Occupational allergy and asthma among food-processing workers in South Africa

M. F. Jeebhay
SOUTH AFRICA

Occupational allergies and asthma – a global health problem

Occupational food allergies and asthma are diseases resulting from a hypersensitivity of the immune system to food substances encountered in the work environment (1). As the proportion of the total number of occupational diseases, occupational allergies constitute 15% of all diseases (2). The proportion of adult cases of asthma attributable to occupational exposure is estimated to be 10–15% (3). Worldwide, the most commonly reported causes of asthma in the workplace are agents of biological origin such as cereal flours, enzymes, natural rubber latex, laboratory animals and some low molecular weight agents (isocyanates and acid anhydrides) (4). In South Africa, the food-processing industry (grain milling, bakery) is one of the top three industries reporting an increasing number of workers with occupational allergies and asthma to the Compensation Commissioner and to the voluntary surveillance system, SORDSA (Surveillance of Work-Related and Occupational Respiratory Diseases in South Africa) (5,6,7). SORDSA data also point to an increasing incidence of occupational asthma in the highly industrialized provinces of South Africa. Occupational allergies and asthma are clearly becoming an increasingly important health problem affecting workers.

Food manufacturing and processing industries in South Africa

The food manufacturing and processing industry in South Africa employs over 180,000 workers (March 2002) involved in a broad spectrum of occupations. These include work with: meat, fish, fruit, vegetables, oils and fats; dairy products; grain mill products, starches, starch products (e.g. sweets, chocolates, confectionery); prepared animal feeds; and other food products and beverages (personal communication, Fil Van Niekerk, Statistics South Africa). Materials processed include both naturally occurring biological raw products (plant/vegetable, animal or microbial origin) as well as chemicals used for the preservation of foods for human (e.g. sulphites) or animal (e.g. formaldehyde) consumption. Additional chemical exposure also occurs in the packaging of food (e.g. plastics, glues, inks) (Photo 1, see next page). Certain techniques in food processing (e.g. thermal denaturation, acidification and fermentation) generate new allergens, while others (e.g. slaughtering, cooking, gutting, grinding, milling, drying, centrifuging, lyophilizing) generate high-risk aerosol exposures to food products that are capable of causing allergic health outcomes among exposed workers (Photo 2 on page 61) (8,9). Workers considered to be at increased risk include farmers who grow and harvest crops; factory workers involved in food processing, manufacturing and storage; and workers involved in food preparation (chefs and waiters) (10).

Allergenic constituents of food products associated with adverse reactions

Common constituents of food products

causing occupational allergies and asthma include proteinaceous material (e.g. pollen, spices, grain and coffee dust, animal hair and secretions, storage mites, insect pests), micro-organisms (e.g. *Aspergillus*), parasites (e.g. *Anisakis sp.*, *Hoya sp.*), toxins (e.g. histamine, endotoxin, mycotoxin), synthetic enzymes such as papain and (1->3)-B-D-glucans (e.g. fungal alpha-amylase) (9,11,12). These constituents enter the body either through inhalation or dermal contact, causing adverse reactions of an irritant or allergic nature. Proteins, both naturally occurring and synthetically derived, with a high molecular weight (>2kDa) commonly cause IgE-mediated allergic reactions among food-processing workers. These are commonly manifested as *allergic rhino-conjunctivitis, asthma, urticaria and protein contact dermatitis*. The reactions can occur in workers as a result of exposure to food allergens in the occupational context or among workers with a known food ingestion-related allergy as a result of cross-reactivity of antibodies to allergens having structural similarities. Important factors influencing the manifestation of occupational allergies and asthma include allergen characteristics (e.g. physical and chemical properties, sensitizing potential), circumstances surrounding exposure (e.g. dose, duration and route of exposure) and host-associated factors (e.g. atopy, smoking status, HLA type) (13).

Recent epidemiological studies

In recent years, there have been an increasing number of studies in South Africa reporting the disease burden attributable to occupational allergies and asthma among food processing workers (14). Cross-sectional studies among grain mill workers in Cape Town indicate that between 17% and 37% of workers have occupational asthma due to cereal grains (wheat, rye), storage mites (*Lepidoglyphus sp., Tyrophagus sp.*) and/or grain weevil (*Sitophilus granarius)* (15). Studies in poultry farms and processing plants in Gauteng province demonstrate that between 11% and 13% of workers have symptoms consistent with asthma associated with sensitization to poultry-specific allergens present in chicken feed, serum, feathers and faeces (16). In our postal surveys of seafood- processing plants along the west coast of the Western Cape province, 50% of employers reported at least one worker with occupational allergies, including asthma, annually (17). More detailed studies among fish-processing workers demonstrated that 16% of workers complained of work-related asthma symptoms, with 3% having occupational asthma due to allergens in bony-fish (pilchard and anchovy) and 4% with occupational asthma due to the fish parasite *Anisakis sp.* An unexpected finding was the high prevalence of latex sensitization (9%) among fish-processing workers using non-powdered latex gloves in their work (18). Current studies among table-grape farm workers in the Hex River Valley of the Western Cape indicate that 26% have work-related asthma symptoms, and 7% of all workers are classified with asthma due to the spider-mite, *Tetranychus urticae* (data in press). This microscopic mite (commonly known as red spider) is found in colonies on the surface of leaves, parasitizing fruit trees, herbaceous plants and greenhouse crops worldwide. It is a known cause of occupational asthma among fruit farmers making widespread use of pesticides for pest control (19). The findings of this study demonstrate that certain outdoor mites associated with work exposure on food-cultivating farms can also result in allergy and asthma similar to the commonly known indoor house dust mites and storage mites.

Photo by M.F. Jeebhay

Photo 1. The heating of plastic wrapping during the packaging of fish products generates pyrolysis products that can cause asthma.

Preventing occupational allergies and asthma

Regulatory exposure standards and economic incentives

While occupational allergies and asthma can in principle be prevented, there is very limited evidence that it occurs in practice (20,21). This is due to the variable nature and ineffective use of legally enforceable standards and economic incentives currently in various countries (22). Legal regulatory imperatives are usually aimed at large industries and/or where there is one dominant putative agent. They can take the form of banning the agent, substitution of the agent or defining a specific exposure standard for compliance. Economic incentives are commonly used for multiple agents and/or small industries. They mainly take the form of taxation, risk-based insurance premiums, fines or pressure from labour and consumer unions. In the South African context, the greatest reliance is placed on legal regulatory frameworks, since they are uniform, cost little and are implementable fairly expeditiously. The problem, however, is that the sanctions (e.g. fines) are low and poorly enforced, leading to ineffectual prevention.

There are various laws that deal with or have a bearing on hazardous agents causing occupational allergies and asthma among food-processing workers in South Africa (23). The primary preventive law, the Occupational Health and Safety Act (OHSA), makes it obligatory for medical practitioners to report all cases of suspected occupational disease to the Department of Labour. The Any incident also requires investigation and prompt action by the employer in order to solicit the expertise of an occupational hygienist so as to identify sources of high-risk exposure and provide recommendations for controlling the hazards. The Hazardous Chemical Substances (HCS) Regulations under this law deal somewhat scantily with substances of foodstuff origin. It does not, however, provide appropriate guidelines for evaluating exposure to specific allergens

causing allergic and inflammatory effects (24,25). Furthermore, the exposure standards stipulated for grain dust, for example, are not sufficiently protective in preventing sensitization to specific allergens. The recently promulgated Regulations for Hazardous Biological Agents (HBA) deal specifically with eliminating, controlling or minimizing exposure to HBA in the food industry among others. These Regulations are based on the comprehensive European Directive No. 2000/54/EC on the protection of workers from risks related to exposure to biological agents at work (26). However, it would appear that the emphasis of these regulations is primarily directed at microbes causing infection. There is therefore a need for legislation dealing specifically with the prevention of occupational asthma due to allergenic and irritant exposures.

Other preventive legislation having a bearing on food products relates to the various legislative requirements for food hygiene and safety are enforced unevenly by a multitude of different government departments (27). These laws are geared primarily towards fulfilling consumer needs, while none deal explicitly with the occupational health concerns of workers exposed to these foods.

The social and economic impact on workers affected by allergic reactions caused by agents at the workplace should not be underestimated. At an individual level they are frequently severe enough to cause workplace absence, change of job, loss of pay, disability and eventual work cessation and job loss. For this reason, occupational asthma is scheduled as a compensable disease under the Compensation for Occupational Injuries and Diseases Act (COIDA), thereby granting some important medical aid and social security benefits to affected workers (23). Recent studies show, however, that affected workers still experience difficulties due to inefficient administration of the current system of dispensing compensation in South Africa (5).

Workplace interventions

Environmental control of allergens is still the mainstay of preventing the development of allergic diseases, including asthma, in the workplace. Improvements in the work environment can contribute significantly to decreasing the risk of sensitization in the case of further, as yet unaffected, workers. It will also reduce the risk of precipitating an asthmatic attack among already sensitized workers. Workplace strategies for controlling allergen exposure generally use a combination of approaches that include substitution of the product, engineering controls (e.g. process isolation, process modification, exhaust ventilation), personal protective equipment (respirators, gloves) and administrative controls (e.g. improved work practices) (28,29). Education and training programmes that inform and educate workers about the allergic health effects associated with food handling are equally important. Material safety data sheets, if adequately compiled, can be a useful adjunct to these programmes, enabling workers to take the necessary precautions when working with these agents (14,30).

In South Africa, the common practice of employers is to opt for personal protective equipment or getting the person to leave the job, rather than dealing with allergen exposure at source. Despite the overwhelming evidence that workplace exposure to flour dust, for example, should be controlled, prevention strategies in bakeries and grain mills have not been very satisfactory (28). Process automation and enclosure as well as other simple strategies such as using vacuum cleaners rather than sweeping grain dust have been introduced in some grain mills. Work with bakeries has been less successful due to the predominance of small-sized bakeries that are not keen to embark on expensive engineering controls. A large-scale intervention study is currently under way to develop indigenous intervention strategies for this sector. Control measures to reduce the emission of bioaerosols containing aeroallergens produced in fish-processing plants include process separation or enclosure as well as the use of local extraction ventilation systems for equipment (gutting machine, fishmeal bagging) (Figure 3). Where there is skin contact with the hazardous agent (fish sorting, spice mixing), appropriate gloves (cotton-lined) and plastic sleeves can be worn, thereby preventing sensitization through non-intact skin (Figure 2). When preventive measures are being instituted, special care should be taken to ensure that one hazard is not replaced by another; an example is the introduction of powdered or high protein latex gloves, which may inadvertently cause latex allergy.

Surveillance

Conventionally, occupational hygiene surveillance programmes employ either direct subjective observation of work processes; total dust levels or protein levels as a proxy for exposure; or direct sampling and environmental quantification of specific occupational aeroallergens. Studies have shown, however, that total dust levels correlate poorly with specific allergen levels, and the third method is thus the preferred one, provided that standardized analytical procedures are utilized (31). The most widely used methods for the medical surveillance of occupational allergic respiratory diseases are questionnaires, spirometry and immunological tests such as skin prick tests or allergen-specific serum IgE levels. The aim is to detect immunological sensitization or occupational asthma early on, before it becomes severe or irreversible (32). The results of occupational hygiene and medical surveillance programmes can be used to assess the effectiveness of recently introduced control measures.

Photo by M.F. Jeebhay

Photo 2. The fish canning process produces bioaerosols as well as fish juice, both potential sources of allergic sensitization through inhalation and skin contact.

Studies in South Africa indicate that only 11–18% of workplaces (mainly large companies) provide some form of occupational health services, mainly concentrated in the urban areas of highly industrialized provinces (7). Recent research into the seafood- processing industry confirmed that – as with most other food industries – the surveillance programmes and preventive strategies for workers in this industry are inadequate. Small and medium-scale workplaces (employing less than 200 workers) were found to be less likely to provide an occupational health service, to conduct medical surveillance programmes, or to identify at least one worker per workplace with work-related allergic symptoms (17). None of the workplaces had occupational hygiene programmes specifically geared towards evaluating bioaerosols in general or aeroallergens in particular.

The future

As new foods are developed, it is possible that new occupational reactions may occur during the processing of these. Of special interest is the recent introduction of genetically modified crops in South Africa. These crops may contain novel proteins, not previously known, which may be capable of causing allergic reactions in the occupational setting well before the products are made available to the consumer market (10). It is therefore crucial that epidemiological surveillance programmes involving sentinel groups such as workers in food-processing plants should be initiated in order to detect the emergence of new allergies and health risks at a very early stage (33). Manufacturer responsibility for product stewardship should include, among other things, product labelling and the provision of material safety data sheets containing detailed information on the allergenicity of these products to workers and consumers handling these foods so as to ensure overall public health and safety (30).

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Dr Mohamed F Jeebhay
Senior Research Fellow
Occupational and Environmental Health Research Unit
School of Public Health and Primary Health Care
University of Cape Town
Room 4.44, Fourth Level, Falmouth Building
Anzio Road, Observatory 7925
South Africa
Tel:27-21-4066309/6300
Fax:27-21-4066163
e-mail:
mjeebhay@cormack.uct.ac.za