

Sensitivity to proteolytic enzymes in laundry detergents

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One hundred two employees of a soap-manufacturing plant were skin tested to alcalase, an enzyme added to laundry detergents. Ninety-three people were exposed to the enzyme material in their work. Fourteen of these stated they had allergic symptoms on exposure to the powder. Seventy-nine reported no symptoms. Thirty-four had strongly positive reactions, including 18 of those who complained of symptoms from exposure. Eleven had equivocal reactions, and 57 did not react, including one of those who complained of symptoms on exposure. Nine administrative or new personnel stated they had no symptoms, and all had negative skin tests. Thirty-five consecutive allergic housewives who had never worked in the manufacture of laundry detergent powder were also tested. None of these complained of symptoms specifically from enzyme detergents. Four had strongly positive skin tests (including one who stated she had asthma and rhinitis from all soap powders), and two had equivocal reactions. Twenty-nine had negative reactions. Although strict safety measures have been instituted in plants manufacturing enzyme-containing laundry detergents and the exposure of employees has been greatly reduced, it is nevertheless important for physicians to be aware of this problem in patients employed in this industry.

Since the addition of enzymes to household laundry powder in 1967, there has been an increasing interest in the possibility of allergic reactions occurring in consumers. More important, however, has been the concern over reported cases of asthma and bronchitis in workers who are exposed to the enzyme in the manufacture of these washing products.

Flindt¹ reported a series of cases of asthma and chest illness in workers exposed to proteolytic enzymes derived from *Bacillus subtilis*. Skin tests were made on 28 exposed workers. "Results of these tests showed a high proportion of positive immediate responses in those with a history of symptoms which could have been attributable to inhalation of enzymatic material." He concluded that these enzymatic preparations, alcalase and Maxatase, had caused sensitization and allergic chest illness.

Pepys and associates² studied the allergic sensitivity produced by the inhalation of high concentrations of enzyme preparations from *B. subtilis* in 3 workers with bronchial disease. They gave strong immediate skin test reactions and asthmatic reactions to inhalation tests. They had no other history of allergy and gave no reactions to skin tests with common allergens.

Griffith and associates discussed the safety of enzyme detergents with

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TABLE I

No. of patients	Exposed to enzyme at work	Symptoms from exposure	Intradermal skin test reactions		
			Pos.	Equiv.	Neg.
14	Yes	Yes	13	0	1
45	Yes	No	14	8	23
9	Minimal*	No	0	0	9
35	No	No	4	2	29
34	Yes	No	7	3	24

*Administrative or new personnel.

regard to skin manifestations. He found them to be equivalent to comparable nonenzyme formulations except for primary irritancy of skin under severe conditions of exposure, such as in patch testing.

PROCEDURE

One hundred two employees of a plant where enzymes are used in the production of various detergent washing powders were skin tested for sensitivity to the enzyme. Thirty-five consecutive allergic patients, housewives who had never been employed in a soap-manufacturing plant, were also skin tested. The majority of these stated they used enzyme detergents. The test material was crystalline, sterile, pyrogen-free alcalase powder derived from *Bacillus subtilis*. Thirty-three employees were given scratch tests using 0.5 mg. per milliliter and 0.05 mg. per milliliter of alcalase. Sixty-eight of the employees and all of the 35 allergic housewives were tested intradermally using 0.02 ml. of a 0.5 mg. per milliliter solution of the enzyme. Buffered saline was used as a control solution.

Skin tests were rated on a scale of 0 to 4+. A wheal of 4 to 5 mm. with pseudopod formation was considered a 4+ reaction. Because of the concentrations employed, only 3+ (3 to 4 mm. without pseudopod formation) and larger reactions were classified as positive.

RESULTS

Intradermal tests

As shown in Table I, 14 employees complained of symptoms after exposure to detergent powder containing the enzyme. These symptoms were: asthma in 10 patients, rhinitis in 3, and skin eruption in 1. Some of these had worked for several years in atmospheres contaminated with dust from nonenzyme formulations without apparent ill effects. Thirteen showed strongly positive reactions to skin tests. One did not react, even when tested intradermally with a solution of 5 mg. per milliliter. Only one of this group gave a past history of allergy.

An equal number of employees (14) who did not complain of symptoms also had positive reactions when tested with the same material. The significance of these reactions is not known. However, reactions not associated with clinical symptoms are often seen in allergy.

Eight employees who did not complain of symptoms had equivocal reactions which could have been either a primary irritant effect or a true allergic response. Thirty-two of the employees reported no symptoms and had no skin test reactions. Three of these had a past history of allergy. Two of these people were skin tested and found to react to common allergens such as pollen and house

dust. This group of 32 included 9 who were either administrative personnel or new employees who had only worked in the plant for a few weeks.

Of the 35 allergic housewives who had never worked in a soap factory, 4 had strongly positive skin test reactions and 2 had equivocal reactions to the enzyme. All of these used the enzyme detergents. One of the 4 who reacted stated she got asthma and rhinitis when using any laundry detergent. All 35 of these patients had positive skin test reactions to various other common allergens, such as pollen, house dust, and danders.

Scratch tests

In this group of 34 employees, none reported symptoms of asthma or bronchitis from exposure to enzyme. Twenty-three people had no reaction to the alcalase solution, 3 had equivocal reactions, and 7 had positive reactions. One employee, who works with the enzyme through the glove box, showed strongly positive reactions at both concentrations. However, he had never had any symptomatic complaints. Another employee had a history of allergic rhinitis. She did not react to the alcalase but did have positive reactions when tested with pollen antigens.

Five of the 102 employees had a history of allergy. Only one of these showed a positive reaction to enzyme. He also complained of persistent cough following exposure to enzyme detergents. The other 4 did not react to alcalase and had no symptoms from exposure to the enzyme detergent powder.

DISCUSSION

Flindt speculates that "inhalation of the material may lead to irreversible impairment of lung function, and that insidious lung damage could occur without episodes of overt illness. He states that "the absence of symptoms in sensitized individuals is unlikely to preclude the possibility that insidious development of pulmonary damage has occurred or will occur if exposure continues." Rigorous preventative measures are therefore recommended.

To the credit of the industry, safety measures have greatly decreased the exposure to raw enzyme dust since Flindt's¹ report. The hazard to employees has been reduced, and their awareness of the problem has been heightened.

Elaborate safety measures were in effect at this plant during the time of these studies. In addition to ventilation and dust control measures, the enzyme powder itself is handled in a completely closed system by employees who work from the outside through a glove box. They are required to wear special protective clothing and masks, and they exit through a decontamination shower.

The enzyme is encapsulated with a water-soluble film and processed into units too large to become air-borne before the material is permitted to be conveyed out into the open. This is also a protection to the consumer. Safety is an ongoing activity and concern, and improvements are constantly sought. Most cases of sensitization undoubtedly occurred before the problem was recognized. Although the exposure of employees to the enzyme dust has now been greatly reduced by advanced health and safety measures adopted by the industry,

physicians nevertheless should be aware of the potential problem in patients employed in this type of work. It remains to be seen, following more extensive use, if the enzyme encapsulated with its protective film sensitizes consumers any more than the ordinary detergents containing no enzymes.

REFERENCES

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