

EDITORIAL

Baker's asthma: diversity of allergens

Since the first cases of baker's asthma described by de Besche in 1929 and Schwartz (1947) an ever increasing number of reports of this occupational asthma affecting bakery workers were published in the 1970s [1–5]. Bakers were soon recognized as one of the occupations carrying the greatest risk of developing asthma [6,7]. The prevalence of asthma among bakers has been shown to be around 10% and the prevalence of cereal allergy 15–25% [5,8,9]. Of those bakers who have cereal allergy, up to 35% experience asthma [10].

IgE-mediated allergy to cereal allergens was the first recognized aetiology, and it has remained the major allergenic aetiology [4,10–12]. IgE antibodies to a number of flour components were demonstrated in the allergic bakers' sera with the strongest reactivities with the water soluble wheat albumins and globulins, the albumins being demonstrated more reactive with the allergic sera than the globulins by RAST inhibition [4]. Use of nitrocellulose for preparing RAST discs enabled the use of potassium hydroxide as an extract solvent. RAST analyses then demonstrated that though the albumin fraction of flour is clearly allergenic, major IgE-binding proteins are found in the other three fractions (globulin, gliadin, and glutenin) as well [13].

In the first analysis of the individual components of wheat flour utilizing quantitative immunoelectrophoresis and crossed radioimmunoelectrophoresis wheat flour was shown to be composed of 40 antigens [10]. Ion exchange chromatography, preparative isoelectric focusing and immunoblotting showed that serum IgE from different allergic bakers had markedly different specificities and bound to numerous wheat proteins [14]. The allergenic activity was found to be distributed among various fractions of different molecular weights in rye too [15]. The 47, 17, and 15 kDa allergens of wheat were recognized as major allergens [16]. The 15 kDa wheat allergen was found to belong to the family of α -amylase/trypsin inhibitors [17,18]. Also the barley 14.5 kDa major allergen has been shown to belong to the family of α -amylase/trypsin inhibitors [19]. In addition to this molecule barley α - and β -amylases with molecular weights 54 kDa and 64 kDa have been recognized [20]. In ingested cereal allergy and atopic dermatitis the IgE responses have appeared more polyspecific being directed against over 30 individual bands of wheat, rye and barley in IgE immunoblotting [21,22]. Although IgE-binding has been shown to several wheat flour proteins, further analysis of the cereal components by monoclonal antibodies has revealed that several water-soluble wheat molecules exhibit identical epitopes [23].

In this issue of *Clinical and Experimental Allergy* Sandiford *et al.* describe a high number of individual allergens in all fractions and especially in the gliadin fraction of wheat using sera from patients with baker's asthma [24]. Furthermore they show that there is clear crossreactivity between the gliadin and other fractions. The identical epitopes are thus found generally in several different allergenic molecules of the cereal flours despite of their different solubility.

The first immunoelectrophoretic and RAST-inhibition analyses revealed that wheat flour allergens were immunologically partially identical with antigens of rye flour and of common grass pollen [10,11]. Further RAST inhibition experiments showed crossreactivity between grain extracts of wheat, rye, barley and oats and suggested that the bran layers of cereal grains are at least as allergenic as flour [25]. Crossreactivity not only within the common flours of wheat, rye, barley and oats but also corn and rice was shown by RAST inhibition tests [15].

The allergens involved in the baker's asthma are not limited however, to cereal allergens. Bakery is a working environment with a wide variety of exposure ranging from possible mould and mite contaminants to several additive agents used in the baking. An important component in baking is the baker's yeast, *Saccharomyces cerevisiae*. It is a fungal allergen, especially its 52 kDa enolase enzyme, against which IgE response has been demonstrated in sera from asthmatic bakers [26]. There are several additives used in bakery industry to improve the fermentation and elasticity of the dough as well as to improve storage of the bread. Bakers are exposed to several powdered fungal enzymes with carbohydrate-cleaving activity that are commonly used to enhance baked products.

α -amylase is a starch cleaving enzyme of fungal origin (*Aspergillus oryzae*) often used as a flour additive and recognized as occupational allergen in baker's asthma [27–29]. Air sampling has detected airborne α -amylase associated with work related respiratory symptoms and positive skin prick tests to α -amylase (30%) of the exposed workers [30]. However, the cereal α - and β -amylases may be more important allergens than fungal α -amylase in baker's asthma. A RAST analysis showed 29 of the 30 subjects with inhalant induced cereal allergy had positive IgE to cereal amylases, but only 16 were positive to fungal α -amylase and RAST inhibition showed little crossreactivity between cereal and fungal α -amylases [20].

In addition to α -amylase, fungal cellulase has been found an occupational allergen by skin testing, histamine release test, positive reverse enzyme-immunoassay for specific IgE

antibodies, and bronchial provocation test [31]. Another additive in the bakery industry, soybean lecithin, has been recognized as an occupational allergen in baker's asthma. The patients having clinical symptoms in relation to an occupational exposure to soybean lecithin also had positive skin tests, RAST and bronchial challenge tests [32].

Enzymes of fungal origin have been recognized as allergens in bakeries, yet the airborne contaminant moulds themselves may imply an allergenic risk as well. In two cases of baker's asthma pulmonary hypersensitivity was found to the fungi *Alternaria* and *Aspergillus* which were also present in the room air of the bakeries [33]. Even though storage mites may be present in bakeries as contaminant allergens of the working environment, a survey on respiratory symptoms and occupational allergens among 226 bakers and pastry makers in northern Italy revealed that wheat allergens and α -amylase must be considered as causative agents but sensitization to storage mites is not important in the occupational allergic response [34].

Recent research has brought lots of new information on the individual cereal allergens, which remain the major cause of allergy in baker's asthma. In addition to improved diagnostics this progress enables new methods and technologies to measure and decrease the risk of allergen exposure in the working environment [35]. However, new allergens, additives and contaminants, each playing a minor part alone, make together a remarkable source of occupational allergy in baker's asthma. Open eyes and minds in the search for yet unknown allergens will accomplish the diagnosis of this common occupational asthma with diverse allergenic aetiologies.

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