Importance of a suitable working protocol in tape stripping experiments

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Introduction

Tape stripping on porcine ears is a well-established and widely used method in dermatological research. However, new findings concerning skin and the employed methods in the tape stripping process necessitate changes in the working protocol to ensure validity. Therefore, the present study on porcine ear skin aims to shed light on a few aspects of the tape stripping method. The main focus of this study is the effect of researched topical formulations on the widely used NIR (near infrared) method to determine the amount of stratum corneum removed per tape strip and the possibility of interference of light scattering creams, thereby leading to inaccurate results and subsequent errors in calculation of stratum corneum thickness, and as a direct consequence, to errors in calculations of drug recovery and skin penetration depth when calculating with inaccurate values.

Experimental Methods

Formulations

Three different formulations were used: 1) a commercially available W/O cream base (Ultrabas®), 2) 7.5% DPPC-liposomes (dipalmitoyl-phosphatidylcholine) produced with the film method, and 3) a microemulsion consisting of lecithin S75, isopropanol, isopropylmyristate and distilled water. Moreover, the model drugs fludrocortisone acetate (FA) and diclofenac sodium (DS) were incorporated into the W/O cream and the microemulsion at 0.5% (w/w).

Protein measurements

NIR-measurements using the Squame Scan® device were conducted in parallel to measurements with the microBCA protein assay kit to determine the amount of corneocytes removed per strip. The results were compared and checked for differences, particularly with regard to the effect of applied formulations. These results were used to determine SC-thickness and skin penetration behaviour of the model drugs.

Tape stripping protocol

Two different working protocols were applied for the W/O cream and microemulsion (ME) containing FA and DS. After a residence time of 1 hour, in one experimental setup (A) the excess of cream was gently removed with a soft tissue; in the other setup (B) the tape stripping procedure was started immediately. As the W/O cream interfered with adherence of the strips, again two different setups were applied. In setups A1/B1 the first applied strip was defined as the first strip, so the not-adhering "pre-strips" were included in the calculation of skin penetration behaviour, in setup A2/B2 the first strip adhering to the skin was defined the first strip.

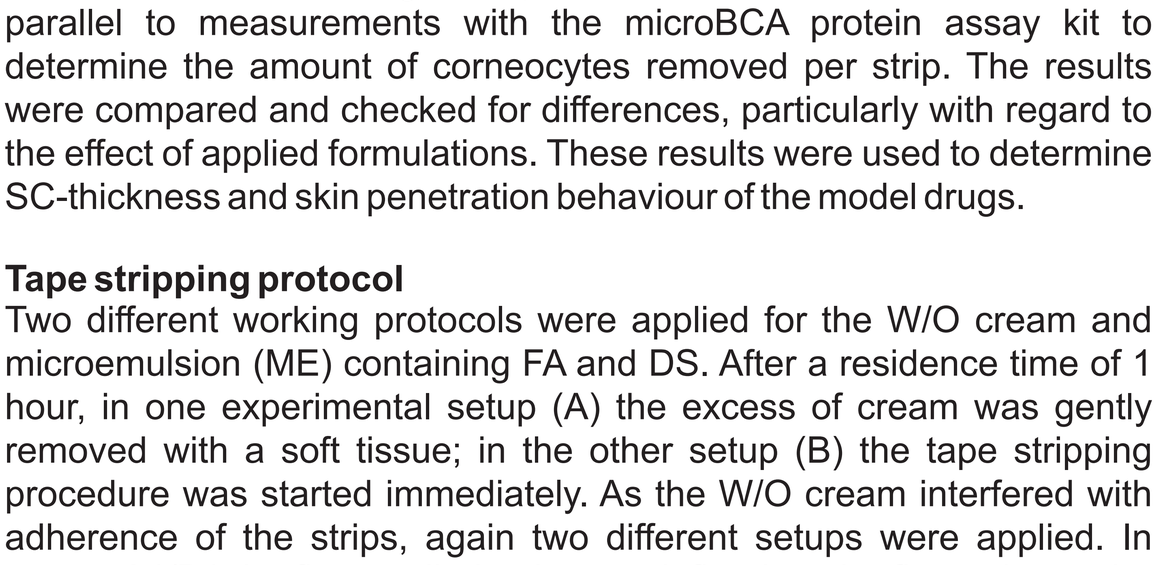

Fig. 1: Course of NIR-measurements from strips 1-15 for areas treated with a W/O cream (blue), liposomes (violet), microemulsion (green) and untreated procine ear skin (red). Values are means and standard deviations from at least 6 measurements.

Results

No significant difference in SC-thickness on various areas of the porcine ear was found and NIR and mBCA results correlated well. Therefore, the whole area of the porcine ear can be used for valid experiments. An SC-thickness of 13.12±1.65 µm was calculated.

Interestingly, from areas treated with the W/O cream less SC was removed with the first 7 strips, even if the cream had been dabbed away (Fig. 1). This indicates a considerable interference of the W/O cream with the adherence of the strips. Therefore, noticeable effects on skin penetration and drug recovery in dependence of the working protocol were expected and also found. Fig. 2 clearly shows the significant effect on drug recovery when excess formulation is dabbed away and lost for further investigation. Especially lipophilic formulations remain on the skin and interfere with the adherence of the tape strips. This was also the case when the W/O cream had been dabbed away, leading to non-adhering pre-strips (protocols A1 and A2) Fig. 3 corroborates the findings shown in Fig. 2 as it indicates that non-adhering strips show a trend to overestimation of skin penetration.

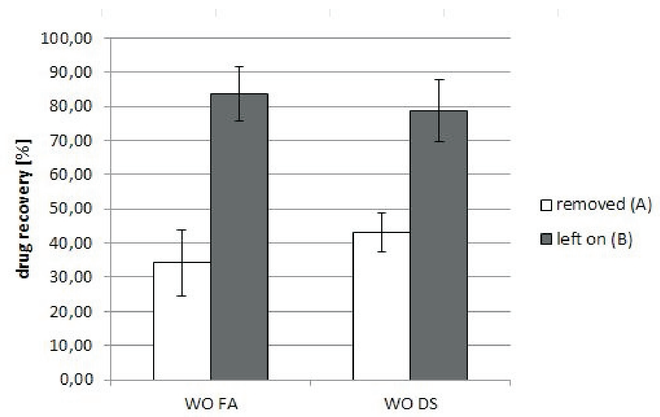

Fig. 2: Recovery of the model drugs FA and DS from W/O cream. Values are means and standard deviations of at least 4 measurements (n ≥4).

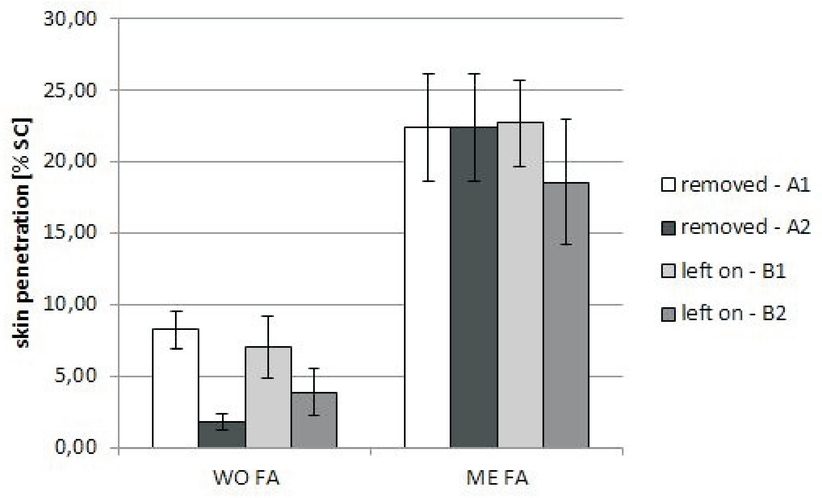

Fig. 3: Penetration depth of the model drug FA from the W/O cream and the ME, calculated according to the 4 different working protocols. Values are means and standard deviations of at least 4 measurements (n ≥4).

Conclusion

A suitable working protocol for tape stripping experiments is necessary to obtain reliable results. This is especially true if lipophilic formulations like W/O creams are used, as a considerable amount of cream remains on the SC surface and does not penetrate, thereby impairing the adherence of tape strips. We suggest carefully removing lipophilic creams with tape strips and to note when the first strip adheres in order determine the first contact with the SC.

Acknowledgements

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