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A Rare Case of Contact Urticaria and Allergic Contact Dermatitis to Maleic and Fumaric Acids*To the Editor:*

Maleic and fumaric acids are unsaturated dicarboxylic acids, differing in the configuration of their carboxylic groups.¹ Fumaric acid is the *trans*-isomer, whereas maleic acid has a *cis*-configuration and is mainly used as a precursor to fumaric acid. Maleic acid is produced industrially from maleic anhydride. Maleic anhydride (CAS 108-31-6) is the acid anhydride of maleic acid.¹ Case reports of allergic contact dermatitis from derivatives of maleic acid (CAS 110-16-7) or fumaric acid (CAS 110-17-8) are rare, and there are even fewer reports on a concomitant sensitivity to both molecules. We report on a plastic-testing technician who developed airborne allergic contact dermatitis to maleic acid and contact urticaria to fumaric acid.

A 50-year-old woman working as a plastic-testing technician since 2006 was referred on suspicion of occupational contact dermatitis. Her medical history included preprofessional atopic hand eczema. Furthermore, a nickel allergy was known. Other diseases such as atopic bronchial asthma were negated by the patient.

She reported first skin lesions in the facial area with burning and itching since April 2014. On the photographs supplied by the patient, which were taken a few hours after she started working, in addition to eczematous plaques on the neck, there was redness on the face together with a distinct swelling located on the chin, forehead, and nasolabial area. In

October 2014, the skin lesions worsened, so she was declared unfit for work and treated with oral prednisolone. When she started work again, she had to leave the workplace after 2 hours because of recurring lesions on the face, together with shortness of breath.

Patch testing was performed with the baseline, rubber, ointment base, and preservatives series as recommended by the German Contact Dermatitis Research Group,² supplemented with patient's own chemicals, such as maleic and fumaric acids (from Fumaderm Tbl). The exposure time was 2 days, except for the fumaric acid patch that had to be removed after 20 minutes because of massive contact urticaria. Reactions are shown in Table 1.

As a laboratory technician testing plastics, the patient carried out tests on the ingredients, extruded films, and specimens. She dealt with a variety of plastics and checked the composition of the granules while the substances were heated and steam rose. The resins contained maleic acid (<1%) according to the material safety data sheet. Isomerization of maleic acid to fumaric acid may occur spontaneously during processing, for example, in the condensation process while heating. Esters of fumaric acid are known to cause allergic contact urticaria,³ and maleic anhydride may locally irritate the skin.¹

In chronic inhalation exposure, irritation of the eyes and respiratory tract is common. Inhalation of high concentrations may lead to bronchial irritation, runny nose, and shortness of breath, as seen in our patient, and in severe cases, to lung damage (pulmonary edema).⁴ Our patient reported urticarial skin lesions in the facial area together with shortness of breath. These symptoms occurred very rapidly when she started working (as the patient said within 2 hours). As the patch testing also showed an immediate urticarial reaction to fumaric acid, to our mind, the shortness of breath might be due to a type I allergic reaction. Hansen et al⁴ reported a patient case of occupational asthma caused by maleic anhydride in the production of insecticides.

Fumaric acid and maleic anhydride are frequently used in practically every field of industrial chemistry worldwide. In 2013, China accounted for almost 39% of the world consumption of fumaric acid, whereas the other Asian countries consumed nearly 25% of the total. The United States and Europe accounted for approximately 20% of the world consumption in 2013.⁵

In summary, our patient experienced both airborne facial allergic contact dermatitis due to maleic acid and contact urticaria to fumaric acid. Because there was no occupational or personal exposure to methylisothiazolinone or (chlor) methylisothiazolinone, we regarded these allergens as being of unknown clinical relevance. The patient had to quit her job in

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TABLE 1. Nonnegative Patch-Test Reactions

Substance	Concentration	Vehicle	20 min	D2	D3
Fumaric acid (Fumaderm Tbl)	As is	Water	+	?	?
Maleic acid	1.0%	Vaseline petrolatum	—	+	+
Methylisothiazolinone	0.050%	Water	—	++	++
(Chlor)Methylisothiazolinone (MCI/MI)	100 ppm	Water	—	+	+

*Patch had to be removed at 20 minutes because of massive contact urticaria.

plastic testing because secondary prevention measures were unsuccessful.

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