

Colourants in transferable picture tattoos for the skin

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Transferable picture tattoos for the skin are popular among children. There is however very little knowledge about the colourants that may be present in the picture tattoos and thus of the risk of contact allergic reactions. In the present investigation, 36 picture tattoos were analysed for the content of 129 organic colourants listed in the Cosmetic Directive, to which these products should comply as they are used on the skin. Only 11 of the cosmetic colourants could be identified in the analysed samples. Allergenic potential of 7 of these colourants (CI 15850, CI 11920, CI 45220, CI 75300, CI 13015, CI 45100 and CI 15525, maximum concentration 35–4479 p.p.m.) was evaluated on the basis of published scientific data. Only scarce information regarding contact allergy to these substances was found in the available literature. Most information in the literature regarding contact allergy has concerned CI 75300, curcumin, which is reported to have caused a few cases of contact allergy as a colourant in food or in disinfectants used prior to surgery. In no case, allergic reactions to any of the colourants have been verified from transferable picture tattoos. On the basis of this investigation, the risk of allergic reactions from the colourants in the transferable picture tattoos seems to be limited.

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It is a fashion to decorate the body with transferable picture tattoos, especially among children. These tattoos are transferred to the skin, normally with the use of water, worn for a short period of time and can be washed/worn off.

The Danish Environmental Protection Agency (Danish EPA) has received a few complaints from parents, whose children developed skin reactions from the use of such picture tattoos. The cause of these skin reactions is not known, and there is only little knowledge about the colourants used in the transferable picture tattoos and their potential for causing allergic reactions.

The aims of the present project were to perform a survey of which organic colourants are commonly used in the picture tattoos and to evaluate whether the identified colourants were known to cause contact allergy.

Materials and Methods

Samples

A market survey revealed that transferable picture tattoos can be purchased as a product in itself or as attached to various food and other

consumer products, e.g. chewing gums, confectionery, yoghurt, weekly/monthly magazines and comics.

During April–July 2004, 40 samples of transferable picture tattoos were purchased from the Danish retail outlets: supermarkets, general merchants, hobby shops, toy shops, kiosks, amusement parks and camping sites. 22 of these samples, which could be used by both children and adults, were selected for the analysis of colourants. Each sample contained 1–10 picture tattoos of different figures composed of various different colours. 1–3 picture tattoos from each sample were selected for the analysis in a way so that most of the colourants in all subsamples were represented. All-in-all, 36 picture tattoos were analysed in the present study. An example is shown in Fig. 1.

Chemical analysis of colourant content

The method adopted for the extraction of colourants from picture tattoos was optimized in a preliminary investigation, where 6 different picture tattoos were extracted with various solvents and by applying different mechanical force. The



Fig. 1. 1 of the investigated picture tattoos (an example).

sample of a picture tattoo, including the paper, was weighed in a centrifuge glass. 5 ml HPLC solvent (an aqueous buffer containing 1.4 g citric acid, 6.0 g tetrabutylammonium hydroxide per litre and pH 9.0/acetonitrile/tetrahydrofuran in the ratio 75 : 12.5 : 12.5) was added to the sample, and the mixture was ultrasonicated for 15 min. The coloured material remaining on the paper was scraped off carefully into the solvent. The paper was removed and the extract was filtered through a Whatman No. 2 filter paper. The undissolved coloured material was further extracted with 2 ml tetrahydrofuran, and the extract was filtered through a Whatman No. 2 filter paper. The 2 extracts obtained above were analysed by an earlier described HPLC method for the analysis of organic colourants in cosmetic products (1).

The presence of 129 organic colourants (1), listed in Annex 4 of the Cosmetic Directive (2), in the picture tattoos was investigated. Semiquantitative determination of the identified colourants was performed using 1-point calibration curve for each colourant.

Results

Matching the retention time and 275–750 nm UV-Vis spectrum of HPLC peaks of the sample extracts with those of reference colourants, analysed under the same conditions, identified the colourants in the samples. The colourants identified in the investigated picture tattoos are described in Table 1.

Table 1. Colourants identified in the investigated 33 picture tattoos, exclusive of 3 black picture tattoos

Colourant (Colour Index No.)	CAS No.	No. present in samples	Concentration (p.p.m.)
CI 11920	2051-85-6	12	6–4479
CI 13015	2706-28-7	3	<2, 3, 800
CI 14815	3277-28-1	2	<2, <2
CI 15525	5850-80-6	1	217
CI 15850	5858-81-1	31	<2–2391
CI 16255	2611-82-7	1	5
CI 42170	5863-51-4	1	<1
CI 45100	3520-42-1	3	6, 52, 55
CI 45220	5873-16-5	10	<2–103
CI 74180	1330-38-7	4	5, 5, 6, 7
CI 75300	458-37-7	4	<2, <2, 14, 35

CI 15850 was present in most of the picture tattoos (31 of 33). Other colourants identified in the investigated picture tattoos were CI 11920 in 12, CI 45220 in 10, CI 75300 and CI 74180 each in 4, CI 13015 and CI 45100 each in 3 and CI 14815 in 2 of the samples. CI 15525, CI 16255 and CI 42170 were present only in 1 picture tattoo each.

The blue colour in 14 samples could not be extracted and thus not identified. This may also be the reason for not-identifiable green (blue + yellow) and violet (blue + red) colours present in 8 and 4 samples, respectively. However, it cannot be ruled out that the unidentified colourants may be those which were not present in our stock of 129 reference colourants.

The colourant(s) in 2 of the 3 black picture tattoos could not be dissolved in the solvents used in the present study. The black colour in the third product was soluble in acetonitrile : tetrahydrofuran (1 : 1). However, the dissolved black colour from this sample could not be identified by the method used in the present investigation (no HPLC peak).

The semiquantitative determination of the identified colourants revealed that the investigated samples contained 6–4479 p.p.m. CI 11920, <2–2391 p.p.m. CI 15850, <2–800 p.p.m. CI 13015, <2–103 p.p.m. CI 45220, 6–55 p.p.m. CI 45100, <2–35 p.p.m. CI 75300 and 217 p.p.m. CI 15525 in the samples (Table 1). The contents of the remaining identified colourants in the picture tattoos were <12 p.p.m.

Discussion

The chemical analysis of 36 picture tattoos stickers revealed that only a limited number of colourants were used in the formulation of these products: CI 15850, CI 11920, CI 45220, CI 75300, CI 74180, CI 13015, CI 45100, CI 14815, CI 15225, CI 16255 and CI 42170. All of these

colourants are permitted for the use in cosmetics according to the Cosmetic Directive (2). However, CI 45100 and CI 45220 should only be used in products, which come in contact with the skin for a short period. The maximum concentration of 7 of the identified colourants (CI 11920, CI 15850, CI 13015, CI 45220, CI 45100, CI 75300 and CI 15525) in the picture tattoos was 35–4479 p.p.m. The content of the remaining identified colourants in the picture tattoos was <12 p.p.m.

The most commonly used colourant in the picture tattoos, i.e. CI 15850 was present in 31/33 (94%) of the samples at a concentration up to 2391 p.p.m. The EU Scientific Committee of Cosmetic Products and Non-Food Products (SCCNFP) has performed a risk assessment of this colourant in May 2004 (3) and concluded on the basis of standard animal sensitization tests that CI 15850 was not a sensitizer. However, using non-standard methods, CI 15850 was reported to be a sensitizer (4), and in a Japanese report, single cases of allergy from lipstick probably containing CI 15850 (pigment 57) have been described (5). In 1 case, the allergic reaction was due to impurities in the pigment.

CI 75300, also known as curcumin (6), was present in 4 of the 33 investigated picture tattoos at a concentration up to 35 p.p.m. This colourant is widely used in food, where it is a component of curry powder. Curcumin is also used for the colouration of the disinfecting liquids that are used before surgery. There are a few reports of allergy from this colourant in association with food/spice production (7, 8). In a study in which 25 patients were investigated for allergy to anaesthetics, allergy in 2 patients was recorded due to curcumin (CI 75300) present in the disinfecting liquid that was used before the surgery. The concentration of the colourant in the disinfecting liquid causing allergic reaction was 0.05% (500 p.p.m) (9). The maximum concentration of CI 75300 in the picture tattoos was found to be 35 p.p.m., which is at least 10 times lower than the concentration of the colourant in disinfecting liquid responsible for allergic reaction. There is no report of curcumin allergy by the use of picture tattoos, possibly due to less frequent use and low concentration of this colourant in picture tattoos compared to that in the disinfecting liquids.

CI 11920 and CI 45100 have been analysed by QSAR to determine whether these can induce allergic reactions in humans (10). The chemical structure of CI 11920 indicates that it may be a moderate-to-strong allergen. However, there is no information on allergic reactions in humans from the use of CI 11920. CI 45100 has been

classified as a weak allergen on the basis of physical chemical characteristics (10), but it produced negative results in animal tests for the sensitization potential employing a validated method (11).

No information concerning allergenic potential of the colourants CI 45220, CI 13015 and CI 15525, neither in animal tests nor in humans, was found. These colourants might have been investigated, but the results are not published.

The black colour could not be identified in 3 picture tattoos, which were composed of only this colour (visible). Paraphenylenediamine (PPD) is used as colouring agent in black temporary tattoos (12, 13) and in hairs dyes, and that is known as a potent contact allergen. Therefore, 1 of the black picture tattoos was investigated for the content of PPD employing a previously described method (14). PPD was not detected in the sample at a detection limit of 2 p.p.m.

The Danish EPA has received a few complaints about children getting skin reactions from the use of picture tattoos. The aetiology of these skin reactions is not known. To our knowledge, no cases of allergic skin reaction from transferable picture tattoos have been published so far. On the basis of the present investigation, it is concluded that the risk of allergic reactions from the identified colourants in transferable picture tattoos seems to be limited.

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