

PHOTOPETTE – A Handheld Personal Spectrophotometer for Instant Measurements in Life-Science, Biomedical and Environmental Applications

Introduction

Photometric methods are universally used in life-sciences, environmental surveillance and in the diagnostics, pharmaceutical, chemical and food & beverages industry to measure concentrations in liquid samples. Today, spectrophotometers are bench-top devices of significant bulk and cost with hardwired data connectivity that require a separate computer. Current spectrophotometers using cuvettes have a tedious workflow, need large sample volumes and risk sample contamination.

There is an unmet demand for a low cost, personal photometer that offers the convenience, performance and seamless integration with cloud, web and mobile computing expected from contemporary devices and applications. Tip Biosystems is delivering such a solution by offering its handheld personal photometer, the “Photopette”.

Photopette Handheld Spectrophotometer

The Photopette® is a handheld spectrophotometer weighting only 180 g. The Photopette® has a modular design and can be configured with 1 to 10 wavelengths from the UV to the visible spectrum that gives flexibility to conduct a large proportion of currently relevant tests. The device is controlled by an app and works together with its disposable measurement tip, the “CuveTip®”.



Working with the Photopette® is easy and fast. The workflow is somewhat similar of using a pipette: Pick up the Photopette® device from its stand and connect it wireless (Bluetooth) with the Photopette® app running on a mobile device such as phone/tablet. Select the wavelength or application in the app. Pick up a CuveTip® from the tip box. Insert the CuveTip® into the sample. Press the button on the Photopette®, ready! The measurement value is displayed in the app. This simple workflow is possible due to the clever design of the CuveTip®. The CuveTip® is replacing the classical cuvette. It's a disposable plastic measurement tip with a cavity that is filled with sample when the tip is immersed. The filling is automatic, by capillary action and does not require any active help.

Thanks to the intuitive Photopette® app, working with the Photopette® is straightforward and does not need training.



All smart devices such as iPhones or tables with iOS or Android operation system can be used. The Photopette® app can be downloaded for free from the App Shop or Play Store. With every measurement taken the GPS position, date/time, notes and pictures can be stored and linked to the respective absorbance data. All such data can be easily shared, send as an email or uploaded onto the cloud. The Photopette® is a novel concept of a “personal spectrophotometer” with interesting and unique functionalities such as:

- ✓ **Handheld, mobile and low cost device “personal photometer”**

- ✓ **Disposable measurement tip, CuveTip**
- ✓ **Small sample volumes, ~150 microliter required in reaction tube**
- ✓ **~10 microliter sample consumption**
- ✓ **No transfer of sample**
- ✓ **No cross-contamination**
- ✓ **Ultra-fast measurements (seconds)**
- ✓ **Simple-to-use – no training needed**
- ✓ **Integrated with other handheld devices such as smart phones/tablets**
- ✓ **DNA and RNA concentration and purity**
- ✓ **Protein concentration (Direct & Bradford)**
- ✓ **Enzyme kinetic/assays via NAD/NADH measurements**
- ✓ **Turbidimetry (Turbidity measurements)**
- ✓ **Bacteria/Yeast/Cell concentration**
- ✓ **Simple 2-point calibration function for any assay**
- ✓ **GPS, time, image and notes linked to data**

Due to its modular design, the Photopette® can be easily customized. Tip Biosystems is manufacturing customized devices, the “Photopette® Custom”, for specific applications of our customers. The company also produces OEM solutions.

Applications

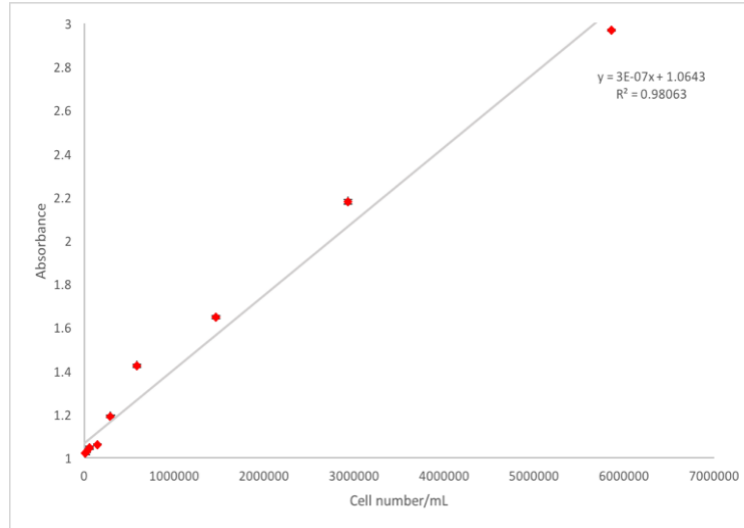
The Photopette® is the ideal instruments for quick measurements at the lab bench, in the cell culture hood or out in the plant or on the field. Two selected applications in the life-sciences are presented in the following.

Direct Cell Counting: Many cell culture experiments require accurate counting of cell number for plating of cells at a given density, for determining the rate of cell proliferation or to determine the best time for cell harvesting. Counts of live cells are routinely performed using either a hemocytometer or Coulter counter. The use of hemocytometers is very tedious and time consuming and Coulter counters require large capital investment.

An alternative method is the indirect measurement of cell numbers by measuring the optical density of cell suspensions. Cells absorb and scatter light. The higher the cell concentration and biomass, the higher the turbidity.

Here we present the use of the Photopette® directly in the cell culture hood to determine cell counts in seconds. Photopette® Bio or Cell at 570 nm was used to

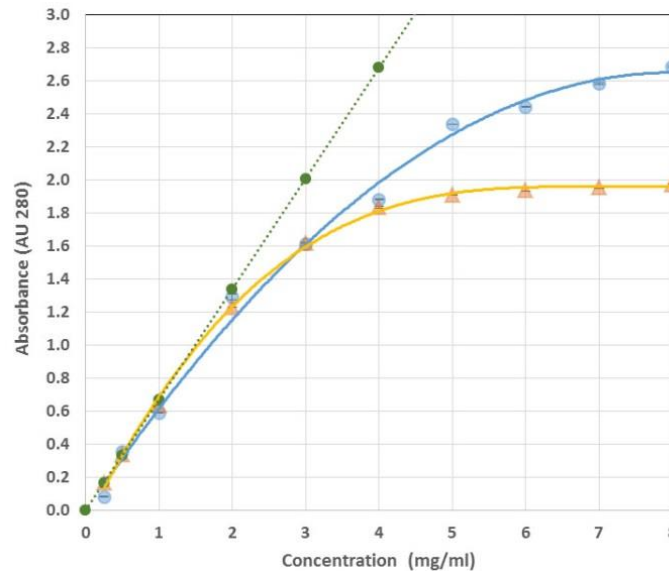
quantify the cell number of HeLa cells in cultures. By using sterile CuveTips®, measurements can be performed directly in the cell culture flask within the hood.



A calibration curve is given above for the HeLa cell count as a function of the absorbance at 570 nm. A dynamic range from 6 thousand to 6 million cells per milliliter was obtained. After calibrating the Photopette once for a given cell type; measurements can be performed within seconds.

Direct Protein A280 method: Proteins are building blocks in all lifeforms. Plants, animals and microorganisms contain proteins in form of enzymes, tissues, hairs, etc. Determination of protein concentration in an aqueous solution is common procedure in life-science, biomedical and pharma research. A purified protein-sample can be analyzed directly and quantified by measuring its optical absorbance at 280 nm (i.e. the "Protein A280 method"). This method does not require additional reagents or sample-prep.

Here we demonstrate the quantitative measurement of protein concentrations by directly measuring the UV absorbance at 280 nm using Photopette® Bio. A standard curve for bovine serum albumin (BSA) absorbance at 280 nm was plotted for Photopette (blue solid line) and a conventional spectrophotometer using a 10 mm cuvette (orange solid line) in the Figure below. In addition, the theoretical BSA absorbance was plotted as a dotted line.



A linear relationship was observed up to 2 mg/ml protein concentration for both instruments. By using the calibration curve for Photopette®, concentrations of up to ~8 mg/ml can be measured without dilution. In comparison, the measurement range of the conventional spectrophotometer was limited to about ~5 mg/ml at where the calibration curve starts to plateau. With Photopette®, the measurements were directly performed at the lab bench or the cold room. This is very handy for example to check the samples from a protein chromatography experiment.

In general, Photopette can perform all measurements or assays than other fixed wavelengths spectrophotometers can perform. More applications are available at the Tip Biosystems webpage (www.tipbiosystems.com) as downloadable application notes.

About Tip Biosystems

Tip Biosystems Pte Ltd was founded 2014 in Singapore by Prof. Dr. Trau to commercialize the Photopette® and CuveTip technology. The company is privately funded and acknowledges support from the SMART Innovation Center and the National University of Singapore (NUS). The company owns exclusive patent rights on its technologies. All products are developed and manufactured in Singapore by a core team of German engineers. Photopette and CuveTip are registered trademarks of Tip Biosystems Pte Ltd, Singapore.