

HETA 86-246-1736
October 1986
ROTH'S FOODLINERS
ALBANY, OREGON

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I. SUMMARY

On March 17, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request from Roth's Foodliners to evaluate cases of dermatitis among its employees. This request followed a report to NIOSH by a local dermatologist of two cases of phytophotodermatitis in courtesy clerks at the Albany, Oregon store. The Oregon State Health Division was contacted and assisted in the evaluation.

On March 21-23, 1986, a questionnaire survey was conducted among courtesy clerks, checkers, and produce clerks at the Albany, Corvallis, and Canby stores of the Roth's Foodliner chain. A total of 57 employees completed the survey. Twenty-one cases of phytophotodermatitis were identified; 19 from the Albany store and 2 from Canby.

Cases of phytophotodermatitis were more likely than non-cases to have used a tanning salon 24-48 hours prior to the onset of the rash (prevalence ratio [PR] = 2.3). In addition, cases were more likely to have greater than two hours of sunlight exposure during the workshift (PR = 2.9). Workers exposed to both a tanning salon and greater than two hours of workshift sunlight had the greatest risk for developing the rash (PR = 4.5). Those workers with exposure to tanning booths generally had the most severe reactions.

Contact with psoralen-containing produce items followed by ultraviolet (UVA) light exposure is necessary to produce phytophotodermatitis. Of the psoralen-containing items, celery (15.2 items/shift) was the most frequently handled during the workshift, while parsnip (4.0 items/shift) was handled the least. Of these items, celery was handled unwrapped or partially wrapped 57.7% of the time.

A four-fold increase in the total psoralen content of the leafy stalks of the celery from the Albany store compared with Corvallis (17.0 ppm vs. 4.4 ppm) was observed. A similar, but less dramatic, difference was noted in the psoralen content of the stalks (8.0 ppm vs. 4.9 ppm). The differences in the psoralen levels are most likely accounted for by factors occurring prior to Roth's receipt of the boxed celery stalks.

Twenty-one cases of phytophotodermatitis were identified among employees of Roth's Foodliners. Contacts with psoralen-containing produce items followed by UVA exposure were responsible for the observed cases. Use of a tanning salon and/or greater than 2 hours of sunlight exposure during the workshift were significant risk factors among cases. Recommendations for reducing potential exposure to psoralen-containing produce items, using sunblocks, and avoiding artificial ultraviolet exposure are presented in Section VIII of this report.

KEYWORDS: SIC 5411 (Grocery Stores), phytophotodermatitis, celery, tanning salons.

II. INTRODUCTION

On March 17, 1986, NIOSH received a request from the management of Roth's Foodliners to evaluate cases of dermatitis among its employees. This followed a report to NIOSH by a local dermatologist of two cases of phytophotodermatitis in courtesy clerks at the Albany, Oregon store. The Oregon State Health Division was contacted by NIOSH and assisted in the evaluation.

On March 21-23, 1986, a questionnaire survey was conducted among courtesy clerks, checkers, and produce clerks at the Albany, Corvallis, and Canby stores of the Roth's Foodliner chain to determine the incidence of the dermatitis, and the risk factors associated with the development of the condition. On April 22, 1986, a letter summarizing the initial results of the evaluation and preliminary recommendations was forwarded to the management of Roth's.

III. BACKGROUND

Phytophotodermatitis is a toxic dermal reaction caused by contact of the skin with psoralen-containing plants followed by exposure to long-wave ultra-violet light (UVA), producing a chemically induced exaggerated sunburn response. Since 1981, researchers from the National Institute for Occupational Safety and Health (NIOSH) have investigated two other outbreaks of dermatitis, clinically diagnosed as phytophotodermatitis, among grocery store workers.^{1,2} An epidemiologic survey of an Ohio supermarket in 1984 revealed that produce-exposed employees who used tanning parlors had the greatest risk for developing this condition.² The causal agent responsible for this outbreak, presumed to be a produce item, could not be identified due to the limitations of this earlier survey.

Roth's Foodliners is a chain of 13 retail supermarkets located in north-central Oregon, with executive offices in Salem, Oregon. All grocery, meat, and produce items sold by the chain are purchased centrally from wholesalers and distributed to the 13 retail outlets. The quantities of produce purchased reflect consumer demands for the items. Produce items are usually sold within 24 to 48 hours after arrival at the supermarket, and are kept refrigerated or cooled at all times.

Produce clerks unpack the boxes of produce prior to setting them out on the consumer displays. Some produce items, such as celery, are trimmed by hand allowing the cut ends of the celery to rub against the produce clerks' hands and forearms. Similar contact occurs when the produce clerks stock the consumer displays. Checkers are responsible for coding the prices of grocery items into the cash register. This requires the handling of every produce item. In addition, checkers bag groceries when a courtesy clerk (bagger) is not available. Checkers rarely are outdoors during the workshift.

Baggers place the grocery items into brown paper bags for transport. The work routine for baggers requires that all customers' groceries be transported by the baggers to the customer's car in the parking lot. As a result, each bagger spends a considerable portion of the workshift outdoors.

IV. METHODS

A. Epidemiologic survey

In March 1986, NIOSH received a report from a dermatologist in Oregon of two cases of phototoxic dermatitis among employees of a local supermarket chain. In both cases the initial clinical descriptions were similar: discrete bullous and erythematous lesions of the forearms. A cross-sectional study of 27 (77%) of 35 current full- and part-time baggers, checkers, and produce clerks at the index store (Albany) and 21 (68%) of 31 similar employees at another store in the same supermarket chain (Corvallis, 12 miles away), was undertaken. The investigation was confined to employees who handle produce at the two stores since the previous NIOSH studies had implicated that a produce item (or items) was responsible.

All participants completed a self-administered questionnaire in which each was asked to report the new onset of any of the following cutaneous reactions on the forearms or dorsa of the hands since March 1st: dark spots or streaks other than moles or freckles, red blotches or streaks, or blistering. Additional questionnaire items included: demographic data; history of current and past allergy and dermatitis; assessment of tanning response to sunlight; use of known photosensitizers, including medications, sun-tanning preparations, soaps, and shampoos; use of sun-tanning booths or parlors; exposure to natural sunlight during and after working hours; and an occupational history, including number of hours per week worked, shift, frequency of dermal exposure to a variety of produce items, the types of protective clothing usually worn (short vs. long sleeves), and the frequency of hand washing during a work shift. Direct visual examination of the skin was performed on 14 of 19 positive responders to the questionnaire for the purpose of case confirmation.

A case of phototoxic dermatitis was defined as the occurrence on the dorsal hands or forearms in a produce handler (bagger, checker, produce clerk) of any of the following: 1) red blotches or streaks and/or blisters confirmed by physical examination; 2) characteristic hyperpigmentation, confirmed by physical examination, with or without preceding red blotches, streaks, or blisters; or 3) a history of characteristic hyperpigmentation with preceding red blotches, streaks, or blisters. Cases were graded as to the maximal severity of the reaction, judged by either physical examination or history, as follows: 1+ hyperpigmentation alone; 2+ erythema; and 3+ blistering.

Produce inventories at the two stores for the two months preceding and during the outbreak were reviewed. The produce storage facilities and refrigeration units were inspected, and the produce managers were interviewed regarding changes in the handling of produce. Observations of the work routine for produce clerks, baggers, and checkers were conducted.

B. Photoprovocation testing

Following initial epidemiological assessment and direct observation of produce handling, three randomly selected, healthy-appearing stalks of trimmed celery and one trimmed parsnip were selected off the consumer displays from

the Albany store. Three investigators rubbed on their upper outer arms (a) freshly cut surfaces from the base ends of the celery stems, and (b) the store-trimmed surfaces of the celery leaves from two samples. The trimmed end of a third celery stalk was rubbed on the forearms. The cut surface of the parsnip root tip, as well as the intact surface of the parsnip root base, were also rubbed on the upper arms. Two hours after dermal exposure, the arms of each investigator were exposed to 7.5 joules of UVA from a phototherapy light box (Psoralite, Daavlon Company, Bryan, OH). Test sites were evaluated 72 hours following exposure and at weekly intervals thereafter for one month.

C. Laboratory analysis

Separated portions of the leaves and stems of the three celery samples (used in the photoprovocation experiments) from the Albany store, as well as an additional three randomly selected celery stalk samples from Corvallis, were randomly removed from the stalks, ground, and frozen at 4°F. These samples were subsequently packed on dry ice and shipped overnight to the Agricultural Research Unit, United States Department of Agriculture (USDA). The samples were analyzed using a high-pressure liquid chromatograph (HPLC) for psoralen, bergapten (5-methoxypsoralen, 5-MOP), and xanthotoxin (8-methoxypsoralen, 8-MOP). Each sample was processed separately on three occasions, and a mean concentration and standard deviation were calculated.

V. RESULTS

A. Epidemiologic survey

Twenty-one cases of phytophotodermatitis were identified. At the time of the initial evaluation on March 21-23, 14 cases were identified by history and physical examination at the Albany store, 13 among courtesy clerks, and 1 in a produce clerk. Seven additional suspect cases were reported by questionnaire alone; five from the Albany store and two from Canby. Because of the small number (9) of questionnaires received from the Canby store, only the 19 cases of phototoxic dermatitis identified among the 48 workers interviewed (Table 1) from the Albany and Corvallis stores were used for analysis. All 19 cases occurred at the Albany store among the 27 participant employees. No cases among the 21 employees of the Corvallis store were reported either on the questionnaire or from other sources.

Dates of onset of the dermatitis ranged from February 14th to March 21st (Figure 1). Four cases reported previous rashes, two in September 1985, and two in January 1986. Superimposed on this information is the number of boxes of celery (24 stalks per box) sold per week at the Albany store. No other produce item experienced a similar increase in sales during the first week in March. Sixteen cases occurred exclusively in baggers, two in individuals who both bagged and checked groceries, and one in a produce clerk. Eight (42%) of 19 cases reported hyperpigmentation and erythematous streaking of the skin with or without blistering (Table II).

Cases were more likely than non-cases to have used a tanning salon 24-48 hours prior to the onset of the rash (prevalence ratio [PR] = 2.3) (Table 3). In addition, cases were more likely to have greater than two hours of sunlight exposure during the workshift (PR = 2.9). Workers exposed to both a tanning salon and greater than two hours of workshift sunlight had the greatest risk for developing the rash (PR = 4.5).

Those workers with exposure to tanning booths generally had the most severe reactions. Six (60%) of 10 cases with blistering reactions had tanning booth exposure, as compared with none of the 9 cases without blistering. Of the 10 individuals with blistering, 7 (70%) were exposed to greater than 2 hours of workshift sunlight, and 5 (50%) had exposure to a combination of excessive sunlight and a tanning booth. The cases of blistering reactions were more likely to have had a combination of both tanning booth exposure and excessive natural sunlight exposure during the workshift (PR = 4.5, p = 0.3).

The frequency of handling psoralen- and non-psoralen-containing produce items was ascertained by questionnaire. Of the psoralen-containing items, celery (15.2 items/shift) was the most frequently handled during the workshift, while parsnip (4.0 items/shift) was handled the least (Table IV). Of these items, celery was handled unwrapped or partially wrapped 57.7% of the time. There was no difference in the number of items handled or the frequency of handling unwrapped items between cases and non-cases. There were no significant differences between the Albany and Corvallis stores in the number of produce items handled per shift or the frequency of handling unwrapped or partially wrapped items. There were no significant differences in age, race, or sex between cases and non-cases. Sensitivity to sunlight (as ascertained by individuals' responses to the questionnaire) was not associated with the development of the dermatitis. Neither the frequency of hand washing during the shift nor the use of long sleeve shirts appeared protective.

From March 14 through March 17, the Albany store held an anniversary sale, including a sale on celery, which accounted for the tripling of volume of celery sold during the week (Figure I). The celery sale was not related to an oversupply of the item, as other stores in the chain did not offer celery at reduced prices during this time. There was no evidence of improper handling or storage of the celery or any other produce item during the outbreak. All celery appeared normal and healthy; no visible evidence of rotting or disease could be ascertained.

Bud-Antle celery was sold during the time of the outbreak. This brand of celery was also sold by the stores involved in the previously reported outbreaks investigated by NIOSH.^{1,2}

Three healthy-appearing stalks of celery and a parsnip were taken from the produce shelves of the Albany store and rubbed on the NIOSH investigators' upper arms. The arms were then exposed to a dose of ultraviolet light, similar to a tanning booth treatment, or the equivalent of two hours of sunlight exposure. Erythema followed by hyperpigmentation were produced from exposure to the cut, leafy end of the celery. Erythema and blistering, followed by hyperpigmentation and itching, were produced by exposure to the cut root end of a parsnip.

A four-fold increase in the total psoralen content of the leafs of the celery from the Albany store compared with

Corvallis (17.0 ppm vs. 4.4 ppm) was observed (Table V). A similar, but less dramatic, difference was noted in the psoralen content of the stalks (8.0 ppm vs. 4.9 ppm). The presence of greater amounts of 8-MOP in the celery from the Albany store accounted in large part for the differences in psoralen content between the stores. The differences in the psoralen levels are most likely accounted for by factors occurring prior to Roth's receipt of the boxed celery stalks. These factors are discussed below.

VI. DISCUSSION

Certain produce items, in particular celery, parsnip, limes, and parsley, may contain sufficient naturally-produced psoralens, which, when rubbed on the skin, may promote a sunburn-like skin reaction following ultraviolet exposure. Our observations strongly suggest that direct skin contact with cut or bruised surfaces of these produce items is necessary to produce a phototoxic reaction; skin contact with intact produce does not appear to be an important risk factor. In particular, celery with the leaf surface trimmed may have been an important produce item responsible for these outbreaks since (1) the plastic bags provided in the produce section were not large enough to contain the entire stalk, (2) the cut surfaces were usually left extending out of the plastic bags, and (3) the celery was usually placed at the top of the grocery bags at check-out, leaving the cut surfaces extending out of the bags and maximizing chances for accidental skin exposure.

Based on our investigation and collaboration with other researchers, there are a number of pre- and post-harvest factors which may be responsible for raising the natural psoralen content of celery. These factors include:

- Pre-harvest -
 - (1) stressful growing conditions in the field, including the use of pesticides, fungicides, and extremes in growing conditions, including excessive heat, cold, wetness, or dryness. Plant diseases and infections will also raise psoralen levels.
 - (2) differing quantities of natural psoralens in a variety of produce items, and between strains of single produce items such as celery.
- Post-harvest -
 - (1) improper storage, or bruising of produce items.

Intermittently elevated psoralen levels are probably responsible for the sporadic cases of phytophotodermatitis observed in produce handlers, checkers, and baggers. In particular, contact with the trimmed leafy ends of celery or cut end of a parsnip root followed by excessive skin exposure to ultraviolet light from natural (sunlight) or artificial (tanning booths, beds, or sunlamps) sources can produce these skin reactions.

VII. RECOMMENDATIONS

1. Employees who handle fresh produce (checkers, baggers, produce clerks) should be made aware of the following:
 - a. Celery, parsnip, lime, and parsley may contain natural levels of psoralens capable of promoting a skin rash.
 - b. Skin contact with the psoralens in celery, parsnips, or other produce items, followed by ultraviolet light exposure from the sun, sunlamps, or tanning booths, may result in a localized sunburn-like reaction.
 - c. The trimmed leafy end of the celery, any bruised or rotting portions of celery, the cut root end of the parsnip, yellowing or wilting parsley, or limes with the outer skin damaged may contain psoralen levels sufficient to promote a skin rash.
 - d. Parsnips contain the highest levels of psoralen.
 - e. Sunscreens with a #15 (or higher) protection factor, used on the arms and back of hands prior to and immediately after the shift, will reduce the amount of UV exposure to skin, particularly for those employees who spend a portion of the workshift outdoors.
2. Consumers should be encouraged to bag all produce items, or, alternatively, a means of reducing the amount of unbagged celery, parsley, and parsnip that reaches the check-out counters should be devised.
3. Plastic bags that are long enough to completely cover the entire celery stalk, so that the trimmed ends do not stick out of the bag, should be provided over the celery rack for use by consumers.

VIII. REFERENCES

1. National Institute for Occupational Safety and Health, Health Hazard Evaluation Determination Report No. HE 80-225, Cincinnati, Ohio, June, 1982.
2. Centers for Disease Control. Phototoxic dermatitis in grocery workers. MMWR 1984;34:11-13.

IX. AUTHORSHIP

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1. Roth's Foodliners
2. Manager, Roth's IGA Foodliner, Albany, Oregon
3. NIOSH, Region X
4. OSHA, Region X
5. Oregon State Health Division

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I
STUDY POPULATION CHARACTERISTICS
ROTH'S FOODLINERS
MARCH 1986

	<u>ALBANY</u>	<u>CORVALLIS</u>
Number of employees studied	27 (77%)	21 (68%)
Baggers	17	15
Checkers	9	5
Produce clerks	1	1
Age (median, years)	28	23
Sex		
Male	12	12
Female	15	9
Duration of employment (median, years)	4	3

TABLE II
SIGNS AND SYMPTOMS
AMONG CASES OF
PHOTOTOXIC DERMATITIS
IN GROCERY WORKERS

<u>Sign/Symptom</u>	<u># reported</u>	<u>% total (N=19)</u>
Redness/streaking (alone)	3	16%
Hyperpigmentation (alone)	2	10%
Blistering (alone)	1	5%
Redness + hyperpigmentation	4	21%
Hyperpigmentation + blistering	3	16%
Redness + blistering	2	10%
All three characteristics	<u>4</u>	<u>21%</u>
TOTAL	19	99%

TABLE III
FACTORS ASSOCIATED WITH
PHOTOTOXIC DERMATITIS
IN
GROCERY WORKERS

<u>Exposure</u>	<u>Cases</u>	<u>Total</u>	<u>AR¹</u>	<u>PR²</u>	<u>Significance</u>
Tanning salons	6	8	75%	2.3	p = 0.04*
Greater than 2 hours sun exposure during shift	13	20	65%	2.9	p = 0.006*
Exposure to both a tanning salon and greater than 2 hours of sun	5	6	83%	4.5	p < 0.01**

1) AR = attack rate

2) PR = prevalence ratio - compared to workers without the exposure

* Fisher's exact test (2-tail)

** $X^2 = 13.47$ (df = 3) for a 2 x 4 contingency table

TABLE IV
PRODUCE HANDLING FREQUENCIES

<u>Produce item</u>	<u># handled/shift</u>	<u>% unwrapped/partially wrapped</u>
Carrots	15.9 ± 7.5	40.7% ± 29.1
Celery*	15.2 ± 8.0	57.7% ± 27.6
Potatoes	15.2 ± 7.7	31.6% ± 27.3
Broccoli	10.4 ± 8.1	43.6% ± 28.6
Spinach	6.3 ± 6.1	42.6% ± 13.9
Limes*	4.5 ± 5.2	48.0% ± 32.8
Parsley*	4.4 ± 4.8	33.4% ± 28.4
Parsnip*	4.0 ± 4.3	38.0% ± 30.0

* - psoralen-containing produce item

TABLE V
VALUES OF LINEAR FURANOCOUMARINS
IN CELERY STALKS AND LEAVES(ppm)

A. CELERY LEAVES

<u>Store</u>	<u>Psoralen</u>		<u>5-MOP</u>	<u>8-MOP</u>	<u>Total</u>
Albany	mean	2.3	2.8	11.9	17.0
	S.D.	±1.1	±0.7	±4.5	±6.2
Corvallis	mean	1.8	1.1	2.0	4.4
	S.D.	±0.5	±0.2	±0.5	±0.9

B. CELERY STALKS

<u>Store</u>	<u>Psoralen</u>		<u>5-MOP</u>	<u>8-MOP</u>	<u>Total</u>
Albany	mean	1.7	0.7	5.5	8.0
	S.D.	±0.2	±0.1	±0.5	±0.7
Corvallis	mean	1.7	0.4	2.9	4.9
	S.D.	±1.1	±0.2	±1.5	±1.6

FIGURE 1

PHYTOPHOTODERMATITIS IN GROCERY WORKERS
Albany, Oregon 1986

☐ = 1 Case

