

Formulations efficacy as topical skin protectants against organophosphorus compounds.



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Topical Skin Protectants (TSP) to prevent occupational and professional chemicals exposure

TSP against Chemical Warfare Agents (CWA) (1,2)

Not designed for a use in all circumstances and for an application on the all body surface.

When the risk of contamination is high, in association with NBC Personal Protective Equipments (PPE) (suits, gloves, gas mask...): to provide an **additional protection** of specific skin areas (seals, closures, skin areas highly permeable to CWA, susceptible to self-contamination when disrobing...);

When the risk of contamination is low, in association with conventional suits/gloves to **improve the operational capacity** (reduce the physical and heat stress due to NBC PPE).



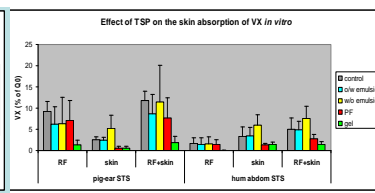
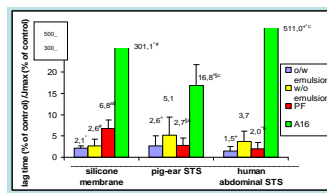
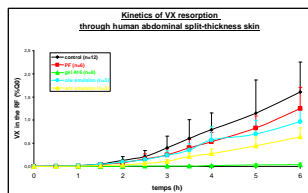
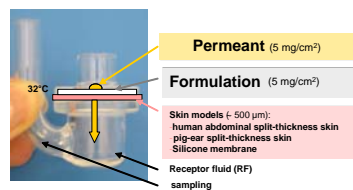
Purpose

- To compare the **efficacy of formulations** specifically designed as TSP against highly toxic OP such as the CWA VX.
- To determine the consistency of results obtained by using **in vitro and in vivo efficacy tests**.

Methods

In vitro tests

Permeation of OP

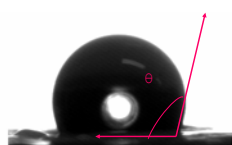


Efficacy evaluated from the ratio λJ_{max} and the fraction of VX totally absorbed. The **hydrogel A16** was the most effective TSP against VX. (3)

Interfacial interactions between formulations and OP



Goniometer (EasyDrop, Krüss)



Contact angle (θ) measurements

TSP were spread as a thick layer on glass plates and 5 µl water, oil, POX, DSM or VX droplets were loaded on the TSP surface.

In vivo test

Permeation of MN on human volunteers' forearms



10 µl liquid droplet of a 0.1% aqueous solution of MN was loaded on the middle of each test site.

Polarization light spectroscopy using modified standard digital camera technology (TIV1600, WheelsBridge® AB, Linköping, Sweden). (5)

Conclusions

- This work demonstrated the importance of the formulation and of some of their specific ingredients in preventing the permeation of chemicals, more specifically OP, through the skin.
- With the exception of the gel A16, there was a good consistency between the wettability of formulations by OP and their efficacy as TSP by using *in vitro* skin models: a low wettability was associated with a high efficacy and vice versa.
- A quick evaluation of formulations efficacy as TSP against OP could thus mainly rely on *in vitro* tests which led to consistent and complementary results. The relevance of these results when extrapolating to human skin *in vivo* and the polyvalence of the formulations will have to be further established.

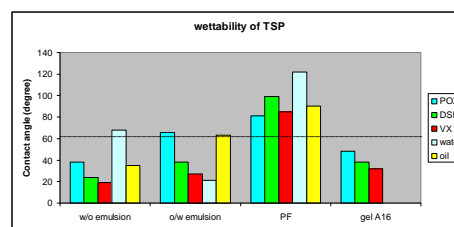
Chemicals

	VX	Paraoxon (POX)	Methyl Nicotinate (MN)
Structure			
MW	267.4	275.2	137.1
Log K _{ow}	0.67	1.98	0.83
Water solubility limit (g/L)	30	4	48
Vapor pressure (mm Hg)	0.0004	0.000001	0.28
Superficial tension (10 ⁻³ N/m) (25°C)	31	46	
Viscosity (cP) (25°C)	10.0	15.8	

Formulations

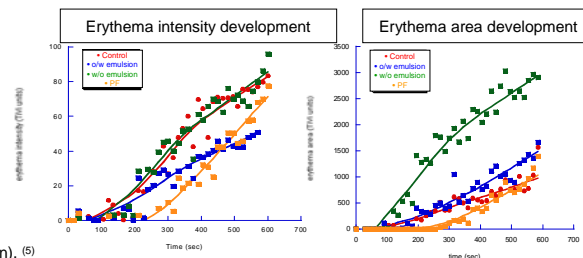
- Oil-in-water (o/w) and water-in-oil (w/o) emulsions
- Perfluorinated compounds-based creams (PF)
- Hydrogels.

Results



OP: POX= paraoxon, DSM= demeton-S-methyl, VX

The **PF** formulation was the least wettable by OP. (4)



Relative to the control, the skin pre-treatment with **PF** delayed the apparition of the erythema by a 2-fold factor.

References

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