


# IN VITRO PERCUTANEOUS PENETRATION OF POLYCYCLIC AROMATIC HYDROCARBONS FROM SUNSCREEN CREAMS

## PENETRAZIONE PERCUTANEA IN VITRO DI IDROCARBURI POLICICLICI AROMATICI DALLE CREME SOLARI

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**Key words:** Polycyclic Aromatic Hydrocarbons, sunscreen creams, percutaneous penetration

 **Parole chiave:** Idrocarburi Policiclici Aromatici, creme solari, assorbimento precutaneo

## Abstract

**Background:** Dermal exposure to Polycyclic Aromatic Hydrocarbons (PAHs) affects many outdoor workers such as asphalt workers. Usually the use of sunscreen creams is suggested to protect them from UV radiation. However sunscreen could prevent or facilitate dermal absorption of industrial chemicals.

**Objectives:** The aim of the study was to assess percutaneous penetration of anthracene using 2 different sunscreen creams as vehicle.

**Methods:** In vitro permeation experiments were carried out using standardized in vitro methods with static diffusion cells. Excised human skin prepared to approximately 350  $\mu\text{m}$  thickness was fixed on the diffusion cells. The receiving phase was a saline solution with 6% PEG 20. The 2 sunscreen creams (one lipophilic and one hydrophilic) were applied uniformly ( $2\text{mg}/\text{cm}^2$ ) on the skin mounted on the diffusion cell. After 20 minutes, a solution of anthracene and artificial sweat was added. Analysis of anthracene in the receptor samples was carried out by beta counter analyzer (Packard).

**Results:** Results did not show a percutaneous penetration of anthracene from sunscreen creams while in previous studies *in vitro* percutaneous penetration of anthracene was demonstrated using the same methodology.

**Discussion and Conclusion:** The use of sunscreen creams among outdoor workers, would not seem to enhance percutaneous penetration of PAHs. On the contrary it seems to be able to reduce dermal absorption of anthracene in the workplace.

## Abstract

**Introduzione:** L'esposizione cutanea ad Idrocarburi Policiclici Aromatici (IPA) interessa molti lavoratori outdoor quali gli asfaltatori. Generalmente si suggerisce di proteggerli dalle radiazione UV per mezzo di creme solari. Tuttavia tali creme potrebbero facilitare la penetrazione di tossici occupazionali.

**Obiettivi:** Scopo dello studio era valutare la penetrazione percutanea dell'antracene utilizzando come veicolo due differenti creme solari.

**Metodi:** Gli esperimenti di passaggio percutaneo sono stati condotti utilizzando metodi in vitro standardizzati con celle di diffusione statiche. Campioni di cute umana di circa 350  $\mu\text{m}$  di spessore erano fissati sulle celle di diffusione. Il fluido recettore era costituito da soluzione salina con l'aggiunta di PEG 20 al 6%. Le due creme solari (una lipofila ed una idrofila) erano applicate uniformemente ( $2\text{mg}/\text{cm}^2$ ) sulla cute montata nelle celle di diffusione. Dopo 20 minuti veniva aggiunta una soluzione di antracene e sudore artificiale. L'analisi dell'antracene nei campioni di recettore era effettuata mediante analizzatore beta counter (Packard).

**Risultati:** I risultati non mostravano un passaggio percutaneo di antracene dalle creme solari, mentre studi precedenti avevano dimostrato la penetrazione transcutanea dell'antracene utilizzando la stessa metodologia.

**Discussione e Conclusioni:** L'impiego di creme solari nei lavoratori outdoor non sembra aumentare il passaggio percutaneo degli IPA. Al contrario potrebbe ridurre l'assorbimento transcutaneo dell'antracene nei luoghi di lavoro.

## Background

Polycyclic Aromatic Hydrocarbons (PAHs) are known to be absorbed through the skin (1, 2, 3). The contamination of workers' skin occurs in a variety of workplaces by deposition of vapors and particles or by splashing, representing an important route of uptake. Dermal exposure to PAHs affects many outdoor workers such as asphalt workers. Usually the use of sunscreen creams is suggested to protect them from UV radiation. However sunscreens could prevent or facilitate dermal absorption of industrial chemicals.

The aim of the study was to assess percutaneous penetration of anthracene after the application of 2 different sunscreen creams (one lipophilic and one hydrophilic).

## Methods

In vitro permeation experiments were carried out using standardized in vitro methods (4) with static diffusion cells (FDC 400, Crown Glass Co, NJ US). The test apparatus was kept at a constant temperature of 37°C so that the skin surface temperature was 32°C. Static ambered cells with individual magnetic stirring and an exposure area of 1.77 cm<sup>2</sup> (diameter 1.5 cm) were used. Excised human skin (obtained from plastic surgery) prepared to approximately 350 µm thickness was fixed on the diffusion cells. Skin samples were frozen at -80° and stored for a maximum of 6 months. The receiving phase was a saline solution with 6% PEG-20 oleyl-ether. Lipophilic substances such as PAHs were previously found to diffuse well with this receptor (5). Yang et al (1986) using this type of experimental setting reported a similar percutaneous absorption of anthracene in vivo on the rat and in vitro through dermatomed rat skin with an in vitro penetration of 20% of the applied dose after 24 hours (6). The lipophilic and hydrophilic sunscreen creams were applied uniformly (2mg/cm<sup>2</sup>) on the skin mounted on 24 and 32 diffusion cells respectively. After 20 minutes a solution of [<sup>14</sup>C]-labeled anthracene (Sigma Aldrich) and artificial sweat was added. Nine 500 µl samples for each cell were drawn every hour for 8 h and at 24 hours and replaced with receptor fluid. Analysis of <sup>14</sup>C-anthracene in the receptor samples was carried out by beta counter analyzer (Packard).

## Results

Results did not show a percutaneous penetration of anthracene after the application of sunscreen creams.

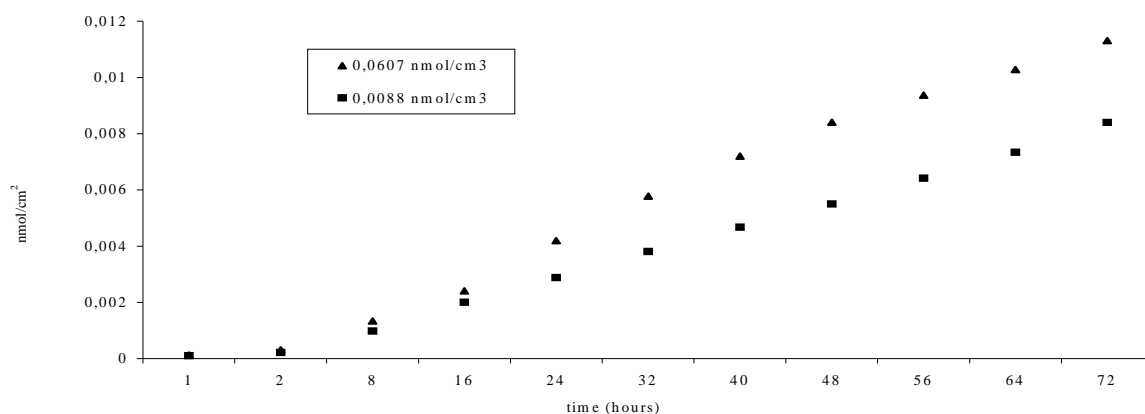
## Conclusions

The use of sunscreen creams among outdoor workers would not seem to enhance percutaneous penetration of anthracene. Taking into consideration the results there is no basis for assuming that sunscreens facilitate dermal absorption of PAHs.

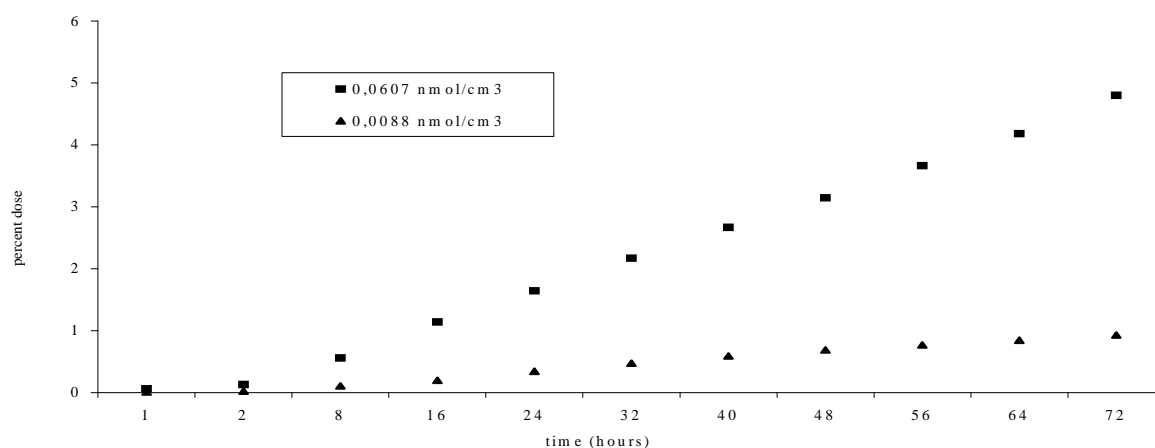
**Table 1** - In vitro percutaneous penetration through human skin of <sup>63</sup>Ni chloride e <sup>57</sup>Co chloride from two different vehicles (14).

compound	vehicle	% after 24 h (M ± SD)	% in the epidermis (M ± SD)	% in the stratum corneum (M ± SD)
<sup>63</sup> Ni	water	0.23 ± 0.34	0.42 ± 0.55	50.33 ± 19.91
<sup>63</sup> Ni	artificial sweat	0.76 ± 1.21	0.34 ± 0.19	36.16 ± 9.30
<sup>57</sup> Co	water	1.04 ± 0.64	0.37 ± 0.20	27.62 ± 14.96
<sup>57</sup> Co	artificial sweat	3.30 ± 2.65	0.23 ± 0.14	41.30 ± 18.83

**Fig. 1 -** *In vitro* cumulative percutaneous penetration through human skin of 203HgCl<sub>2</sub> applied in two different concentrations in an aqueous vehicle (13).



**Fig. 2 -** *In vitro* percutaneous penetration through human skin of 203HgCl<sub>2</sub> applied in two different concentrations in an aqueous vehicle (13).



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