

SARS-CoV-2 genetic material on the surface of cardboard boxes containing frozed food?

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The Chinese authorities have reported the apparent detection of SARS-CoV-2 RNA on the surfaces of cardboard boxes (secondary packaging) containing frozen beef from Argentina. Based on the scientific information available, the following comments can be made:

- The COVID-19 pandemic is not a food safety crisis.

- The main route of transmission of the virus is between people, through tiny particles expelled from the mouth or nose when an infected person coughs or sneezes, and from aerosol transmission.

- There is no scientific evidence to support that:

1) Viruses that cause respiratory diseases in human beings (such as SARS-CoV-2) are transmitted through food.

2) Animals for human consumption (cattle, pigs, poultry, fish) transmit the virus or can become ill.

3) The SARS-CoV-2 virus is transmitted through the meat of fish, pigs, cattle, poultry or other animals for human consumption.

- Different international agencies recognize that so far, it has not been demonstrated that food is a probable source or route of transmission of SARS-CoV-2 (FAO 2020; EFSA 2020; WHO 2020; USDA 2020; FDA 2020; CDC 2020; and RSA-CONICET 2020, among others).

- Journalistic information (without scientific basis) published during the last months has caused confusion in the public opinion regarding the detection of SARS-CoV-2 genetic material on the surfaces of boxes and containers of frozen food (shrimp, salmon, chicken, pigs and cattle) from Norway, Brazil, Germany, New Zealand, Ecuador and Argentina, among others.

In this regard, it is highlighted that:

- Food production is controlled by Argentine domestic agencies/authorities, which have established protocols for the different productive sectors in relation to COVID-19.
- Meat exporting abattoirs strictly comply with work protocols, which are adequate to prevent contagion and the eventual contamination of the product.
- Most pathogenic microorganisms, including coronaviruses (CoV), can be inactivated by the Sanitation Standard Operating Procedures (SSOP) used in the food industry. SARS-CoV-2 is sensitive to the main disinfectants commonly used industrially. In this regard, it is not necessary to use special disinfection agents for virus removal.
- Based on the experimental data available (controlled temperature and humidity, among other conditions), the maximum survival of SARS-CoV-2 on surfaces such as plastic and stainless steel has been estimated to be seven days. However, there is no scientific evidence to date showing that the virus can be transmitted this way.
- The genetic material (RNA) of SARS-CoV-2 was found on the surface of cardboard boxes and not on meat produced and packaged in Argentina. Considering its structure, cardboard is considered a porous surface, and the genetic material was found after a 55-day sea voyage and after eight days of mobilization and handling within China. It should be mentioned that there is no scientific literature lending support to the fact that the virus is viable after 60 days under conditions similar to those previously mentioned.
- The sole detection of viral RNA in a sample does not imply that it contains infective viral particles. A positive result from an RNA amplification analysis (PCR or LAMP) simply indicates the detection of genetic material. Thus, the inference of the presence of infective virus is a misconception. In people who

have recovered from COVID-19, positive PCR swabs but negative viral cultures have been found.

- It has been even hypothesized that SARS-CoV-2 could survive for 20 years at -20 °C or three months at -4°C (Times Now News, 2020). Under experimental conditions, the virus has been shown to be thermolabile, although it can survive at low temperatures (4, -20 and -80°C) in special preservation media (Chin et al., 2020; WHO, 2020). Cardboard surface would not be one of these special preservation media.

Next, we present a theoretical exercise carried out with published journalistic information:

From 227,934 food samples (their packaging and environmental samples) taken in China ports (Xinhuanet, 2020), SARS-CoV-2 RNA was found in only three container samples. In July 2020, it was estimated that SARS-CoV-2 genetic material could be found on the surface of one food container out of a total of 250,000 analyzed (95% CI 1.06×10^{-6} - 2.44×10^{-5}). This estimate was reaffirmed with information generated in the ports of China: since last September, three million surface samples were analyzed, of which only 22 were positive for the detection of the virus genetic material, i.e., 1.8 per 250,000 samples.

For human cases of COVID-19 to occur from consumption of imported food, the following events should occur:

- 1) the virus should come from the exporting country;
- 2) the virus should have remained viable during transport from the country of origin to the importing country under temperature and humidity conditions;
- 3) the virus should pass from the outer surface of containers to the food inside (through the primary and secondary packaging that contains the food);

4) the virus should survive from arrival in the country of destination to final handling at homes or consumer stalls;

5) food should be handled and the handler should touch with his hands (without washing or disinfection) the mucous membranes that are viable for virus transmission (eyes, nose and mouth);

6) the dose of virus a person is exposed to should cause an infection.

Although there is no solid information to model the probability of occurrence of each of these events, it could be assumed that it is low. For infection to occur through this route, all the events detailed above should be combined. Accordingly, the ultimate risk of a person acquiring SARS-CoV-2 from handling imported food could be considered negligible. In an unfavorable scenario, it would be less than one case in a billion (1,000,000,000,000) people potentially exposed. Compared with the 7,800,000,000 people that make up the world population, the estimated risk of SARS-CoV-2 transmission through surfaces is negligible.

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