BIOCOMPATIBILITY/TOXICITY OF TATTOO INKS

Marta Sanchiz Cruz – Biochemistry Degree – 2016
Tutor: Lleonard Barrios

UAB Universitat Autònoma de Barcelona

INTRODUCTION: Tattooing is defined by the introduction of exogenous pigments and dyes in the dermis to obtain permanent design. Nowadays is a normal practice being very important to understand the biochemical reactivity of the ink particles in the skin, tissues and cells with regards to the toxicological risks of the ingredients used. Especially knowing all the lacks in the regulation of tattoo inks.

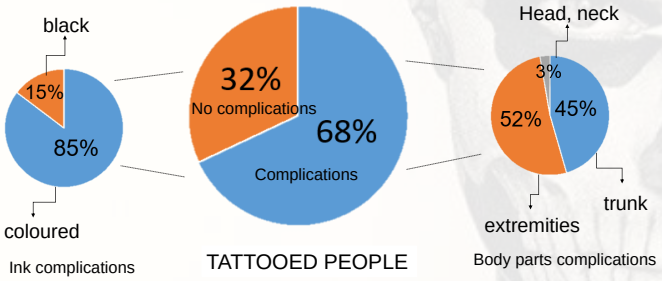
OBJECTIVES:

- Which are the general problems associate with tattooing?
- What are the components of tattoo inks?
- Which biocompatibility/toxicity problems are related to the component of tattoo inks?

RESULTS:

General problems:

It is estimated that about 68% of tattooed people report complications, being the coloured tattoos the most concern. There is also a higher incidence of adverse reactions on the extremities.



Principal adverse reactions:

- Risk of infection (bacterial, fungi or viruses)
- Granulomatous reactions
- Lichenoid reactions
- Hypersensitivity allergic reactions

Caused by the Immune System

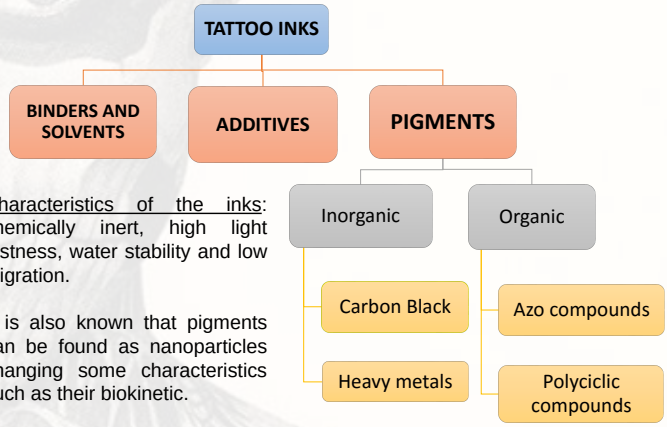
All studies indicates that allergens are formed inside the skin.

- Tumours → Related as coincidences

Components:

It is impossible to know the exact composition due to the lack of regulation and the breach of information by the manufacturers and producers.

The majority of the pigments were first produced for industrial purposes.



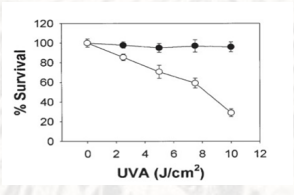
Characteristics of the inks: chemically inert, high light fastness, water stability and low migration.

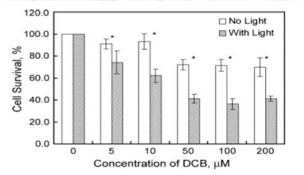
It is also known that pigments can be found as nanoparticles changing some characteristics such as their biokinetic.

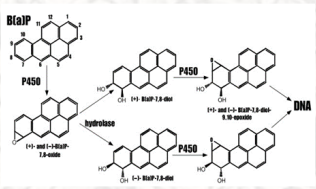
The principal impurities/contaminants are: heavy metals, polycyclic aromatic hydrocarbons (PAHs) and aromatic amines.

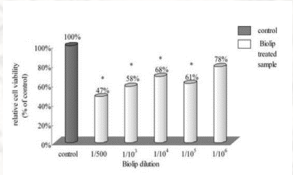
Biocompatibility/toxicity:

A part from the contaminants that can be toxic de *per se,* different processes can transform tattoo inks or generate cleavage compounds that can be potentially carcinogenic, genotoxic or citotoxic agents.









Toxicity:

Heavy metals such as nickel and chromium are found in higher concentrations and might cause allergic reactions or can be potentially genotoxic.

TiO_2 can be phototoxic due to the creation of ROS. Also PAHs generate oxygen radicals when exposed to sunlight.

Photodecomposition:

The exposure to natural sunlight (UVA, UVB) can due to the formation of reactive species, toxic components or bioactive fragments by photocleavage of the pigments; mostly organic.

Metabolism:

Slow rate metabolism lifelong is important. This process can make potential systemically available components.

- PAHs by CYP450 (1A1, 1B1) can due to diol-epoxides.
- Azo compounds → aromatic amines

Biocompatibility:

In general all the assays in vitro (MTT) cause a decrease in the cell cultures viability. For example, in fibroblasts can also decrease the formation of procollagen type I.

In addition, pigments can activate adaptative stress responses.

Conclusions:

- Cause tattoo inks are not regulated infinite combination of pigments and impurities are present; some of them potentially toxic.
- Tattoo inks can have dangerous substances in higher concentrations than recommended (dose-dependant).
- Pigments through metabolism or photodecomposition can form a lot of problematic components like diol-epoxides or aromatic amines.
- Inks can due to bioavailable substances that can distribute systemically through the body, although the total distribution is not known yet.

Principal references:

- Kluger N., Bäumler W. Tattooed Skin and Healt. *Current problems in Dermatology.* Vol.48; Karger editions (2015).
- Laux, P. *et al.* A medical-toxicological view of tattooing. *Lancet* 395–402 (2016
- Engel, E. *et al.* Photochemical cleavage of a tattoo pigment by UVB radiation or natural sunlight. *JDDG;* **2007,** 583–589 (2007)

Image references:

1. Toxicity: Warner, W. G. & Yin, J. Photocytotoxicity in human dermal fibroblasts elicited. *J. Cosmet. Sci*
2. Photodecomposition: Wang, L. *et al.* Light-induced mutagenicity in Salmonella TA102 and genotoxicity / cytotoxicity in human T-cells by 3 , 3 -dichlorobenzidine: a chemical used in the manufacture of dyes and pigments and in tattoo inks. *Toxicology*
3. Metabolism: Article, R. Metabolic activation of polycyclic aromatic hydrocarbons to carcinogens by cytochromes P450 1A1 and 1B1. *Cancer Sci*
4. Biocompatibility.Falconi, M. *et al.* Influence of a commercial tattoo ink on protein production in human fibroblasts. *Arch. Dermatol.*