

# The influence of hydrogen peroxide on the permeability of protective gloves to resorcinol in hairdressing

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## Summary

**Background.** Hairdressers are exposed to hair dye chemicals, for example resorcinol and hydrogen peroxide. Adequate skin protection is an important preventive measure against occupational skin disease.

**Objectives.** To examine whether hydrogen peroxide may cause deterioration of protective gloves.

**Methods.** Permeation of resorcinol through gloves of polyvinylchloride (PVC) ( $n = 8$ ), natural rubber latex (NRL) ( $n = 5$ ) and nitrile rubber (NR) ( $n = 5$ ) was studied in a two-compartment cell, with resorcinol as an indicator for hair dyes. The amount of resorcinol that had permeated was analysed with a high-performance liquid chromatography instrument. Cumulative breakthrough time and permeation rate were compared for hydrogen peroxide-pretreated and untreated gloves.

**Results.** The cumulative breakthrough time was  $> 1$  hr but  $< 4$  hr for all tested gloves. Pretreatment of PVC gloves resulted in a slightly decreased breakthrough time, and pretreatment of NRL gloves decreased the permeation rate. No change was recorded in NR gloves.

**Conclusions.** Treatment with hydrogen peroxide had a minor effect on permeation in the tested gloves. NR gloves provided the best protection. However, taking the allergy risk of rubber gloves into account, plastic gloves are recommended in hairdressing. PVC gloves may be used, but not for  $> 1$  hr. Disposable gloves should never be reused, regardless of material.

**Key words:** hair dyes; hairdressers; permeation; protective gloves; resorcinol.

Hairdressers face an increased risk of developing occupational hand eczema (1, 2), owing to factors such as frequent wet work and repeated manual contact with skin irritants and sensitizers. Dyeing is one of the most

common hair treatments today, and oxidative (also called permanent) hair dyes are the most common dyes on the world market (3–6).

Hair dye compounds such as *p*-phenylenediamine (PPD), toluene-2,5-diamine (TDA) and toluene-2,5-diamine sulfate (TDAS) are known sensitizers, but recent surveys have shown that modern hair dyes also contain other substances that are potent skin allergens (4, 7). Consumers and hairdressers are exposed to numerous such compounds during a single hair-dyeing procedure. The surveys showed that most hair dye formulations on the market contain resorcinol, another known sensitizer. According to the EU regulation on cosmetic products, the maximum concentration of resorcinol applied to hair must not exceed 1.25%.

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The chemical process of permanent hair dyeing is complex: primary intermediates such as PPD and TDA react with couplers such as resorcinol, forming larger molecules that become trapped inside the hair fibre, thus making the colour permanent. The hair dye compounds are mixed with hydrogen peroxide before they are applied to the hair. Hydrogen peroxide is used to trigger the hair dye reaction; it also removes the natural (or synthetic) colour of the hair, and enhances the penetration of the hair dye product into the hair shaft. Different concentrations (6–12%) of hydrogen peroxide are used (8).

Measurements of hairdressers' occupational skin exposure have shown that they are exposed to chemicals in hair dyes such as PPD, TDA and resorcinol during the application of dyes and also while cutting newly dyed hair (9). The amounts found on hairdresser's hands are great enough to pose a risk of sensitization or to elicit an existing contact allergy. It has also been shown that the use of protective gloves does not always reduce exposure to hair dye compounds. This could be attributable to a number of factors, including permeation through the glove material, penetration through holes or welded seams in the gloves, reuse of disposable gloves, or simple lack of knowledge about proper glove use.

The rate of permeation through materials may vary among brands and batches. In Sweden, the disposable gloves most commonly used by hairdressers are made of either natural rubber latex (NRL) or polyvinylchloride (PVC). Other glove materials found on the market and used by hairdressers are polyethylene and nitrile rubber (NR); the latter is recommended by the Research Centre for Hairdressers and Beauticians in Denmark (10).

The permeation of hair dye compounds through the protective gloves used by hairdressers has previously been investigated (11); in that study, several pure hair dye compounds were studied separately. However, as mentioned earlier, hydrogen peroxide is added to hair dye mixtures prior to their application. It has been suggested, or speculated, that hydrogen peroxide may cause deterioration of the glove material and influence the protective effect of the glove. Several studies have shown that exposure to various compounds may have a destructive effect on protective gloves (12).

The aim of this study was to investigate the influence of hydrogen peroxide on the rate of permeation of resorcinol through the protective gloves used by hairdressers. Resorcinol may be regarded as a representative substance for hair dye exposure, and in the present study it was used as an indicator for measuring the permeation of hair dye compounds through protective gloves.

**Table 1.** Description of the protective glove materials tested for resorcinol permeation

| Glove material<br>(all powder-free) | Product<br>trade name | Manufacturer/<br>distributor                                                    | Thickness<br>(mm)<br>mean $\pm$ SD |
|-------------------------------------|-----------------------|---------------------------------------------------------------------------------|------------------------------------|
| Polyvinylchloride                   | Evercare Soft         | Selefa Trade AB,<br>Spånga, Sweden                                              | 0.12 $\pm$ 0.005                   |
| Natural rubber<br>latex             | Black Touch           | Hercules Sägemann,<br>Hamburg/STUK,<br>Germany                                  | 0.17 $\pm$ 0.008                   |
| Nitrile rubber                      | Abena<br>Hospicare    | Abena Production,<br>Aabenraa,<br>Denmark/Finess<br>Hygiene AB, Kisa,<br>Sweden | 0.10 $\pm$ 0.005                   |

SD, standard deviation.

## Materials and Methods

### Gloves

Three different kinds of disposable, non-powdered protective gloves used by hairdressers in Sweden and Denmark at the time of the investigation were tested for resorcinol permeation. NRL and PVC gloves were provided by distributors in Sweden who also provide protective gloves to hairdressers, and the NR gloves recommended by the Research Centre for Hairdressers and Beauticians in Denmark (10) were provided by the Swedish distributor of those gloves. Details regarding the gloves are shown in Table 1. One circular piece (~5 cm in diameter) was cut from one side of the unused glove, just beneath the base of the thumb. The other side of the same glove was pretreated with hydrogen peroxide immediately before the permeation test was performed (Fig. 1), and after pretreatment one circular piece (~5 cm in diameter) was cut from the pretreated area just beneath the base of the thumb. The surface area of the exposed membrane (given by the design of the test cell) was 0.865 cm<sup>2</sup>. Before the sample was placed in the test cell, the thickness of the material was measured at five points, one central and four peripheral, according to ISO 4648 (23529:2004), with a spring-loaded caliper (Oditest; Kroeplin, Schlüchtern, Germany). The mean thickness and the standard deviation were calculated for each material.

### Chemicals

The following chemicals were used: resorcinol (CAS no. 108–46–3) (99%) from Lancaster Synthesis (Lancaster, UK); L( $\alpha$ )-ascorbic acid p.a. (CAS no. 50–81–7) (99.7%); sodium tetraborate decahydrate (CAS no. 1303–96–4)

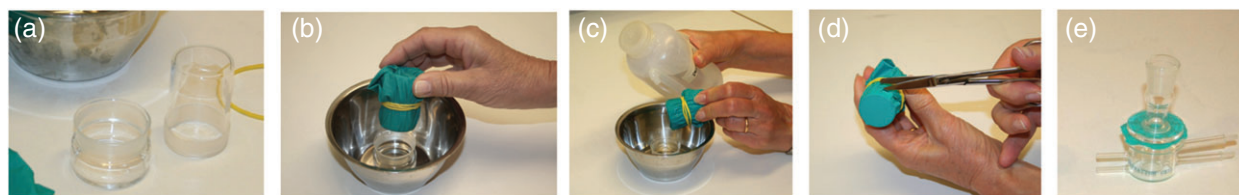


**Fig. 1.** Pretreatment with hydrogen peroxide of a piece of unused glove performed before testing permeation in a two-compartment permeation cell. (a) The lid of a weighing glass with hydrogen peroxide solution and the bottom of the weighing glass. (b) The piece of glove fixed around the bottom of the glass is placed into the hydrogen peroxide solution. (c) Rinsing with water after 15 min. (d, e) Hydrogen peroxide-exposed part removed (d) and mounted in the two-compartment cell (e).

(> 99%); methanol [LiChrosolv, high-performance liquid chromatography (HPLC) grade > 99.8%]; and hydrochloric acid (37%) from Merck KGaA (Darmstadt, Germany). Pure water (15 M $\Omega$ /cm quality) was obtained with a PURELAB Option R7 system from Elga LabWater (High Wycombe, UK). Buffer solution (pH 8.0) was prepared by mixing 0.1 M hydrochloric acid and 0.05 M sodium tetraborate (13). Standard solutions of resorcinol were prepared in buffer, and ascorbic acid was added as an antioxidant to a final concentration of 0.2 M.

#### Pretreatment of glove material with hydrogen peroxide

The pretreatment of pieces of glove materials with hydrogen peroxide is illustrated in Fig. 1. For this process, a weighing glass was used (Fig. 1a). The lid was filled with 6% or 30% hydrogen peroxide solution, and a piece of each glove was then wrapped around the outside of the bottom of the glass, the outside of the glove facing outwards. The assembly was then dipped into the hydrogen peroxide solution in the lid (Fig. 1b). After 15 min of exposure to hydrogen peroxide, the glove was rinsed with deionized water (Fig. 1c). The hydrogen peroxide-exposed part of the glove was then removed (Fig. 1d) and placed in a permeation cell (Fig. 1e).

#### Permeation test

The permeation through gloves made of PVC, NRL and NR was tested with a two-compartment LGA-1084-SPC small penetration cell, made of glass (Laboratory Glass Apparatus, Berkeley, CA, USA) (Fig. 2). Pieces of gloves pretreated with either 6% or 30% hydrogen peroxide were compared with pieces of untreated gloves. The cumulative breakthrough time [time-lag breakthrough (Lag-BT); see below] and the steady-state permeation rate ( $P_s$ ) were calculated for each glove. The tests were performed at room temperature (20.5–23.8°C). The material to be tested was placed horizontally without tension as a barrier between the two compartments, the gloves' normal

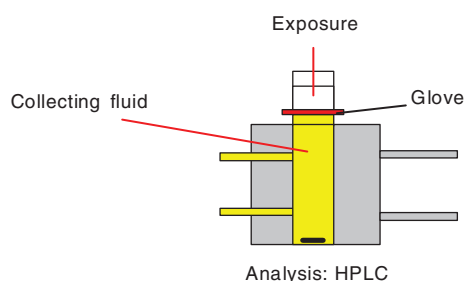


**Fig. 2.** Schematic drawing of a two-compartment cell (LGA-1084-SPC). HPLC, high-performance liquid chromatography.

outside surface facing the exposure compartment. The exposure compartment contained the exposure solution, and the collecting compartment contained 0.2 M ascorbic acid in buffer solution as a collecting fluid. The total volume of the collecting fluid was 3.6 ml. The collecting fluid was continuously mixed with a magnetic stirring bar in the collecting compartment. The exposure solution was 10% resorcinol in borate buffer, with 0.2 M ascorbic acid. Each experiment was repeated five times consecutively.

#### Sampling

Aliquots of 200  $\mu$ l were taken from the collecting medium at 15-min intervals and placed in vials prior to HPLC analysis. We added 200  $\mu$ l of buffer solution with 0.2 M ascorbic acid to the collecting chamber to make up the volume of the collecting fluid. A sample of the collecting fluid was taken immediately before the start of each experiment in order to check for possible contamination.

#### Chemical analysis

The samples were analysed with an HPLC instrument consisting of a pump, solvent degasser, autosampler, column oven, and diode-array detector (Merck Hitachi LaChrome D-7000 HPLC; Merck KGaA). The column was a Merck ChromoLith Performance RP-18

**Table 2.** The arithmetic means and standard deviations for time-lag breakthrough (Lag-BT) and steady-state permeation rate ( $P_s$ ) for resorcinol permeation through untreated gloves and gloves pretreated with hydrogen peroxide

| Permeation                       | PVC glove            |                                 |                                       | NRL glove            |                                      | NR glove             |                                 |
|----------------------------------|----------------------|---------------------------------|---------------------------------------|----------------------|--------------------------------------|----------------------|---------------------------------|
|                                  | Untreated<br>(n = 5) | Treated <sup>a</sup><br>(n = 5) | Treated <sup>b</sup><br>(n = 3)       | Untreated<br>(n = 5) | Treated <sup>b</sup><br>(n = 5)      | Untreated<br>(n = 5) | Treated <sup>b</sup><br>(n = 5) |
| Lag-BT (min)                     | 99.3 ± 7.7           | 98.4 ± 5.6<br><i>p</i> = 0.841  | 89.0 ± 1.2<br><b><i>p</i> = 0.039</b> | 155.4 ± 9.1          | 158.2 ± 10.5<br><i>p</i> = 0.052     | 222.7 ± 6.3          | 221.1 ± 4.9<br><i>p</i> = 0.350 |
| $P_s$ (nmol/cm <sup>2</sup> min) | 3.1 ± 0.5            | 3.0 ± 0.7<br><i>p</i> = 0.848   | 3.0 ± 0.5<br><i>p</i> = 0.825         | 1.7 ± 0.7            | 1.2 ± 0.6<br><b><i>p</i> = 0.045</b> | 2.2 ± 1.1            | 2.4 ± 1.2<br><i>p</i> = 0.492   |

NR, nitrile rubber; NRL, natural rubber latex; PVC, polyvinylchloride.

*p*-Values for the comparison of untreated gloves with pretreated gloves are shown. Statistically significant differences (*p* < 0.05) are in bold type.

<sup>a</sup>Pretreated with 6% hydrogen peroxide.

<sup>b</sup>Pretreated with 30% hydrogen peroxide.

100 × 4.6 mm<sup>2</sup>. The sample volume was 10 µL. The column temperature was 30°C. External standards of the tested chemical were used to calculate the concentration in the sample. The wavelength used for detection was 201 nm. The detection limit was 0.2 nmol/mL. The minimum detectable mass that permeated was 1.06 nmol/cm<sup>2</sup> (which corresponds to 0.12 µg/cm<sup>2</sup> for resorcinol).

#### Calculation of permeation rate, lag breakthrough time, and permeation coefficient

$P_s$  was calculated as the slope of the curve obtained by plotting the amount of chemical that cumulated in the collecting medium against time. This formula can be derived from Fick's law (13, 14). The breakthrough time is the elapsed time (in minutes) between the initial application of a test chemical in the exposure compartment and its subsequent presence on the other side of the material. The cumulative breakthrough, called the time-lag breakthrough (Lag-BT), was calculated as the interception of the linear portion at  $P_s$  with the *x*-axis. The Lag-BT is independent of the detection limit of the analytical method. This is in contrast to breakthrough time, which decreases with a decreasing detection limit of the analytical method chosen.

The amount of test chemical that had permeated through the glove material after *t* min was calculated as  $Q_t = (t - t_{\text{Lag-BT}}) \times P_s$ . The permeation coefficient (*L*) was calculated as  $L = P_s / C_e$ , where  $C_e$  is the concentration of the test chemical in the exposure compartment.

The tests ended after 5 hr, except when  $P_s$  was achieved sooner.

#### Statistical methods

To compare Lag-BT and  $P_s$  for the untreated and pretreated gloves, we used Student's *t*-test (two-sided distribution, paired observations). For PVC gloves, we used

Student's *t*-test (two-sided distribution, unpaired observation) to compare untreated gloves and gloves treated with 30% hydrogen peroxide.

## Results

#### Time-lag breakthrough and steady-state permeation rate

Lag-BT and  $P_s$  for the untreated and treated glove materials are shown in Table 2. The permeation curves are shown in Fig. 3. All of the tested gloves had a Lag-BT of > 1 hr, but had been permeated by resorcinol within 4 hr. For the PVC glove, we found a statistically significant decrease in Lag-BT for the samples pretreated with 30% hydrogen peroxide, but no increase in permeation rate could be seen after pretreatment with hydrogen peroxide. The NRL gloves showed a statistically significant decrease in permeation rate after exposure to hydrogen peroxide but no change in the Lag-BT. Pretreatment of the NR glove had no effect on the Lag-BT or permeation rate.

#### Estimated amount permeated and permeation coefficients

Table 3 shows the estimated amount of resorcinol that permeated (*Q*) the three different gloves. The NR glove had the lowest *Q*; after 240 min, *Q* for the NR glove was approximately 10-fold lower than *Q* for the PVC glove, and approximately one-third to half of *Q* for the NRL glove. Pretreatment with hydrogen peroxide slightly decreased the permeation coefficients (cm/min) for the NRL glove (Table 4).

## Discussion

The permeation of resorcinol through gloves used by hairdressers was tested with a two-compartment-cell method.

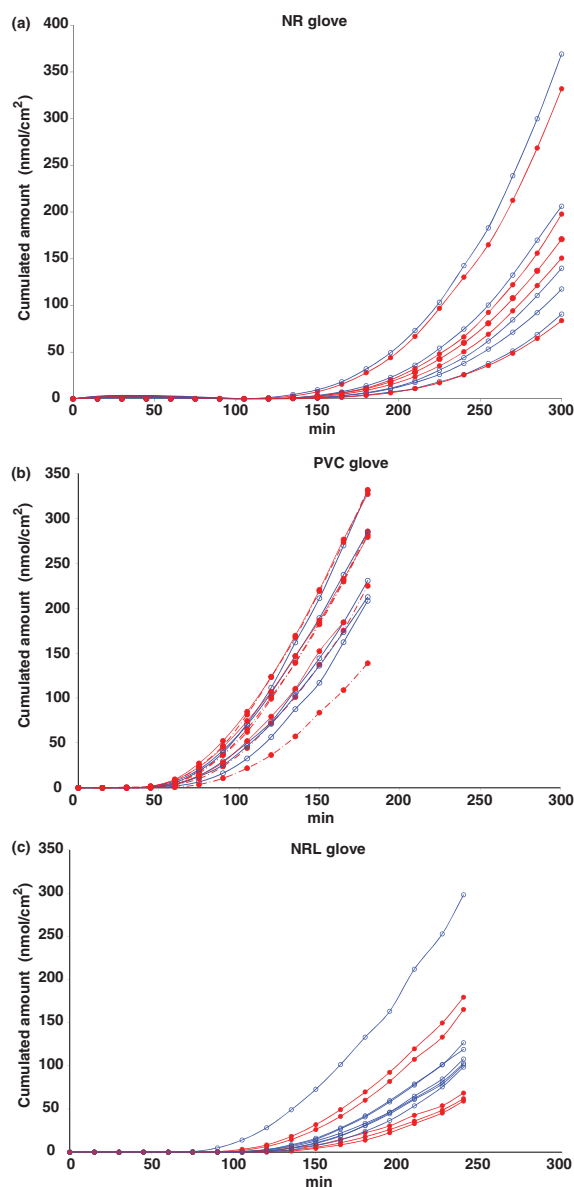


**Fig. 3.** Permeation curves for resorcinol permeation through gloves treated with hydrogen peroxide and through untreated gloves: (a) nitrile rubber (NR), (b) polyvinylchloride (PVC), and (c) natural rubber latex (NRL). Treated gloves: filled data points are red (dashed line for 6% hydrogen peroxide and continuous line for 30% hydrogen peroxide). Untreated gloves: unfilled data points are blue.

The possible influence on permeation of hydrogen peroxide, an oxidizing agent used during hair dyeing, was investigated. The tested gloves were made of PVC, NRL, and NR. All of the tested gloves had a Lag-BT of >1 hr, which is consistent with findings in previous studies (11). The NR glove gave the best protection against permeation, followed by the NRL glove; the PVC glove was pretreated with

both 6% and 30% hydrogen peroxide; here, we found a statistically significant decrease in the Lag-BT after treatment with 30% hydrogen peroxide but no effect  $P_s$ .

The NRL glove had the lowest  $P_s$ , and a statistically significant decrease in permeation rate after treatment with 30% hydrogen peroxide was found.  $P_s$  values for the PVC and NR gloves were not affected by the treatment; the PVC glove had the highest permeation rate. After treatment with hydrogen peroxide, a decrease in the permeation coefficient for the NRL glove was found, indicating that hydrogen peroxide affected the membrane.

The NR glove gave better protection against resorcinol permeation than did the NRL glove, even though the NRL glove was thicker. The PVC glove offered the lowest protection against resorcinol, showing the lowest Lag-BT and the highest permeation rate; furthermore, treatment with hydrogen peroxide affected the glove material in a negative way.

The PVC glove was treated with both 6% and 30% hydrogen peroxide. We started with the lower concentration, and because no effect on permeation was seen we used a higher concentration in subsequent experiments in order to detect any potentially deleterious influence. During hair dyeing in salons, the concentration of hydrogen peroxide is most frequently between 6% and 12%.

In this study, we chose resorcinol as an indicator substance for hair dyes; the results are presumably representative of other hair dye compounds with similar chemical properties, such as molecular weight and water/lipid partitioning. It is difficult to conclude whether the observed effect would be the same for hair dye compounds with a greater molecular weight; to our knowledge, no such studies have been performed.

Glove resistance to permeation by chemicals should be tested according to EN 374-3, a CEN standard (15). A standard test method has been designed for testing of glove materials under laboratory conditions, and can only be regarded as a method for comparing different gloves and glove materials; it is not intended to represent all conditions likely to occur during working situations. The test methods are useful for studying the influence on permeation of important factors such as material thickness, quality, and formulation. Test cell and design, the collecting medium, the sensitivity of the analytical equipment or system and the test temperature are method-dependent factors that can influence the permeation test results (13). The present study was performed as a series of experiments under identical experimental conditions, with the same batch for each type of glove. This allows for a detailed comparison of the influence of hydrogen peroxide on the resorcinol penetration of different glove materials.

**Table 3.** Estimated amount of resorcinol that had permeated ( $Q$ ) (nmol/cm<sup>2</sup>) after 120 and 240 min

| Time (min) | PVC glove            |                                 |                                 | NRL glove            |                                     | NR glove             |                                 |
|------------|----------------------|---------------------------------|---------------------------------|----------------------|-------------------------------------|----------------------|---------------------------------|
|            | Untreated<br>(n = 5) | Treated <sup>a</sup><br>(n = 5) | Treated <sup>b</sup><br>(n = 3) | Untreated<br>(n = 5) | Treated <sup>b</sup><br>(n = 5)     | Untreated<br>(n = 5) | Treated <sup>b</sup><br>(n = 5) |
| 120        | 65                   | 68                              | 94<br>$p = 0.170$               | 0                    | 0                                   | 0                    | 0                               |
| 240        | 441                  | 434                             | 459<br>$p = 0.776$              | 141                  | 97<br><b><math>p = 0.046</math></b> | 42                   | 49<br>$p = 0.435$               |

NR, nitrile rubber; NRL, natural rubber latex; PVC, polyvinylchloride.

$$Q_t = (t - t_{\text{Lag-BT}}) \times P_s$$

$p$ -Values for the comparison of untreated gloves with treated gloves are shown. Statistically significant differences ( $p < 0.05$ ) are in bold type.

<sup>a</sup>Pretreated with 6% hydrogen peroxide.

<sup>b</sup>Pretreated with 30% hydrogen peroxide.

**Table 4.** Permeation coefficients (cm/min) for the tested gloves

|  | PVC glove             |                                      | NRL glove                            |                                 | NR glove                                               |                                      |
|--|-----------------------|--------------------------------------|--------------------------------------|---------------------------------|--------------------------------------------------------|--------------------------------------|
|  | Untreated<br>(n = 5)  | Treated <sup>a</sup><br>(n = 5)      | Untreated<br>(n = 5)                 | Treated <sup>b</sup><br>(n = 5) | Untreated<br>(n = 5)                                   | Treated <sup>b</sup><br>(n = 5)      |
|  | $3.44 \times 10^{-6}$ | $3.34 \times 10^{-6}$<br>$p = 0.847$ | $3.36 \times 10^{-6}$<br>$p = 0.825$ | $1.84 \times 10^{-6}$           | $1.31 \times 10^{-6}$<br><b><math>p = 0.045</math></b> | $2.42 \times 10^{-6}$<br>$p = 0.492$ |

NR, nitrile rubber; NRL, natural rubber latex; PVC, polyvinylchloride.

The permeation coefficient ( $L$ ) was calculated as  $L = P_s/C_e$ , where  $C_e$  is the concentration of the test chemical in the exposure solution.

$p$ -Values for the comparison of untreated gloves with pretreated gloves are shown. Statistically significant differences ( $p < 0.05$ ) are in bold type.

<sup>a</sup>Pretreated with 6% hydrogen peroxide.

<sup>b</sup>Pretreated with 30% hydrogen peroxide.

In a previous study, our research group tested the permeation of PPD, TDAS and resorcinol through protective gloves used by hairdressers (11). We found that the Lag-BT of resorcinol for the NR glove was 183 min, and for the PVC glove it was 90 min, whereas for the NRL glove no breakthrough occurred during the 4 hr for which the gloves were tested. In the previous study and the present study, the gloves to be tested were selected from inventories of the brands most frequently used by hairdressers in Stockholm during the years 2002 and 2009, respectively. Only for the PVC gloves did we examine the same brand in both studies; here, we found the same magnitude of Lag-BT and  $P_s$  both times. However, the NRL and NR gloves tested in this study were not the same as those used in the first study; the Lag-BT and  $P_s$  for these gloves differed between the two studies. It is known that resistance to permeation can vary in gloves of different brands; the two different NRL gloves, for example, differed in material thickness. In our previous study, the NRL glove showed the best resistance against permeation, but in this study the NR glove fared better; this can be explained by the fact that the NRL glove in the present study was thinner than that used in the first study. According to our inventories in 2002 and 2009, most hairdressers in Stockholm use

gloves made of PVC or NRL, and presumably this applies also for the majority of the hairdressers in Sweden. In Denmark, the majority use gloves made of either PVC or NRL, according to a survey by Lysdal et al., whereas 22% reported using NR gloves (16). The NR glove selected for this study was the same brand as that used by many hairdressers in Denmark, following a recommendation by the Research Centre for Hairdressers and Beauticians in Denmark (10). This is a so-called accelerator-free glove, which reduces the risk of contact allergy being caused by the glove; however, like all rubber gloves, this glove must contain rubber additives.

Leakage through pinholes or welded seams can decrease the protective effect of a glove. All of the gloves tested in this study had an acceptable quality level of 1.5, which means that, on average, 1.5% of the gloves can be defective because they contain pinholes. Some of our permeation tests were aborted because of leakage through such holes in the material; some holes could be seen with the naked eye, and these gloves were excluded from testing.

We consider the small differences in permeation of resorcinol (and probably other hair dye substances) caused by glove exposure to hydrogen peroxide to be of

minor significance as compared with hairdressers' overall exposure scenario. There are many potential causes of exposure to hair dyes and other compounds in the hair-dressing environment; among them are contamination of gloves, contact with contaminated surfaces, direct exposure to newly formed hair dye products while mixing the hair dye cream with hydrogen peroxide, and exposure to dyed hair.

Excessive glove use can also cause impairment of the skin barrier, contact allergy to rubber chemicals, and IgE-mediated allergy to latex proteins (17).

Gloves can provide a sense of protection against hair dyes that becomes a sense of false security if hair dye compounds permeate through or penetrate the gloves. It is also important for the wearer's hands to be clean before gloves are put on. The gloves should be disposable, and they should be changed frequently. All of these factors must be considered when the risks of hair dye use among hairdressers are assessed. The predominant route of exposure to hair dye compounds is probably through the skin, because these compounds are non-volatile; adequate skin protection is most likely the best way to avoid exposure to these substances. Personal protective equipment, such as gloves, should be compulsory for hairdressers while they perform many of their work tasks.

## Conclusion

Treatment with hydrogen peroxide had very little effect on the gloves' resistance to permeation ( $L_{ag-BT}$  or  $P_g$ ). NR gloves provided the best protection. However, all three tested glove materials are approved according to the CEN standard for testing permeation of chemicals through protective gloves. Therefore, we conclude that all of the tested gloves give good protection against hair dye exposure during hair dyeing. As the PVC gloves do not contain rubber allergens, we suggest that PVC is the best choice for gloves in order to minimize the risk of contact allergy resulting from hair dyeing. Hairdressers should use disposable gloves and discard them when they are taken off. It is important to remember that disposable glove should never be reused, regardless of material.

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