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A Study on Temperature Affects Viruses' Survival in Vegetables and Fruits

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ABSTRACT

A ready-to-use or ready-to-eat form of raw and slightly processed fruits and vegetables is often sold to consumers. Preservatives and antimicrobial agents are rare in these items, and they are rarely heated before eating. Foodborne viruses were identified as one of the top-rated food safety priority in a recent analysis by risk assessment specialists using the Delphi technique, and the food industry has grown increasingly concerned about them in recent years. Viral control measures are needed throughout the food supply chain, according to researchers. The effectiveness of these controls and the proper validation of their performance, whether it is personal hygiene of food handlers or the impacts of processing at-risk foods or the interpretation and action required on positive virus test results, are still unclear. s. If faecal contamination occurs, viruses can sometimes be found on fresh produce. Polluted water and untreated sewage sludge used for irrigation and fertilisation can cause this contamination at the farm and harvesting site. An infected person's fruits and vegetables may also become contaminated with the virus and spread it.

Keyword: Food Safety, viruses , temperature effect , foodbrone

Introduction

Many health advantages come from a diet rich in fruits and vegetables. Even so, it's important to select and prepare them correctly. Nutritionally, fruits and vegetables can prevent heart disease, stroke, and several types of cancer. Choose low-calorie foods like vegetables and fruit over high-calorie ones to keep your weight in check. Salmonella, E. coli, and Listeria are some of the germs that can make you and your family sick if you eat raw fruits and vegetables. According to the CDC, a high percentage of foodborne infections are caused by microorganisms on fresh produce. [1]

Every year, millions of people throughout the world contract foodborne infections, and the number of patients is expected to rise in tandem with the rate of climate change. The fecal-oral route and direct contact between people are the primary means of spreading foodborne illnesses. Human norovirus (HuNoV) and hepatitis A virus (HAV) are two of the most common intestinal pathogenic viruses. There have been several recent studies (4–6) linking HuNoV and HAV epidemics to fresh produce (e.g. leafy greens and fruits), shellfish (e.g. oysters, clams, and mussels), and prepared foods (e.g., salads and sandwiches, etc.). [2]

It's not possible for viruses to multiply in food or water since they need a suitable host. After a virus is infected, it is susceptible to deterioration. The stability of the virus, the treatment of the food, and environmental conditions all play a role in the survival of foodborne viruses [3]. Viral persistence in a variety of habitats (e.g. marine and soil environments) and fresh foods has been observed to be relatively resistant to environmental conditions (e.g. low pH, heat and water activity) (19).

Vinyl coupons, a model system for examining surfaces in fruit preparation and storage environments, show the potential for cross-contamination of deciduous fruit products under conditions of poor sanitization. ' To avoid cross-contamination, foodborne bacteria that thrive and survive at multiple temperatures and in varied nutritional circumstances must be eliminated. [4] In contaminated fruit packing buildings and storage conditions, temperature mismanagement could lead to pathogen proliferation. To maintain food safety, proper hygiene and sanitation techniques, the elimination of possible contaminants, and proper food safety management systems are required.

Survival of viruses on fruits and vegetables

It was found that Rotavirus SA-11 was able to persist for up to 30 days at 4°C on lettuce, radish and carrot. Rotavirus SA-11 was remained detectable on lettuce 25 days after inactivation at room temperature (25°C) compared to 4°C. Refrigerated storage temperatures (2–8°C) often slow down respiration, senescence, browning, moisture loss, and microbial development in minimally processed fruits and vegetables, but they can also help viruses survive and spread to humans. [5]

We injected water or diluted faeces with viruses, and then kept the samples at 4 °C for up to 8 days in both covered and uncovered conditions. After 1 day, the virus titer on uncovered samples dropped to 30 % or less of the original, and no infectious virus could be recovered after 4 days, whereas on covered samples, the virus titer remained stable. When it came to virus survival, lettuce and celery were seen to be the greatest options. [6] Coxsackie B5 virus, echovirus, and reovirus can survive at 4 °C in uncovered or closed containers holding water on strawberries, cherries, and peaches. Individual fruits were inoculated with viruses in a drop of solution for the study. The water containers were tightly sealed to maintain a certain humidity level. Dilute faeces was used in half of the studies to mimic natural contamination conditions. [7]

Review of Literature

There is no doubt that bacterial pathogens play a significant role in food-borne illness connected with produce. From 1973 to 1997, bacteria were responsible for 60 % of outbreaks in which an etiologic agent was discovered (Sivapalasingam et al., 2004)[8]. Bacteria was the most common bacterial infection, accounting for approximately half of all bacteria-related outbreaks (Sivapalasingam et al., 2004)[8].

Fresh fruits and vegetables, such as salads, are often eaten raw, which increases the risk of foodborne illness. As a result of this, many countries' fresh produce industries have implemented a variety of risk management measures in an effort to limit contamination. This hasn't stopped an increasing incidence of illnesses due to tainted products being reported in the USA (Sivapalasingam et al., 2004)[8]. New agricultural practises, such as triple-washing pre-packed leafy greens, have expanded both the supply and the variety of products available, which may have led to an increase in the likelihood of more widespread outbreaks as well.

The Delphi method (Rowe and Bolger, 2016)[9] was used by risk assessment specialists to identify foodborne viruses as one of the most pressing food safety concerns. As a result, in recent years, the food industry and regulatory agencies have been increasingly concerned about foodborne viruses. Only a few developed countries have begun to consistently track infections caused by foodborne viruses in their surveillance systems.

Fecal-oral transmission is the most common mode of transmission for foodborne virus infections. Other routes of transmission include person-to-person contact and secondary routes of infection. As previously stated, human faeces, diseased food handlers, and animals (and their waste) harbouring zoonotic viruses have been recognised as important transmission pathways (FAO and WHO, 2008)

Both Larkin et al. [10] and Tierney et al. [11] sprayed poliovirus-seeded sewage by spray or flood irrigation to small field plots before or shortly after planting lettuce and radish seeds, respectively, in their studies. All sludge-irrigated vegetables kept visible particle material after spraying, and this material remained on the plants until the crops were harvested. Poliovirus was detected in mature vegetables for up to 36 days after spray irrigation of sludge or effluent [54], although a 99 % loss in detectable viruses was noted during the first 5–6 days of it, and up to 14 days in another experiment conducted earlier in the growing season.

Objectives

- To study effect of temperature on food safety
- To study measure to be followed to ensure the provision of food safety
- To study cascading effects of climate change impacts on food security and nutrition
- To study classification of foodborne viruses

Research Methodology

Interviews, observations, and documents were all used in this study's qualitative design. Rather than attempting to establish a causal chain, qualitative research seeks to comprehend a situation or event from different perspectives. This research relies on data that has already been published in the form of secondary sources. A variety of relevant websites were used to gather the information needed to write this paper.

Result and Discussion

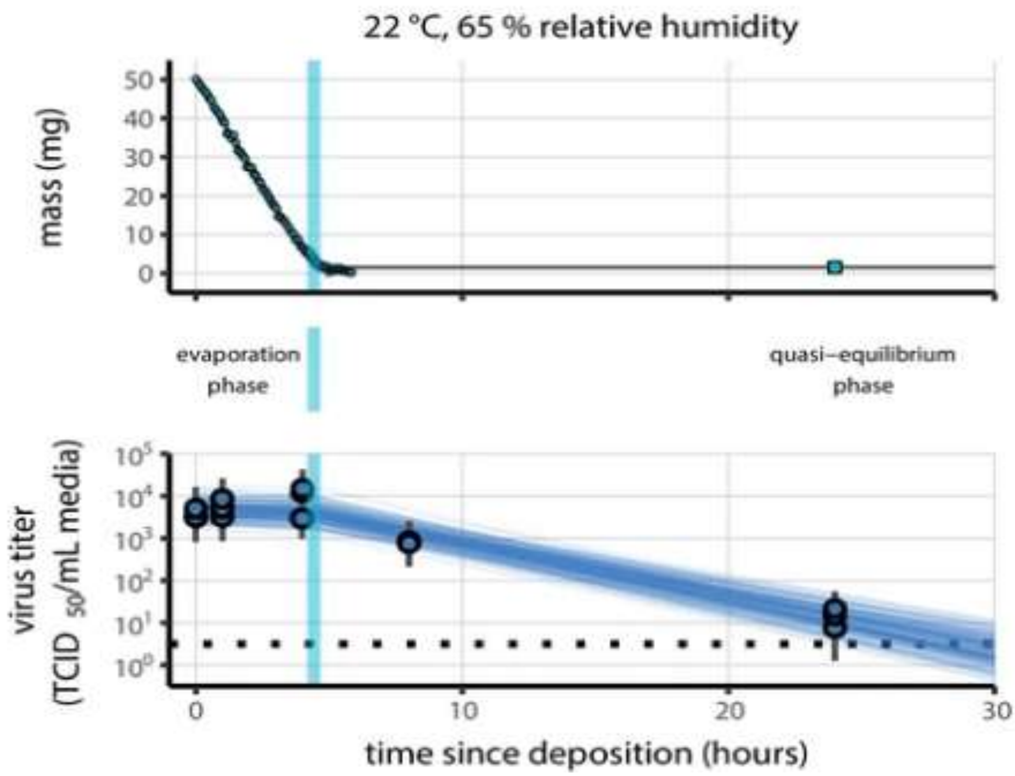
There has been a rise in viral foodborne infections all across the world. Multiple viruses have been linked to outbreaks of foodborne illness around the world. It is possible for foodborne viruses to persist without losing their infectivity over long periods of time. There is a summary of foodborne viruses in Table 1[12].

Table 1. Foodborne viruses.

Viruses	Particle/Genome [1]	Genus/Family
Human norovirus (HuNoV)	Non-enveloped/ssRNA	*Norovirus/Caliciviridae*
Human rotavirus (HRV)	Non-enveloped/segmented dsRNA	*Rotavirus/Reoviridae*
Hepatitis A (HAV)	Non-enveloped/ssRNA	*Hepatovirus/Picornaviridae*
Human astrovirus (HAtVs)	Non-enveloped/ssRNA	*Mamastrovirus/Astroviridae*
Aichi virus (AiV)	Non-enveloped/ssRNA	*Kobuvirus/Picornaviridae*
Hepatitis E (HEV)	Non-enveloped/ssRNA	*Orthohepevirus/Hepeviridae*
Human adenovirus (HAdV)	Non-enveloped/dsDNA	*Mastadenovirus/Adenoviridae*
Sapovirus (SaV)	Non-enveloped/ssRNA	*Sapovirus/Caliciviridae*
Enterovirus (EV)	Non-enveloped/ssRNA	*Enterovirus/Picornaviridae*

RNA—single-stranded RNA; dsRNA—double-stranded RNA; dsDNA—double-stranded DNA

Environmental persistence of SARS-CoV-2 could vary meaningfully across the range of temperatures and humidities encountered in daily life, with posterior median [95 % credible interval] half-lives ranging from 27 hr [20, 39] (10°C, 40 % RH) to 1.5 hr [1.1, 2.1] (27°C, 65 % RH), once droplets reach quasi-equilibrium with the ambient air conditions is shown in Figs. A a and b[13].



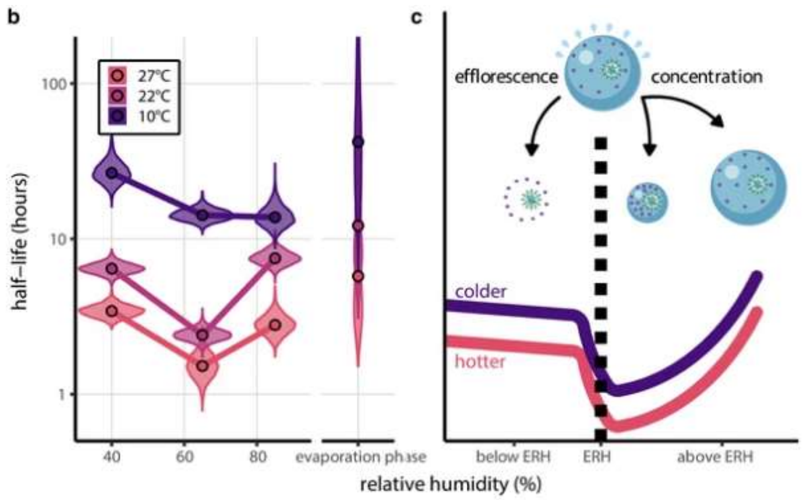
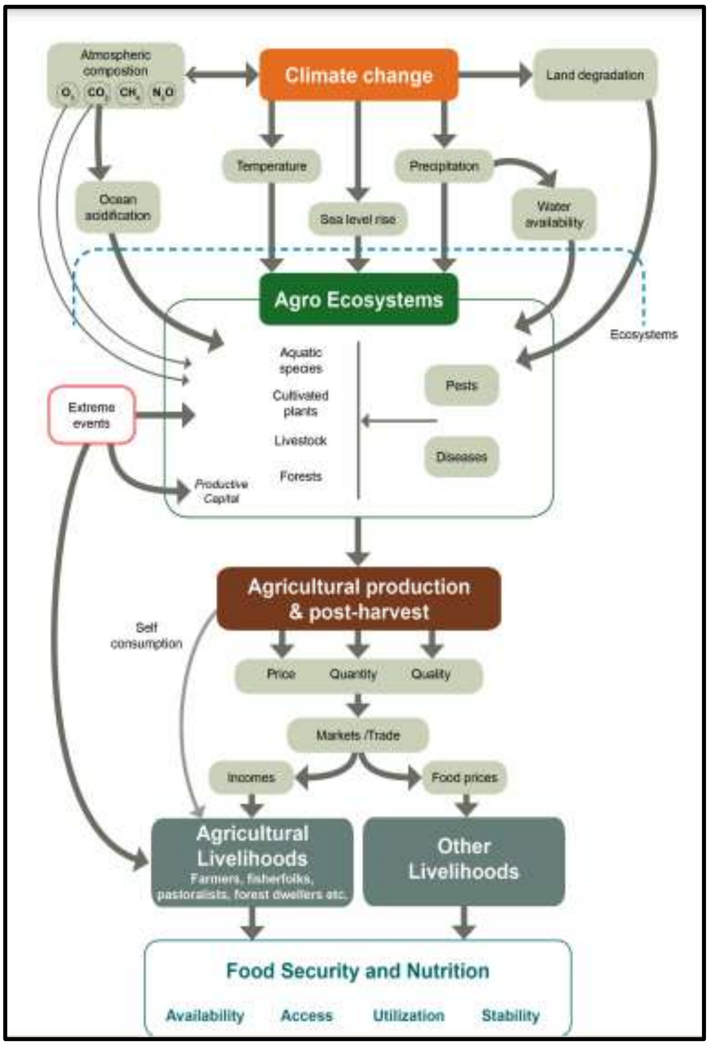


Figure 1 shows the effects of temperature and relative humidity on the inactivation kinetics and estimated half-life of SARS-CoV-2 on an inert surface (RH).

As a result of the added hazards on agricultural productivity, the people who directly rely on agriculture for their food and living face additional risks. Through price volatility and disrupted trade, they can also have an impact on the food security and nutrition of remote people. Through illustrate this, Fig 2 depicts a chain reaction from climate change to agro-ecosystems and agricultural productivity to the effects on food security and nutrition. [14]



Climate change consequences on food security and nutrition are shown in Fig. 2 schematically. Ecosystems and agroecosystems are subject to a variety of physical, biological, and biophysical effects, all of which have an effect on agricultural production. This has a direct impact on the income of farm families and the purchasing power of non-farm families, both directly and indirectly. Food security and nutrition are affected on all four levels by these factors.

Cooked dishes should not be kept out in the open for more than two hours at room temperature. Ideally, these foods should be refrigerated at a temperature of less than 5°C. At normal temperature, microorganisms can multiply incredibly quickly. Microorganisms' reproduction slows or stops at temperatures below 5°C and over 60°C. A food safety checklist is shown in Table 2 of this document. [15]

Step	**Danger**	**Measure**
Supply/Purchase	Contamination of raw foods	Purchase foods from reliable suppliers.
		Make sure that hygienic conditions are provided and maintained during supply and transportation.
	Contamination of ready-to-eat foods	Purchase foods from reliable suppliers.
		Purchase foods from companies that apply HACCP' system.
Storage	Contamination	Keep foods in wrapped or closed containers.
		Perform pest control.
	Reproduction of bacteria	Monitor the time and temperature of storage.
		Follow the FIFO" principle.
Preparation	Contamination resulting from personal hygiene	Wash hands before touching the food.
		Prevent cross-contamination by surfaces and containers.
		Separate cooked foods from raw foods.
		Use boiling water, especially if the food will not undergo additionally cooking.
	Reproduction of bacteria	Pay close attention to the amount of time foods remain at room temperature.
Cooking	Survival of the pathogen	Make sure that the food is cooked well (the food in its entirety should have a temperature of 70°C)
Cooling and keeping at cool temperatures	Reproduction of the bacteria and spores which did not die in high temperature; toxin production	Make sure that the temperature of the food drops below 5°C as soon as possible when cooking it.
		Do not let foods remain at room temperature longer that two hours.
		Avoid storing too much food in the refrigerator or in the cool spaces in it.
		Beware of the internal agitations in long-term cold storage.
	Contamination by various sources	Wrap the foods appropriately and prevent their direct or indirect contact with raw foods

		Make sure that the food containers are clean when storing he cooked foods.
Waiting in high temperature	Reproduction of the bacteria and spores which did not die in high temperature; toxin production	Keep temperature of the food above 60°C.
Re-heating	Survival of the bacteria	Re-heat the food properly.
Service	Reproduction of the bacteria, production of spores, and toxins	Re-heat the food properly.
	Contamination	Do not touch the food with hands.
		Serve the food hot.
		Prevent contact between uncooked foods and unclean containers.

Table 2. Measures to Be Followed to Ensure the Provision of Food Safety

Conclusion

Global health is at risk due to the spread of foodborne viruses. Except for a few sectors like shellfish and food service, which have seen an increase in scientific knowledge about viruses, the industry has received little guidance on effective mitigation techniques or risk assessments. There is no doubt that climate change is already and will continue to have a negative effect on food security and nutrition. It affects agricultural output, the people and countries who rely on it, and eventually consumers through greater price volatility as a result of its effects on agro-ecosystems. As a result of both the actual changes in climate and the inherent vulnerabilities in food systems, climate change has an effect on both the availability and the quality of food.

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