# Packinghouse Environmental Monitoring Programs: Using ATP, Protein, and Allergen Swabs

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**As a part of a packinghouse environmental monitoring program, adenosine triphosphate (ATP), protein, and allergen swabbing is used to ensure that packinghouse equipment and surfaces have been properly cleaned and prepared for sanitation.**

ATP, protein, and allergen swabbing is frequently incorporated to complement microbial swabbing practices or as an independent program. These swab types indicate the presence of soils and residues on equipment, determining the effectiveness of the cleaning portion of a sanitation program.

Sample results can be read in minutes, unlike microbial swabs, which take days. For this reason, ATP, protein, and allergen swabs are used immediately after cleaning to rapidly confirm that cleaning procedures were thorough (Figure 1). Operations then sanitize and collect microbial swabs to verify the effectiveness of the sanitation process.

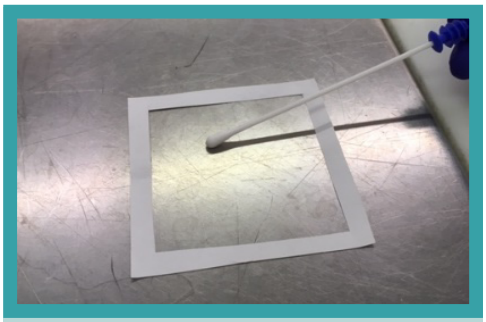

**Figure 1**. Collecting an ATP swab from a Zone 1 contact surface.

## What is ATP swabbing?

ATP is a biochemical substance present in all living cells, and an improperly cleaned packinghouse surface will have residual ATP resulting from contact with any living organism, such as fruits and vegetables, microorganisms, or workers around the packing line.

When possible, ATP samples should be collected after cleaning but before sanitation, as sanitizers do little to remove soil and may interfere with the results of an ATP test.

ATP is measured in relative light units (RLUs) using a device called a "luminometer" (Figure 2).


**Figure 2.** Placing an ATP swab in the luminometer for measurement.

When the sample swab is mixed with liquid reagent in the collection tube, the ATP present on the swab surface reacts with the compounds in the liquid to produce bioluminescence.[3] This bioluminescence is due to the same reaction that naturally produces light when fireflies light up at night.[6] The luminometer measures this light and reports the levels as RLUs.

A high RLU reading means a lot of light was produced by the reaction, indicating that a high level of ATP was present on the sampled surface. Conversely, a cleaner surface should have less ATP contamination and a lower RLU measurement.

Results do not differentiate among ATP residue sources. High levels of ATP do not necessarily indicate the presence of microorganisms, but they do indicate that the surface may need to be recleaned prior to sanitizing. A surface must be properly cleaned—soil removed from the surface using mechanical action and/or a detergent—prior to sanitation to ensure that the chemical sanitizer can completely contact the surface and reduce microorganisms.

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# ATP swabbing

## Materials:

1. Disposable gloves
2. Calibrated ATP luminometer (e.g., Hygiena™, 3M™, etc.)
3. ATP swabs (should match your luminometer brand)

## Calibration:

Always follow the manufacturer's recommendations regarding calibration frequency and methods. Depending on the frequency of use and number of samples collected, calibration may need to occur weekly or every other week to ensure the accuracy of the readings. The calibration process uses a positive and a negative control rod designed to verify that the instrument is functioning properly. The positive control emits a constant, low level of light and demonstrates that the instrument will accurately measure light emitted when samples are processed. The negative control does not produce light and verifies that light is not leaking into the luminometer and interfering with results.

## Swabbing methodology:

Swab handling instructions will vary depending on the manufacturer used; always follow the manufacturer's instructions for use.

1. Swab a 4–in. by 4-in. (10-cm by 10-cm) area—using a template, if needed (Figure 1)—horizontally, then vertically, and finally diagonally, rotating the swab tip while sweeping across the surface. Do not allow the swab to touch other surfaces as it will interfere with your results.
2. Return the swab to the collection tube.
3. Release the reagent liquid stored in the bulb on the top of the tube or swab stick, and then shake vigorously for the time prescribed by the manufacturer for that swab.
4. Place the entire tube in a calibrated ATP luminometer, making sure to hold the unit upright throughout the entirety of the measurement process (Figure 2). Record the RLU measurement and the location swabbed.

It may be necessary to establish an ATP baseline prior to implementation of an ATP monitoring program. Factory settings for many ATP meters are established for food manufacturing facilities or medical applications and are much lower than is possible for many packinghouse settings. An outdoor packinghouse will generally have higher RLU readings than an enclosed facility, and each facility will need to determine acceptable and unacceptable levels of residual ATP for their own operation.

Determining the acceptable ATP levels for a facility should be done over the course of several weeks. Prior to cleaning, ATP measurements should be taken and recorded to establish an upper limit that management can use to determine typical contamination levels on uncleaned surfaces. Next, cleaning—but not sanitizing, as some sanitizers interfere with swab results—should occur under the observation of the food safety manager. Cleaner type, concentration, contact time, solution temperature, crew members, and any other relevant information should be monitored and recorded. Once surfaces dry, they should be swabbed and recorded to establish an average lower limit that is acceptable after thorough cleaning activities take place. Values that meet or exceed the upper limit should be considered failures, indicating recleaning is necessary, while all values in between the upper and lower limits should be treated with caution[3,4] and indicate that recleaning may be required prior to sanitizing. Values that are below or meet the lower limit indicate cleaning activities were sufficient and the crew may proceed with sanitizing.

## When to use protein and allergen swabs

Protein swabbing also indicates the effectiveness of the cleaning portion of the sanitation program in facilities. In the produce packinghouse, protein swabs are not the most effective indicators of sanitation as most produce commodities contain little protein. However, some third-party audit schemes allow the use of protein swabbing for verification of produce sanitation programs.

Protein swabs may be most useful to monitor cleaning efficiency in facilities that only process nuts or nut-containing products, as nuts do contain protein. However, an operation that handles nuts as well as a non-allergen containing commodity—such as watermelons, citrus, peaches, etc.—should use tree nut or peanut-specific allergen swabs to ensure allergen cross-contact does not occur, especially on shared equipment or space.

Specificity is critical when selecting the appropriate swabs to use. If the concern is contamination from pecans, swabs specific for a different allergen or generic protein swabs cannot be used to replace pecan/tree nut allergen swabs.

# Protein and allergen swabs

### Materials:

1. Disposable gloves
2. Protein or allergen swabs—do not use a luminometer with these swabs

### Swabbing methodology:

1. Swab a 4–in. by 4-in. (10-cm by 10-cm) area—using a template, if needed (Figure 1)—horizontally, then vertically, and finally diagonally, rotating the swab tip while sweeping across the surface. Do not allow the swab to touch other surfaces as it will interfere with your results.
2. Return the swab to the collection tube.
3. Release the reagent stored in the bulb on the top of the tube or swab stick; shake vigorously for the time prescribed by the manufacturer for that swab.
4. Acceptable or non-acceptable protein and allergen swab results are indicated by a color change of the liquid after contacting the swab. For instance, in some tests green indicates satisfactory conditions, while gray to dark purple indicate that the surface requires recleaning. See package instructions or contact the supplier if you need clarification.

**For further information**, the U.S. Food and Drug Administration has provided two draft guidance documents including "Control of Listeria Monocytogenes in Ready-To-Eat Foods"[1] and "Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables."[2] United Fresh has provided an excellent resource called "Guidance on Environmental Monitoring and Control of Listeria for the Fresh Produce Industry."[5] More information from the "Packinghouse Environmental Monitoring Programs" series can be found in part one, "Identifying Packinghouse Zones" or part two, "Microbial Sampling."

## *References*


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