

Digital camera : myths and realities

Gel documentation system based on a consumer digital cameras have appeared on the market. These cameras were firstly developed for the mass market and were then marketed for the scientific gel documentation market.

They promise a lot : "mega-resolution", "a fraction of the price of most video systems", "simplicity". They deliver few.

■ CAMERA AND OPTICS

- **"The digital camera provide better image resolution than video gel documentation system." FALSE. The quality of the camera sensor array is counterbalanced by a very poor optical system.**

The resolution of a gel documentation system is a mix of its sensor array resolution AND of its optical resolution.

The sensor array resolution is usually given in pixels. The multiplication of the height pixels by the width pixels give the total resolution of the sensor. If the camera is a color camera, the number of pixels has to be divided by 3 in order to be compared with a black and white sensor array resolution.

The optical resolution depends on the zoom magnification. For the same number of pixels, lower the zoom magnification is, coarser is the image.

Kodak Edas 290 system is a color camera with a resolution of 2,1 millions color pixels which

means 700 000 black and white pixels. The optical zoom is 3 x.

♦ The Vilber Lourmat systems have a resolution of 437 600 black and white pixels and an optical zoom 6 x.

♦ The pixel resolution is 1.59 times better for the Kodak system. The optical resolution is 2.00 times better for the Vilber Lourmat systems.

♦ Altogether, Vilber Lourmat systems have a better resolution than the Kodak Edas 290 system.

- **"The digital camera have a better dynamic range than the video gel documentation system." FALSE. Digital camera have same dynamic range than all 8 bits gel doc systems.**

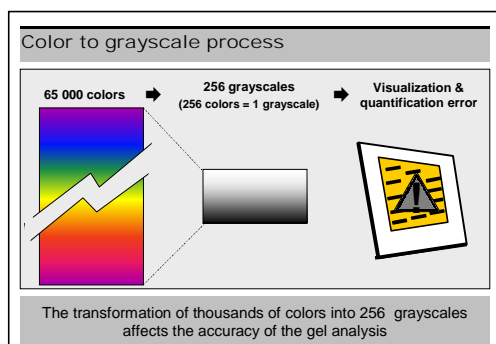
The dynamic range of a gel documentation system is crucial for quantitative accuracy. Gel analysis software requires black and white images as the image analysis is based on the gray levels.



Gel Documentation

The digital camera are 8 bit and therefore their dynamic range reach 256 gray levels which is adequate for gel electrophoresis and common to most of video gel documentation system.

However, the digital cameras are color camera. The image is thus captured in color and is transformed in gray levels. This transformation of thousands of colors into 256 gray levels may affect the accuracy of the analysis.



■ IMAGING PROCESS CONTROL

▪ **“Digital camera are easy to use.” FALSE.** Due to their USB connection and to their lack of real-time readout, digital camera is a nightmare to use and increase the risk of gel damage.

Ease of use is one of the most important issue to considered when purchasing a gel documentation system. To assess the user friendliness of a system, it is important to look at the steps required for taking pictures.

① First of all, the Digital Camera has to be connected to the computer while image acquisition. This connection is assured by an USB connection. The image preview appears on the computer monitor. At this step, it is necessary to position ideally the gel and to

adjust the camera to optimize zoom and exposure. However, the USB port transmit the image at around one frame per second, which is not enough for real time display (25 frames per second). Before to obtain the optimize image, the manipulation can last a long time.

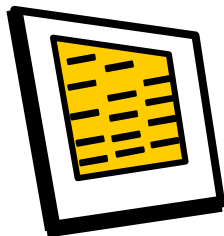
According to Kodak, it takes 4 seconds to get an on screen preview image and 25 seconds to capture and spool an image to the printer. Several image previews are necessary before saving the proper image.

This time consumption under UV exposure can result into gel damage and make digital camera system really unfriendly

② At best image resolution, the uncompressed file format is between 6 to 8.2 MB in TIFF or BIP format. This means that 4 to 6 diskettes would be necessary to save only one image ! This is due to the color sensor array of the camera which record unnecessary pixels.

③ The manipulation of such big amount of data requires state of the art personal computer. If not, it takes a lot of time to open the image, add some text or perform an analysis and save it.

④ Another consideration to consider is traffic management. With Kodak system, the imposing file size make difficult their transfer from one computer to another. Then, the gel documentation and the analysis software are often centralized. In such case, bottleneck can occurs if a user want to perform an image acquisition while another user performs an analysis on the system site.



Gel Documentation

“Digital camera has all the necessary features regarding electrophoresis gel documentation.” FALSE. None of the important features for electrophoresis gels are available with Kodak System.

A good gel photo is a photo which is not saturated, which has a high sensitivity and which cover the largest possible dynamic range.

Then, the gel documentation systems should include the following features:

- ◆ Real time
- ◆ Visualization of the saturation
- ◆ Long exposure time (integration time)
- ◆ Visualization of the obtained dynamic range while taking the picture

None of these features are available with a digital camera. Then, these systems can not ensured the quality of the taken image.

Necessary features regarding gel documentation			
Necessary features		KODAK	VILBER LOURMAT
		⓪ Real time	NO
⓪ Integration time (long exposure time)	YES	YES	
⓪ Saturation visualization	NO	YES	
⓪ Dynamic range visualization while taking the picture	NO	YES	

With a poor sensitivity or a saturated image, analysis will be inaccurate or even impossible. In such case, long PCR and electrophoresis process will result in nothing except waste of time and of precious reagents.

■ SOFTWARE

▪ **“Digital camera software are GLP compliant.” FALSE. Digital camera are absolutely not GLP compliant.**

The principles of Good Laboratory Practice (GLP) define a set of rules and criteria for a quality system concerned with the organizational process and the conditions under which non-clinical health and environmental safety studies are planned, performed, monitored, recorded, archived and reported.

State of the art gel documentation system facilitates the compliance to GLP procedure. This implies :

- the setting of the image is saved in a GLP file at the same time the image is captured. It records the integration time and the dynamic range.
- any modification of the image with the analysis software is recorded accordingly in a GLP file.

All Vilber Lourmat gel documentation systems have a GLP file. None digital camera software has one.

■ PRINTING

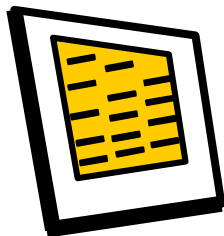
▪ **“Digital camera does not require computer for printing.” FALSE.**

According to Kodak, prints can not be sent directly from a digital camera to a printer. It requires a computer which spools the image file to the printer.

Considering the size of the uncompressed image (6 to 8 megabytes), this can last more than half a minute.

Kodak Digital Camera is recommended for the three following technology :

- Dye sublimation printer with high grayscale sensitivity but very expensive print paper. The print time is around 90 seconds after data transfer.



Gel Documentation

- Laser printer with limited contrast and resolution.
- Inkjet printer with expensive print media.

■ PRICE RANGE

- **“Digital camera is cheaper than a gel documentation system.” FALSE.**

A package including a digital camera; a cabinet; and an acquisition & analysis software, is given at a special promotional price of \$7.540 (valid in the US only).

The transilluminator is quoted \$1.789. The IBM computer is quoted \$1.795.

■ OTHER ISSUES TO BE CONSIDERED IN EVALUATING A DIGITAL CAMERA

▪ Theft

Digital camera are poorly protected against theft. As they can be use by the public as a normal camera, they are very attractive to the theft.

▪ Consumer goods versus scientific equipment

Digital camera were not designed for scientific purpose. They are consumer goods and then inadequate for laboratory use.

▪ Battery

The digital camera is powered with 4 AA alkaline batteries. In order to ensure the good use of the gel documentation system, laboratories have to keep stock of these batteries.

▪ Benchspace

Kodak camera has to be connected to a computer. Consequently, it requires an higher benchspace than standalone system. Also, laboratory have to be sure to prevent the computer from any chemical contamination.

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