



NIOSH HEALTH HAZARD EVALUATION REPORT

HETA #2006-0153-3022

**Sara Lee Foods
Storm Lake, Iowa**

October 2006

**DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health**



PREFACE

The Hazard Evaluation and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health (OSHA) Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employers or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

HETAB also provides, upon request, technical and consultative assistance to federal, state, and local agencies; labor; industry; and other groups or individuals to control occupational health hazards and to prevent related trauma and disease. Mention of company names or products does not constitute endorsement by NIOSH.

ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

This report was prepared by Bradley King and Elena Page of HETAB, Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS), and Amir Khan of the Engineering and Physical Hazards Branch (EPHB), Division of Applied Research and Technology (DART). Field assistance was provided by Srinivas Durgam and Diego Belanger. Analytical support was provided by Jennifer Ernst of the Chemical Exposure Monitoring Branch (CEMB) of DART. Desktop publishing was performed by Robin Smith. Editorial assistance was provided by Ellen Galloway.

Copies of this report have been sent to employee and management representatives at Sara Lee Foods and the OSHA Regional Office. This report is not copyrighted and may be freely reproduced. The report may be viewed and printed from the following internet address: <http://www.cdc.gov/niosh/hhe>. Copies may be purchased from the National Technical Information Service (NTIS) at 5825 Port Royal Road, Springfield, Virginia 22161.

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.

Highlights of the NIOSH Health Hazard Evaluation

The National Institute for Occupational Safety and Health (NIOSH) received a management request for a health hazard evaluation (HHE) at Sara Lee Foods in Storm Lake, Iowa. The management requested a follow-up evaluation to assess soluble chlorine and trichloramine exposures to evisceration line area workers in their poultry processing facility. In an HHE conducted in 2002-2003, NIOSH investigators made recommendations, which the company has implemented, to reduce worker exposures to these compounds. NIOSH investigators conducted the follow-up investigation in June 2006.

What NIOSH Did

- We tested the air for chlorine-related compounds called chloramines.
- We asked workers about eye and respiratory symptoms they had at work.
- We identified new engineering and ventilation controls installed since the previous evaluation.

What NIOSH Found

- We found a considerable reduction in the number of evisceration line area workers reporting eye and respiratory symptoms.
- We found reduced levels of soluble chlorine compounds in the evisceration line area compared to the previous investigation.

What Sara Lee Foods Managers Can Do

- Continue to monitor reported health problems.
- Perform routine maintenance on the ventilation and engineering controls.

What Sara Lee Foods Employees Can Do

- Tell health personnel at work if you have health problems that may be associated with the work environment.



What To Do For More Information:
We encourage you to read the full report. If you would like a copy, either ask your health and safety representative to make you a copy or call 1-513-841-4252 and ask for HETA Report #2006-0153-3022



Health Hazard Evaluation Report 2006-0153-3022

**Sara Lee Foods
Storm Lake, Iowa
October 2006**

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SUMMARY

On February 23, 2006, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from management of Sara Lee Foods in Storm Lake, Iowa. The company requested a follow-up to a previous evaluation of chloramine exposure to evisceration line area workers in the poultry processing facility. In 2002-2003, NIOSH investigators conducted an HHE (HETA 2002-0257-2916) at the worksite in response to a request for technical assistance from the Occupational Safety and Health Bureau of the Iowa Division of Labor regarding complaints of eye and respiratory irritation. A survey of evisceration line and dark meat area workers regarding these symptoms was conducted in 2002. An exposure evaluation for chloramine compounds was conducted in 2003. The company has since implemented the majority of the engineering controls NIOSH investigators recommended and asked NIOSH to return to evaluate these controls.

On June 5-8, 2006, NIOSH investigators conducted a site visit to the Sara Lee Foods facility. Personal breathing zone (PBZ) and area air samples were collected for soluble chlorine (a combination of chlorine byproducts such as monochloramine, dichloramine, hypochlorous acid, and hypochlorite) and trichloramines in the evisceration line and dark meat areas of the facility. Questionnaires were administered to workers from the evisceration line to determine the extent of work-related symptoms experienced in the previous 4 weeks. Engineering and ventilation controls implemented since the previous evaluation were identified and documented. Results of this symptom and exposure evaluation were compared to results from the previous investigation.

Rates of all symptoms reported by evisceration line area workers were much lower during this visit than during the site visit made in June 2002. Exposure levels for soluble chlorine were reduced in the evisceration line area.

The potential health hazard documented in HETA 2002-0257-2916 has been effectively addressed by Sara Lee Foods facility management. The reduced rates of symptoms reported by evisceration line area workers paired with reduced levels of soluble chlorine compounds in this area demonstrate the effectiveness of the new engineering controls implemented at this facility.

Keywords: NAICS 311615 (poultry processing), turkeys, chlorine, chloramine, soluble chlorine, trichloramine, eye irritation, upper respiratory irritation, evisceration, engineering controls.

Table of Contents

Preface.....	ii
Acknowledgments and Availability of Report.....	ii
Highlights of Health Hazard Evaluation	iii
Summary.....	iv
Introduction and Background	1
Methods.....	1
Industrial Hygiene	1
Medical.....	2
Evaluation Criteria	2
Chloramines.....	3
Soluble Chlorine.....	3
Trichloramine.....	3
Results	3
Engineering Controls.....	3
Industrial Hygiene	5
Medical.....	6
Discussion and Conclusions	6
Recommendations.....	7
References.....	7

INTRODUCTION AND BACKGROUND

In May 2002, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation (HHE) request from the Occupational Safety and Health Bureau of the Iowa Division of Labor after they received a complaint from an employee of Bil-Mar Foods, Inc., a turkey processing facility employing approximately 600 workers in Storm Lake, Iowa. (Since the time of the original request, the Bil-Mar Foods facility has been renamed a Sara Lee Foods facility.) The request for technical assistance noted that employees in the evisceration line area were experiencing symptoms such as eye and respiratory irritation, and that the Occupational Safety and Health Bureau had not been able to determine the cause. It was suspected that chloramines, specifically trichloramine (NCl₃) was a primary cause of the reported symptoms because of the interaction between the super-chlorinated water and the nitrogenous material from the turkeys.¹

The request resulted in several site visits conducted by NIOSH investigators to determine the prevalence of work-related symptoms and to evaluate chlorine and chloramine exposures. A survey of evisceration line and dark meat area workers regarding these symptoms was conducted in 2002. An exposure evaluation for chloramine compounds was conducted in 2003. The NIOSH investigators found that concentrations of chloramine compounds (trichloramine and soluble chlorine) were significantly higher in the evisceration line area than in the dark meat area, which had little to no use of super-chlorinated water. The levels of soluble chlorine compounds measured by personal breathing zone (PBZ) air samples were significantly higher for employees who reported work-related stuffy or itchy nose, frequent sneezing, cough, and burning or stinging eyes. In addition, the levels of trichloramine were significantly higher in employees who reported burning or stinging eyes. NIOSH issued a final

HHE report on the investigation in October 2003. Recommendations included improving general and local exhaust ventilation and ensuring consistent chlorine levels in the chiller tanks.² In November 2003, NIOSH engineers visited the facility and made a series of more detailed recommendations for reducing worker exposures to chloramines. Recommendations provided to the company included further assessing and modifying the facility's ventilation system in order to maximize its ability to dilute and exhaust airborne contaminants.³

In February 2006, NIOSH received a request for a follow-up evaluation from the management of the Sara Lee Foods facility to evaluate and comment on their progress in reducing symptoms and exposures as the result of the new engineering and ventilation controls. In June 2006, a site visit was conducted to determine the efficacy of these controls by evaluating the levels of chloramine compounds in the evisceration and dark meat areas of the facility and by determining the prevalence of symptoms experienced by employees on the current workforce in the evisceration line area.

METHODS

Industrial Hygiene

PBZ and area air samples were collected for soluble chlorine and trichloramines in the evisceration line and dark meat areas of the facility using samplers that were a combination of an absorption tube (analyzed for soluble chlorine, the combination of chlorine compounds such as monochloramine, dichloramine, hypochlorite, and hypochlorous acid) and a treated filter cassette (analyzed for trichloramine) according to a draft method under development at NIOSH. Samplers were constructed from a tube containing silica gel coated with sulphamic acid and a 37-millimeter (mm) polystyrene cassette containing two quartz fiber filter pads in series soaked in sodium carbonate and diarsenic trioxide. Analysis involved a simple extraction followed by inductively coupled plasma atomic emission spectroscopy (ICP-AES) for both tube and filter.

During sampling, air was pulled through the silica gel-containing tube prior to passing through the filter-containing cassette. The soluble chlorine compounds were collected in the silica gel-containing tube, while the trichloramine passed through the tube. The trichloramine was then trapped separately by the filters as it chemically reacted with them. The air samples were collected using calibrated SKC Hi-Flow sampling pumps at a flow rate of one liter per minute (Lpm). The sampling pumps were pre- and post-calibrated using a primary standard to verify the flow rate. Samplers were shipped overnight to the NIOSH laboratory after daily sampling. Upon receipt, the samples were immediately desorbed and stored in the dark in a refrigerator until analysis.

The samples were desorbed by placing the impregnated silica gel from the tube into a 20 milliliter (mL) vial. Ten mL of a 1 gram/liter (g/L) sulfamic acid solution was added to each vial and rotated for 30 minutes. The sample extracts were decanted into another vial and refrigerated until analysis. Samples were analyzed for chloride using an ICP-AES method at a wavelength of 134.724 nanometers (nm). An instrumental limit of detection (LOD) was determined to be 7 micrograms (μg)/sample, with an instrumental limit of quantitation (LOQ) of 25 μg /sample.

During analysis of the filters, each filter was removed from the cassette and placed in a 20 mL sample vial. After 10 mL of deionized water was added, the samples were rotated for 30 minutes. Sample filters were refrigerated and then filtered prior to analysis on the ICP-AES at a wavelength of 134.724 nm. An instrumental LOD for trichloramine was determined to be 6 μg /sample with an LOQ of 19 μg /sample.

For calculation of geometric means, values for sampling results that were 'non-detectable' were assigned the value of one half the LOD.

Medical

A confidential questionnaire was administered by NIOSH personnel in either Spanish or English to all evisceration line area workers

present on the day shift. It consisted of questions about demographics (age, gender); occupational descriptors (job title, years worked, work department); personal history of allergies, eczema, asthma, and smoking; upper and lower respiratory symptoms at work in the last 4 weeks (not related to cold or seasonal allergies); and whether those symptoms remained the same, got worse, or got better on days off work. This questionnaire was identical to that used during the site visit in June 2002.

EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for the assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects even though their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increases the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH Recommended Exposure Limits (RELs),⁴ (2) the American Conference of

Governmental Industrial Hygienists' (ACGIH®) Threshold Limit Values (TLVs®),⁵ and (3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs).⁶ Employers are encouraged to follow the OSHA limits, the NIOSH RELs, the ACGIH TLVs, or whichever are the more protective criteria.

OSHA requires an employer to furnish employees a place of employment that is free from recognized hazards that are causing or are likely to cause death or serious physical harm [Occupational Safety and Health Act of 1970, Public Law 91-596, sec. 5(a)(1)]. Thus, employers should understand that not all hazardous chemicals have specific OSHA exposure limits such as PELs and short-term exposure limits (STELs). An employer is still required by OSHA to protect their employees from hazards, even in the absence of a specific OSHA PEL.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended STEL or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from higher exposures over the short-term.

Chloramines

Chloramines are formed by the reaction between chlorine disinfectants and nitrogenous compounds such as ammonia, amines, or organic nitrogen-containing material. The species and concentrations of chloramine are influenced by the concentration of residual chlorine, ammonia (or other nitrogen sources), pH, and temperature.⁷ In general, the lower the pH and the greater the chlorine to ammonia ratio, the higher the likelihood of producing chloramines.

Soluble Chlorine

The term soluble chlorine has been used in this report to designate a combination of chlorine compounds collected using the silica gel-containing tube portion of the sampler used.

These chlorine compounds include monochloramine, dichloramine, hypochlorous acid, and hypochlorite. No occupational exposure criteria have been developed for soluble chlorine or for its specific possible constituents.

Trichloramine

Trichloramine, or nitrogen trichloride (NCl₃), is a brownish-yellow gas, has a pungent chlorine odor (sometimes described as rotting grapefruit or geraniums), is a strong irritant, and causes excessive tearing of the eyes.⁸ NCl₃ has low solubility, aerates easily, and decomposes rapidly in sunlight. Eye and respiratory tract irritation appear to be the primary effects of exposure, although asthma has been documented in lifeguards and swimming instructors.⁹ The irritant characteristics of NCl₃ seem to be similar to that of chlorine.¹⁰ Occupational exposure criteria for NCl₃ have not been established.

RESULTS

Engineering Controls

The request from the facility's management asked NIOSH investigators to evaluate and comment on their progress in reducing symptoms and exposures after implementation of engineering and ventilation controls previously recommended by NIOSH investigators. The progress made in implementing these recommendations is briefly discussed below.

Chlorination of water: NIOSH investigators recommended that the concentration of chlorine in the chlorinated water be constantly maintained at the USDA-recommended level.

Implementation Status: Sara Lee Foods has installed a system that allows more consistent chlorination levels in the chillers.

General Ventilation: The fog machine tests conducted by NIOSH investigators during the previous site visit demonstrated that ventilation in the evisceration line area was non-uniform. Exhaust fans in the evisceration line area

appeared to be drawing contaminated air past the workers' breathing zones. According to the design specifications provided by the plant, the total ventilation of the evisceration line area was low and needed to be upgraded. According to Hixson, an engineering and architecture consultant hired by Sara Lee Foods to help them troubleshoot the ventilation deficiencies in the operation of the evisceration line area, this area had an estimated 7.6 air changes per hour (ACH).

The overall airflow pattern of the evisceration line area also needed to be improved to ensure adequate and uniform laminar air flow. The distribution of air in any ventilated room depends on the size, type, and locations of ventilation supply and exhaust diffusers. During the previous visit, it was observed that the supply and exhaust locations in the evisceration line area were detrimental to uniform ventilation, promoting short-circuiting and creation of dead spaces. In order to ensure uniform ventilation in the evisceration line area, NIOSH investigators recommended the supply and exhaust ductwork of the evisceration line area be appropriately re-designed and relocated.

Implementation Status: In the evisceration line area, a new make-up air unit was added that supplies 30,000 cubic feet per minute (cfm) of filtered and conditioned outside air to the area via two diffusers (15,000 cfm per diffuser). Two new exhaust fans with 15,000 cfm capacity each were added on the opposite side of the new supply airflow diffusers in the evisceration line area and are located over areas where high levels of chloramine aerosolization occurred. One of the new exhaust fans is installed over the second high-pressure inside/outside bird washer, while the other is installed between chillers A and B. One of the existing 7,200 cfm exhaust fans is relocated over the first bird washer to improve the overall air circulation patterns in the evisceration line area. It is estimated that the new ventilation increased the air changes from 7.6 to 19 ACH in the evisceration line area.

Bird Washers: There are two bird washers in the evisceration line area, a bird-scrubber at the start

of the processing line, and a high-pressure inside/outside bird washer at the end of the line (just prior to separation of the white and dark meat). Substantial quantities of super-chlorinated water were used in these washers to disinfect the birds. The scrubbing of the birds in these washers generates aerosols. As each bird that had been saturated with super-chlorinated water exited the washer, these compounds were aerosolized into the work environment through drag-out of aerosol-laden air. NIOSH investigators recommended that the ventilation system for the evisceration line area be modified to include local exhaust ventilation (LEV) for both washers.

Implementation Status: The facility eliminated the spraying of super-chlorinated water for washing the inside/outside of the birds in the second washer. Currently, regular city water is used for washing birds in this washer. A new 15,000 cfm exhaust fan is installed over the inside/outside bird washer, and an existing exhaust fan of 7,200 cfm has been relocated over the first bird washer.

Chiller: The chiller used to hold turkey necks was not covered or exhausted with LEV. This open chiller contained super-chlorinated water and was located near the center of the evisceration line area. NIOSH investigators recommended the chiller be exhausted to prevent the escape of airborne contaminants into the work environment resulting from the interactions of chlorinated water in the tank and the organic matter from the turkey necks.

Implementation Status: The facility has eliminated the use of super-chlorinated water in this chiller and has substituted it with regular city water.

High-pressure Cleaning: High-pressure bird washing occurred in all of the reprocessing and salvage stations. Splashing and spraying of the birds with both city and super-chlorinated water provided ample opportunity for aerosolization of chloramines and soluble chlorine compounds. Chlorinated water was sprayed with enough force so that the enclosures used for

reprocessing and salvage were ineffective with some of the spray hitting the operator. The high-pressure cleaning that occurred on breaks and during the cleaning shift can also potentially aerosolize chloramines and soluble chlorine products from the floor. NIOSH investigators recommended that low pressure cleaning methods be explored that involve lower water pressure and nozzle velocity. Exploration of different nozzle designs was recommended to minimize aerosolization and splashing onto the operator and the floor. NIOSH investigators also recommended modifying the existing centralized high pressure chlorinated water system to reduce pressure and thus minimize aerosolization of chlorine compounds.

Implementation Status: The facility installed and uses low-pressure water nozzles in the reprocessing and salvage work stations to minimize aerosolization and splashing.

Trough: An open trough ran through the evisceration line area and caught used super-chlorinated water and discarded or dropped turkey parts under the evisceration line. The purpose was to direct the used water away from the evisceration line area to be treated and disposed of properly. During the previous visit, turkey parts in the trough frequently built up and required periodic cleaning to ensure the trough was fully operational in directing the used water away from the evisceration line area. The frequent clogging resulted in a poor flow of water through the trough and a buildup of standing water and turkey parts inside the trough, with the potential for overflow of contaminated water into the surrounding area. To minimize frequent clogging of the trough, NIOSH investigators recommended covering the trough with screens. NIOSH investigators also recommended constructing new troughs in areas where the current trough did not run to capture the contaminated water.

Implementation Status: The facility has rerouted the used water from the inside/outside bird washer directly into the trough. This change provides for a very strong flow of water through the trough, ensuring continuously flowing water,

which prevents buildup of stagnant water and turkey parts inside the trough.

Work Stations: The reprocessing and salvage work stations were grouped into pairs and were exhausted by a single exhaust fan. A qualitative evaluation of these work stations by NIOSH investigators indicated that very little ventilation was present. Smoke tests indicated the work station exhaust fans had inadequate capture velocity. The poor work station ventilation performance was attributed to the undersized exhaust ducts and improper connection to the work station. Because the primary goal of these work stations is to capture contaminants released during reprocessing and salvage tasks, NIOSH investigators recommended that the exhaust system for these work stations be redesigned to provide optimum capture velocities.

Implementation Status: Sara Lee Foods addressed this issue by increasing the exhaust airflow at these work stations through modifications of existing ventilation systems.

Industrial Hygiene

Results from the PBZ and area air sampling in the evisceration line and dark meat areas are summarized in Tables 1-4. Table 5 compares the geometric means of the PBZ and area air sample results for soluble chlorine from the 2003 exposure assessment site visit (“pre-controls”) to the geometric means of the sample results from the 2006 site visit (“post-controls”). Additionally, it lists the percentages of samples that returned a result of “non-detectable” for the PBZ and area air samples in both areas. Fewer than a third of the samples returned “non-detectable” results. In order to calculate geometric means, values for sampling results that were “non-detectable” were assigned the value of one half the LOD.

As shown in Table 5, the geometric mean for the PBZ sample results for soluble chlorine in the evisceration line area (the site of the complaints of respiratory and eye irritation in the original request in 2002) was reduced from 63.5 μg per cubic meter ($\mu\text{g}/\text{m}^3$) to 24.3 $\mu\text{g}/\text{m}^3$. The geometric mean for the area air sample results in

this area was reduced from 129.5 $\mu\text{g}/\text{m}^3$ to 19.0 $\mu\text{g}/\text{m}^3$. Both of these reductions were statistically significant, with a P value of less than 0.05. In 2003, the mean of PBZ soluble chlorine levels measured in the evisceration line area was significantly higher than the mean of PBZ levels in the dark meat area. However, in 2006, the results showed no statistically significant difference in the means of PBZ levels for soluble chlorine between the two areas. As shown in Table 5, higher percentages of samples that returned “non-detectable” levels were seen in the 2006 results compared to the 2003 results. This is a result of a higher LOD for the 2006 samples versus the 2003 samples.

Specific geometric means for the PBZ and area air samples for trichloramines in the dark meat and the evisceration line areas were not calculated due to the very high percentage of “non-detectable” sample results returned. All samples in the dark meat area returned “non-detectable” levels of trichloramines for the 2006 site visit, and 67% of samples in the evisceration line area returned “non-detectable” levels. As an estimate, the geometric mean for the trichloramines would be less than or equal to 12.5 $\mu\text{g}/\text{m}^3$, the minimum detectable concentration based on a sample volume of 480 liters.

Medical

All 55 evisceration line area employees on the first shift who were present on the day of the interviews participated. Eleven evisceration line area employees were either ill or on vacation that day. Eighteen of the 55 participants had participated in June 2002. The rest had been hired since that time. Table 6 compares basic demographics of the participants in June 2002 to those at this site visit. They were similar in mean age, tenure, gender distribution, and smoking history. Table 7 compares the prevalence of work-related symptoms between the two time periods. Rates of all symptoms were lower at this visit than in June 2002. Two of the participants of the 2006 survey who reported eye symptoms stated they were specifically from a fan blowing in their faces. Most employees who reported symptoms at this visit reported that they

were less severe than before the controls were implemented.

DISCUSSION AND CONCLUSIONS

The controls implemented in the Sara Lee Foods facility included ventilation improvements and other engineering controls designed to reduce employee exposures to chlorine byproducts. These controls were focused in the evisceration line area, where significantly more employees had reported symptoms such as work-related wheezing, coughing, sneezing, and watery eyes during the 2002 site visit compared to employees in the dark meat area. The beneficial effect of the engineering controls implemented since that site visit is evidenced by the considerable reduction in symptoms reported by evisceration line area workers during the 2006 site visit, as well as a considerable decrease in soluble chlorine compound concentrations in the evisceration line area. Management also reported a considerable drop in the number of health complaints reported to them in the time period after implementation of the controls compared to the time period before control implementation.

On the days sampling was performed during the 2003 exposure assessment, the mean TWA soluble chlorine concentrations were significantly higher for persons who reported burning or stinging eyes, itchy or stuffy nose, cough, asthma symptoms, and frequent sneezing, compared to those who did not report such symptoms. Mean TWA soluble chlorine concentrations were also higher for persons who reported watery eyes and sore throat, but not significantly so. After the controls were implemented, soluble chlorine concentrations in the evisceration line area were reduced as were symptoms reported by workers in this area. The levels of soluble chlorine in the dark meat area were higher this time, but comparable to the evisceration line area, where symptoms were now infrequently reported.

Because 100% of dark meat PBZ and area air samples for trichloramine returned levels of “non-detectable” and 67% of the evisceration line area air samples for trichloramine returned levels of “non-detectable,” accurate geometric means could not be calculated to compare against 2003 results. When much more than half of the data are “non-detectable” results, assigning the value of one half the LOD to all “non-detectable” results to calculate a geometric mean results in imprecise estimates of the geometric mean and is not recommended.¹¹ A ten-fold increase in the LOD in 2006 compared to 2003 may be a factor in the number of ‘non-detectable’ results returned. LODs for analyses are sample set specific, and are therefore subject to change between sample sets.

As in 2003, the findings of the current evaluation need to be considered in light of several methodologic limitations. One limitation is the intermittent and unpredictable nature of the exposure and symptoms, possibly related to fluctuations in the amount of nitrogenous material from the turkeys and in chlorine concentration in the water (although minimized by new controls). Therefore, results may vary depending on the conditions at the specific time of the sampling and may not represent exposures on a consistent, everyday basis. An additional limitation is the change in the LOD and LOQ (and resulting minimum detectable concentrations [MDC] and minimum quantifiable concentrations [MQC]) for the 2006 study compared to the 2003 study. Although the same analytic method was utilized for both studies, variation in LODs can occur for a variety of reasons. These include instrument or operator variability as well as the difficulty in creating standards against which to compare the samples. Continuing work on this analytical method is planned by NIOSH. As was the case in the 2003 study, data points fall between the MQC and the MDC, which limits the ability to state with confidence that the results reported represent the exact level of exposure.

The trend in reduced levels of symptoms reported by evisceration workers paired with reduced levels of soluble chlorine compounds in

this area demonstrate the effectiveness of the engineering controls Sara Lee Foods management has implemented in this facility.

RECOMMENDATIONS

1. Sara Lee Foods should perform routine maintenance on the ventilation and engineering controls.
2. Sara Lee Foods management should continue to monitor reported health problems.
3. Employees should tell health personnel at work if they have health problems that may be associated with the work environment.

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**Table 1. Personal Breathing Zone Air Sampling Results
HETA 2006-0153 Sara Lee Foods
Evisceration Line Department, June 6-8, 2006**

Date	Location	Soluble Chlorine (tube)[†] µg/m³	Trichloramines (filter) µg/m³
6-Jun	Cropper/Lung Gun	41.2	ND
7-Jun	Cropper/Lung Gun	15.6*	ND*
8-Jun	Cropper/Lung Gun	ND	ND
6-Jun	Floater	43.3	ND
6-Jun	Hind Halfer	56.3	ND
7-Jun	Hind Halfer	77.5*	ND*
7-Jun	Hind Halfer	55.8*	19.4*
8-Jun	Hind Halfer	38.2	(7)
6-Jun	Ice Attendant	41.4	10
6-Jun	Inspector's Helper	68.4	ND
7-Jun	Pinning Room	25.3*	ND*
6-Jun	Salvage	44.6	(7)
7-Jun	Salvage	(11.8*)	22.6*
7-Jun	Salvage	76.3*	ND*
8-Jun	Salvage	ND	(6)
6-Jun	Trimming	ND	ND
7-Jun	Trimming	ND*	ND*
8-Jun	Trimming	ND	ND
7-Jun	Two-point	19.9*	ND*
8-Jun	Two-point	ND	ND
6-Jun	Vent Gun	55.4	ND
	GEOMETRIC MEAN:	24.3	--**
	MDC:	14.6	12.5
	MQC:	52.1	39.6

ND denotes 'non-detectable level'

µg/m³ denotes micrograms per cubic meter

MDC denotes minimum detectable concentration based on a sample volume of 480 L

MQC denotes minimum quantifiable concentration based on a sample volume of 480 L

[†] field blank corrected

* may represent an underestimation of typical concentration due to a stoppage in the production line for approximately 2 hours due to a power loss

** a geometric mean cannot be calculated due to the high percentage of samples with 'non-detectable' levels

() trace amount

**Table 2. Area Air Sampling Results
HETA 2006-0153 Sara Lee Foods
Evisceration Line Department, June 6-8, 2006**

Date	Location	Soluble Chlorine (tube)[†] µg/m³	Trichloramines (filter) µg/m³
6-Jun	Chiller	324.7	72.1
7-Jun	Chiller	275.7*	ND*
6-Jun	Delunger	44.6	ND
7-Jun	Final Wash Q.A. Station	34.1*	206.3*
7-Jun	I/O Bird Wash	38.2*	ND*
6-Jun	Ice Machine	(11.3)	ND
8-Jun	Inspector's Helper	ND	21.4
8-Jun	Pinning Room	ND	ND
8-Jun	Salvage	(4.2)	85.5
7-Jun	Trimming	(2.0*)	210.5*
8-Jun	Trimming	ND	ND
6-Jun	Vent Gun	(11.1)	ND
	GEOMETRIC MEAN:	19.0	--**
	MDC:	14.6	12.5
	MQC:	52.1	39.6

ND denotes 'non-detectable level'

µg/m³ denotes micrograms per cubic meter

MDC denotes minimum detectable concentration

MQC denotes minimum quantifiable concentration

[†] field blank corrected

* may represent an underestimation due to a stoppage in the production line for approximately 2 hours due to a power loss

** a geometric mean cannot be calculated due to the high percentage of samples with 'non-detectable' levels

() trace amount

Table 3. Personal Breathing Zone Air Sampling Results
HETA 2006-0153 Sara Lee Foods, Dark Meat Department, June 6-8, 2006

Date	Location	Soluble Chlorine (tube) [†] µg/m ³	Trichloramines (filter) µg/m ³
8-Jun	Floater	ND	ND
6-Jun	Hot Dog Grind	79.3	ND
7-Jun	Hot Dog Grind	93.1*	ND*
6-Jun	Thigh Trim Table	95.8	ND
7-Jun	Thigh Trim Table	92.6*	ND*
8-Jun	Thigh Trim Table	18.9	ND
8-Jun	Thigh Trim Table	ND	ND
	GEOMETRIC MEAN:	35.1	--**
	MDC:	14.6	12.5
	MQC:	52.1	39.6

Table 4. Area Air Sampling Results
HETA 2006-0153 Sara Lee Foods, Dark Meat Department, June 6-8, 2006

Date	Location	Soluble Chlorine (tube) [†] µg/m ³	Trichloramines (filter) µg/m ³
7-Jun	Hot Dog Grind	44.1*	ND*
8-Jun	Hot Dog Grind	ND	ND
6-Jun	Reprocessing Station	60	ND
7-Jun	Reprocessing Station	82.7*	ND*
6-Jun	Side Trimmer	15.7	ND
8-Jun	Thigh Deboner	ND	ND
	GEOMETRIC MEAN:	23.8	--**
	MDC:	14.6	12.5
	MQC:	52.1	39.6

ND denotes 'non-detectable level'

µg/m³ denotes micrograms per cubic meter

MDC denotes minimum detectable concentration

MQC denotes minimum quantifiable concentration

[†] field blank corrected

* may represent an underestimation of typical concentration due to a stoppage in the production line for approximately 2 hours due to a power loss

** a geometric mean cannot be calculated due to the high percentage of samples with 'non-detectable' levels

**Table 5. Comparison of Geometric Mean Soluble Chlorine Concentrations
HETA 2006-0153 Sara Lee Foods
Pre-Controls (June 2-6, 2003) and Post-Controls (June 6-8, 2006)**

Location	Pre-Control Soluble Chlorine (tube) $\mu\text{g}/\text{m}^3$	Post-Control Soluble Chlorine (tube) $\mu\text{g}/\text{m}^3$
Evisceration (PBZ)	63.5 (0% ND)	24.3 (29% ND)
Evisceration (Area)	129.5 (0% ND)	19.0 (25% ND)
Dark Meat (PBZ)	9.4 (0% ND)	35.1 (29% ND)
Dark Meat (Area)	7.4 (0% ND)	23.8 (33% ND)
MDC:	1.5	14.6
MQC:	183.3	52.1

$\mu\text{g}/\text{m}^3$ denotes micrograms per cubic meter

MDC: minimum detectable concentration based on a 480 L sample volume

MQC: minimum quantifiable concentration based on a 480 L sample volume

**Table 6. Comparison of Employee Demographics and Selected Characteristics
HETA 2006-0153 Sara Lee Foods
June 2002 to June 2006**

	June 2002	June 2006
Participation Rate	68/69 (98%)	55/66 (83%)
Mean Age (Years)	36	37
Mean Tenure at Sara Lee Foods (Years)	8	8
Gender		
Male	57%	55%
Female	43%	45%
Smoking Status		
Current	24%	29%
Former	32%	20%

**Table 7. Comparison of Work-Related^a Symptoms Reported by Evisceration Line Workers
HETA 2006-0153 Sara Lee Foods
June 2002 to June 2006**

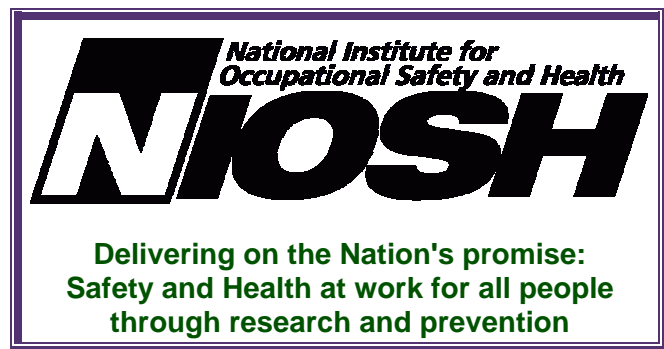
	June 2002 n=68	June 2006 n=55
Itchy, runny nose	32 (47%)	7 (13%)
Watery eyes	31 (46%)	7 (13%)
Frequent sneezing	30 (44%)	0 (0%)
Cough	28 (41%)	4 (7%)
Burning or stinging eyes	27 (40%)	7 (13%)
Asthma symptoms ^b	18 (26%)	0 (0%)
Stuffy nose	17 (25%)	5 (9%)
Wheezing	15 (22%)	0 (0%)
Sore throat	14 (21%)	2 (4%)
Shortness of breath	10 (15%)	1 (2%)
Chest tightness	10 (15%)	0 (0%)

^a defined as experienced at work during the last 4 weeks, but improved on days away from work

^b defined as wheezing, or any two of the following three symptoms: cough, chest tightness, and shortness of breath

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