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Gel nail varnishes from Swiss «.ch» online stores

Colourants, monomers, oligomers, stabilisers, photoinitiators, plasticisers, preservatives and contaminants

Joint campaign of the cantons of Aargau and Basel-Stadt
(coordination and analyses)

Number of samples examined:	28 samples and sets (39 individual varnishes)
Number of non-conforming Products:	27 (96%)
Reasons for non-conformities:	Unauthorised use of colourants (21), use of banned monomers (5) exceeding limits of stabilisers (7), exceeding limit of photoinitiator (3), N-nitrosamines (2), undeclared colourants (21), undeclared monomers and oligomers (9), undeclared stabilisers (11), undeclared photoinitiators (12), undeclared plasticisers (1), main declared ingredients not present (4), missing or insufficient warning labels (10), ingredients list absent or incomplete (7)



Background and objectives

When nails are artistically enhanced in nail salons, the varnish should not begin to chip after just a few days. Instead of the traditional solvent-based nitrocellulose nail varnishes, longer-lasting polishes are therefore used in salons and increasingly at home. These varnishes are usually based on methacrylates or acrylates and are typically cured under UV light. They are commonly referred to as "gel nail varnishes" or "UV nail varnishes". Most of these products are intended only for professional use due to the presence of sensitizing substances. However, it is known that private use is increasing. Many online shops offer such products, although it is not always clearly indicated or apparent that they are only meant for professional use. Lack of knowledge and skill in using them, as well as poor ventilation in peoples' homes, increase the risk of allergic reactions or complications. Numerous scientific articles report an increase in health problems associated with the use of these varnishes. In addition to dermatological issues, respiratory illnesses can also be triggered, a condition known as „Dip flu.“

In recent years, we have repeatedly examined UV gel nail varnishes in nail salons, specialist retailers, and occasionally in retail outlets. We have contested many products due to unauthorized colourants, solvents, stabilizers, and impurities. In 2024, 50 out of 54 samples were non-compliant (93%). Bans on sale or, in salons, application were imposed on 31 products (57%) due to prohibited ingredients or exceedance of limit values¹.

The current control campaign focused on testing products from Swiss online shops only.

Legal considerations

The requirements for cosmetic products are regulated in the Swiss Food and Utility Articles Ordinance (LGV) and the Swiss and EU Cosmetic Products Regulation (VKos and EU CPR).

Parameter	Legal requirements
Banned substances (e.g. nitrosamines, formaldehyde, phenol)	LGV, art 54, par. 1 / EU CPR, Annex II
Approved substances with limits (e.g. stabilisers, photoinitiators)	LGV, art 54, par. 2 / EU CPR, Annex III
Colourants	LGV, art 54, par. 3 / EU CPR, Annex IV
Preservatives	LGV, art 54, par. 4 / EU CPR, Annex V
Labelling	VKos, art. 8 and 9

Sample description

The 28 sampled acrylate or methacrylate-based nail varnishes from 18 brands were all intended for professional use only. The products were sampled from 14 different Swiss (.ch) online stores, three of these stores sold own brand products.

Five products from two manufacturers were made in Switzerland, the rest originates from various countries in Europe, the USA and China.

Origin	Number of samples / sets
China	7, of which 3 were sets with 14 colours
Switzerland	5
Poland	5
Austria	3
USA	2
Germany	2
European Union	1
Italy	1
The Netherlands	1
Sweden	1
Total	28 (39 individual varnishes)

¹ <https://doi.org/10.5281/zenodo.13711588>

Measurement methods

Parameter group	Methods
Multimethods for UV/Vis-light absorbing substances: <ul style="list-style-type: none"> • Preservatives • Fragrances • Stabilisers, photoinitiators • Film forming agents • Impurities (e.g. phenols) • N-nitrosamines 	UHPLC-DAD at pH 2.7 after extraction with 0.1% phosphoric acid & UHPLC-DAD at pH 6.2 after extraction with methanol and dimethylformamide respectively N-methylpyrrolidone (colourants)
Colour pigments (non-polar)	HPLC-DAD after extraction with chloronaphthalene
Multimethod for problematic substances (e.g. aromatic amines)	HPLC-HRMS after extraction with methanol
Formaldehyde, acetaldehyde and other aldehydes and ketones	HPLC-DAD after in-line pre-column derivatisation with 2,4-dinitrophenylhydrazine
N-nitrosamines	HPLC-HRMS(/MS) after extraction with an acidic mixture of water and methanol (polar) and methanol (apolar)

Results and measures

27 out of the 28 tested products (96%) were found to be non-compliant. Sales bans had to be issued for 22 products (79%) due to prohibited ingredients or exceedance of limit values. Reasons for the bans included unauthorized colourants, prohibited monomers and photoinitiators, exceedance of limit values for stabilisers, photoinitiators, and film formers, and in one product a high concentration of a prohibited contaminant (nitrosodimethylamine). Furthermore, the declarations of ingredients did not match the substances found in many products. Several products were already considered to be unsuitable for sale due to clearly incomplete ingredient labelling or declaration of unauthorized substances.

Colourants

In 31 of the 39 nail polishes examined, we found 66 instances of colourants, whose use in nail varnish is not permitted. In the case of two products from European manufacturers, multiple unauthorized colourants were listed as ingredients. As a safety assessment must be provided for each cosmetic product, we were curious to see how the use of unauthorized colourants in these products would be justified. In the safety assessment provided by the German manufacturer, the use of unauthorized colourants was justified by stating that these colourants are not regulated in cosmetics and may be used until a so-called final EU regulation is in place. This was the first time we saw this excuse as to why clear legally binding positive lists for cosmetics can be ignored.

Colourants in the 39 varnishes examined

Colourant	Non-approved (not in Annex IV)	Non-permitted in leave-on products	Banned (Annex II)	Not listed as ingredient
C.I. 11780	1			1
C.I. 12475	3			3
C.I. 21100		4		4
C.I. 21160	2			2
C.I. 42595	1			1
C.I. 45160	5			5
C.I. 45161	10			10
C.I. 45170			1	1
C.I. 45174	13			
C.I. 45175	1			
C.I. 51319		2		
C.I. 56110	4			
C.I. 73900		7		6
C.I. 73915		5		4
Basic Yellow 40	1			
Solvent Yellow 172	4			4
Not identified	2			2
Total	47	18	1	63

Acrylates

Only a few of the monomers used in UV gel nail varnishes are subject to legal regulation:

HEMA (2-Hydroxyethyl Methacrylate; 28 samples with concentrations > 0.3%) is still the most commonly used monomer or oligomer. It was not listed as an ingredient in six out of 28 cases, and the warning instructions were missing on nine products. The advertising claim „HEMA-Free“ on one product was incorrect because the nail polish contained 0.9% HEMA. On the other hand, one nail polish contained no HEMA despite it being declared as a main ingredient.

The use of Di-HEMA Trimethylhexyl Dicarbamate appears to have decreased: only six samples contained relevant amounts (> 1%). Three products that had declared the substance as a main ingredient actually contained no Di-HEMA Trimethylhexyl Dicarbamate (< 0,1%). The use of these two sensitizing substances is only permitted for professional products. The required warning label was missing on three products.

Some other products contained undisclosed acrylates (see table „Mono- and Oligomers etc.“). However, the second most frequently detected Hydroxypropyl Methacrylate was correctly listed in all 14 samples we found it in.

The use of Trimethylolpropane Triacrylate has been prohibited since the end of 2023. We found it in five products in quantities between 0.5 and 2%.

Monomers, oligomers stabilisers and photoinitiators in the samples

Analyte	# of samples	Not listed ingredient	Safety warning	Limit	Above limit	Concentration range
1,6-Hexanediol Diacrylate	5	3 (60%)		-		0,4 - 9,3%
Benzophenone*	1	-		banned		On label, < 0.001%
Benzoyl Isopropanol	3	-		-	-	3,1 - 7,6%
Benzoyl Peroxide**	1	-		0.7%	1	1.1%
BHT	13	5 (38%)		0.8%	-	0.02 - 0.48%
Bis-Trimethylbenzoyl Phenylphosphine Oxide	5	-		-		0.03 - 2.5%
Di-HEMA Trimethylhexyl Dicarbamate***	8	-		-	-	0.2 - 13%
Ethyl Trimethylbenzoyl Phenylphosphinate	14	4 (29%)		-	-	0.24 - 11%
HEMA***	28	6 (21%)	9 (32%)	-	-	0,3 - 36%
Hydroquinone***	1	1 (100%)		0,02%	1	0,024%
Hydroxycyclohexyl Phenyl Ketone	26	5 (19%)		-	-	0.02 - 8.4%
Hydroxypropyl Methacrylate	14	-		-	-	2,5 - 42 %
Isobornyl Methacrylate	3	-		-	-	1,2 - 13 %
Isopropylidenediphenyl Bis-Oxyhydroxypropyl Methacrylate	4	4 (100%)		-	-	0,8 - 30%
PEG-9-Dimethacrylate	1	-				Not quantified
p-Hydroxyanisole***	29	17 (59%)	12 (41%)	0,02%	13	0,0057 - 0,16%
Tetrahydrofurfuryl Methacrylate	3	1 (33%)		-	-	2,0 - 14%
Tosylamide	4					0,05 - 0,25%
Triethylene glycol Dimethacrylate	3	1 (33%)				2,5% - 15%
Triethylene glycol Diphenylphosphine Oxide*** / ****	27	9 (33%)		5%****	3	0,9 - 7,5%
Trimethylolpropane Triacrylate*	5	5 (100%)		banned		0,2 - 2,0%
Triphenyl Phosphate	1	1 (100%)		-	-	0,37%
Tripropylene Glycol Diacrylate	2					7,4% - 7,8%

* Banned

** Contradiction between warning and use

*** Permissible only in products for professional use

**** Banned as of 1/9/2025

Stabilisers

To prevent premature polymerisation in the container, acrylate nail varnishes must be stabilized. p-Hydroxyanisole is the preferred substance for this, which we detected in 29 out of 39 varnishes. The use of this stabiliser is only permitted in products for professional use up to a limit of 0.02 %. In 17 of the 29 varnishes, the declaration was missing, and in eight, the limit was even exceeded, with the worst case reaching eight times the allowed amount (0.16%).

The same application restrictions apply to hydroquinone. This substance was previously used more frequently as a stabiliser. As in the last campaign, we found it in only one product. In this case, the limit was slightly exceeded at 0.024%, and in addition, the declaration of the substance was missing.

Butylated hydroxy toluene, or BHT for short, was also frequently detected as a stabiliser in gel nail varnishes (13 out of 39 products). The wide range of concentrations between 0.02 and 0.48 % suggests that the substance may have entered the final product as a stabiliser of a raw material. But also in these cases, the substance must be labelled in the ingredients list. In five of the thirteen products, BHT was not declared.

Photoinitiators

Photoinitiators are required to initiate the polymerisation of the coatings by means of UV or „visible light.“ The use of most photoinitiators is not restricted. They are usually present in the products in concentrations between 0.5 and 10 %.

Trimethylbenzoyl diphenylphosphine oxide, together with Hydroxycyclohexyl phenyl ketone, were by far the most frequently used photoinitiators. Its use in nail varnishes was permitted at the time of sampling up to a concentration of 5 %; however, since September 1, 2025, its use in cosmetics has been prohibited because the substance has been classified as reprotoxic. 27 coatings contained this photoinitiator in concentrations between 0.25 and 8.2 %. Three of the tested products clearly exceeded the limit of 5 %. In 9 products (33 %), the declaration was missing. Furthermore, we also objected the absence of the declaration for other photoinitiators: ethyl trimethylbenzoyl phenylphosphinate (4 out of 14; 29%) and hydroxycyclohexyl phenyl ketone (5 out of 26; 19 %).

We found benzoyl peroxide in one dipping product. During application, the fingertips are dipped into the acrylic powder. This is clearly in contradiction to the prescribed warning statement for benzoyl peroxide: „Avoid contact with skin.“

The photoinitiator benzophenone, has been banned for several years. Analytical tests revealed levels under 0.001% in one varnish, where it was stated to be present.

Other ingredients

Although gel nail varnish is not actually required to be preserved against microbial contamination, we have repeatedly found products containing unauthorised preservatives in recent years. This year, in contrast, we did not detect any unauthorised preservatives.

Phthalates were added to nail varnish for a long time as plasticisers. Since their ban, they are no longer found in relevant concentrations. In an Italian product, we detected 0.37% undeclared triphenyl phosphite. The substance is under scrutiny due to its potential reproductive toxicity.

Impurities

In contrast to traditional nitrocellulose-based nail varnishes, gel nail varnishes rarely contain technically avoidable amounts of genotoxic N-nitrosamines exceeding 10 µg/kg. However, in the last campaign, we found two products with very high levels. This year, we detected 3,000 µg/kg of N-nitrosodimethylamine in a Swiss product and 860 µg/kg of the same nitrosamine in a green coloured nail varnish in a set. We have not yet identified the cause of these impurities.

Labelling and warnings

Due to the numerous deficiencies in the composition of the varnishes, the legal conformity of the declaration was not probed comprehensively. In addition to the undeclared ingredients mentioned earlier, the deficiencies in the table below are particularly noteworthy.

For three products, the ingredient declaration was entirely missing, one of them having been produced in Switzerland. For two other coloured products, no colourants were declared. It would also be possible for the responsible person to recognise the deviation from the legal requirements without chemical analysis. The ingredients of cosmetics must be listed according to the common name in the annex of the implementing decision (EU) 2022/677. In at least two products, it was not clear from the ingredient lists which substances were contained in the products. This deficiency concerned the main ingredients in both cases, i.e. the acrylates.

Reason for non-compliant labelling	# of samples
No ingredient list	3
No colourants listed for coloured product	2
Ingredient list with substances that are not permissible	3
Inaccurate ingredient lists	2
Product with label "not for cosmetic use"	1
Missing warning required based on declared ingredients	10
Online advertising does not match warning	2
Missing lot number	2
Missing information on shelf life	2

Two nail varnishes, which were intended solely for professional use and had additional substance-specific warning statements, were advertised in two web shops with the claim that the products are easy to apply and suitable for beginners and for home use! This claim was prohibited.

Another such inconsistency was observed directly on a set advertised as "home manicure" although the same packaging and the varnishes bore the warning "for professional use only".

An Italian nail varnish was correctly labelled as a cosmetic, including an ingredients list, the warning statements required for the ingredients, and other cosmetic-specific declaration requirements. On the back side of the double-sided adhesive label, which is not visible to consumers at the point of purchase, the additional warning statement „Not a cosmetic product“ was added. The question arises whether this should legitimize the use of unauthorized colourants listed in the ingredients list?

Conclusions

Following repeated inspections of gel nail varnishes in nail salons and retail outlets with poor results, this year, we checked the Swiss online market, as such products are increasingly used privately and there is a large supply in web shops. The results are similarly poor. The legal compliance of this product category remains unacceptable: the detection of unauthorized colourants in nearly half of the samples tested, exceedances of limit values for stabilisers and photoinitiators and missing or incorrect declarations of main ingredients in many products indicate the producers have completely inadequate quality control regarding the raw materials used and/or insufficient knowledge of the legislation. Unfortunately, it cannot be ruled out that certain manufacturers deliberately use unauthorized colourants.

All products tested were not intended for use by non-professional individuals, yet they are easily available online for private use. In some web shops, the warning statement „only for professional use“ is indeed given, sometimes, however, hidden and no inquiry into the intended use is made during the sale, as is also the case in retail. Additionally, there appears to be a legal loophole: legislation allows the use of some ingredients only in products for professional use. However, there is no clear way to restrict their sale to non-professional individuals. This can even be counterproductive, as the warning statement „for professional use only“ could well serve as an incentive to purchase rather than a warning, as it may suggest a particularly good product.