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# Assessment of the CDR FoodLab®

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# Assessment of the CDR FoodLab®

## Executive Summary

We have trialled the CDR FoodLab® to establish whether it could meet the requirements for analysing a number of important food quality parameters.

In our work with the CDR FoodLab® we found that:

- The instrument was easy to use
- The user interface was logical and user friendly
- Initial calibration is required for the products matrices being used
- Compared to traditional laboratory methods the CDR FoodLab® methods were much quicker
- A downside is that the user needs to know what range the data is expected to be within

Our assessment of the ability of the CDR FoodLab® to analyse for Anisidine Value, Peroxide Value and Free Fatty Acid content showed that, after calibration, the instrument gave comparable results to the reference methods with very high correlation coefficients suggesting good accuracy of results. Analysis of ten replicates of one sample of olive oil showed very good precision for all three analyses.

## Background

CDR has developed the CDR FoodLab® as a fast, simple and reliable analysis system for determining a variety of parameters in food such as milk, eggs, tomatoes, vegetable puree, cheese, dairy products, edible fats and oils. It can be used for real time quality control when raw materials are purchased and stored as well as during all the production phases.

The CDR FoodLab® produces rapid results in minutes with no sample preparation, using low toxicity reagents in pre-filled cuvettes. The extensive range of tests includes Free Fatty Acid content (acidity), Peroxide Value and pAnisidine Value. The CDR FoodLab® is easy to use via pre-programmed tests selectable from the touch screen. The analyser is supplied pre-calibrated and requires no maintenance.

The instrument was assessed for accuracy and repeatability in a range of fats/oils against more traditional laboratory-based methods used routinely at Campden BRI.

## Evaluation

The CDR FoodLab® is a self-contained unit requiring only a mains power supply. It is straightforward to use and requires no more than one hour of training. The instrument is maintenance-free and no additional equipment is required to analyse samples.

Before turning the instrument on it should be positioned on a flat surface. It takes approximately 15-20 minutes for the sample block to warm up and a further 5 minutes for the solvents to reach the required temperature before analyses can be performed.

For sampling, a positive action pipette is provided and is used to transfer the appropriate aliquot of sample to the test vials. In addition, the pipette is used to mix samples with the reagents in the test vials provided. Once set up no calibration of the instrument is required but a blank containing no sample is used for the Peroxide Value test. Sample size is small at 10 µl so, although a positive action pipette is provided, good pipetting technique is necessary.

The instrument has clear and concise on-screen instructions to guide the user through its operation. Results are obtained via the in-built printer but can also be exported using a USB stick for transfer to a computer. The ability to connect the instrument directly to a computer would be a useful option but transfer by data stick is straightforward. It would also be helpful to have results displayed on the screen but that is a minor point.

An area where a consistent approach is required for accurate and precise results is for the Anisidine Value analysis which is based on signal change over time. Waiting a long time to analyse the samples post-mixing has the potential to introduce errors, although we did not experience any problems.

One potentially important issue is that the user needs to have a reasonably good idea of what range the values are likely to be for the Peroxide Value and Free Fatty Acid content tests. If the results are not within the range expected a reset is required and the samples need to be rerun. Clearly, in most routine applications where the product being tested is well known or experience of typical results is available this will not present a problem but it may be an issue for new products or in shelf life testing, for example.

## Sample analysis

To establish robustness over a range of values ten different fat/oil samples were analysed in triplicate using the CDR FoodLab® and compared to reference methods used routinely in Campden BRI's laboratories. The samples were analysed for:

- Anisidine Value (AV)
- Peroxide Value (PV)
- Free Fatty Acid content (FFA)

The fat/oil samples used (see Tables 1a and 1b) were from commercially available products, aged samples stored at Campden BRI or provided by the client and used as found. Samples were selected to cover as wide a range of AV, PV and FFA results as possible. The repeatability data was performed on an aged sample of olive oil.

Each sample was tested using the CDR FoodLab®, according to the procedures as trained, and via the appropriate laboratory analysis used at Campden BRI.

| Sample name | Description |
|---|---|
| 1 | Sunflower Oil (Fried) |
| 2 | Peanut Oil |
| 3 | Almond Oil |
| 4 | Linseed Oil |
| 5 | Corn Oil |
| 6 | Palm Oil |
| 7 | Coconut Oil |
| 8 | Lard |
| 9 | Tallow |
| 10 | Soybean Oil |

**Table 1a Fats/oils used in PV and AV studies**

| Sample name | Description |
|---|---|
| 11 | Rapeseed oil |
| 12 | Olive oil 1 |
| 13 | Pure corn oil |
| 14 | Olive oil 2 |
| 15 | Toasted Sesame Oil |
| 16 | Goose Fat |
| 17 | Olive oil 3 |
| 18 | Sunflower Oil 1 |
| 19 | Sunflower Oil 2 |
| 20 | Palm Oil |

**Table 1b Fats/oils used in FFA study**

### Anisidine Value

Anisidine Value was determined using the CDR FoodLab® instrument and the Campden BRI laboratory method (Campden BRI Method TES-AC-360).

The Anisidine Value data for the CDR FoodLab® was found to be reasonably consistent across the three replicates even at relatively low values, as demonstrated by small standard deviations. When the data was compared to the Campden BRI laboratory data the correlation, $R^2$, was found to be 0.9942 (see Figure 1) which indicated that the signal from the instrument was proportional to the Anisidine Value in the samples as determined by laboratory analysis. In order to convert the signal to meaningful Anisidine Values the instrument uses a simple equation as shown below:

AnV= **K** x (ABS) + **Q**

The K and Q values are pre-determined within the instrument software but, in this assessment using these samples, the absolute Anisidine Values were found to be inaccurate using the existing values of K and Q. Once calibrated against the laboratory data, and therefore using more appropriate K and Q values, the results from the CDR FoodLab® were found to be very similar to the laboratory data. See Table 2.

| Sample name | CDR FoodLab® data | | | | | Campden BRI reference method data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Replicate 1 | Replicate 2 | Replicate 3 | Mean | St dev | Replicate 1 | Replicate 2 | Replicate 3 | Mean | St dev |
| 1 | 103.4 | 103.9 | 105.9 | 104.4 | 1.30 | 107.50 | 107.73 | 108.33 | 107.85 | 0.43 |
| 2 | 20.1 | 22.6 | 21.3 | 21.3 | 1.23 | 21.55 | 21.36 | 21.53 | 21.48 | 0.11 |
| 3 | 46.2 | 45.3 | 43.9 | 45.2 | 1.15 | 39.26 | 39.01 | 38.87 | 39.05 | 0.20 |
| 4 | 2.1 | 1.7 | 1.9 | 1.9 | 0.16 | 3.19 | 3.17 | 3.15 | 3.17 | 0.02 |
| 5 | 1.2 | 1.6 | 0.9 | 1.2 | 0.33 | 1.95 | 1.99 | 1.98 | 1.97 | 0.02 |
| 6 | 15.2 | 15.0 | 14.2 | 14.8 | 0.53 | 14.71 | 14.79 | 14.66 | 14.72 | 0.06 |
| 7 | <0.5 | <0.5 | <0.5 | <0.5 | 0.00 | 0.40 | 0.39 | 0.39 | 0.39 | 0.00 |
| 8 | 9.8 | 10.4 | 9.3 | 9.8 | 0.58 | 10.24 | 10.20 | 10.24 | 10.23 | 0.02 |
| 9 | <0.5 | <0.5 | <0.5 | <0.5 | 0.00 | 0.76 | 0.77 | 0.78 | 0.77 | 0.01 |
| 10 | 45.3 | 47.9 | 43.6 | 45.6 | 2.15 | 43.79 | 43.55 | 43.51 | 43.62 | 0.15 |

**Table 2 Calibrated triplicate runs for Anisidine Values (AnV)**

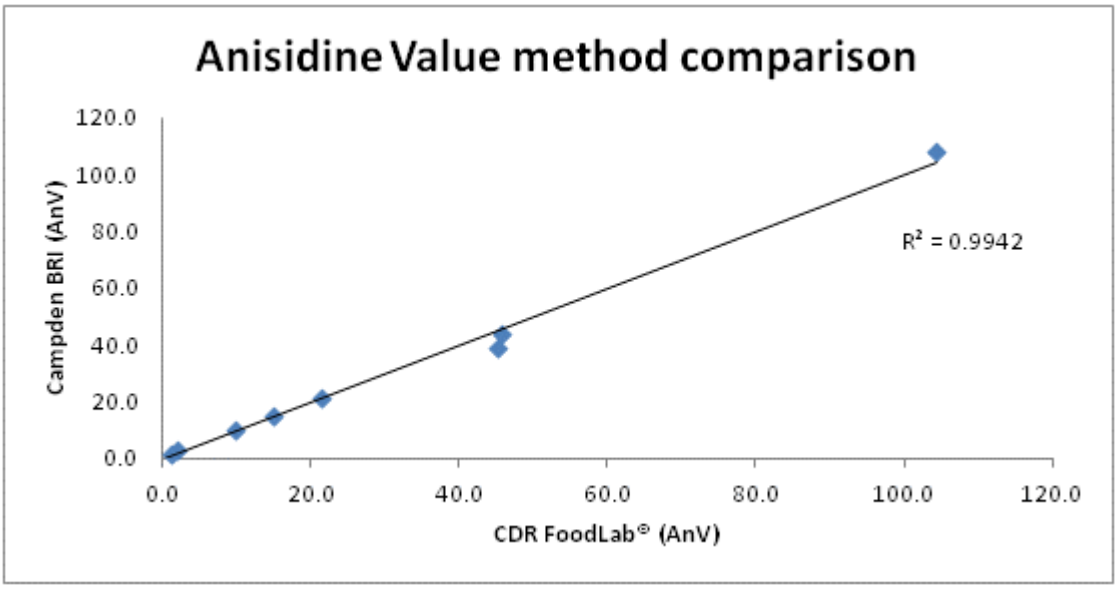


**Figure 1 Correlation between analyses for Anisidine Value (AnV)**

## Peroxide Value

Peroxide Value was determined using the CDR FoodLab® instrument and the UKAS accredited titration method used by Campden BRI (Campden BRI Method TES-AC-511).

The data for Peroxide Value using the CDR FoodLab® was also found to be very consistent with good reproducibility across the triplicate runs. When the data was compared to the Campden BRI laboratory data the correlation, $R^2$, was found to be 0.9681 (see Figure 2) which indicated that the signal from the instrument was proportional to the Peroxide Value in the samples determined by laboratory analysis. In order to convert the signal to meaningful Peroxide Values the instrument uses a simple equation as shown below:

mEq $O_2$/Kg= **K** x (ABS) + **Q**

As with Anisidine Values a calibration was required using the laboratory data to modify K and Q, after which results similar to the laboratory data for Peroxide Value were demonstrated. See Table 3.

| Sample name | CDR FoodLab® data | | | | | Campden BRI reference method data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Replicate 1 | Replicate 2 | Replicate 3 | Mean | St dev | Replicate 1 | Replicate 2 | Replicate 3 | Mean | St dev |
| 1 | 4.75 | 4.54 | 4.73 | 4.67 | 0.12 | 4.1 | 4.2 | 4.2 | 4.16 | 0.05 |
| 2 | 9.58 | 9.67 | 9.64 | 9.63 | 0.05 | 7.9 | 8.5 | 8.1 | 8.15 | 0.30 |
| 3 | 19.82 | 19.83 | 19.84 | 19.83 | 0.01 | 16.0 | 17.1 | 17.2 | 16.76 | 0.69 |
| 4 | 13.68 | 13.79 | 14.43 | 13.97 | 0.41 | 12.8 | 12.8 | 13.1 | 12.87 | 0.17 |
| 5 | 9.96 | 9.92 | 10.17 | 10.02 | 0.13 | 9.1 | 9.3 | 9.4 | 9.27 | 0.15 |
| 6 | 4.05 | 4.18 | 4.12 | 4.12 | 0.07 | 5.4 | 5.6 | 5.4 | 5.46 | 0.12 |
| 7 | 2.16 | 1.95 | 2.07 | 2.06 | 0.11 | 2.0 | 2.0 | 2.1 | 2.03 | 0.09 |
| 8 | 8.19 | 8.06 | 8.21 | 8.15 | 0.08 | 8.8 | 8.7 | 8.9 | 8.77 | 0.10 |
| 9 | 1.57 | 1.58 | 1.46 | 1.54 | 0.07 | 1.8 | 1.8 | 1.8 | 1.81 | 0.04 |
| 10 | 13.7 | 13.62 | 13.72 | 13.68 | 0.05 | 13.5 | 14.4 | 14.4 | 14.10 | 0.55 |

**Table 3 Calibrated triplicate runs for Peroxide Values (mEq $O_2$/Kg)**

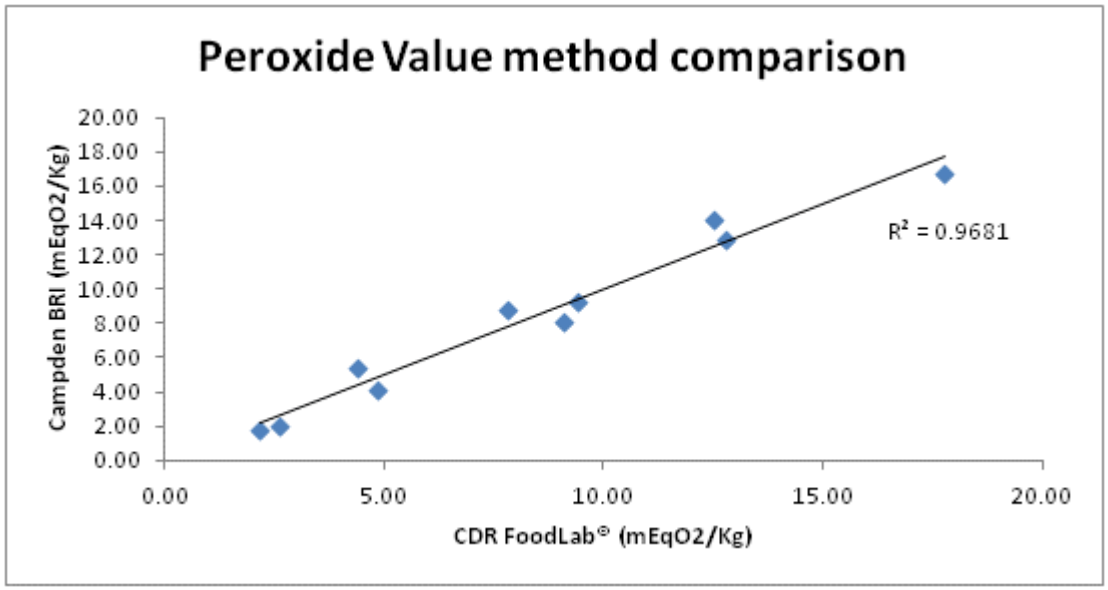


**Figure 2 Correlation between analyses for Peroxide Value**

### Free Fatty Acid Content

Free Fatty Acid content was determined using the CDR FoodLab® instrument and the titration method used by Campden BRI (Campden BRI Method TES-AC-211).

The data for Free Fatty Acids using the CDR FoodLab® was also found to be very consistent with good reproducibility across the triplicate runs. When the data was compared to the Campden BRI laboratory data the correlation, $R^2$,was found to be 0.9834 (see Figure 3) which indicated that the signal from the instrument was proportional to the Free Fatty Acid value in the samples determined by laboratory analysis.

In this case, no additional calibration of the CDR FoodLab® was required with good alignment between the instrument's results and the laboratory results. See Table 4.

| Sample name | CDR FoodLab® data | | | | | Campden BRI reference method data | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Replicate 1 | Replicate 2 | Replicate 3 | Mean | St dev | Replicate 1 | Replicate 2 | Replicate 3 | Mean | St dev |
| 11 | 0.05 | 0.05 | 0.05 | 0.05 | 0.00 | 0.05 | 0.06 | 0.06 | 0.06 | 0.00 |
| 12 | 0.53 | 0.53 | 0.55 | 0.54 | 0.01 | 0.61 | 0.61 | 0.61 | 0.61 | 0.00 |
| 13 | 0.09 | 0.09 | 0.1 | 0.09 | 0.01 | 0.10 | 0.11 | 0.10 | 0.11 | 0.01 |
| 14 | 0.57 | 0.58 | 0.55 | 0.57 | 0.02 | 0.70 | 0.68 | 0.69 | 0.69 | 0.01 |
| 15 | 0.86 | 0.87 | 0.91 | 0.88 | 0.03 | 0.94 | 0.90 | 0.92 | 0.92 | 0.02 |
| 16 | 0.41 | 0.37 | 0.39 | 0.39 | 0.02 | 0.36 | 0.31 | 0.34 | 0.34 | 0.03 |
| 17 | 0.36 | 0.34 | 0.33 | 0.34 | 0.01 | 0.37 | 0.35 | 0.36 | 0.36 | 0.00 |
| 18 | 0.07 | 0.07 | 0.07 | 0.07 | 0.00 | 0.09 | 0.10 | 0.09 | 0.09 | 0.00 |
| 19 | 0.06 | 0.06 | 0.06 | 0.06 | 0.00 | 0.06 | 0.08 | 0.06 | 0.07 | 0.01 |
| 20 | 0.11 | 0.11 | 0.09 | 0.10 | 0.01 | 0.10 | 0.10 | 0.10 | 0.10 | 0.00 |

**Table 4 Triplicate runs for Free Fatty Acid content (% oleic acid)**

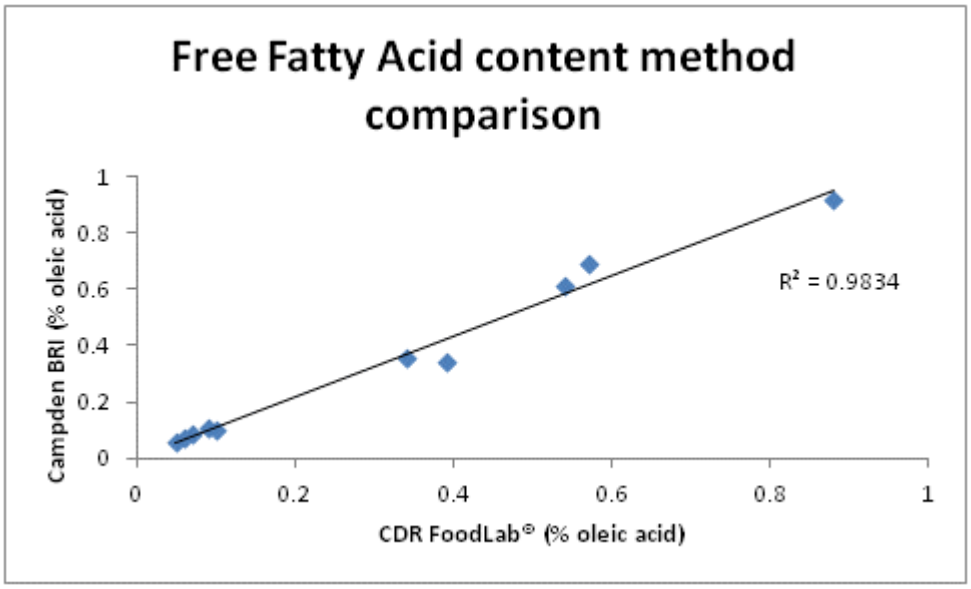


**Figure 3 Correlation between analyses for Free Fatty Acid content (% oleic acid)**

## Repeatability

To assess repeatability of the instrument more thoroughly, a sample of olive oil was tested ten times using the CDR FoodLab® and the relevant Campden BRI reference methods. The data for Anisidine Value, Peroxide Value and Free Fatty Acid content is shown below in Tables 5, 6 and 7.

### Anisidine Value

| | CDR FoodLab® data | Campden BRI reference method data |
|---|---|---|
| **Replicate number** | **Anisidine (AnV)** | **Anisidine (AnV)** |
| 1 | 5.1 | 5.1 |
| 2 | 5.2 | 5.1 |
| 3 | 5.2 | 5.1 |
| 4 | 4.9 | 5.0 |
| 5 | 5.3 | 5.2 |
| 6 | 5.3 | 5.1 |
| 7 | 5 | 5.2 |
| 8 | 5.1 | 5.3 |
| 9 | 5.3 | 5.1 |
| 10 | 5.2 | 5.1 |
| **Mean** | **5.2** | **5.1** |
| **Standard deviation** | **0.13** | **0.07** |

**Table 5 Repeatability for Anisidine Value (using Olive Oil 3)**

**Peroxide Value**

| | CDR FoodLab® data | Campden BRI reference method data |
|---|---|---|
| **Replicate number** | **Peroxides (mEq $O_2$/kg)** | **Peroxides (mEq $O_2$/kg)** |
| 1 | 9.22 | 9.69 |
| 2 | 10.51 | 9.13 |
| 3 | 10.56 | 9.57 |
| 4 | 9.33 | 9.66 |
| 5 | 9.25 | 9.57 |
| 6 | 9.38 | 9.41 |
| 7 | 9.3 | 9.25 |
| 8 | 9.1 | 9.92 |
| 9 | 9.14 | 9.15 |
| 10 | 9.31 | 9.76 |
| **Mean** | **9.51** | **9.51** |
| **Standard deviation** | **0.52** | **0.27** |

**Table 6 Repeatability for Peroxide Value (using Olive Oil 3)**

**Free Fatty Acid content**

| | CDR FoodLab® data | Campden BRI reference method data |
|---|---|---|
| **Replicate number** | **FFA (% oleic acid)** | **FFA (% oleic acid)** |
| 1 | 0.36 | 0.37 |
| 2 | 0.34 | 0.35 |
| 3 | 0.33 | 0.36 |
| 4 | 0.34 | 0.35 |
| 5 | 0.34 | 0.35 |
| 6 | 0.35 | 0.36 |
| 7 | 0.34 | 0.36 |
| 8 | 0.35 | 0.35 |
| 9 | 0.35 | 0.35 |
| 10 | 0.34 | 0.35 |
| **Mean** | **0.34** | **0.36** |
| **Standard deviation** | **0.01** | **0.01** |

**Table 7 Repeatability for Free Fatty Acid content (using Olive Oil 3)**

The repeatability data produced by the CDR FoodLab®, as expressed through the standard deviation of the ten replicates, was good for all three analyses. The data suggests that the CDR FoodLab® had slightly lower precision than the reference methods for AV and PV but well within acceptable limits for an instrument of this type.

**Summary**

Based on the results obtained during this study, the CDR FoodLab® instrument has been shown to provide comparable data for the measurement of Anisidine Value, Peroxide Value and Free Fatty Acid content to traditional laboratory-based methods.

Once the instrument had been calibrated against the laboratory data the accuracy was found to be very good for the oil/fat samples used in the study. In addition, assessment of ten replicate samples demonstrated good precision data for all three analyses.

The CDR FoodLab® instrument is very easy to use with minimal training and provides data faster than traditional laboratory-based methods. Good pipetting technique is required.

We highly recommend that newly purchased instruments are calibrated against either known reference samples or samples analysed using a different methodology across a range of product matrices intended for analysis to determine the most appropriate values of K and Q for the instrument.