



## Evaluating Misinformation on YouTube about Washing Produce Before and During the COVID-19 Pandemic

### ABSTRACT

YouTube videos have been a significant source of public health and food safety misinformation during the COVID-19 pandemic. Specifically, the washing of produce with soap and other substances was promoted in the early stages of the pandemic through YouTube videos. Therefore, we conducted a study to analyze produce washing messaging in YouTube videos posted during, compared to prior to, the COVID-19 pandemic. Videos were identified via targeted keyword searches. Produce washing methods were coded and classified according to government recommendations. A total of 100 YouTube videos were identified and analyzed; 66 videos were posted during the pandemic and 34 before the pandemic. Of the 100 videos, 70 contained nonfactual information about produce washing. Videos posted by bloggers were more likely to contain nonfactual information compared to videos posted by the government and organizations (78 versus 29%). Videos posted during the pandemic were more likely to have nonfactual information than those posted before the pandemic (56 versus 17%). This study found that individual

bloggers contributed to the spread of misinformation about produce washing in YouTube videos, resulting in potentially harmful behavior changes among consumers. Efforts are needed from food safety educators and public health officials to improve the accuracy of food safety information disseminated on YouTube.

### INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has disrupted social and economic lifestyles, creating uncertainty regarding health information. The World Health Organization (WHO) declared a global pandemic on 11 March 2020, due to the rapid spread and increased severity of the novel COVID-19 virus worldwide (10). The COVID-19 pandemic occurred in an era heavily influenced by social media, which allowed the propagation of nonfactual information. During the pandemic, social media has become an essential platform for rapid dissemination of health-related information, much of it is false, inaccurate, and not based on scientific evidence (19). Misinformation poses a significant threat to societal health and well-being, and it influences others to engage in unsafe

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behaviors (10). For example, over 70% of adults rely on the Internet for health information, a reliance that significantly increased during the COVID-19 pandemic (9).

During the early stages of the COVID-19 pandemic, individuals feared that the virus could be transmitted through food, specifically fruits and vegetables. However, food contact or consumption is not a transmission route for the COVID-19 virus, which primarily is spread person-to-person through aerosols (8). The WHO and U.S. Centers for Disease Control and Prevention (CDC) state that there is no evidence of transmission of the COVID-19 virus via food (8). Despite this, various online and social media sources disseminated misinformation, telling consumers they should wash their fruits and vegetables with soap and other potentially harmful or unnecessary chemicals during the pandemic, which influenced consumer practices. Consumers also feared the possible transmission of the virus via food packaging (14). Risk perceptions may have driven behavioral changes based on the fear that the virus would survive on food and food surfaces (14). As a result, consumers took extra precautions that were not recommended by official governments (14).

A study conducted in the United States in May 2020 found that 19% of participants reported washing foods with bleach to prevent COVID-19 virus transmission (5); another longitudinal survey of consumer practices conducted from April to August 2020 found an increase in the number of consumers who washed their produce with soap (15). Similarly, an online focus group study conducted in Canada during May to June 2020 reported changes in food safety behavior among several participants (7). Higher rates of washing produce with soap were reported among participants aged 40 or older in the study (7). In addition, several participants reported washing their produce with various substances even before the COVID-19 pandemic (7). These practices, which expose consumers to cleaners and disinfectants, contributed to increased calls to poison control centers in the United States in the early stages of the pandemic (5). Similarly, Canadian poison control centers also witnessed increased calls during March 2020 (20). Calls were related to household exposures to bleach, hand sanitizer, disinfectants, chlorine gas, and chloramine gas due to unsafe mixing of chemicals (20).

Government agencies have warned against the use of detergents and soaps to wash produce because these can make consumers ill if ingested (16). Several fruits and vegetables are porous and can absorb potentially toxic substances in soap or other products used for washing (18). Moreover, inadequate rinsing may leave residues of the products used to wash produce. Resultant ingestion of soaps and detergents can irritate the gastrointestinal system, leading to stomach pain, vomiting, or diarrhea (7). Soaps are alkaline in pH and have a surfactant composition that can cause irritations when ingested (2). Government agencies in the United States and Canada suggest that consumers wash fruits and vegetables only under running water (6, 16–18). The process of rinsing with water

removes soil, microflora, microorganisms, and debris that may be present on the surface (4).

YouTube, one of the most popular websites globally, with more than one billion users, has increasingly been used to communicate health-related information and disinformation during the COVID-19 pandemic (13). A study conducted early in the pandemic found that an estimated 23 to 26% of health-related YouTube videos contained nonfactual information about the COVID-19 virus, whereas videos posted from credible sources were underrepresented (9). YouTube videos reach large audiences that can share and interact with the videos and influence behavioral changes among viewers. The spread of false information on an easily accessible platform can cause potentially harmful behavioral changes, putting consumer health at risk. The spread of misinformation can amplify a public health crisis, in which false information can be perceived as factual (11). Given the increase in incorrect produce washing practices observed during the COVID-19 pandemic, this study aimed to evaluate produce washing videos on YouTube as a possible source of misinformation. The study compared videos uploaded prior to and during the pandemic to examine the prevalence of factual versus nonfactual information provided across both time periods.

## MATERIALS AND METHODS

### Identification and classification of videos

The data collection took place by searching for relevant videos on YouTube in October 2021. The targeted search terms used were “how to wash fruits and vegetables,” “fruits and vegetables washing techniques,” and “food washing techniques during the COVID-19 pandemic.” For each search term used, the videos were sorted by view count. The inclusion criteria were that the videos must be in English or have English subtitles, have more than 1,000 views, and cover washing of produce (fruits and/or vegetables) in a household setting. Prepandemic videos included content from 2008 to 2019; videos related to the COVID-19 pandemic included those posted from March 2020 to September 2021. Descriptive information was collected from each video: video title, posting date, number of views, comments, likes, dislikes, URL, washing techniques used, and the upload source. The source was defined as individual blogger, the government, or other organization (e.g., news channel, university, medical center, or clinic).

The specific produce washing techniques used or recommended in the videos were coded and classified as follows: soap (including vegetable washes), vinegar (including apple cider vinegar), salt (sea salt and Himalayan salt), baking soda, spices, lemon or lime, and other. Temperature abuse was also recorded if the video recommended that pre-cut or ready-to-eat produce be stored at room temperature for >2 h. Videos were classified as “factual” if they corresponded to safe food handling recommendations from the CDC and Health Canada, including washing produce only with running water and not storing pre-cut or ready-to-eat produce at room tem-

perature for >2 h (6, 16). After one researcher independently coded produce washing practices on all the videos, a second researcher validated the coding.

### Data analysis

Data on all videos that met the inclusion criteria were compiled in an Excel 2021 spreadsheet (Microsoft Corporation, Redmond, WA) and were then uploaded to R Studio version 1.4.1717 to conduct frequency tabulations, summary measures, and statistical testing. Specifically, Pearson's  $\chi^2$  or Fisher's exact tests were conducted to evaluate differences in the factual or nonfactual content status of the videos and specific practices reported by posting date (prior to versus during the COVID-19 pandemic). We also evaluated differences in the factual versus nonfactual status and in the posting date (prior to versus during the pandemic) by upload source (individual bloggers versus government or other organizations). We compared the number of comments, likes, views, and incorrect food safety techniques reported by videos posted prior to and during the COVID-19 pandemic, and the number of comments, likes, and views by the factual versus nonfactual content status. These continuous variables did not follow a normal distribution; therefore, a Wilcoxon rank-sum test was conducted for these comparisons. For all statistical tests conducted, results with a *P*-value <0.05 were considered statistically significant.

## RESULTS

### Descriptive results

Of a total 100 YouTube videos analyzed, 66 were posted during the COVID-19 pandemic (median 22 April 2020; range

17 March 2020 to 23 September 2021). The other 34 videos were posted before the COVID-19 pandemic (median 19 February 2015; range 6 June 2008 to 9 April 2019). Of the 100 videos, 70 contained nonfactual information regarding food safety techniques for washing fruits and vegetables or storing produce at room temperature. Most of the videos posted were from individual video bloggers (83%) compared to other organizations (12%) and government agencies (5%).

Among videos posted during the COVID-19 pandemic, 55 (83%) contained nonfactual information, a percentage that was significantly higher than seen in videos posted prior to the pandemic (Table 1). The most commonly recommended produce washing methods were vinegar (45.5%), salt (33.3%), baking soda (28.8%), and soap (25.8%), as shown in Table 1. Among these methods, significantly more videos posted during the COVID-19 pandemic recommended using soap (25.8 versus 5.9%) and other washing methods (24.2 versus 2.9%) compared to prior to the pandemic (Table 1). Temperature abuse was reported only in videos posted during the pandemic.

Table 2 displays the comparison between the number of comments, likes, views, and incorrect techniques reported in videos during versus prior to the COVID-19 pandemic. The median number of comments was higher in videos posted during versus prior to the pandemic (16 versus 4), whereas the median number of likes was higher prior to the pandemic (134 versus 84); however, these differences were not statistically significant. Prepandemic videos had a significantly higher number of median views (22,787 versus 5,576); this is influenced by the time frame: 11 years for videos before COVID-19, 18 months for videos during COVID-19. Videos

**TABLE 1. Comparison of factual content and produce washing techniques in videos posted prior to and during the COVID-19 pandemic<sup>a</sup>**

| Characteristics    | During COVID-19 (N = 66) | Before COVID-19 (N = 34) | <i>P</i> -value <sup>b</sup> |
|--------------------|--------------------------|--------------------------|------------------------------|
| Factual            | 11 (16.7)                | 19 (55.9)                | <0.001                       |
| Soap               | 17 (25.8)                | 2 (5.9)                  | 0.016                        |
| Vinegar            | 30 (45.5)                | 13 (38.2)                | 0.633                        |
| Baking soda        | 19 (28.8)                | 6 (17.6)                 | 0.329                        |
| Salt               | 22 (33.3)                | 3 (8.8)                  | 0.007                        |
| Spices             | 4 (6.1)                  | 1 (2.9)                  | 0.659                        |
| Lemon              | 5 (7.6)                  | 3 (8.8)                  | 0.900                        |
| Other <sup>c</sup> | 16 (24.2)                | 1 (2.9)                  | 0.009                        |
| Temp abuse         | 5 (7.6)                  | 0 (0.0)                  | 0.163                        |

<sup>a</sup>Data are shown as no. (%).

<sup>b</sup>Pearson's  $\chi^2$  test; Fisher's exact test.

<sup>c</sup>Other includes washing fruits and vegetables with potassium permanganate, isopropyl alcohol, hydrogen peroxide, toothpaste, and essential oils, and also using the dishwasher.

**TABLE 2. Comparison of comments, likes, views, and number of incorrect techniques identified between videos posted prior to and during the COVID-19 pandemic<sup>a</sup>**

| Characteristics      | During COVID-19 (N = 66) | Before COVID-19 (N = 34) | P-value <sup>b</sup> |
|----------------------|--------------------------|--------------------------|----------------------|
| Comments             | 16 (2, 71)               | 4 (1, 50)                | 0.456                |
| Likes                | 84 (30, 299)             | 134 (31, 700)            | 0.432                |
| Views                | 5,576 (2,072, 21,676)    | 22,787 (2,954, 110,974)  | 0.030                |
| Incorrect techniques | 2.00 (1.00, 3.00)        | 0.00 (0.00, 1.00)        | <0.001               |

<sup>a</sup>Data are shown as median (interquartile range).

<sup>b</sup>Wilcoxon rank-sum test.

**TABLE 3. Comparison of comments, likes, and views between videos that contained factual versus nonfactual information about produce washing and temperature control<sup>a</sup>**

| Characteristics | Nonfactual (N = 70)   | Factual (N = 30)       | P-value <sup>b</sup> |
|-----------------|-----------------------|------------------------|----------------------|
| Comments        | 19 (3, 71)            | 2 (0, 37)              | 0.026                |
| Likes           | 100 (34, 637)         | 72 (28, 425)           | 0.412                |
| Views           | 7,027 (2,072, 57,892) | 14,500 (2,846, 77,740) | 0.305                |

<sup>a</sup>Data are shown as median (interquartile range).

<sup>b</sup>Wilcoxon rank-sum test.

**TABLE 4. Comparison of video factual content and posting time frame by video source<sup>a</sup>**

| Characteristics    | Government and organizational videos (N = 17) | Individual bloggers (N = 83) | P-value <sup>b</sup> |
|--------------------|---|------------------------------|----------------------|
| Factual content    |   |                              | <0.001               |
| No                 | 5 (29.4)                                      | 65 (78.3)                    |                      |
| Yes                | 12 (70.6)                                     | 18 (21.7)                    |                      |
| Posting time frame |   |                              | 0.070                |
| During COVID-19    | 8 (47.1)                                      | 58 (69.9)                    |                      |
| Before COVID-19    | 9 (52.9)                                      | 25 (30.1)                    |                      |

<sup>a</sup>Data are shown as no. (%).

<sup>b</sup>Pearson's  $\chi^2$  test.

posted during the pandemic reported a significantly higher median number of incorrect food safety techniques (2 versus 0).

Table 3 shows that videos with nonfactual food safety content received significantly more comments than factual ones (median 19 versus 2). Whereas median likes were higher among nonfactual videos, views were higher for factual videos; however, these differences were not statistically significant (Table 3). Table 4 indicates that YouTube videos posted by individual bloggers were more likely to contain nonfactual

information than videos posted by government agencies and other organizations (78.3 versus 29.4%). Bloggers generated a higher proportion of videos posted during, versus before, the COVID-19 pandemic (88 versus 74%), although this difference was not statistically significant.

## DISCUSSION

During the COVID-19 pandemic, food safety became relevant due to fears about transmission of the SARS-

CoV-19 virus. A sharp increase was seen in posted videos that contained inaccurate information including extreme or unnecessary washing techniques to kill or remove the virus. Fear of the COVID-19 virus is a strong motivating factor that can encourage citizens to perform unsafe food practices (14). Consumers' risk perception level regarding contracting the COVID-19 virus can cause them to take unsafe precautions that are not recommended by the government (14). Also, these unnecessary additional sanitation and decontamination steps for produce can contribute to anxiety among consumers (8).

The use of soap to wash produce was reported at a much higher frequency in videos posted during versus prior to the COVID-19 pandemic (Table 3). Persistent recommendations from government agencies during the COVID-19 pandemic increased awareness of proper hand washing techniques to prevent the spread of the SARS-CoV-19 virus (14). Hand hygiene includes washing hands with soap and water for at least 20 s or using an alcohol-based hand sanitizer to help protect against the COVID-19 virus. Also, the increased awareness led social media platforms to state the importance of hand washing, which may have influenced recommendations to wash fruits and vegetables with soap and water. Washing fruits and vegetables with soap is potentially harmful and can cause adverse health effects if the soap is ingested (2). YouTube provided a platform for rapid and wide dissemination of "viral" videos containing incorrect food safety information early in the pandemic. In contrast, public health and other government officials were slower to release evidence-based campaigns on food safety messaging related to COVID-19 to dispel misinformation. More timely food safety education and messaging from government agencies and other credible information sources (e.g., extension services) via YouTube early in the pandemic might have helped to combat this misinformation.

Recommendations to wash produce with salt were also reported at a higher frequency in videos posted during the COVID-19 pandemic (Table 3). The popularity of using salt may have risen from common cultural practices shared through social media. Similarly, during the pandemic, individuals created their own methods to wash fruits and vegetables to prevent the spread of the COVID-19 virus. The "other" category displayed in Table 3 included washing fruits and vegetables with potassium permanganate, isopropyl alcohol, hydrogen peroxide, toothpaste, and essential oils. Several videos also showed washing fruits and vegetables in the dishwasher. Using a dishwasher or isopropyl alcohol to wash fruits and vegetables are unsafe practices; the chemicals can leach into the fruits and vegetables and cause harmful effects if ingested (3). Individuals may have thought that the antimicrobial properties in the chemicals used could disinfect and sanitize fruits and vegetables (3). However, harmful chemicals used to wash produce can cause a risk of tissue damage and corrosive injury (3).

Five of the videos posted during the COVID-19 pandemic reported unsafe storage of fruits and vegetables at room temperature. During the pandemic, consumers feared that the

COVID-19 virus could survive on surfaces for long periods, including on fruits and vegetables (3). Research shared by the CDC and WHO indicated that, although there were no reports of the virus being transmitted through food or food packaging, the virus could be transmitted through indirect contact with contaminated surfaces (3). Therefore, videos advised keeping fruit and vegetables at room temperature for more than 2 h to prevent the transmission of the COVID-19 virus. Similarly, a few videos recommended soaking fruits and vegetables in a water solution for more than 2 h up to 24 h, a practice that may contribute to a significant risk of microorganism growth and toxin production. Time-temperature abuse is one of the most significant contributing factors to foodborne illness outbreaks (4).

The pandemic created an opportunity for individual bloggers to post and share their methods of washing produce, which often contained potentially harmful misinformation. In its early stages, the novelty of the pandemic led to a lack of information from the government and other credible sources about the effect of washing produce on virus transmission; individual bloggers filled the gap. With their popularity and influence, individual bloggers have a worrisome potential to widely spread misinformation about food safety. We found that bloggers were much more likely to report nonfactual information about produce washing and temperature abuse. A prior study looked at YouTube posts concerning *Escherichia coli*; it found that videos posted by the government had fewer views than videos from other sources (1). These results indicate that governments and other organizations (e.g., universities, extension services) need to make more effort to use YouTube to promote food safety practices for consumers at home.

Videos posted during the pandemic and those that promoted nonfactual content had more user engagement, measured by number of comments; this raises the concern that they may influence consumers to use potentially harmful and incorrect practices. Although the comments posted on the videos were not systematically or formally analyzed in this study, they tended to reinforce the behaviors shown and to motivate others to practice various produce washing techniques. Comments show the positive engagement of viewers with nonfactual information posted on YouTube. In addition, several individuals who posted YouTube videos claimed that they were in a position of authority, such as a doctor, which provided them with credibility among consumers. Similarly, individuals who post these unsafe washing techniques may claim to have used them for several years, stating that the techniques are correct and necessary.

With its ease of access and its audiovisual format, YouTube has become a very popular source for health-related information. YouTube videos about food safety techniques promote interactions and may influence unsafe behavioral changes (12). Because YouTube videos represent reality visually, the techniques shown are easy to process, learn, and replicate (12). Thus, these videos encourage viewer

engagement, and, if misinformation is included, they can motivate others to practice potentially unsafe produce washing methods.

This study has some limitations. First, only English videos were analyzed; this potential language bias limits our findings to English-speaking countries with similar information related to the COVID-19 pandemic. Further, the search terms were limited to three targeted phrases. These search terms are general and may not reflect all videos posted on produce washing. Therefore, some additional popular videos could have been missed. Whereas only one researcher collected and coded the videos, a second researcher conducted validation of the coding results to minimize the possibility of misclassification errors. Further studies could analyze YouTube videos in different regions and languages to determine different socioeconomic and cultural factors that might influence the results. Additionally, further studies could examine additional food safety practices beyond produce safety during the pandemic.

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## CONCLUSION

Posting of nonfactual YouTube videos about produce washing increased during, compared to prior to, the COVID-19 pandemic. Nonfactual videos were most commonly posted by individual video bloggers. The spread of misinformation can result in unnecessary and potentially harmful behavior changes such as using soap to wash produce. Furthermore, misinformation disrupts the accurate information provided by public health and food safety professionals. More efforts are needed to promote safe food handling techniques and to dispel misinformation about food safety and the COVID-19 virus on YouTube. Social media is a powerful tool for the rapid spread of misinformation that can influence behavioral change concerning food safety. Public health and food safety professionals should use more active and compelling social media campaigns to reduce food safety misinformation. A process to fact-check and verify YouTube videos that contain information related to food safety is needed to prevent the spread of misinformation.

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