



Respiratory viruses in foods and their potential transmission through the diet: A review of the literature

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ABSTRACT

Respiratory viruses are the main agents causing respiratory tract diseases. Nowadays, coronaviruses – and specifically, SARS-CoV-1, MERS-CoV and SARS-CoV-2 – are the principal responsible for the major epidemic outbreaks of the 21st century. The major routes of transmission for respiratory viruses – including coronaviruses – are via direct and indirect contacts. However, transmission through contaminated foods has not been extensively assessed. The present paper was aimed at reviewing scientific data on the transmission of respiratory viruses through potentially contaminated foods. While the current data seem to suggest that this route of transmission is not likely to occur, in order to increase the knowledge on this issue further investigations are still clearly necessary for a more complete prevention of the risks. Studies should include fresh produce and cooked foods. Anyway, prevention measures and good hygienic practices for both consumers and workers are mandatory when handling and cooking foods.

1. Introduction

Respiratory viruses are the main etiological agents for the respiratory tract diseases, which cause important health and socioeconomic impacts around the world (Bosch et al., 2018; Cho et al., 2020; Ciotti et al., 2020; Jacobs et al., 2013; Lehtoranta et al., 2014). The most relevant groups of respiratory viruses include rhinovirus, enterovirus, influenza, adenovirus, bocavirus and coronavirus.

Human rhinoviruses (HRVs) are the most common cause of the upper respiratory tract infection, also usually known as common cold (Royston and Tapparel, 2016). However, HRVs have been also linked with asthma, severe bronchiolitis and fatal pneumonia (Jacobs et al., 2013; Jamieson et al., 2015; N. Zhang et al., 2020a). In turn, human enterovirus (HEV) contains four genus (HEV-A, -B, -C and -D), with phenotypes ranging from a common cold to acute flaccid paralysis (AFP) (Tapparel et al., 2013). In contrast to rhinoviruses, enterovirus resists body temperature and acidic conditions (Tapparel et al., 2013).

On the other hand, influenza viruses cause acute respiratory infections leading to a significant morbidity and mortality throughout the world (Gaitonde et al., 2019; Jia et al., 2017; Pawelka et al., 2020). Influenza viruses include four types of virus (A, B, C and D), being the type A the one containing most subtypes – which are determined by the Hemagglutinin (H) and the Neuraminidase (N) antigens – types B and C

do not have known subtypes, while influenza D viruses are not known to infect people (Kumar, 2017).

Even though adenoviruses (AdVs) cause mild respiratory infections, either in the upper or in the lower respiratory tract, in some cases can lead to more severe effects, such as haemorrhagic cystitis and colitis, encephalitis, myelitis, AFP or multiorgan failure (Langley, 2005; Lynch et al., 2011; Lynch and Kajon, 2016; Onda et al., 2020). Outbreaks in the human population are mainly caused by the species A, B, C, D and E, with most infections (80%) occurring in children (Lynch et al., 2011).

For its part, human bocavirus (HBoV) is a parvovirus that causes acute respiratory infections with symptoms ranging from those similar to a common cold to severe respiratory tract infections (Lee et al., 2019). Similarly to AdVs, HBoV mainly affects children, with evidence suggesting that nearly all the population is infected with HBoV during childhood (Allander, 2008; De et al., 2017; Petrarca et al., 2020). Four subtypes of HBoV have been identified since its discovery in 2005, named as HBoV1, HBoV2, HBoV3 and HBoV4 (Guido et al., 2016).

Last, human coronaviruses (HCoVs) are a kind of viruses principally linked to respiratory tract diseases (van Der Hoek et al., 2006). Up to seven strains of coronavirus have been identified (229 E, OC43, NL62, HKU1, SARS-CoV-1, SARS-CoV-2 and MERS-CoV), being SARS and MERS strains, those causing the most severe health outcomes (Ezhilan et al., 2021; Thippreddi et al., 2020; Van Der Hoek et al., 2006). In

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relation to this, SARS-CoV-1 was the responsible of the first big epidemic of the 21st century. It was initially reported in China in 2002, with an associated fatality rate of 9.6% (Mann et al., 2020). Subsequently, MERS-CoV caused the second outbreak. It was first detected in Saudi Arabia in 2012, having a fatality rate of 36% (Mann et al., 2020; Roychoudhuri et al., 2020; Ryabkova et al., 2020). In recent months, SARS-CoV-2 is causing the latest coronavirus outbreak, known as COVID-19, with more than 90 million of infected people and 2.06 million deceased as of January 21, 2021. Although SARS-CoV-2 is associated with milder health effects than SARS-CoV-1 and MERS-CoV, SARS-CoV-2 is more efficiently transmitted within the community, while SARS-CoV-1 and MERS-CoV are associated with nosocomial spread (Pergolizzi et al., 2020; Petrosillo et al., 2020). The most common symptoms caused by SARS-CoV-2 include fever, dry cough, fatigue, shortness of breath, and loss of taste and smell, while the less common include skin lesions, gastrointestinal outcomes, neurological manifestations and respiratory failure (Carrascosa et al., 2020; Gisondi et al., 2020; Matar et al., 2020; Romoli et al., 2020; Zheng et al., 2020).

The main routes of transmission of the above respiratory viruses are through direct – human to human – contact, or indirectly, via droplets or aerosol transmission (Kutter et al., 2018; Liang et al., 2020; Morawska and Cao, 2020). Another possible route of transmission might be through particulate matter (PM), since PM could be acting as a carrier, transporting SARS-CoV-2 in deeper bronchial and alveolar regions (Domingo et al., 2020; Domingo and Rovira, 2020; Marquès et al., 2021; Patel et al., 2020; Setti et al., 2020; Thanh et al., 2020).

The potential infectivity through contaminated foods is a gap in the current knowledge of the transmission of respiratory viruses. The dietary route as a possible pathway of infection has been much less studied than others, in spite of the fact that production, processing, and cooking involve the manipulation of a great number of foodstuffs (Jalava, 2020; O'Brien et al., 2021; Thippareddi et al., 2020). In this sense, it is basic to know all the potential routes of infectivity for a better prevention of the transmission of all respiratory viruses, including SARS-CoV-2. Recently,

we reviewed the results of a number of studies on contamination of inert surfaces by SARS-CoV-2, and its persistence, stability and infectivity (Marquès and Domingo, 2020). The present review is aimed at reviewing scientific data on the transmission of respiratory viruses through contaminated foods. Moreover, environmental conditions, which could impair the viruses' stability, have been also reviewed.

2. Search strategy

PubMed (<https://pubmed.ncbi.nlm.nih.gov/>) and Scopus (<https://www.scopus.com>) were used as the databases to found the available studies in the scientific literature. On one hand, the terms “respiratory virus”; “human rhinovirus”; “human bocavirus”; “human influenza”; “human enterovirus”; “human adenovirus”; “human coronavirus”; “SARS-CoV-1”; “SARS-CoV-2” and “MERS-CoV”, were used in order to describe the different respiratory virus selected. On the other hand, the terms “food”; “food products”; “foodborne” and “fresh produce” were used to narrow the search. Additionally, the terms “stability”; “transmission” and “viability” were used to further refine the search in those cases where the number of articles were considerably high. The combination of terms was done with the Boolean operator AND. A total of 3986 articles were retrieved from the literature, where 3729 corresponded to “food”, 16 to “food products”, 88 to “foodborne”, 46 to “fresh produce”, 87 to “food AND stability”, 19 to “food AND viability” and 1 to “food AND transmission”. Duplicates were removed and the abstracts of the remaining articles were checked. A summary of the studies here revised is presented in Table 1.

3. Persistence and stability of SARS-CoV-2 in foods

Contamination of foods by viruses in general, and by SARS-CoV-2 in particular, could potentially occur during all the steps of the food production chain (farming, processing, storage, transport and retailing), as well as by infected workers, who do not follow strict hygienic practices

Table 1
Persistence and prevalence of respiratory viruses on different foods.

Type of virus	Food product	Main results	Reference
SARS-CoV-2	Human milk	Inactivation of the virus at 56 °C or 63 °C during 30 min. Storage at 4 °C or –30 °C did not impact on the infectious titre during 48 h.	Walker et al. (2020)
SARS-CoV-2	Salmon, chicken, pork	Storage at 4 °C, –20 °C or –80 °C did not affect the titre during 21 days.	Fisher et al. (2020)
SARS-CoV-2	Tomatoes, apples, jalapeños	No infectious titre could be recovered 1 h after simulated low-dose aerosol exposure,	Haddow et al. (2020)
MERS-CoV	Dromedary milk, cow milk, goat milk	Reductions of the infectious titre (37–64%) when stored at 4 °C during 72 h	van Doremalen et al. (2014)
HAdV	Mussels	Detection in 36% of the samples	Diez-Valcarce et al. (2012)
HAdV	Snails	Not detected in any sample	Paszkiwicz et al. (2016)
HAdV	Fish, bivalve molluscs, crustaceans, cephalopods	DNA from AdV detected in 21.27% of samples	Ghosh et al. (2019)
HAdV	Fresh raspberries, frozen raspberries, fresh strawberries	Prevalence of HAdV was between 0.7 and 3.2% in the sale point	Maunula et al. (2013)
HAdV	Fresh lettuce, strawberries	Detection in 93.3% of the samples	Marti and Barardi (2016)
HAdV	Chinese cabbage, cucumber, lettuce, strawberries	Not detected in any sample	Shin et al. (2019)
HAdV	Lettuce, strawberries, cherry tomatoes	Log reduction between 0.92 and 2.13 when treated with UV during 30 min. Log reduction ranged 0.36 and 0.85 with US disinfection	Birmipa et al. (2016)
HAdV	Fresh produce	Log reduction of infectious virus between 3 and 4 after 24 h at 30 °C	Carratalà et al. (2013)
HAdV	Strawberries, raspberries	Virus was persistent at 4 °C, but infectious particles decayed rapidly at 21 °C	Verhaelen et al. (2012)
HAdV, murine norovirus	Strawberries, raspberries	Irradiation with a dose of 4 kGy reduced infectious particles by 2 log PFU/g	Pimenta et al. (2019)
HAdV, HCoV-229	Lettuce, strawberries, raspberries	Storage at 4 °C resulted in no recovery of HCoV-229 after 4 days, and reductions of 1.97 log ₁₀ and 2.38 log ₁₀ of HAdV	Yépez-Gómez et al. (2013)
Bovine coronavirus	Lettuce	Viral RNA copy number ranging between 6.6 × 10 ⁴ to 1.7 × 10 ⁶ was found during 30 days, while infectious virus could be detected for at least 14 days	Mullis et al. (2012)
Influenza	Poultry	Heating products more than 10 s at more than 70 °C resulted in inactivation of the virus	Harder et al. (2016)
HBoV	Mussels	Virus was detected in 8.5% of the samples	La Rosa et al. (2018)
HBoV	Mussels	Virus was found in 2 of 30 analyzed samples	Onosi et al. (2020)

(Han et al., 2020). Hence, different measures are required to ensure the safety of the foods and avoid the potential risk of transmission, in each step of the food production, handling and cooking processes. These measures include checking for potential symptoms in workers, washing hands, disinfection of surfaces, proper window ventilation, cooking at appropriate temperatures, and keeping social distancing, among others (Olaïmat et al., 2020; Rizou et al., 2020). In this sense, the Centre for Disease Control and Prevention (CDC) has elaborated a guidance document for meat and poultry processing workers and employers in order to ensure safety within their facilities (CDC, 2020a). Notwithstanding, according to several international organizations, the risk of infection through consumption of contaminated foods is being considered to be very low (Government of Canada, 2020; CDC, 2020b; EC, 2020; FDA, 2020). However, SARS-CoV-2 pandemic has had a great impact in the food industry, as well as in the food safety due to the high economic losses (Ma et al., 2020; Mardones et al., 2020). For example, recently White et al. (2021) have reported that seafood catches, imports and exports in the US seafood sector have declined by 40%, 37% and 43%, respectively, when compared to the previous year.

In turn, zoonotic viruses, which are responsible for up to the 70% of the current emerging diseases, might be another potential source of food contamination (Ceylan et al., 2020; Faslu Rahman et al., 2020). A recent evidence suggests that SARS-CoV-2 is able to infect pig and rabbit cells under certain *in vitro* conditions (Yekta et al., 2020). In addition, it is widely known that heparin and heparan sulfate are present in many foods, such as seafood, poultry or pork (Pressman et al., 2020; Yekta et al., 2020). SARS-CoV-2 requires these compounds in order to attach to the target cells (Clausen et al., 2020; Tiwari et al., 2020; Zhang et al., 2020b). Therefore, poor hygienic conditions when handling meat-based products, for example, could be a potential route for SARS-CoV-2 infection.

The society is globally concerned by the ongoing pandemic of SARS-CoV-2. Consequently, knowledge on all the potential routes of infection – including contaminated foods – is crucial. In a recent survey conducted by Faour-Klingbeil et al. (2021), it has been shown that 70% of the 1074 subjects surveyed in Lebanon, Jordan and Tunisia, were concerned about the possibility that SARS-CoV-2 could be transmitted through contaminated foods. Moreover, the perception of risk was even higher when considering transmission by touching contaminated surfaces and being exposed to infected people during shopping. Consequently, studies to establish whether the transmission through contaminated foods might be a source of infection by respiratory viruses, including the currently feared SARS-CoV-2, are needed. In fact, airborne virus-like particles have been isolated from Grana Padano and Gorgonzola cheese production plants (Colombo et al., 2018). Thus, this route of transmission could be a key aspect for certain epidemic outbreaks.

To date, only a rather simple study on the persistence of SARS-CoV-2 on foods has been published. Thus, Walker et al. (2020) investigated if pasteurization treatment and storage of milk could affect SARS-CoV-2 inactivation and stability. Results showed that after heat treatment at 63 °C or 56 °C for 30 min, SARS-CoV-2 could not be detected in human milk samples. Moreover, cold storage either at 4 °C or –30 °C did not impact on the infectious titre over a period of 48 h (Walker et al., 2020). In turn, no infections by SARS-CoV-2 through cow milk consumption have been reported (Duda-chodak et al., 2020). Similarly, Fisher et al. (2020) found that titre of SARS-CoV-2 remained unchanged for 21 days when stored at 4 °C, –20 °C and –80 °C in samples of salmon, chicken and pork collected from Singapore, while Haddow et al. (2020) modelled the stability of SARS-CoV-2 on the surface of tomatoes, apples and jalapeños, after a simulated low-dose aerosol exposure. The results showed that 1 h after exposure, no infectious virus could be recovered; thus, potential risk of infectivity remains low (Haddow et al., 2020). Other unfavourable conditions for the survival of SARS-CoV-2 include acidic pH (less than 3), minimum relative humidity, and production of foods fortified with vitamins, amino acids and tannins (Goli, 2020). Moreover, development of antiviral materials and coatings can be useful

to diminish the transmission of SARS-CoV-2 (Bueckert et al., 2020).

Results of the rather scarce number of studies on the topic found in the scientific literature and here reviewed, clearly pointed out that infection risk from SARS-CoV-2 through contaminated foodstuffs and packaging is very low (Anelich et al., 2020; Ceylan et al., 2020; Hakovirta and Hakovirta, 2020; Olaïmat et al., 2020). Although foodborne transmission has not been evidenced, by contrast, some incidents with frozen foods have been reported (Han et al., 2020; Liu et al., 2020). Thus, SARS-CoV-2 was detected in a cutting board used for processing salmon, while it was also detected in packaging materials (Han et al., 2020). In this sense, van Doremalen et al. (2020) evaluated the stability of SARS-CoV-2 in different materials (cardboard, stainless steel, plastic and copper). Results showed that SARS-CoV-2 was more stable on plastic and stainless steel than on copper and cardboard. Moreover, the coronavirus could be detected in plastic and stainless steel up to 72 and 48 h, respectively. In other surfaces (copper and cardboard) no viable virus could be detected after 4 h (copper) and 24 h (cardboard) (van Doremalen et al., 2020). Similarly, Malenovská (2020) evaluated the persistence of alphacoronavirus-1 dried on a plastic carrier at 4 °C, with and without wet wiping. Results showed that if the plastic surface was not wiped, the loss of infectivity was 0.93 log₁₀ per day, while if it was wiped a reduction by 2.4 log₁₀ of the initial virus titre was found (Malenovská, 2020). In general terms, the persistence of respiratory viruses on inanimate surfaces can vary from minutes to a month. It depends on the environmental conditions and absorbent material – such as cotton – that are safer for the protection from virus infection than unabsorbent materials (Ren et al., 2020). Consequently, contamination through contaminated plastic packaging materials is susceptible to occur since SARS-CoV-2 may survive on inanimate surfaces from hours to a few days. However, this potential risk of transmission could be highly reduced if surfaces are properly disinfected (Marquès and Domingo, 2020).

On the contrary, and even though the evidence is limited, the faecal-oral route of transmission is more likely to occur since diarrhoea is caused by SARS-CoV-2, and its RNA has been detected in faeces (Anelich et al., 2020; Chen et al., 2020; Li et al., 2020; Wang et al., 2020; Wu et al., 2020; Yekta et al., 2020). It is caused by the presence of angiotensin-converting enzyme 2 (ACE2), which is a cell surface protein used by the SARS-CoV-2 to enter the cells (Ceylan et al., 2020). ACE2 is expressed in numerous epithelial cell types, such as mucosal, bronchial and intestinal (ileum and colon) (Anelich et al., 2020; Duda-chodak et al., 2020). In fact, Lamers et al. (2020) found that both, SARS-CoV-1 and SARS-CoV-2, were able to infect enterocytes from the human small intestinal organoids, which subsequently produced infectious viral particles. Hence, influencing intestinal microbiota could have a potential role in the alleviation of the disease (Duda-chodak et al., 2020). According to Gwenzi (2021), contamination through faecal-oral route can be caused by three pathways: 1) contaminated drinking water; 2) uncooked and/or poorly cooked contaminated foods; and 3) vector-mediated transmission from faecal sources to foods. Thus, SARS-CoV-2 has been detected in wastewater, which raises the possibility of food contamination (Ahmed et al., 2021; Gonçalves et al., 2020; Thippareddi et al., 2020). It is well known that foodborne viruses are transmitted mainly through the faecal-oral route by consuming contaminated foods and/or water, as well as by infected food handlers and animals, so foodborne outbreaks for respiratory viruses would be plausible (Bosch et al., 2018). Nevertheless, further investigations are clearly required for a better knowledge of these three potential risks of infection.

The infectivity through foods of other coronaviruses such as MERS-CoV have been also investigated. Infectious virus titres of MERS-CoV in different types of milk stored at 4 °C decreased over 72 h. Specifically, reductions were reported to be 37% (dromedary milk), 56% (cow milk) and 64% (goat milk) (van Doremalen et al., 2014). As previously mentioned, higher temperatures (22 °C) resulted in a greater loss of infectivity (15%) than lower (4 °C). Following heating milk samples at

63 °C during 30 min, no infectious virus was recovered.

4. Persistence and stability of other respiratory viruses in foods

Regarding AdV, several studies have been conducted in recent years. HAdV was detected in 36% of the analyzed mussel samples collected from three European countries: Finland, Spain and Greece (Diez-Valcarce et al., 2012), while it was not found in any of the tested edible snail samples (Paszkiwicz et al., 2016). On the other hand, Ghosh et al. (2019) collected samples of fish, bivalve molluscs, crustaceans and cephalopods to evaluate the presence of HAdV. These authors reported that DNA from AdV was detected in 21.27% of the samples, being the highest detection rate found in clams (14.89%) and oysters, shrimps and finfish, with 2.13% each (Ghosh et al., 2019). On the other hand, the prevalence of HAdV in fresh raspberries, frozen raspberries and fresh strawberries, at the sale point, was 0.7, 3.2 and 2%, respectively (Maunula et al., 2013). In turn, Marti and Barardi (2016) analyzed the occurrence of HAdV in organic fresh lettuce, strawberries and green onions. Surprisingly, the virus could be detected in 93.3% of the samples, a value considerably higher than that reported for other fresh products and various foods (Diez-Valcarce et al., 2012; Ghosh et al., 2019; Maunula et al., 2013; Paszkiwicz et al., 2016). Notwithstanding, infectious HAdV particles were only found in 33.3% of the analyzed samples (Marti and Barardi, 2016). In contrast, HAdV could not be detected in any of the samples collected from South Korea, namely Chinese cabbage, cucumber, lettuce and strawberry (Shin et al., 2019).

With respect to the conditions that can affect viability and infectivity of the HAdV, Birmpa et al. (2016) compared ultraviolet (UV) and ultrasound (US) technologies to disinfect fresh products from HAdV. Results showed that when treatment with UV was applied for 30 min, a log reduction of 2.13, 1.25 and 0.92 was achieved for lettuce, strawberries and cherry tomatoes, respectively. Otherwise, US disinfection reached only log reductions of 0.85, 0.53 and 0.36, respectively, for these same products. Moreover, the authors reported a synergistic effect of both techniques when they were used sequentially (Birmpa et al., 2016). However, a study performed by Carratalà et al. (2013) concluded that temperature is a major factor affecting the stability of HAdV in fresh produce surfaces, with a decrease between 3 and 4 log of infectious HAdV after 24 h at 30 °C. In relation to this, Verhaelen et al. (2012) studied the stability of HAdV on soft berries, namely strawberries and raspberries, at different temperatures (4 °C, 10 °C and 21 °C). The virus was persistent at 4 °C and 10 °C on raspberries and at 4 °C on strawberries. At 21 °C, infectious HAdV particles decayed rapidly in only one day in strawberries, while it lasted up to 3 days in the surface of raspberries (Verhaelen et al., 2012). Recently, Pimenta et al. (2019) irradiated fresh strawberries and raspberries with doses between 1 and 11 kGy after inoculating HAdV type 5 and/or murine norovirus type 1 to the fresh produce. A reduction of 2 log PFU/g was observed when a dose of 4 kGy was administered. Unexpectedly, infective viral particles could still be detected after treatment with 11 kGy, the highest dose tested. It means that inactivation curves were non-linear. Anyway, radiation with doses greater than 7 kGy would compromise the food quality (Pimenta et al., 2019).

Yépez-Gómez et al. (2013) investigated the recovery efficiencies from lettuce, strawberries and raspberries for two respiratory viruses: HAdV type 2 and HCoV-229 E. HAdV type 2 was recovered with efficiencies of 56.5, 31.8 and 34.8% for lettuce, strawberries and raspberries, respectively. However, HCoV-229 E could be only recovered from lettuce (19.6%). Storage at 4 °C resulted in the inability of recover HCoV-229 E after 4 days from lettuces, and reductions of 1.97 log₁₀ and 2.38 log₁₀ of HAdV type 2 from lettuce and strawberries, respectively (Yépez-Gómez et al., 2013). A longer stability was reported for bovine coronavirus in lettuce, where viral RNA copy number ranging between 6.6 × 10⁴ to 1.7 × 10⁶ was found during the 30 days of the study. Moreover, infectious virus could be detected for at least 14 days (Mullis et al., 2012). On the other hand, Harder et al. (2016) concluded that heating poultry products

according to the cooking standards (more than 10 s at more than 70 °C), efficiently inactivated avian influenza leading to a full safety of the food products.

Although most of the procedures to control foodborne viruses rely on thermal processing, these techniques could lead to an alteration of the organoleptic properties. To avoid that, non-thermal inactivation food-processing technologies have recently been gaining popularity. They include high-pressure processing (HPP), cold plasma (CP), ultraviolet light (UV), irradiation and pulsed electric field (PEF) (Pexara and Govaris, 2020).

HBoV has been rarely detected in food samples. Specifically, it has been only found in bivalve species, but at a very low detection rates. On one hand, La Rosa et al. (2018) detected HBoV in 8.5% of mussel samples (27 out of 316) collected in three different regions of Italy. On the other hand, Onosi et al. (2020) only found this virus in 2 out of the 30 samples of mussels. Studies concerning other selected types of respiratory viruses, namely human rhinovirus and human enterovirus, and their stability on food surfaces were not available in the scientific literature.

Some of the above respiratory viruses, such HAdV, HEV, influenza and MERS-CoV are also considered foodborne viruses. However, major foodborne outbreaks have not been reported to date (Todd and Greig, 2015). Consequently, even being airborne viruses, foodborne outbreaks are plausible if safety measures and appropriate cooking techniques are not followed during the food production and cooking.

5. Conclusions

According to the evidence from the scientific literature reviewed in the present article, transmission of respiratory viruses through contaminated foods does not seem a potential route of exposure. It includes also SARS-CoV-2. However, more investigations on this issue are still clearly necessary. Interestingly, the cooking temperature is an effective way of inactivating respiratory viruses, since high temperatures significantly decrease virus stability and infectivity. On the other hand, although fresh produce could act as fomites, commonly available household chemicals reduce virus titre. It is important to remark that prevention measures and good and strict hygienic practices for workers involved in all processes handling foods (i.e.: cooks and waiters) and consumers, are absolutely mandatory in order to ensure the safety of fresh produce, cooked foods, and ready-to-eat food. Finally, eating in restaurants complying all established protocols and from a strict point of view of the food items consumed, should not pose infection risks by respiratory viruses, such as SARS-CoV-2, through the foods. This conclusion might be especially important for those concerned about eating in these establishments.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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