

Hand eczema in 45 bakers – a clinical study

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The skin of bakers is heavily exposed to dough, spices, water and detergents. This is follow-up of a previous Swedish questionnaire study showing bakers to have a 3-fold increased risk of hand eczema. The aims were to establish diagnoses and to study consequences of hand eczema. From a cohort study of 2226 bakers, a random sample among bakers reporting hand eczema was examined. Of 60 randomly selected bakers reporting a history of hand eczema, 52 attended an examination comprising a standardized interview, documentation of clinical skin signs, patch testing and prick testing with standard and bakery series, and serum analyses. In all, 45 bakers confirmed a history of hand eczema, for which 11 (24%) had been on sick leave, with a median duration of 14 weeks. 13 (29%) had changed their occupation due to skin disease, 19 had positive patch test reactions to standard contact allergens – and 5 to bakery contact allergens. 16 bakers had positive prick tests to standard allergens, 10 to bakery allergens, of whom 9 reacted to flours. Since considerable medical and social consequences of hand eczema are seen, thorough diagnosis of contact allergy and IgE-mediated allergy in bakers, as well as preventive measures, are essential.

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In traditional bakeries, the baker's skin is intensely exposed to wet dough, flours with additives, spices, water and detergents. This exposure can cause contact allergy and/or irritation of the skin as well, and bakers have an increased risk of hand eczema (1–3). Work-related contact urticaria (CU) has also been reported (4).

The recognized occupational contact allergens in bakeries are found mainly among spices, flour improvers and antioxidants, such as cinnamon and cardamom, benzoyl peroxide, α -amylase, gallates and sodium metabisulfite (1, 2, 5–10). CU is reported mainly from contact with spices, flours and α -amylase (1).

In a previous population-based study, Swedish bakers exhibited a 3-fold increased risk of hand eczema (3). The study was based on a postal questionnaire. Self-reported data on hand eczema have in the present study been followed up by clinical examination, patch and prick testing and serological analyses. The aims were to establish diagnoses and to investigate the occurrence of contact allergy and IgE-mediated allergy in bakers reporting hand eczema. Consequences of skin disease were also asked for.

Subjects and Methods

Study population

From Swedish trade schools, 2986 people born between 1943 and 1972, who had graduated from bakery classes between 1961 and 1989, were identified through the school records. In 1992, after tracing in the population register, 2923 of these individuals were invited to participate in a retrospective cohort study to estimate the risk to bakers of developing hand eczema. Of those invited, 2226 (76.2%) answered the questionnaire. The mean age for men (= 1280) was 31 years, and for women ($n = 946$) 27 years.

Questionnaire

A self-administered questionnaire was mailed to the former bakery students. It included questions on hand eczema, rapid itching on hands when handling foods, respiratory symptoms and history of childhood eczema, work history and change of work due to hand eczema. Detailed results have been presented previously (3, 11).

Dermatological examination

In all, 81/377 (21%) responders in the Göteborg area gave an affirmative answer to the question: 'Do you have or have you had hand eczema?' 60 of these were randomly selected and invited to a clinical examination.

52 of the invited responders attended, 24 females and 28 males, the mean age 33 years (range 22–50 years). In 45 (22 females, 23 males) the history of hand eczema was confirmed at the examination.

In the 7 bakers without a history of hand eczema, the following diagnoses were represented: other eczemas, contact urticaria, pustulosis palmo-plantaris and acne vulgaris.

The clinical examination of the 45 bakers with a confirmed history of hand eczema comprised a standardized interview and documentation of clinical skin signs. Patch and prick tests and serum analyses were performed. An experienced dermatologist (BM) performed the dermatological examination.

Patch testing

Patch testing was performed with the European standard series and an extended bakery series (Table 1) supplied by Chemotechnique Diagnostics AB, Tygelsjö, Sweden. Finn Chambers (Epitest Ltd Oy, Tuusula, Finland) and Scanpor tape (Norges-plaster A/S, Vennesla, Norway) were used for substance application. The application time was 2 days and readings were done 3 or 4 days after application. The test results were classified according to established methods (12).

Prick testing

Prick tests were performed on the forearm, with a standard series of common allergens (ALK, Copenhagen, Denmark). This included birch, timothy, and mugwort pollens; the mites and moulds *Dermatophagoides pteronyssinus*, *D. farinae*, *Aspergillus fumigatus*, *Cladosporium*; cat and dog danders; a control dilution, and histamine dihydrochloride 10 mg/mL. PT responses were regarded as positive if the mean wheal diameter was at least 1/2 that of the histamine wheal and there was no reaction to the negative control.

Prick testing was simultaneously carried out with a bakery series containing standard preparations of wheat, rye, barley and oats and also freshly moistened flour of wheat and rye at a concentration of 1:2 w/v; the store mite *Lepidoglyphus destructor* (1000 NU/mL, Diephuis, the Netherlands), fungal α -amylase A (Novo Industries, Bagsvaerd, Denmark), at a concentration of 10

Table 1. Positive reactions to substances in the standard and extended bakery series in 45 patch-tested bakers with hand eczema

Substance	Concentration, %	n	%
<i>European standard series</i>			
potassium dichromate	0.5	4	9
4-phenylenediamine base	1.0	0	
thiuram mix	1.0	0	
neomycin sulphate*	20.0	1	2
cobalt chloride	1.0	5	11
benzocaine	5.0	1	2
nickel sulphate*	5.0	11	24
clioquinol	6.0	0	
colophonium	20.0	2	4
paraben mix	15.0	0	
PPDA rubber mix	0.6	0	
lanolin alcohol	30.0	1	2
mercapto mix	2.0	0	
epoxy resin	1.0	0	
Myroxydon Pereirae resin	25.0	1	2
4-tertbutylphenol-formaldehyde resin	1.0	0	
mercaptobenzothiazole	2.0	0	
formaldehyde	1.0	1	2
fragrance mix	8.0	5	9
sesquiterpene lactone mix*	0.3	0	
quaternium-15	1.0	0	
primin	0.01	0	
Cl + Me-isothiazolinone (Kathon CG)*	0.01	2	4
<i>Extended bakery series</i>			
octyl gallate**	0.25	0	
propyl gallate	1.0	0	
dodecyl gallate	0.25	0	
2-tert-butyl-4-methoxyphenol (BHA)	2.0	2,0	
2,6-ditert-butyl-4-cresol (BHT)*	2.0	0	
benzoyl peroxide*	1.0	4	7
sodium benzoate*	5.0	0	
benzoic acid	5.0	0	
sorbic acid	2.0	0	
propionic acid	3.0	0	
eugenol	2.0	0	
isoeugenol	2.0	1	2
cinnamic aldehyde	1.0	1	2
d-limonene	3.0	1	2
α -amylase	1.0	1	2
vanillin	10.0	0	
wheat***	as is	0	
rye****	as is	1	2

In addition faint erythema was seen in:

* 1 patient, ** 2 patients, *** 3 patients, **** 6 patients.

mg/mL, and α -amylase B (Grindsted Products, Braband, Denmark) 100 mg/mL; flours of commercial soy, all diluted in 0.9% saline with 50% glycerol and 0.5% phenol.

Serum analyses

Blood samples were collected and kept frozen (-20°C) until analysed.

RAST analyses of wheat flour (f4) and fungal α -

Table 2. Positive prick-test reactions to bakery allergens in 45 bakers with hand eczema and in a subgroup of 6 bakers who also reported contact urticaria (CU) from flours

Prick test	Whole group (n = 45)	CU group (n = 6)
<i>Bakery series</i>		
Storage mite (<i>L. destructor</i>)	2	0
Wheat, extract	8	4
Wheat, moistened flour	9	5
Rye, extract	8	4
Rye, moistened flour	9	5
Barley, extract	7	4
Oats, extract	3	1
α -Amylase	4	0
Flour of soy	3	0

amylase (k87) were done according to routine CAP-FEIA procedures (Pharmacia Diagnostics).

Results

Clinical examination

27 (60%) cases reported actual hand eczema during the previous year, and 4 of these cases (9%) had started within the previous year. The mean duration of hand eczema from the first symptoms to the examination was 11 years (1–29 years). 10 (22%) had a history of childhood eczema.

32 (71%) had consulted a physician for hand eczema, 22 of them more than once. Continuous symptoms were reported by 4 (9%). 11 (24%) had been on sick leave for hand eczema, 8 of them twice or more. The median of the total time on sick leave was 14 weeks (range 2–88). Treatment with topical corticosteroid was reported by 67% of the cases and with emollient cream by 69%. 13/45 (29%) had changed their occupation due to the skin disease.

6 reported localized CU when in skin contact with flours at interview. 1 of them had noted symptoms from the eyes, 3 had rhinitis and 2 had respiratory symptoms from contact with flours. 4 also reported that flour-induced CU usually was followed by eczema.

Patch testing (Table 1)

20 (44%) of the 45 patch tested cases presented at least 1 positive reaction. In 19 bakers, 33 reactions were found to substances in the standard series and in 5 bakers, 9 reactions were found to substances in the bakery series. 1 baker had a reaction only to a substance in the bakery series. Several substances in the bakery series provoked weak erythema at the test area, particularly flour (Table 1).

Prick testing (Table 2)

19 (42%) of the 45 bakers presented at least 1 positive reaction, 16 had positive reactions to allergens in the standard series and 10 (22%) had positive reactions to bakery allergens. 9 bakers reacted to any of the flours while 3 had reactions solely to bakery allergens. Testing with moistened wheat and rye flours gave 1 case in addition to the commercial extracts.

The 1 baker with a positive patch test to rye flour and the 1 patch test positive to α -amylase were both prick test negative. Of the 3 bakers with only erythema on patch testing with wheat flour, 1 had a positive prick test, the corresponding figure for rye being 2/6.

Serum analyses

10/45 (22%) bakers were RAST positive to wheat, 2 (4%) to α -amylase. 3 of the 35 with negative RAST to wheat were positive on prick testing. The corresponding figures for α -amylase were 2/43.

On prick testing and/or RAST, 14 (31%) bakers showed IgE sensitization towards 1 or more bakery allergens. 3 were sensitized to flour, 4 to α -amylase, 3 to soy and 2 to storage mites.

Discussion

In occupations such as bakery in which foods are handled manually, hand eczema offers double problems. There is occupational skin wear, and dermatitis may lead to difficulties in working. Causes of hand eczema, consequences, and prevention in bakery work are therefore of special interest in occupational dermatology. Of 60 randomly selected bakers reporting hand eczema, 52 attended for examination. The loss of follow-up is rather low, indicating that the findings are representative of all Swedish bakers with a history of hand eczema. Furthermore, the cohort consisted of all students who had finished trade schools, including persons with a very short career as a baker. Thus, there should be no healthy worker bias.

The majority (71%) of our bakers with hand eczema had consulted a physician, 24% had been on sick leave with a median time of more than 3 months, and nearly 1/3 (29%) had left their occupation due to skin disease. The severity of the dermatitis and its consequences are thus notable in addition to the previous findings of high prevalence figures (3).

Hand eczema without diagnosed contact allergy was the dominant diagnosis, and skin irritation from the intense exposure to wet work seemed to be the dominant cause of the hand eczemas. But

contact allergy was found in nearly 1/2 of the hand eczema cases (44%). This indicates a high rate of contact sensitization compared to that in a general population with hand eczema (32%) (13). The corresponding figure in dentists with hand eczema is 50% (14). It may be that hand eczema in occupations with a high exposure to hand washing and irritants also facilitates contact sensitization.

By far the most reactions were seen to standard patch test allergens, which may reflect their presence in the baker's working environment. No specific pattern of sensitization was observed. These findings accord with previous studies (1, 2, 15).

Only 5/45 (11%) had developed contact allergy to substances in the bakery series, dominated by reactions to benzoyl peroxide. 1/3 of the bakery patch test allergens gave positive reactions and several of the test preparations, especially moistened flour, benzoyl peroxide and octyl gallate, elicited weak erythema, difficult to interpret.

The prevalence of contact allergy to benzoyl peroxide is comparable with figures found when testing in unselected eczema patients (16). The 4 bakers sensitized to this contact allergen had no reported non-occupational allergen exposure and occupational exposure was unclear. According to official lists of food additives from the Swedish National Food Administration, benzoyl peroxide has not been permitted since 1967, but it may still be used in other countries (Swedish National Food Administration, personal communication Ulrica Colberg).

Aromatic substances found in spices were the second most common patch test preparations found to give positive patch test results. The problem of patch testing with spices has been recognized previously (17). Patch testing with fragrances and balsam of Peru (Myroxylon Pereirae) in the standard series also identified the 2 cases with allergy to spices, pointing to a pattern of possible cross-reactivity between aromatics, in accordance with previous findings (1). The difficulties of evaluating the relevance of patch test reactions to the allergens in the bakery series points to a need to up-date this series, according to the actual exposure to occupational bakery contact allergens, as well as to a need for further work to find non-irritant test preparations.

How far IgE-mediated sensitization is of importance to skin reactions and the development of dermatitis in food handling is incompletely understood. Baker's eczema, as an example of protein contact dermatitis, is discussed in several papers (18, 19). In the present study IgE sensitization to bakery allergens was diagnosed with prick testing and RAST in around 30% of the cases, compared to the prevalence of contact allergy in 44%. In a

concomitant clinical study of Swedish bakers comprising 44 randomly selected reference bakers (20), 16% were prick test positive to flours and 7% were positive to α -amylase. The corresponding prevalences in our study – 20% and 9% – were similar. We also found a lack of correspondence between reported CU and IgE sensitization. Of the 9 bakers with positive prick tests to flours, only 5 reported clinical signs of CU, while none of the 4 who were prick test positive to α -amylase did so. There thus remain several questions regarding the clinical role of IgE sensitization in the development of hand eczema and CU.

Even though skin irritation seems to be the dominant cause of the dermatitis, the role of contact allergy and IgE sensitization needs further evaluation in this type of relapsing hand dermatitis. However, no difference in sick leave pattern, numbers of medical consultations or occupational changes was seen between the bakers with diagnosed, IgE-mediated or contact allergy and those with no such sensitization.

In conclusion, our findings show that hand eczema in bakers causes serious medicosocial consequences measured as need of medical consultations, sick leave and job change. Hand eczema from non-specific skin irritation was the most common diagnosis, but a high percentage of cases showed contact allergy to substances in the standard and bakery series as well as IgE-mediated reactions to bakery allergens. The study clearly shows the need for prevention and optimal care of hand eczema in bakers, and this also includes further evaluation of the clinical impact of the contact- and IgE-mediated allergic reactions.

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References

1. Vein N K. Bakers. In: Kanerva L, Elsner P, Wahlberg J E, Maibach H I, eds. *Handbook of Occupational Dermatology*. Berlin: Springer-Verlag, 2000.
2. Rycroft R J G. Occupational contact dermatitis. In: Rycroft R J G, Menné T, Frosch P J, eds. *Textbook of Contact Dermatitis*, 2nd edn. Berlin: Springer-Verlag, 1995.
3. Brisman J, Meding B, Järvholm B. Occurrence of self reported hand eczema in Swedish bakers. *Occup Environ Med* 1998; 55: 750–754.
4. Kanerva L, Toikkanen J, Jolanki R, Estlander T. Statistical data on occupational contact urticaria. *Contact Dermatitis* 1996; 35: 229–233.
5. Rietschel R L, Fowler J F, eds. *Occupational dermatitis*. In:

- Fisher's Contact Dermatitis*, 5th edn. Philadelphia: Lippincott, 2001.
6. Nixon R. Cinnamon allergy in a baker. *Australasian J Derm* 1995; 36: 41.
 7. Vicenzi C, Stinchi C, Ricci C, Tosti A. Contact dermatitis due to an emulsifying agent in a baker. *Contact Dermatitis* 1995; 32: 57.
 8. Morren M A, Janssens V, Dooms-Goossens A et al. α -Amylase, a flour additive. An important cause of protein contact dermatitis in bakers. *J Am Acad Dermatol* 1993; 29: 723–728.
 9. Bojs G, Nicklasson B, Svensson Å. Allergic contact dermatitis to propyl gallate. *Contact Dermatitis* 1987; 17: 294–298.
 10. Lee A, Nixon R. Contact dermatitis from sodium metabisulfite in a baker. *Contact Dermatitis* 2001; 44: 127–128.
 11. Brisman J, Belin L. Clinical and immunological responses to occupational exposure to α -amylase in the baking industry. *Br J Ind Med* 1991; 48: 604–608.
 12. Wahlberg J E. Patch testing. In: Rycroft R J G, Menné T, Frosch P J, eds. *Textbook of Contact Dermatitis*, 2nd edn. Berlin: Springer-Verlag, 1995.
 13. Meding B, Swanbeck G. Occupational hand eczema in an industrial city. *Contact Dermatitis* 1990; 22: 13–23.
 14. Wallenhammar L-M, Örtengren U, Andreasson H et al. Contact allergy and hand eczema in Swedish dentists. *Contact Dermatitis* 2000; 43: 192–199.
 15. Tacke J, Schmidt A, Fartasch M, Diepgen T L. Occupational contact dermatitis in bakers, confectioners and cooks – A population-based study. *Contact Dermatitis* 1995; 33: 112–117.
 16. Lindemayer H, Drobil M. Contact sensitization to benzoyl peroxide. *Contact Dermatitis* 1981; 7: 137–140.
 17. Meding B. Skin symptoms among workers in a spice factory. *Contact Dermatitis* 1993; 29: 202–205.
 18. Janssens V, Morren M, Dooms-Goossens A, Degreef H. Protein contact dermatitis: myth or reality? *Br J Dermatol* 1995; 132: 1–6.
 19. Wüthrich B. Food-induced cutaneous adverse reactions. *Allergy* 1998; 53: 131–135.
 20. Brisman J, Lillienberg L, Belin L, Åhman M, Järvholm B. Sensitisation to occupational allergens in bakers' asthma and rhinitis – a case-referent study. Submitted.
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