

Sensitivity to isopropyl alcohol

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Positive patch test reactions to isopropyl alcohol in connection with proved allergy to ethyl alcohol have already been published. A case of allergy to isopropyl alcohol with positive reactions to isopropanol (unpurified test material) and negative reactions to ethanol and methanol has also been reported. We report a case of a occupationally acquired sensitivity to isopropyl alcohol in which, on testing with gas chromatographically purified material, positive patch test reactions were found to 1-propanol, 1-butanol, 2-propanol, 2-butanol and methanal (formaldehyde) but not to the primary alcohols methanol, ethanol and amyl alcohol; not to the aldehydes acetal (acetaldehyde) and butanal; nor to the ketones acetone, butanon and isobutyl ketone, nor to methanoic (formic) acid. A tentative explanation for this peculiar pattern of reactions is given.

Key words: Formaldehyde – isopropyl alcohol – lower molecular primary and secondary alcohols.

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Positive patch test reactions indicating sensitivity to isopropyl alcohol have already been published (Drevets & Seeböhm 1961, Fregert et al. 1969, van Ketel & Tan-Lim 1975). These positive reactions, however, were observed on patch testing patients with a contact dermatitis due to ethyl alcohol in whom sensitivity to ethyl alcohol had been demonstrated by patch tests. Wasilewski (1968) was the first to report a case of contact dermatitis due to isopropyl alcohol, substantiated by positive patch test reactions to isopropyl alcohol but not to other lower aliphatic alcohols. However, he does not mention explicitly having used purified isopropyl alcohol for his tests. Considering the obvious rarity of cases reacting to isopropyl alcohol but not to lower aliphatic primary alcohols and, the fact that our tests were performed with highly purified isopropanol, it seemed worthwhile publishing the following case.

Case report

A 45-year-old female employee working in the laboratories of a cosmetic company manufacturing hair cosmetics participated as a paid volunteer in a patch testing program, the objective of which was to prove the safety of a hair lotion. As she was the only volunteer out of a total of 50, exhibiting a two plus positive reaction of an allergic nature on readings after 24, 48 and 72 h, she was subjected to further tests. Closed patch tests were performed with each of the ingredients of the hair lotion dissolved in 60 % commercial isopropyl alcohol. All tests including 60 % isopropyl alcohol alone were uniformly positive. To ascertain that the positive reaction was not due to contaminants present in commercially available isopropyl alcohol, tests were performed with chemically pure isopropyl alcohol (1-propanol p.a. Riedel de Haen) in

Table 1. Results of patch tests with alcohols and chemically related compounds

Compound	Concentration %	Diluent	24 h	48 h	72 h
2-Propanol	99,7		+++	+++	+++
2-Propanol	50	aq.	+++	+++	+++
2-Propanol	25	aq.	+++	+++	+++
2-Propanol	10	aq.	++	++	++
2-Propanol	99	as is	++	+++	+++
2-Propanol	10	aq.	++	++	++
2-Propanol	7,5	aq.	++	++	+
2-Propanol	5	aq.	++	++	+
2-Propanol	2,5	aq.	+	+	+
2-Propanol	1	aq.	Ø	Ø	Ø
Ethanol	99,8		Ø	Ø	Ø
Methanol	99,5		Ø	Ø	Ø
1-Propanol	99,5		++	++	++
1-Propanol	50	aq.	+	+	+
1-Propanol	10	aq.	(+)	(+)	(+)
1-Butanol	99,5		++	++	++
1-Butanol	10	aq.	++	++	—
2-Butanol	99		++	++	++
2-Butanol	10	aq.	++	++	—
Amyl alcohol	99	aq.	Ø	Ø	Ø
Methanal	1	aq.	++	+++	+++
Methanal	0,5	aq.	++	++	++
Methanal	0,25	aq.	+	+	+
Methanal	0,1	aq.	Ø	(+)	(+)
Methanal	0,075	aq.	Ø	Ø	Ø
Acetal	1	aq.	Ø	Ø	Ø
Butanal	2	aq.	Ø	Ø	Ø
Acetone	50	aq.	Ø	Ø	Ø
Butanon	2	aq.	Ø	Ø	Ø
Methyl isobutyl ketone	2	ethanol	Ø	Ø	—
Methanoic acid	1	aq.	Ø	Ø	Ø

decreasing concentrations down to a 2.5 % dilution. All tests were nearly as positive as with the commercial isopropyl alcohol. Questioned about her past medical history, she reported to have had repeatedly slight itching eczematous lesions on her fingers and hands. Advised by her doctor to protect her hands by wearing rubber gloves while cleaning vessels in the laboratory, she had no further skin symptoms. With these data she was referred to the Department of Allergy of the Hamburg University Dermatological Clinic, as a case of isopropyl alcohol sensitivity.

Testing procedures

Commercially available test patches (Testpflaster für die epicutane Lappchenprobe Beiersdorf) were used and all tests were performed on the upper back. All test materials were applied for 24 h and the readings were made 24, 48 and 72 h after removal of the test patches. In addition to patch tests with isopropyl alcohol further tests were carried out with various lower aliphatic alcohols with their corresponding aldehydes, as well as with some other chemically related compounds (Table 1).

Table 2. Cases of contact dermatitis described in literature due to lower aliphatic alcohols

Authors	Sensitization with	Primary alcohols	Secondary and tertiary alcohols	Positive cross reactions to: Aldehydes a. ketones	acids	Remarks
Haxthausen 1945	ethanol	methanol } probably propanol } undiluted	-- --	-- --	-- --	not purified
Martin-Scott 1960	ethanol	methanol 5% pos. propanol 5% pos.	-- --	-- --	-- --	not purified
Drevets et al. 1961	ethanol	methanol 70% ++ + butanol 35% ++ + amylalcohol 35% ++ +	isopropanol (1 pat.) 70% ++ +	-- --	-- --	not purified
Fregert et al. 1963	ethanol	methanol 10% + propanol 10% + butanol 10% + 8 further alcohols +	-- --	ethanol 1% + 2-butanal 0.001% + benzaldehyde 2% + 3-phenylpro-penal 1% +	-- --	purified by gas liquid chroma-tography (GLC)
Wasilewski 1968	isopropanol	-- --	-- --	-- --	-- --	not purified
Fregert et al. 1969	ethanol	methanol undil. + propanol undil. + butanol undil. + pentanol undil. +	isopropanol un-dil. (2 pat.) + 2-butanol undil. (1 pat.) +	2-butanal 0.01% +	-- --	purified by GLC
Kurwa 1970*)	isopropanol	-- --	-- --	-- --	-- --	not purified
Van Ketel et al. 1975	ethanol	methanol 7% ++ + propanol 7% ++ + butanol 70% +	isopropanol 70% +	methanol (= formalde-hyde) 2% ++ + acetone 50% ++ +	formic acid 1% ++	highly purified Uvasol® (Merck)

*) Kurwa, A. R. (1970) Contact dermatitis from isopropyl alcohol. *Contact Dermatitis Newsletter* 8, 168.

The isopropanol used was distilled three times and then examined gas chromatographically and by mass spectrometry for purity. The other compounds tested were of pro analysi quality (E. Merck). Prior to application butanal (not p.a. quality) was distilled twice and subsequently gas chromatographically examined for purity.

Results

Results are summarized in Table 1. In addition to isopropanol, the following substances gave positive results: 1-propanol and 1-butanol from the group of primary alcohols, 2-butanol from the secondary alcohols and methanal (formaldehyde) from the aldehydes. Primary alcohols with less than 3 C atoms, aldehydes except methanal, acetone, butanon, isobutylketone, methanoic acid and amyl alcohol reacted negatively.

Discussion

When one considers the pattern of positive and negative reactions, which differs from those found in all previously published reports, (Table 2), it should be borne in mind that the tests reported in the papers of Drevets & Seeböhm (1961) and Wasilewski (1968) were performed with non-purified materials, which by definition must contain contaminants, a fact which limits the validity of the results obtained by testing and the conclusions drawn. The case reported here appears to be the first instance of an unequivocally proved sensitivity to the secondary alcohol isopropanol, without concomitant sensitivity to alcohols with less than 3 carbon atoms. The pattern of allergic sensitivities found in this case may be interpreted as follows. The repeated contact over the years with commercial isopropyl alcohol may have sensitized the patient to isopropanol. The positive reactions to 1-propanol, 1-butanol und 2-butanol could be

considered the expression of a group allergy comprising primary and secondary alcohols with 3 and 4 carbon atoms. The strongly positive reaction to methanal (formaldehyde) is difficult to explain in the same way. One would rather have expected positive reactions to the structurally more closely related aldehydes propanal and butanal as well as to acetone. It is therefore reasonable to assume that the positive reactions disclose an allergy to formaldehyde, acquired independently from that to isopropyl alcohol. Allergies to formaldehyde are not uncommon in housewives. In many instances the offending product which has induced the allergy remains unidentified. In the case reported here it developed that the patient at home regularly cleans a bird cage with various disinfectants, which may well contain formaldehyde. The negative test reactions to propanal and butanal in contrast to the positive ones to propanol and butanol are of interest in so far as they do not lend support to the hypothesis advanced by Fregert et al. (1963, 1969), according to which allergic reactions to lower aliphatic alcohols are possibly due to the corresponding aldehydes formed in the skin or contained as contaminants in the alcohols.

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Addendum

In the meantime we detected the paper Kurwa, A. R. (1970) Contact dermatitis from isopropyl alcohol, *Contact Dermatitis Newsletter* 8, 168-169, reporting a case of isopropyl alcohol allergy. The positive patch test reactions occurred by testing with unpurified material.

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