

Bioprinting of Corning® Matrigel® Matrix with the Corning Matribot® Bioprinter: Evaluating the Precision of the Temperature-controlled Syringe Pump Printhead

CORNING

Application Note

Introduction

Corning Matrigel matrix is commonly used in 3D cell culture, as it provides structure and signaling cues necessary for 3D and organoid models. In these models, Matrigel matrix is typically either used to coat the bottom of a microplate surface or it is dispensed as droplets to form domes. This latter method, which is commonly used when working with precious samples such as organoids, can be time-consuming and variable between users due to the Matrigel matrix's viscosity and temperature sensitivity.

The Corning Matribot bioprinter is a 3D bioprinter that contains a temperature-controlled printhead, enabling an ideal system for Matrigel matrix dispensing. This syringe-based system can be used to accurately and precisely dispense small volumes of hydrogels with or without cells in a semi-automated throughput. Here we demonstrate the precision and accuracy of the Matribot bioprinter for dispensing Matrigel matrix as 10 μL and 50 μL droplets.

Materials and Methods

Corning Matrigel matrix solution with a protein concentration of 9 mg/mL was dispensed as single droplets into pre-weighed weigh boats using the Corning Matribot bioprinter dispense parameters listed in Table 1. The volume of each dispensed droplet, as represented by mass, was measured by determining the mass difference of the weigh boat before and after Matrigel matrix addition.

Results and Discussion

When programming a target volume of 10 μL droplets of 9 mg/mL Corning Matrigel matrix in the Corning Matribot bioprinter, we were able to dispense 9.63 ± 0.80 mg of Matrigel matrix droplets with a coefficient of variation (CV) of 8.3% and systematic error under 4% (Table 2 and Figure 1).

When programming a target volume of 50 μL droplets of 9 mg/mL Corning Matrigel matrix in the Corning Matribot Bioprinter, we were able to dispense 49.16 ± 1.39 mg of Matrigel matrix droplets with a CV of 2.8% and systematic error under 2% (Table 2 and Figure 2).

Table 1. Conditions for dispensing 10 μL and 50 μL droplets of 9 mg/mL Corning Matrigel matrix solution.

Target volume	10 μL	50 μL
Nozzle type	27G needle, 0.5"	27G needle, 0.5"
Volume loaded in 3 mL syringe	2.5 mL	2.6 mL
Set temperature in printhead	0°C	0°C
Set temperature of printbed	37°C	37°C
Room temperature	23°C	23°C
Volume purged before experiment	200 μL	200 μL
Distance between nozzle and substrate	1 mm	1 mm
Sample size	48	47

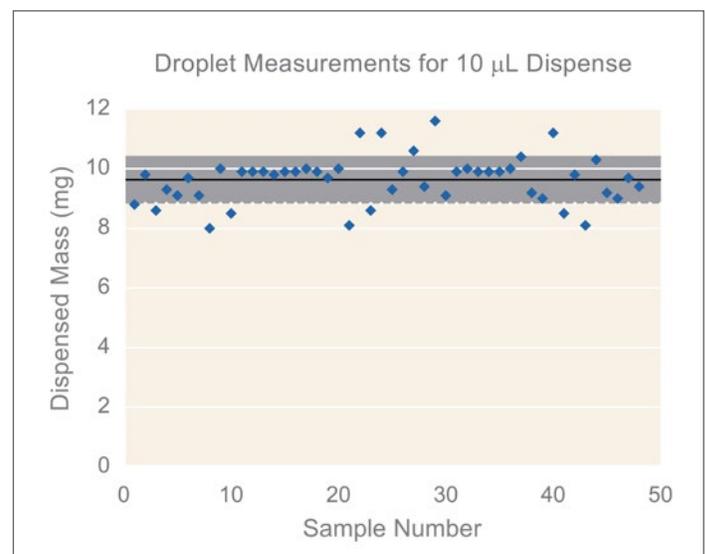


Figure 1. The dispensed droplet volume for 10 μL dispensing of 9 mg/mL Corning Matrigel matrix as measured by mass. The average mass for 48 dispenses is represented by a black line and the standard deviation is shown by gray shading.

Table 2. Mean dispensed mass from dispensing 10 μL and 50 μL droplets of 9 mg/mL Corning Matrigel matrix solution.

Target volume	10.00 μL	50.00 μL
Mean dispensed mass	9.63 mg	49.16 mg
Standard Deviation	0.80 mg	1.39 mg
Trueness/systematic error	3.7 %	1.7 %
% CV	8.3	2.8

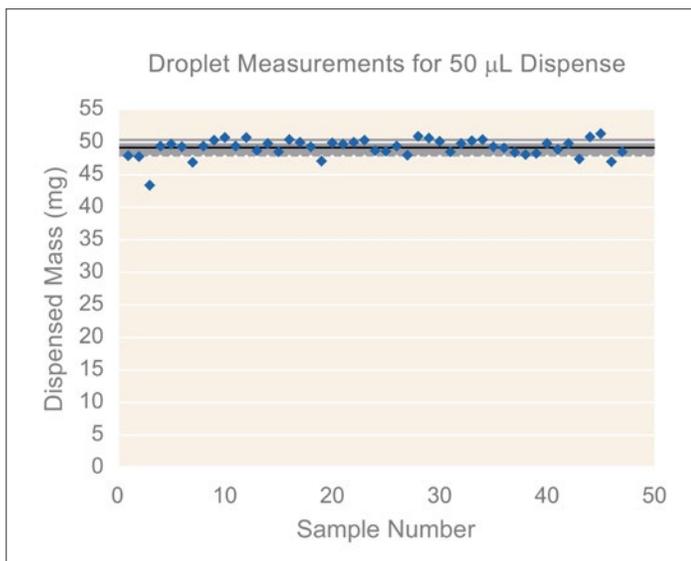


Figure 2. The dispensed droplet volume for 50 µL dispensing of 9 mg/mL Corning Matrigel matrix as measured by mass. The average mass for 47 dispenses is represented by a black line and the standard deviation is shown by gray shading.

To determine systematic error (% SE)

$$\bar{V} = \frac{1}{N} \sum_{i=1}^N V_i \quad \%SE = \frac{\bar{V} - V_T}{V_T} \times 100\%$$

\bar{V} is the average of all measured volumes;

N is the number of replicate deliveries;

V_i is a single measured volume;

V_T is the target volume, the volume intended to be delivered.

To determine random error (% CV)

$$\%CV = \frac{100\%}{\bar{V}} \sqrt{\frac{\sum_{i=1}^N (V_i - \bar{V})^2}{N - 1}}$$

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Conclusions

The Corning® Matrigel® matrix solution dispensed by the temperature-controlled syringe pump printhead as measured by mass matched the target volumes with a high accuracy and reproducibility.

We also found the dispensing precision to be dependent on the target volume, where it has a higher precision for a volume of 50 µL (CV of 2.8%) compared to 10 µL (CV of 8.3%). In both cases, the systematic error was well below 5%, indicating the robustness of this bioprinting technology.

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