

Respiratory function and immunologic status in workers processing dried fruits and teas

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Background: Workers exposed to different organic aerosols may develop respiratory symptoms and lung function changes.

Objectives: To study the immunologic status and respiratory function in workers processing dried fruits and teas.

Methods: The study was performed in 54 exposed and in 40 non-exposed female workers. Skin prick testing was performed with occupational allergens derived from the workplace. Respiratory symptoms were recorded for all workers. Lung function was measured in exposed workers by recording maximum expiratory flow-volume (MEFV) curves.

Results: Significantly more exposed workers than controls reacted with positive skin tests to at least one of the occupational allergens ($P < .01$). Only the response to sage was significantly greater in exposed (60.0%) than in control workers (20.0%) ($P < .01$). Thirty percent of these workers had elevated IgE level (compared with 2.5% of control workers) ($P < .01$). Higher prevalences of all chronic respiratory symptoms were noted in exposed compared with control workers. The exposed workers with positive skin tests had significantly higher prevalences of dyspnea ($P < .05$) and nasal catarrh ($P < .01$) than those with negative skin tests. A large number of exposed workers complained of acute symptoms that developed during the work shift. In exposed workers there were statistically significant across-shift reductions of ventilatory capacity, particularly for FEF₅₀ and FEF₂₅ on Monday and the following Thursday. Skin test status was not associated with more severe changes in lung function. The mean FEF₂₅ measured before the Monday shift was significantly lower than predicted ($P < .01$).

Conclusion: Our data suggest that following exposures to aerosols of dried fruits and teas some workers develop deleterious immunologic and respiratory changes.

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INTRODUCTION

There is a growing interest in the adverse health reactions to food products and the workers who process them.

Dried fruits and teas are used in the preparation of flavored beverages. Only a few sporadic reports, however, have examined the effect of these products. Food may induce respiratory symptoms by both reagenic and nonreagenic mechanisms.¹ Food allergies may coexist with other inhalant allergies or may enhance nonspecific sensitivity to nonallergens such as pollutants, cigarette smoke, and food additives. Conversely, the presence of multiple irritants in the workplace may modulate or modify bronchial reactivity and thus favor food allergen action. Sensitivity to melons and bananas was described by Anderson et al,² Walker,³ and by Makinen-Kijunen.⁴ Hypersensitivity to fruits such as apples,

peaches, cherries, pears, plums, or apricots has been reported more often by patients with birch pollen allergy.⁵ Zhu et al⁶ described an allergy to oranges and reported that the major allergenic components to orange reside in the orange seeds. Amat et al⁷ demonstrated hypersensitivity to dried fruits and showed a correlation with pollen allergy; among these dried fruits, almonds were the most sensitizing (89%) followed by peaches (47%). Our previous studies of tea workers demonstrate that exposure to different tea dusts may cause the development of chronic respiratory and immunologic changes.^{8,9}

There are no studies of the respiratory effects of working conditions in the processing of dried fruits and teas in the preparation of beverages. In the present study we investigated a group of workers occupationally exposed to the dust of dried fruits and teas employed in one industry in Croatia preparing powder for fruit and tea beverages.

SUBJECTS AND METHODS

Subjects

The study included a group of 54 female workers employed in the processing of dried fruits and teas into a fine powder used for making nonalcoholic beverages. This group comprised 95% of all employed workers in this plant. The mean age of the workers was 34 years (range 19 to 51 years), the mean height 161 cm (range 155 to 170 cm) and the mean duration of employment in this industry 7 years (range 1 to 18 years). Ten percent of the studied workers were light smokers smoking on the average ten cigarettes daily.

Workers were employed in one large open working area with exposure

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Table 1. Prevalence of Chronic Respiratory Symptoms in 54 Exposed and 40 Control Workers*

Group	Mean Age, yrs	Mean Exposure, yrs	Chronic Cough	Chronic Phlegm	Chronic Bronchitis	Occupational Asthma	Dyspnea	Nasal Catarrh	Sinusitis	Chest Tightness
Exposed N = 54	30±7	7±5	9 16.7%	7 12.9%	7 12.9%	0 0%	18 33.3%	22 40.7%	8 14.8%	9 16.7%
Control N = 40	30±6	7±6	NS† 2 5.0%	NS 1 2.5%	NS 1 2.5%	NS 0 0%	<.01 1 2.5%	<.01 1 2.5%	NS 0 0%	NS 0 0%

* Age and exposure are presented as mean ± SD.

† NS = difference statistically not significant ($P > .05$).

to dust of different dried fruits (pineapple, orange, lemon, apple, peach) and teas (sage, dog rose, chamomille). Dried fruits and teas were first sorted and cleaned and separated from their leaves and stems on a moving open conveyor. After that process each sorted preparation was placed separately into the open grinding machine in order to produce a fine powder which was then stored in big containers.

In addition, a group of 40 non-exposed workers employed as transport workers were studied. These individuals were selected from a large group of unexposed workers previously studied and matched to the exposed workers.

As can be appreciated from Table 1, both groups of studied workers had similar demographic characteristics. In particular, there was no difference in their mean ages or duration of employment. All transport workers were women as were the exposed workers. Both groups had few smokers, six (11%) for the exposed group and four (10%) for the control group. The smokers in both groups smoked an average of ten cigarettes per day.

Respiratory Symptoms

Respiratory symptoms were documented in the exposed and in the control workers by using a modification of the Medical Research Council questionnaire on chronic bronchitis¹⁰ and occupational asthma.^{11,12} In all workers detailed occupational and smoking histories were recorded. Specific symptoms were determined as follow:

Chronic cough or phlegm: cough and/or phlegm production for at least 3 months per year;

Chronic bronchitis: cough and phlegm for a minimum of 3 months a year and for not less than 2 successive years;

Dyspnea: grade 3—shortness of breath when walking with other people at an ordinary pace on level ground; grade 4—shortness of breath when walking at their own pace on level ground;

Occupational asthma: recurring attacks of dyspnea, chest tightness, wheezing and pulmonary function impairment of the obstructive type diagnosed by physical examination and spirometric measurements during exposure to dust at or following work (decrease of $FEV_1 > 15\%$), confirmed by the medical records.

The prevalence of acute symptoms during the work shift was also recorded for all workers. Such symptoms included cough, dyspnea, irritation or dryness of the throat, secretion, dryness or bleeding of the nose, eye irritation and headache.

Ventilatory Capacity

Ventilatory capacity was measured in 54 exposed workers by recording maximum expiratory flow-volume (MEFV) curves on a Pneumoscreen spirometer (Jaeger, Wurzburg, Germany). Work shift changes in ventilatory capacity were measured in the 54 workers on Monday and among 44 of these 54 workers also on the following Thursday before (6 AM) and after (2 PM) the work shift. The forced vital capacity (FVC), the 1-second forced expiratory volume (FEV_1) and flow rates at 50% and the last 25% of the vital capacity (FEF_{50} , FEF_{25}) were read from the MEFV curves. In five work-

ers with acute and chronic respiratory symptoms and with positive skin tests to occupational allergens we measured the residual volume (RV) by the closed-circuit helium dilution technique, using the "Pulmonet" spirometer (Godart, Holand) and the single-breath pulmonary diffusing capacity (DLCO) on the "Resparametar" spirometer (P K Morgan, Ltd, Chatham, Kent, England). Residual volume and DLCO were measured only once during the work shift. Lung function testing was performed according to the recommendations of Quanjer et al.¹³ Monday preshift values of ventilatory capacity tests were compared with the predicted values of Quanjer et al.¹⁴ Measured RV values were compared with the predicted of Commission des Communautes Europeenes¹⁵ and measured DLCO with predicted values of Cotes.¹⁶

Immunologic Study

Skin prick tests were performed in 50 of 54 exposed workers who consented to testing and in 40 control workers with aqueous extracts of dried fruit powder (pineapple, lemon, orange, peach, and apple) and teas (sage, chamomille, and dog rose). Extracts (1:20 wt/vol) were prepared using a standard immunologic technique employing the material collected in the workroom where the workers were examined.¹⁷ Skin prick testing was performed according to the recommendations of Dreborg et al.¹⁸ using a lancet with a 1-mm tip. In addition, workers were skin tested with histamine base (1 mg/mL) and buffer as control solutions. Skin reactions were read after 20 minutes. A test was considered positive if

the diameter of the observed wheal was 3 mm greater than that of the (buffer) control solution.

The serum level of total IgE immunoglobulin was determined by a reference laboratory, PRIST Pharmacia Diagnostics AB (Uppsala, Sweden), using the direct radioimmunologic "sandwich" technique. Levels of IgE below 125 IU/mL were considered normal.

Environmental Dust Measurements

The airborne dust in the workplace was sampled during the 8-hour work shift at the sites where the workers were examined. Casella samplers with Millipore field monitors and Millipore AA membrane filters were used to estimate total dust exposures. In addition, two stage samplers consisting of a filter preceded by a horizontal elutriator were used to determine the respirable fraction. A total of 12 dust samples were collected.

RESULTS

Immunologic Study

The prevalences of positive skin tests to occupational allergens in exposed and in control workers are presented in Figure 1. All subjects reacted to histamine and none to buffer or bacteria. Among exposed workers 39/50 (78.0%) reacted to at least one of the occupational allergens. The highest prevalence was obtained for sage (30/50; 60.0%), followed by dog rose (10/50; 20.0%), peaches (9/50; 18.0%), orange (7/50; 14.0%), lemon (5/50;

10.0%), pineapple (3/50; 6.0%), chamomille, and apple (2/50; 4.0%). Significantly ($P < .01$) fewer control workers 14/40 (35.0%) reacted to one or more of the occupational allergens. The highest prevalence of positive skin tests in control workers was found for sage (8/40; 20.0%), followed by dog rose (2/40; 5.0%), orange (2/40; 5.0%), lemon (1/40; 2.5%), and pineapple (1/40; 2.5%). The difference in the prevalence of positive skin tests between exposed and control workers was statistically significant only for sage ($P < .01$).

Increased levels of total IgE in exposed workers were found in 15/50 (30.0%) and in 1/40 (2.5%) of control workers ($P < .01$). Only workers with positive skin reactions had increased IgE.

Respiratory Symptoms

The prevalences of chronic respiratory symptoms in the 54 exposed and in the 40 control workers are presented in Table 1. There was a higher prevalence of all symptoms in the exposed than in the control group although the differences were statistically significant only for dyspnea and nasal catarrh ($P < .01$). No case of occupational asthma was recorded in this group of exposed workers.

Table 2 demonstrates that exposed workers with positive skin reactions to occupational allergens had higher prevalences of all chronic respiratory symptoms than workers with negative

skin tests; the differences were statistically significant for dyspnea (positive skin test: 15/39, 38.5%; negative skin test: 2/11, 18.2%; $P < .05$) and nasal catarrh (positive skin test: 20/39, 51.3%; negative skin test: 2/11, 18.2%; $P < .01$). Among control workers there was no difference in the prevalence of chronic respiratory symptoms between workers with positive and negative skin tests.

In exposed workers there was a high prevalence of acute symptoms during the work shift. The highest was headache (38.9%), followed by cough and dyspnea (33.3%), dryness of the throat (29.6%), irritation of the throat (25.9%), dryness and bleeding of the nose (25.9%), and nasal secretion (12.9%). The prevalence of acute symptoms was similar in workers with positive and negative skin tests to occupational extracts.

Ventilatory Capacity

Table 3 presents the mean measured ventilatory capacity data in 54 exposed workers on Monday and their mean predicted values. Statistically significant across shift reductions were recorded for all tests being largest for FEF₂₅ (-14.2%). Measured preshift Monday FEF₂₅ values were significantly lower than predicted values ($P < .01$). There were no significant differences in across shift reductions by skin test reactivity (positive skin tests: FVC 2.6%, FEV₁ 4.5%, FEF₅₀ 6.6%, FEF₂₅ 14.9%; negative skin tests: FVC 2.2%, FEV₁ 3.7%, FEF₅₀ 5.7%, FEF₂₅ 13.6%). Similarly, there was no significant difference in baseline (pre-shift) lung function by skin test reactivity (positive skin tests: FVC 94.9%, FEV₁ 86.1%, FEF₅₀ 96.5%, FEF₂₅ 79.2%; negative skin tests: FVC 98.1%, FEV₁ 91.9%, FEF₅₀ 98.1%, FEF₂₅ 83.7%).

The mean measured ventilatory capacity data on Monday and the following Thursday in 44 workers are presented in Table 4. The remaining ten workers were unavailable for repeated testing. Statistically significant across-shift reductions were recorded on Monday and Thursday with no differ-

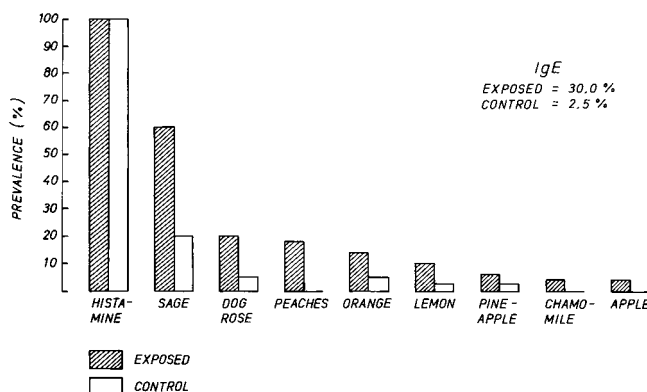


Figure 1. The figure illustrates the prevalence of positive skin prick tests to different occupational dust extracts in 50 exposed and 40 control workers.

Table 2. Prevalence of Chronic Respiratory Symptoms in Exposed and Control Workers by Skin Prick Tests

Group	Skin Test	Chronic Cough	Chronic Phlegm	Chronic Bronchitis	Occupational Asthma	Dyspnea Grade 3 & 4	Nasal Catarrh	Sinusitis	Chest Tightness
Exposed N = 50	Positive	7	6	6	0	15	20	7	7
	N = 39	17.9%	15.4%	15.4%	0%	38.5%	51.3%	17.9%	17.9%
		NS*	NS	NS	NS	<0.05	<0.01	NS	NS
Control N = 40	Negative	2	1	1	0	2	2	1	2
	N = 11	18.2%	9.1%	9.1%	0%	18.2%	18.2%	9.1%	18.2%
	Positive	1	1	1	0	1	1	0	0
	N = 14	7.1%	7.1%	7.1%	0%	7.1%	7.1%	0%	0%
		NS	NS	NS	NS	NS	NS	NS	NS
	Negative	1	0	0	0	0	0	0	0
	N = 26	3.8%	0%	0%	0%	0%	0%	0%	0%

* NS = difference not statistically significant ($P > .05$).

Table 3. Ventilatory Capacity in 54 Exposed Workers*

Day	FVC				FEV ₁				FEF ₅₀				FEF ₂₅			
	Before Shift L	Difference Before-After Shift		Before Shift L	Difference Before-After Shift		Before Shift L/s	Difference Before-After Shift		Before Shift L/s	Difference Before-After Shift		Before Shift L/s	Difference Before-After Shift		
		%	P		%	P		%	P		%	P				
Monday	3.78 ± 0.65	−2.4	<.05	3.01 ± 0.66	−4.0	<.01	4.74 ± 1.21	−5.1	<.01	2.25 ± 0.86	−14.2	<.01				
	NS†			NS			NS			<.01						
	3.18x‡ ± 0.31			3.07x ± 0.27			4.81x ± 0.26			2.72x ± 0.29						

* Data are presented as mean ± SD.

† NS = difference statistically not significant ($P > .05$).

‡ x = predicted values.

Table 4. Ventilatory Capacity in 44 Exposed Workers on Monday and the Following Thursday*

Mean Age, yrs	Mean Exposure, yrs	Day	FVC			FEV ₁			FEF ₅₀			FEF ₂₅		
			Before Shift L	Difference Before-After Shift		Before Shift L	Difference Before-After Shift		Before Shift L/s	Difference Before-After Shift		Before Shift L/s	Difference Before-After Shift	
				%	P		%	P		%	P		%	P
35 ± 8	8 ± 4	Monday	3.52 ± 0.55	−2.3	<.05	2.92 ± 0.65	−4.5	<.05	4.52 ± 1.69	−10.8	<.01	2.10 ± 0.92	−23.8	<.01
			NS†			NS			NS			NS		
		Thursday	3.48 ± 0.53	−2.5	<.05	2.87 ± 0.65	−4.6	<.05	4.37 ± 1.65	−7.4	<.01	2.00 ± 0.91	−22.1	<.01

* Data are presented as mean ± SD.

† NS = difference statistically not significant ($P > .05$).

ences noted between the two days. The preshift values on Thursday were somewhat lower than on Monday, although the differences were not statistically significant (NS).

Table 5 presents individual data on lung function in the five workers with chronic cough, chronic phlegm, chronic bronchitis and dyspnea, and with positive skin tests to several occupational allergens. In these workers

the values for the FVC were within the normal range but the FEV₁, FEF₅₀, and particularly the FEF₂₅ were decreased. Residual volume was increased but DLCO was within normal limits.

Among the 54 tested workers, values below 80% of predicted were found in four (7.4%) for FVC and FEV₁, in nine (16.7%) for FEF₅₀ and in 18 (33.3%) for FEF₂₅. The duration of

their exposure varied from 10 to 14 years.

Environmental Dust Measurements

The mean total dust concentration was 16.8 mg/m³ (range 8.3 to 24.9 mg/m³) with the mean respirable fraction 3.2 mg/m³ (range 1.0 to 6.4 mg/m³). The data suggest that workers employed in this industry are exposed to airborne dust concentrations that are frequently

Table 5. Respiratory Function in Five Workers with Multiple Respiratory Symptoms and with Positive Skin Tests as Percentage of Predicted Values

Subject	Age, yrs	Exposure, yrs	Test (%)					
			FVC	FEV ₁	FEF ₅₀	FEF ₂₅	RV	DLCO
1	40	15	80.6	76.2	30.8	27.3	160.4	99.9
2	37	13	88.0	74.7	44.4	31.6	165.1	100.7
3	45	16	87.6	77.1	69.5	61.2	139.0	93.6
4	38	14	82.4	72.5	67.2	64.3	140.3	87.8
5	39	15	80.1	73.4	69.5	63.2	159.1	88.7

higher than those allowed by the Croatian standards for organic dust (total 10 mg/m³; respirable dust fraction: 3 mg/m³).

DISCUSSION

Our data suggest that exposure to dried fruits and tea dusts causes the development of immunologic changes, acute and chronic respiratory symptoms, and lung function changes. Considerably higher prevalences of all chronic respiratory symptoms were recorded in exposed than in control workers, particularly for dyspnea and nasal catarrh ($P < .01$). Among this group of workers we did not find any cases of occupational asthma. This may be due to relatively short exposure of these workers in the industry (mean exposure 7 years) or to a healthy worker effect with those sensitive workers leaving the industry before severe respiratory symptoms develop. This plant is known for its high worker turnover rate. The prevalence of shift-related and chronic respiratory symptoms in our studied workers is similar to that recorded in workers processing coffee,¹⁹ tea,⁸ spices,²⁰ soybean,²¹ animal food,²² and in confectionery workers.²³

Sporadic reports on the health effect of fruits refer primarily to allergic reactions.² Enberg et al²⁴ described that watermelon-specific IgE appears to mediate oropharyngeal symptoms after watermelon ingestion. Hypersensitivity to apple, apple seeds, and carrot seeds was described by Lahti and Hanuksela.²⁵ These authors suggested that the allergens of these fruits and vegetables might be enzymes. In their study, skin reactions among atopics

were rare, and nonatopic patients showed no reaction to fresh fruits or vegetable extracts. The effects of fruits and teas can probably be compared to the effect of some vegetables.²⁷⁻³¹ These authors reported that aromatic plants should be considered possible causal agents of allergic reactions when investigating hypersensitivity. Similarly, several authors have demonstrated allergic reactions to dust in mushroom soup processors exposed to paprika dust and chilli grindings.³²⁻³⁵

On the basis of the positive skin reactions to fruits and tea allergens documented in our workers, we can only speculate as to the possibility of a relationship between the processed fruit and tea allergens on one hand and specific sensitivity of the respiratory system on the other. The significantly increased serum IgE levels in this large number of exposed workers (30%) compared with the control group (2.5%) do, however, suggest that allergic sensitization of the respiratory system may be responsible for the development of acute and chronic respiratory findings. The percentage of our exposed workers with total IgE above the normal level is similar to the frequency found in our previous studies of coffee workers (24%), tea workers (27%), spice factory workers (37%), and animal food workers (40%).^{9,36-38} Pharmacologic characterization of aqueous extracts of vegetable dusts (different teas and coffee) suggest, however, that the bronchospasm associated with the handling of these vegetable dusts in the workplace may also be mediated in part by non-IgE mechanisms.³⁹

The data on ventilatory capacity in the present study indicate obstructive changes predominantly in smaller airways. Across-shift reductions in our workers were similar to those found in our previous study of workers exposed to coffee, tea, soybean, spices, animal food, and confectionery.^{8,19-23,40} In the present study the across-shift reductions were similar in magnitude for both skin test positive and negative workers. The study of Zuskin et al^{41,42} demonstrated that inhalation of coffee and herbal tea dust extracts may cause acute reductions in lung function. Comparison of the preshift data with the predicted values demonstrated significantly decreased FEF₂₅ indicating that occupational exposure to these types of dusts may lead to the development of chronic lung function changes involving smaller airways. Such changes were found in workers after a relatively short duration of employment such as 3 to 4 years.

Airborne dust concentrations in this workplace were high. These data suggest the importance of reducing the dust level as a measure to prevent the development of respiratory disorders. In addition, we suggest that medical surveillance in these industries is required to detect sensitive individuals and prevent them from working in areas that carry a risk of respiratory allergy and lung function disorders.

REFERENCES

1. Brooks SM. Occupational asthma. In: *Bronchial Asthma* (Weiss EB, Segal MS, Stein M, eds.) 2nd ed., Little, Brown and Co., Boston/Toronto, 1985; 461-493.
2. Anderson LB, Dreyfuss EM, Logan J,

- et al. Melon and banana sensitivity coincident with ragweed pollinosis. *J Allergy* 1970;45:310-319.
3. Walker EC. Food allergy. *Am Fam Physician* 1988;38:207-212.
 4. Makinen-Kijunen S. Banana allergy in patients with immediate-type hypersensitivity to natural rubber latex: characterization of cross-reacting antibodies and allergens. *J Allergy Clin Immunol* 1994;93:990-996.
 5. Eriksson NE. Food sensitivity reported by patients with asthma and hay fever. *Allergy* 1978;33:189-196.
 6. Zhu SL, Ye ST, Yu Y. Allergenicity of orange juice and orange seeds: A clinical study. *Asian Pacific J Allergy Immunol* 1989;7:5-8.
 7. Amat A, Valero A, Sanosa J, et al. Hypersensitivity to dried fruits. XIII International Congress of Allergology and Clinical Immunology, Oct. 16-21, 1988, Montreaux, Switzerland, page 16-21.
 8. Zuskin E, Skuric Z. Respiratory function in tea workers. *Br J Industr Med* 1984;41:88-93.
 9. Zuskin E, Kanceljak B, Skuric Z, Ivankovic D. Immunological and respiratory changes in tea workers. *Int Arch Occup Environ Health* 1985;56:57-65.
 10. Medical Research Council Committee on the Aetiology of Chronic Bronchitis. Standardized questionnaire on respiratory symptoms. *Br Med J* 1960;2:1665.
 11. World Health Organization: Early Detection of Occupational Disease. Geneva, 1986;35-39.
 12. Maestrelli P, Baur X, Bessot JC, et al. Guidelines for the diagnosis of occupational asthma. *Clin Exper Allergy* 1992;22:103-108.
 13. Quanjer PhH, Tammeling GJ, Cotes JE, et al. Lung volumes and forced expiratory flows. Report working party standardisation of lung function tests European Community for Steel and Coal. *Eur Respir J* 1993;6(Suppl 16):5-40.
 14. Quanjer PhH. Standardized lung function testing. Report of the working party "Standardization of lung function tests" of the European Community for Coal and Steel, Luxembourg, *Bull Europ Physiopathol Respir* 1983;19(Suppl 5):I:1-95.
 15. Commission des Communautes Europeenes-CECA (1971). Aide memoire pour la pratique de l'examen de la fonction ventilatoire par la spiropgraphie, Collection D'Hygiene et de Medicine du Travail, No. 11, Luxembourg 1971; pp 107-111.
 16. Cotes JE. Lung Function. Davis Co., Philadelphia, 1975:340-95.
 17. Sheldon JM, Lowel RG, Mathews KP. A Manual of Clinical Allergy. Saunders, Philadelphia-London, 1967; page 507-531.
 18. Dreborg S, Backman A, Basomba A, et al. Skin test used in type I allergy testing. Position paper. EAACI Subcommittee on Skin Tests. *Allergy* 1989;44 (Suppl 10):1-59.
 19. Zuskin E, Valic F, Skuric Z. Respiratory function in coffee workers. *Br J Industr Med* 1979;36:117-122.
 20. Zuskin E, Skuric Z, Kanceljak B, et al. Respiratory findings in spice factory workers. *Arch Environ Health* 1988a;43:335-339.
 21. Zuskin E, Skuric Z, Kanceljak B, et al. Respiratory symptoms and ventilatory capacity in soy bean workers. *Am J Industr Med* 1988;14:157-165.
 22. Zuskin E, Mataija M, Pokrajac D, et al. Respiratory function in animal food processing workers. *Am J Industr Med* 1989;16:179-187.
 23. Zuskin E, Mustajbegovic J, Schachter EN, Kern J. Respiratory symptoms and ventilatory function in confectionery workers. *Occup Environ Health* 1994;51:435-439.
 24. Enberg RN, McCullough J, Ownby DR. Antibody responses in watermelon sensitivity. *J Allergy Clin Immunol* 1988;82:795-800.
 25. Lahti A, Hannuksela M. Hypersensitivity to apple and carrot can be reliably detected with fresh material. *Allergy* 1978;33:143-146.
 26. Kauppinen K, Kousa M, Reunala T. Aromatic plants—A cause of severe attacks of angio-edema and urticaria. *Contact Dermatitis* 1980;6:251-254.
 27. Lybarger JA, Gallagher JS, Pulver DW, et al. Occupational asthma induced by inhalation and ingestion of garlic. *J Allergy Clin Immunol* 1982;69:448-454.
 28. Falleroni AE, Zeiss CR, Levitz D. Occupational asthma secondary to inhalation of garlic dust. *J Allergy Clin Immunol* 1981;68:156-160.
 29. Pauli G, Bessot JC, Braun PA, et al. Celery allergy: clinical and biological study of 20 cases. *Ann Allergy* 1988;60:243-246.
 30. Nava C, Brambilla G, Briatico-Van-gosa G, et al. L'astma professionale negli alimentaristi: studio di tre casi. *Med Lav* 1983;74:302-307.
 31. Wutrich B, Dietschi R. Das "Sellerie-KarottenBeifuss-Gewuerz-Syndrom": Hauttest-und RAST-Ergebnisse. *Schweiz Med Wschr* 1985;115:358-364.
 32. Symington IS, Kerr JW, McLean DA. Type I allergy in mushroom soup processors. *Clin Allergy* 1981;11:43-47.
 33. Tatrai E, Ungvary G. The aetiology of experimental fibrosing alveobronchiolitis induced in rats by paprika dust. *Br J Industr Med* 1992;49:494-498.
 34. Van Toorenbergen AW, Dieges PH. Occupational allergy in horticulture: demonstration of immediate-type allergic reactivity to freesia and paprika plants. *Int Arch Allergy Appl Immunol* 1984;75:44-47.
 35. Uragoda CG. Symptoms among Chilli grinders. *Br J Industr Med* 1967;24:162-164.
 36. Zuskin E, Valic F, Kanceljak B. Immunological and respiratory changes in coffee workers. *Thorax* 1981;36:9-13.
 37. Zuskin E, Kanceljak B, Skuric Z, et al. Immunological and respiratory findings in spice-factory workers. *Environ Res* 1988;47:95-108.
 38. Zuskin E, Kanceljak B, Schachter EN, et al. Immunological and respiratory changes in animal food processing workers. *Am J Industr Med* 1992;21:177-191.
 39. Zuskin E, Duncan PG, Douglas JS. The pharmacological characterization of aqueous extracts of vegetable dusts. *Lung* 1983;161:301-306.
 40. Zuskin E, Kanceljak B, Skuric Z, Butkovic D. Bronchial reactivity in green coffee exposure. *Br J Ind Med* 1985;42:415-420.
 41. Zuskin E, Kanceljak B, Witek TJ, Schachter EN. Acute effects of herbal tea dust extracts on lung function. *Chest* 1989a;96:1327-1231.
 42. Zuskin E, Kanceljak B, Witek TJ, Schachter EN. Acute ventilatory response to green coffee dust extract. *Ann Allergy* 1991;66:219-224.

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