Guide to Cleaning And Disinfection Regime With Regard To novel Coronavirus

Introduction

With the ongoing SARS-CoV-2 situation across the world we have assembled here some guidance notes specifically focussed on the role that cleaning and disinfection regimes can play in the management of this issue in a food, dairy or beverage operation.

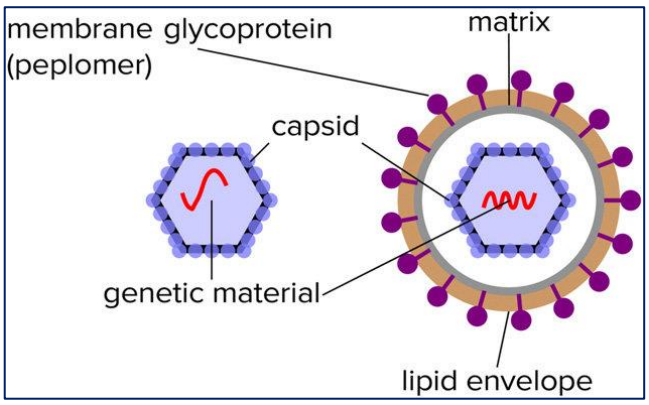
Chemicals and Viruses

When considering viruses, we face a challenge and a mind-set change as these infective agents do not behaviour or respond in the same way that bacteria do – fundamentally this is because they are not strictly "alive" in the sense that we consider life. Let's start with understanding what a virus is as this informs us about management strategies.

A virus is a microscopic parasite which can infect living organisms and cause disease. It can make copies of itself inside another organism's cells. Viruses consist of nucleic acid + a protein coat, usually the nucleic acid is RNA; sometimes it is DNA. Viruses are much smaller than bacteria and indeed can infect bacteria (commonly called a bacteriophage).

On that basis, we cannot rely on the traditional disinfection method of getting a chemical into a cell and either breaking apart the cell membrane (bacteria dies) or interfering with the reproduction process (bacterial population reduces and eventually dies out) as viruses do not respire or consume nutrients. It is for this reason that this class has their own Euro Norm (BS EN 14476) and isn't included in bacterial tests such as BS EN 1276 or 13697.

Even within the virus class we have two types: - Non-enveloped viruses are composed of capsid protein and nucleic acid (DNA or RNA), termed the nucleocapsid, which constitute an infectious unit, the virion, whereas enveloped viruses are composed of an envelope along with the nucleocapsid.

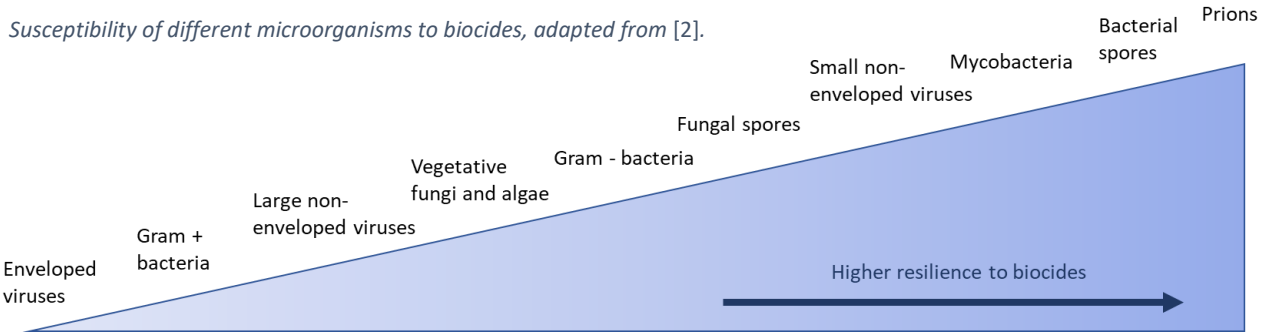


In this respect we are seeking to inactivate the virus by disrupting the genetic material. It may seem counter-intuitive, however enveloped (or encapsulated viruses) are easier to inactivate than non-enveloped simply because the former rely heavily on the matrix of the envelope as the primary "defence" whereas the non-enveloped have to be made of sterner stuff to survive without the benefit of this lipid-protein layer.

So, what is the practical value of this knowledge? Well, if we know that disrupting the envelope matrix layer leads to more rapid infective material inactivation then the actions of a good detergent will assist us through emulsification of said layer (neutral detergents) or saponification (alkaline detergents).

The figure below shows the susceptibility of the different classes of microorganisms to biocides with enveloped viruses being the most susceptible based on the removal of infectivity following the disruption of the envelope.

Susceptibility of different microorganisms to biocides, adapted from [2].



As for bacterial issues; cleaning remains the most effective method of contaminant control.

This is also true for hand hygiene where a good quality soap and water will serve to disrupt the same layer, remove the viral particles and achieve a reduction in cross-contact, however focus is often on hand *disinfection* rather than the more important hand-washing.

Virus Susceptibility to Biocides

The WHO is currently advising the use of, among others, disinfectants based on chlorine, ethanol, hydrogen peroxide or quaternary ammonium compounds [3]. In addition to this, different authorised disinfectants have their viricidal activity recognised by the authorities in each country. These are products that, at the moment of submission of the product dossier for authorisation, included the required reports on viricidal efficacy tests. However, due to the high costs of these tests and that this is not a basic requisite, only a fraction of the authorised disinfectants has these claims.

It is of high interest for producers and handlers of food products to have comprehensive information on which disinfectants they can apply to fight against SARS-CoV-2 presence on surfaces. Knowledge of the activity of the different active substances is useful to identify the best options available for selection of disinfectants, and to assess whether the disinfectants currently in use can be effective against SARS-CoV-2.

The table on the next page, drawn from a variety of reference publications, illustrates the relative ease of inaction of members of the Coronavirus family: -

Table 1 – Biocidal Active Effect on Viruses

Active	Concentration	Time	Viricidal action	Source
Peracetic acid	0,01 %	1 min	Activity against enveloped viruses (EN14476 - Vaccinia)	[4]
Peracetic acid	0,15 %	5 min	General viricidal activity (EN14476 – Poliovirus, Adenovirus and Murine Norovirus)	[5]
Benzalkonium chloride	0,05 – 0,1 %	10 min	Activity against coronaviruses of animal origin. Activity against SARS-CoV-2	[6,7]
Didecyl dimethyl ammonium chloride	0,0125 %	10 min	Activity against enveloped viruses	[8]
Ethanol	70 %	1-5 min	General viricidal activity. Activity against SARS-CoV-2	[7,9]
Sodium hypochlorite	0,1 – 0,5 %	1 min	SARS-CoV-2 decontamination on surfaces, Activity against coronaviruses of animal origin	[6,10]
Isopropanol	50 %	10 min	Activity against coronaviruses of animal origin	[6]
Glutaraldehyde	0,5 %	1 min	Activity against SARS-CoV	[11]
Hydrogen peroxide	0,5 %	1 min	SARS-CoV-2 decontamination on surfaces	[10]
Hydrogen peroxide	0,5 %	1 min	Activity against Human coronavirus (HCov 229E)	[11]

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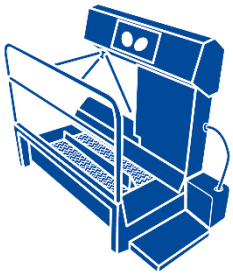
Hard Surface / Common Contact Point Identification

Identification and risk assessing of common contact points such as door handles, touch-screens, hand-rails and the like is crucial to avoid cross-contamination of employees hands.

Of course, each operation will have their own intricacies and we suggest assembling a cross-functional team (virtually if necessary) to brain-storm ideas, suggestions and locations of those items of equipment, fabrication or utilities that personnel regularly and routinely touch and interact with. From this a schedule to allow for at least daily cleaning and disinfection can be created and implemented.



This is especially important given the reported lag between an individual being infective and shedding viral particles and displaying symptoms. As an example, if a food handler reports testing positive for COVID-19 then a preventative programme will have reduced the risk of common contact points having transferred the virus to other employees. Suggestions such as colour coding contact points as "red, amber, green" in terms of cross-transfer capability are worth factoring into your risk assessment.

In terms of routine cleaning and disinfection regimes for food contact and processing equipment, the message is to carry on as normal with an overlay of a product capable of inactivating viral contaminants for those common contact points – specifically a product tested against BS EN 14476.

Whilst this standard does not include this newly identified novel Coronavirus, it does contain Rotavirus which is also an encapsulated virus. The WHO have reported that products based on hydrogen peroxide, peracetic acid or sodium hypochlorite are all effective against the coronavirus "family" as are solutions containing greater than 60% alcohol. Generic products are: -

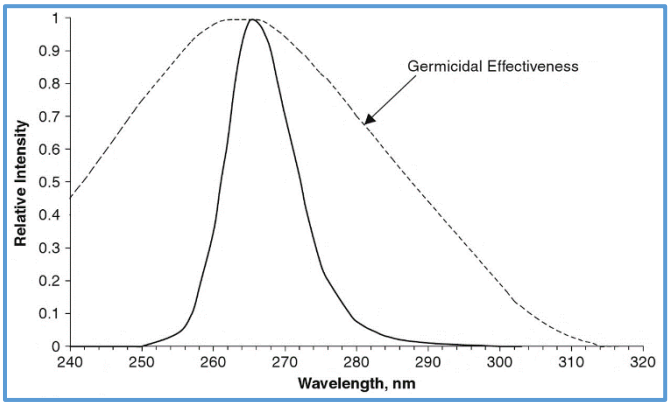
- **Alcohol Based** – available as a ready to use solution or a pre-impregnated wipe based on 70% Propyl alcohols. The product should have verified viricidal efficacy under BS EN 14476
- **Peracetic Acid Based (foaming)** – an OPC Peracetic Acid disinfectant containing at least 250 ppm PAA at 1% v/v
- **Peracetic Acid** – 5 and 15% w/w respectively Peracetic Acid disinfectant concentrates suitable for CIP. The products have verified viricidal efficacy under BS EN 14476
- **Sodium Hypochlorite** - solutions of Sodium Hypochlorite, typically 14 – 15% delivering 1,000 PPM free Chlorine
- **Hydrogen Peroxide** – Only really useable as a stabilised solution often in a ready to use trigger spray based on Hydrogen Peroxide, stabilised with ionic silver (other methods may leave a residue) and a suitable shelf-life at ambient temperatures. The product should have verified viricidal efficacy under BS EN 14476.
- **In-Situ Generation** – examples include hypochlorous acid (electrolysis of a brine solution), chlorine dioxide and Ozone. Each of these can demonstrate viricidal efficacy, however they require the introduction of suitable generation equipment and monitoring systems to effectively control them.
- **Non-oxidising disinfectants** – QAC and Triamine based products have been demonstrated to have achieved efficacy against some enveloped viruses (check the specific accreditation on a product by product basis).

The Technical Account Management team from your hygiene support provider will be able to advise on the safe deployment and use of these disinfectant products as they may differ from those in routine use and, in the particular case of sodium hypochlorite solutions, they may require a rinse step to be included to avoid product taint or contamination.

Many of the UK hygiene support suppliers have produced a range of generic CIC's (Cleaning Instruction Cards) which deal specifically with the issues of equipment disinfection as well as environmental decontamination which are readily available from your Technical Account Manager and can be deployed as part of your Food Safety Management System.

Physical Methods of Disinfection

Some of the most common methods of physical disinfection are to employ UV-C or steam. Ultraviolet germicidal irradiation (UVGI) is a disinfection method that uses short-wavelength ultraviolet (ultraviolet C or UV-C) light to kill or inactivate microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions. UVGI is used in a variety of applications, such as food, air, contact surface and water purification. Campden BRI have undertaken projects examining the benefit and use of UV-C for the decontamination of surfaces such as conveyor systems, for water decontamination and for direct treatment of food itself within the final packaging. Whilst UV-C can be a highly effective decontamination process the technology is hindered by "shadowing".



Shadowing is where folds, undersides or particulate matter, such as debris, prevents the UV-C light from impacting a surface or population (such as bacterial populations or viral particles) thereby shielding them from inactivation.

For this reason, care should be exercised if selecting UV-C as a methodology to ensure that shadowing does not take place – as an example, if exposing a contact surface to this light source then a good rule of thumb is that only those areas where the light touches will benefit from a decontamination event.

Steam is also an effective decontamination medium, whereby bacterial populations may be killed outright through the application of high temperatures or the viral envelop may be degraded, SARS-CoV-2 for example is reported to be inactivated at temperatures as low as 60º C. In these instances steam applied to surfaces can be effective at reducing both viral and bacterial loading, however surface condition and the health & safety aspects of using steam need to be carefully considered to avoid injury or surface damage.

What about fogging?

Fogging of disinfectants may prove of benefit as an additional control measure following a successful cleaning and disinfection regime.

As this accompany graphic illustrates; fogging should be regarded as the top level of the pyramid and never as a replacement for disinfection regimes in the hygiene regime.

Fogging is, that said, effective at reducing air-borne contaminants as well as reaching high levels and other difficult to access ledges and equipment tops. However, a key limitation is the inability of fog to sufficiently penetrate closed sections (such as control panels, box sections, etc) nor to impact on the loading on downward facing vertical surfaces. One must also bear in mind that vertical surfaces will receive limited contact with the disinfectant fog as gravity will intervene and cause run off. Attempts have been made, with limited success, to impart an electrical charge to the fog droplets (electrostatic fogging) which can help to overcome this limitation by causing fog to "cling" to surfaces of an opposing charge. It is this last statement that is pertinent here as if the surface has no discernible charge, plastic for example, or an opposing charge then cling will **not** take place.

Suitable chemicals for application by fog include: -

Product Name	Typical Recommended Concentration	Microbial Efficacy					Material Compatibility	Operator Safety
		B	S	Y	M	V		
Triamine	0.5 - 2.0%	+++	0	++	+	0	+++	++
QAC (BAC/DDAC)	2.0 – 5.0%	+++	0	++	+	+	+++	++
Sodium Hypochlorite	0.25 - 1.00% 292.5 – 1,170ppm Cl_2	+++	+++	+++	+++	+++	- - -	+
Peracetic Acid	1.10 – 2.20% 280.0 – 560ppm PAA	+++	+++	+++	+++	+++	- -	+
Silver-stabilised Hydrogen Peroxide	3 - 6% H_2O_2	+++	+++	+++	+++	+++	+++	+

Key:- B = Vegetative bacteria **S =** Spores **Y =** Yeast **M =** Moulds **V =** Viruses

Anticipated Reductions in Micro-flora Populations.

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Extensive research has been conducted into the pros and *cons* of fogging, the following details some of the main points identified: -

- Fogging is found to have a good disinfecting effect on upwardly facing horizontal surfaces reported as up to 6 log reductions after 60 minutes.
- Fogging is not an effective method for disinfection of vertical surfaces, the undersides of equipment or dismantled components because of the lack of chemical coverage on such surfaces.
- Airborne microbiological contamination can be reduced by fogging - 2 log reductions after 30 minutes; 3 log reductions after 60 minutes.
- Fogging is most effective with particle sizes in the range 10 - 20 microns (µm) with an air velocity at the nozzle of 100m/s. for larger particle sizes, i.e. above 35 µm (microns) then the droplets may need to be fan assisted for dispersal and enhanced distribution. For smaller particle droplets - below 10 µm (microns), then the settling time will need to be increased.
- Under typical factory conditions, fogging needs to be carried out for a minimum 15 - 30 minutes to enable the fog to disperse and the chemical action to occur. After fogging an additional period of 45 - 60 minutes is required to allow the droplets to settle and reduce the risk of operators inhaling the chemical droplets.
- Compressed air driven fogging nozzles are recommended, either plumbed in systems or mobile units. Portable electric fogging machines do not operate at sufficient volume flow rate for most applications and are therefore not recommended.

Where possible, nozzles should not be placed near the floor or be pointed at surfaces within the range of the plume generated by the nozzle.

Future Developments

Information and search results pertaining to SARS-CoV-2 is continuing to evolve and both the NHS and WHO have commented that the situation, at least in the UK and Ireland, is unlikely to have peaked. SOFHT will continue to monitor developments and will issue further guidance should the situation change, or new technologies become available.

In the meantime, if you have any questions or queries then please do not hesitate to contact your local Technical Account Manager Hygiene Support company's Central Technical Team.

Peter Littleton
Chair and Training Services Director
The Society of Food Hygiene & Technology
4th July 2020

References: -

1. Gorbalenya, A.E.; Baker, S.C.; Baric, R.S.; de Groot, R.J.; Drosten, C.; Gulyaeva, A.A.; Haagmans, B.L.; Lauber, C.; Leontovich, A.M.; Neuman, B.W.; et al. The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat. Microbiol.* **2020**, *5*.

2. McDonell, G.E. *Antisepsis, Disinfection, and Sterilization: Types, Action, and Resistance*; 2nd ed.; American Society for Microbiology Press: Washington DC, 2017;

3. World Health Organization, W. *Laboratory biosafey guidance related to coronavirus disease 2019 (COVID-19)*; 2020;

4. Rabenau, H.F.; Rapp, I.; Steinmann, J. Can vaccinia virus be replaced by MVA virus for testing virucidal activity of chemical disinfectants? *BMC Infect. Dis.* **2010**, *10*.

5. Becker, B.; Brill, F.H.H.; Todt, D.; Steinmann, E.; Lenz, J.; Paulmann, D.; Bischoff, B.; Steinmann, J. Virucidal efficacy of peracetic acid for instrument disinfection. *Antimicrob. Resist. Infect. Control* **2017**, *6*, 1–6.

6. European Centre for Disease Prevention and Control Interim guidance for environmental cleaning in non-healthcare facilities exposed to SARS-CoV-2. **2020**, 1–3.

7. Chin, A.W.H.; Chu, J.T.S.; Perera, M.R.A.; Hui, K.P.Y.; Yen, H.-L.; Chan, M.C.W.; Peiris, M.; Poon, L.L.M. Stability of SARS-CoV-2 in different environmental conditions. *The Lancet Microbe* **2020**, *5247*, 2004973.

8. Shirai, J.; Kanno, T.; Tsuchiya, Y.; Mitsubayashi, S.; Seki, R. Effects of Chlorine, Iodine, and Quaternary Ammonium Compound Disinfectants on Several Exotic Disease Viruses. *J. Vet. Med. Sci.* **2000**, *62*, 85–92.

9. Kampf, G. Efficacy of ethanol against viruses in hand disinfection. *J. Hosp. Infect.* **2018**, *98*, 331–338.

10. Ministerio de Sanidad Documento técnico Prevención y control de la infección en el manejo de pacientes con COVID-19. **2020**, 1–14.

11. Kampf, G.; Todt, D.; Pfaender, S.; Steinmann, E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J. Hosp. Infect.* **2020**, *104*, 246–251.