"Bakers'Asthma"

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This paper presents a viewpoint of Bakers' Asthma from the perspective of an occupational physician with ten years' experience of working in the food industry. Although some of the opinion represents mainstream academic views, a large part reflects personal views in the light of practical experience.

It is appropriate to start with some background to the condition commonly known as Bakers' Asthma. The history dates back to around 1700 when an Italian physician called Ramazzini published a work called 'De Morbis Artificium". He studied a number of occupational conditions amongst which he recognised respiratory problems in millers and bakers. Although knowledge of causation at that time was fairly scant, he considered that the problem could have been caused by stickiness of flour from the inhaled dust entering the person's air passages.

Very little happened in terms of Bakers' Asthma between Ramazzini's time and the twentieth century. In the 1960s a number of papers started to appear in the medical journals relating to Bakers' Asthma. Since then, quite a large body of research has accumulated. It is possible to summarise the research findings as a simple statement that bakery dust can produce two symptom complexes. These consist of asthma and rhinitis. Most people understand asthma as a condition where there is intermittent wheezing and shortness of breath. Rhinitis is an inflammation of the nasal passages that causes either a runny or blocked nose and sneezing.

Looking closer at asthma, it is a disorder of the air passages where the muscle in the walls of the passages constricts in relation to stimuli for the lining (ie the mucosal layer). However, asthmatics should not be considered to be a separate group from the rest of the population because the sensitivity of the air passages has a continuous skewed distribution across the whole population. The following chart shows the distribution of the population in terms of airway hypersensitivity.

Airway hypersensitivity relates to how the lining of the air passages reacts to external stimuli, in terms of causing a trigger to constrict the muscles in the airway walls and hence restrict the flow of air. The line shows a typical distribution of airway hypersensitivity in the general population. Within the overall distribution, individuals have some degree of day-to-day variation, as shown by the doubleheaded horizontal lines. A point will occur along the curve of airway hypersensitivity when the airway constriction is great enough to cause a wheeze due to restricted air flow. The line indicates this point on the curve.

Therefore anyone who lies to thelett of the line will not wheeze a@d anyone to the right will wtieeze. However, if an individual's range of airway hypersensitivity straddles the point, whilst they are to the left they will not wheeze but when their airways are most hypersensitive, ie they are to the right of theline, they will wheeze. This is effectively what

happens to individuals with intermittent asthmatic symptoms. Asthmatics therefore are not a separate subgroup of the population but rather part of a continuum described by their airway hypersensitivity.

The next point to consider is occupational asthma. In the early 1980s, occupational asthma was defined very simply as asthma caused by allergy to a particular substance at work. It is important to understand that allergy is an acquired condition, ie people are not born with any allergies but they can acquire them due to exposure to potential allergens. In some people who are exposed to a particular allergen, the body reacts by producing a type of antibody (an 19E antibody), which will then react specifically with this allergen. Once an individual has become sensitised, exposure to very small amounts of allergen will then trigger symptoms of asthma. Incidentally the same mechanism is true for rhinitis, the only difference being the type of symptom.

With the passage of time, occupational asthma has acquired much more mystique in terms of how it might be caused, ie it is no Ion er just thought to be allergy mediated by lgE antibodies. Furthermore, the diagnosis of Baker's Asthma is probably the most complex of all the causes of occupational asthma. As such, it is recognised to have a number of features that are different from other types of occupational asthma.

The first point of difference is that the majority of those with respiratory symptoms in bakeries have no evidence of lgE antibodies to flour (or any other recognised bakery allergen). At the current state of knowledge, the mechanism by which these symptoms is caused is still Ynclear. Could Ramazzini have t)een right after all, with his thought that symptoms are caused by stickiness of flour in the person's air passages?

Secondly, other allergens have been recognised in the bakery environment, particularly the enzymes fungal amylase and hemicellulase, which have been added to bread improvers since the 1960s. At one point there was also a question as to whether flour Storage mites might be responsible for allergic symptoms in Bakers' Asthma, although this proved to be a bit of a red herring as the flour storage mite cross reacts with house dust mite, one of the commonest allergens in the United Kingdom. Understanding of the role of fungal amylase as a bakery allergen is still in its infancy but, with the passage of time, the medical establishment is increasingly recognising amvlase as a cause of Bakers' Asthma.

The third point of difference relates to the way in which allergens are presented in a bakery environment. Exposure to most occupational allergens takes place against a background of very low dust levels. In contrast, exposure to the allergens in bakeries is usually in the context of relatively high total inhalable dust levels. This situation is relatively unique for allergens encountered at work and mav be the reason for the different symptoms occurring with and without evidence of allergy.

Not only has the level of understanding of Bakers' Asthma given rise to some confusion, but occupational asthma has been redefined in terms of its causation. We currently talk about *inaucers and inciters. An inducer* **is** a substance which can initiate airway inflammation and hyperresponsiveness. In contrast an *inciter* is an agent which can provoke airway narrowing in people with already hyperresponsive airways. Perhaps bakery dust acts as both an inducer and an inciter?

The next issue to consider is the incidence of occupational asthma. In the United Kingdom we have had a national surveillance scheme called 'SWORD' which has operated since

1989. SWORD stands for Surveillance of Work-related and Occupational Respiratory Disorders. Occupational asthma and asbestos-related respiratory diseases ar

Amongst the causes of occupational asthma, asthma due to grain or flour dust is the second most frequently reported relationship after isocyanates. It is interesting to consider how grain and flour have come to be grouped together in this way. When occupational asthma first started to be recognised, grain and flour were thought to be allergenically similar. The passage of time has shown this to be completely incorrect but the hangup of their grouping together has persisted. The SWORD scheme has reported the incidence of Bakers' Asthma up to 1997 with the number of new cases in each year remaining largely unchanged with time, giving an annual incidence of 811 per million employees.

At this point the discussion will Temporarily move away from medical issues and instead look at dust measurements in the workplace, starting with the issue of dust sampling techniques. Dust measurements can be based on either personal or static samples. To collect a personal sample, the sampler is attached to the employee whereas, in order to collect a static sample, the sampler placed on a stand at a suitable position within an area where dust exposure might arise. For regulatory purposes all of the standards are framed around personal sampling. In addition. measurement times are important. Regulatory standards are largely related to either an 8-hour time weighted average (8hr TWA) or a 15 minute short-term exposure limit (STEL). However, it is also possible to look at the dynamics of sampling in order to obtain some idea of peak exposures.

U.K. exposure standards are framed in units of measurement of milligrams per cubic metre of air (nig.m-3). However, they are based on the total inhalable dust rather than specific constituents of the dust. The exposure standard for flour dust is called a Maximum Exposure Level (MEL) and is set as 10 (mg.m-3) as an 8 hour time weighted average (8 hr TWA) and 30 mg.m-3, as a 15 minute Short Term Exposure Limit (STEL).

It is interesting to compare some of the actual exposures that arise **in** bakery environments with these limits. The next table (Table

1) shows a summary of a large number of measurements performed in RHM Bakeries without any control measures in place. All of these were on bread plants, rather than morning goods, and are expressed as eight hour time weighted averages. The four jobs chosen are sieving, weighing, mixing and cleaning. The figures exceeding statutory Maximum Exposure Limit are highlighted. For both sieving and weighing operations, even the mean exposure lies above the MEL of 10 mg.m-3. Furthermore, for all of the jobs, the maximum exposures are well in excess of the MEL, essentially because each of these jobs has a wide variation in the range of exposure.

Table 1 - Exposures (Mg.M-3) Without Local Exhaust Ventilation

Job	Mean	Range
Sieving	15.8	5.8 - 28.5
Weighing	17.8	4.2 - 25.7
Mixing	4.5	0.3 - 21.7
Cleaning	7.0	1.2 -

The next two charts illustrate sampling with a dynamic sampler. The first shows the change in exposure during manual addition of ingredients to a Tweedie mixer. The graph shows a short term high level of exposure lasting only some five seconds, against a relatively low background dust level.

The second chart shows the exposure that occurs as an ingredient is scooped from a tub and dropped into a bowl. Again the background is quite low but there is a peak exposure lasting around five seconds.

Figure 3 - Dynamic Exposure

During Scooping Ingredient and

Dropping in Bowl

The key points regarding exposure can be summarised as follows:

• There is considerable variation from person to person (interpersonal). There is also considerable variation for the same person doing the same job from day to day (intrapersonal).

• Measurements using a static sampler are typically lower than personal samplers. The reason for this is that an individual's exposure is determined by the dust generated while performing the task rather than by a (continuous) background level of dust from the process.

• The measurements'are of total inhalable dust and do not relate to any specific component substance.

Moving on to the RHM Health Surveillance programme, it might be helpful to understand some of the background. The programme started in 1993 in response to a statutory duty under the Control of Substances Hazardous to Health Regulations. The programme itself covers employees in flour milling, bread baking, cake baking and other flour using activities. In all, around 3,500 employees are part of the regular surveillance programme.

Two important observations came out of the early stages of the programme. The first of these was that most cases of sensitisation seem to come from bread bakeries. The second was that these cases were principally due to sensitisation to fungal amylase contained in the bread improver. As a result of these observations, the company started to implement specific control measures aimed at limiting the risk of sensitisation to fungal amylase. Essentially, the aims of control were in two parts.

Firstly bread improver exposures would be limited to one Mg.In-3 as an eight hour time weighted average. Secondly all other ingredient dusts, including flour, would be lin-dted to 10 $Mg.M^{-3}$ as an eight hour time weighted average. Although these in-house limits are expressed as eight-hour time weighted averages, the real aim of imposing limits at these levels is to limit the short term or peak high exposure levels. This situation is particularly true

with bread improver exposures, since short-term high exposures, rather than cumulative exposures, are thought to be more important in terms of risk of sensitisation.

The strategy for application of the control measures has four main elements. The first of these is installation of local exhaust ventilation that might take the form of either walk-in booths or hoods, depending upon the particular circumstances. However, it is important to n that local exhaust ventilati cannot be used in circumstances. A particu problem area is extraction of la mixers such as Tweedies a Hitexs.

Secondly there has been emphasis on improved work practices. This has involved b the provision of information direct training. One of the age oldproblems about handling powered ingredient material been a general disregard health effects associated inhalation of dusts from carel handling. Although this probably the hardest measure implement, it probably has greatest potential benefit reducing dust exposure.

The third control measure been a mandatory requirement the wearing of respirat protection when bread improv are being handled. This- meas has been mandated even w local exhaust ventilation is place. The fourth measure been use of bread improv reformulated as a liquid. In long term the movement to liq improvers could be instrume in preventing sensitisati However, at present, liq improver is not suitable for recipes.

Having described the theoret basis and practical aspects of strategy, the next step is determine how effective controls have been. There are ways of looking at this:

- · The impact on exposure levels
- · The impact on health

Starting with the effect of 1 exhaust ventilation and expos levels. The next table (Table shows the mean exposures sieving and weighing jobs be and after the application of 1 exhaust ventilation.

Table 2 - Mean Exposures (mg.m-3) It is interesting to note that, since

Without and With Local Exhaust Ventilation

With LEV

job	Without LEV	
Sieving	15.8	8.7
Weighing	17.8	2.7

For both jobs the mean exposures were above ten mg.m-3 without local exhaust ventilation but came within the ten Mg.M-3 limit after LEV has been installed. However, this is not the whole story because the following table (Table 3) shows the effect of LEV on maximum exposures. As the range of exposures for different jobs varies considerably, it is necessary to consider not just the mean exposure, but also the maximum exposure. Even with LEV, it is still possible to see some exposures for sieving operations which fall outside the ten Mg.M-3 MEL.

Table 3 - Maximum Exposures (Mg.M-3) Without and With Local Exhaust Ventilation

Job	Without LEV	With LEV
Sieving	28.5	21.2
Weighing,	45.7	8.0

Turning to the issue of impact on health, the next chart shows the annual number of cases of symptomatic sensitisation, ie asthma or rhinitis caused by allergy, across RHM. The cases are attributed to the year in which symptoms began.

Figure 4 - Summary of New Cases of Symptomatic Sensitisation

It is interesting to note that, since 1998, there has been a dramatic fall in the number of new cases. This would have been even more marked but for four cases which occurred in a company that was acquired in May 1998 and had significantly poorer dust control than existing RHM bakeries. Even taking this into consideration, the incidence of symptomatic sensitisation fell from 2085 per million employees per year in the five years up to 1998, to 405 per million employees per year for the five years from 1998 onwards.

It is possible to summarise the effect of the RHM control strategy as follows. In terms of exposure levels the impact has had some benefits but cannot ensure that all individual exposures fall within the statutory Maximum Exposure Limit of ten mg.m-3. On a much more encouraging note, in terms of the reduction in sensitisation, the impact on health has been quite marked. It is important to qualify this success, since sensitisation is only responsible for a relatively small proportion of the respiratory symptoms attributed to ingredient dust exposure. However, symptomatic sensitisation is arguably the most important health issue in terms Of its detriment to the sufferer.

Question: Terry Humber, London What is the local exhaust ventilation approach?

Answer - 1 talked about walk-in booths. Walk-in ventilation booths have a design whereby the air flow comes from above and behind the person to the front wall of the booth and goes from above and behind to below and in front and the filters are down at low level so it sucks the air in that direction away from the breathing zone, and walk-in extract booths, if they are used properly with good working practices, are certainly capable of reducing exposure to very low levels for example in pharmaceutical industry, but a lot of bakery premises just really haven't properly taken this into consideration in the past in terms of design and ventilation. It merely gets the dust out of the place in some way or another.

Question: Chris Morrant, Manchester Do you have skin problems with bread improvers?

Answer - Interestingly we have quite a lot of people who handle powder bread improver and whilst we get occasional skin problems with people handling powdered ingredients usually they are not through allergy. Usually its an irritant problem on the skin and whilst it's theoretically possible it doesn't seem to be an issue in practice.

Question: Chris Wells

Are we sitting on a claims time bomb?

Answer - No it's gone off. There have been quite a large number of claims in relation to occupational asthma. 1 can only speak for RHM and in RHM its dwindling and perhaps its dwindling because we've been doing something right.

Yes, bear in mind that an employee can make a claim not just because of sensitisation but in relation to aggravation of an existing problem, in other words if you go to what I was describing as an inciter problem, rather than a sensitisation inducer problem, and we do still see those, but because we're not sensitizing people any more we're not seeing these people with the more serious problems. Interestingly we don't tend to need,to retire people on health grounds in RHM because of respiratory problems **in** general and particularly because of occupational asthma.