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Microneedles as versatile delivery vehicles for Traditional Chinese Medicine-derived compounds

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Abstract: Microneedles, as arrayed delivery platforms composed of micron-sized needles, have attracted extensive attention in the field of transdermal drug delivery in recent years. They are capable of delivering not only small and large molecules but also therapeutic and diagnostic agents, while offering the advantage of good patient compliance. Meanwhile, microneedles also provide new ideas for the delivery of active ingredients derived from Traditional Chinese Medicine (TCM). This article comments on a recent study by Lang and Xie *et al.* published in *Advanced Science*. In this work, a metabolically stable derivative of cordycepin and its microneedle system were successfully developed, and the system exhibited potent *in vivo* activity in psoriasis management. By integrating structural optimization of TCM-derived compounds with microneedle delivery technology, this study offers a useful reference for the transdermal delivery of active ingredients from TCM. To further promote clinical translation, this article suggests that the mechanical strength of microneedles should be monitored as a critical quality attribute during scale-up manufacture, and that their storage stability should be systematically investigated, particularly the hygroscopic behavior of polyvinylpyrrolidone (PVP)-based microneedles and the necessity of low-humidity storage conditions.

Keywords: microneedle; delivery; Traditional Chinese Medicine

In the history, the medical science community set a distinct boundary between drugs and devices. While in the recent years, a concept of drug-device combination emerges [1], which deepens the understanding of relevant pharmaceutical systems. Microneedles, array systems with a large number of needles in micron size, may be regarded as drug-device combination to some degree [2]. They are widely considered as versatile and promising delivery systems for small and large, therapeutic and diagnostic molecules, with satisfactory patient compliance [3]. Noticeably, microneedles are also potent delivery vehicles for Traditional Chinese Medicine (TCM)-derived compounds. For instance, it is well documented that investigational microneedle systems have been established for curcumin [4], ginsenoside [5], and dihydroartemisinin [6], and promising experimental outcome has been witnessed.

Recently, in Advanced Science, Lang and Xie *et al.* from Lingang Laboratory reported an impressive study on microneedle delivery for a TCM-derived compound, a C-nucleoside analog of

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cordycepin, CPD3a. The authors firstly screen CPD3a from a 22-entry library to obtain a metabolic-stable compound, which was further encapsulated into a polyvinylpyrrolidone (PVP)-matrixed microneedle, termed as CPD3a-MN. Psoriasis-like mouse model was constructed to validate the pharmacodynamic effects of CPD3a-MN, and the underlying therapeutic mechanisms were comprehensively investigated. The major story told by this article is illustrated in Figure 1. These findings are of considerable interest, which may trigger the development of new therapies for psoriasis and novel approaches for TCM-derived compound delivery. Overall, this study can reflex and provoke burgeoning research paradigm of both TCM and drug delivery.

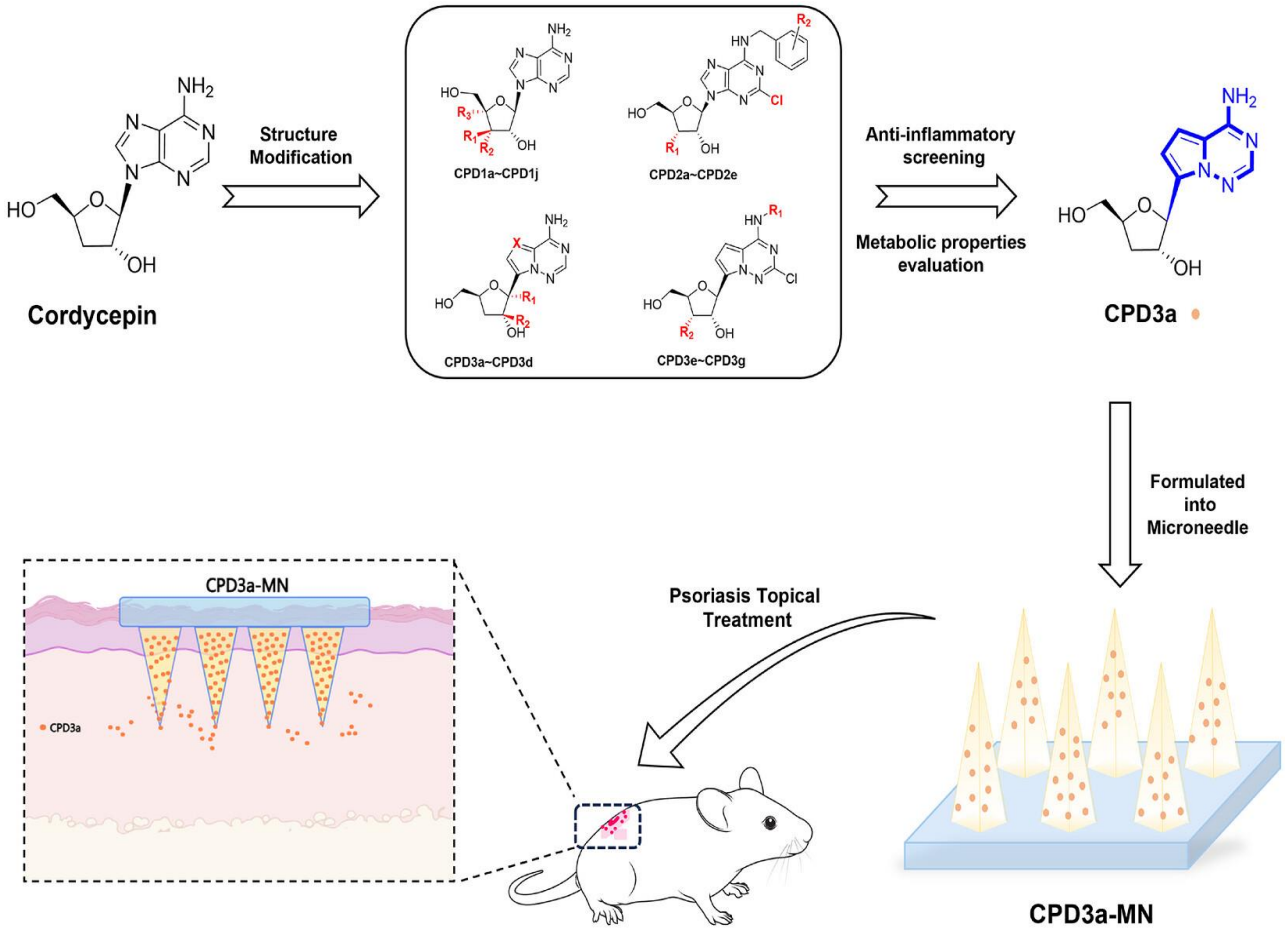


Figure 1. Scheme of the study design of Pan *et al.* Reuse from [7], under the terms of the Creative Commons CC BY license.

As stated by Lang and Xie *et al.*, cordycepin and its derivate suffer from poor pharmacokinetic properties due to metabolic instability under adenosine deaminase catalysis. In this context, the authors designed and synthesized 22 novel cordycepin derivatives and construct a compound library for metabolic stability screening. This approach is of particular importance, which motivates the future research on TCM-derived compound with similar attributes. On top of this, the authors produced the optimized compound CPD3a into microneedles, which are properly adapted to the intended implications, viz. psoriasis, whose lesion site is mainly on the epidermal areas. It should be noticed that the component of microneedles is relatively simple, and the major matrix material is PVP that is a highly commercially available pharmaceutical excipient. This circumstance facilitates the clinical translation of CPD3a-MN. Moreover, the Psoriasis Area and Severity Index (PASI) score of mouse model was largely relieved after

CPD3a-MN treatment, demonstrating great clinical significance. We consider that structural optimization confers markedly improved metabolic stability on CPD3a, ensuring that it reaches the lesion site and exerts its therapeutic effect, while microneedle-mediated localized delivery targets the drug to the epidermal lesion areas of psoriasis. The two strategies were complementary and jointly contribute to improved therapeutic outcomes. The combination of compound screening and microneedle technology reinforced the scientific significance of this study.

We herein would like to shed light on this study, and anticipate the successful application of CPD3a-MN in clinics. To accelerate the clinical translation, the authors are suggested to pay attention to the mechanical strength of microneedles during scale-up manufacture. If PVP is used as the needle material, the microneedles may become fragile, which is also reported by other investigators [8]. The mechanical strength can possibly suffer from the fragility. As a result, in a large batch, the pass rate of mechanical strength is probably challengeable. Hence, the mechanical strength should be set as a Critical Quality Attribute (CQA) to be monitored during the pilot and industrialization practice.

Besides, it is recommended to further investigate the storage stability of microneedles. Storage stability is one of the vital characteristics of pharmaceutical products, which determines their shelf life [9]. The consideration of storage stability as well contributes to the compliance to drug administration regulation. As abovementioned, the major ingredient of microneedles is PVP, a water-soluble excipient [10]. During storage, the hygroscopicity of microneedles should be monitored. The storage conditions should also be taken into consideration, and a low relative humidity (RH) environment will be advisable.

Notwithstanding the above comments, we are positive that the authors have achieved a phased success in CPD3a-MN development. These recommendations are intended to facilitate new drug/device/drug-device combination application.

In conclusion, Lang and Xie *et al.* successfully developed a metabolically stable derivative of cordycepin and the microneedle system thereof, which exhibited potent *in vivo* activity in psoriasis management. We again congratulated on the thrilled results, and also suggest to pay attention to the mechanical strength and storage stability of microneedles during industrialization process. Qualified mechanical strength and storage stability is the prerequisite for qualified microneedle products, advancing the clinical application.

Declaration of generative AI and AI-assisted technologies

The authors did not use generative AI or AI-assisted technologies in the writing of this manuscript.

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Authors' contribution

Writing—original draft preparation, S.S.; writing—review and editing, W.C.; funding acquisition, H.Z. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

References

[1] Nguyen BD, Vaughn-Cooke M. Design and labeling differences between generic and reference listed drug inhalers: human factors considerations in US FDA-approved devices. *Expert Opin. Drug Delivery* 2026, 23(3):557–595.

[2] Younas S, Kumar M, Khalid R, Gopal K, Kumar A, *et al.* Microneedle-assisted delivery of biologics: from large molecules to cancer vaccines, *Aaps Pharmscitech* 2026, 27(3):160.

[3] Gattu K, Godugu D, Jain H, Jadhav K, Cho H, *et al.* Microneedle technologies for drug delivery: innovations, applications, and commercial challenges. *Micromachines* 2026, 17(1):102.

[4] Zhao R, Ni S, Yang M, Gu Z, Zhu Y. Piezo-herbal microneedle patches enable wireless endometrial regeneration and fertility recovery. *J. Nanobiotechnol.* 2026, 24(1):416.

[5] Yang J, Chen Z, Zhang T, Hu R, Wang D, *et al.* Microneedle patch loaded with immune-evading engineered cell membrane vesicles promotes myocardial repair by blocking the cGAS-STING pathway. *Chem. Eng. J.* 2026, 546:180543.

[6] Anjani QK, Volpe-Zanuto F, Miatmoko A, Moreno-Castellanos N, Novais JT, *et al.* Polymeric microarray patches for transdermal delivery of amodiaquine and artesunate: a novel strategy against Plasmodium falciparum. *Mater. Today Bio.* 2025, 35:102500.

[7] Pan W, Shao X, Zhong Y, Sun X, Yin L, *et al.* A C-Nucleoside analogue of cordycepin with high metabolic stability and potent anti-psoriatic activity via microneedle delivery. *Adv. Sci.* 2026:e77012.

[8] Cheng A, Sun W, Xing M, Zhang S, Gao Y. The hygroscopicity of polymer microneedles on the performance of dissolving behavior for transdermal delivery. *Int. J. Polym. Mater. Polym. Biomater.* 2022, 71(1):72–78.

[9] Suzuki Y, Taguchi K, Okamoto W, Enoki Y, Komatsu T, *et al.* Pharmaceutical stability of methemoglobin-albumin cluster as an antidote for hydrogen sulfide poisoning after one-year storage in freeze-dried form. *Int. J. Pharm.* 2023, 645:123433.

[10] Kurakula M, Rao GSNK. Pharmaceutical assessment of polyvinylpyrrolidone (PVP): as excipient from conventional to controlled delivery systems with a spotlight on COVID-19 inhibition. *J. Drug Delivery Sci. Technol.* 2020, 60:102046.