

Occupational allergic contact dermatitis from cinnamon including one case from airborne exposure

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Background: The bark of the cinnamon tree is used as a spice; its flavour is from an essential oil containing mainly cinnamal.

Objective: To report new cases of occupational allergic contact dermatitis (ACD) from cinnamon and a novel case of airborne cinnamon contact allergy.

Methods: We examined the patient material of two dermatological clinics in Helsinki to find cinnamon contact allergic patients and review their clinical records.

Results: We found six patients with delayed contact allergy to cinnamon. In four patients, cinnamon was the main cause of occupational ACD. Three of them had dermatitis on their hands and one patient on the face and neck. In the latter case, the exposure was shown to be airborne. In addition, the fifth patient was occupationally sensitized to cinnamon, but it was not the main cause of his hand dermatitis. In the sixth patient, cinnamon allergy was considered to derive from cross-allergy to fragrances. Five of the patients reacted to cinnamal separately and in fragrance mix I. None of the six patients had immediate-type cinnamon allergy.

Conclusions: Occupational contact allergy to cinnamon is rare but needs to be considered in workers handling foods. Cinnamal is possibly the main allergen in cinnamon.

Key words: cinnamal; cinnamyl alcohol; fragrance mix I; patch test; spices. © Blackwell Munksgaard, 2009.

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Chefs, bakers, and other restaurant workers having skin exposure to foods may develop both Type I and Type IV allergy to different kinds of foods (1, 2), including spices (3–5). Allergic contact dermatitis (ACD) from spices is, however, seldom reported (5–9).

Cinnamon is derived from the bark of cinnamon trees (*Cinnamomum zeylanicum* or *Cinnamomum cassia*). The word ‘cinnamon’ is properly used to refer to Ceylon cinnamon, also known as ‘true cinnamon’ from the bark of *C. zeylanicum*. However, the cinnamon used in Europe is derived from a related tree species *C. cassia*. Besides other components, cinnamon contains about 1–3% essential oil (oil of cinnamon) with cinnamal (cinnamic aldehyde) as the main constituent and allergen with about 35 other components such as eugenol,

isoeugenol, and cinnamyl alcohol (cinnamic alcohol) (10). Cinnamon is widely used in the food, cosmetic, and pharmaceutical industries. Case reports of occupational ACD from cinnamon and its derivatives have been previously reported in two bakers baking cinnamon rolls (7, 9) and a chef (5). A coffee room worker had occupational ACD from natural cinnamon extract, which was used as a flavouring agent in coffee (8). Spice factory workers were shown to have more contact allergy to cinnamal and cinnamyl alcohol than the general population, but the clinical relevance of this was difficult to evaluate (6). A physiotherapist had occupational ACD from oil of cinnamon, which was in the massage cream she was using on patients (11). Allergic dermatitis due to cinnamon has also been reported from toothpaste (12), mud

bath (13), odour-neutralizing agent in shoe insoles (14), and lipstick (15). Systemic allergic dermatitis from cinnamon is also known (3, 9). Because of its sensitizing properties, the use of oil of cinnamon in perfumes is limited.

Here, we report six patients with delayed contact allergy from cinnamon, diagnosed during a 17-year period (1991–2007) at the Skin and Allergy Hospital (SAH) in Helsinki and the Finnish Institute of Occupational Health (FIOH). One of the patients (no. 6) was included in a previous report of spice allergy from FIOH (5).

Materials and Methods

We examined the patient material of two dermatological clinics in Helsinki during 1991–2007 to find patients with positive patch test reactions from cinnamon. Approximately 800 patients are referred annually to our two clinics because they are suspected to have occupational skin disease and they are all patch and/or prick tested.

All patients were patch tested with a modified European baseline series and with additional series depending on exposure. The standard series included *Myroxylon pereirae* (balsam of Peru) 25% petrolatum (pet.) and fragrance mix I 8% pet. containing cinnamyl alcohol, cinnamal, hydroxycitronellal, amyl cinnamal, geraniol, eugenol, isoeugenol, and *Evernia prunastri*. The test substances used at SAH were from Chemo-technique Diagnostics AB, Malmö, Sweden, and those used at FIOH were from Trolab, Hermal, Reinbek, Germany. Patients were also tested with their own materials brought from the workplace. Cinnamon and other spice powders were placed 'as is' on a filter paper in a test chamber and moistened with water. Cinnamon powder *as is* has been tested in recent years at the FIOH in 145 patients with 14 patients eliciting an irritant reaction. As spices may cause irritation in patch testing, a dilution series has been used. Garlic was applied as a 10% water extract. Patch testing was performed on the patients back with 2-day occlusion and scored as previously described (16).

Prick testing of the patients included environmental allergens, basic foods, spices and vegetables, and flours. Prick testing was also performed with their own materials brought from the workplace. Test results were scored as described previously (17).

Results

During 1991–2007, four patients were diagnosed as having occupational ACD from cinnamon without any immediate-type allergy to cinnamon.

One patient (no. 4) was considered to have been sensitized to cinnamon at work, but it was not the main cause of his dermatitis. In one patient (no. 5), cinnamon allergy was probably due to cross-allergy to cinnamal in fragrances. The characteristics of the patients are summarized in Table 1. Patch test reactions from cinnamon, fragrance mix I and its constituents, and *M. pereirae* are shown in Table 2. The data on patient no. 1 with airborne contact allergy to cinnamon are given in more detail.

Case report

Patient no. 1 was a female baker with no atopic history. She had been working part-time in a bakery for 2-week period separated by 2-week period of not working. Her job consisted of making and baking cakes and cookies. She developed erythematous and vesicular eczema on her face and neck on the second day of each work period. During the periods when she was not working, the eczema always healed completely. During summer holidays, her skin was normal. She wore protective gloves on her hands, and she did not have any hand eczema. She had a 1+ reaction to fragrance mix I and a negative result to *M. pereirae*. In the fragrance series, she had a 2+ reaction to cinnamyl alcohol and a 1+ reaction to cinnamal. Cinnamon *as is* elicited a 2+ reaction, and dispersions in aqua and pet. were clearly positive (Table 2). She was not handling cinnamon herself at work, but she worked in a room where cinnamon rolls were made. Her contact allergy was considered to be airborne. The prick test for cinnamon was negative. She had not experienced any symptoms from cosmetics or perfumes. Following retirement from work, she had no recurrence of the eczema. She was diagnosed as having had occupational ACD from cinnamon.

Discussion

Spices and foods may be irritating when used in patch testing, and false-positive patch test reactions cannot be totally ruled out when patch testing with such materials *as is*. During recent years, we have confirmed such patch test reactions by a dilution series. In patients 1 and 2, cinnamon allergy was confirmed by a positive dilution series. However, based on clinical experience, exposure history, and course and site of dermatitis combined with patch test data, we concluded that two patients described in this article also had occupational ACD from cinnamon (patients 3 and 6). Patient no. 1 had ACD from cinnamon, which was shown to be airborne allergy. She did not have any eczema on the hands because she

Table 1. Clinical characteristics of the patients

Patient no.	1	2	3	4	5	6
Age (years) when diagnosis was made/sex	61/female	34/male	48/female	41/male	30/female	37/male
Occupation	Baker	Baker	Restaurant worker	Baker	Restaurant worker	Restaurant worker
Location of dermatitis	Face and neck	Palmar sides of hands and fingers	Palmar and dorsal sides of hands and fingers	Palmar and dorsal sides of hands and fingers	Palmar and dorsal sides of hands and fingers	Dorsal sides of hands and fingers
History of respiratory atopy	No	No	No	No	Yes	Yes
Diagnosis/year	OACD (cinnamon)/2006	OACD (cinnamon)/2007	OACD (cinnamon), OICD (wet work, detergents, handling of food)/2003	OPCD (wheat and rye flour), OICD (wet work) *Allergia epicutanea prof. (cinnamon)/2005	OICD (wet work), †Allergia epicutanea non-prof. (cinnamon), probably due to cross-reaction with fragrances/2004	OACD (cinnamon, garlic, paprika)/1992

OACD, occupational allergic contact dermatitis; OICD, occupational irritant contact dermatitis; OPCD, occupational protein contact dermatitis.

*Allergia epicutanea prof. (cinnamon) means that the patient had been sensitized to cinnamon at work, but the present exposure was so limited that it was not considered to be among the main causes of his dermatitis.

†Allergia epicutanea non-prof. (cinnamon) means that the patient reacted to cinnamon in the patch test, but she had not been exposed to cinnamon at work. Her primary cinnamal allergy derived from perfumed products.

used protective gloves. However, she was working in a room where cinnamon rolls were made and the eczema appeared on skin areas that were not covered – the face and neck. To our knowledge, this is the first reported case of airborne ACD from cinnamon. The allergic reaction to cinnamon in patient no. 5 was considered to result from cross-allergy to cinnamal in fragrances.

Spices, *M. pereirae*, and perfumes include several of the same or related substances, of which cinnamal, cinnamyl alcohol, and eugenol are well-known strong sensitizers (18). In a recent study by Schnuch et al. (19), cinnamal was the sixth most common and cinnamyl alcohol the eighth most common fragrance allergens. Cinnamyl alcohol and cinnamal are chemically closely related terpenes. However, cinnamyl alcohol itself cannot bind to protein (20). It is thought that cinnamyl alcohol is a 'prohaptent', transformed by alcohol dehydrogenase in the skin to cinnamal, which is able to bind to protein and act as a hapten (21). This might explain a high rate of simultaneous patch test reactions of these chemicals, 63% in one recent study (22). *M. pereirae* has been considered to act as a screening substance for spice allergy (4). However, it has been shown by many authors that the absence of an allergic patch test reaction to *M. pereirae* does not rule out spice allergy (3, 9). All patients presented here also had negative patch test reactions to *M. pereirae*. However, all but one patient had allergic patch test reactions to fragrance mix I and its constituent cinnamal. Three of the patients also had reactions to cinnamyl alcohol. In previously reported cases of ACD from cinnamon, a baker had positive patch test reactions to *M. pereirae*, fragrance mix I, and both cinnamal and cinnamyl alcohol in addition to cinnamon (9). A coffee room worker had allergic patch test reactions to *M. pereirae*, fragrance mix I, and cinnamal (8), and a physiotherapist had allergic patch test reactions to fragrance mix I and eugenol while *M. pereirae*, cinnamal, and cinnamyl alcohol were negative (11). Therefore, although positive reactions to fragrance mix I can be a sign of spice allergy, it must be remembered that all positive patch test reactions to spices are not always clinically relevant but can be a sign of fragrance allergy.

Spices are also known to cause allergic contact urticaria (2, 6, 23), and non-immunologic contact urticaria from cinnamal has been reported (24). None of our patients had immediate-type allergy to cinnamon.

In conclusion, delayed-type allergic contact eczema from spices is relatively rare but should be considered when examining patients who work in relevant occupations such as a baker or restaurant

Table 2. Patch test reactions to cinnamon, fragrance mix I, cinnamal, cinnamyl alcohol, the other constituents of fragrance mix I, and *Myroxylon pereirae*

Patch test allergen	Concentration, vehicle	Patient					
		1	2	3	4	5	6
Cinnamon	<i>As is</i>	2+	3+	1+	1+	2+	2+
	32% aqua*	3+	2+				
	10%	2+	1+				
	3.2%	1+	?+				
	1%	–	–				
	32% pet.	2+	1+				
	10%	1+	?+				
	3.2%	–	–				
	1%	–	–				
Fragrance mix I	8% pet.	1+	2+	1+	1+	2+	–
Cinnamal	1% pet.	1+	2+	2+	1+	1+	NT
Cinnamyl alcohol	2% pet.	2+	?+	?+	–	–	NT
Other constituents of Fragrance mix I		–	–	Isoeugenol 2+	–	–	NT
<i>M. pereirae</i>	25% pet.	–	–	–	–	–	–

NT, not tested; pet. petrolatum.

*The dilutions of cinnamon are the geometrical series of the square root of 10 ($\sqrt{10}$).

worker. Cinnamal is the main constituent of the essential oil of cinnamon bark and possibly the main contact allergen in cinnamon. An allergic reaction to cinnamal in fragrance mix I may be a sign of occupational cinnamon contact allergy.

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