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Immediate Hypersensitivity to a Hydrolyzed Wheat Protein

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ABSTRACT

A 35-year-old hairdresser with no known food allergy to wheat suffered from contact urticaria on her hands, generalized urticaria, coughing and dyspnea whenever she used a specific hair conditioner at a beauty salon. In this case report, 5 conditioners that she used while at work has been texted. Prick testing elicited a positive wheal and flare response to a conditioner and negative reactions to other four conditioners. Total 13 products (7 ingredients and 6 prepared mixtures) has been tested, they were components of the conditioner that produced a positive reaction. She reacted positively toone of the products (prepared mixture 1) which was composed of eight ingredients: a hydrolyzed wheat protein, water, phenoxyethanol, isobutyl parahydroxybenzoate, ethyl parahydroxybenzoate, butyl parahydroxybenzoate, propyl parahydroxybenzoate and methyl parahydroxybenzoate. These seven ingredients have been performed by prick testing and she only reacted positively to a hydrolyzed wheat protein. Wheat and gluten also have been tested and she reacted negatively to those products. Her specific IgE levels of wheat and gluten were low (<0.34 IU). It has been found that she could eat wheat and food with hydrolyzed wheat proteins without having an allergic reaction.

Key words: Allergy, contact urticaria, gluten, hydrolyzed wheat protein, occupational disease

INTRODUCTION

Common causes of the occupational diseases of hairdressers are p-phenylenediamine, aminophenols and p-tolylenediamine in hair dyes, thioglycolic acid in permanent wave solution (Sugiura and Sugiura, 2009), surfactant agents in shampoo and latex in gloves. There were some reports about hydrolyzed wheat proteins causing an allergy (Codreanu *et al*., 2006; Varjonen *et al*., 2000; Pecquet *et al*., 2002; Lauriere *et al*., 2006; Hann *et al*., 2007; Fukutomi *et al*., 2009). Hydrolyzed wheat protein is often contained in shampoo because hydrolyzed wheat protein acts more sheen of hair. Many hair dressers use some shampoos contained this protein, it needs to illuminate about wheat allergy for hair dressers. If chronic hands dermatitis of hair dressers is difficult to treat, wheat allergy might be related with their hands. Recently, in Japan, some allergies cases caused by hydrolyzed wheat protein in soap are noted (Fukutomi *et al*., 2009). Wheat-dependent exercise-induced anaphylaxis (WDEIA) stemmed from a kind of soap contained hydrolyzed wheat protein. In this case, she had an immediate hypersensitivity to a hydrolyzed wheat protein in a hair conditioner.

CASE

A 35-year-old female hairdresser with no known food allergy to wheat started using five different hair conditioners at work several years ago. After using one of these hair conditioners for

2 years, she began to suffer from contact urticaria on her hands. She suffered from progressively generalized urticaria, coughing and dyspnea whenever she used it at the beauty salon. She used it approximately 5 times a month.

THE METHODS OF SKIN TEST

This study was conducted from January, 2008 to December, 2010. Specific IgE levels of wheat and gluten were measured by a blood test. It has been examined by five conditioners, which were diluted with 1% aqua (aq.). A drop of each of the materials was applied on her upper back and pricked them using a PRICK-LANCETTER (Leti, Madrid, Spain). Histamine dihydrochloride 1% aq. was tested as a positive control and to draw a comparison between the reactions to the five conditioners and to histamine dihydrochloride. The reaction was evaluated after 20 min. The results were regarded as positive reactions when the results were more than 50% greater than the size of the reaction of histamine dihydrochloride (Lathi and Turjanmaa, 1992). Specific prick test using 13 products (7 ingredients and 6 prepared mixtures that were components of the conditioner that produced a positive reaction (Table 1) was performed. The names and test concentrations of the 7 ingredients were as follows: Betaine 1% aq., diethoxyethyl succinate 1% aq., polyoxyethylene (20) oleyl ether 1% aq., 1,3-butylene glycol 5% aq., glycerine 30% petrolatum (pet.), ethanol as is and methyl 4-hydroxybenzoate 1% petrolatum (pet.). The ingredients in prepared mixture 1 were water, phenoxyethanol, hydrolyzed wheat protein, isobutyl 4-hydroxybenzoate, ethyl 4-hydroxybenzoate, butyl 4-hydroxybenzoate, propyl 4-hydroxybenzoate and methyl 4-hydroxybenzoate. The ingredients in prepared mixture 2 were 1,3-butylene glycol, glycerine, water, hydrolyzed soy protein, propyl 4-hydroxybenzoate and methyl 4-hydroxybenzoate. The ingredients in prepared mixture 3 were 1,3-butylene glycol, glycerine, hydrolyzed soy protein pg-propyl methyl dianediol, propyl 4-hydroxybenzoate, methyl 4-hydroxybenzoate and water. The ingredients in prepared mixture 4 were ethanol, water, sericin and ethyl 4-hydroxybenzoate. The ingredients in prepared mixture 5 were water, methyl 4-hydroxybenzoate, propyl 4-hydroxybenzoate, hydrolyzed wheat protein, phenoxyethanol and benzoic acid. The ingredients in prepared mixture 6 were a variety of fragrances. The test concentrations of prepared mixes were 10 and 5% aq. Each of the 7 ingredients in prepared

Table 1: Test materials

No.	Materials
1	Betaine 1% aq.
2	Diethoxyethyl succinate 1% aq.
3	Polyoxyethylene (20) oleyl ether 1% aq.
4	1,3-butylene glycol 5% aq.
5	Glycerine 30% pet.
6	Ethanol as is
7	Methyl 4-hydroxybenzoate 1% pet.
Prepared mixture 1	Water, phenoxyethanol, hydrolyzed wheat protein, isobutyl 4-hydroxybenzoate, ethyl 4-hydroxybenzoate, butyl 4-hydroxybenzoate, propyl 4-hydroxybenzoate, methyl 4-hydroxybenzoate
Prepared mixture 2	1,3-butylene glycol, glycerine, water, hydrolyzed soy protein, propyl 4-hydroxybenzoate, methyl 4-hydroxybenzoate
Prepared mixture 3	1,3-butylene glycol, glycerine, hydrolyzed soy protein pg-propyl methyl dianediol, propyl 4-hydroxybenzoate, methyl 4-hydroxybenzoate, water
Prepared mixture 4	Ethanol, water, sericin and ethyl 4-hydroxybenzoate
Prepared mixture 5	Water, methyl 4-hydroxybenzoate, propyl 4-hydroxybenzoate, hydrolyzed wheat protein, phenoxyethanol, benzoic acid
Prepared mixture 6	Some fragrances

mixture 1 (water as is, phenoxyethanol 10 and 1% pet., hydrolyzed wheat protein 2 and 0.5% aq., ethyl 4-hydroxybenzoate 1% pet., butyl 4-hydroxybenzoate 1% pet., propyl 4-hydroxybenzoate 1% pet., methyl 4-hydroxybenzoate 1% pet.) was also tested. The isobutyl 4-hydroxybenzoate in prepared mixture 1 couldn't be tested because we could not obtain it from a company. Wheat 50% pet. and 50% aq. and gluten 50% pet. and 50% aq. were tested by a prick test.

RESULTS AND DISCUSSION

The patient's specific IgE levels of wheat and gluten were low (<0.34 IU). Prick testing elicited a positive wheal and flare response to one of the conditioners and negative reactions to the other four conditioners (Fig. 1a). She reacted positively to prepared mixture 1 (Fig. 1b) and to the hydrolyzed wheat protein in this mixture (Fig. 1c). On the other hand, she reacted negatively to prepared mixture 5 which also contained a hydrolyzed wheat protein.

She also reacted negatively to other ingredients and prepared mixture 2, 3, 4 and 6. We also found that she reacted negatively to wheat and gluten.

Hydrolyzed wheat proteins are obtained by acid, alkaline, or enzymatic hydrolysis of wheat germ, mainly gluten. Hydrolyzed wheat proteins were compounded in cosmetics since they have various antistatic, film-forming, hair-conditioning and skin-care products. Hydrolyzed wheat proteins are also found in medicinal products and foods such as hams and preserved foods. The types of allergic reactions to hydrolyzed wheat proteins have been reported as immediate reactions (Codreanu *et al*., 2006; Varjonen *et al*., 2000; Pecquet *et al*., 2002; Lauriere *et al*., 2006) and contact dermatitis (Hann *et al*., 2007). In our case there was an immediate-type allergy to a hydrolyzed wheat protein in a hair conditioner. Her symptoms were contact urticaria on her hands, generalized urticaria, coughing and dyspnea after using the hair conditioner. She had previously shown no food allergy to wheat and her specific IgE levels of wheat and gluten were low. After experiencing the allergic reaction to the hydrolyzed wheat proteins in the hair conditioner, she still showed no problems in response to wheat and hydrolyzed wheat proteins in food. She also presented with an episode of induced coughing and dyspnea during a prick test of the hydrolyzed wheat protein. In previous reports, the symptoms of an immediate-type allergy to a hydrolyzed wheat protein in cosmetics such as shower gels (Codreanu *et al*., 2006), shampoo (Codreanu *et al*., 2006), body cream (Varjonen *et al*., 2000), eyelid cream (Pecquet *et al*., 2002) and a product that is used before getting a perm have been contact urticaria (Codreanu *et al*., 2006; Varjonen *et al*., 2000; Pecquet *et al*., 2002; Lauriere *et al*., 2006) and dyspnea. Some of these cases had a previous food allergy to wheat (Codreanu *et al*., 2006) and some of them didn't have a previous food allergy. They didn't mention why some cases had a previous food allergy to wheat or not in previous reports. Some cases had experienced generalized urticaria or anaphylaxis in response to food containing hydrolyzed wheat proteins (Lauriere *et al*., 2006) and wheat (Codreanu *et al*., 2006) after they had an immediate allergy to hydrolyzed wheat proteins in cosmetics. One case had an episode of anaphylaxis during a prick test of wheat (Codreanu *et al*., 2006). Fukutomi *et al*. (2009) has reported that a hairdresser developed Wheat-dependent Exercise-induced Anaphylaxis (WDEIA) and the cause of the symptoms was an occupational sensitization through air passage of hydrolyzed wheat proteins in hair conditioner. Immediate hypersensitivity to hydrolyzed wheat proteins can develop in three ways: isolated contact allergy, previous sensitization to wheat flour and later development of a food allergy to wheat. Our case took a prick test using two kinds of hydrolyzed wheat proteins in a hair conditioner. One of them, a component of prepared mixture product 1, showed a positive reaction and the other, prepared mixture product 5, showed a negative

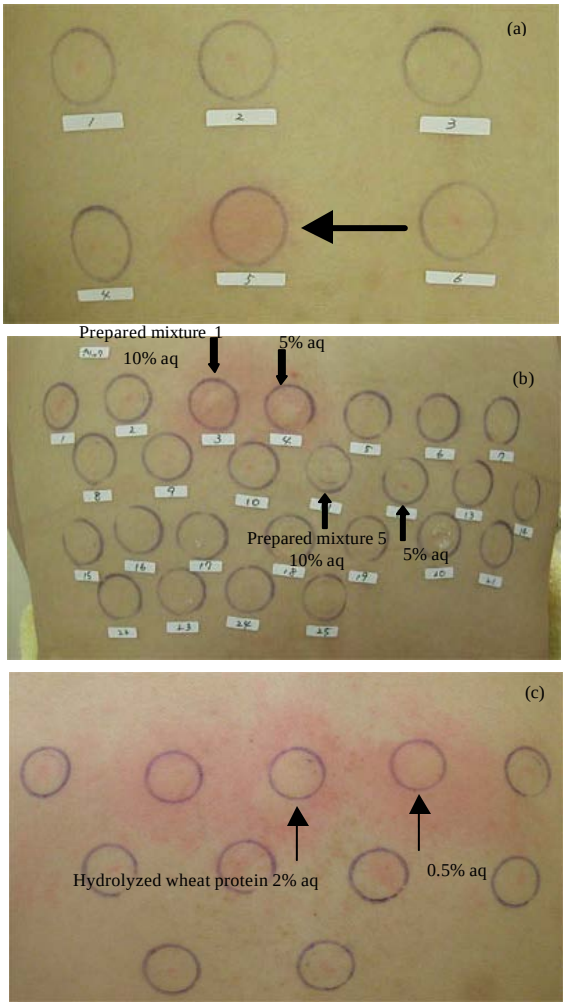

Fig. 1 (a-c): (a) Arrow show positive reaction of a conditioner (b) Results of 13 products (7 ingredients and 6 products of prepared mixture): arrows show positive reactions (c) Arrows show a positive reactions of hydrolyzed wheat protein 2 and 0.5% aq

reaction. The amount of hydrolyzed wheat protein in prepared mixture product 5 was the same as in prepared mixture product 1. Therefore, the concentration of the test material (prepared mixture product 5) was enough to affect a prick test. If she had been allergic to a hydrolyzed wheat protein in mixture product 5, we could have detected it by the test. The difference between the hydrolyzed wheat protein in prepared mixture product 1 and that in prepared mixture product 5 was the molecular weight. The molecular weight of the hydrolyzed wheat protein in prepared mixture product 1 that showed a positive reaction was higher than that of the protein found in prepared mixture product 5. Previous reports have not mention the type of hydrolyzed wheat proteins causing an allergy (Codreanu *et al*., 2006; Varjonen *et al*., 2000; Pecquet *et al*., 2002; Lauriere *et al*., 2006; Hann *et al*., 2007; Fukutomi *et al*., 2009). Our speculation was that some

kinds of hydrolyzed wheat proteins induce contact urticaria, some induce generalized urticaria or anaphylaxis, some induce immediate allergic reactions through air passage and some induce contact dermatitis. We intend to further pursue the details of hypersensitivity to hydrolyzed wheat proteins.

CONCLUSION

Our case suffered from an immediate hypersensitivity due to a hydrolyzed wheat protein in hair conditioner. It has been found that she could eat wheat and food with hydrolyzed wheat proteins without having an allergic reaction. Some kinds of hydrolyzed wheat proteins induce contact urticaria, some induce generalized urticaria or anaphylaxis, some induce immediate allergic reactions through air passage and some induce contact dermatitis. Immediate hypersensitivity to hydrolyzed wheat proteins can develop in three ways: Isolated contact allergy, previous sensitization to wheat flour and later development of a food allergy to wheat.

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