

Contact allergens and irritants in household washing and cleaning products

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Background: Household cleaning products often contain potential allergens and irritants but allergic contact dermatitis from these products in general consumers is rarely reported in the literature.

Objectives: The purpose of this study was to evaluate the presence of irritants and allergens as indicated on the labels or on the product information found on the website of household cleaning products marketed in Italy.

Material/Methods: We examined the labels and the product information of 291 liquid household washing and cleaning products, including 43 washing-up liquids, 63 laundry detergents, 61 fabric conditioners, 47 spray detergents, and 77 hard surface cleaning products. We obtained the data from the product information found on the websites for 263 products and directly on the product packages for 28 products. For each product we specifically recorded the presence of surfactants, preservatives, and fragrances listed in Annex III of Directive 76/768/EEC.

Results: The websites of two Italian brands do not respect EU regulations as they provide product information only with bar codes of the products. Preservatives and fragrances are the main allergens declared in the label of household cleaning products with methylchloroisothiazolinone/methylisothiazolinone (MCI/MI) listed in 35.7% and limonene in 43.6% of the products. Surfactants were listed in 16.5% of the studied products.

Conclusions: Our study shows that household cleaning products in Italian market contain several allergens, particularly preservatives and fragrances. For consumers, at least in Italy, it may not be easy to retrieve product information from the website for two widely sold brands. The information had to be taken from the actual package.

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Housework represents 3–10% of the paid work and a big part of unpaid work in human society. It is one of the most important causes of hand eczema and includes housecleaning, babysitting, and help services for old and disabled people (1).

Household cleaning products are an important source of exposure to irritants and allergens. According to the literature, irritant contact dermatitis due to cleaning agents is mostly caused

by the anionic surfactant sodium lauryl sulfate (2). Other ingredients that are utilized in household cleaning products include propylene glycol and cocamidopropyl betaine (3, 4). The first is a solvent and humectant with a very low sensitization and irritation potential. Cocamidopropyl betaine, an amphoteric surfactant also used in cosmetics products, is more irritating than propylene glycol and can occasionally cause skin sensitization (5).

Preservative and fragrances are important allergens in household cleaning products (6). Methylchloroisothiazolinone (MCI) and methylisothiazolinone (MI) are preservatives widely utilized both in cosmetics and household cleaning products (6–8). In Europe the frequency of sensitization to the mixture MCI/MI is between 0.4% and 11.1% depending on the country (6, 9). Another popular preservative is 1,2-benzisothiazolin-3-one belonging to the group of isothiazolinones; a study on guinea pig lymph nodes showed that MCI/MI tested positive at a concentration of 0.01% whereas 1,2-benzisothiazolin-3-one was clearly active only within a 30–50% concentration range (10).

Among fragrances, linalool and limonene are frequently present in household cleaning products (11). A patch test study on consecutive patients showed that the oxidized limonene is a common cause of contact allergy in Europe (11, 12). Oxidized linalool and its hydroperoxide fraction were also found to be common contact allergens. In a European study, 1.3% of the patients tested showed a positive reaction to oxidized linalool. Auto-oxidation of fragrance terpenes contributes greatly to fragrance allergy (11). Air oxidation of the fragrance terpenes linalool and limonene also increases skin irritation, as reported by a very recent paper which documented that oxidized limonene was more irritating than oxidized linalool (13).

The purpose of this study was to evaluate the presence of irritants and allergens in the labels of household cleaning products marketed in Italy. We did not investigate their concentrations in these products. We merely reported the name of the substances among surfactants, preservatives, and selected fragrances without investigating and discussing their concentrations in the household products. Establishing the risk of these products in terms of their capability to induce or elicit skin sensitization in general consumers falls outside the scope of this study.

Materials and Methods

We examined the ingredients listed on the label of 291 liquid household cleaning products in Italian markets belonging to both international and Italian brands.

The products categories included:

- Washing-up liquids (43 products)
- Laundry detergents (63 products)
- Fabric conditioners (61 products)
- Spray cleaners (47 products)
- Liquid hard surface cleaning products, including wood and other material polishing agents (77 products).

For each group we evaluated the presence of irritants and allergens. In particular, we considered surfactants, preservatives, and fragrances including the generic statement containing 'parfum', and the presence of each of the 26 fragrances listed in Annex III of directive 76/768/EEC.

We obtained the data from the labels found on the websites for 263 products and directly from the product packages for 28 products.

Results

Product information of two Italian brands, Conad and Despar, are not readily available for consumers. The brand Conad does not have a dedicated website as they sell products produced by different suppliers, and refer to the suppliers' websites; all websites checked, however, require the product bar code to provide information about the formulation. The brand Despar websites also require the product bar code to provide the information about formulation.

The irritants and allergens declared in the different household cleaning products are detailed in Table 1.

Washing-up liquids

Washing-up liquids are detergents formulated for dish washing. Their primary use is the hand washing of glasses, plates, and cutlery.

In this category, preservatives were labelled in most of the products: the most frequent labelled preservative was MCI/MI, followed by 2-bromo-2-nitropropane-1,3-diol. Fragrances were labelled in almost all products: the most frequent fragrance was limonene. Cocamidopropyl betaine was labelled in about half of the products.

Laundry detergents

Laundry detergents are used for washing fabrics. Laundry detergent has traditionally been a powder or a tablet but during recent years the popularity of liquid detergents has increased.

In this category, preservatives and fragrances were listed in about two-thirds of products: the most frequent labelled preservative was MCI/MI, followed by methylisothiazolinone and 1,2-benzisothiazolin-3-one; the most frequent labelled fragrance was butylphenyl methylpropional, followed by hexyl cinnamal; and propylene glycol was frequently listed.

Brighteners are laundry detergents to be applied on fabrics before washing. The label of these products reported the presence of optical brightener with no reference to the chemical name.

Table 1. Irritants and allergens declared in the studied household cleaning products

	Washing-up liquids (43 products)	Laundry detergents (63 products)	Fabric conditioners (61 products)	Spray cleaners (47 products)	Liquid hard surface cleaning products (77 products)	Total (291 products)
Preservatives ^a (%)	39/43 (90.7)	45/63 (71.4)	47/61 (77.0)	7/47 (14.9)	42/77 (54.5)	180 (61.9)
Methylchloroisothiazolinone/ methylisothiazolinone	34/43 (79.0)	22/63 (34.9)	26/61 (42.6)	4/47 (8.5)	18/77 (23.4)	104 (35.7)
1,2-benzisothiazolin-3-one	11/43 (25.6)	15/63 (23.8)	18/61 (29.5)	3/47 (6.4)	20/77 (26.0)	67 (23.0)
2-bromo-2-nitropropane-1, 3-diol	25/43 (58.1)	7/63 (11.1)	4/61 (6.6)	1/47 (2.1)	7/77 (9.0)	44 (15.1)
Methylisothiazolinone	1/43 (2.3)	20/63 (31.7)	1/61 (1.6)	–	8/77 (10.4)	30 (10.3)
Fragrances ^b (%)	41/43 (95.3)	45/63 (71.4)	50/61 (82.0)	21/47 (44.7)	57/77 (74.0)	214 (73.5)
Limonene	37/43 (86.0)	19/63 (30.2)	17/61 (27.9)	16/47 (34.0)	38/77 (49.4)	127 (43.6)
Geraniol	7/43 (16.3)	20/63 (31.7)	5/61 (8.2)	4/47 (8.5)	11/77 (14.3)	47 (16.1)
Linalool	7/43 (16.3)	15/63 (23.8)	23/61 (37.7)	3/47 (6.4)	26/77 (33.8)	74 (25.4)
Hexyl cinnamal	2/43 (4.7)	23/63 (36.5)	28/61 (45.9)	6/47 (12.8)	24/77 (31.2)	83 (28.5)
Butylphenyl methylpropional	1/43 (2.3)	29/63 (46.0)	38/61 (62.3)	5/47 (10.6)	20/77 (26.0)	93 (32.0)
Solvents and surfactants ^c (%)	21/43 (48.8)	24/63 (38.0)	–	3/47 (6.4)	–	48 (16.5)
Cocamidopropyl betaine	21/43 (48.8)	–	–	–	–	21 (7.2)
Propylene glycol	–	20/63 (31.7)	–	–	–	20 (6.9)
Sodium lauryl sulfate	1/43 (2.3)	4/63 (6.3)	–	3/47 (6.4)	–	8 (2.7)

^aMost products listed more than one preservative.^bMost products listed more than one fragrance.^cOne product listed two surfactants.

Fabric conditioners

Fabric conditioners are used to prevent cloth felting and to make fabric softer. There are liquid and dry fabric conditioners: liquid fabric conditioners are the most popular and may be sold as diluted or undiluted.

In this category, preservatives are listed in most products: the most frequent labelled preservative was MCI/MI, followed by 1,2-benzisothiazolin-3-one. For all brands, the mixture MCI/MI was present in diluted but not in undiluted products.

Fragrances were present in almost all products: the most frequent labelled fragrance was butylphenyl methylpropional, followed by hexyl cinnamal and linalool. Surfactants were not listed in this category.

Spray cleaners

Household cleaning sprays are utilized to clean glass, plastic, wood, and metal surfaces. These products are widely chosen by consumers as they provide fast cleaning without the need of rinsing for most products.

In this category, preservatives were present in few products: the most frequent labelled preservative was MCI/MI, followed by 1,2-benzisothiazolin-3-one. Fragrances were present in about half of the products: the most frequent labelled fragrance was limonene. The only labelled surfactant was sodium lauryl sulfate, listed in three products.

Liquid hard surface cleaning products

Liquid hard surface cleaning products represent a category of specialty chemicals. They are used to remove dirt and oil stains on hard surfaces. They include both rinse-off and leave-on products.

In this category, preservatives were present in about half of the products: the most frequent labelled preservative was 1,2-benzisothiazolin-3-one, followed by MCI/MI. Fragrances were present in two-thirds of the products: the most frequent labelled fragrance was limonene, followed by linalool and hexyl cinnamal. Surfactants were not listed in this category.

Discussion

Although household cleaning products often contain potential allergens and irritants, allergic contact dermatitis from these products in general consumers is rarely reported in the literature (14–16). Possible explanations may be either that the responsible products are not identified as the cause of the dermatitis or that the concentration of the potential allergens in household cleaning products is below the threshold for elicitation of a reaction in sensitized individuals (17–19).

However, hand dermatitis from cleaning products is well documented in occupational workers such as hospital and kitchen cleaners (20, 21), and a recent study assessed that some cleaning tasks such as mirror/window, sink, and toilet cleaners are at high potential for inhalation and dermal exposure (22).

The aim of this study was only to identify the presence of potential irritants and allergens in the label of household cleaning products in the Italian market, and to verify if the EU Detergents Regulations requiring manufacturers to provide product labelling on a website address were respected by the Italian manufacturers and/or distributors.

In our study, irritants such as cocamidopropyl betaine and sodium lauryl sulfate are contained in few household cleansers, the former in 21 products (7.2%) and the latter only in 8 products (2.7%).

Preservatives and fragrances are the main allergens declared on the labels of household cleaning products on the Italian market. The mixture MCI/MI is the most common preservative in the entire product categories included in our study. In particular, the mixture MCI/MI was labelled in 104 products (35.7%), 1,2-benzisothiazolin-3-one in 67 (23.0%), 2-bromo-2 nitropropane-1,3-diol in 44 (15.1%) and methylisothiazolinone in 30 (10.3%).

Washing-up liquids and fabric conditioners are the products where these preservatives were most commonly found (90.7% in washing-up liquids and 77.0% in fabric conditioners).

Almost all household cleaning products declare perfumes. Among fragrances that should be listed in the labels according to the EU regulations, we found that limonene, butylphenyl methylpropional, hexyl cinnamal, linalool, and geraniol were frequently included in the formulations; in particular, limonene was detected in 127 products (43.6%), butylphenyl methylpropional in 93 (32.0%), hexyl cinnamal in 83 (28.5%) linalool in 74 (25.4%), and geraniol in 47 (16.1%).

Most washing-up liquids and fabric conditioners declared one or more of these fragrances (95.3% and 82.0%, respectively). Although limonene was the most recorded fragrance among terpene, linalool predominated in the group of fabric conditioners (37.7% of terpene versus 27.9% of limonene). These data are comparable with those reported in a study performed in the UK in order to evaluate the exposure pattern of consumers to fragrances in which limonene and linalool were found respectively in 29 (51.0%) and in 17 (29.8%) out of 57 household products (23). Oxidized terpenes are emerging contact allergens, and they might be present in household products as these products are frequently left exposed to air (11).

The risk of skin damage from household cleaning products depends on the type of contact that the consumer has with the product. Some products such as washing-up liquids, spray detergents, and liquid hard surface cleaning products come frequently in contact with the user's skin and may be a

possible source of irritant or allergic dermatitis. Other categories such as fabric conditioners and laundry detergents, even if they have a high content in preservatives and fragrances, are unlikely to be handled by the cleaner and to come in contact with the skin.

Washing-up liquids are rinse-off products that contain preservatives (90.7%) and fragrances (95.3%) in most cases. Although consumers are supposed to wear gloves when hand washing cutlery and dishes, this does not occur in all cases.

Spray detergents are frequently used as leave-on products, and therefore may have a considerable risk of causing a contact dermatitis, even if their content in preservatives and fragrances is not as high as in washing-up liquids.

Consumers usually utilize sprays without gloves for a large range of different cleaning activities, and airborne exposure to these products has been well documented. In the last few years spray-cleaning products have been linked to the occurrence of allergic asthma, and there is evidence that using sprays several times a week increases the incidence of asthma (24). Occupational asthma due to spray detergents has been reported in cleaners, who are considered a high-risk category of workers for this condition (25).

Liquid hard surface cleaning products can be utilized as rinse-off or leave-on with or without hand protection; preservatives are listed in 54.5% and fragrances in 74.0% of these products.

The limitations of our study are that data were only obtained by checking products labels and we did not perform an analytical control to verify if the contents of the products corresponded to the label. In a Danish study published in 2000, where 67 skin creams were analysed for preservatives, ingredient labelling was incorrect in 23% of the investigated products (26). In a previous similar study conducted on the Swedish market, 10% of the investigated moisturizing creams were labelled as containing preservatives that were not in the products, and 17% contained at least one preservative which was not declared in the label (27). This was despite EU Cosmetic Directive requiring mandatory preservative labelling.

The EU Detergents Regulations (648/2004) (28) require all preservatives to be listed on the label, irrespective of their concentration. Regulations on fragrances are identical to those of rinse-off cosmetics as the 26 allergenic fragrances listed in Annex III, Part 1 to Directive 76/768/EEC should be reported on the label only when their concentration exceeds the limit of 0.01% (100 p.p.m.).

The amending regulation no 907/2006 also requires manufacturers to provide product labelling

on a website address that should be reported on product packaging. Access to the website should not be subjected to restrictions or conditions and its contents should be kept up to date. The website should include a link to the Commission Pharmacos website or to any suitable website that provides a table of correspondence between INCI names, Pharmacopoeia names, and CAS numbers.

Some Italian brands do not appear to follow EU Regulations as they provide online product information only with bar codes of the products; this means that the consumer needs to look at the actual product package to obtain the information. These products are sold in over 2000 supermarkets throughout Italy.

In conclusion, our study shows that household cleaning products in Italian market contain several allergens. Although there is no evidence that these products can be a source of sensitization for exposed cleaners, the possibility that some products that are not rinsed off, particularly spray detergents and hard surface cleaners, might elicit a contact dermatitis in subjects who are already sensitized to some ingredients should be considered. In our country, EU regulations on website labelling are not fully respected and already sensitized cleaners might have difficulties in retrieving the information for avoiding the offending agents.

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