Cooling Characteristics of the BioOdyssey™ Calligrapher™ Cooling Module

Theresa Redila-Flores, Cathleen Karlak, and Luis Ugozzoli, Bio-Rad Laboratories, 2000 Alfred Nobel Drive, Hercules, CA 94547 USA

Introduction

The BioOdyssey Calligrapher miniarrayer is a benchtop instrument for creating microarrays on various substrates. This instrument is capable of printing most soluble samples; however, temperature-sensitive molecules, such as proteins, require use of the optional cooling module, which allows cooling of both the source plate region and the platen to 10–15°C. When teamed with the humidity control module (HCM), the cooling module allows printing in a cooled environment while eliminating condensation at the slide surface. Here, we describe the efficiency of the cooling module at the various room temperatures and levels of humidity that may be encountered in laboratories worldwide.

Methods

The BioOdyssey Calligrapher system was used with the optional cooling system, which includes the HCM. For each run, fresh desiccant was placed in the HCM, the chiller was filled with 50% (v/v) ethylene glycol in water, and the temperature was adjusted to 0.0°C. The platen was cleared of all printing material, and two thermocouples were securely taped, one at the area labeled "Slide 1" and the other in the source plate region. Thermocouples were used to measure the actual temperatures of the platen and source plate region. The temperature of each of the thermocouples, the temperature of the chiller, and the humidity levels were recorded every 15 min for 90 min.

Results

To quantitate the cooling efficiency of the BioOdyssey Calligrapher miniarrayer cooling module, the platen, source plate, and chiller temperatures were first monitored at a constant humidity of 40%. When the initial platen temperature was set to 24°C (a typical room temperature), the platen and source plate region were cooled below 15°C within 60 min (Figure 1A); an additional 15–30 min period was required when the initial platen temperature was set to 32°C (Figure 1B).

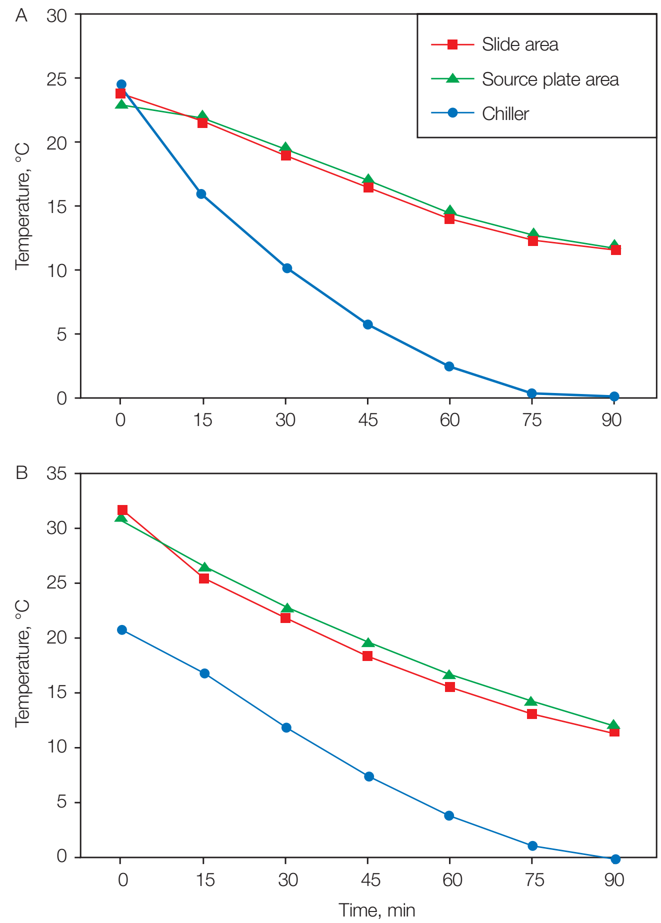

Fig. 1. Time course of slide and source plate temperature reduction. A, reduction from 24°C to 10°C; B, reduction from 32°C to 10°C. Humidity was set to 40%; values shown are averages obtained from three replicate experiments.

Next, we tested whether humidity is a factor in temperature reduction. At an initial temperature of 24°C, we monitored the temperature reduction of the platen, source plate, and chiller at 40, 50, or 60% humidity (Figure 2). At all settings, 60 min was required for adequate cooling, which validates the results shown in Figure 1A and demonstrates that humidity does not appreciably affect temperature reduction.

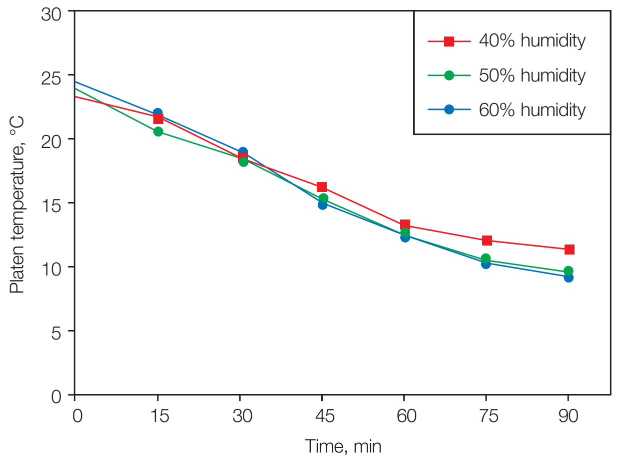

Fig. 2. Time course of slide and source plate temperature reduction at various humidity settings. Initial platen temperature was 24°C, and constant humidity was maintained with the HCM. Values shown are averages obtained from three replicate experiments.

Finally, we examined the correlation between the temperature displayed by the humidity control window in the graphical user interface (GUI) of the BioOdyssey Calligrapher miniarrayer (Figure 3) and the temperature data collected using the thermocouples. These values showed a linear correlation (Figure 4).

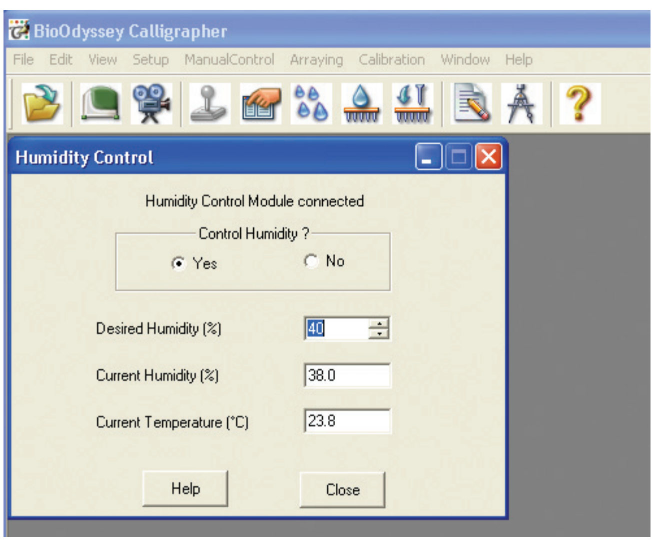

Fig. 3. Humidity control window.

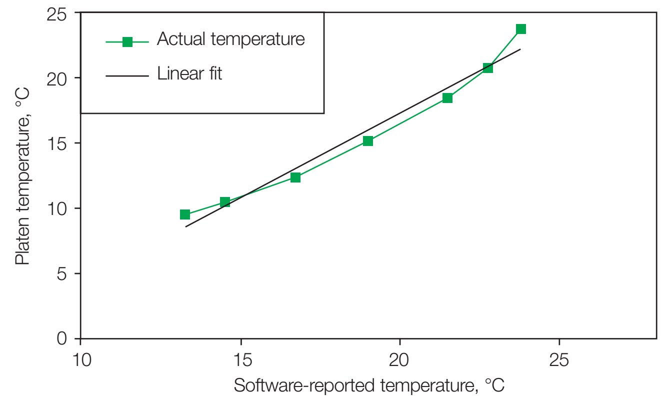

Fig. 4. Correlation between platen temperature as measured by the thermocouples and the chamber temperature as displayed by the GUI. Temperatures were measured at 50% humidity. Values shown are averages obtained from three replicate experiments. The equation of the best-fit line between the points was y = 1.29x – 8.6322, with an R^2 value of 0.972.

Discussion

Many laboratories do not have optimal environmental temperature settings for printing microarrays. To allow effective use of the BioOdyssey Calligrapher miniarrayer's cooling module in different environments, we established a higher ambient temperature to understand the time required to effectively cool the unit. At a typical room temperature (24°C), the platen and the source plate were cooled to 10–15°C within 60 min; at the higher temperature of 32°C, an extra 15–30 min was required. In addition, we demonstrated that humidity plays a minimal role in temperature reduction, and based on our results, we recommend a humidity setting of 50%.

A common problem during cooling in many slide printing systems is the buildup of condensation on the slide surface. Condensation results in poor print runs, because the liquid causes the spots to merge. While performing this study, we monitored the platen for condensation, and, regardless of the humidity settings, none was observed. It is also important to point out that prior to each run fresh desiccant was added to ensure adequate dehumidification of the unit.

The temperature that is shown in the GUI is that of the Calligrapher's chamber, which is not identical to the platen temperature due to the positioning of the internal sensor. We have generated a formula (see Figure 4) that allows a more accurate indication of the actual platen temperature.

This tech note was current as of the date of writing (2005) and not necessarily the date this version (rev A, 2006) was printed.

BIO-RAD

Bio-Rad Laboratories, Inc.

Life Science Group

Web site *www.bio-rad.com* ***USA*** *800 4BIORAD* ***Australia*** *02 9914 2800* ***Austria*** *01 877 89 01* ***Belgium*** *09 385 55 11* ***Brazil*** *55 21 3237 9400* ***Canada*** *905 712 2771* ***China*** *86 21 6426 0808* ***Czech Republic*** *420 241 430 532* ***Denmark*** *44 52 10 00* ***Finland*** *09 804 22 00* ***France*** *01 47 95 69 65* ***Germany*** *089 318 84 0* ***Greece*** *30 210 777 4396* ***Hong Kong*** *852 2789 3300* ***Hungary*** *36 1 455 8800* ***India*** *91 124 4029300/5013478* ***Israel*** *03 963 6050* ***Italy*** *39 02 216091* ***Japan*** *03 5811 6270* ***Korea*** *82 2 3473 4460* ***Mexico*** *55 5200 05 20* ***The Netherlands*** *0318 540666* ***New Zealand*** *64 9415 2280* ***Norway*** *23 38 41 30* ***Poland*** *48 22 331 99 99* ***Portugal*** *351 21 472 7700* ***Russia*** *7 095 721 14 04* ***Singapore*** *65 6415 3188* ***South Africa*** *27 0861 246 723* ***Spain*** *34 91 590 5200* ***Sweden*** *08 555 12700* ***Switzerland*** *061 717 95 55* ***Taiwan*** *886 2 2578 7189/2578 7241* ***United Kingdom*** *020 8328 2000*