

Self-testing for contact allergy to hair dyes – a 5-year follow-up multicentre study

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Summary

Background. In 2011, a multicentre study was conducted in order to determine how hair dye manufacturers instructed consumers to perform a self-test prior to dyeing their hair, in order to identify individuals who are likely to react upon subsequent hair dyeing. A number of concerns were raised concerning the variability in instructions between products and producers, and the safety and validity of this tool.

Objectives. To perform a 5-year follow-up study in order to determine whether manufacturers still recommend a self-test, and if so, whether the procedures have been changed.

Methods. During March 2016, a total of 40 oxidative hair dye products from 21 different manufacturers were bought in retail stores in 8 European countries.

Results. The consumers were instructed to perform a self-test prior to hair dyeing for 39 of the products; however, the procedures varied greatly regarding the method of application, the amount of hair dye applied, the location and size of the application area, the number of applications, whether or not rinsing was performed after application, the reading times, and how a positive reaction was defined.

Conclusions. Self-testing is still recommended by almost all manufacturers of permanent hair dyes. There are major variations in the instructions, even in products from the same manufacturer. The previously raised concerns regarding safety and validity still remain.

Key words: allergy alert test; hair dyes; self-test; self-testing; skin alert test.

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Hair dyes contain different substances, some with allergenic properties (1–4), such as *p*-phenylenediamine (PPD) (CAS no. 106-50-3), toluene-2,5-diamine (CAS no. 95-70-5), *p*-aminophenol (CAS no. 123-30-8), resorcinol (CAS no. 108-46-3); hair bleaching products contain the persulfates [ammonium persulfate, potassium persulfate, and sodium persulfate (CAS nos. 7727-54-0, 7727-21-1, and 7775-27-1, respectively)] (5–8). In 2006, the European Commission's Scientific Committee on Consumer Products (SCCP) published a memorandum on substances in hair dyes and their skin-sensitizing properties,

in which 27 substances met the EU criteria for classification as a skin sensitizer (R43/H317) (9). In 2013, the SCCP updated this memorandum, which now contains a list of 114 hair dye chemicals, of which 13 were classified as extreme sensitizers, 23 as strong sensitizers, and 20 as moderate sensitizers, based on Organization for Economic Co-operation and Development (OECD) test guideline methods. This meant that 56 substances used in hair dyes met the EU criteria for skin sensitizers (R43/H317) (10). The SCCP stated that substances with the R43/H317 classification may not be safe for the consumer, especially those that are categorized as extreme and strong sensitizers. This implies that there is a risk for consumers of becoming sensitized, which is in accordance with the clinical experience that hair dyes sometimes cause severe allergic symptoms in consumers/customers and hairdressers (6, 7).

In 2011, a multicentre study was conducted in order to determine how hair dye manufacturers instructed consumers to perform a self-test (also called the 'allergy alert test' by industry) prior to dyeing their hair, in order to identify individuals who are likely to react upon subsequent hair dyeing (11). A number of concerns were raised concerning the variability in instructions between products and producers, and generally questioning the safety and validity of this tool. The EU Commission held a workshop on 'Skin Sensitivity Test' in April 2011 to help manufacturers address these issues. The aim of this study was to perform a 5-year follow-up to determine whether manufacturers still recommend a self-test, and if so, whether the procedures have been standardized.

Materials and Methods

During March 2016, a total of 40 permanent hair dye products from 21 different manufacturers were bought in retail stores in eight countries (Belgium, Denmark, France, Germany, Norway, Spain, Sweden, and the United Kingdom). For 39 of 40 (97.5%) products from 21 manufacturers [Bysalerm, Casual Spa, Clairol, Eugène, Eugene Perma Paris, FarmaVita, Frank Provost, Garnier, Hardford Sweden, 'Jihanna Laboratorium Kosmetyczne, Joanna Sp. Poland', Llongueras Colomer, L'Oreal, L'Oreal professional, Naturigin Organic Beauty, Phergal, Schwarzkopf, Syoss, TAHE, Tigi Int., Vitanove & Pascal Coste (Marque repère Eleclerc), and Wella], the consumer was instructed to perform a self-test prior to hair dyeing. Thirty-five of the products were commercially available, and five were for professional use, the latter all being bought in Belgium. We investigated instructions in the product leaflets for the self-test procedure for 'amount of hair dye and suggested area size', 'place of test',

're-application', 'rinsing', 'resting time', and 'definition of a positive allergic reaction'.

Results

There was much variation in the instructions (Table 1). Three instructions stated that the colouring agent should be oxidized, supposedly by mixing colouring agent and developer, five suggested that a mixture of colouring agent and developer should be applied, and the rest suggested applying only the colouring agent or dyeing product (cream). The amount of hair dye to be applied on the skin was described as 'sufficient', 'a small amount', 'a touch of', 'a pinch of', 'some', or 'a thin layer'. The suggested sites for performance of the self-test were behind the ear, the earlobe, the elbow flexure, the upper arm, and no advice at all. The suggested sizes of the skin area for application were 'not specified', 1–2 cm², size of a EURO cent coin (2.1 cm²), size of a Danish one-crown coin (3.2 cm²), size of a Norwegian one-crown coin (3.5 cm²), and size of a Swedish 10-crown coin (3.3 cm²). For 10 (35.7%) of the products, up to three applications were recommended, with reapplications 'after drying'. No applicator was suggested for four products, a piece of cotton wool was suggested for one, and a cotton bud was suggested for the others. For 13 (32.5%) products no rinsing was recommended, for one product rinsing was to be performed after 30 min, for 13 products rinsing was to be performed after 45 min, and for 12 products rinsing was to be performed after 48 h. The time before rinsing differed not only between the different manufacturers, but also between products from the same manufacturer (Table S3). The time before reading was 48 h in all cases; for two products, readings were also recommended after 45 min and after 24 h, respectively. There was no consistent description of how a positive reaction should look, but the terms redness, itchy and swelling were mentioned in most of the product leaflet instructions.

Discussion

The results of this study show that no progress has been made in the last 5 years (Fig. 1) (11). The instructions still vary considerably, even more than in the previous investigation, and even between different hair dye products from the same manufacturer. The sample size in 2011 was relatively small, being 17 different products from 13 different manufacturers, bought in 6 countries. This follow-up study is much larger, including 40 different hair dye products from 21 different manufacturers, bought in 8 different countries, and is therefore considered to be more representative. The leaflets were analysed concerning the same issues related to performing the

Table 1. Overview of the allergy self-test instructions found inside the 40 different hair dye products bought in the eight different countries^a

Amount of hair dye and suggested area size	Place of test	Number of applications and, if mentioned, when	Rinsing	Resting time	Definition of positive allergic reaction
Apply 'sufficient amount' (n = 10)					
2 cm ² (n = 1)	No suggestions (n = 1)	Not specified – repeated two or three times (n = 1)	No rinse (n = 1)	48 h (n = 1)	Itch, pain, burning sensation, erythema, swelling (n = 1)
One-crown coin ^b (n = 3)	Behind the ear (n = 3)	After drying – repeated two times (n = 3)	After 48 h (n = 3)	Up to 48 h (n = 3)	Non-normal reaction such as itch, redness, or swelling at or around the area (n = 3)
A Euro cent coin ^c (n = 1)	Behind the earlobe (n = 1)	Not specified – repeated two times (n = 1)	No rinse and no cover (n = 1)	Up to 48 h (n = 1)	Itch, erythema. Specification: do not use if the age is < 16 years (n = 1)
1 cm ² (n = 4)	Inner elbow (n = 1)	Not specified – repeated one time (n = 1)	No rinse (n = 1)	Up to 48 h (n = 1)	Burning sensation, erythema (n = 1)
	No suggestions (n = 1)	Not specified – repeated two times (n = 1)	No rinse (n = 1)	Up to 48 h (n = 1)	Burning sensation, erythema (n = 1)
	No suggestions (n = 1)	Not specified – repeated two or three times (n = 1)	No rinse (n = 1)	48 h (n = 1)	Itch, erythema (n = 1)
	Behind the earlobe (n = 1)	Not specified – repeated one time (n = 1)	No rinse (n = 1)	Up to 48 h (n = 1)	Itch, erythema. Specification: do not use if the age is < 16 years (n = 1)
	Behind the earlobe (n = 1)	Not specified – repeated three times (n = 1)	No rinse (n = 1)	Up to 48 h (n = 1)	Itch, erythema (n = 1)
Sufficient amount of colouring agent (n = 4)					
1–2 cm ² (n = 1)	Behind the earlobe (n = 1)	Two times (n = 1)	No rinse (n = 1)	48 h (n = 1)	Itching, redness, swelling (n = 1)
A Euro cent coin ^c (n = 3)	Behind the ear (n = 3)	Two or three times (n = 1)	No rinse (n = 1)	48 h (n = 1)	Itching, redness, swelling (n = 1)
	Behind the ear (n = 1)	Repeated (n = 1)	No rinse (n = 1)	48 h (n = 1)	Itching, redness, swelling (n = 1)
	Behind the ear (n = 1)	Two times (n = 1)	No rinse (n = 1)	48 h (n = 1)	Itching, redness, swelling (n = 1)
Small quantity of colouring agent (n = 2)					
1 cm ² (n = 1)	Inner elbow (n = 1)	One time (n = 1)	After 45 min (n = 1)	48 h (n = 1)	Any reaction (n = 1)
1–2 cm ² (n = 1)	Forearm or behind the ear (n = 1)	One time (n = 1)	After 48 h (n = 1)	48 h (n = 1)	Itching, redness, swelling (n = 1)
Small quantity of unmixed colourant product (creme colourant tube) (n = 1)	Behind the ear (n = 1)	After drying – repeated two times (n = 1)	After 45 h (n = 1)	48 h (n = 1)	Any abnormal reactions, such as itching, redness or swelling in or around the test area (n = 1)
Small amount of colour cream in a thin layer (n = 1)	Inside of the elbow (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Any reaction (n = 1)
Small amount of colour cream (n = 1)	Inside of the elbow (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Redness or itch (n = 1)
Small amount of colour cream mixed with oxidizer in a thin layer (n = 1)	Inside of the elbow (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Any reaction (n = 1)

Table 1. Continued

Amount of hair dye and suggested area size	Place of test	Number of applications and, if mentioned, when	Rinsing	Resting time	Definition of positive allergic reaction
A thin layer (n = 1)	Inside of the elbow (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Any reaction (n = 1)
A touch of dyeing cream (n = 1)	Elbow crease, upper arm (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min, with warm water (n = 1)	Reading at 45 min and 48 h (n = 1)	Tingling, burning and blackout feeling, redness, itching, eczema, blister, swelling of eyes or face, weeping (n = 1)
A 'pinch' amount of colour cream and the activator (n = 1)	Inside of the elbow (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Any reaction (n = 1)
Not defined: some ('etwas') (n = 1)	No suggestions (n = 1)	Not applicable – repeated one time (n = 1)	Rinse thoroughly after 45 min	48 h (n = 1)	'Reactions' (n = 1)
Apply 'sufficient amount', not mixed (n = 2)	Behind the ear (n = 2)	After drying – repeated two times (n = 2)	Not mentioned. Area should not be touched, washed or covered for 48 h (n = 2)	48 h (n = 2)	Any abnormal reactions, such as itching, redness or swelling in or around the test area (n = 2)
Sufficient quantity (n = 2)	Behind the ear (n = 1) Behind the ear (n = 2)	After drying – repeated two times (n = 1) After drying – repeated two or three times (n = 2)	After 48 h (n = 1) Not mentioned. Area should not be touched, washed or covered for 48 h (n = 2)	48 h (n = 1) 48 h (n = 2)	Itching, redness, or skin rash, swelling (n = 1) Red or itchy or swollen skin (n = 2)
Small amount of colour cream in a thin layer (n = 2)	In the elbow fold (n = 2)	Not applicable – repeated one time (n = 2)	After 45 min, with warm water. Avoid covering and contact with textiles (n = 2)	48 h (n = 2)	Any reaction (n = 2)
Small amount of hair dye developer mixture ('révéléateur' – hydrogen peroxide) (n = 1)	Behind the ear or elbow crease (n = 1)	Not applicable – repeated one time (n = 1)	After 48 h (n = 1)	48 h (n = 1)	Redness, tingling feeling, itching, swelling of eyes or face (n = 1)
Thin layer of mixture	Just mentioned 'small surface' (n = 1) 1 cm ² (n = 1)	Not applicable – repeated one time (n = 1) One time (n = 1)	After 30 min (n = 1) After 45 min (n = 1)	48 h (n = 1) 48 h (n = 1)	Redness, tingling feeling, itching (n = 1) Any reaction (n = 1)

Table 1. *Continued*

Amount of hair dye and suggested area size	Place of test	Number of applications and, if mentioned, when	Rinsing	Resting time	Definition of positive allergic reaction
Sufficient amount of mixture (n = 1)	Behind the ear or elbow crease (n = 1)	One time (n = 1)	No rinse (n = 1)	48 h (n = 1)	Rash, stinging, itching (n = 1)
Unspecified quantity of the mixture (n = 1)	Behind the ear or elbow crease (n = 1)	Two or three times (n = 1)	No rinse (n = 1)	48 h (n = 1)	Any reaction (n = 1)
Not specified (n = 1)	Ten-crown coin ^d or 1 cm ² (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Swelling, itch, redness at or around the area (n = 1)
A small quantity of the hair dye as prepared for use (n = 1)	A small area of skin (n = 1)	Not applicable – repeated one time (n = 1)	After 48 h with soap and water (n = 1)	24 h and 48 h (n = 1)	Any reaction (such as swelling, redness, itching, eczema, or blistering) (n = 1)
Mix a small amount of tint and developer. Apply mixture to test area (n = 1)	1 cm ² (n = 1)	Not applicable – repeated one time (n = 1)	After 45 min (n = 1)	Up to 48 h (n = 1)	Any signs of rash, redness, swelling, burning, itching, or similar (n = 1)
No recommendations for a self-test (n = 1)	–	–	–	–	–

Purchase: March 2016, n = 40.

^aBelgium, Denmark, France, Germany, Norway, Spain, Sweden, and the United Kingdom.^bA crown coin could either be a Danish (~3.2 cm²) or a Norwegian (~3.5 cm²) one-crown coin.^cA EURO cent coin (2.1 cm²).^dA Swedish 10-crown coin (~3.3 cm²).

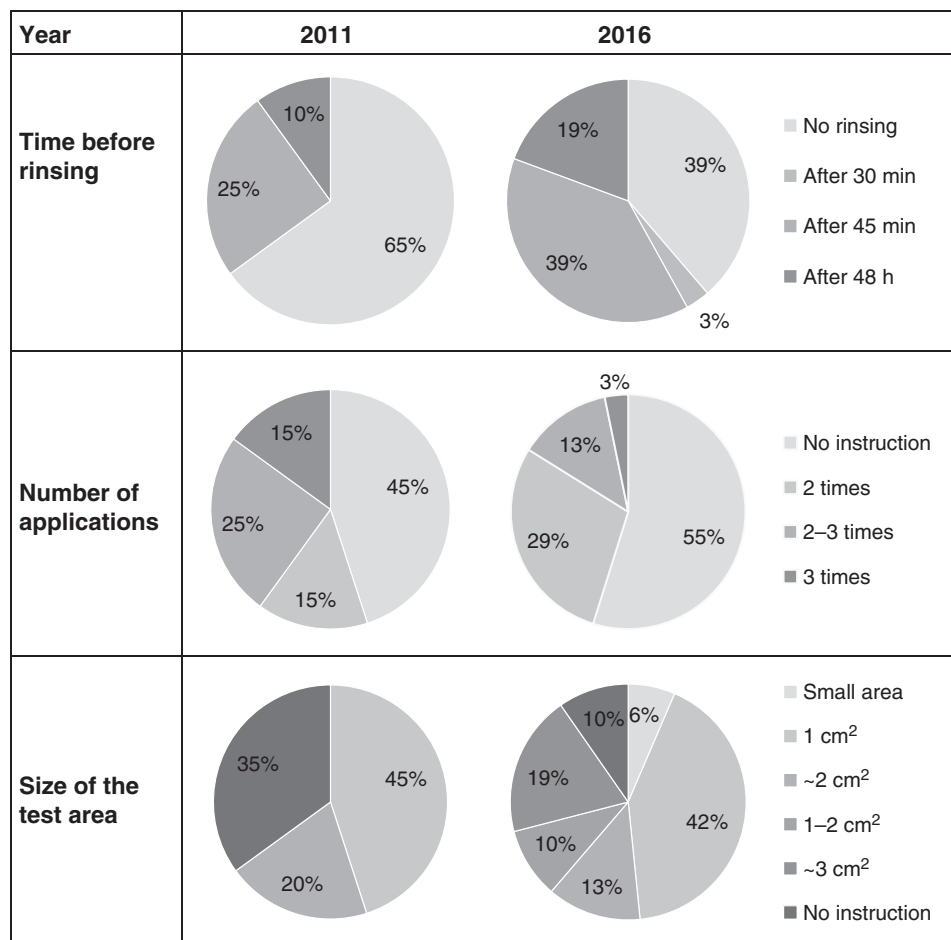


Fig. 1. Comparison between hair dye product instructions on how to perform the self-test before hair dyeing in 2011 and 2016. Values on the left are based on data in table 2 ($n = 20$) in Thyssen et al. (11). Values to the right are based on data in the current study ($n = 31$). The size of the test area was sometimes compared with the size of coins (Table 1).

self-test prior to hair dyeing as 5 years ago, namely, (i) the amount of hair dye applied, (ii) the number of applications, (iii) when to rinse, (iv) the resting time before reading, and (v) the definition of a positive reaction. Although several products were of the same brand and from the same manufacturer, major differences were still found in the instructions (Table 1 and Tables S1–S3). Cosmetics Europe – The Personal Care Association [the former European Cosmetics Toiletry and Perfumery Association (COLIPA)] advises hair dye manufacturers to recommend to the users of their products the self-test as a precaution against any allergic reaction to permanent hair dyes (12). Cosmetics Europe has made an on-line introduction on ‘how to do the 48 h Allergy Alert Test?’ (13). Here, they briefly state that the manufacturers may have slightly different ways of performing the test, based on their experience with the particular method, but also because of the

variations in product formulations, packaging, and applications (13). However, this cannot sufficiently explain the major variations in instructions found in this study.

Thyssen et al. concluded in 2013 that the self-test has some limitations: (i) it is not a screening test, but a diagnostic test; (ii) it has not been validated according to basic criteria defined by scientists; (iii) it has been evaluated in PPD-allergic individuals, which is an inappropriate population for the evaluation of diagnostic performance, as the self-test is supposed to be used by persons who are not yet diagnosed with PPD allergy; (iv) skin reactions have been read by dermatologists and not by the targeted group (consumers and hairdressers); (v) hair dyes contain strong and extreme sensitizers that are left on the skin in high concentrations, potentially resulting in active sensitization; and (vi) recommendations and instructions on how to perform the hair dye self-test vary

greatly, even among products from the same company, again suggesting that the basis for safe use of the test has not been determined (11). The risk of sensitization resulting from performance of the self-test has been a particular focus. The concerns are based on a substantial portfolio of experiments and general knowledge about the sensitization process. Authorities and doctors in several countries, such as Germany, Sweden, and Denmark, have discouraged use of the self-test. In addition, the self-test is not very practical, as it has to be performed at least 48 h before the intended hair dyeing. Therefore, it could be speculated that hairdressers and consumers in general are not performing the test or are only performing it sporadically.

In April 2011, a workshop was held by the EU Commission to help manufacturers develop a uniform protocol for pretesting and to perform risk assessment. This was reported to the subgroup on skin allergies under the EU Commission expert working group on Cosmetic Products (14). According to the minutes from the meeting, a validation study should have been launched by the industry in the first quarter of 2013 by testing selected PPD-positive hair dye-allergic subjects and controls, and have been concluded with a study report in 2016. It is surprising that the study was carried out in PPD-allergic individuals, as this is exactly the major criticism raised previously: this is not the correct target group, and therefore it cannot be predicted how the test will perform in consumers who have not yet been diagnosed with PPD allergy (11).

Some Member States experts were concerned about this approach, because the safety of the self-test had not been established (14). They had the same concerns as outlined above from the article by Thyssen et al. (11, 14), and expressed their concern that industry continued to advise consumers to perform the self-test even though the test has not been validated. It was also suggested to obtain an opinion from the SCCS on the proof of concept study (14). Overall, the Member States experts were of the opinion that the proposed timescale was too long, and that

the alignment of the vast majority of the test parameters could have been performed by industry much earlier (14).

Despite all this, the current study shows that no changes have been made, no assessment of risks to the consumer resulting from performance of the test seems to have been made even though it was announced in 2012, and the advice to perform the self-test is still given to every consumer buying a hair dye product. This is of great concern, especially as the safety of the test has not been established.

Conclusion

In conclusion, the concerns regarding safety and validity previously raised fully remain. It is of major concern that no assessment of the risk to the consumer of performing the test has been made, and no standardization has been performed.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. The suggested amount of hair dye, divided into the different countries in which the products were bought. Purchase: March 2016. n = 40.

Table S2. The suggested place for making the self-test, divided into the different countries in which the products were bought. Purchase: March 2016. n = 40.

Table S3. The suggested rinsing time, divided into the different countries in which the products were bought. Purchase: March 2016. n = 40.

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Table S1. The suggested amount of hair dye, divided into the different countries they were bought. Purchase: March 2016. n=40.

Producer	Amount of hair dye	Bought in Country							
		Belgium	France	Germany	Norway	Denmark	Spain	Sweden	United Kingdom
Bysalerm (n=1)	Apply "sufficient amount" (n=1)	0	0	0	0	0	1	0	0
Casual Spa (n=1)	Apply "sufficient amount" (n=1)	0	0	0	0	0	1	0	0
Clairol (n=1)	Mix a small amount of tint and developer.. Applay mixture to test area (n=1)	0	0	0	0	0	0	0	1
Eugene (n=1)	Apply "sufficient amount" (n=1)	0	0	0	0	0	1	0	0
Eugene Perma Paris (n=2)	Small amount of mixture hair dye developer ("révélateur"-hydrogen peroxide) (n=1)	0	1	0	0	0	0	0	0
	Sufficient amount of mixture (n=1)	1	0	0	0	0	0	0	0
FarmaVita (for professional use) (n=1)	Small quantity of colouring agent (n=1)	1	0	0	0	0	0	0	0
Frank Provost (n=1)	Apply "sufficient amount", not mixed (n=1)	0	1	0	0	0	0	0	0
Garnier (n=6)	Apply "sufficient amount" (n=3)	0	0	0	2	0	1	0	0
	Apply "sufficient amount", not mixed (n=1)	0	0	0	0	1	0	0	0
	"sufficient quantity" (n=1)	0	0	1	0	0	0	0	0
	Not specified (n=1)	0	0	0	0	0	0	1	0
Hardford, Sweden (n=1)	Small amount of color cream (n=1)	0	0	0	0	0	0	1	0
Jihanna Laboratorium Kosmetyczne, Joanna Sp. Poland (n=1)	Small amount of color cream mixed with oxidizer in a thin layer (n=1)	0	0	0	0	0	0	1	0
Llongueras Colomer (n=1)	Apply "sufficient amount" (n=1)	0	0	0	0	0	1	0	0
L'Oreal (n=4)	Apply "sufficient amount" (n=1)	0	0	0	1	0	0	0	0
	Sufficient amount of colouring agent (n=1)	1	0	0	0	0	0	0	0
	Small quantity of unmixed colourant product (creme colourant tube) (n=1)	0	0	0	0	0	0	0	1
	Apply "sufficient amount", not mixed (n=1)	0	0	0	0	1	0	0	0
	"sufficient quantity" (n=1)	0	0	1	0	0	0	0	0
L'Oreal Professional (for professional use) (n=3)	Sufficient amount of colouring agent (n=3)	3	0	0	0	0	0	0	0
Naturigin Organic Beauty (n=1)	No instruction or advise on how to perform the allergy test (n=1)	0	0	0	1	0	0	0	0
Phergal (n=1)	a small quantity of the hair dye as prepared for use (n=1)	0	0	0	0	0	0	0	1
Schwarzkopf (n=7)	Small amount of color cream in a thin layer (n=1)	0	0	0	0	0	0	0	1
	A thin layer (n=1)	0	0	0	0	0	0	1	0
	A touch of dying cream (n=1)	0	1	0	0	0	0	0	0
	A "pinch" amount of color cream and the activator (n=1)	0	0	0	1	0	0	0	0
	Thin layer of mixture (n=1)	1	0	0	0	0	0	0	0
	Not defined: some ("etwas") (n=1)	0	0	1	0	0	0	0	0
	Small amount of color cream in a thin layer (n=1)	0	0	0	0	1	0	0	0

Syoss (n=2)	Small amount of color cream in a thin layer (n=1)	0	0	0	0	1	0	0	0
	Small quantity of colouring agent (n=1)	1	0	0	0	0	0	0	0
TAHE (n=1)	Apply "sufficient amount" (n=1)	0	0	0	0	0	1	0	0
Tigi Int. (for professional use) (n=1)	Quantity unspecific of mixture (n=1)	1	0	0	0	0	0	0	0
Vitanove & Pascal Coste (Marque repère Eleclerc) (n=1)	Small amount of mixture hair dye developer ("révélateur"-hydrogen peroxide) (n=1)	0	1	0	0	0	0	0	0
Wella (n=1)	Apply "sufficient amount" (n=1)	0	0	0	0	0	1	0	0

Table S2. The suggested place for making the self-test, divided into the different countries they were bought. Purchase: March 2016. n=40.

Producer	Place	Bought in Country							
		Belgium	Denmark	France	Germany	Norway	Spain	Sweden	United Kingdom
Bysalerm (n=1)	Behind the earlobe	0	0	0	0	0	1	0	0
Casual Spa (n=1)	Behind the earlobe (n=1)	0	0	0	0	0	1	0	0
Clairol	Bend of your elbow	0	0	0	0	0	0	0	1
Eugene (n=1)	no suggestions	0	0	0	0	0	1	0	0
Eugene Perma Paris (n=2)	Behind the ear or elbow crease (n=2)	1	0	1	0	0	0	0	0
FarmaVita (for professional use) (n=1)	Forearm or behind the ear	1	0	0	0	0	0	0	0
Frank Provost (n=1)	Behind the ear (n=1)	0	0	1	0	0	0	0	0
Garnier (n=6)	Behind the ear (n=5)	0	1	0	1	2	0	1	0
	Behind the earlobe (n=1)	0	0	0	0	0	1	0	0
Hardford, Sweden (n=1)	Inside of the elbow (n=1)	0	0	0	0	0	0	1	0
Jihanna Laboratorium Kosmetyczne, Joanna Sp. Poland (n=1)	Inside of the elbow (n=1)	0	0	0	0	0	0	1	0
Llongueras Colomer (n=1)	no suggestions (n=1)	0	0	0	0	0	1	0	0
L'Oreal (n=5)	Behind the ear (n=5)	1	1	0	1	1	0	0	1
L'Oreal Professional (for professional use) (n=3)	Behind the ear (n=3)	3	0	0	0	0	0	0	0
Naturigin Organic Beauty (n=1)	No instruction or advise on how to perform the allergy test (n=1)	0	0	0	0	1	0	0	0
Phergal (n=1)	behind the ear or on the inner surface of the forearm	0	0	0	0	0	0	0	1
Schwarzkopf (n=7)	Inside of the elbow (n=3)	0	0	0	0	1	0	1	1
	no suggestions (n=1)	0	0	0	1	0	0	0	0
	In the elbow fold (n=1)	0	1	0	0	0	0	0	0
	Inner elbow (n=1)	1	0	0	0	0	0	0	0
	Elbow crease, upper arm (n=1)	0	0	1	0	0	0	0	0
Syoss (n=2)	In the elbow fold (n=1)	0	1	0	0	0	0	0	0

	Inner elbow (n=1)	1	0	0	0	0	0	0	0
TAHE (n=1)	no suggestions	0	0	0	0	0	1	0	0
Tigi Int. (for professional use) (n=1)	Behind the ear or elbow crease	1	0	0	0	0	0	0	0
Vitanove & Pascal Coste (Marque répère Eleclerc) (n=1)	Behind the ear or elbow crease or upper arm (n=1)	0	0	1	0	0	0	0	0
Wella (n=1)	Inner elbow	0	0	0	0	0	1	0	0

Table S3. The suggested rinsing time, divided into the different countries they were bought. Purchase: March 2016. n=40.

Producer	Rinsing	Bought in Country							
		Belgium	Denmark	France	Germany	Norway	Spain	Sweden	United Kingdom
Bysalerm (n=1)	No rinse (n=1)	0	0	0	0	0	1	0	0
Casual Spa (n=1)	No rinse (n=1)	0	0	0	0	0	1	0	0
Clairol (n=1)	After 45 min (n=1)	0	0	0	0	0	0	0	1
Eugene (n=1)	No rinse (n=1)	0	0	0	0	0	1	0	0
Eugene Perma Paris (n=2)	After 48 h (n=2)	1	0	1	0	0	0	0	0
FarmaVita (for professional use) (n=1)	After 48 h (n=1)	1	0	0	0	0	0	0	0
Frank Provost (n=1)	After 48 h (n=1)	0	0	1	0	0	0	0	0
Garnier (n=6)	After 45 min (n=1)	0	0	0	0	0	0	1	0
	After 48 h (n=2)	0	0	0	0	2	0	0	0
	No rinse and no cover (n=1)	0	0	0	0	0	1	0	0
	Not mentioned. Area should not be touched, washed or covered for 48h (n=2)	0	1	0	1	0	0	0	0
Hardfor, Sweden (n=1)	After 45 min (n=1)	0	0	0	0	0	0	1	0
Jihanna Laboratorium Kosmetyczne, Joanna Sp. Poland (n=1)	After 45 min (n=1)	0	0	0	0	0	0	1	0
Llongueras Colomer (n=1)	No rinse (n=1)	0	0	0	0	0	1	0	0
L'Oreal (n=5)	No rinse (n=1)	1	0	0	0	0	0	0	0
	After 48 h (n=2)	0	0	0	0	1	0	0	1
	Not mentioned. Area should not be touched, washed or covered for 48h (n=2)	0	1	0	1	0	0	0	0
L'Oreal Professional (for professional use) (n=3)	No rinse (n=3)	3	0	0	0	0	0	0	0
Phergal (n=1)	After 48 hour with soap and water (n=1)	0	0	0	0	0	0	0	1
Schwarzkopf (n=7)	After 45 min (n=4)	1	0	0	0	1	0	1	1
	After 45 min. With warm water. Avoid covered and contact with textile (n=1)	0	1	0	0	0	0	0	0
	Rinse thoroughly after 45 min (n=1)	0	0	0	1	0	0	0	0
	After 45 min, with warm water (n=1)	0	0	1	0	0	0	0	0
Syoss (n=2)	After 45 min. With warm water. Avoid covered and contact with textile (n=1)	0	1	0	0	0	0	0	0
	After 45 min (n=1)	1	0	0	0	0	0	0	0
TAHE (n=1)	No rinse (n=1)	0	0	0	0	0	1	0	0
Tigi Int. (for professional use) (n=1)	No rinse (n=1)	1	0	0	0	0	0	0	0
Vitanove & Pascal Coste (Marque repère Eleclerc) (n=1)	After 30 min (n=1)	0	0	1	0	0	0	0	0
Wella (n=1)	No rinse (n=1)	0	0	0	0	0	1	0	0