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COVID-19 ABATEMENT MEASURES AND DECLINES IN FOOD-BORNE ILLNESSES: WHAT IS THE EVIDENCE?

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Abstract

Coronavirus Disease 2019 (COVID-19) is a current pandemic infection caused by a positive-sense RNA virus named the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) which is quickly spread through the air that has fueled the current pandemic. Public health government agencies in various countries have made dramatic measures, such as a full lockout. Nevertheless, limited consideration has been devoted to food safety and security, and its possible association with the coronavirus (COVID-19) pandemic. The COVID-19 outbreak has given birth to a new age throughout the world, though we already see the implications of various facets of our everyday lives. The agricultural manufacturing process and the food processing industry do not form the exception. For the time being, the risk of transmission via the food industry is considered marginal and the detection of SARS-CoV-2 in the working setting is not perceived to be a problem for government authorities. Nevertheless, the adverse impacts on the climate, food processes and individuals in the food industry are also clear. Reducing contamination during food production, processing, and preparation will require more widespread implementation of known prevention measures and of new strategies that target particular pathogens and serotypes. The health agency suggests that the safety and health programs that have already been placed in motion since the pandemic may play an important role in the prevention of foodborne disease outbreaks. The aim of this review article is to discuss an indirect evidence about the decline in food-borne outbreaks during the COVID-19 pandemic.
Keywords: COVID-19; SARS-CoV-2; Food-borne diseases and pathogens; Food safety practices.

MESURES PRÉVENTIVES LIÉES AU COVID-19 ET DECLIN DES TOXI-INFECTIONS ALIMENTAIRES: EXISTE T-IL UNE CORRÉLATION?

Résumé

La maladie à coronavirus 2019 (COVID-19) est une infection pandémique causée par un virus à ARN nommé le virus du syndrome respiratoire aigu sévère Coronavirus 2 (SRAS-CoV-2) qui se propage rapidement dans l'air. Les agences gouvernementales de santé publique de divers pays ont pris des mesures drastiques telles que le confinement des populations. Néanmoins, une attention limitée a été consacrée à la sécurité sanitaire alimentaire et à son association possible avec la propagation de la pandémie COVID-19. Cette épidémie mondiale a donné naissance à une nouvelle ère à travers le monde, même si nous voyons déjà les implications de diverses facettes de notre vie quotidienne. Les processus de fabrication agricole et les industries agroalimentaires ne font pas exception. Pour le moment, le risque de transmission via les produits et denrées alimentaires est considéré comme marginal et la détection du SRAS-CoV-2, en milieu de travail, n'est pas perçue comme un problème pour les autorités gouvernementales. Néanmoins, les impacts négatifs sur le climat, les processus alimentaires et le personnel de l'industrie agro-alimentaire sont également évidents. La réduction de la contamination pendant la production, la transformation et la préparation des aliments exigera une mise en œuvre plus généralisée de mesures de prévention connues et de nouvelles stratégies ciblant des agents pathogènes et des sérotypes particuliers. Les agences sanitaires suggèrent que les programmes de sécurité et de santé qui ont déjà été mis en œuvre depuis la pandémie peuvent jouer un rôle important dans la prévention des épidémies de maladies d'origine alimentaire. L'objectif assigné, à travers cet article de synthèse, consiste à discuter l'existence d'une probable corrélation indirecte entre le déclin des intoxications et toxi-infections alimentaires et les mesures préventives prises en aval de la pandémie COVID-19.
Mots clés: COVID-19; SRAS-CoV-2; Agents pathogènes d'origine alimentaire; Pratiques de sécurité alimentaire.

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LIST OF ABBREVIATIONS

CDC = U.S. Centers for Disease Control and Prevention
COVID-19 = Coronavirus disease 2019
CoVs = Coronaviruses
FDA = U.S. Food & Drug Administration
HPSC = Health Protection Surveillance Center
MENA = Middle East and North Africa
MERS = Middle East respiratory syndrome
NIH = U.S. National Institutes of Health
PHE = Public Health England
SARS-CoV-2 = Severe Acute Respiratory Syndrome Coronavirus 2
WFBD = Water and Food-Borne Diseases
WHO = World Health Organization

1. CORONAVIRUS DISEASE (COVID-19): AN OVERVIEW

1.1. COVID-19 Pandemic

Coronaviruses are a family of viruses that can cause diseases such as the common cold, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). In 2019, a new coronavirus was recognized as the cause of an infection outbreak that originated in China. The virus is now identified as the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [1]. The disease it causes is named Coronavirus Disease 2019 (COVID-19). In March 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a pandemic (Figure 1) [2]. Public health agencies, including the U.S. Centers for Disease Control and Prevention (CDC) and WHO, are monitoring the pandemic and publishing updates on their websites [3]. These groups have also delivered recommendations and advices for preventing, avoiding and treating the COVID-19 [4-8]. The cumulative host spectrum of viruses is wide and covers animals, humans, plants and bacteria [9]. Severe viral outbreaks include Ebola, acquired immunodeficiency syndrome, and avian influenza. The latter two are worldwide. Coronaviruses (CoVs) are part of the Orthocoronavirinae subfamily of the Coronaviridae family. CoV-related diseases include common cold (caused by HCoV-229E and HCoV-OC43), MERS, SARS, and COVID-19, which is caused by SARS-CoV-2 [10-11]. The latter is the cause of an ongoing pandemic.

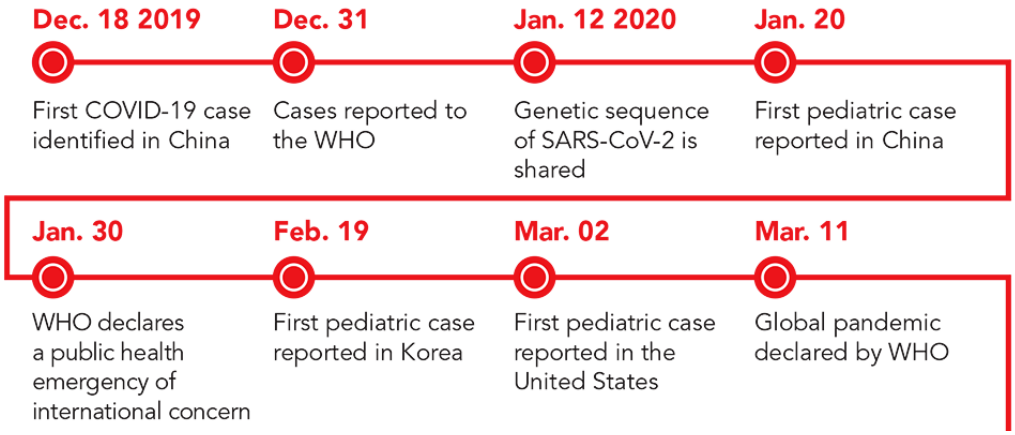

Figure 1. Timeline of the impact of the COVID-19 pandemic [12].

1.2. Transmission of the Coronavirus

Coronaviruses spread through animals and can, in certain situations, infect people. Evidently, MERS, SARS-CoV, and SARS-CoV-2 can be due to zoonotic propagation (Figure 2) [13, 14]. Even then, SARS-CoV-2 is the only one with a possible pandemic [15]. The first SARS-CoV2 infection is correlated with the Huanan fisheries sector [16], where alive and killed bats, snakes, marmots, and dog organs are distributed [17]. Zhou et *al.* [18] proposed bats as a potential source of SARS-CoV2 because the most recent bats have a common gene sequence (up to 96.2%) with coronavirus. After all, several species may also be causative agent of SARS-CoV2. For example, MERS-CoV and SARS-CoV can be spread to humans from camels and civet cats, respectively [19]. Ingestion of exotic animals such as horseshoe bats, which contain a large pool of SARS-CoV related viruses, increases the ability for novel viruses to evolve from animals or specific ecosystems [20, 21].

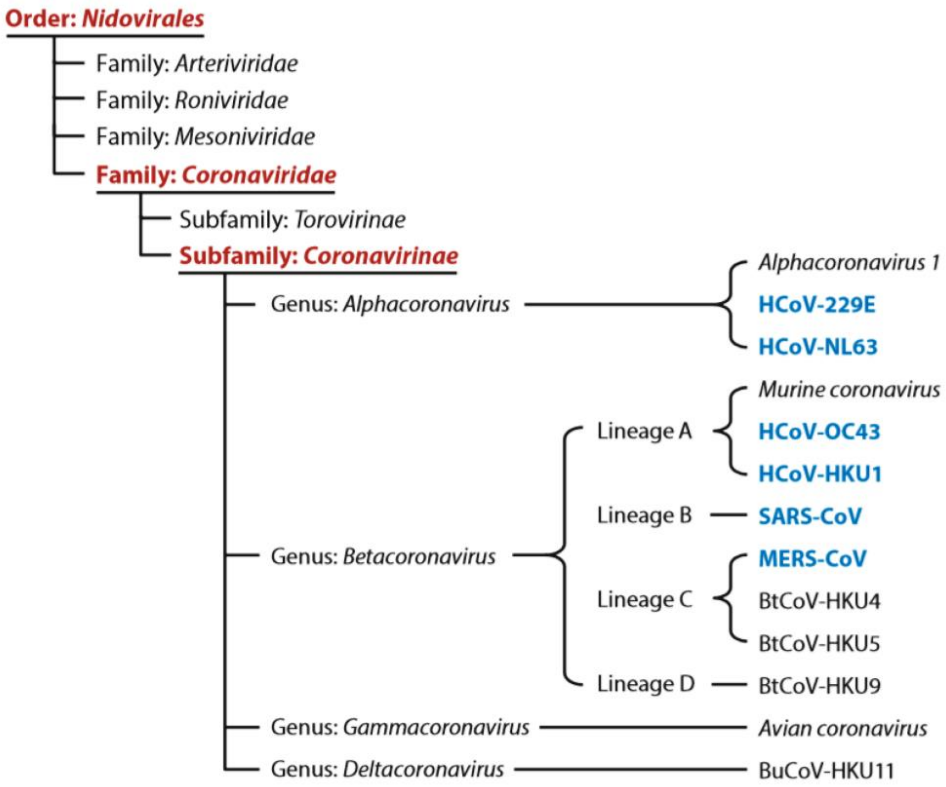

Figure 2. Taxonomy order of SARS-CoV and other coronaviruses [22]

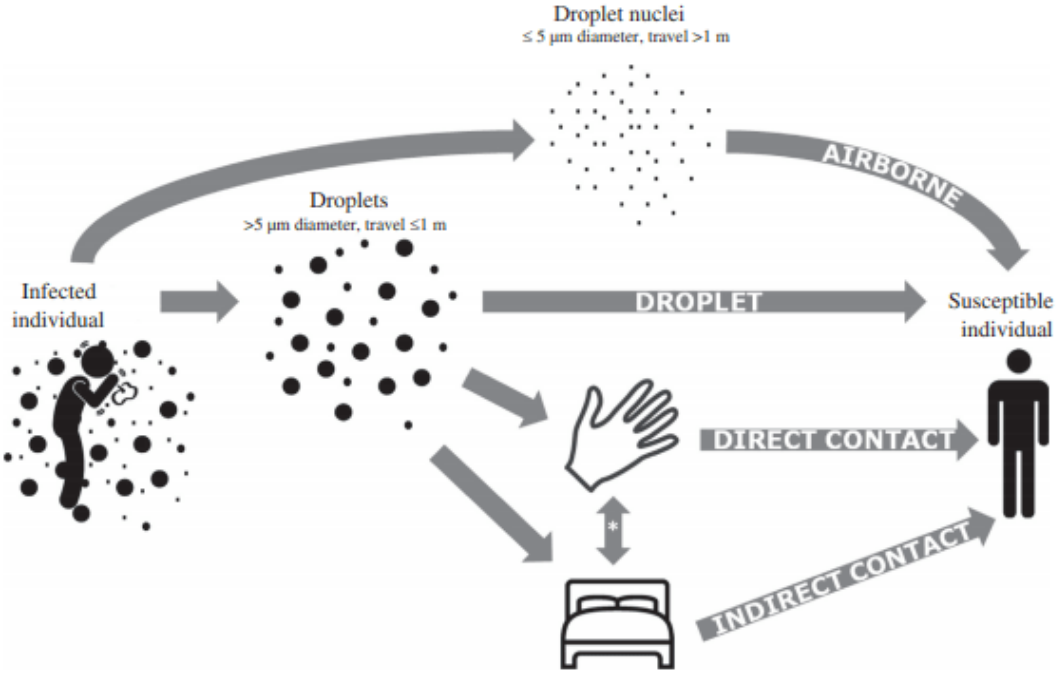

Figure 3. Transmission routes involving a combination of hand & surface [23]

1.3. COVID-19: Symptoms and Treatment

COVID-19 is an infection that is caused by a recently discovered coronavirus virus. Most individuals infected with the COVID-19 virus will develop mild to moderate respiratory disease and recover without needing special care. Aged individuals and those with ongoing medical conditions such as cardiovascular disease, asthma, chronic respiratory disease and cancer are most likely to experience severe illnesses. At this time, no treatment is suggested to treat COVID-19, and no medication is available. Antibiotics are not active against viral infections such as COVID-19. Scientists and researchers are testing a variety of possible treatments [24]. The U.S. Food & Drug Administration (FDA) has decided emergency use agreement for the antiviral drug remdesivir

to treat COVID-19. Recently, the U.S. National Institutes of Health (NIH) suggested the corticosteroid dexamethasone for individuals with severe COVID-19 who need supplemental oxygen or mechanical ventilation [25-28].

1.4. Total Coronavirus Cases

SARS-CoV-2 was detected in December 2019 and, roughly three months later, COVID-19 announced a pandemic by the WHO [29]. On 30 May 2020, the COVID-19 pandemic extended to more than 5.9 million individuals in even more than 188 countries, resulting in over 365,000 fatalities [30] and a lockout with one-third of the world's population [31]. No standard medication, treatment or vaccine for COVID-19 infection has been established at this time (October, 2020). Since 31 December 2019 and as of 10 October 2020, 36 941 672 cases of COVID-19 (in accordance with the applied case definitions and testing strategies in the affected countries) have been reported, including 1 068 944 deaths**.** On 25 February, Algeria laboratory-confirmed its first case of SARS-CoV-2, an Italian man who arrived on 17 February; on 28 February, Algeria deported him back to Italy, via a special flight from Hassi Messaoud Airport where he was subject to quarantine. There were 6,874 new cases in September (Figure 4), raising the total number of confirmed cases to 51,368. The death (Figure 5) toll rose to 1,726. The number of recovered patients increased to 36,063, leaving 13,579 active cases at the end of the month [32].

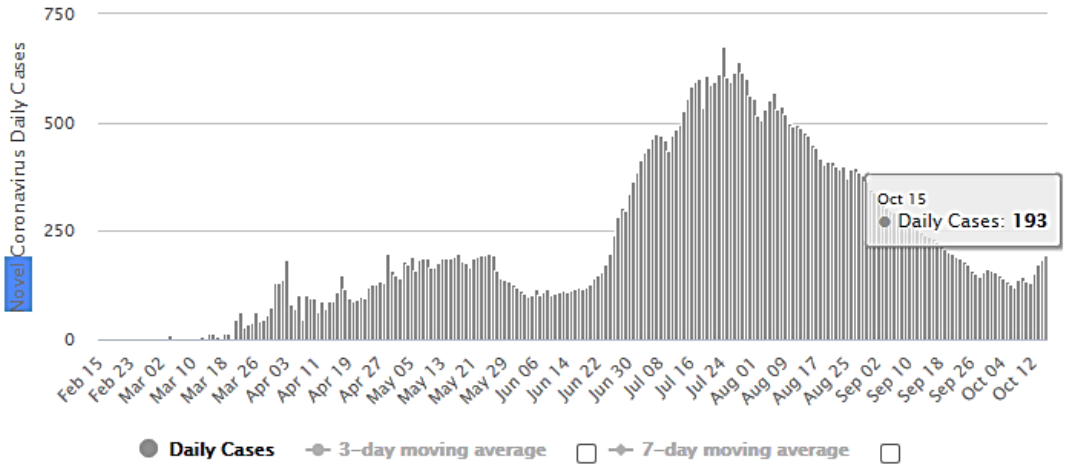

Figure 4. Daily new COVID-19 cases in Algeria [32]

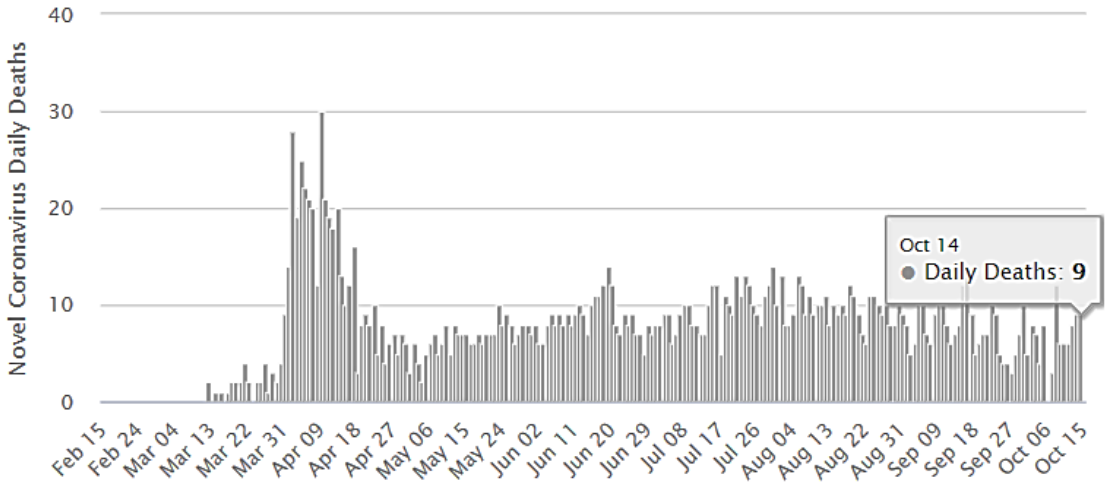

Figure 5. Daily new deaths in Algeria related to COVID-19 [32]

2. COVID-19 AND FOODBORNE DISEASE OUTBREAKS

2.1. Foodborne Disease Outbreaks as a Major Public Health Problem

The problem of water and food-borne diseases (WFBD) and digestive diseases is considerable in developing nations [33, 34]. Estimations of the prevalence of WFBD are affected by a variety of reasons: varying meanings of acute diarrheal infections are used in multiple reports, most diarrheal diseases are not identified to public health agencies, and limited diseases can be unequivocally related to food. Although not all gastroenteritis is foodborne, and not all foodborne infections cause digestive tract diseases, food and water are effective vectors for microorganisms and pathogens of major public health implication (Table 1).

A variety of experiments are in progress to offer an improved picture of the global public health problem of foodborne diseases and gastroenteritis [35]. Foodborne infections appear to be a huge public health issue with an approximate 600 million people becoming sick every year. In exchange, international regulations, which pose obstacles to food trade, are getting tougher. In view of the growing burden of WFBD, several countries in the Middle East and North Africa (MENA) region have updated their food regulations and made improvements to the operational framework of their regulatory agencies to sustain or extend international export activities, tighten control on local and imported products, and protect consumers' health [37].WFBD is a major public health problem which has impacts on human health, well-being and medical services, but also influences global trade across national management practices for the enforcement of food regulations and laws. With constant shifts in world food exchange trends, food use habits, food processing climate and technologies, and the proliferation and resurgence of foodborne contaminants and chemical pollutants affecting the food chain, WFBD continues to be a growing problem [38]. The 14 international sub-regions, selected on the basis of adult and children fatalities, had substantially different loads of WFBD, with the highest decreases in subareas in Africa, followed by sub-regions in South East Asia and the Mediterranean region. One explanation that certain areas of the world suffering most from water and foodborne diseases is that the system of public health can be undermined and their treatment and prevention methods are not well enough defined [39, 40]. Reducing contamination during food production, processing, and preparation will require more widespread implementation of known prevention measures and of new strategies that target particular pathogens and serotypes. Today, food security is a growing issue that has provided great importance in the MENA region in view of the upcoming impacts of climate change and the ongoing depletion of water supplies. Ongoing conferences in the area have encouraged emphasis on the importance of water resources, agricultural development and food production [41].

Table 1. Foodborne Hazards in WHO Global Estimates [36]

Foodborne agents	Examples
Diarrheal Disease Agents	*Campylobacter* spp., *Cryptosporidium* spp., *Entamoeba histolytica*, Enteropathogenic *E. coli* (EPEC), Enterotoxigenic *E. coli* (ETEC), *Giardia* spp., Norovirus, *Salmonella enterica* (non-invasive infections) non-typhoidal, *Shigella* spp., Shiga toxin-producing *E. coli* (STEC), *Vibrio cholera.*
Invasive Infectious Disease Agents	*Brucella* spp., *Hepatitis A* virus, *Listeria* spp., *Mycobacterium bovis*, *Salmonella enterica* (invasive infections) non-typhoidal, *Salmonella enterica* Paratyphi A, *Salmonella enterica* Typhi.
Helminths	*Ascaris* spp., *Echinococcus multilocularis*, *Echinococcus granulosus*, *Clonorchis sinensis*, *Fasciola* spp., Intestinal flukes, *Opisthorchis* spp., *Paragonimus* spp., *Taenia solium*, *Toxoplasma gondii*, *Trichinella* spp.
Chemicals	Aflatoxin, Cassava cyanide, Dioxin.

There are several factors why WFBD remains a major public health problem. As certain pathogens are regulated, others are emerging as potential problems. In several nations, the percentage of the population who are aged, immunocompromised or otherwise excessively vulnerable to major complications from food contamination is rising. The growth in food production has contributed to a fast and universal worldwide delivery of food [42, 43]. Inadvertently, bacteria can be imported into different geographical regions, such as the release of ballast water polluted with *Vibrio cholerae* in the Americas in 1991 [44]. Foreign tourists, migrants and newcomers may be vulnerable to unidentified food-borne dangers

in changing environments. Forms in microbes contribute to the continuous emergence of new contaminants, the production of tolerance to antibiotics and increases in the infectivity of established infectious agents. In several nations,

2.2. COVID-19 and Food Safety

CoV is zoonotic, which means that it can move from animals to people. This is usually the case where tainted cattle are killed for consumption [46-48]. CoV has been reported in birds, cattle, cats, rodents, chickens, turkeys, pigs, dogs, rabbits, horses and may cause gastrointestinal and respiratory illnesses [49]. SARS-CoV-2 is quickly spread through the air that has fueled the current pandemic. Government agencies in various states have made dramatic measures, such as a full lockdown. Nevertheless, limited consideration has been devoted to food safety and security, and its possible association with the coronavirus (COVID-19) pandemic [30, 50].SARS-CoV-2 spread from workers to food items or food surfaces is possible. Consumers must disinfect the surface of frozen food before consumption. In addition to advising or applying basic measures, such as the use of gloves, policymakers must perform mandatory SARS-CoV-2 checks on a daily and occasional basis for workers processing food products or supporting materials (e.g., plastic bags) [51, 52]. Research studies of foodborne diseases, along with analyses of germ evidence that make us sick and habits that lead to food poisoning, help us recognize where changes can be made to the country's food safety infrastructure [53]. This infrastructure ranges from producing crops on the farm to manufacturing, packaging, delivery, storage and transport, to preparing food for use. According to the WHO, the United States CDC and several other public health agencies, there's really actually no indication that the COVID-19 virus can be spread via fruit or packaged food [50,54]. COVID-19 is a viral infection, which spreads primarily by person-to-person by close contact with respiratory secretions triggered when an infectious individual sneezes or coughs [55]. Although no foodborne propagation of COVID-19 has been confirmed, eliminating undercooked or raw foods of animal origin (meat, eggs, milk products) will minimize exposure to all pathogens as well as other WFBD, which is recommended for high-risk groups such as the elderly, children 5 years of age and below, pregnant women and people with compromised immune systems due to medical care [56]. FAO has found that almost all microbes, like coronaviruses, can be killed with one of the most specific detergents and cleaning products used in food production. A 0.05% hypochlorite solution, equal to a 1:100 dilution of household bleach, is efficient in destroying certain bacteria and could be used to clean areas after washing [57-59].

as consumers are rapidly eating a meal cooked from outside household, increasing numbers are vulnerable to the hazards of inadequate sanitation in food catering settings [45].

2.3. Declining Trend in Foodborne Disease Outbreaks Possibly Attributed to COVID-19 Measures: is there any Link?

The FAO has stated that the eating of meat products (of domestic or wild origin), eggs and dairy is deemed a source of disease acquisition. Therefore, infection of food sources with many other microbes, such as *Salmonella* spp., *Campylobacter* spp., *Escherichia coli* and *Listeria monocytogenes*, is a real problem for food security globally [60]. Food may become infected with bacteria that cause serious illnesses from various sources in the food supply chain, from infections in animals to the consumption point. Trying to prevent such exposure can eliminate food contamination and minimize the risk of new pathogens arising from the food supply [61].

2.4. Water and Food-Borne Diseases decreasing due to COVID-19 Pandemic outbreak

The COVID-19 global epidemic has had severe impacts on the food market, with many food companies experiencing substantial economic losses related to partial closing [62]. Given the problems presented by the COVID-19 pandemic, there seem to be certain beneficial results that have not been expected. Results demonstrate that pandemic protective policies are leading to a reduction in food contamination. The Finnish Center for Health and Welfare has seen a substantial decrease in the amount of food-borne outbreaks in Finland over the last few weeks. As per the center, only four presumed outbreaks of WFBD were recorded within March and May 2020 – considerably fewer than in prior seasons when a total of 18 confirmed outbreaks were recorded. *Campylobacter*, *Yersinia* and *norovirus* are suspected infections in the four outbreaks. More than 130 WFBD outbreaks were reported in Finland between 2014 and 2016, according to an earlier research reported in 2019.

Norovirus became the most common agent liable for 42 infections. One *Yersinia pseudotuberculosis* and five *Campylobacter* outbreaks were documented during that era. The health agency suggests that the safety and health programs that have already been placed in motion since the pandemic may play an important role in the prevention of foodborne disease outbreaks. When hands are cleaned regularly and food is cooked for smaller populations, fewer pandemics arise [63, 64]. What has been found in Finland is close to what is happening in the rest of the globe. In Australia, the incidence of *Campylobacter* and *Salmonella* infections significantly declined since the lockdown steps were placed in effect. The Food Safety Information Committee issued a progress report on Australia's food hygiene record, showing that such particular pathogens had declined by half relative to the preceding two years. This is encouraging news for Australians, who see 4.1 million cases of WFBD registered per year. Around 31,920 hospital admissions and 86 deaths also occurred. These statistics emphasize the importance of food security, particularly in the food industries. After the lockdowns started back in March, the recorded concentrations of *Campylobacter* and *Salmonella* infections per 100,000 Australians have mostly cut in half relative to the previous 2 years. It also was reported that the decline in food contamination reports may be attributed to the reduction in the number of citizens grouped around each other due to COVID-19. Foodborne disease outbreaks are greater when food is cooked in advance and delivered to set of consumers (such as self-service and restaurants) [65]. The drop in WFBD reports is also happening today in Ireland. Drawing on statistics from the Health Protection Surveillance Center (HPSC) from the beginning of the year to the beginning of May, *Campylobacter* records are down from 921 in the same timeframe in 2019 to 592 this year. There was also a lower decline in *Salmonella* and *E. coli* Infections. However, it is not unexpected that less incidents of WFBD are identified as medical researchers who would usually be monitoring and researching cases and outbreaks are concentrating their primary efforts and energy on COVID-19 [66].

Professionals also advised vigilance in reading the fall in WFBD data in the United Kingdom and Ireland after the coronavirus epidemic as a real reduction in infection. Public Health England (PHE) reported that it is just not currently possible to determine the effect of the COVID-19 disease outbreak on digestive pathogen testing and to report findings to the Agency. Results from clinical records of intestinal diseases in England and Wales published to PHE from the end of February to the end of March indicate that *Campylobacter* decreased from 930 in February to 394 in March. *Salmonella* decreased from 93 records to 67 and norovirus from 204 to 38, respectively. Other PHE data indicate that cases of WFBD in England and Wales have been at 1,700 since the beginning of 2020 to May. This is contrasted to 2,674 and 3,071 for about the same time in 2019 and 2018, respectively [66]. Dutch people pay greater attention to sanitation in the kitchen, according to a study of behaviors and practices after the coronavirus pandemic and associated locks. A study by the Netherlands Diet Center focused at how many other participants were concentrating on their safety. Experts hope that good improvements would persist just after outbreak, as improved sanitation could lead to less food contamination. A total of 1,030 Dutch citizens aged 18 and over were part in the survey at the end of April. Seventy percent of the respondents mentioned washing their hands frequently and/or faster before cooking, and 65 percent indicated doing so before eating. About half said they cleaned their vegetables or fruit quite often and/or better before preparing or dining. There was little distinction between men and women, but people 65 and older were more likely to consent or consent to do so than those between 30 and 64 years of age. On the basis of the study, in fact, the over-65s have begun to pay more attention to hygiene while cooking in recent weeks. Just 39% of 30 to 49 year olds approved or totally agreed that they would give greater attention to sanitation while cooking. The study showed only small improvements in buying, cooking and eating behaviour after the COVID-19 steps came into practice. Many consume as much as usual and have not mentioned any change in the preference of nutritious food. Often, most of them did not eat or consume more than at other occasions [67].

2.5. *Why is there a Decline in Food-Borne Diseases during COVID-19 Pandemic ?*

In attempt to elucidate how this is occurring, it is important to know what causes clusters of food contamination in first instance. WFBDs are caused once food is infected by microbial pathogens that are then eaten. This food-borne contaminants may be microbes, yeast and fungi, viruses, or parasites. Food might be infected in

a number of forms – by bacterial pollution, environmental pollution, physical contamination and cross-infection [68, 69]. There seems to be a greater chance of foodborne disease arising from banquet-type facilities, whereby foods can quickly becoming infected as persons served oneself. Food is also at increased danger of being stored in the temperature range (5°C–60°C) because dangerous microbes can spread quickly in high-risk foods [70]. WFBD incidents can indeed be attributed to inappropriate food storage by food companies or to inappropriate preparing food by workers. The sudden closing of restaurants and fast food companies removed the possible cause of WFBD spreads. As food companies are currently re-opening with more stringent rules in effect, safety and health (such as food security) is the highest priority. This could also lead to a decline in foodborne disease outbreaks. Some of the strategies to avoid the transmission of microbial pathogens and minimize the risk of food poisoning include adequate hand washing and cleaning and disinfection procedures. The COVID-19 disease outbreak triggered a rise in hand hygiene, which seems to have a direct impact on the effectiveness of food contamination. Washing and sanitation is now carried out more regularly in industries [71]. If food companies continue to re-open and a 'new trend' develops, it needs to be seen whether food-borne infection levels will begin to decrease. In the meanwhile, food suppliers and food companies are advised to continue to implement adequate basic hygiene, washing and disinfecting procedures regularly and remain in compliance with the COVID-19 safety and health recommendations. Overall, the WHO and FAO report demonstrates how standard food practices, such as the good hand washing technique, are helpful in preventing food contamination. It is important that, as restaurant owners begin to re-open around the world, people maintain cleaning their hands properly, particularly those employed in the food sector. It is also important that food producers guarantee that all kitchen workers within their company provide legitimate Declarations of Qualification. If this is not the case, workers must be trained in a nationally accredited program on food quality and public health [50,72,73]. Scientists in the UK and Ireland called for caution in reading the fall in foodborne disease data during the coronavirus epidemic as a real reduction in infections, although a Dutch survey showed that people paid greater attention to kitchen hygiene [66]. There would be far less food served outside of the house to be eaten, definitely not all-you-can-eat buffets or mass catering activities. Those providing packages are likely to have simplified their recipes, meaning less meat would be processed. Users have been cleaning their hands frequently. Likewise, people who believe they have foodborne illness are far less likely to mention it or consult a doctor. In April, the WHO and the FAO provided guidelines to the agencies responsible for national food safety management systems. "Basic capability in chemical and microbiological protection must be established to help food monitoring in high-risk companies, to deal with customer concerns and contamination accidents, and to investigate and handle occurrences in food contamination. Global health infection monitoring programs may have a diminished ability to detect specific incidence of foodborne infection, but it is important to retain a sufficient national capacity" as per the guidelines [73].

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