



Received: 18 April, 2022

Accepted: 20 May, 2022

Published: 21 May, 2022

***Corresponding author:** Wabi Bajo Nagessa, Department of Food Science and Nutrition, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia; Email: wabib2014@gmail.com

Keywords: Food security, Coronavirus (COVID-19), Pandemic, Food safety, Food value chains, Consumers

Copyright License: © 2022 Nagessa WB, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

<https://www.peertechzpublications.com>



Check for updates

Review Article

Food security and safety during Novel coronavirus (COVID-19)

Wabi Bajo Nagessa^{1,4*}, Francois Lusamaki Mukunda^{2,4} and Gemechu Geleta Abdi³

¹Department of Food Science and Nutrition, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia

²Department of Human Nutrition, Kisangani University, Kisangani, Democratic Republic of Congo

³Department of Food Science and Post-Harvest Technology, Jimma University, Jimma, Ethiopia

⁴Department of Chemical Engineering, Faculty of Engineering, Eduardo Mondlane University (UEM), Mozambique, Ethiopia

Abstract

This review paper was prepared by reviewing and summarizing several findings including research articles, FAO, and WHO databases concerning the pandemic and related issues. The security and safety status of foods during the pandemic outbreak and the possible solutions to food-related problems were also reviewed. The COVID-19 pandemic is currently not only affecting health but also the security of foods and nutrition. The effect of the Covid-19 on the entire food along the value chains was reviewed in this paper. The Coronavirus has been disturbing the health of world populations and food security. It is critically affecting the food processing business in various ways. The mitigating measures taken to contain the virus and decrease transmission to society are directly and indirectly affecting food security and safety. The overall food system is being disturbed by movement restrictions, closure of borders, and quarantine in turn resulting in low availability of food and an increase in the price of food products. The effect of the pandemic on food security can be estimated based on the impacts the previous pandemic Ebola made on the DRC and Liberia in 2014. The effects of the pandemic on the food production system and availability are similar. The mitigating measures suggested like movement restrictions, social distancing, and border closing and quarantine to protect the people from the COVID-19 are affecting global food security at large. Keeping the movement of foods along the value chain is crucial to creating and maintaining the confidence of consumers in the availability and safety of foods. Both security and the safety of foods are important things to be considered throughout the pandemic era. The important issue is that the low access to food and increase in price is challenging because; the pandemic affects labour for production at the farm, food processing personnel, marketing, and all the supply chains from production up to fork.

Introduction

COVID-19, caused by the SARS-CoV-2, is a transmissible disease that was first identified in China, Wuhan city, in December 2019 [1 [3]. The global population has been facing an unaccustomed challenge from the COVID-19 itself as well as the controls that the Centers for Disease Control and Prevention (CDC) have initiated. Several countries are pursuing the recommendations, directed by WHO, relating to the implementation of social distance measures which can reduce the transmission of the disease [2]. These measures of mitigation lead to the closure of lots of business centers, and institutes of education, and restricted free movement and mass gatherings. The methods suggested by health professionals such as working from home (teleworking), and online conferences

keep people safe from the COVID-19. However, food trade personnel, do not have the conditions which permit them to work from home, and therefore, their physical presence at the workplace is obligatory to do their job [2].

Within the production and value chains of foods, the protective health of all employees is essential for the even present COVID-19. Keeping the movement of foods along the value chain is crucial to creating trust, and confidence in consumers in the availability and safety of foods. Both security and the safety of foods are the foremost important things to be considered throughout the pandemic era. The Coronavirus is not only a health threat but additionally affects food availability and nutrition security. In low financial gain regions, food insecurity is occurring as a result of increased food

convenience. In addition, the worth and market price chain is being affected. Many people were already experiencing hunger and nutrient deficiency disease even before the virus outbreak. The collective impacts of Coronavirus and the consequences of the mitigation measures, and international economic decline may weaken the functioning of food systems [4]. Food safety on the other hand must be considered to control viral transmission between farmers, retailers, and customers [5]. It is essential [2], that the food trade approved the compliance measures to safeguard employees in Food industries to prevent the disease, stop transmission, and ensure sanitation practices and food hygiene. Food industry personnel should grasp and follow smart hygienic practices as explicit in the Codex Alimentarius Commission [6] to safeguard the customers from the coronavirus unwellness. There is a gap in information on the issues of food availability and food safety during the COVID-19 era. The scientific report on this current issue about food security and safety is important to be reviewed and summarized to give the scientific communities and concerned bodies updated information. Therefore, this review article aims to review the status of food security and safety and the way they are affected throughout the corona virus pandemic period.

Food security in pandemic period

Food security exists once all individuals, in any respect times, have access to ample, safe, and nutritious food that can meet individual's dietary requirements [7]. The food security problem is not new and lots of individuals around the globe already featured this issue. The world's food security conditions, as illustrated by the FAO, in 2018 over 820 million individuals suffered from hunger and deficiency diseases [8] (Figure 1).

The four required components for food security were outlined by FAO [10] as 1) Availability of food within the offer aspect. 2) Food accessibility to consumers from the demand aspect, 3) Utilization by consumers. 4) Stability of availability, accessibility, and utilization over time.

The Coronavirus is increasingly threatening food systems by affecting the supply of foods and demand and through a

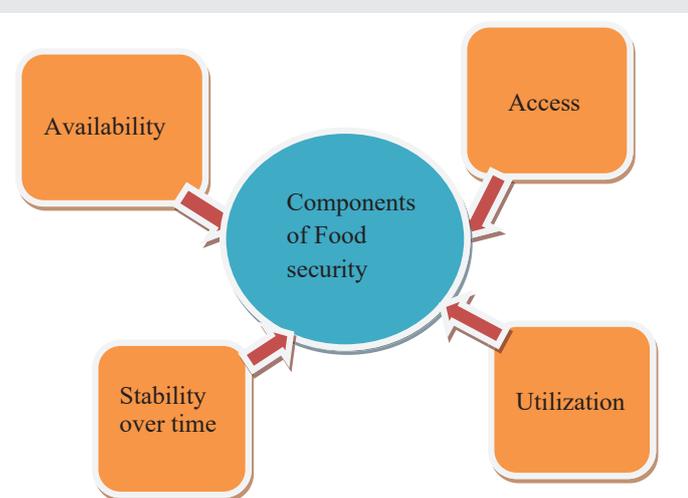


Figure 1: Components of food security [9].

'reduction in consumers' purchasing capacity, and the capacity to cultivate crops and distribute them, which might have a serious effect on vulnerable and low-income societies.

The risk for worldwide food supply and costs can depend on how long the outbreak persists and the severity of containment measures required [11]. Food security, throughout the pandemic novel coronavirus, is turning into a significant issue and threatening the lives of many low-income or poor societies. It is disturbing the food systems including production, shipping, food processing, and different vital products, delaying the delivery times and lowering the availability of even the most basic food items.

It was illustrated by the FAO that it could be difficult to predict the impact of coronavirus on the food system. The experience of the previous pandemic Ebola virus in 2014 or the food costs crises of 2008 indicated its effects on food security could be estimated. The limitation on social movement and the virus containment efforts to avert disease impacted food supply and access throughout the Ebola outbreak. The Food and Agriculture organization has been focusing on four main activities including raising a world information facility, balancing incomes and food availability, making certain sustainability of the vital chains of foods supply for the foremost exposed populations, and securing certain individuals along chains of food systems that do not seem to be in danger of COVID-19 transmission while meeting new needs from the consequences of the virus, specifically involving latent impacts of the virus and associated containment attempts food security and livelihoods in vulnerable situations and where the population is already affected by the food crisis [12].

The Coronavirus disease is already directly affecting food security which includes food availability, accessibility, and utilization in food systems through its effects on the supply and demand of food. Its indirect impacts can be manifested through decreasing the consumer's purchase capacity, the power to produce and distribute food, and also care task intensification, all of which can have differentiated impacts and would powerfully have an effect on the poor and people at risk. Throughout the outbreak of the Ebola virus, its impact on Liberian agriculture was determined directly effecting the productive force through the disease or death, shortly or permanently limiting the agricultural labor force and thereby disturbing crop cultivation and collection from the farm. The agricultural labor force participation was fallen indirectly because of mitigating measures like travel restrictions, and quarantines, to prevent the dissemination of the virus especially due to the accumulated concern of the congregation in team works. The limited availability of the labor force, particularly for pre-planting preparation, reduced farmland expected for the cultivation of rice and doubtlessly lower yields [13]. The pandemic covid-19 mitigating measures like travel restrictions, closing meat production firms for safety purposes and quarantine is additionally touching the production system and food availability similarly.

According to the results of a survey conducted by the Techno-Serve programs by interviewing seventy-five

corporations in Benin, Ethiopia, Kenya, Nigeria, Malawi, Tanzania, and Zambia, most of the companies face sales declines and disruptions to their supply chains (Figure 2). The decline in the sale is a result of the reduced client purchasing capacity, closure of various institutions like schools, and limitation of logistics for the rural customers to travel to cities to purchase products for sale. It was observed that there is the highest (40%) and lowest (1%) decline in sales of food products recorded in Kenya, and Benin & Malawi respectively. It was further stated that the primary product like flours, edible oils, dairy, and others (therapeutic foods, snacks &, etc) showed a 47%, 23%, 16%, and 14% decline in sales respectively [14].

Many Africans are getting food unsecured as a result of this pandemic crisis. Food unavailability at the market and price increment are occurring throughout the lockdown. The United Nations suggested that it may be necessary to give more attention to the agricultural sector by declaring it an important sector that should not be interrupted by Coronavirus disease prevention measures to secure food systems and to make sure uninterrupted supplies and food security. It had also been suggested to focus on mostly acute regions and society, strengthening social protection systems and ensuring access to food and nutrition, especially for young children, pregnant women, lactating mothers, and older people [15]. Impacts of pandemic COVID-19 are affecting food systems in Ethiopia. For example, rural-urban supply chain holdup and shortage of agricultural products in urban areas are the consequences of the COVID-19 plague.

The supply chain interruptions were seen as milk collections from smallholders were hampered and in short supply for dairy processors in cities. The low supply of cereals, fruits, and vegetables was conjointly a giant challenge for urban consumers [16]. On the hand, for dairy processors, the COVID-19 affected the demand from the market. In response to the surveys conducted by TechnoServe business solutions to poverty, dairy processors in Ethiopia were replied as 'Demand from the service sector has decreased; dairy is a perishable product, and it is troublesome to manage stock once there is no market'. They may not also access pasteurized milk packaging material from my supplier because it is difficult to import materials during the pandemic period [14]. Similarly, in Mozambique, it had been foreseen by FAO that the conditions

of food security in 2019 worsened considerably, and the effects of the pandemic might play a vital role in extending the food insecurity problem in the coming years. It was illustrated by Food and Agriculture Organization that mitigating actions for food products are set, however, there may be concerns associated with the effects on food prices as a consequence of panic shopping, billboard, and potential disruptions to the flow of food supply along the value chains. About this, the capacity of oversight bodies has been strong to control market costs [4]. Provision of food materials started frightened and the price soared in the Mozambican market once South Africa closed the border. Figure 3 shows the results Global food security Index 2019 in nearly 113 countries where Ireland, Singapore, and the USA were the most effective acting countries while the lowest levels of food security are observed for Venezuela, Burundi, and Yemen.

The ways prompt to unravel the matter of food production are: supporting farmers to continue food security and safety like was selling of food, evaluating the impact of pandemic Coronavirus on foods production, supporting medium and enormous agribusiness, and lowering the risks of food insecurity problem due to global climate change by focusing on the areas at risk [3]. The food insecurity problems which aroused as a consequence of the lockdown itself can cause the consumers more vulnerable to the pandemic COVID-19. The potential of the consumers to get immune-boosting nutrients from food is decreased because of low purchasing capacity as well as inadequate availability of food. It was stated by the [18] that the role of nutrients in the boosting immune system is very important during a pandemic crisis like COVID-19.

Covid-19 directly or indirectly affects food security. Many countries in the world reacted in response to the food and nutrition security problems that occurred due to the pandemic. According to Gentilini et al., [19], many Countries had taken measures concerning social assistance aimed primarily at ensuring the food security of the population. Social assistance is the most widely used, followed by actions in the area of social insurance and supply-side labor market interventions. Within social assistance, cash transfer programs are the intervention most widely used by governments. About 58 countries have such programs in place, with 35 introducing new initiatives specifically to respond to COVID-19.

The role of informal workers in the food supply chain is huge and can directly affect the safety of foods. Informal urban food markets have been severely affected as a result of the pandemic. The social safety net coverage to informal workers can contribute to effectively reducing the effect of the pandemic in the Least Developing countries. A key metric that will illustrate the success or failure of the fight against COVID-19 in the LDCs will be the ability of governments and their partners to reach informal workers in the market value chain. Moreover, providing sustainable support for smallholder farmers and small-scale agriculture during the pandemic period is crucial to combat food insecurity [20].

The risk to food security recently does not exactly arise from disruptions along food supply chains, but rather from

Sales decline (%)

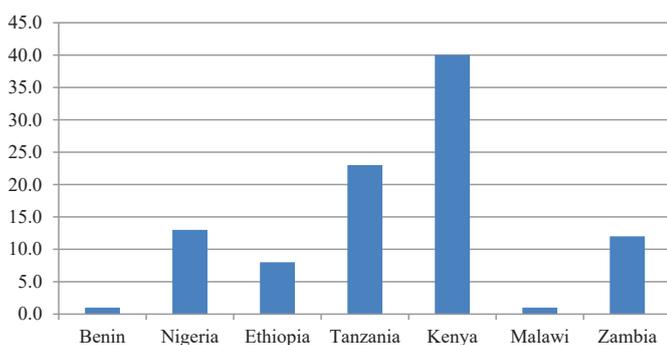


Figure 2: Sale declines of African food processors. Source: [14].

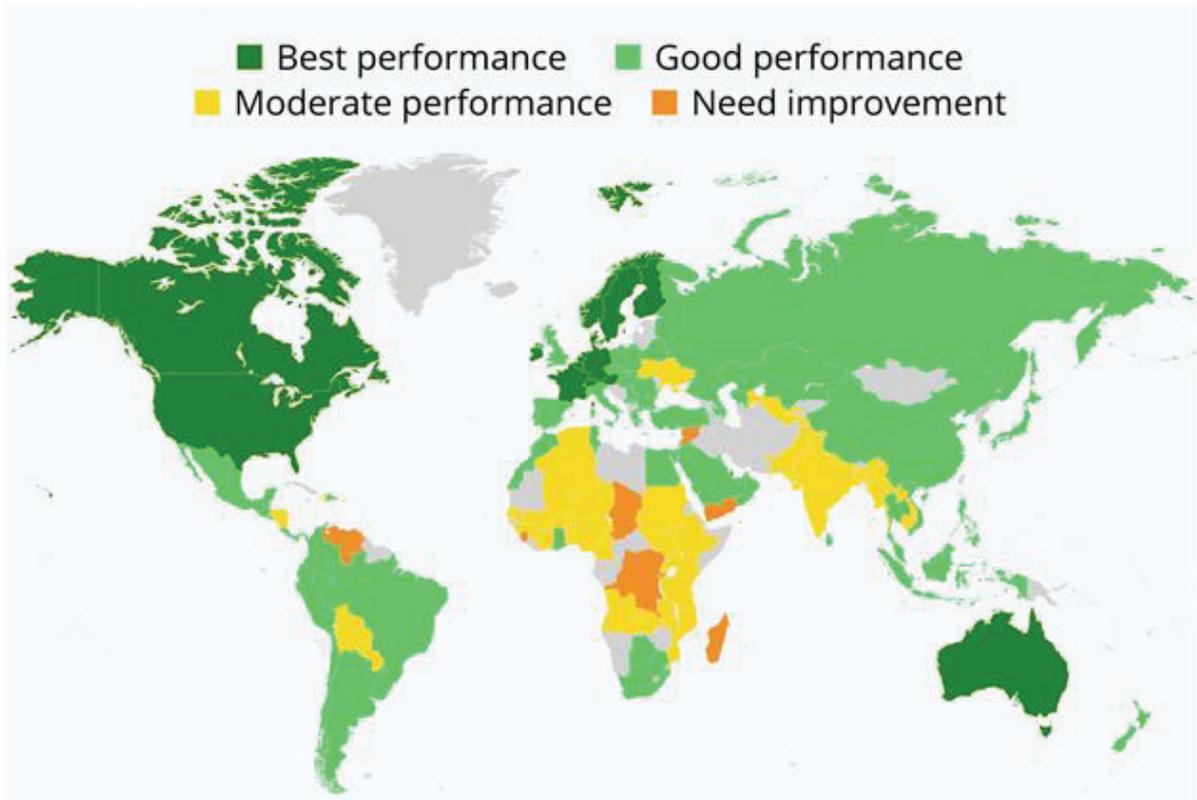


Figure 3: Food security status. Source: [17].

the negative effects of COVID-19 on jobs and livelihoods. In developing countries, social safety nets are not well developed and Covid-19 can lead to absolute poverty and hunger [21]. In response to the Covid-19 disruption, the World Food Program should double the assistance to the people in acute food insecurity.

The vulnerable groups like women, smallholder farmers, urban poor, children, and elders are at the highest risk during the outbreaks of pandemics. The government and donors should jointly work to reach these groups during emergency periods like disease outbreaks and conflicts. The social safety nets need to be maintained and expanded to safeguard food and nutrition security among these vulnerable groups and those experiencing the greatest income losses. The food system interventions are also important to be adapted to respect safety and hygiene standards and be flexible, avoiding earmarked funds since adaptability of interventions is essential to provide need-based aid. In-depth research and real-time data are critical to understanding how well the measures taken in response to Covid-19 are working. The data on disaggregated target groups is also crucial to inform policy decisions to ensure that assistance is equally provided to the target groups [22].

Food safety in relation to COVID-19

Food is crucial to sustaining the life of human beings however if deteriorated can lead to food-borne illness and deaths of consumers. Food safety is the proper handling, cooking, and preservation of food to guard consumers against foodborne illnesses. Food-borne illnesses, as stated by World

Health Organization, are food and waterborne related illnesses with or without showing symptoms. It includes any illness of an infectious or toxic nature caused by or thought to be caused by, the consumption of food or water [23].

The US Food and Drug Administrations and European Food Safety Authority (EFSA) is closely following the dissemination of the pandemic, which is affecting many countries around the world. According to FAO [24] report, previous outbreaks of related coronaviruses, mainly Middle East Respiratory Syndrome (MERS-CoV) Coronavirus and Severe Acute Respiratory Syndrome coronavirus (SARS-CoV), showed that food is not a route of transmission for these viruses. For the safety of food, WHO has also issued advice on good hygiene practices during food handling and processing or preparation, like washing hands, cooking meat thoroughly, and avoiding potential cross-contamination between cooked and uncooked foods. There is no evidence stating that consumers can contract Coronavirus from food or food packaging materials.

COVID-19 is a respiratory illness and its main routes of transmission are through contact among people and direct contact with respiratory droplets created when infected individuals cough. But this concern should not be undermined under the current rising situation of the disease. Coronaviruses do not survive and reproduce in food; they rather require a host organism [2]. However, there is a high probability of contamination of food contact surfaces, packaging materials, and equipment with the virus from infected food processors. 2019. Consumer's awareness of food safety.

Besides food security, the safety of food is always being undermined in the food supply systems; before the onset of COVID-19. Consumers are assuming the food that they consume is healthy and hygienically safe [25]. According to Huang [26], the outbreak of COVID-19 in the Wuhan live animal market and later on the second wave of COVID-19 outbreak in China that was closely related to contaminated salmon created concern in food safety.

The current research on the evaluation of survival of the viruses on different mediums conducted by Corman et al., [27] reported that the virus remains alive on plastic and stainless steel, copper, and cardboard for 72 hours, four hours, and 24 hours respectively. The viability of the virus on food processing and packaging equipment should be considered in the real-life environment of the food industry to prevent the transmission virus from the food handlers to the equipment in turn not contaminating the consumers.

A previous study revealed that there is a strong positive relationship between livestock-processing plants and local community transmission of the virus. It was suggested that these plants may act as transmission vectors into the surrounding population and accelerate the spread of the covid-19 [28].

It was stated by Koopman that the potential transmission loop of SARS-CoV-2 spreading from humans to animals and back to humans is a serious concern [29]. The author also added that there is a growing consensus that both farmed and household animal species can be the host for SARS-CoV-2 variants. The research finds also illustrated that the COVID-19 infections have been reported among workers in slaughtered meat processing plants in different countries. For instance, four new COVID-19 infected cases were reported in August 2020, one of whom was a worker engaged in handling frozen food in Auckland, New Zealand. There were also positive cases reported in Qingdao, China, for two dockers handling imported frozen seafood.

The previous report by Perly [30] stated that to ensure the smoothness of food processing plant operations even during disease outbreaks, investment in technology in the food production systems such as automation, robotics system, and central palletized systems are needed to get ready for the next pandemic. The authors added that these technologies not only improve food safety and reduce food wastage but also minimize human food contact thereby ensuring a smooth operation during disease outbreaks. Food processing plants should abide by the good hygienic practices rules and the governance and policy for food processing and manufacturing could be revised if necessary.

The processing employees and staff were likely exposed unwittingly to COVID-19 through slaughtering and handling infected animals. Although food handlers and staffs are not the primary shoppers of the food being sold within the market, direct inhaling the infectious agent-containing atmosphere could cause them to get infected. Moreover, patients infected with the COVID-19 can shed the virus which may contaminate

the environment and food products. Food chains are struggling to maintain a stable food supply. Policymakers should assess the risk and gaps in supporting all areas of the food systems/chains to guarantee the consumer's food demand is secured and its employees are safeguarded [31].

According to WHO [32] and Pal et al., [2], it was advised that manufacturers should follow good hygienic practices to help make sure that the consistent quality and safety of foods. It was also illustrated that the procurement of raw materials should be from known and reputable sources, and cooking should also be done thoroughly until a safe holding temperature is attained. The cooking utensils like cooking boards, refrigerator handles, and equipment should be cleaned and sanitized. The employees with some symptoms of illness must not come to work.

The food plants ought to have Food Safety Management Systems (FSMS) supported by the Hazard Analysis and Critical Control Point (HACCP). Food processing plants' FSMS are underpinned by prerequisite programs that embrace smart hygienic practices, cleanup and neatness, sectionalisation of processing areas, supplier controlling, employees' hygiene, and fitness to work. Codex Food Hygiene principles [6] set up a base for the application of vital hygiene controls at every level of the food processing and marketing chain to avoid contamination of foods. As general advice suggested by Unhale et al., [3], food processors should implement hygienic practices to ensure the safety of end-users/consumers. The raw material should be purchased from reputable sources, food should be thoroughly cooked and maintained at safe holding temperatures, food contact surfaces and equipment should be cleaned and sanitized, staff should be well trained on hygiene measures, and the employees showing signs of infectious illness should stay at home for 24 hours and reducing the number of staff in food processing division are among the ways to keep the food safe from contamination. To ensure the safety of foods during this pandemic period, the following safety measures play a crucial role (Figure 4).

Conclusions

Pandemic Coronavirus is currently a serious world public health problem in many countries. It is directly or indirectly affecting food security as well as food safety, and threatening vulnerable societies. It is not solely a health crisis but also leads to social and economic problems. Its impacts on food systems are a bit difficult to estimate. The current study finding showed that the covid-19 can be transmitted through live animals and disseminated to healthy individuals which make the situation worst. However, the experience of the Ebola outbreak that occurred in West Africa in 2014 which disrupted food production systems, labor force, and land preparation could be a base to forecast the effect of a pandemic on food systems. Most food businesses are facing sales declines and disruptions to their supply chains during the lockdown due to the reduced purchasing capacity of customers. The assurance of the proper food transport along the food supply chain very crucial activity all food processing stakeholders need to contribute to keeping the distribution of food products to consumers. The joint role of government and non-government is very important



Figure 4: COVID-19 practice for food safety Source: [3].

in identifying the most vulnerable groups in the society and allocating necessary food and financial aid to help them survive throughout the pandemic period. Immediate demand for the food industry to make sure compliance with measures to protect food handlers not to transmitting the virus, avoid exposure to or transmission of the virus, and enhance the status of food hygiene and sanitation. The stakeholders in food processing plants and businesses should abide by good hygienic practices and good manufacturing practices guidelines established by codex Alimentarius commission to deliver safe and quality products to the consumers.

References

1. WHO (2020) "WHO Director-General's opening remarks at the media briefing on COVID19 -March 2020," PubMed.gov.
2. WHO (2020) "COVID-19 and food safety: guidance for food businesses: Interim guidance 7 April 2020."
3. Unhale SS (2020) "Impact of COVID-19 on food safety and Food Security World Journal of Advance," no. May, 1-5.
4. FAO (2020) "COVID-19 and smallholder producers' access to markets. Rome,," <https://doi.org/10.4060/ca8657en>. ISBN 978-92-5-132414-1, p. #9 p.
5. Charis M. Galanakis (2020) "The Food Systems in the Era of the Coronavirus (COVID-19) Pandemic Crisis," Foods.
6. WHO/FAO (2004) Codex Alimentarius: Food hygiene Basic texts, Fourth edi.
7. FAO (2003) "Trade Reforms and Food Security: Conceptualizing the Linkages,," (Food Agric. Organ. United Nations, 2003).
8. FAO (2019) "Production of dry beans produced worldwide 2013-2017 AVAILABLE ONLINE: <https://www.statista.com/statistics/722015/dry-beans-production-volume-worldwide/#statisticContainer>,"
9. Fraanje S, Lee-Gammage W (2018) "What is food security? (Foodsource: building blocks).," Food Clim. Res. Network, Univ. Oxford.
10. FAO (2008) "An Introduction to the Basic Concepts of Food Security," FAO Food Secur. Program. www.foodsec.org/docs/concepts_guide.pdf.

11. Shafiur Rahman MH, Hossain I, Rahman A (2020) "Food Security and the Coronavirus Disease 2019 (COVID-19): A Systemic Review," J Med Sci Clin Res. 8(5) 180-184.
12. FAO (2020) "Addressing the impacts of COVID-19 in food crises April-December 2020: FAO's component of the Global COVID-19 Humanitarian Response Plan. Rome. <https://doi.org/10.4060/ca8497en>,"
13. Jacoby HG (2019) "Impact of the West African Ebola Epidemic on Agricultural Production and Rural Welfare Evidence from Liberia,"
14. Technoserve business solutions to poverty (2020) "Survey: COVID-19 Challenges and Responses for African Food Processors, Second Edition <https://www.technoserve.org/wp-content/uploads/2020/07/Food-Processing-COVID-Survey-July-2020.pdf>," no. Second Edition.
15. United Nations (2020) "Policy Brief: Impact of COVID-19 in Africa,"
16. Mulugeta M (2020) "The Impact of COVID-19 Pandemic on Food Security in Ethiopia,"
17. Global Food Security Index (2019) "Strengthening food systems and the environment through innovation and investment <https://foodsecurityindex.eiu.com/Home/DownloadResource?fileName=Global%20Food%20Security%20Index%202019%20report.pdf>," © Econ. Intell. Unit Ltd. 2019, no. 8th edition.
18. François LM, Nagessa WB, Victor BM, Moleka M, Stuart I, et al. (2020) "Coronavirus and Nutrition : An Approach for Boosting Immune System-A Review," 12(9) pp. 72-86.
19. Gentilini U (2021) "Social Protection and Jobs Responses to COVID-19 : A Real-Time Review of Country Measures,"
20. Bank W (2020) "Effects of COVID-19 on food security, nutrition, and agriculture in the LDCs. https://www.un.org/ldc5/sites/www.un.org/ldc5/files/pdf/stateLDC_2021/11_stateldc_2021_c.pdf," www.un.org/ldc5.
21. M W, David Laborde RV (2020) "'Poverty and food insecurity could grow dramatically as COVID-19 spreads',16 April 2020. <https://www.ifpri.org/blog/poverty-and-food-insecurity-could-grow-dramatically-covid-19-spreads>," IFPRI BLOG.
22. Hanna Freudenreich AFLJ, Demmler KM (2020) "Effective interventions to increase food and nutrition security in response to," www.un.org/ldc5.
23. Katrin S (1995) "WHO Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe," Fed. Inst. Heal. Prot. Consum. Vet. Med. Berlin, vol. 6th Report.
24. FAO (2020) "COVID-19 and its impact on food security in the Near East and North Africa: How to respond? Cairo. <https://doi.org/10.4060/ca8430en>. ISBN 978-92-5-132496-7,"
25. Nagyova L, Andocsova A, G'eci A, Zajac P, Palkovi'c J, et al. (2019) "Consumer's awareness of food safety. Potravinarstvo," 13(1).
26. Huang H (2020) "Beijing's Coronavirus Outbreak. South China Morning Post. <https://multimedia.scmp.com/infographics/news/china/article/3090290/beijing-coronavirus-outbreak/index.html>,"
27. DG Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, et al. (2020) "Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR,," Eurosurveillance, 25(3) 2000045.
28. Taylor CA, Boulos C, Almond D (2020) "Livestock plants and COVID-19 transmission. <https://www.pnas.org/lookup/suppl/doi:10.1073/pnas.2010115117/-/DCSupplemental>," 117(50).
29. Koopmans M (2021) "SARS-CoV-2 and the human-animal interface : outbreaks on mink farms," Lancet Infect. Dis. 1(1) 18-19.



30. Perly N (2020) "Three highs, one low: How CP foods pre-covid-19 technology investments helped it through crisis-Chairman Exclusive part II. <https://www.foodnavigator-asia.com/Article/2020/08/18/Three-highs-one-low-How-CP-Foods-pre-COVID-19-technology-investments-helped->".

31. Shahbaz M, Bilal M, Moiz A, Zubair S, Hafiz MN Iqbal (2020) "Food Safety and COVID-19: Precautionary Measures to Limit the Spread of Coronavirus at Food Service and Retail Sector," J. Pure Appl. Microbiology, vol. (Spl Edn).

32. Pal M, Berhanu G, Desalegn C, Kandi V (2020) "Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2): An Update," 2(3) 2020.

Discover a bigger Impact and Visibility of your article publication with Peertechz Publications

Highlights

- ❖ Signatory publisher of ORCID
- ❖ Signatory Publisher of DORA (San Francisco Declaration on Research Assessment)
- ❖ Articles archived in worlds' renowned service providers such as Portico, CNKI, AGRIS, TDNet, Base (Bielefeld University Library), CrossRef, Scilit, J-Gate etc.
- ❖ Journals indexed in ICMJE, SHERPA/ROMEO, Google Scholar etc.
- ❖ OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting)
- ❖ Dedicated Editorial Board for every journal
- ❖ Accurate and rapid peer-review process
- ❖ Increased citations of published articles through promotions
- ❖ Reduced timeline for article publication

Submit your articles and experience a new surge in publication services (<https://www.peertechz.com/submission>).

Peertechz journals wishes everlasting success in your every endeavours.