

Allergen Removal Testing on ESCO “Jetstream Air Shower” JAS-1B8-030

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Introduction

Laboratory animal allergy is one of the most common occupational health hazards in laboratory animal work. The removal and control of allergens in the animal facility is important for staff working with laboratory animals. In recent years, increased focus on laboratory animal allergy has led to the development of various types of allergen-reducing equipment, such as animal containment workstations and air showers.

Air showers are commonly incorporated into laboratories using animal handling workstations to prevent the spread of interfering allergens from personnel to products. The air shower psychologically reinforces change of attire, and physically removes skin microorganisms and allergens. Air showers can thereby prevent infections inside the animal facility and the spread of allergens outside. Nevertheless, the type of clothing is an important factor in affecting the efficacy (*Whyte, 2001*).

The aim of this study is to test the efficiency of the air shower on jump suit and lab coat material contaminated with a specific amount of mice allergen by evaluating the amount of allergen removed from the suit.

Method

A. Sample Preparation

Allergen powder was collected by sieving dirty bedding used for 4 days by male mice. A test sieve with wire mesh aperture size of 355 microns was used to remove large particles. The final powder was made up of small particles of dirty bedding. The collected powder was mixed extensively to ensure that allergens were distributed equally throughout the mixture.

The allergen content (ng/m^3) was estimated by Enzyme-Linked Immunosorbent Assay (ELISA) after diluting the sample in 5 ml phosphate-buffered saline (PBS). To prepare the samples of clothing for testing, 0.5 g of the dry allergen powder was distributed over a $5 \times 5 \text{ cm}^2$ square drawn on the cloth material to be tested; excess powder was brushed away. The initial allergen concentration was obtained by calculating the amount of allergen applied at sampling one of the marked spots before entrance into the air shower.

1. Sieve the mice allergens



2. Store the allergen in a jar, and put it into Ziploc bag



B. Testing a different type of material clothing and showering time

For this test, the air shower was used at the standard set up of 25 mm (1") nozzles and 22 m/s (4330 fpm) air velocity. To determine the effect of air showering on allergen removal of the material clothing, three types of material clothing were used: Polyester pm-1, Integrity 2000-C, and Cotton.

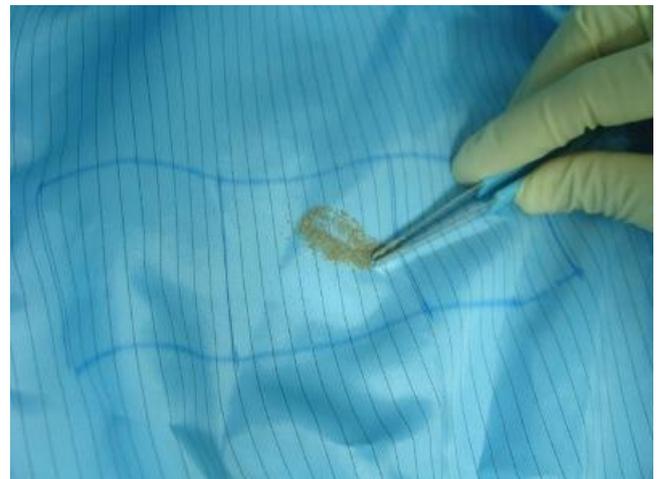
On each shoulder, stomach and thigh of the 3 clothing materials, 3 squares with the size of 5 x 5 cm (2 x 2 inches) were drawn using a marker. Allergen powder was added to the marked squares. The suit was subjected to one of 3 showering times (12, 30 and 60 seconds). After treating the lab coat with allergen, the coat was worn by the operator, who then went into the air shower.

After air showering, samples were collected using Dustream™ Collector from Indoor Biotechnologies™ connected to vacuum pump with air sampling rate of 2600 l/min (92 cfm) for 30 seconds.

1. Draw 3 squares (each 5 x 5 cm) at each location



2. Add allergens into the marked spot



3. Clean with air shower



4. Allergen sampling with Dustream™ Collector



Allergen Analysis Using ELISA

To dilute allergens from the sampled squares, a method from past study (*Renstrom, 1997*) was modified. Each Dustream™ filter, placed in 50-ml falcon tube containing 5.0 ml PBS, and incubated at room temperature for 2 hours.

A 1.0 ml aliquot of the solution was transferred into 1.5 ml micro centrifuge tube which was then centrifuged at 2500 rpm and 4°C for 20 minutes to produce supernatant.

The supernatant was analyzed with Mus m1 ELISA Kit from Indoor Biotechnologies, Manchester, UK.

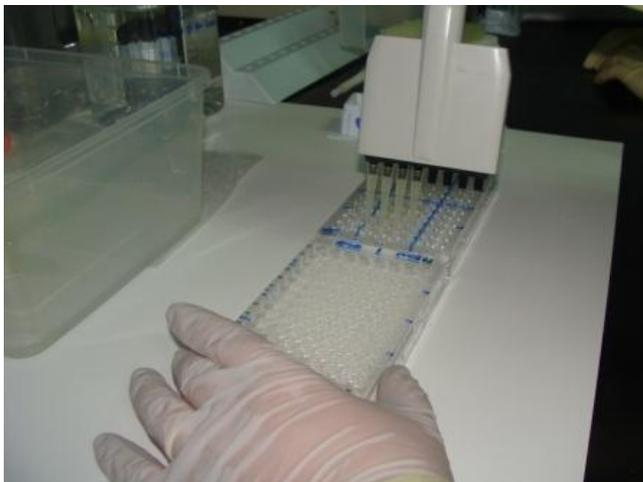
1. Incubate sample at room temperature



2. Centrifuge at 2500 rpm and 4°C for 20 minutes



3. ELISA assay



4. Allergens concentration measurement



Results

Based on ELISA analysis, the concentration of allergen in the powdered bedding was 31.46 ng/m³, which was used as initial (100%) allergen concentration. Below is table comparison of the 3 different clothing materials at 3 sampling locations, for 3 different showering times:

Material	Market spot location	Allergen Removal (%)		
		12 s	30 s	60 s
Polyester	Shoulder	62.87	80.89	94.33
	Stomach	65.79	87.1	97.78
	Thigh	59.24	85.03	94.33
	Average	62.63	84.34	95.4
Integrity	Shoulder	69.33	69.55	88.21
	Stomach	60.38	80.63	88.32
	Thigh	62.28	79.22	91.56
	Average	64	76.47	90
Cotton	Shoulder	58.89	75.16	89.78
	Stomach	63.33	79.11	86.42
	Thigh	60.19	76.53	83.53
	Average	60.80	76.93	86.57

Table1. Percentage Allergen Removal for Various Types of Clothing Material and Different Air-showering Times

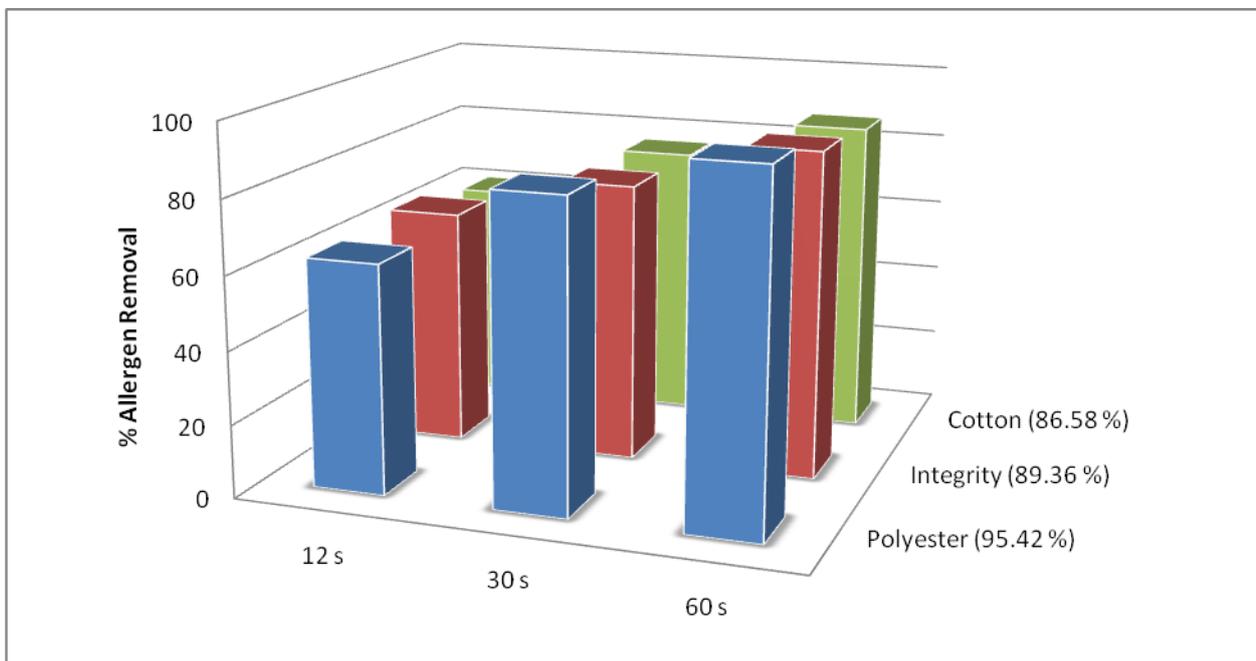


Figure1. The efficiency of JAS on allergen removal of 3 various clothing materials at 3 different showering times

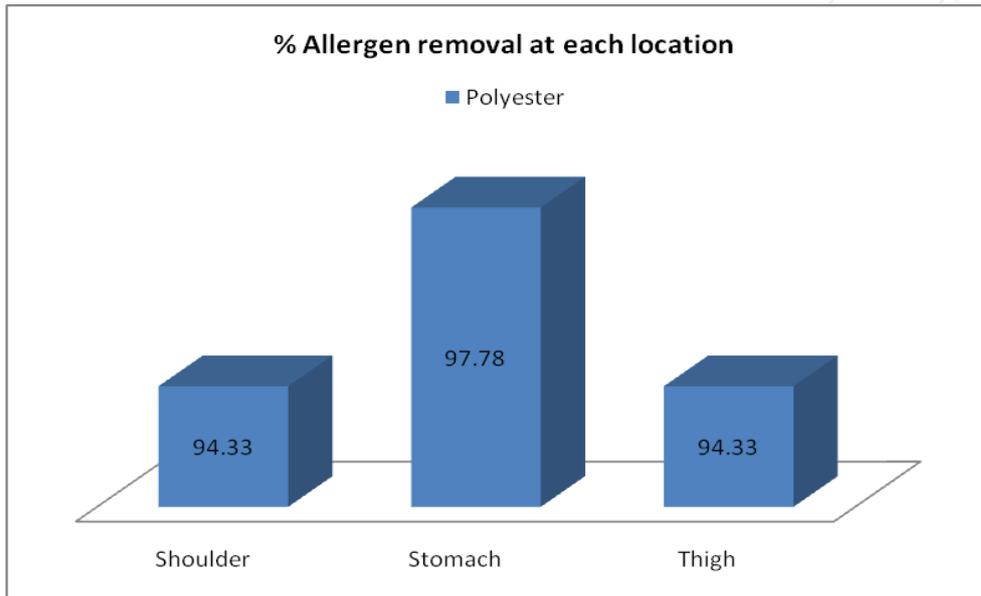


Figure2. JAS allergen removal efficiency at 60 s showering time for polyester material at different locations

Observation

1. The data from Table 1 shows that the Jetstream Air Shower JAS-1B8-030 is capable of removing allergen from all three (cotton, Integrity, and polyester) lab coat materials, given sufficient time of air showering.
2. Allergen removal effectiveness improves with increasing air-showering time. The suggested air showering time is 60 seconds, to remove approximately 90% of the allergen from the lab coat.
3. The amount of allergens that binds to clothing varies considerably, depending on the type of clothing material. Polyester Pm-1 is the recommended material. With 60 seconds of air showering 95.4 % of the mice allergen was removed. Cotton is the least suitable material, with the allergen removal efficiency of only 86.5 %.
4. The allergen removal effectiveness also mildly depends on the location. The most effective removal occurs on the stomach with 97.8% effectiveness, while the shoulder and thigh are both at 94.3%. This suggested that the JAS air shower primarily targets the middle part of the body, with slightly reduced but symmetrical effectiveness at the higher and lower portions of the body.

Conclusion

In regards to effectiveness of animal allergen removal, a traditional cotton lab coat is a poor choice, as allergens cling more easily to cotton compared to synthetic clothing. The recommended synthetic clothing material for minimizing the transfer of allergens from animal facilities is Polyester Pm-1. When cleaning the Polyester Pm-1 lab coat, the Jetstream Air Shower (JAS) managed to effectively remove 95.4 % of the allergens after 60 seconds of air showering. This is the same duration and effectiveness as found by T.C. Krohn and A.K. Hansen in their previous study using another air shower from manufacturer SB.

References

- Harrison, D.J. Controlling Exposure to Laboratory Animal Allergens. The Jackson Laboratory, Bar Harbor, Maine. 2001
- Krohn, T.C., Hansen, A.K. Test of the Efficiency of Air Shower. Center for Applied Laboratory Animal Research. 1998
- Renstrom A. Allergy to laboratory animals [dissertation]. National Institute for Working Life, 1997, Solna, Sweden.
- Whyte W. Cleanroom technology—fundamentals of design, testing, and operation. Hoboken (NJ): John Wiley and Sons. 2001