PROTECTION - SCIENCE AND TECHNOLOGY ADVANCES FOR CHEMICAL AND BIOLOGICAL PROTECTION

Evaluating The Impact Of Dosing Vehicles And Occlusion States In Methyl Salicylate Absorption Through Porcine Skin: An In-vitro Study

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Methyl salicylate (MeS) is widely used as a simulant for the chemical warfare agent sulfur mustard (HD) during testing and evaluation of chemical and biological (CB) protective ensembles for industrial, emergency response, and military applications. The assessment of an ensemble's effectiveness against chemical warfare agents (CWAs) necessitates reliable methods for estimating skin dose under realistic exposure scenarios. The accuracy of current methodologies, which estimate skin dose via uptake onto passive adsorbent dosimeters in the Man-In-Simulant-Test (MIST), is limited by their inability to account for the entirety of MeS that interacts with the skin. This study aims to refine the estimation of whole-body MeS dose during CB protective equipment testing by exploring the impact of different dosing vehicles and occlusion states on MeS absorption through porcine skin, thereby developing a more accurate method for quantifying dose. The pursuit of precise methodologies for estimating skin dose of chemical warfare agents is critical for the advancement of protective clothing assessments. This study's exploration of MeS absorption through porcine skin, using various dosing vehicles and occlusion states, addresses a significant gap in current testing protocols. By integrating findings from dermatopharmacokinetics and chemical defense research, the study not only enhances our understanding of skin absorption dynamics but also informs the development of more accurate models for CWA protective equipment evaluation. The implications of this research extend beyond military applications, potentially benefiting industrial and emergency response scenarios where skin exposure to hazardous substances is a concern.
The study employed in vitro flow-through diffusion testing using freshly excised porcine skin. MeS was applied in four different liquid vehicles (neat MeS, artificial sweat solution, olive oil, and a 50/50 olive oil/acetone mixture) under both occluded and non-occluded conditions. The vehicles were selected to represent a range of options with varying levels of solubility of MeS. The absorption of MeS was monitored over an 8-hour period, and the flux (µg/cm2/h) and cumulative absorption (µg/cm2) were measured. The study found that occlusion significantly increased MeS absorption across all dosing vehicles, with the artificial sweat vehicle resulting in the highest absorption. The non-occluded trials showed lower absorption rates, likely due to evaporation. Among the vehicles tested, synthetic sweat appeared most effective, suggesting its potential as a preferred dosing vehicle for human studies. The findings indicate that both the choice of dosing vehicle and the state of occlusion play critical roles in the absorption of MeS through the skin. These results underscore the need for careful consideration of these factors in the development of methodologies for estimating whole-body MeS dose during protective equipment testing. Further research involving human subjects and additional dosing vehicles is warranted to validate these in vitro findings and refine dose estimation methods. This study lays the groundwork for more accurate assessments of protective clothing's effectiveness against CWAs, contributing to enhanced chem-bio defense strategies.