

Type I allergy in mushroom soup processors

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Summary

Eight workers employed in a food manufacturing factory presented with symptoms of rhinorrhoea, dyspnoea and wheezing, originating during the preparation of dried mushroom soup. Five had positive immediate skin tests to dried mushroom extract and in four the FEV₁ fell by over 30% following a bronchial challenge with mushroom dust. The features detected were those of a type I allergic response, without evidence of the extrinsic allergic alveolitis described in 'mushroom worker's lung'.

Introduction

Mushrooms were first described as a cause of allergic respiratory disease when Bringhurst, Byrne & Gershon-Cohen (1959) reported the occurrence of a form of extrinsic allergic alveolitis (EAA) in a group of workers engaged in growing mushrooms in Pennsylvania. A confirmatory report from Sakula (1967) has observed similar features in British agricultural workers and the term 'mushroom worker's lung' (MWL) has been coined to describe the condition a type III allergy with precipitating antibodies. Mushrooms are also cultivated extensively in Japan and studies from there by Kondo (1969) and Shichijo *et al.* (1969) describe features of bronchial asthma developing in two subjects growing mushrooms in plastic greenhouses. These cases were not associated with EAA and the authors named the condition 'mushroom spore asthma' to differentiate it from MWL. The present study describes the development of respiratory illness in a group of factory workers who had occupational contact with dried mushroom dust during the preparation of mushroom soup.

Industrial background

A large food processing plant in the West of Scotland employing 400 staff has a section devoted to the preparation of a range of dried packeted soups. Different varieties of

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mushrooms (*Boletus edulis*, *Psalliota hortensis* and Champignon de Paris) were used in the preparation of mushroom soup. The dried constituents are drawn by suction to separate storage bins on the top floor. From these bins quantities are released for each batch recipe, then mixed, emulsified, blended and finally packeted in a form ready for marketing. The process is mainly enclosed and the operators were most exposed to dried soup dust in the packaging area. Dust contamination of the atmosphere was maximal in this area when the machinery was cleaned with a compressed air line between each recipe batch. An employee working in this department presented to the factory medical officer with respiratory symptoms and subsequent investigations were made.

Clinical details

Case 1

A 49-year-old female supervisor in the packaging area complained of attacks of rhinorrhoea, conjunctival irritation and chest tightness with wheezing and associated breathlessness. These symptoms were episodic and of gradual onset, but had increased in severity in the year prior to her presentation. She had noticed that these features were restricted to working days with the onset occurring within 4 hr of starting a shift. They were of sufficient severity at times to require her to absent herself from work, but the attacks generally settled within 6 hr of onset and no associated fever or malaise was noted. There was no daily or seasonal specificity. A review of the factory records was made for her 'symptomatic' days and of all the varieties of soup being prepared mushroom was the only recipe common to these days.

Physical examination while asymptomatic revealed no clinical abnormality and the results of full blood count, eosinophil count (172 cells/mm^3), total IgE (131 iu/ml) and chest radiograph were all normal. Precipitin studies to *Aspergillus fumigatus*, farmer's lung antigen, mushroom spores, mushroom compost and mushroom mycelia were all negative.

Skin testing. Skin prick tests were carried out using extracts prepared with Coca's solution from each of the vegetable materials used in the soup recipes. Bencard's standard reagents were used to test for the common allergens: house dust, house dust mite, dog, cat, feathers, *A. fumigatus* and *Candida albicans*. The tests for common allergens were all negative and the vegetable extracts gave the following reactions: tomato—weak positive (erythema $< 3 \text{ mm diam.}$); asparagus—weak positive (erythema $< 3 \text{ mm diam.}$); mushroom—strong positive (weal $> 5 \text{ mm diam.}$ with erythema). No delayed skin reactions were noted.

Pulmonary function assessment. The vital capacity (VC) and forced expiratory volume in one second (FEV_1) were measured on a Garthur Portable Vitalograph Spirometer. The total lung capacity (TLC) was measured by the helium dilution method in a closed circuit using a Pulmotest. The resting gas transfer (D_LCO) was measured by the steady state method using carbon monoxide and an end tidal sampler. The following results were obtained, consistent with a moderate degree of airways obstruction; predicted values are in parentheses: FEV_1 (litres)—1.63 (2.2); VC—3.22 (3.05); TLC—5.58 (4.62); D_LCO (ml/CO/min/mmHg)—12.3 (14.3).

Inhalation challenge. Using samples of dried mushroom (*P. hortensis*) taken from the soup recipe an inhalation challenge test was performed in the respiratory laboratory. With the patient sitting, the material was agitated by tipping from one container

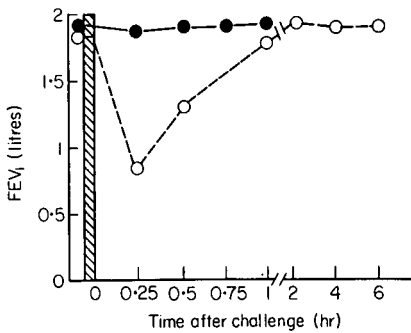


Fig. 1. Typical responses to inhalation of mushroom and tomato dust from the soup making process. $\bullet$, Challenge; $\bullet$ — $\bullet$, dried tomato dust; $\circ$ — $\circ$, dried mushroom dust.

to another for 1 min within the subject's breathing zone and within 10 min a fall in FEV₁ was observed (Fig. 1) from 1.8 to 0.7 l. The symptoms during the challenge were similar to those encountered in the working situation and were reversed by a salbutamol inhalation (200 μ g). Serial measurements up to 6 hr failed to show evidence of a delayed respiratory response up to that time and no symptomatic response was observed during the ensuing 24 hr. Further tests were made using tomato and asparagus dust but no significant change in respiratory performance was noted. An additional mushroom challenge test preceded by the inhalation of two capsules of disodium cromoglycate showed no significant change in FEV₁.

Cases 2–8

A further seven employees were subsequently found to have similar symptomatology related to mushroom dust exposure within the factory and all agreed to have further tests performed. The results of these studies are summarized in Table 1. Following the challenge tests, two cases (5 and 6) developed severe rhinorrhoea and eye irritation without change in the dynamic ventilatory measurements. Three developed an imme-

Table 1. Summary of features in eight employees complaining of respiratory symptoms on exposure to mushroom dust. 'Atopic' signifies a positive skin prick test to two or more common allergens (weal greater than 2 mm)

	Case No. and Sex							
	1 (F)	2 (F)	3 (M)	4 (M)	5 (F)	6 (M)	7 (F)	8 (F)
Years of exposure	10	9	9	16	8	5	5	3
'Atopic'	No	No	Yes	Yes	No	No	No	No
Mushroom skin tests	+++	+	—	++	—	—	+++	+
Mushroom challenge test	Fall in FEV ₁ > 30%	Fall in FEV ₁ > 30%	Fall in FEV ₁ > 30%	Fall in FEV ₁ > 30%	No change in lung function; developed copious rhinorrhoea	No change in lung function; developed rhinorrhoea	No response	No response

diate fall in FEV₁ greater than 30% of the pre-test level. Pre-test levels were regained within 3 hr and no evidence of pyrexia or late effects on ventilatory function or diffusing capacity were noted in the ensuing 6 hr. Chest radiographs were normal and precipitin studies for mushroom compost, mycelia and spores were negative. Where other materials such as onion or asparagus were suspected, the bronchial challenge tests were repeated, but no significant changes were observed in the recordings.

Discussion

In this group clinical features of asthma or rhinitis with conjunctivitis developed on days when mushroom soup was being prepared. The tests undertaken did not show any features of extrinsic allergic alveolitis but suggest from the clinical history, immediate skin prick tests, immediate response to inhalation challenge and therapeutic response to Intal that a type I hypersensitivity reaction had taken place after exposure to mushroom dust. These cases therefore differ from the original reports of 'mushroom worker's lung' (Bringhurst *et al.*, 1959; Sakula, 1967) which suggest that the resulting alveolitis is caused by the presence of thermophilic fungi found in great numbers during the mushroom spawning process. No reports of associated asthmatic features have been described in that situation but the Japanese studies (Kondo, 1969; Shichijo *et al.*, 1969) have described 'mushroom spore asthma' in several mushroom growers and emphasize the differences from MWL. It is not clear from these studies, however, if other thermophilic fungi were excluded but it is likely that the mushroom spores were responsible.

In this study the dried mushroom materials were examined for bacteria and fungi and only very scanty quantities of *Micropolyspori faeni* were obtained after culture at 28°C. This suggests that the mushroom itself is acting as the primary allergenic material and not other organic contaminants as in MWL. The size of the dust particles may be of importance in this situation. Less than 0.3% of the mushroom dust to which the workers were exposed was in the size range of < 10 µm. For this reason the lack of alveolar reaction may be explained.

At the time of the study the variety *P. hortensis* was the main variety which had been used for at least 3 years. Some of the employees, however, maintained that their symptoms had been more troublesome in the years prior to the introduction of this variety at a time when *B. edulis* was being used. There may therefore be variations in the allergenicity of different species of mushroom but investigation of this aspect requires further study.

The occurrence of these respiratory symptoms in the food industry is a further reminder that workers can be exposed to a variety of biological materials which are potentially allergenic. In this factory, improved industrial hygiene practice has reduced exposure considerably but in some instances sensitized individuals had to be relocated elsewhere in the complex away from dust. Increased awareness of the potential hazards to those working with organic dusts is essential to prevent recurrence of similar problems in the future.

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