

Testing Food, Packaging or Production Facilities for Coronavirus: A Guide for Food Businesses

Summary

- There is no evidence that food or food packaging is a transmission route for COVID-19.
- Surface and airborne transmission within busy workplaces, including in the food industry, is a concern.
- There is best-practice guidance to reduce this transmission risk.
- Analytical testing for residual viral RNA is of limited benefit to verify that these cleaning and hygiene systems are working.
- If it is used, any analytical testing needs to be carefully planned in terms of meaningful sampling, meaningful interpretation of results, and the action that will be taken on results.
- There is minimal benefit in testing a specific food consignment or batch to certify it as “Coronavirus-free”.

Introduction – The Role of Laboratory Testing in Food Safety Assurance

Laboratory testing is routinely used to check for microbiological contaminants, chemical contaminants, or food quality or authenticity attributes. It is not a Quality Control check. It is, rather, an occasional and periodic verification check that the QC systems are effective. For example, these QC systems are based around:

- Pathogens: hygiene, cleaning, and disinfection
- Allergens: segregation and raw material specifications
- Mycotoxins: storage and transport conditions at primary production
- Authenticity: VACCP, audit and supply chain visibility

Testing can be conducted on the food itself (raw material or finished product) or on the production environment, manufacturing equipment or other inputs (e.g. environmental monitoring or cleaning verification testing).

It follows that a positive analytical result is not purely an accept/reject criterion for the particular batch sampled. A positive result should trigger a systematic challenge that the QC system is effective. It should lead to Root Cause Analysis and improvement actions.

Using analytical testing for “positive release” of every batch is a last resort. The test then becomes analogous to a Critical Control Point. It is an admission that the QC system is not effective.

Introduction – The Importance of Sampling

Tests are usually conducted on a small analytical sample, a few grams or a small swab. The result is extrapolated to the entire production batch or factory. The way the sample(s) are selected and taken is therefore more important than the validity of the analytical method.

In the case of pathogens such as coronavirus, the infective agent might be homogeneously (evenly spread and/or with samples being similar to each other) or heterogeneously (unevenly spread and/or with different characteristics between samples) distributed. The former case is more common for spoilage microorganisms, or more common pathogens. The latter case applies if the organism is present at low levels or is associated with point contamination events. In water, for example, the distribution is normally homogenous, but in machinery or food the contamination could be heterogenous. Clustering can also occur with both heterogenous and homogenous distribution; each contamination point having a localised higher level of contamination than the mean distribution. All of these points mean that sampling has to be carried out carefully, and according to a sampling plan



designed to give the maximum chance of capturing the pathogen in the sample taken. Covid-19 is likely to show a heterogenous distribution.

Wash down sampling or large swabs can be useful methods to detect low level or discontinuous contamination. In the former case, sampling from swabs left in the drains can capture low levels of microorganisms that are washed off the food product or machinery during normal operations or cleaning. This is probably less useful for viral contamination. In the latter case, large sponge swabs make sampling a large area much simpler.

The samples need to be transported to the laboratory for testing as quickly as possible, in order to reduce the likelihood of sample degradation. It is not certain if this is an issue with SARS-CoV-2. The sample transport medium must not degrade the sample in any way.

COVID-19: What would you be testing for?

There is no evidence that food or food packaging is a transmission route for COVID-19. But surface and airborne transmission within busy workplaces, including in the food industry, is a major concern. The concern is person-to-person transmission within the workplace.

SARS-CoV-2 is the virus that causes COVID-19. The infective agent is called a virion. This is an encapsulated virus; a small particle comprising a strand of viral RNA surrounded by a shell of proteins and lipids. It cannot replicate outside the human (or host animal) body, but it can survive on surfaces before infecting others.

If you test for the presence of the virion, then there are significant unknowns about the significance of the number of virions detected or the form they are in. How many virions are required to cause a person to become ill? Is there an effect due to age, ethnicity, sex or underlying health conditions? Can these be quantified? There is evidence regarding the likelihood of certain people becoming ill; is there also data for the number of viral particles to infect each category of person? Is there an effect due to the method of contamination: via hands from contaminated fomites (objects or materials which are likely to carry infection, such as clothes, utensils, and furniture), or from hands, or from inhalation of coughed or sneezed droplets, or smaller droplets produced by breathing?

SARS-CoV-2 Cleaning and Disinfection Protocols, and their Impact on Interpretation of Test Results

All evidence to date is showing that SARS-CoV-2 is not a robust virion. It is relatively easy to disinfect. Disinfection regimes that work for other pathogens should work for SARS-CoV-2.

Some disinfection agents (e.g. alcohol, chlorine-based) are believed to work by damaging the viral RNA. The exact form of this damage is unknown. Others (e.g. Quaternary Ammonium Compounds (QACs)) work by damaging the outer lipid envelope, leaving the RNA intact but not infective. Tests for the presence of viral RNA are therefore no benefit in verifying this latter type of disinfection.

Cleaning protocols are commonly validated by purposefully contaminating the surface with a pathogen, then testing for its presence before and after cleaning. This is not possible for SARS-CoV-2. Surrogates that behave in a similar way to SARS-CoV-2 are available, in order to conduct validation studies, but given the theoretical ease of disinfecting SARS-CoV-2 they have had a very limited uptake.

Cleaning is then verified on a routine basis by taking post-cleaning swab samples. There is no need to specifically test for this virion; testing for the absence of other common pathogens can be used as evidence of cleaning and disinfection effectiveness.



Choosing an Appropriate Test Method

The correct testing method is required, to reduce the risk of false positives or negatives. Most current commercial methods are based on identifying a section of the viral RNA (using the polymerase chain reaction or “PCR” method).

Several important questions should be asked relating to PCR testing and the results obtained. Is the virus stable enough that the target portion of RNA has not changed in any way? If the test targets the outer protein coating, the same point applies. Does the method target the whole genome, or a portion? PCR testing detects the presence of small sections of RNA. It does not necessarily detect whether the virus is present whole and cannot detect whether the virus is present in a form that could be infectious. So, does this mean that damaged or non-viable virions could be detected as positives? Does the sample matrix interfere with the test method? What is the sensitivity and specificity of the method?

Antibody based tests are also becoming available to detect SARS-CoV-2. The results of PCR and antibody tests often have different interpretations and are difficult to compare. They both give different information and can both give incorrect results under certain circumstances. For example, the reliability at which antibody tests for norovirus correctly identify infected people can range from 17-92%, whereas reliability of correctly identifying an uninfected person range from 87-100%.

It is important to ask whether the method is within the testing laboratory's ISO 17025 accredited scope, and that this scope of accreditation includes your sample type.

ATP (adenosine triphosphate) testing is commonly used as a non-specific hygiene verification check within food processing operations, but this gives no information about the disinfection of viruses. This technology is useful for illuminating the presence of organic material, such as bacterial or product debris. Viruses do **not** contain ATP within their structure.

Virions are also not detected by alternative test methods to ATP, such as the simple colorimetric test spray on the market called FreshCheck™. This has been demonstrated to reveal the presence of bacterial and organic debris through the disruption of an organic dye-iron complex by Campden BRI.

Conclusion - Interpreting the Test Result

In general, there is no benefit conducting any analytical testing unless you know what you will do with the result. Results for SARS-CoV-2 testing (particularly if a PCR test) are likely to be expressed by laboratories as “positive” or “negative”. There are strong caveats in interpreting both. For testing of food, particularly, these caveats may be strong enough to undermine the purpose of the test.

Cleaning Verification Testing

Negative Result	Positive Result
<p>In countries where population prevalence of COVID-19 is low, it is relatively unlikely that SARS-CoV-2 virions would be present in the environment pre-cleaning.</p> <p>Absence of SARS-CoV-2 post-cleaning is therefore not a good verification measure of cleaning effectiveness.</p> <p>Analysis of a more prevalent pathogen would give much greater confidence.</p>	<p>PCR tests are extremely sensitive – a positive result may just be due to a few virions, which are too few to be infective.</p> <p>A positive result could also be given by a successfully disinfected/inactivated virion which is no longer infective.</p>



Testing of Food

Negative Result	Positive Result
<p>In the (unfounded) hypothesis that food is a transmission route, the number of infective virions is likely to be very low, and heterogeneous.</p> <p>A negative result from a small number of samples would not imply that there are not infective “hotspots” within the batch.</p>	<p>There is no way to differentiate between a virion originating from the food itself and from surface contamination (e.g. chopping boards or other food preparation surfaces).</p> <p>A positive result could be given by a successfully disinfected/inactivated virion which is no longer infective</p>

There are other reasons to test for the SARS-CoV-2 virion, but the purpose of the test must be well defined and the outcome actions pre-planned. Examples are environmental monitoring for site or population-level presence (e.g. effluent testing) or due-diligence testing of product because it is a specification or contractual requirement of your customer.

