrophotometers in the brewing industry and in the majority of samples, the Selectra Pro XS proved more precise than that of both reference instruments. The Selectra Pro XS is straightforward to use and faster than more traditional methods.