THE FOOD PROCESSING INDUSTRY AND COVID-19 Part 2

This popular paper was prepared by Prof Elna M. Buys Head Department of Consumer and Food Sciences, University of Pretoria and students from her research group: Katiyo W. (PhD student), Olaonipekun B. A. (PhD student), Agbemavor S. W. K. (PhD student), Torgby-Tetteh W. (PhD student), Elegbeleye J. (PhD student) and Faife S.L. (PhD student).

Food safety management systems (FSMS) and SARS-CoV-2 in food processing

Food safety is primarily achieved through preventive measures. HACCP system is an internationally recognised system of food safety management whose focus is on process control and the prevention of identified microbiological, physical and chemical hazards. FSMS are designed to manage food safety risks and prevent food contamination and therefore mitigate contamination of food by the SARS-CoV-2 virus. FSMS are built on prerequisite programmes that include: good hygiene practices, cleaning and sanitation, zoning of food processing areas, supplier control, storage, distribution and transport, personnel hygiene and health. These promote environmental conditions that are favourable to the production of safe food. No evidence showed that consumers will receive potentially infectious exposures of SARS-CoV-2 via the consumption of contaminated food or the handling of food contact materials or packaging. So, it may not be anticipated that food products will need to be recalled or withdrawn from the market because of SARS-CoV-2 contamination.

Nonetheless, the food industry must reinforce all good hygiene practices and ensure that they are practised preventing person-to-person COVID-19 transmissions in food processing facilities. Some food facilities may also need to consider a more frequent cleaning and disinfection schedule for high-risk food product processing, such as ready-to-eat foods. It has been reported that SARS-CoV-2 virus is susceptible to many chemicals already in use in the food industry. For more information, access https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19.

The COVID-19 pandemic has affected travel and/or access resulting in the temporary suspension of third-party food safety audits. The level of direct regulatory and auditing has thus been reduced to prevent the risk of virus transmission during on-site visits. In the meantime, some FSMS certification bodies have resorted to remote food safety auditing and conducting risk assessments on certified food processors. This is to ensure continued compliance and to check the effectiveness of the system of food safety practices. The current pandemic is also an opportunity for food processors to execute and test their crisis management programmes and make improvements if needed.

The majority of SMEs in South Africa do not have an FSMS established. There is a need to appoint a person/team responsible for ensuring that employees know how to work hygienically in these SMEs. This designated person/team must liaise with local food safety authorities for basic guidelines. There is an urgent requirement for the food industry to strengthen FSMS to protect employees from contracting and transmitting COVID-19.

Food processing technologies: which are more effective?

Foodborne viruses such as Hepatitis A and noroviruses consist of two main structural components. The genome and the capsid and their virulence require both. The capsids are responsible for adhesion to the receptors of the host cell receptors and subsequent entry and shielding of the virus, especially the enteric ones against environmental dynamics such as UV lights, heat, and pH. Therefore, to inactivate the foodborne virus, processing technologies must be targeted in such a way that can damage their nucleic acids, capsids or even both. Destruction of the viral genome (nucleic acids) during rigorous food processing procedures reduces the infectivity of the virus.

There are chemicals or biochemical substances that are used to control pathogenic microorganisms when applied on surfaces. These usually come in the form of sanitisers and disinfectants. The efficacy of these disinfectants can be decreased with multiplicity of applications from farm to fork such as clean-up of handling equipment, processing water, processing equipment, wash water, and factory floors.

Effect of thermal, refrigeration, freezing, and irradiation on SARS-COV-2

Food-based viruses can be inactivated by extrinsic and intrinsic elements of the food, chemical centred technologies and food processing technologies. A multiplicity of factors determines the survival dynamics of the SARS-CoV-2 virus. Therefore, we must understand the different environmental conditions, including temperature, pressure, humidity, and acidity that predict the stability, survival, and infection abilities of the virus. Extrinsic properties of foods such as water activity, pH, refrigerated and frozen storage temperatures of foods conventionally are relied upon to control and keep foods microbiologically safe. This is mainly due to their ability to inhibit microbial growth within such foods. in the case of viruses, some of these regulatory procedures might not be relevant because infectivity is key contrary to growth in the case of food spoilage or pathogenic bacteria.

Like many bacterial pathogens, viruses can remain relatively stable under refrigeration and freezing storage conditions. For over 6 months, no reduction was recorded for Murine Norovirus (MNV) on spinach and spring onions whereas, after 28 days of frozen storage, a reduction of <1.2 log10 reductions were recorded in strawberries (whole and puree).

SARS-CoV-2 has been demonstrated to be stable up to 72 hours and two years at refrigeration (4 □) and deep feezing (-20 □) temperatures respectively. SARS-CoV can be inactivated at a minimum temperature of 75 □ for up to 15 min, unlike MERS which can be inactivated at 65 □ for 1 min. SARS-CoV-2 was reported to be thermolabile from a minimum temperature of 70 □ for at least 5 minutes. These findings imply that conventional cooking temperatures are adequate to inactivate the virus. However, fresh and frozen foods may still serve as vehicles for transmission. Strict adherence to safety protocols, particularly comprehensive handwashing even after handling such foods is essential. Foods that are shipped over a couple of days irrespective of packaging and transportation temperature have much lower probabilities of transmission. Like foods, drinking water is not considered as a means of transmission of the SARS-CoV-2 per reports from the Environmental Protection Agency (EPA) and CDC. This is because water treatment procedures are generally adequate for the inactivation of the virus.

Thermal processing of foods has been demonstrated over and again to be one of the best efficient techniques of inactivating foodborne viruses such as HAV, Hepatitis E (HEV) and NoV just like pathogenic bacteria. At lower temperatures such as pasteurisation temperatures, MNV and HAV were demonstrated to record more than 3.5 log10 at 72 after 1 minute in water. Similarly, MNV and TuV were also reported to be inactivated after heating at 70 °C for 2 min. Steam blanching of produce like spinach for 1 minute at 80 □ reduced the infectivity of MNV by a minimum of 2.4 log10. Similarly, FCV and HAV were also immensely inactivated after blanching at 95□ for 2.5 minutes. Strategic combination of acidification (pH reduction) of foods in addition to thermal treatment was also reported to be very effective against the inactivation of HAV.

Regardless of the minimum temperature and time requirements for inactivation of different viruses, in most cases, a minimum of 90 s of thermal processing at a minimum temperature of 90 □ is generally sufficient in inactivating enteric viruses irrespective of the complexity of the food matrix. It is generally believed that a boiling liquid medium such as water is capable of effectively inactivating the virus after about just 1 minute for more than 4 log10 for most enteroviruses including, human NoV, human rhinovirus (HRV), HEV, and HAV.The dried virus was reported to retain its infectivity at 22-25 □ and relative humidity of 40-50 % over 5 days. At higher temperatures (38 □) and relative humidity (> 95 %) quickly loss this its viability (> 3 log10).

Extrinsic changes in pH levels as occurs in fermentation or acidification of carbohydrate substrates as well as in water activities levels of foods for example by means adding solutes like sugar or salt and drying or their combinations and even coupled with dynamics of storage conditions have different effects on the infectivity of viruses. MNV and TuV for example were found to tolerate low pH levels (pH 2) due to lactic acid fermentation. Even though fermentation was reported to be

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Child Labour and Young Workers, Discrimination, Freedom of Association and Collective Bargaining, Harassment and Abuse, Compensation and Hours of Work.

However, the audit process is not without its flaws, something we should be aware of. According to ethicaltrade.org "We still see workers bullied and harassed – and having to work long hours for very low wages. Audits can also miss key issues such as discrimination against minority groups or management resistance to allowing workers their right to freedom of association".

It seems that even ethical audits can become a box-ticking exercise if they are driven by the desire to certify a site for sourcing, rather than genuinely trying to assess the situation for workers.

The bigger picture

To drive sustainable improvement in their supply chains, companies must think about the bigger picture and not just take corrective action on specific issues. As recent events in the media have shown is, there may be labour rights issues that are common within a country and region. Like with food fraud, horizon scanning is essential to ensure that the audit results are consistent with the bigger picture.

As Ethicaltrade.org stress: "It certainly means recognising that where specific problems are known to be endemic, a clean bill of health from an audit may well be incorrect and put the business at risk."Ethical audits are here to stay, and it is not if you are required to have one, but rather when. As we have learnt with food safety, the hard way, audits can be a useful tool in the responsible business toolkit if used skilfully and appropriately. But, like any toolkit, there needs to be other tools appropriate for other tasks. Doing the right thing is not to tick an audit box, it because it is the right thing to do

References
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capable of producing antiviral properties and compounds with potential usage as food additives, the underlying antiviral mechanisms are still yet to be fully understood.

Antiviral food components and food packaging

Plant extracts have been demonstrated to exhibit varying antimicrobial properties and are as such utilised for the preservation of raw and processed foods particularly for preservation and transmission control of viruses within the gut. In this vein, extracts from cranberries, grape seeds, mulberries, pomegranates and raspberries were found very useful in different concentrations and substrate conditions for inactivation of multiple viruses. The inactivation of Hepatitis A virus and (HAV) and Norovirus (NOV) was generally found to be subject to the concentration and the time of exposure to the active compound. It was found that the grape seed extracts reduced the adhesion of Murine norovirus (MNV), Feline calicivirus (FCV), and HAV to the host cells. Raspberry seed extracts was also found to have similar effects on FCV, and MNV. Lemongrass was also reported to have a time dependent reduction effect on MNV in addition to reducing the infectivity of the virus by coating the viral capsid. Spice oil was also reported to affect the viral RNA and the capsid.

A positively charged polysaccharide called chitosan consisting of acetyl glucosamine and glucosamine was also shown to have intense antiviral effects against MS2, FCV and, MN. Incorporation of green tea and grape seed extracts into chitosan films also reported to have a synergistic effect against MNV. with Plant based phenolic compounds such as flavonoids and phenolic acids were demonstrated to show immense antiviral effects against rotavirus and FCV.

Other naturally occurring biochemicals were also illustrated to have immense antiviral effects. Low concentrations (1.0 µg/ml) of saponin for example was reported to have inhibitory effect against rotavirus by obstructing its attachment to host cells. Citric acid was also reported to block the human Noroviruses (NoVs) from their co-receptors known as histoblood group antigens (HBGA). Additionally, some milk proteins such as lactoferrins were reported to block the entry of certain viruses e.g. FCV, rotavirus, and PV into the host cell.

Effects of irradiation on SARS-CoV-2

Ultraviolet (UV) radiation has been reported to be effective in activating some viruses. Its efficacy against the SARS-CoV-2 has not yet been tested. SARS coronavirus was extremely susceptible to the ultraviolet irradiation. It has been recommended as an additional level of safety during the physical process of disinfection.

Comparing the efficiency of disinfection: manual chemical methods reduced the contamination with 36% and a 96 to 99.99 % reduction by ultraviolet irradiation from

PurpleSun® E300 system UV system was achieved. At lower viral concentrations, low dose of UVC radiations (200 – 280 nm) completely inactivated the SARS-CoV-2, and higher doses altogether disabled higher concentrations of the virus.

Gamma irradiation between 3 000 to 15 000 rad had no effect on the inactivation of the SARS-CoV, indicating that the irradiation dose range was too low to affect the virus. Whereas the virus was inactivated by UVC (unlike UVA 320 – 400 nm) after about

6 minutes of exposure. This implies that low wavelength UVC radiation could be effective in deactivating the virus from suspected foods products.

Recommendations for future outbreaks

There is a need for a cross-platform strategy to mitigate the spread of the virus along the food chain. This may involve international and governmental agencies, food industry, retailers, food handlers and consumers. The use of artificial intelligence (AI) to monitor and trace any exposure to SARS-CoV-2 is recommended, especially in the industry dealing with fresh products such as meat and vegetables.

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