

Optimization of the process of preparing microneedle patches based on natural polymer

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INTRODUCTION & AIM

Microneedles are one of the modern transdermal delivery systems. These are small projections that penetrate the epidermis, delivering the active substance directly into the skin.

They can vary in length, depending on which layer of the epidermis they are intended to reach. Their application is simple and virtually painless.

When preparing these patches, it is important to remove all air bubbles and fill the mold thoroughly in order to obtain sharp microneedle tips.

The aim of the study was to optimize the preparation process of dissolvable microneedle patches based on sodium hyaluronate.

METHOD

10 % w/w aqueous solutions of sodium hyaluronate were prepared using five different methods:

- sonication,
- shaking,
- mechanical mixing,
- mechanical mixing combined with sonication,
- mechanical mixing combined with shaking.

The resulting solutions were poured into the silicone molds shown in Figure 1. In order to optimize the accurate filling of the mold and eliminate residual air bubbles, the molds with the solution were subjected to one of the procedures shown in Figure 2.

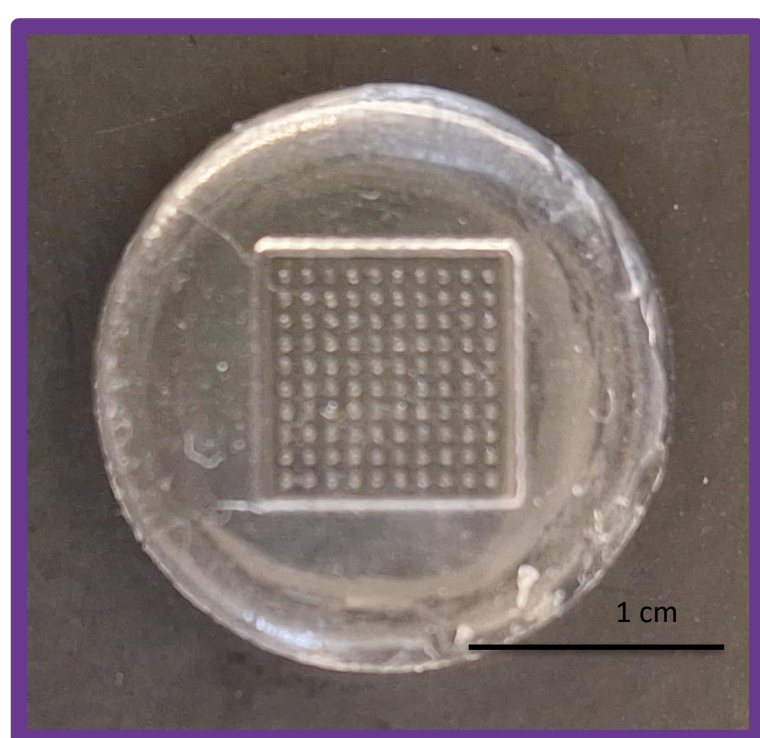


Figure 1. Silicone mold.

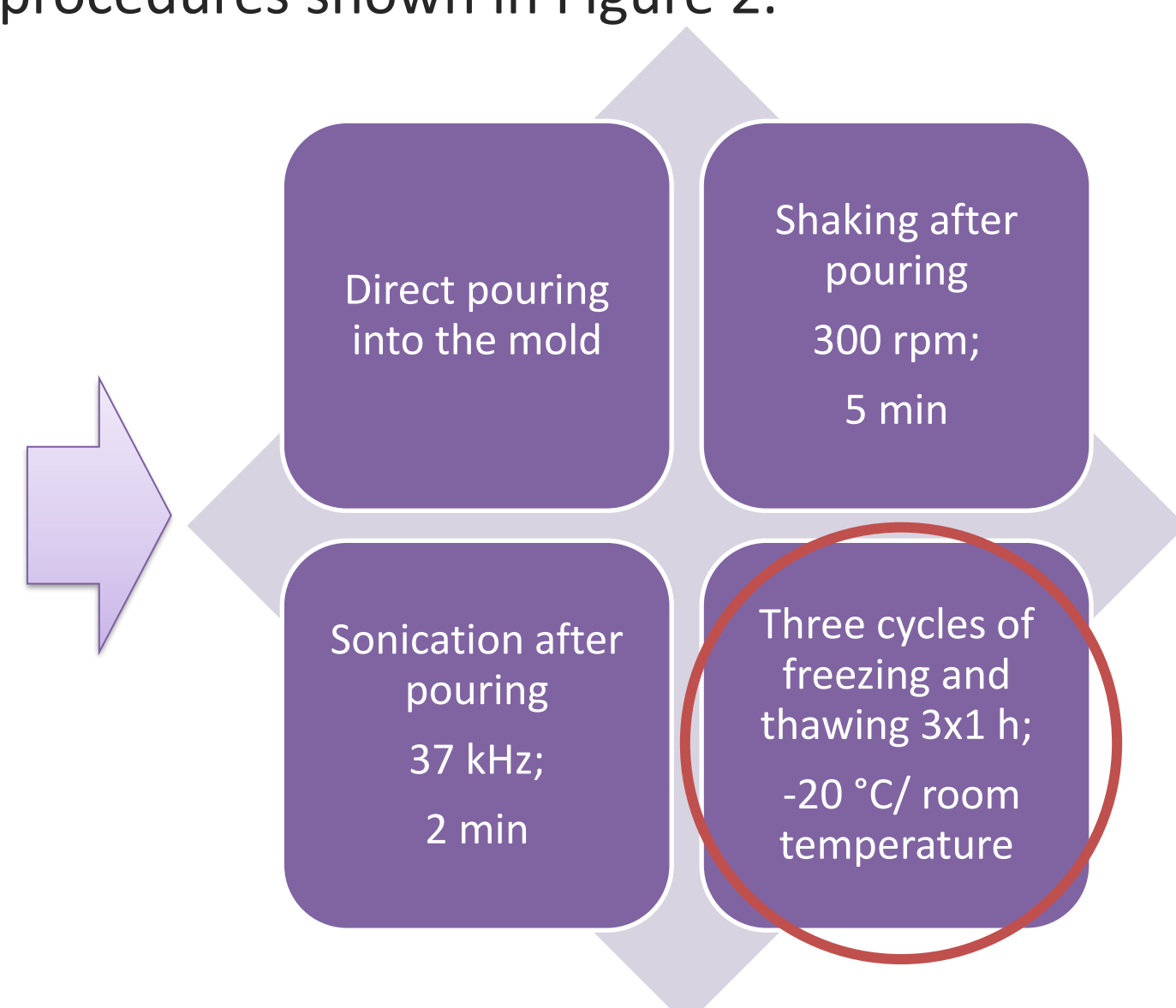


Figure 2. Optimization of accurate mold filling.

Next, the mold filled with the sodium hyaluronate solution was left to dry in the air at room temperature for 24 hours.

The resulting microneedle patches were characterized using stereoscopic microscopy.

RESULTS & DISCUSSION

The results of the solution preparation optimization are presented in Table 1.

Table 1. Optimization parameters for sodium hyaluronate solution preparation.

Method	Time	Observation
Mechanical mixing	2 min	Highly aerated solution
Sonication 37 kHz	45 min	Long dissolving time
Shaking 300 rpm	1h 25 min	Long dissolving time
Mechanical mixing combined with sonication 37 kHz	2 min; 25 min	-
Mechanical mixing combined with shaking 300 rpm	2 min; 1h 25 min	Aerated solution

Pouring the solution directly, or using only ultrasound or a shaker, resulted in incomplete filling of the silicone mold, and no needles were formed. In contrast, the procedure involving freezing and thawing produced the best results. The patch prepared using this method is shown in Figures 3 and 4.



Figure 3. The obtained microneedle patch.

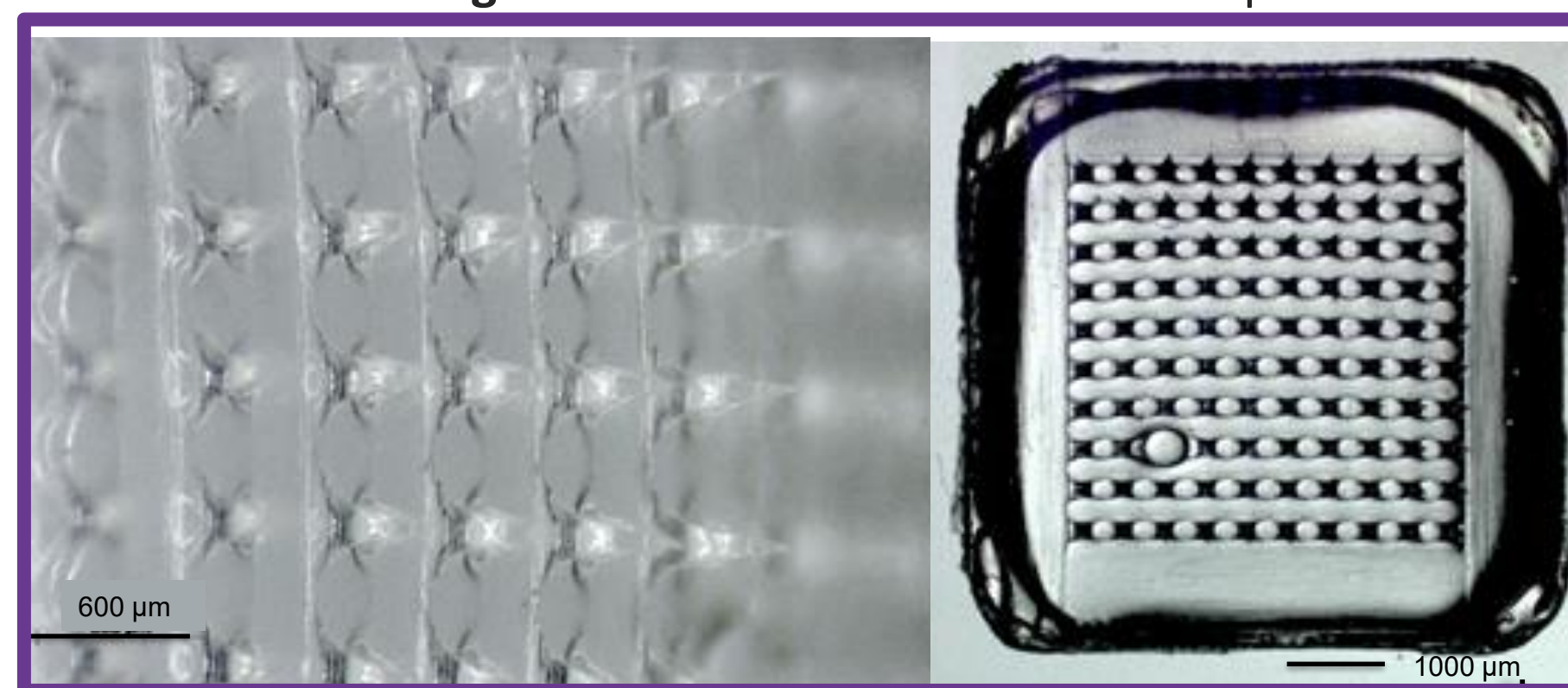


Figure 4. Photographs of microneedles taken using a stereoscopic microscope.

CONCLUSION

- ✓ Mechanical mixing combined with sonication enabled rapid dissolution of sodium hyaluronate without aerating the solution.
- ✓ Three cycles of freezing and thawing ensured complete filling of the mold and the formation of sharp needles.

FUTURE WORK

Future studies will focus on modifying the patch composition to reduce the sodium hyaluronate content.