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ORIGINAL ARTICLE

Analysis of 275 DIY recipes for eye cosmetics and their possible safety issues

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Email: laurence.coiffard@univ-nantes.fr**Abstract**

Some consumers have become very suspicious of certain health products such as medicines, medical devices and cosmetics. This can lead them to choose to make such products themselves. The aim of this work was therefore to analyse recipes for eye makeup and makeup removal products, as well as eyelash and eye contour care products. We collected recipes for do-it-yourself products found on blogs and social media (YouTube channels, Facebook, Pinterest, Instagram and TikTok) in French and English and then analyse their composition as well as how practical it is to make these recipes. We compiled and studied 275 recipes for products that can be used in or around the eye (periocular area). This work has shown that the quantities of the various ingredients are very imprecise, that the proposed substances are not suitable for the intended use and that the preservation of the finished products is not sufficiently guaranteed. The results obtained suggest that recipes for products intended for use in the eye or in the periocular area are not safe to use and that their use is likely to have relatively serious consequences.

KEYWORDS

do it yourself, eye, periocular area, recipes

Résumé

Certaines personnes sont devenues très méfiantes vis-à-vis des différents produits de santé que sont les médicaments, les dispositifs médicaux et les cosmétiques. Dans ce contexte, elles font le choix de réaliser elles-mêmes leurs produits. Le but de ce travail était l'analyse de recettes de produits de maquillage et de démaquillage des yeux, ainsi que de produits de soin des cils et du contour des yeux. Dans cet objectif, nous avons collecté des recettes de produits à faire soi-même sur des blogues et des médias sociaux (chaînes YouTube, comptes Facebook, Pinterest, Instagram et Tiktok) de langue française et de langue anglaise, puis nous les avons analysé d'un point de vue de leur réalisation pratique et de leur composition. 275 recettes de produits utilisables au niveau de l'œil ou de la zone périoculaire ont ainsi été compilées et étudiées. Il ressort de ce travail que les quantités des différents ingrédients sont très imprécises, que les substances proposées ne

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sont pas adaptées à l'usage visé et que la conservation des produits finis n'est pas suffisamment assurée. Les résultats obtenus suggèrent que les recettes de produits destinés à être utilisés au niveau de l'œil ou dans la zone péri-oculaire ne sont pas sûrs d'emploi et que leur utilisation est susceptible d'engendrer des conséquences relativement graves.

INTRODUCTION

It may seem that do it yourself (DIY) is a very recent practice, but in reality, it is much older. A 1934 issue of the *Lancet* journal specifies that, at the time, there were two techniques for colouring eyelashes and eyebrows black [1]. The first technique consisted of using lampblack, which temporarily colours the eyelashes and may, in some cases, cause forms of intolerance, for example conjunctivitis. In 1914, Mabel Williams chose this technique and ended up scorching both her eyelashes and eyebrows, which she then tried to reconstruct artificially [1]. We will see that the recipes studied here are inspired by this 80-year-old method. The second technique consists of using dyes to achieve permanent colouring. These dyes, especially a commercial product called Lash Lure, included aniline derivatives. Several ocular reactions were observed following the application of this product. The first case was reported by Dr. Greenbaum of Philadelphia, who described an immediate and fairly mild reaction followed by symptoms that increased in severity within the days that followed and resulted in swelling. An improvement was noted when the eyelashes were cut. Six other cases were also reported, with varying degrees of severity. It was shown in all cases but one that the observed effects were caused by the Lash Lure product used to colour the eyelashes. The other case involved a hair and beard dye marketed by a French company. One other case involved a 52-year-old woman with plucked eyebrows who wanted to have them redrawn using a permanent dye. The product used in this case was again Lash Lure, which led to her death from sepsis [2]. Because the eyebrow hair had been removed, this created conditions conducive to the penetration of the ingredients and microorganisms found in poor-quality products.

In the 1960s, in the San Francisco hippie community, the reference was the *Whole Earth Catalogue* written by Stewart Brand, which provided numerous tips on how to do everything yourself at low cost. This magazine and product catalogue were published from the late 1960s to early 1970s [3].

Although it shrank to a hobby activity thereafter, the practice of making one's own cosmetics and pharmaceuticals re-emerged in the 21st century, becoming more popular following a number of health product scandals, such as the Mediator case [4] and the *Poly Implant Prothese* (PIP)

implants case, as well as controversies involving substances widely used in medicinal products and cosmetics, such as parabens [5] or ethoxylate derivatives [6]. Today's consumers rely on social media and online platforms, including blogs, to obtain health information. The lack of trust caused by these cases has led some people to want to make their cosmetics themselves, thinking that they can do it well and that they are using products that are safer for their health than those used in the industry. This practice concerns the fields of hygiene, especially oral health, due to a fear of fluorine and its salts [7]; sunscreens, due to a fear of organic filters [8]; and makeup.

In this context, we studied 275 eye cosmetic recipes to be used in and around the eye that we collected on the Internet to analyse the formulas and to determine what the consequences of their use might be.

EXPERIMENTAL

Recipes for various DIY products to be used as eye makeup, eye makeup removers, eyelash products and eye contour care products were collected from blogs and social media (YouTube channels, Facebook, Pinterest, Instagram and TikTok) in both French and English, using the keywords "Homemade recipes" "DIY," "mascaras," "eye shadows," "eyeliners," "eyeliner pencils," "Eye makeup removers," "eyelash dye," "eye contour" and "concealer." We then analysed these recipes in terms of how practical they were to make and their composition. To do this, we studied the type of dyes proposed in the recipes for making the makeup products and which other substances were presented as being effective for eyelash care or to conceal dark circles. Regarding product preservation specifically, we compared the composition of the recipes analysed with the formulas of the corresponding products currently on the market. Following our presentation of this analysis below, we will discuss the problems related to the dissemination of such recipes.

RESULTS AND DISCUSSION

The results obtained come from the consultation of 163 French- and 112 English-language sources, that is on the

analysis of 275 recipes for products that can be used in or around the eye.

The 163 French-language recipes analysed correspond to eye makeup (mascaras, eye shadows, eyeliners and eyeliner pencils), eye makeup removers, eyelash care, eye contour care and concealer products including those intended to lighten the eye or dye the eyelashes. The 112 English-language recipes are generally for making the same products as those found in French, apart from products to lighten the eyes (we were not able to find any of these in English) (Figure 1).

These products are primarily ointments, that is monophasic preparations, and oils (Table 1). In rare cases, some English-language recipes use a product in its raw state, such as chamomile flowers (1 recipe), cucumber or potato slices (5 recipes) or even suggest the misuse of a product (use of lipstick as a mascara). Colourant raw materials found in the mascara and eye shadow recipes studied are presented in Figure 2. We found charcoal, calcined almonds, cocoa powder and various clays and pigments. Excipients found in various recipes studied are presented in Figure 3. Various oils (especially coconut oil and castor oil) are suggested in the recipes. Hair gel and baby shampoo are particularly inappropriate. We compared the preservatives suggested in recipes with those of equivalent commercial products (Figure 4). Very few recipes incorporate a preservative, which poses a problem for the ocular area.

We found water, sage leaves, castor oil and petroleum jelly in the eyelash dyes.

In the eye makeup remover recipes, we found sweet almond oil, castor oil, olive oil, almond and coconut oils, water and a hydrosol. As for the four recipes on how to lighten the eyes, which we found only on French-language sites, these contained water, lemon and honey.

A blog can be defined as a website that disseminates personal views, photographs, videos, hyperlinks and other content written by the blogger concerned. In the field of cosmetics particularly, blog authors have no expert legitimacy with regard to this type of product [9]. The same goes for the social media platforms from which we collected the recipes studied here. These sites and channels can reach a large number of people and gain a high profile, for example the number of monthly active users worldwide in 2017 was 800 million on Instagram and 200 million on Pinterest. In our study, for example, certain mascara recipes were viewed almost 400 000 times on YouTube channels with 275 000 subscribers, and slightly over 155 000 times on a channel with 331 000 subscribers. The most viewed recipe was one posted on Instagram by influencer, Farah Dhukai, a YouTuber, fashion blogger, makeup artist and hairdresser who had over 2 million subscribers on her YouTube channel and over 6.5 million subscribers on her Instagram account. One of the recipes to lighten the iris (original French title: ‘*éclaircir l’iris de ses yeux durablement*’) has been viewed almost 124 000 times on a YouTube channel that has only 600 subscribers; the channel belongs to Ellia Rose who makes it clear right away at the start of her video that she is not a specialist and, therefore, cannot guarantee that it is safe to follow her advice.

General problems with recipes for products used in, on or around the eyes

Taking medicinal products for the eyes (ointments and ophthalmic gels, eye drops, etc.) as a reference, we can see that these products must be manufactured using sterile ingredients, under very strict aseptic conditions, and must meet the requirements for sterility testing. In addition, the

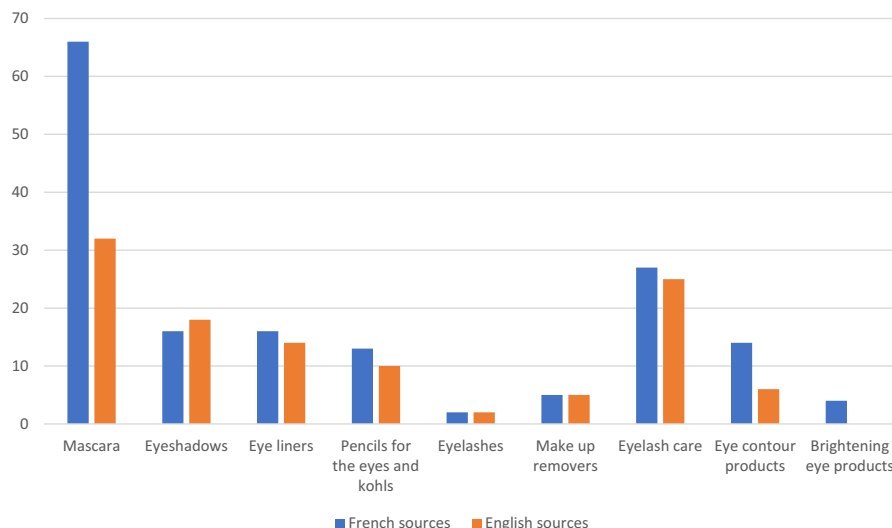


FIGURE 1 Eye cosmetics corresponding to the collected recipes

TABLE 1 Pharmaceutical forms of the products corresponding to the recipes studied

Type of products	Pharmaceutical forms	Number of relevant recipes collected on French-language sites	Number of relevant recipes collected on English-language sites
Mascaras	Ointment	47	28
	Emulsion	2	–
	Gel ^a	12	4
Eyelash care	Ointment	13	5
	Oil	25	21
	Gel ^a	1	1
Eye shadows	Powder	6	7
	Paste	8	4
	Gel ^a	1	1
	Ointment	1	4
Eyeliners	Paste	3	–
	Ointment	3	10
	Gel ^a	7	3
	Emulsion	1	–
	Suspension	1	1
	Solution	1	–
Eyeliner pencils	Ointment	7	3
	Suspension	2	2
	Powder	4	–
Eyelash dyes	Biphasic	2	1
	Ointment	–	1
Eye makeup remover	Biphasic	1	5
	Solution	1	4
	Ointment	–	1
Eye contour products/concealer products	Solution	2	–
	Ointment	5	3
	Suspension	2	–
	Oil	–	3
Eye lightening products	Solution	4	–

^asolid three-dimensional network.

ideal pH for this type of product is 7.4, that is as close as possible to the pH of tears. The pH value of an ophthalmic formulation outside the range 5.0–8.5 causes extra lachrymation [10]. The same goes for the osmolarity, which must be equivalent to that of a 0.9% sodium chloride solution, that is 310 mOsm/kg. Lastly, the average particle size should be under 10 µm [11].

Problems with the quantities given in the recipes

In the Internet recipes analysed, the quantities of the various raw materials—most powders or solid ingredients

and vegetable oils, but not essential oils—are nearly always given in tablespoons or teaspoons or smaller fractions (1/2, 1/4 or 1/8 of these measures). This means that, in practice, there is a total uncertainty about the quantities really being used. Today, there is a lot of variation in spoon design, with their capacities ranging from 2.5 to 7.3 ml for tablespoons and from 3.9 to 4.9 ml for teaspoons [12]. It appears difficult for the person using the recipe to precisely quantify teaspoon fractions such as 1/8 of a teaspoon. In a few cases, we only find indications for ‘small quantities’ or ‘very small quantities’. Lastly, for 41 of the recipes, no quantities at all are given for the ingredients.

Quantities of essential oil are given in numbers of drops. As a result, it is easy to imagine that dosage

FIGURE 2 Colorant raw materials found in the mascara and eye shadow recipes studied

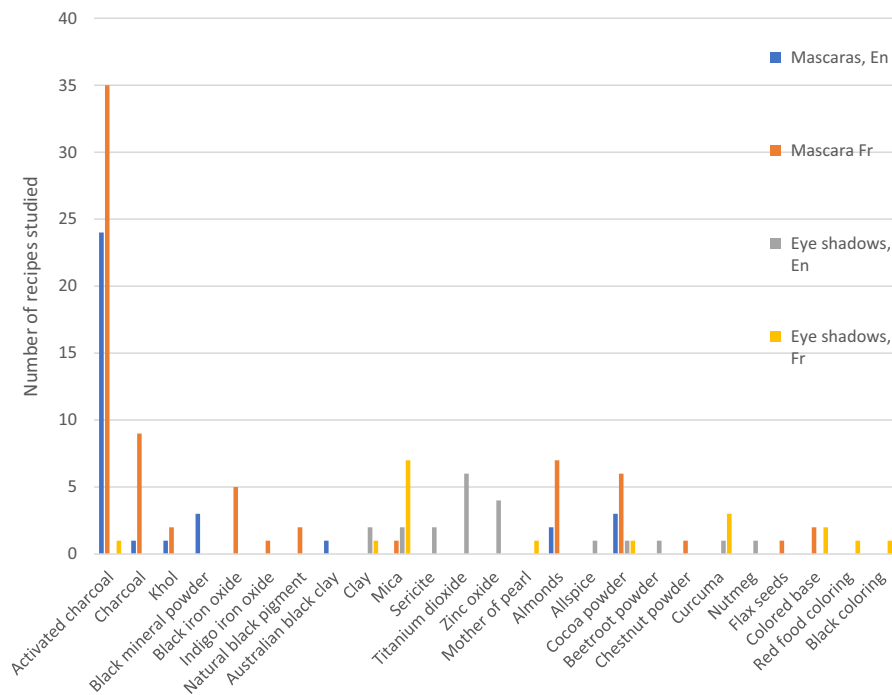
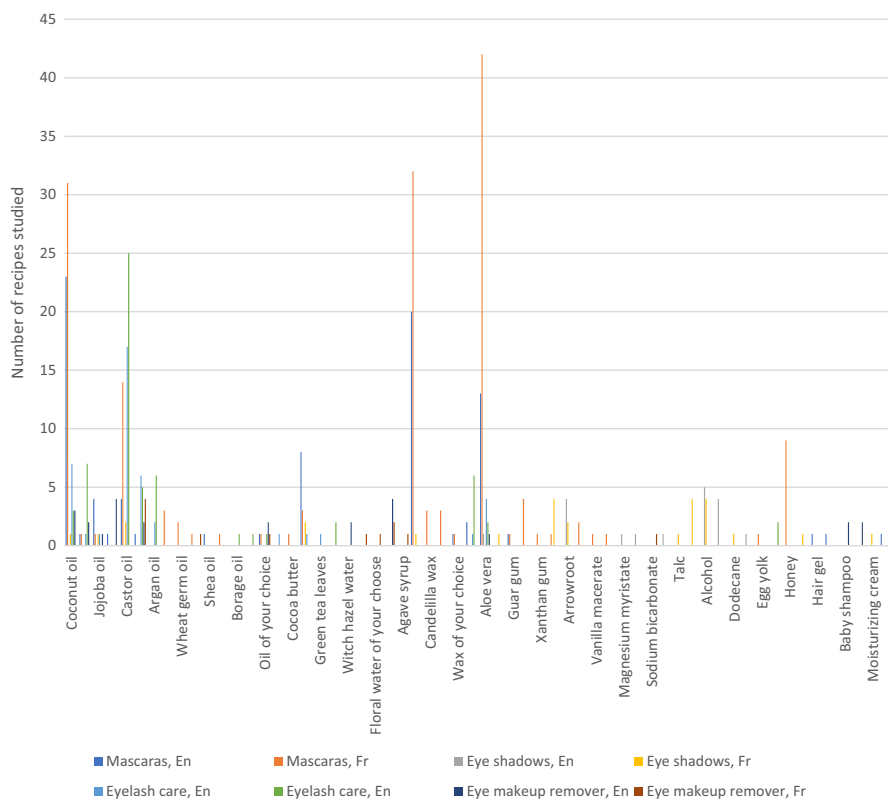


FIGURE 3 Excipients found in various recipes studied



fluctuates a great deal, given that the people following the recipes will not have a standardized dropper like those described in pharmacopoeias [13].

This problem of the total imprecision of the various dosages is recurrent, and we have already highlighted it when studying recipes for toothpastes and sun products [7,8].

Problems with the suggested ingredients

Most mascara recipes suggest using activated charcoal as the black pigment (Figure 2). Unlike for other ingredients, the recipes sometimes suggest using charcoal tablets or capsules. The various forms that are currently found on the market contain varying amounts of charcoal

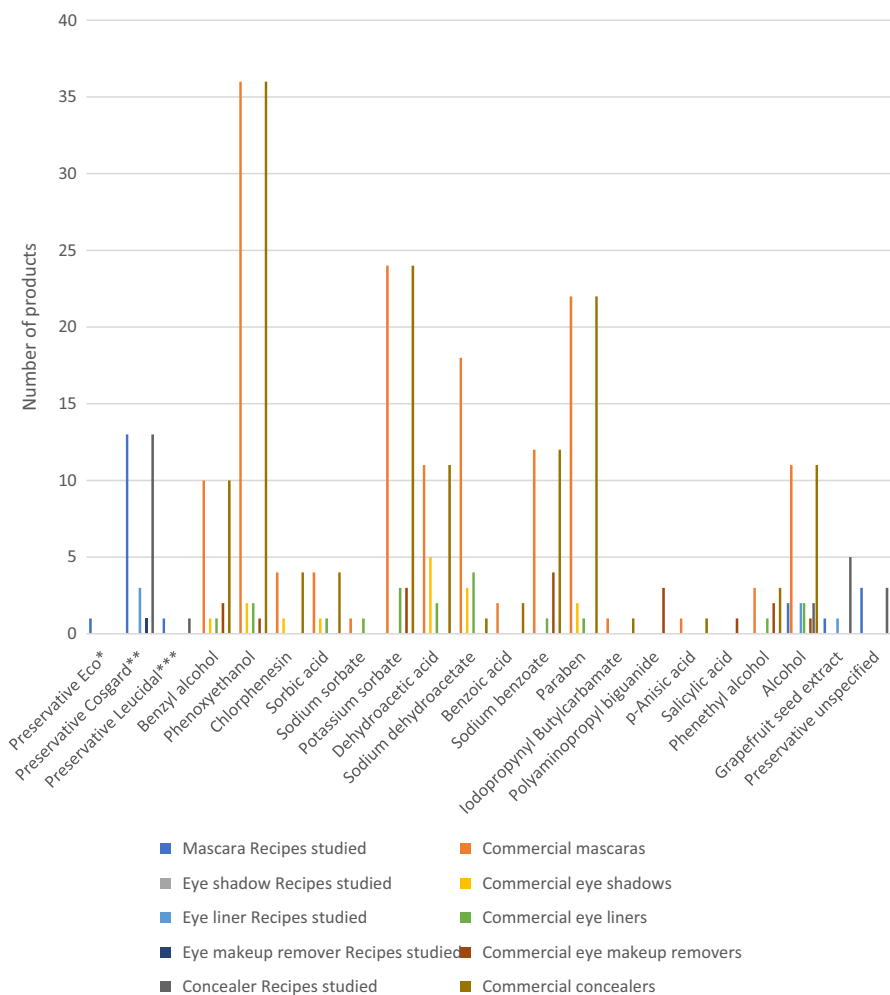


FIGURE 4 Comparison of preservatives suggested in recipes with those of equivalent commercial products. * Benzyl alcohol, salicylic acid, sorbic acid and glycerin. ** Benzyl alcohol and dehydroacetic acid. *** Radish root ferment filtrate

(ranging from 70 to 160 mg/unit). Activated charcoal is produced from materials that naturally contain high amounts of carbon, such as bamboo, coconut or wood that has been heated to high temperatures and then processed into powder. The charcoal production method does not exclude the presence of toxicants, which could have harmful effects on human health. Consequently, some of these recipes may possibly contain cadmium, antimony, tellurium, mercury, thallium or even lead at concentrations ranging from several ng/g to several tens of thousands of ng/g charcoal, depending on the element [14–16]. Exposure to heavy metals appears to be a risk factor for various ocular pathologies such as glaucoma [17], so it seems important to strongly advise against charcoal-based preparations insofar as it would not be possible to check its quality before incorporation into the excipient. Some of the recipes do not specify ‘activated’, and only mention ‘charcoal’. Other recipes propose alternatives to activated charcoal such as almonds that are to be charred using a candle or a gas lighter, and then ground using a pestle and mortar. Knowing that we obtain powders with a particle size between 250 and 500 μm using this artisan grinding technique if 80–100 rotations are performed [18],

it follows that the resulting particle size of the recipe will not be compatible with an average size of 10 μm . One recipe suggests using surma, also known as kohl in India and Pakistan, which is composed of lead sulphide and may cause lead poisoning [19–21]. Cocoa powder (Figure 2) is specified for obtaining a brown mascara. Anecdotally, we noted that one recipe lists *Fucus* powder. Other ingredients are also suggested that are somewhat undefinable, vague and, therefore, quite dubious, such as ‘natural volcanic clay’ (1 recipe) or ‘black mineral powder’ (2 recipes). The suppliers of ‘Australian red reef clay’ state that this substance is made up of red iron oxide. These different ingredients used as colour dyes are dispersed in mixtures of fatty substances (various vegetable oils and beeswax) sometimes combined with aloe vera gel (Figure 3). Three recipes suggest using talcum powder or cornstarch that is ‘to be applied to the lashes between two coats of mascara’. Lastly, one recipe is a misuse of a product as it suggests using a liquid lipstick on the eyelashes instead of mascara.

A few of the recipes use kohl (Figure 2) and two of these, found on English-language sites, include kajal powder. In ancient times, this product was used to protect the eyes from the sun’s harmful UV rays [22]. It is widely used

TABLE 2 Recipes presented as potentially being able to lighten the eyes

Recipes	Instructions for use
Orange or lemon juice	–
Spring water (30%) Unpasteurized organic honey (70%)	2 or 3 drops in each eye morning, noon and night
Organic chamomile tea Lemon (2 drops) Water	2 drops in each eye every evening
Honey (a small quantity) Saline solution or mineral water (a somewhat generous quantity)	–

as makeup in South Asia, the Middle East, Pakistan, India and parts of Africa [23]. Users are exposed to a significant amount of lead due to the presence of galena (PbS) or minium (Pb₃O₄). Other undesirable elements such as mercury, cobalt, nickel, chromium and arsenic have also been detected in kajal powders [24,25]. The use of kajal and surma in eye should be strictly restricted because they contain polyaromatic hydrocarbons (PAHs) [26]. The other recipes studied include fake red sandalwood (*Pterocarpus santalinus*), known to contain pterostilbene or 3,5-dimethoxy-4'-hydroxystilbene [27]; ajwain (*Carum ajowan*), a spice cultivated in southern India [28]; charred almonds, as in the mascaras mentioned above; or, even more surprisingly, cotton. In the kohl recipes collected from French-language sources, we also find charred almonds as well as dried and charred rose petals, dried jasmine, camphor (the author of this recipe states that a black colour is obtained by recovering the soot that forms on the surface of a copper or silver plate placed above a candle) or even antimony. This brings us back to an ancient form of makeup, but disregards the toxicity of the product for which its use is being promoted [29].

We found only four recipes for eyelash dyes: two on English-language sites and two (identical) on French-language sites. The first case involves a dispersion of iron oxide or henna powder in a mixture of water and olive oil or petroleum jelly (i.e. heterogeneous mixtures since there is no surfactant). In the second case, the recipe involves boiling 20 sage leaves in a mixture of water (150 ml) and castor oil (3 tablespoons). This recipe was taken from a book on the various possible uses of sage. Some eyelash dyes are known to cause ocular symptoms such as blepharitis-conjunctivitis and even facial oedema, especially when the product in question is homemade [30]. Henna is particularly implicated in such problems [31,32].

Eyeliner pencil recipes are based on sticks, that is mixtures of waxes, fats and oils (Figure 3) in varying quantities. Castor oil and candelilla wax are the main waxes used, although carnauba wax and beeswax are also employed, as well as more rarely used butters such as kokum butter. Ghee, a processed fat used in Indian cuisine, is found

in one recipe. It should be noted that there is a tendency for some unscrupulous manufacturers to replace the more expensive ghee with lower quality fats [33,34] without the knowledge of the person making the recipe.

The DIY eye shadow recipes studied are primarily preparations that mash together various dye materials, mostly micas of different colours (Figure 2), using various oils rather than powders (Figure 3). We identified one instance of misuse which involves mixing a foundation with a concealer and a body care product.

We also identified and analysed recipes for eye makeup removers. Looking at the galenic formulation, we notice that these products are either oily or biphasic solutions, as the preparations are based on an oil and either water or floral water (Figure 3), and no surfactant is added that would allow a homogeneous mixture to be obtained, which would then be a cleansing milk. However, we would like to point out three somewhat unusual recipes: one suggests mixing coconut oil with a baby shampoo and the other two instruct users to add soap to olive oil or to any other oil selected by the person making the recipe (Figure 3).

We also analysed recipes for care products. Some of these recipes are for eyelash products that promise longer, fuller lashes. Long, thick eyelashes have an aesthetic value in many cultures [35], and women have resorted to various techniques over the centuries to achieve this look [36]. Today, it is fashionable to use castor oil for this purpose and this oil is the one that is most commonly found in the recipes analysed, either used alone or in combination with another oil (Figure 3). In 1950, in the *Encyclopédie De La Femme*, in the section dedicated to the eyes, we find the following sentence: 'In adulthood, we can increase eyelash growth by coating their root with castor oil, however the disadvantage of this oil is that it stings the eyes'. Yet, it seems impossible to determine why this craze for such a substance came about, especially since we know that only bimatoprost has been proven effective in treating eyelash hypotrichosis [37].

The other recipes studied here were for products intended to be used around the eyes and for concealment purposes (e.g. to cover up dark circles). These recipes include either

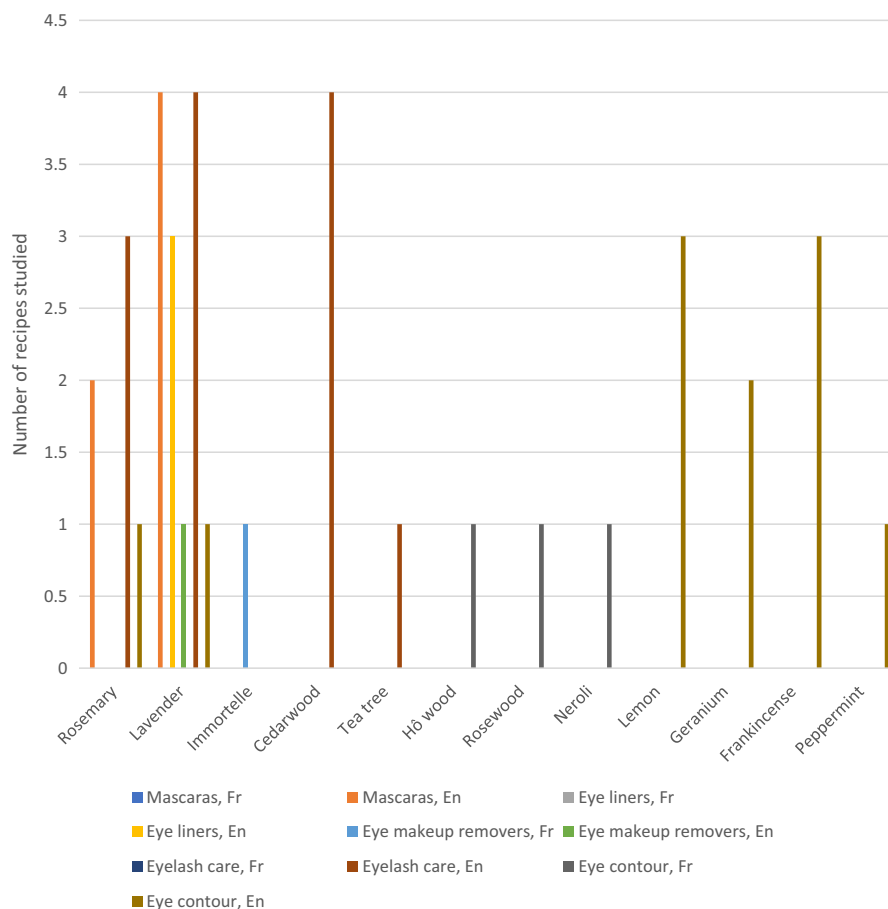


FIGURE 5 Various essential oils identified in the recipes studied

TABLE 3 Number of recipes containing an antimicrobial preservative and/or an antioxidant preservative

Types of products	French sources		English sources	
	Antimicrobial preservatives	Antioxidant preservatives	Antimicrobial preservatives	Antioxidant preservatives
Mascaras	16	12	0	19
Eye shadows	1	1	0	0
Eyeliner pencils	4	1	0	2
Eyeliner pencils	0	1	0	2
Eyelash dyes	0	0	0	0
Eye makeup removers	1	0	0	1
Eyelash care	1	10	0	14
Eye contour and concealer care	2	3	0	4

mixtures of oils combined with a cornflower hydrosol, or the use of foods such as infused tea, milk, slices of cucumber, quince, potato, chervil or chopped parsley. One recipe from an English-language source suggests mixing caffeine with aloe vera juice and then adding mint essential oil for its scent. In fact, caffeine is found in commercial concealers, since it was demonstrated roughly ten years ago that it has the ability to improve microcirculation and lipolysis [38–41].

Lastly, we identified four recipes for lightening the eyes, taken from French blogs. Two of these suggest

using orange or lemon, the other two suggest using honey (Table 2). The instillation of lemon juice in the eyes, by some people, is not new and serious adverse ocular events have been observed for many years [42]. Some people wish to bleach their iris with hydrogen peroxide. As the collected recipes show, some people also use honey for this purpose instead of hydrogen peroxide. Honey is a complex mixture made up of approximately 200 different molecules, primarily sugars (fructose, glucose, maltose, sucrose, etc.), but also traces of organic

acids, amino acids, pigments (resulting in a colour specific to each honey), vitamins, minerals, enzymes and hydrogen peroxide. The latter results from biological reactions involving oxidases (enzymes present in certain secretions of the bee), which is why honey is used here. However, honey should not be used in the eye because it has an acidic pH of <4 [43].

Problems caused by the poor preservation of prepared products

Although it may broadly seem as though the recipes from English-speaking and French-speaking sources are similar, there are large differences in terms of the additives used to ensure good preservation of the products made. Very few of the mascara recipes studied (less than a quarter), all from French-language sources, suggest using an antioxidant preservative, even though these recipes include oxidizable oils such as castor oil, which is made up of almost 90% ricinoleic acid [44]. Conversely, mascara recipes taken from English-language sources include vitamin E in 59% of cases. Furthermore, very few, if any, antimicrobial preservatives are used. Yet, quite a few recipes contain aloe vera gel and we know that this gel, if it has not undergone any processing treatment, contains Gram-negative bacteria, primarily *Rhanella aquatilis* and yeasts, especially *Rhodotorula mucilaginosa* [45]. During extraction process, *Aloe vera* gel may become contaminated with microorganisms that are present on the leaves [46]. The growth and activity of microorganisms can adversely affect the quality and shelf-life of homemade product [47]. When an antimicrobial preservative is not used, it should be expected that the bacteria present will proliferate, which is not compatible with use in the eyes. The problem is significantly worse for the eyelash dye recipes, which we found not to include any preservatives, even though these products are mixtures of castor or olive oil and water. Likewise, among the eye shadows, only one recipe contains an antimicrobial or antioxidant preservative. The same is true for eye makeup removers as these recipes often contain floral water that may quickly become contaminated (hydrolats are very vulnerable to fungal and bacterial contamination due to the aqueous nature of the environment, the possible presence of plant fragments and the low content of organic compounds) [48] and vegetable oil that may become rancid [49]. We noticed that no antimicrobial preservatives are ever included in recipes from English-language sources. There is a limited diversity of preservatives listed in French-language recipes that is quite different from what is observed in commercial products (Figure 4). When an antioxidant agent is present in a recipe, it is always vitamin E regardless of the origin of the recipe.

Given that it is crucial to preserve products used for makeup, makeup removal and eye care, we can note that almost all commercial products contain an antimicrobial preservative. In mascaras, the most common preservatives used are phenoxyethanol and potassium sorbate (Figure 4). With regard to antioxidant agents, we note that Vitamin E is systematically used and is usually combined with one of its derivatives (e.g. tocopheryl acetate) or with vitamin C derivatives such as ascorbyl palmitate. The antioxidants butylated hydroxytoluene (BHT) and pentaerythrityl tetra-di-t-butyl hydroxyhydrocinnamate are also suggested, whereas these antioxidants are never used in commercial recipes. On the contrary, some recipes contain essential oils (Figure 5) proposed to perfume the preparation (Table 3).

Problems raised by a lack of possible controls

Once the preparation has been made, the artisanal maker or 'operator' is unable to carry out any basic physical or chemical checks, such as determining the pH for example. The operator also is unable to verify that any tears produced are isotonic and that the preparation is indeed sterile. This lack of verification measures and the use of vague dosages are recurrent problems with DIY makeup recipes, already highlighted with other categories of product [7,8].

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CONFLICT OF INTEREST

None.

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