Prevalence of sensitisation to cellulase and xylanase in bakery workers

J Elms, D Fishwick, J Walker, R Rawbone, P Jeffrey, P Griffin, M Gibson, A D Curran

METHODS

As previously reported, a cross sectional study was carried out in 18 small bakeries in Scotland. Two hundred and twenty four workers participated, and supplied 205 serum samples. This paper reports the results of a subanalysis of 135 sera, selected as a sample of convenience, representing those workers with enough serum available for further analysis. Radioallergosorbent (RAST) analysis was performed according to Ceska and colleagues, using a mixed enzyme disc prepared by conjugating an equal amount of Aspergillus niger derived cellulase, hemicellulase (Sigma, Dorset, UK), and xylanase (Megazyme, Wicklow, Ireland) to cyanogen bromide activated discs. A RAST score of 2 or more was considered positive. For subsequent analysis, workers were separated into three discrete groups, according to their pattern of specific IgE response. These were defined as follows:

- Not sensitised—RAST negative to wheat flour, fungal α-amylase, and mixed enzyme.
- Wheat flour—RAST positive to wheat flour allergens, but negative to fungal α-amylase and mixed enzyme.
- Enzyme—RAST positive to either fungal α-amylase or the mixed enzymes (with or without specific IgE to wheat flour).

The data from the original standard respiratory questionnaire were used to define four diagnostic groups: any respiratory symptom; any work related respiratory symptom; any nasal symptom; and any work related nasal symptom. Work related symptoms were defined as either rest day improvement or improvement on holidays; nasal symptoms were defined as nasal itching, running, or blockage and sneezing.

All analyses were performed by cross tabulation in SPSS (Statistical Package for Social Scientists, v 10, SPSS Inc., Chicago, USA) with a Mantel-Haenszel common odds ratio estimate. A χ² test was used to compare proportions. Statistical significance is assumed at the 5% level.

RESULTS

The 135 workers undergoing further analysis did not differ significantly in age (p = 0.817), smoking status (p = 0.249), or exposure group (p = 0.368), from those 70 workers whose serum was not available.

Of those samples reanalysed, 16 (12%) were found to have specific IgE to fungal α-amylase, 25 (19%) to wheat, and eight (6%) to the mixed enzyme bakery disc. It is of note that of the 18 individuals sensitised to enzymes, 12 were sensitised to wheat flour. Of those individuals who had specific IgE to the mixed enzymes, two individuals were negative for fungal α-amylase disc. Only one of these individuals was positive for wheat flour, and although both of these individuals had nasal symptoms, only the wheat positive individual reported that they were work related. There were sufficient sera to screen seven of the eight mixed...
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Interestingly, however, Quirce and colleagues reported no cross reactivity between these enzymes. However, insufficient quantities of sera to assess cross reactivity between the enzymes.

Table 1 details the levels of sensitisation to these workplace allergens, compared to the presence of respiratory and nasal symptoms, and reports Mantel-Haenszel common odds ratio estimates. These data show a significant relation between sensitisation to enzymes (with or without wheat flour) and prevalence of any nasal (χ² value 11.9, p = 0.001), and work related nasal symptoms (χ² value 13.4, p < 0.0001), compared to non-sensitised individuals. The prevalence of such symptoms was greater in those sensitised to enzymes compared to wheat flour, which in turn was greater than those not sensitised.

DISCUSSION
The inhalation of cereal allergens has been suggested as a cause of sensitisation and the reporting of respiratory symptoms in bakers. However, the list of potential causative agents has increased to include agents such as flours from other sources, storage mites, and now enzymes of the Aspergillus lineage. In this study, we showed sensitisation to either cellulase, hemicellulase, or xylanase in 6% of bakery workers studied. Due to insufficient sera, it was not possible to investigate the degree of cross reactivity between these enzymes. Previous work has, however, showed a degree of cross reactivity between xylanase and cellulase, as the hemicellulase extract may have had a xylanase component, and as the hemicellulase extract may have had a xylanase component, cross reactivity between these cannot be ruled out. Interestingly however, Quirce and colleagues reported no cross reactivity between cellulase and α-amylase, and in the current study two workers with specific IgE to the mixed enzymes showed no detectable specific IgE to fungal α-amylase. This suggests that these enzymes should be included in the evaluation of sensitisation in bakers.

The present study suggests a significant relation between sensitisation and prevalence of “any”, and “work related” nasal symptoms. Importantly, nasal symptoms were significantly more prevalent in the enzyme sensitised group compared to those sensitised to wheat flour allergens alone. This increased association of nasal symptoms in individuals sensitised to enzymes underlines the importance of evaluating sensitisation to both wheat flour and enzymes used in the baking industry. While limited by sample availability, this study is one of the first to show a relation between clinical symptoms and sensitisation (measured by a positive RAST test) to other allergens within the flour improver mix.

Because this was a cross sectional study in a limited number of samples from small bakeries, it is not possible to comment further on the relation between sensitisation and symptoms suggestive of rhinitis. However, it is plausible to conclude that nasal symptoms may be a consequence of sensitisation related to the repeated exposure to airborne agents, and in particular enzymes used in this industry. Furthermore, it is reported that rhinitis is a risk factor for asthma, and it is conceivable that work related nasal symptoms represent early airway responses to allergen, and may identify an “at risk” group with a greater likelihood of developing occupational asthma.

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Table 1
Prevalence of sensitisation in symptomatic individuals

<table>
<thead>
<tr>
<th>Sensitisation status</th>
<th>Symptoms</th>
<th>No symptoms</th>
<th>Odds ratio (95% CI) compared to group 1</th>
<th>Odds ratio (95% CI) between groups 2 and 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any respiratory symptoms</td>
<td>65</td>
<td>39</td>
<td>1.0</td>
<td>to</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>4</td>
<td>1.35 (0.39 to 4.67)</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>6</td>
<td>1.2 (0.42 to 3.49)</td>
<td>0.89 (0.19 to 4.12)</td>
</tr>
<tr>
<td>Work related respiratory symptoms</td>
<td>1</td>
<td>27</td>
<td>77</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>11</td>
<td>0.52 (0.11 to 2.49)</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>13</td>
<td>1.10 (0.36 to 3.37)</td>
<td>2.16 (0.34 to 13.16)</td>
</tr>
<tr>
<td>Any nasal symptoms</td>
<td>1</td>
<td>41</td>
<td>63</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>7</td>
<td>1.32 (0.41 to 4.20)</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>3</td>
<td>7.68 (2.09 to 28.5)</td>
<td>5.85 (1.12 to 30.3)</td>
</tr>
<tr>
<td>Work related nasal symptoms</td>
<td>1</td>
<td>14</td>
<td>90</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>8</td>
<td>4.01 (1.15 to 14.08)</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>9</td>
<td>6.42 (2.18 to 18.87)</td>
<td>1.6 (0.38 to 6.80)</td>
</tr>
</tbody>
</table>

Sensitisation status: 1 = not sensitised; 2 = WF only; 3 = enzyme plus or minus WF.
WF, wheat flour.
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