FINAL REPORT

The Effectiveness of The Saturno Super Saturated Steam Appliance For Removing Food Allergens From Common Food Processing Surfaces

Project # PPT 149

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Executive Summary

- The performance of the Saturno Super saturated steam appliance was assessed by measuring levels of common allergens before and after cleaning various food processing work surfaces.

- A concrete floor, a stainless steel cart, a plastic pallet, and a Teflon conveyor belt were smeared with a muffin mix containing egg, peanut, wheat flour, and milk.

- Work surfaces were washed until visibly clean using hot (60°C) water from a standard 1" hose with a pressure nozzle.

- A follow-up wash was completed with the Saturno Super utilizing various steam, water and vacuum settings, but without the use of any detergents or sanitizers.

- Allergen levels, across all work surfaces, decreased by approximately one log cycle after the initial hot water wash and ranged from 9.8×10^{1} to 6.2×10^{2} μg/100 cm^2.

- After a follow-up wash using the Saturno Super, allergen levels decreased further by as much as 2 log cycles. Levels ranged from 1.5×10^{-1} to 3.1×10^{2} μg/100 cm^2.

- The Saturno Super was particularly effective at reducing allergen levels on "hard to clean" surfaces such as the ridged plastic pallet and the segmented Teflon conveyor belt.

- A water wash alone is not sufficient to clean food processing surfaces of allergen residues.

- The Saturno Super was effective at further reducing allergen levels beyond that already achieved with the hot water wash.

- It is speculated that an additional reduction in allergen levels may be obtained by utilizing the steam + detergent feature available on the Saturno Super.

Objective

To evaluate the effectiveness of the Saturno Super saturated steam appliance in removing food allergens from common food processing surfaces.

Methods

Test Material

The test material was a raw, peanut butter muffin mix containing, among other ingredients, all-purpose flour (30%), peanut butter (20%), milk (17%) and eggs (9%).

Ingredients were blended for approximately 2 minutes in a small Hobart mixer resulting in a homogenous, thick, batter.

Tested Allergens

Levels of the following food allergens were measured before and after washing, and again after sanitizing various work surfaces that had been smeared with the muffin mix:

- egg white protein
- wheat gluten (gliadin)
- peanut
- milk protein (β-Lactoglobulin)

Preparation Of Work Surfaces

Four work surfaces commonly found in food processing plants – a concrete floor, a stainless steel cart, a plastic pallet, and a Teflon conveyor belt – were used.

Prior to evaluation, each work surface was cleaned using a general purpose cleaner followed by alkali and acid washes and a fresh water rinse. Evaluations were completed one work surface at a time. Each work surface was marked off with nine 10 cm x 10 cm square outlines using a cardboard template and permanent marker. One gram samples of muffin mix were spread evenly within each of the marked outlines using a rubber spatula. All samples were left at room temperature for one hour prior to sampling.

Sample Collection:

For each work surface:

- three of the nine test areas were randomly selected as positive control samples. Each selected test area was swabbed with a sterile, pre-moistened, cotton-tipped swab in a cross-hatched pattern – across, up and down, and at a 45° angle. All three swabs were collected in a new glass test tube containing 10 mL of heated (60°C) phosphate/saline buffer. The test tube was vortexed for 2 min. at high speed. The sample was filtered through a 0.45 μm Naglene syringe filter into a

disposable glass test tube. All samples were immediately frozen and stored at -20°C.

- all nine test areas were cleaned using the prescribed procedure for each work surface (see below). Three of the six test areas not yet sampled were selected at random, swabbed and prepared as previously described.

- all nine test areas were treated with saturated steam according to the prescribed procedure for each work surface (see below). The three test areas not yet sampled were swabbed and prepared as previously described.

Cleaning and Steam Treatment Procedures

Each work surface was:

- scraped of excess muffin mix using a rubber spatula
- washed with hot (60°C) water using a high pressure water hose
- treated with the Saturno Super using saturated steam or a combination of saturated steam + vacuum

Note: No detergents or disinfectants were used during cleaning and sanitizing. Steam lances were held within ¼" of the treated surface. Steam vacuum implements were pressed on to treated work surfaces with sufficient pressure to maintain a vacuum throughout the treatment. All implements were steam sanitized prior to use on each surface.

The implements and cleaning/treatment times employed are specified as follows:

	Cleaning		Steam Treatment		
Surface	Implement	Time	Implement	Setting	Time
Floor	Water hose	30 sec.	floor cleaner	steam + vacuum	180 sec.
Stainless Steel Cart	Water hose	30 sec.	small handheld vacuum	steam + vacuum	180 sec.
Plastic Pallet	Water hose	45 sec.	small brush long lance	steam + water steam only	205 sec. 240 sec.
Teflon Conveyor Belt	Water hose	30 sec.	small brush small lance small lance	steam + water steam + water steam only	120 sec. 120 sec. 120 sec.

Allergen Testing

Enzyme immunoassay test kits manufactured by R-Biopharm AG, Darmstadt, Germany and distributed in Canada by Xygen Diagnostics Inc. were used to quantify the targeted allergens. Specifically, the RIDASCREEN® Ei/Egg protein, RIDASCREEN®FAST Gliadin, RIDASCREEN®FAST Peanut, and RIDASCREEN® β-Lactoglobulin kits were utilized.

Sample preparation was as described previously. For gluten analysis only, the collected samples were further diluted at 1 mL of sample in 5 mL of 60% v/v ethanol.

In general, allergen testing involved specific antigen-antibody reactions that, after several intermediary steps, resulted in colour development in proportion to the enzyme being quantified. Details of the egg protein, wheat gluten, peanut and milk protein assays can be found in R-Biopharm articles R6401, R7002, R6202, and R4901 respectively.

Results

Egg White Protein

	Allergen Concentration (µg/100 cm2)		
	Prior to Cleaning	Hot Water Clean	Steam Clean
Floor	na	2.4×10^3	1.1×10^2
Stainless Steel Cart	1.1×10^4	1.3×10^2	3.5×10^1
Plastic Pallet	6.3×10^3	7.4×10^3	3.0×10^2
Teflon Conveyor Belt	na	5.3×10^3	7.8×10^1

Wheat Gluten

	Allergen Concentration (µg/100 cm2)		
	Prior to Cleaning	Hot Water Clean	Steam Clean
Floor	2.9×10^3	3.3×10^2	$< 6.7 \times 10^1$
Stainless Steel Cart	2.1×10^3	1.6×10^2	$< 6.7 \times 10^1$
Plastic Pallet	na	1.3×10^2	$< 6.7 \times 10^1$
Teflon Conveyor Belt	3.2×10^3	9.8×10^1	$< 6.7 \times 10^1$

Peanut

	Allergen Concentration (µg/100 cm2)		
	Prior to Cleaning	Hot Water Clean	Steam Clean
Floor	na	3.7×10^2	3.0×10^2
Stainless Steel Cart	na	2.5×10^2	2.3×10^2
Plastic Pallet	4.0×10^3	6.2×10^2	3.1×10^2
Teflon Conveyor Belt	na	3.8×10^2	1.6×10^2

Milk Protein (β-Lactoglobulin)

	Allergen Concentration (µg/100 cm2)		
	Prior to Cleaning	Hot Water Clean	Steam Clean
Stainless Steel Cart	1.9×10^3	3.6×10^1	1.6×10^1
Plastic Pallet	2.8×10^3	1.0×10^2	1.5×10^{-1}

Note: Allergen test results are not available (na) for all work surfaces prior to cleaning. It is assumed that allergen levels for these non-tested surfaces are comparable to that for the work surfaces tested prior to cleaning.

Discussion

Food allergies affect a small proportion of the population, but in some cases result in serious, even life-threatening, reactions. Consequently, it is incumbent upon food processors to minimize the risk of contamination of foods with serious allergens. Good manufacturing practices employed to reduce the risk include scheduling production to avoid cross-contamination of products; control of rework material; dedicated production lines or facilities for allergen-containing products; and intensive cleaning procedures.

In this study, competitive enzyme immunoassays were used to measure the level of four common allergens – egg white protein, wheat gluten, peanut, and milk protein - before and after cleaning various food processing surfaces. Initial cleaning consisted of a hot (60°C) water rinse using a standard 1" water hose and pressure nozzle. Work surfaces were washed until visibly free of food residues. A follow-up cleaning was performed with the Saturno Super utilizing various steam, water and vacuum options as deemed appropriate for each work surface.

In general, across all work surfaces, the initial hot water rinse resulted in a 1 log reduction of allergens. An additional reduction of allergens, as high as 2 log cycles for egg white and milk proteins, was observed after follow-up cleaning with the Saturno Super.

The Saturno Super was particularly effective on the "hard to clean", non-smooth work surfaces, i.e. the plastic pallet and Teflon conveyor belt. The reduction of allergens on these work surfaces, after cleaning with the Saturno Super, was as high as 7.1×10^3 $\mu g/100\ cm^2$ (egg white protein on the plastic pallet).

Conclusions

While threshold allergen levels – i.e. minimum levels for inducing an allergic reaction – have yet to be established, levels as low as 0.25 mg peanut protein, 0.1 mg egg protein and 0.6 mg milk protein have been reported to illicit an allergic response (Taylor et al, 2002). Based on this information, a water rinse alone is insufficient in reducing allergen levels to acceptable levels.

The Saturno Super saturated steam appliance, using steam and hot water only, was effective at reducing egg white protein, wheat gluten, peanut, and milk protein allergens beyond that already reduced by the hot water rinse.

Though not evaluated in this study, it is felt that the Saturno Super unit could have been used in place of the standard water hose for initial cleaning, as well as follow-up cleaning.

It is speculated that an additional reduction in allergen levels would be achieved by utilizing the steam + detergent feature available on the Saturno Super.

References

Taylor, S.L. et al. 2002, Factors affecting the determination of threshold doses for allergenic foods: How much is too much?, J. Allergy Clin Immunol, 109, 24-30.