

ALLERGIES IN THE WORKPLACE

ALLERGIC CONTACT DERMATITIS IN THE FOOD INDUSTRY – FROM AGRICULTURE TO FOOD PROCESSING AND MANUFACTURE: A CASE STUDY OF A DAIRY FARMER

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ABSTRACT

Agriculture and food production have a high prevalence of occupational skin disease when compared with other industries. This article discusses contact dermatitis in a farmer. The discussion outlines the three main different allergic skin conditions: allergic contact dermatitis, protein contact dermatitis and contact urticaria, as well as diagnosis and management of work-related allergic skin disease, with emphasis on the allergens found in different parts of the food industry. It highlights the need for health care practitioners to consider occupational causes for all skin conditions and to take a detailed occupational history.

INTRODUCTION

Occupational allergy is defined as an allergy caused by exposure to a substance in the workplace.¹ Allergies at work can affect various organ systems, leading to several different clinical syndromes including allergic contact dermatitis, contact urticaria, occupational rhinitis and asthma, and even anaphylaxis.²

Occupational skin diseases, and contact dermatitis in particular, are some of the commonest health problems caused by work, accounting for around 30% of reported, compensatable occupational diseases in several European countries.³ The incidence rate is believed to be around 0.5-1.9 per 1 000 workers per year.³ In agriculture and the food industry, many different allergens can lead to allergic contact dermatitis, ranging from chemicals and pesticides used on farms to foodstuffs, preservatives and additives used during food processing.

Worldwide more than one billion people are employed in agriculture,⁴ and around 7.5% of South Africa's workforce is employed in the industry.⁵ An additional 22 million people are employed in the food and drink industry globally, although in South Africa, employment in this sector fell by 19% between 1999 to 2004.⁶ This number reflects formal employment, so there are likely to be many more people employed informally and in small businesses throughout the country.

A high burden of occupational skin disease in this sector translates into large costs, both to the individual and to employers in terms of days lost from work, and adjustments necessary in the workplace. Early recognition of allergic contact dermatitis may lead to improved outcomes for the individual in a condition

which has been thought to have a relatively poor prognosis for full recovery.³ Therefore, the health care practitioner needs to be aware of possible occupational causes for all skin disease.

CASE REPORT

A 53-year-old manager of a dairy farm presented with an 8-month history of a burning, erythematous rash, particularly on his face and forearms. It had started 4 months after moving to a new dairy farm, although he had performed a similar role on several different farms. Prior to this episode, he had suffered from cracked fingers in 2006, and seen a dermatologist. He had been patch tested using commercially available allergens in 2006 and had a positive reaction of questionable relevance to Quaternium 15. His rash had resolved with use of steroid creams and had not recurred. He had no history of atopy, eczema or asthma, and no other chronic medical conditions.

A course of potent topical steroid had not controlled a recent flare, but he mentioned that while he had been on holiday in Australia his rash had resolved spontaneously, only to recur on the airplane back to South Africa. He lives on the dairy farm in a recently built house.

On examination, he had chronic eczematous skin changes on both wrists and over the knuckles. There were cracks in the web spaces of his fingers, and erythema and scaling of the upper arms. The rest of his examination was unremarkable. The clinical picture was compatible with dermatitis.

A workplace visit was conducted to assess exposures. As one of two managers, his role is mainly supervisory, but he may perform any part of the milking process as needed. There are 600 cows on the farm and they are milked 3 times a day. The udders are sprayed with a disinfectant prior to being attached by rubber tubing to milking machines (Fig. 1). Following milking, the cow's teats are treated with a teat dip to prevent infection, and they then walk across a formaldehyde-impregnated mat to disinfect their hooves. Any cows with health problems are assessed by the farm managers, and may then be treated with a laxative, stool hardener or antibiotic. Artificial insemination is also performed by the managers.

The milk is stored in large stainless steel vats. These are cleaned with industrial chemicals. Periodically, the cows are treated for ticks. Following milking, the cows return to open sheds for feeding with a grain mix that is manufactured on the farm (Fig. 2).

CAUSES OF SKIN DISEASE IN AGRICULTURE AND THE FOOD INDUSTRY

There are many skin disorders associated with farming, food production and processing. Infections such as milker's nodule and orf, which present as papules on the hands and fingers, are caused by parapox viruses carried by cows and sheep respectively. Most workers know what the cause is and seldom seek medical help for the conditions especially as they become immune. Microsporium and dermatophyte infections are carried by dogs, cattle and horses and these can infect humans causing inflammatory dermatophytosis. Other

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Fig. 1. Udders have been sprayed with disinfectant, and attached to rubber-tubed milking machine.



Fig 2. Grain-mix feed after milking.

important zoonoses include systemic diseases such as brucellosis and anthrax. Skin cancers are more common in susceptible outdoor workers.⁷

This article focuses on causes of dermatitis in the industry.

Irritants are a common cause of dermatitis.⁸ Irritant dermatitis is related to wet work, exposure to detergents and cleaning agents, hand cleaners and abrasives,³ and tends to have a more gradual onset with repeated exposure to one or several irritants.

Allergic contact dermatitis is a delayed hypersensitivity inflammatory reaction. It follows previous sensitisation to an agent which is usually a low-molecular-weight hapten. The substance is small enough to penetrate the stratum corneum and is taken up by Langerhans cells which then present it as an antigen to T-lymphocytes in the lymph nodes and skin. Antigen-specific T-lymphocytes enter the blood stream and circulate to the skin. During the next exposure to the substance, there is a cytokine-induced inflammatory reaction, and dermatitis generally develops within 12 to 48 hours.⁹

It may be difficult to distinguish allergic contact dermatitis from irritant contact dermatitis. If dermatitis corresponds to the site of contact and develops within 12-48 hours of minimal exposure it is likely to be allergic in origin.

Irritant contact dermatitis was thought to be more common than allergic contact dermatitis, but recent studies have argued that allergic contact dermatitis, or a combination of both, may be found to occur as frequently as irritant dermatitis, depending on how thoroughly a doctor investigates when looking for the allergen and the type of occupation.^{8,10} Kucenic and Belsito¹⁰ found that nearly 50% of contact dermatitis in some professions was allergic in nature.

Since the late 1970s, a separate entity known as protein contact dermatitis has been described.¹¹ Clinically it is similar to other types of contact dermatitis, but a distinguishing feature is an immediate itch and urticaria developing within minutes of contact, especially on already damaged skin. Proteins which cause protein contact dermatitis are larger than the low-molecular-weight haptens usually associated with allergic contact dermatitis, and are normally divided into four groups – vegetable/fruit/spice; animal; grains; and enzymes.¹² These are all present in the food industry. It is a rare entity, and there are minimal epidemiological data for incidence or prevalence in different industries.¹² Usually patch testing with the agents will be negative, but a skin-prick or 'scratch' test (when the raw food is applied to a scratch rather than intact skin) will give a wheal and flare reaction. Because the causative agents

are large proteins which would not normally penetrate skin, it is thought that skin needs to be damaged, either through irritation or atopic dermatitis, before it can develop.¹²

Contact urticaria may be immune-mediated (by IgE) or not, and in some cases the mechanism of action is not yet understood. Abnormal skin, for instance from an irritant dermatitis, may predispose to sensitisation.¹³

Some of the more common substances reported to cause contact urticaria and contact dermatitis in the food and agriculture industry are listed in Tables I and II.

Table I. Substances known to cause contact urticaria in agriculture and the food industry*

Animal proteins	Milk, cheese, eggs, beef, liver, lamb, chicken, turkey, seafoods (fish, prawns, shrimp, oyster)
Plant proteins (fruit and vegetables)	Asparagus, apple, banana, beans, cabbage, castor bean, celery, garlic and onion, kiwifruit, lemon and lime, mushrooms, mango, parsley, parsnip, peach, potato, soybean, strawberry, thyme, tomato, watermelon
Grains, nuts and spices	Almond, buckwheat, cashew nuts, cayenne pepper, cinnamic acid and cinnamic aldehyde, curry, flour, maize, menthol, rice, vanillin, wheat
Enzymes and additives	Benzoic acid, sodium benzoate, sorbic acid, tartrazine

* Adapted from Tanglertsampan & Maibach,¹³ Ale & Maibach.¹⁶

Agriculture

The agricultural industry has the highest reported rates of occupational skin disease in the USA.¹⁴ Allergic contact dermatitis has been described for pesticides, disinfectants, rubber chemicals and feed additives (minerals, antibiotics, antioxidants).¹⁵ Animal dander (cows, sheep) can also be a sensitiser.¹⁵ In a Finnish study,¹⁴ cow dander was the commonest cause of contact urticaria followed by rubber, flour grains and feed. Cow's milk and hen's eggs may cause contact urticaria,¹² as may various other plant and animal proteins as listed in Table I. Pesticides, especially fungicides,¹⁶ are known allergens. Fertilisers may contain phosphated compounds as well as cobalt and nickel, which can cause contact dermatitis.¹⁵

Table II. Contact dermatitis in agriculture and the food industry: common allergens*

Foodstuffs: Plants	Almond, apple, banana, bean, cardamom, carrot, cashew nut, castor bean, citrus fruits, coffee bean (green), cauliflower, celery (also causes photosensitivity), chicory, coriander, cress, cucumber, dill, eggplant, endive, fig, garlic, hazelnut, horseradish, kiwi, lemon, lettuce, mango, mushroom, ²⁷ nutmeg and mace, onion, paprika, parsley, parsnip, peanuts, pineapple, potato, tomato, turmeric
Animal	Meat, seafood (crab, fish, mussels, shrimps)
Miscellaneous	Animal proteins – animal dander, mites, milk, eggs Feed additives – antioxidants, minerals, grains, antibiotics Latex – from gloves Nickel – in farm implements and fertilisers and in kitchen utensils Pesticides and fertilisers Rubber – in farm implements

Adapted from Rietschel & Fowler,¹⁸ Guin.²⁶

Beekeepers develop allergic contact dermatitis following exposure to propolis. This resinous substance from trees (often poplar) is incorporated into the hive as a sealant by bees,¹⁷ and is widely used in cosmetics and toothpaste. 'Hoppicker's dermatitis' describes a condition thought to be related to resin on hops plants when they are picked for brewing beer.¹⁸

Green coffee beans are a well-known cause of occupational allergy.^{19,20} Contact dermatitis from lettuce²¹ and carrots²² is reported in occupational and non-occupational settings. Celery has been described as a cause of phytophotodermatitis.²³ This is due to high quantities of psoralens in the picked stems. Contact with the psoralens followed by sun exposure leads to dermatitis.

Bakers and confectioners

Baker's asthma due to flour allergy is a well-described clinical entity. Flour and grains may also cause protein contact and allergic contact dermatitis.¹⁴ Mites and pesticides contaminating stored grain are further sources of exposure. Enzymes, such as α -amylase which is used to improve baking quality, are allergens and 'flour whiteners' (e.g. benzoyl peroxide) have been found to cause dermatitis.²⁴

Aside from grains, bakers are also exposed to numerous spices. The five spices which most commonly cause contact dermatitis in the USA are capsicum, cinnamon, cloves, nutmeg and vanilla.¹⁸

Capsicum is also an irritant – so strong that it is used in teargas. Cinnamon is used as a flavourant not only in baking, but also in toothpaste, chewing gum and spiced cola soft drinks or alcoholic beverages. Cinnamic aldehyde is used in sunscreens, and has some cross-reactivity with balsam of Peru,¹⁸ which may be found in fragrances and tested for with commercially available allergens.

Nutmeg and clove are frequently used in cooking and baking. Clove oil is also used to flavour toothpaste and mouthwashes. Vanilla may cause contact dermatitis in workers involved in cultivation, trade and industrial use of vanilla. These workers may report additional symp-

toms of rhinitis, asthma and vertigo in a syndrome known as 'vanillism'.¹⁸ Contact urticaria (and contact dermatitis) to turmeric (curcumin) has been reported recently.²⁵

Chefs and cooks

Chefs and cooks are exposed to a wide variety of both irritants and allergens. Frequent hand-washing, and exposure to irritant and abrasive food products such as citrus fruits, can be contributory factors. Garlic and onion are common contact allergens.¹⁸ Other foods reported to cause contact dermatitis are listed in Table II.

Food additives such as dyes, preservatives, stabilisers and antioxidants cause dermatitis. Although it is rare, a dye used to colour oranges, cheese, jam and fish known as Citrus Red No. 2, can cause contact dermatitis.¹⁸ Tartrazine and Sunset Yellow dyes may cause contact urticaria.¹⁸ Benzoic acid and sorbic acid which are used as preservatives produce non-immunological contact urticaria.¹³

Contact urticaria has been reported to milk as well as cheeses. The major allergen is thought to be casein.²⁸ Contact urticaria to parmesan cheese has recently been reported.²⁹ Italian cheesemakers wrap their cheese in rags. These have been found to support growth of the *Rhizoglyphus* mite, which is a known sensitiser.²⁸

Non-food exposures include latex gloves and nickel in cooking utensils.

Butchers, poultry processors and seafood workers

In poultry processing, most dermatitis is irritant, as a result of the frequent wet work. Contact urticaria results from direct animal protein contact (blood, skin, meat and viscera) on already damaged skin.³⁰ Butchers have similar contact. Urticaria has been reported after exposure to beef, lamb and calf liver.¹³ Seafood processing workers have a particularly high prevalence of occupational allergy. A recent study³¹ found a prevalence of protein contact dermatitis (diagnosed by a history of recurrent skin problems and a positive skin-prick test) of between 1% and 2%. This is thought to be due to high-molecular-weight proteins generating an IgE response.

DIAGNOSIS AND MANAGEMENT

Early diagnosis is key, as prolonged exposure is more likely to lead to intractable dermatitis which persists after removal from exposure.³² Prognosis worsens with chronicity, treatment delay, underlying atopic dermatitis and poor understanding of the condition by the worker.³²

Avoidance of exposure is the mainstay of treatment. Before this can be done, the allergen needs to be identified. Because of the numerous exposures listed, this may be difficult, and relies heavily on an extensive, detailed and informed history. Patch testing with commonly implicated allergens or agents specific for the individual job or task may be helpful. These commercially available allergens may identify a cause in up to 80% of cases.³³ For contact urticaria and protein contact dermatitis, a scratch test may be necessary if the patch test is negative.

A workplace visit is mandatory as patients may not recall or even be aware of all of their exposures when questioned in the office. Material Safety Data sheets from the workplace provide some information, but by law do not need to declare substances which make up less than 1% of the product. Therefore, an allergen

may be present in a product but not declared. A patch test with the products identified from the workplace visit may be required. Patch testing needs to be performed by an expert with full knowledge of the risks, particularly when testing non-standard agents which may be dangerous. Interpretation of the results of these patch tests requires expertise as they may illicit false-positive or irritant reactions if not tested appropriately.

Patients need to be informed of their allergy and likely sources of the allergen. They should be encouraged to read product constituents and, if possible, informed about use of alternative products and where the allergen may be encountered outside of the work place.

Previously, occupational contact dermatitis was thought to have a very poor prognosis, but a recent review³² has shown that 78-84% of people recover without significant impairment. However, people sensitised to common ubiquitous allergens, especially, may suffer significant disability and recurrent disease as they will struggle to avoid exposure from these widely occurring substances. A change of occupation is not usually necessary and does not influence prognosis in most cases. A 'holiday from work' or temporary job change should be considered for very severe allergy in cases where the allergen cannot be avoided in the workplace, and for people with a skin barrier defect who would frequently be exposed to irritants.³²

Treatment of allergic contact dermatitis after allergen avoidance is as for other types of dermatitis. Saary *et al.*³⁴ found good quality studies showing benefit of treatment with potent and moderately potent topical steroids. Unfortunately, there is limited information about prevention of allergic contact dermatitis in the workplace.³⁴

Case study evaluation

In the case of the farmer, no definitive diagnosis for his dermatitis has been made. As noted above, the number of exposures is vast. He is in contact with cow dander, pesticides, fungicides, cleaning agents, medications, animal feed and rubber. He lives in a newly built house with exposure to paint, new carpets and cleaning products. The history of recurrence of his symptoms on the airplane suggests a link to cleaning products, an insecticide sprayed prior to departure or even products in the upholstery or paint.

The previous positive reaction to Quaternium 15 needs to be revalidated relevant to his current dermatitis and exposures. Quaternium 15 is a formaldehyde-releasing preservative used in cosmetics, moisturisers and shampoos, as well as in disinfectants and other industrial agents such as adhesives, polishes and paints. The farmer is exposed to disinfectants used to clean the milk tanks, as well as disinfectants used on the cows' udders. We will need to perform a patch test with commonly available allergens to assess whether it is positive again, as well as a patch test with specific allergens found on the farm, and then decide which results are relevant to his presentation. A prick test with cow dander is necessary. If positive, a change of occupation or work holiday will be required, as cow dander is ubiquitous on the farm. If he is allergic to other products, such as disinfectants, medications or food additives, a change of those products will end his exposure and lead to improvement in his dermatitis.

Conclusion

Occupational contact dermatitis is a common occupational illness, and is particularly prevalent in agriculture and the food-processing industries. Allergic contact

dermatitis may be more common than we anticipate, so it is useful to perform patch tests on patients with suspected contact dermatitis to rule out potential allergens even if the dermatitis is thought to be mostly irritant. Although there are many unusual allergens, patch testing with commercially available allergens may reveal allergens such as nickel, rubber and some spices.

All health practitioners should bear this in mind when assessing dermatitis, and should remember the possible work-related causes of the condition, especially in cases which appear to be refractory to treatment or when there is a clear history of symptoms worsening with work and clearing on vacation, as with our patient. Allergen avoidance and early treatment should lead to a good outcome in most cases and allow the individual to continue in his or her chosen occupation.

Declaration of conflict of interest

The author declares no conflict of interest.

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