

**Allergic contact dermatitis
due to mono(2-ethylhexyl)
maleate in di-(*n*-octyl)
tin-bis(2-ethylhexyl
maleate) in polyvinyl
chloride gloves**

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Key words: allergic contact dermatitis; di-(*n*-octyl)tin-bis(2-ethylhexyl maleate); hand eczema; mono(2-ethylhexyl) maleate; patch test; polyvinyl chloride gloves.

Recently, a case of contact dermatitis due to adipic polyester used as a plasticizer and di-(*n*-octyl)tin-bis(2-ethylhexyl maleate) as a stabilizer in polyvinyl chloride gloves was reported (1). Here, we report three cases of allergic contact dermatitis caused by household-type polyvinyl chloride gloves from the same manufacturer who has more than 50% of the market share of such gloves in Japan. We demonstrated that the allergen was di-(*n*-octyl)tin-bis(2-ethylhexyl maleate). From the results of patch tests, we concluded that mono(2-ethylhexyl) maleate is the probable epitope responsible for the allergic contact dermatitis caused by di-(*n*-octyl)tin-bis(2-ethylhexyl maleate).

Case Reports

Case 1

A 42-year-old woman presented with a 5-year history of itchy erythema and

nodules on the dorsal surfaces of both hands. For 7 years, she had been using polyvinyl chloride gloves for housework.

Case 2

For 38 years, a 62-year-old woman had been using polyvinyl chloride gloves for cooking and dishwashing. She was referred to our clinic because of a 1-month history of erythema on the dorsal surfaces of both hands.

Case 3

A 30-year-old woman presented with lichenification and erythema on the dorsal surfaces of both hands. She had started to use polyvinyl chloride gloves for cooking 3 years previously and had suffered from dermatitis for 2 years.

Materials and Methods

We performed a 2-day closed patch test with the glove material 'as is'. Readings were taken at D2, D3, and D7 after application according to the criteria of the International Contact Dermatitis Research Group. To examine which component of the polyvinyl chloride gloves had induced the allergic contact dermatitis, we extracted the glove components with acetone and methanol, then purified with hexane, chloroform, and methanol. The purified solutions were analysed by high-performance liquid

chromatography/mass spectrometry (HPLC/MS) and gas chromatography (GC)/MS. We performed patch testing of these purified samples, ingredients of the polyvinyl chloride gloves provided by the manufacturer, and mono(2-ethylhexyl) maleate (Tokyo Kasei Kogyo Co., Ltd., Tokyo, Japan) using Finn Chambers[®]. Four healthy volunteers were tested with adipic polyester (5.0% pet.) and di-(*n*-octyl)tin-bis(2-ethylhexyl maleate) (0.1% and 0.5% pet.), and 21 healthy volunteers were also tested with mono(2-ethylhexyl) maleate (1.0% pet.). No allergic or irritant reaction was elicited at D2, D3, and D7.

Results

In all cases, patch testing of the polyvinyl chloride gloves elicited a positive response. In case 1 as shown in Table 1, only one extracted sample elicited a positive response and in that sample, we detected adipic polyester by HPLC/MS. In the glove material, we detected di-(*n*-octyl)tin-bis(2-ethylhexyl maleate) by GC/MS. Next, we performed patch testing of ingredients of the causative gloves. Only case 1 showed a positive reaction to adipic polyester, but all cases showed positive reactions to di-(*n*-octyl)tin-bis(2-ethylhexyl maleate). Then, we performed patch testing of mono(2-ethylhexyl) maleate (Tokyo Kasei Kogyo Co., Ltd), which is a component of

Table 1. Results of patch tests

Materials	CAS no.	Component level in gloves (%)	Patch test concentration	Case 1			Case 2			Case 3		
				D2	D3	D7	D2	D3	D7	D2	D3	D7
Extracted samples												
Acetone: methanol extracted sample			1.0% pet.	—	—	—			NT			NT
Hexane extracted sample			1.0% pet.	—	—	—			NT			NT
Hexane: chloroform extracted sample			1.0% pet.	—	—	—			NT			NT
Chloroform extracted sample			1.0% pet.	—	IR	—			NT			NT
Chloroform: methanol extracted sample			5.0% pet.	+	+	—			NT			NT
Methanol extracted sample			1.0% pet.	—	—	—	—	—	—	—	—	—
Ingredients in causative vinyl chloride gloves												
Poly(adipic acid-co-1, 2- propylene glycol)	25101-03-5	26.0	5.0% pet.	+	+	—	—	—	—	—	—	—
Alkyl sulfonic acid phenyl ester	91082-17-6	12.0	5.0% pet.	—	—	—	—	—	—	—	—	—
Tributyl <i>o</i> -acetylacrylate	77-90-7	4.0	5.0% pet.	—	—	—	—	—	—	—	—	—
4,4-Butylidene-bis(6- <i>tert</i> -butyl- <i>m</i> -cresol)	85-60-9	Unknown	2.0% pet.	—	—	—	—	—	—	—	—	—
Diisononyl adipate	33703-08-1	4.0	5.0% pet.	—	—	—	—	—	—	—	—	—
Epoxidized soya bean oil	8013-07-8	1.0	5.0% pet.	—	—	—	—	—	—	—	—	—
Di-(<i>n</i> -octyl)tin-bis(2-ethylhexyl maleate)	10039-35-5	0.2	0.1% pet.	—	—	—	+	+	+	+	+	+
			0.5% pet.	?+	+	+	++	++	+	++	++	+
			5.0% pet.	+	+	+		NT			NT	
Mono(2-ethylhexyl) maleate	2370-71-0	Unknown	1.0% pet.	+	++	+	+	+	+	++	++	+
Pet.			As is	—	—	—	—	—	—	—	—	—

NT, Not tested.

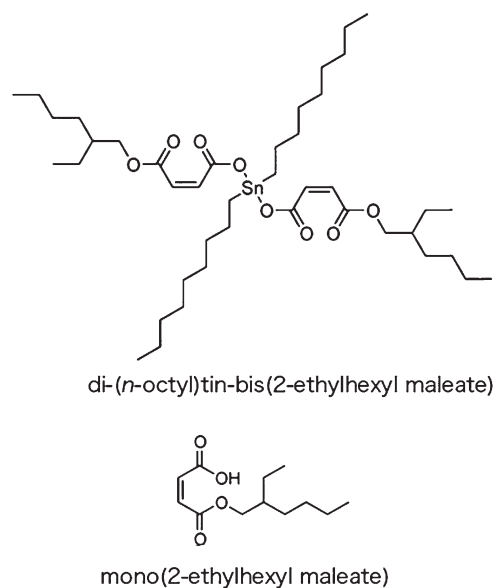


Fig. 1. Chemical structure of two allergens in the polyvinyl chloride gloves.

di-(n-octyl)tin-bis(2-ethylhexyl maleate). All cases showed positive reaction to mono(2-ethylhexyl) maleate (Table 1). All the three patients subsequently stopped using polyvinyl chloride gloves, and none of them has had any further complaint.

Discussion

In 1999, five cases of allergic contact dermatitis due to polyvinyl gloves were reported in Japan (2). In four of them, the allergen was not determined, while in one case, there was a positive reaction on patch testing to adipic polyester. Since about 2000, the use of nonylphenol and phthalic esters has been considered to pose an environmental problem, and regulation of the use of these compounds has been proposed in order to reduce the incidence of contact dermatitis due to polyvinyl chloride. In Japan, the manufacturers of gloves no longer use nonylphenol and phthalic esters as plasticizers and have changed the adipic polyester used. However, in 2005, a case of a Japanese female showing a positive reaction to the adipic polyester in the gloves was reported (3). Di-(n-octyl)tin-bis(2-ethylhexyl maleate) has been used in Japan for about 20 years. In this paper, all the three cases showed a positive reaction to di-(n-octyl)tin-bis(2-ethylhexyl maleate) and its component mono(2-ethylhexyl) maleate.

From these results, we suggest that mono(2-ethylhexyl) maleate is the probable epitope of di-(n-octyl)tin-bis(2-ethylhexyl maleate) responsible for the allergic reaction (Fig. 1). In response to our results, the manufacturer of the gloves stopped using di-(n-octyl)tin-bis(2-ethylhexyl maleate) in 2007.

References

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