

**Opinion**

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# Portable Digital Camera or Smartphone as Tools for Micrographs Obtention Straight from the Microscope Eyepiece



**Carlos André Espolador Leitão\***

*Universidade Estadual do Sudoeste da Bahia, Brazil*

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**\*Corresponding author:** Carlos André Espolador Leitão, Universidade Estadual do Sudoeste da Bahia, Departamento de Ciências Naturais, Estrada do Bem Querer, Km 04, s/Nº, Bairro Universitário, Vitória da Conquista-BA, Brazil

## Abstract

Micrographs obtention is a crucial step for carrying out scientific work in several knowledge areas that involve the analysis of microscopic structures. Although a photomicroscope is a, relatively, expensive equipment, capturing images straight from the microscope eyepiece with a portable digital camera or a smartphone capable of taking digital photographs is a valuable alternative to mitigate its absence. With proper care and using good equipment, you can obtain quality micrographs that even meet the requirements of scientific journals.

**Keywords:** Alternative techniques; Cytology; Digital micrography; Histology; Microbiology; Microscopy; Plant anatomy; Smartphone

## Introduction

The light microscope is a fundamental laboratory equipment in several knowledge areas such as histology, anatomy, cytology, parasitology, microbiology, mineralogy, etc. When carrying out work in these study fields, micrographs acquisition is essential. For this purpose, a photomicroscope is used, which is consisted of a microscope with an attached photographic camera [1,2]. The photographic cameras from the last century were analog, which used photographic plates or films. The photo acquisition process was slow, expensive, and the photographs result was a surprise, as it was not immediate, requiring a laborious process of developing the photographic film and enlarging it on photographic paper. When it comes to micrographs obtention, this process was even more complicated, as it required a series of prior adjustments on the microscope before capturing the image with a camera. At the end of the last century, digital cameras emerged, which was a major revolution in the photographic world. With its advent, it became possible to see the final results of a photograph before it was developed. Expanding the photos on paper is no longer necessary. This technology was promptly incorporated into microscopes, giving place to trinocular photomicroscopes with an attached digital camera. Thus, a large number of micrographs can now be obtained without the concern of deterioration and the

expense of film development and its enlargement on photographic paper. Even organizing hundreds or thousands of photographs has become much easier.

A good photomicroscope is a, relatively, expensive equipment, being inaccessible to research or teaching laboratories with financial limitations. Currently, in the second decade of the 21<sup>st</sup> century, digital cameras have become extremely popular and increasingly accurate and affordable, including those on smartphone devices. Taking a large volume of photos in different situations is a reality in the contemporary way of life. In this sense, obtaining micrographs with a portable digital photographic camera, including the ones from smartphone devices, through one of the eyepieces of a light microscope, is an intuitive, quickly performed, and widely practiced action by students and teachers. This technology eliminates the dependency of having a trinocular microscope with an appropriate digital camera attached to itself for acquiring digital micrographs. However, some prerequisites are necessary for obtaining quality micrographs using a digital camera or a smartphone straight from the eyepiece of a light microscope.

The microscope must have plan objectives, that is, with a correction to eliminate field curvature.

It is required that the microscope light source has a good illumination to ensure sharp images at a minimum exposure time, as the camera or the smartphone will be held manually. For best results, work in a dark environment. The eyepieces should preferably be with 10x magnification power and with a wide field of view of 18 mm (WF 10X/18). Additionally, the lens component facing the viewer's eyes should be 16 mm in diameter. Lenses with this specification allow an ample field of view and are well suited to the small objective lenses of portable digital cameras or smartphone devices. Thick ocular lenses of large diameter may not allow the needed approximation of a smartphone or a portable digital camera, making it difficult to obtain quality micrographs; The digital camera to be used must be portable, with an objective lens of small diameter. Smartphone handset cameras from nowadays typically have an objective lens of small diameter. The equipment must have a sufficiently high resolution, preferably with at least four Megapixels, and sharp color fidelity.

For micrographs acquisition, it is important to ensure that all lenses are properly cleaned: the light source lens, the condenser lens, objectives, eyepieces, and the portable camera or smartphone objective lens. The micrographs acquisition process consists of:

- a. Focusing the sample under the microscope,
- b. Bringing the portable digital camera or the smartphone objective lens closer to the eyepiece lens, holding it with both hands and ensuring that, during this process, the luminous circle emanating from the eyepiece lens is in the center of the photographic equipment display. The correct distance between the microscope eyepiece and the photographic equipment objective lens is that in which the entire field is illuminated, centered on the display, and without any dark spots. To be firmer, you must

place your hands on the microscope eyepieces while holding the photographic equipment;

- c. Once the photographic equipment is properly positioned, it may be necessary to adjust the focus again on the micrometer knob;
- d. With the image being centered on the display and properly focused, its capture is performed.

### Conclusion

In addition to quality equipment, appropriate skills, and training on the procedures described in this work are also required for obtaining good micrographs. In the case of techniques that result in weaker luminosity, such as fluorescence microscopy, darkfield, or polarization feature, it may become infeasible to obtain satisfactory micrographs due to the impossibility of firmly handling the photographic equipment for a long exposure time to capture the image. However, when it comes to more basic techniques, it is possible to obtain micrographs that perfectly meet the requirements to be published in scientific journals.

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