

Contact urticaria and protein contact dermatitis from corn in a patient with serum IgE specific for a salt-soluble corn protein of low molecular weight

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Among the cereals, wheat, rye, barley and oats, have been reported to cause protein contact dermatitis. However, in these cases neither the involvement of an immunological mechanism nor the role of specific protein(s) has been demonstrated. We present a case of protein contact dermatitis from corn. The patient presented with a Type I sensitization to corn, as shown by the presence of specific immunoglobulin (Ig)E and positivity to prick tests with both a flour suspension and the salt-soluble protein fraction of this cereal. The same corn preparations induced a strong urticarial reaction on scratch testing. This reaction was followed several days later by the appearance of erythema and then eczema at the site of application. When boiled, these preparations became inactive on both prick and scratch testing. Patch tests were negative in all cases. Immunoblotting performed with the patient's serum showed the presence of a unique IgE-binding protein band with a molecular weight of around 14 kDa, belonging to the salt-soluble corn protein fraction. Our results give the first clear evidence that cornflour can induce protein contact dermatitis. The IgE-binding 14-kDa protein has characteristics identical to those of the trypsin/ α -amylase inhibitors from cereals.

Key words: contact urticaria; corn; corn allergen; protein contact dermatitis; trypsin/ α -amylase inhibitors. © Blackwell Munksgaard, 2004.

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Protein contact dermatitis is a chronic, recurrent dermatitis caused by contact with proteinaceous material (1). Although the involvement of an immunological mechanism has not yet unequivocally been demonstrated, it is suspected that a Type I hypersensitivity reaction may play a role in the pathogenesis of this disorder (2). According to some authors (3, 4), immunoglobulin (Ig)E bound to Langerhans' cells in the epidermis and dermis possibly mediates this type of contact dermatitis. Foods are commonly the causative agents and workers handling them are the persons most frequently affected (2).

Among the cereals, wheat, rye, barley and oats, have been reported to cause protein contact dermatitis, especially in bakers (1, 5–8). However, in all these cases, neither the role of specific protein(s) nor the involvement of an immunological mechanism has been demonstrated.

In this article, we report a case of protein contact dermatitis from corn. By IgE-immunoblotting, we have identified a low molecular weight protein of

the cornflour as the possible causative agent of this disorder.

Case Report

A 56-year-old man was admitted to our day-hospital department because of a severe, pruritic eczema localized to the hands. He reported that the dermatitis was recurrent, appearing each time that he handled cornflour. He also reported that, shortly after contact with cornflour, he experienced episodes of urticaria localized mainly to the hands, volar side of arms and upper eyelids. Topical medications, including corticosteroid creams, and oral antihistamines provided relief. In spite of these corn-induced symptoms, the patient could eat polenta and other corn-based cooked meals without any health problem. The patient reported not suffering from allergic symptoms from inhalants or atopic dermatitis.

On admission, the total serum IgE was only slightly elevated (144 kUA/l), and no specific

IgE for inhalants was found by the Immuno CAP-system (Pharmacia Diagnostic, Uppsala, Sweden). The presence of specific IgE for different cereal flours (wheat, barley, rye, millet, corn and rice) was also investigated by Immuno CAP-system. Positive results were obtained only for cornflour (3.57 kUA/l) and, to a lesser extend, for rice (1.40 kUA/l).

Materials and Methods

Skin tests

A handling test was performed by allowing the patient to knead cornflour for several minutes. Prick testing was performed by using commercial allergen extracts from Stallergènes (Anthony, France). Prick testing was also performed with the following fresh corn extracts: a suspension made with 1 part of cornflour and 5 part of water (Su); salt-extractable proteins (SEPs) solubilized by mixing the flour with 0.5 M NaCl for 2 h at 4°C in a flour to solvent ratio of 1:5 (w/v); and reduced soluble proteins (RSPs) extracted from the SEP-free residue with 50 ml of 50 mM Tris-HCl, pH 7.4, containing 20 mM dithiothreitol, as previously reported (9). Su and SEP were also prick tested after boiling at 100°C for 5 min. In addition, unheated Su and SEP were assayed by scratch and patch tests. The results of prick testing were evaluated at 20 min and the positive results were graded in the following manner, according to the diameter of the weal: 3–5 mm (+), 5–10 mm (++), 10–15 mm (+++), more than 15 mm (+++). Scratch testing was evaluated in the same manner. Patch tests with corn preparations were performed with Al-test® (Imeco ab, Södertälje, Sweden) on Leukotest® (Beiersdorf AG, Hamburg, Germany). Reading and scores were taken following international guidelines after 2 days.

Electrophoresis and immunoblotting

Electrophoresis and immunoblotting were performed as previously reported (9) by using SEP and RSP fractions.

Results

Handling test produced urticarial erythema after several minutes. Table 1 summarizes the results of the skin tests with the different corn extracts. Prick testing performed with the commercial extract gave a strong positive response. Positive responses were also obtained with Su and SEP when these fractions were assayed by prick and scratch testing, on scratch testing, a strong urticarial reaction was observed after only 10 min.

Table 1. Results of skin tests with different corn extracts

Extracts	Prick	Scratch
Commercial allergen	++++	Not determined
Flour suspension	+++	+++
Heat-treated flour suspension	Negative	Negative
Salt-soluble protein	++++	++++
Heat-treated soluble proteins	Negative	Negative
Reduced soluble protein fraction	Negative	Negative

Following this test, papulovesicular lesions appeared at the site of application of the corn extracts after 3 days. In contrast, the RSP fraction gave negative results on both prick and scratch testing. After boiling, both Su and SEP gave negative results on prick and scratch testing. Patch tests, performed with Su and SEP, gave negative results. However, the patch test with Su, when read at 20 min, gave an urticarial erythema in the area of application (data not shown).

Immunoblotting performed with the patient's serum showed the presence of a unique IgE-binding protein band with a molecular weight of around 14 kDa in the SEP fraction (Fig. 1b, lane 1). No IgE-binding protein was found by immunoblotting with RSP (Fig. 1b, lane 3). In all cases, no IgE-binding proteins were observed on immunoblotting with the pooled sera of 10 healthy subjects (data not shown).

Discussion

The case here reported can unequivocally be classified as a protein contact dermatitis from cornflour. In fact, it meets all the criteria for the diagnosis of this condition (10): (a) contact with cornflour induced an eczematous reaction; (b) scratch tests with cornflour preparations were positive; and (c) RAST and prick test responses to corn protein fractions gave positive results.

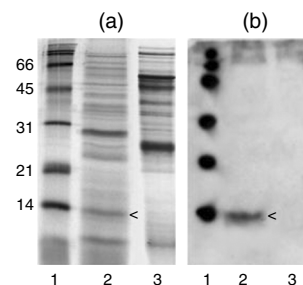


Fig. 1. SDS-PAGE analysis of cornflour proteins. (a) Coomassie staining. (b) IgE immunoblot with the patient serum. Lane 1: molecular weight standard proteins; lane 2: salt-extractable proteins; lane 3: reduced soluble proteins fraction. The arrowheads indicate the putative allergen. Molecular weights in kDa are reported on the left side.

The protein that is recognized by the serum IgE of the patient here reported has solubility characteristics and electrophoretic mobility corresponding to those of the members of the cereal trypsin/ α -amylase inhibitor protein family, a highly homologous group of proteins with molecular weights ranging from 12 to 16 kDa (11). Members of this protein family have been shown to act as major allergens in determining the occupational allergic disease known as bakers' asthma which results from the inhalation of flour particles (12).

In addition to contact skin reactions, an allergenic food might induce, after ingestion, gastrointestinal and systemic symptoms that are distinctive of a food allergy (2). However, our patient could eat cooked corn-based foods without any problem. This can be explained by the immunological instability of the causative protein agent to the heat treatments employed in the preparation of corn-based foods. In fact, we have demonstrated that the trypsin/ α -amylase inhibitors lose their IgE-binding capacity after baking of wheat dough into bread (13). In general, it appears that the food antigens responsible for the skin contact reactions that are mediated by IgE are typically heat labile (14). Clearly, the proteins which have been found to be involved in food allergy to cornflour, the lipid transfer protein 1, a salt-soluble, basic protein of 9 kDa (15) and a protein of 50 kDa belonging to the RSP fraction (9), maintain their allergenic potential after cooking at 100°C (9, 16). However, some of the patients with food allergy to corn studied by Pastorello et al. (15) were sensitized to a 16-kDa protein belonging to trypsin/ α -amylase inhibitor family and cross-reacting with grass, wheat, barley and rice trypsin inhibitors. The data here presented indicate that this type of protein, in spite of its ability to sensitize in its native state, is unlikely to be involved in corn food allergy, because it loses its allergenic property when cornflour is cooked.

Some authors have suggested an association between protein contact dermatitis and atopic predisposition (3, 5, 17). However, only 50% of the patients described in literature have been atopic (2). The case we examined had no history of atopy at all.

Guin et al. (18) have reported the case of a paper-bag maker who developed severe contact dermatitis following contact with a cornstarch-based adhesive. On the basis of the results of the skin tests performed with cornstarch, they concluded that the case examined was a protein contact dermatitis from cornstarch. However, in their article they did not give any details about

the cornstarch utilized for the skin test carried out in the patient. For this reason, it is impossible to speculate about the nature of the causative agent involved in such a case: is the starch itself (though it is not a protein!) responsible for the reaction, or an endogenous protein associated with cornstarch or, even, a protein contaminant of exogenous origin?

In conclusion, our results give the 1st clear evidence that cornflour can induce protein contact dermatitis. A corn protein, having characteristics (solubility, electrophoretic mobility and immunological heat lability) identical to those of the trypsin/ α -amylase inhibitors from cereals, is likely to be involved in this disorder, because it is recognized by the serum IgE of the patient examined.

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