

Skin symptoms among workers in a spice factory

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Workers in a Swedish spice factory ($n=70$), and in the office ($n=23$) of the same company, were investigated by questionnaire regarding skin symptoms. In a 2nd part of the study, subjects reporting skin symptoms were examined and investigated by patch and prick testing. Skin symptoms were reported by $\frac{1}{2}$ the factory workers. Pruritus and skin irritation, particularly from cinnamon powder, were common. Patch test reactions to cinnamic aldehyde were found in 11/25 factory workers, but in several cases, the nature of the reactions was difficult to evaluate. Irritant patch test reactions were seen from powders of cardamom, paprika and white pepper. On prick testing, 6/25 workers reacted to cinnamic aldehyde. The results illustrate the difficulties of patch testing with spices and indicate the need for further research and validation of methods.

Key words: contact allergy; contact urticaria; spices; foods; cinnamon; cardamom; paprika; white pepper; pruritus; occupational; spice manufacture; patch testing technique; false-positive reactions.
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Spices contain essential oils that are known skin irritants (1). There are also reports of contact allergy (2, 3). Spices are used not only in foods and beverages but also in cosmetics and perfumes. Contact allergy to perfumes is common and Calnan et al. (4) reported that 7% of dermatitis patients had positive patch test reactions to the fragrance mix in the European standard series. When testing the ingredients separately, the highest number of positive reactions were to cinnamic aldehyde. Another substance used as a marker of allergy to perfumes is balsam of Peru. Spices are also known to cause contact urticaria (5, 6).

In spice factories, the raw materials are cleaned, crushed, ground, mixed and packed. This work is to a large extent manual, so that the skin of the workers is heavily exposed to spices.

In one of the larger spice factories in Sweden the workers complained of skin symptoms. The aim of this study was to find out if their skin symptoms were attributable to occupational exposure to spices.

Materials and Methods

A questionnaire on skin symptoms was distributed to all the workers in the spice factory ($n=72$), and in the office ($n=27$) of the same company. Many of the workers in the factory were heavily exposed to spices, whereas the office workers, serving as a con-

trol group, were not exposed. Answers to the questionnaire were given at a personal interview with a health care nurse.

As a second part of the study, all persons reporting skin symptoms were invited to a *dermatological examination*.

Patch testing was performed with the European standard series and a special series of spices (Table 1). In the standard series were balsam of Peru 25% pet. and fragrance mix 8% pet. (cinnamic alcohol,

Table 1. Spices: special patch test series

Substance	Concentration (%)	Vehicle
vanillin	10	pet.
eugenol	2	pet.
isoeugenol	2	pet.
menthol	2	pet.
cinnamic alcohol	2	pet.
cinnamic aldehyde	2	pet.
anethole	5	pet.
peppermint oil	2	pet.
eucalyptus oil	2	pet.
dipentene	2	pet.
alfa-pinene	15	pet.
white pepper powder	as is	
clove powder	as is	
ginger powder	as is	
paprika powder	as is	
black pepper powder	as is	
cardamom powder	as is	
garlic	10	aq.
garlic	10	alc.

Table 2. Test substances for prick testing

Substance	Concentration (%)	Vehicle
eugenol	5	alc.
isoeugenol	5	alc.
cinnamic alcohol	5	alc.
cinnamic aldehyde	5	alc.
balsam of Peru	25	alc.
garlic	10	alc.
garlic	10	aq.
white pepper powder	as is	
cloves powder	as is	
ginger powder	as is	
paprika powder	as is	
black pepper powder	as is	
cardamom powder	as is	

cinnamic aldehyde, hydroxycitronellal, amylcinnamaldehyde, geraniol, eugenol, isoeugenol, oakmoss absolute). The test substances were obtained from Chemotechnique Diagnostics AB, Sweden. For those spices tested as is, the commercial powder from the factory was used. For patch testing, Finn Chambers® (Epitest Ltd. Oy, Finland) and Scanpor® tape (Norgesplaster, Norway) were used. Patches were removed after 2 days and reactions read 3 days after application. Results were classified based on Fregert (7).

Prick testing was performed on the inner aspect of the lower arm with fragrances and spices (Table 2). Reactions were read at 20 min.

Statistics

Confidence interval for the difference between proportions was calculated using the normal distribution (8).

Results

Answers to the *questionnaire* were obtained from 70/72 (97%) workers in the factory, and 23/27 (85%) in the office. The female/male ratios were 2.5 and 3.6, respectively. The mean ages were 37 and 39 years and the mean employment times 9 and 6 years respectively.

36/70 (51%) in the factory group reported having at least 1 skin symptom. Dry skin was reported by 24 persons, pruritus by 20, skin lesions by 22 and hand eczema by 15. Among the control group in the office, 3/23 (13%) reported skin symptoms. One had dry skin, 3 had pruritus and 2 had other skin lesions. The observed difference between factory workers and office workers was statistically significant (95% confidence interval for the difference 20–56%; $p < 0.001$).

All 36 symptomatic persons from the factory and 2/3 from the office attended for *dermatological*

examination. 25 of the factory workers were patch tested.

The diagnoses made at dermatological examination of the factory workers reporting skin symptoms are shown in Table 3. Skin symptoms were mainly on areas not covered with clothes. 6 employees had been on sick leave at some time because of skin disease.

Of the office workers who attended the examination, one was diagnosed as having urticaria and an unspecified dermatitis and the other rosacea and an irritant contact dermatitis.

12 positive patch test reactions to substances in the standard series were found in 9/25 of the factory workers. The reactions are summarized in Table 4.

On testing with the special series, there were 3 reactions to paprika powder and 1 each to cardamom and white pepper, as is. Control tests were performed on 22 dermatitis patients from the dermatology department without occupational exposure to spices. 2 of these patients reacted to paprika powder, 1 to cardamom and 1 to white pepper, as is. When the substances were diluted to 50%, 10% and 1% pet., none reacted. Some of the reactions to paprika and cardamom were pustular. 1 person had an irritant reaction to garlic 10% alc.

Among the 25 spice factory workers who were patch tested, there were 11 (44%) reactions to cinnamic aldehyde and 3 (12%) to cinnamic alcohol (Table 5). Among the 96 dermatitis patients from the dermatology department, 15 (16%) had reac-

Table 3. Distribution of diagnoses made at dermatological examination of 36 spice factory workers

Diagnosis	n
allergic contact dermatitis	6
irritant contact dermatitis	4
atopic dermatitis	2
other dermatitis	4
pustulosis palmoplantaris	1
tinea manuum	1
pruritus + skin irritation ^{a)}	16
pruritus	4

2 persons had double diagnoses

^{a)} Dry and/or erythematous skin.

Table 4. Positive patch test reactions to allergens (pet.) in the standard series in 25 spice factory workers

Substance	Concentration (%)	n	(%)
nickel sulphate	5	3	12
fragrance mix	8	3	12
colophony	60	2	8
cobalt chloride	0.5	1	4
potassium dichromate	0.5	1	4
epoxy resin	1	1	4
neomycin sulphate	20	1	4

Table 5. Distribution of test reactions to colophony, fragrance mix, cinnamic aldehyde and cinnamic alcohol in 25 spice factory workers

	Person number														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>patch test</i>															
colophony 60% pet.	-	-	+++	-	-	-	-	-	-	-	-	-	-	-	+++
fragrance mix 8% pet.	-	-	-	-	-	+++	-	+	-	++	-	-	-	-	-
cinnamic aldehyde 2% pet.	-	?+	?+	-	?+	+++	?+	+	?+	++	?+	?+	?+	-	-
cinnamic alcohol 2% pet.	-	-	++	-	-	+	-	-	-	+	-	-	-	-	-
<i>prick test</i>															
cinnamic aldehyde 5% alc.	e	-	e,w	e	-	-	e	-	-	e	-	-	-	e,w	-
cinnamic alcohol 5% alc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Classification of patch test reactions based on Fregert (7).

e=erythema, w=wheal.

In person nos. 16-25, no positive test reactions to colophony, fragrance mix, cinnamic aldehyde or cinnamic alcohol were found.

tions to cinnamic aldehyde 2% pet. The nature of the reactions was difficult to evaluate. At least 4 test reactions in the factory workers and 5 in the control dermatitis patients were assessed as allergic, while the other reactions were considered uncertain.

On *prick testing*, 6/25 subjects from the factory reacted to cinnamic aldehyde. 4 showed local erythema and in 2 there was also wheal formation. No reactions were obtained to the rest of the spices.

Discussion

Skin symptoms were very common among the workers in the spice factory. That every second person had some kind of complaint indicated a work-related problem. It is reasonable to expect about 25-30% reporting skin problems if all kinds of skin symptom are included (9). It is possible that the problem was in fact still larger than found in this study, which was of cross-sectional design. We do not have information on changes over time, meaning that persons might have left the job because of skin symptoms.

Dry skin and pruritus were the main complaints. In many cases, no other diagnosis was found at dermatological examination. Symptoms were mainly located on uncovered skin areas. When patch testing with the standard series, contact allergies were found in 1/3 of the subjects, which is about the same frequency as in routine patch test series in dermatology departments (10). Substances for which positive reactions tended to be more common than usual were fragrance mix, with 3/25, and colophony, with 2/25. These substances are considered as possible indicators of allergy to spices (3).

Evaluating patch test reactions to spices proved to be difficult because of their irritant properties. This has also been reported by Niinimäki (6). Paprika, cardamom and white pepper powder elicited

positive reactions in occupationally unexposed control persons about as often as in the factory workers, and these reactions were lost when the substances were diluted. This indicates that the reactions were not allergic.

A still greater problem was the interpretation of reactions to cinnamic aldehyde, which is a well-known contact allergen, but also an irritant (11). Some of the reactions were evaluated as allergic but others were doubtful (Table 5). To differentiate allergic reactions from irritant reactions was not possible in all cases. In this type of field study, the possibility of further testing is limited.

To perform reliable patch testing with spices, the procedure needs to be standardized. The optimal particle size and vehicle require study and the possibility of extracting the allergens should be evaluated. It is possible that the allergen content differs in spices from different sources and that it might vary among batches.

Contact urticaria from cinnamic aldehyde is well-known and considered to be non-immunologic (12). Notable is that 2/6 who reacted to the prick test also had reactions of delayed type. A combined reaction of immediate and delayed type to cinnamic aldehyde has also been reported by Kirton (13).

Exposure to spices was heavy almost throughout the factory. Many of the spices, particularly cinnamon, were ground to fine powders. Ventilation at the cinnamon mill was insufficient to prevent cinnamon powder from being dispersed over large areas. The irritant properties of cinnamon and several other spices were the probable cause of much of the symptoms. Because of skin contamination, frequent washing may also have contributed to skin dryness.

To reduce the problems, improved ventilation, particularly when handling cinnamon powder, better cleaning routines and good skin care and hygiene information were suggested.

Spice factory workers do not constitute a large occupational group but the irritant and sensitizing properties of spices are also of interest in other occupations, e.g., cooks, kitchen maids, house-keeping service workers and bakers. Skin contact with spices when cooking at home may also be one of many aggravating factors for hand eczema.

From this study, it can be concluded that exposure to spices, in particular cinnamon powder, causes skin irritation and in some cases also contact allergy. To evaluate patch test reactions to spices proved to be difficult. Further investigation of how to perform reliable patch testing with spices is desirable.

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