

COVID-19 Control in the Food Industry: Is there a Role for Analysis?

Summary

- 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 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 system. 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 (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 ineffective.

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 or heterogeneously 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 if machinery or food could show heterogenous contamination. 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 microbe 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 Covid-19. 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, 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 Test Interpretation

SARS-COV-2 is still a new virus, with lots of unknowns, but early evidence is that it is not a robust virion. It is relatively easy to disinfect. Disinfection regimes that work for other pathogens may 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. 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. Research work is ongoing to find a suitable surrogate that behaves in a similar way to SARS-CoV-2, in order to conduct validation studies.

Cleaning is then verified on a routine basis by taking post-cleaning swab samples. If the early evidence about the fragility of the SARS-CoV-2 virion proves correct then 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 (the "PCR" method). 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; 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. 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 ranges from 87-100%.

It is important to ask has the method been accredited to ISO17025? Does the scope of the accreditation include your sample type?

ATP testing is commonly used within food processing operations to verify the efficacy of the cleaning & disinfection regime. This technology is useful for illuminating the presence of organic material, such as bacterial or product debris, and is beneficial as a non-specific hygiene verification technique. Users should bear in mind that viruses do **not** contain ATP within their structure and would not be directly identified via this technology.

As commented previously, direct assessment is not necessary in this instance as an effective cleaning & disinfection regime for more challenging contaminants could be taken by extension to have removed or inactivated enveloped viral particles such as Coronavirus.

In addition to ATP, there are alternative test methods 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. This simple colour change may also help as a non-specific hygiene assessment methodology in this instance, although as with ATP there is no direct identification of virion presence.

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>Their absence 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

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|---|--|
| <p>Negative Result In the (unfounded) hypothesis that food is a transmission route, the number of infective virions is likely to be very low, and heterogeneous. A negative result from a small number of samples would not imply that there are not infective “hotspots” within the batch.</p> | <p>Positive Result 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). A positive result could be given by a successfully disinfected/inactivated virion which is no longer infective</p> |
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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.

