Food Source Information: Connecting Public Health Professionals with Food Production

Marisa Bunning,[1*] James Peth,[1] Catherine Davis,[1] Alice White,[2] and Elaine Scallan Walter[2]

[1]Dept. of Food Science and Human Nutrition, Colorado State University, Fort Collins, CO 80523, USA
[2]Colorado Integrated Food Safety Center of Excellence, Dept. of Epidemiology, University of Colorado–Anschutz, Aurora, CO 80045, USA

ABSTRACT

As the worldwide food system becomes increasingly complex, the challenge of maintaining food safety increases. Professionals working in state and local health departments and those working in food safety outreach at universities often share common goals to inform the public about food-related issues and prevent foodborne illness. Collaborations between public health agencies and academic departments can combine complementary strengths to better address many food-related issues. Links between these groups may not be formalized, but fostering connections between food safety networks can be beneficial in various ways, including providing assistance during outbreak investigations. One example of an innovative agency–academic collaboration is the development of the Food Source Information website: https://www.chhs.colostate.edu/fsi/. Created under the auspices of the Colorado Integrated Food Safety Center of Excellence, this was an interdisciplinary effort by staff, faculty, and students at the Colorado School of Public Health, Colorado Department of Public Health and Environment, and Colorado State University Extension. The idea for the Food Source Information website was formed following the 2011 *Listeria* outbreak associated with Colorado-grown cantaloupe. That outbreak signaled a need for readily accessible farm-to-table food information, because it can be vital for public health professionals engaged in surveillance and outbreak investigations. In-depth knowledge of food systems is generally outside the range of public health training, but this is familiar territory at land-grant universities. This on-tap resource was designed to provide rapid access to basic information and production practices for a range of food commodities. The original goal was to promote better understanding of existing agricultural production practices within the Rocky Mountain region and increase awareness of risks associated with processing fresh produce. This goal has broadened over the past 10 years. The website now includes information contributed from other regions of the United States, and it addresses a wider variety of food commodities. The website has evolved from a concept to an easily accessible resource designed to assist public health professionals during outbreak investigations and improve food safety outcomes on a national level.

OVERVIEW

State and territorial public health agencies report an average of 850 foodborne outbreaks annually *(8)* to the Centers for Disease Control and Prevention. An increasing diversity of foods has been causing illness *(23)*, particularly commercially distributed foods that have been contaminated during production *(3, 19)*. As such, foodborne outbreak investigations have become more complex. Investigations require coordination among epidemiologists, environmental health investigators or regulators, and industry partners to identify not only the foods causing illness but also the source of contamination in the farm-to-fork continuum, contributing factors leading to contamination, and the antecedents that allowed that contamination to occur *(22)*. Investigators with different expertise must rely heavily on one another and work closely together to identify and control sources of illness in an outbreak *(21)*. For example, fresh produce has been implicated in numerous foodborne illness outbreaks, and in many cases, contamination occurred during production *(4)*. Time is a critical factor during an outbreak investigation, and rapid identification of the source of contamination is one of the key responses needed by public health professionals to help prevent more illness. Knowledge of typical steps in the growing, harvesting, packing, and shipping of various commodities may be critical for determining the source of contamination. However, public health curricula rarely include coursework in agricultural or food science.

The need for public health investigators to have readily accessible food production information became apparent during a multistate outbreak investigation of listeriosis associated with cantaloupe grown in Colorado *(17)*. Outbreak investigators needed to understand steps in the production of local cantaloupe to help identify potential contamination sites to sample for the presence of *Listeria*. The opportunity to contact university specialists in crop production and produce safety helped fill this information gap. This outbreak called attention to an important need for public health investigators during outbreaks to have access to production information related to food products and agricultural commodities. The goal of this paper is to summarize the creation of this food production resource

*Author for correspondence. Phone: +1 970.491.7180; Email: Marisa.Bunning@colostate.edu

targeted to public health professionals and to highlight the value of academic–agency collaborations in reducing the risk of foodborne illness.

Website Development

In 2012, the Integrated Food Safety Centers of Excellence (CoEs) were established under the Food Safety Modernization Act (FSMA) to serve as resources for federal, state, and local public health professionals who detect and respond to foodborne illness outbreaks *(7)*. As part of the FSMA legislation, each Food Safety CoE is a collaboration between a state public health agency and an academic institution. The Colorado Food Safety CoE *(10)* is a partnership of the Colorado Department of Public Health and Environment (CDPHE), the Department of Epidemiology at the Colorado School of Public Health (CSPH) on the Anschutz Medical Campus, and the Department of Food Science and Human Nutrition at Colorado State University (CSU), which is supported by the CSU Extension *(Fig. 1)*.

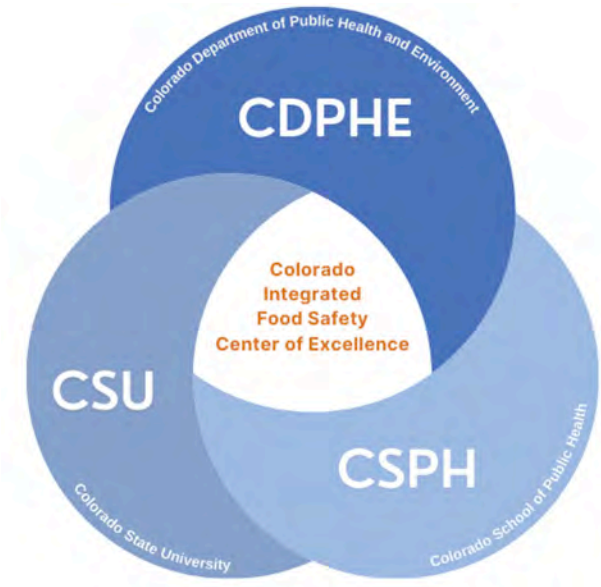

FIGURE 1. Graphic illustration of collaborators involved in the Colorado Integrated Food Safety Center of Excellence.

Following the outbreak of listeriosis associated with cantaloupe, epidemiologists, food safety experts, and academics from CDPHE, CSPH, and CSU convened a Colorado-based *Listeria* summit. One of the needs identified by experts during this summit was centralized food production information for public health professionals during outbreak investigations. Following these discussions, the Colorado Food Safety CoE created the Food Source Information (FSI) website *(11)* in 2013, with the goal of providing basic and timely information related to production practices for foods suspected or implicated during foodborne outbreaks. The FSI website was initially envisioned as a wiki, a website that allows collaborative editing of its content by users, but it currently functions as a website with restricted access.

Design of the FSI website was based on specific information needed by public health professionals during investigations of foodborne illness outbreaks. It was determined that each web page associated with a food commodity would include the following:

1. Key facts: bulleted information that summarizes main points of the article
2. Introduction: basic commodity information that may include genus and species name, if applicable; an overview of origin; history; global distribution; and unique attributes
3. Foodborne outbreaks: summary of historical outbreaks, description of notable outbreaks, pathogens previously associated with this food, and contributing factors in previous outbreaks
4. Production
   a. Food production level I: Basic production information that may include preharvest factors, soil specifications, water or irrigation requirements, pest issues, possible wild or domestic animal access, and where and how much of this commodity is produced in the United States. If it is a processed food, information may include ingredient specifics.
   b. Food production level II: Relates to harvest information. Is this crop hand harvested? Are there multiple crops per year? When is the usual harvest time? Is field heat an issue? If the food is fermented, is there an aging process? Are there packaging issues?
   c. Food production level III: Addresses typical postharvest steps. What potential problems exist postharvest? Is there a cold-chain requirement? How is this food distributed? What is the expected shelf life? Is consumer mishandling a potential issue?
5. Food safety: contamination risks, usual sanitization practices, and safe handling recommendations for raw, prepared, and/or preserved forms, including storage temperatures and shelf life
6. Consumption: per capita consumption, distribution networks, and how is food normally prepared, if applicable
7. Nutrition: associated nutrients and culinary or cultural attributes
8. References

Articles were drafted by university researchers, extension personnel, or graduate students and received an initial review by team members. Some articles were written by personnel with expertise in agriculture production, and then outbreak information was supplemented by public health graduate students. Revised versions of articles

TABLE 1. FSI food commodity articles by category

Category	Food commodity articles
Animal products	Cheese, lamb, eggs, poultry, fresh beef, yogurt
Complex foods	Chocolate, marijuana edibles, honey, tofu, kombucha
Dairy	Cheese,[a] yogurt,[a] ice cream, protein powder
Meat and poultry	Fresh beef,[a] lamb,[a] poultry[a]
Nonproduce plants	Dry beans, nut butters, flour, sunflower seeds and oil, kratom
Pediatric infant formula	Infant formula
Produce	Avocados, cucumbers, peaches, sweet corn, bell peppers, iceberg lettuce, pomegranates, Swiss chard, broccoli, jalapeno peppers, potatoes, watermelon, cantaloupe, kale, romaine lettuce, wine grapes, carrots, mushrooms, specialty mushrooms, cilantro, onions, sprouts, collard greens, oranges, strawberries
Shellfish and Seafood	Canned tuna, Oysters

[a]Denotes duplicated articles.

were reviewed by commodity experts, university faculty, and public health specialists, with final versions posted on the website. As more articles were added to the website, eight food commodity categories were determined: animal products, complex foods, dairy, pediatric infant formula, meat and poultry, nonproduce plants, produce, and shellfish and seafood *(Table 1)*. Some articles were cross-listed in two categories; for example, cheese is included in animal products and dairy. Suggestions for new article topics were gathered from the Colorado Food Safety CoE Regional Advisory Committee and other stakeholders following conference presentations and recent foodborne outbreaks. Articles initiated as a direct result of recent foodborne illness outbreaks associated with that product included flour, kratom, sunflower seeds, and cannabis-infused edible products. The process for selection, drafting, and review of articles is shown in *Fig. 2*. The schematic shows the process for developing articles takes approximately 6 months from idea to publication. Once a topic is identified, the coordinator recruits experts and students involved with the topic through graduate study via a personal invitation or online request. The author constructs the first draft, which is sent to the website coordinator, who checks the content and formatting of the article. Once that is complete, it is forwarded to at least one partnership member, who suggests revisions and/or accepts the article. The coordinator works with the CSU communications specialist to upload the article on the web page. Articles are marked as "pending external review" or, if fully vetted by the process outlined in *Fig. 2*, "externally validated." The process for developing and modifying the website is iterative. As new information becomes available (e.g., current outbreaks associated with the food), pages are updated.

RESULTS

From 2014 to 2023, 46 food articles were developed, reviewed, and published, as well as tutorials for users and a glossary of more than 100 common food production terms. Food articles were contributed by public health professionals associated with the Food Safety CoEs located in Washington, Florida, and Colorado.

Google Analytics was used to monitor pageviews and viewing time. From March 2020 to March 2023, there were 644,287 total pageviews (average of 588 per day and 214,762 per year). Combined, the top 10 accessed articles received more than 120,000 views yearly from March 2020 to March 2023 and were viewed for more than 12,000 hours *(Table 2)*. The actual pageviews for some of the most frequently viewed items are shown in *Fig. 3*, with the number of individual pageviews on the y axis and the years on the x-axis so that trends can be appreciated. Website viewing trends varied across food commodities, with some showing wider periodic variation and others exhibiting noticeable spikes in views *(Fig. 3)*.

Student education

Training the next generation of outbreak investigators and food safety specialists is a responsibility shared by schools of public health and land-grant universities. Education in the areas of food safety and health promotion requires a multidisciplinary approach that includes knowledge related to microbiology, food science, epidemiology, and effective communication. More than 50 graduate students from several disciplines, including food science, public health, horticulture, and animal sciences, have had experiential learning

FIGURE 2. Process and timeline for selecting, drafting, and reviewing articles for the FSI website.

TABLE 2. Top 10 viewed articles on the FSI website

Article topic	Average annual pageviews, March 28, 2021, to March 27, 2023	Average annual hours viewed, March 28, 2021, to March 27, 2023
Yogurt	26,609	3,148.51
Sprouts	17,839	1,327.66
Flour	13,502	1,326.41
Avocados	11,701	1,162.19
Mushrooms	11,533	996.26
Kombucha	9,196	962.64
Cucumbers	8,757	844.99
Jalapeño peppers	8,331	808.34
Ice cream	7,525	778.32
Canned tuna	5,857	650.53
Total	120,850	12,005.85

opportunities as developers and reviewers of articles, aligning well with recommended practices *(1)* and the educational aim of the Colorado Food Safety CoE to provide professional training for students. Partnerships with local and state health departments can provide opportunities for students to learn about current food safety issues and outbreak surveillance and investigations, as well as future career options.

Partnering for community education

Educational outreach to communities is an important focus at both land-grant universities and schools of public health *(16, 20)*. A common mission statement of land-grant schools includes identifying and sharing solutions that empower state residents to address emerging issues and providing outreach education aimed at improving the quality of life *(12, 14)*. Because extension networks include

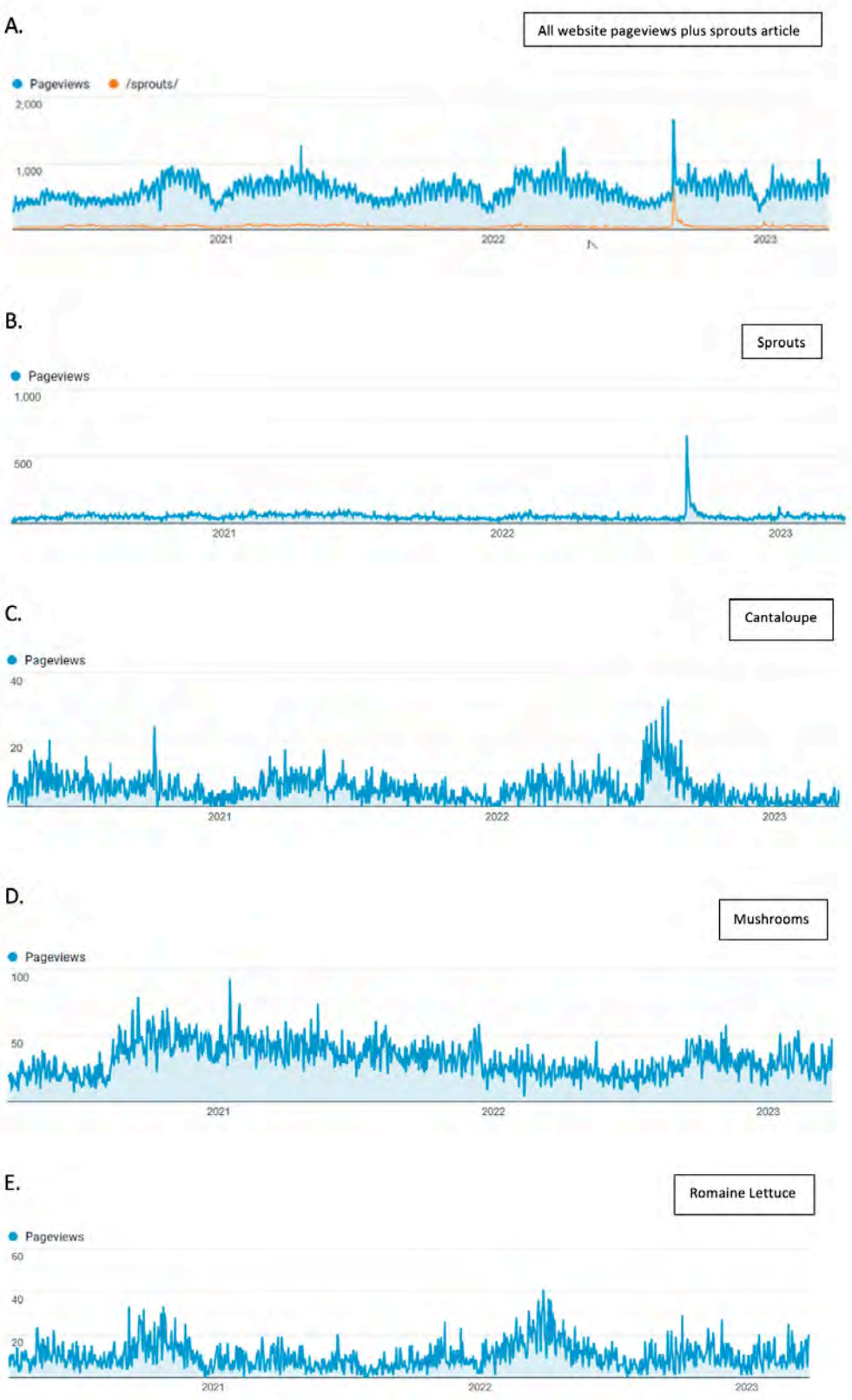

FIGURE 3. Website pageview graphs from March 28, 2020, to March 27, 2023. (A) All FSI website pageviews plus sprouts. (B) Sprouts pageviews. (C) Cantaloupe pageviews. (D) Mushrooms pageviews. (E) Romaine lettuce pageviews.

county-based agents, a statewide outreach network can share information at the community level. Historically, extension organizations offered outreach assistance that addressed agricultural issues, gardening, and youth development through 4-H organizations. Food-related information is also offered to consumers, usually in the areas of food safety, food security, home food preservation, and nutrition. In recent years, awareness of health impacts associated with food-related issues has increased and the National Institute of Food and Agriculture has identified food safety, food security, and childhood obesity prevention as three of the top six key challenge areas that need to be addressed *(18)*. In addition to providing information for public health investigators, the FSI website is accessible to the public. Food producers and consumers are often interested in gaining a better understanding of production aspects of particular foods, but credible information can be difficult to locate. Information related to the production of novel foods such as kombucha, specialty mushrooms, and nut butters can be challenging to find. For a food entrepreneur, information from FSI can be beneficial for becoming familiar with production processes and potential food safety risks.

The FSI website is one example of agency–academic collaboration. Having an established connection has led to other collaborations among CDPHE, CSPH, and CSU:

- In 2023, following the identification of human salmonellosis isolates with similarity to those isolated from pigs, cobranded hand washing signage was developed to post at county fairs, petting zoos, and livestock events.
- In 2022, following an outbreak of 23 cases of salmonellosis associated with households that prepared kitfo, a traditional Ethiopian dish containing raw or undercooked beef, an educational resource (Preparing Kitfo, written in English and translated to Amharic) was distributed broadly within Ethiopian communities and at local markets. Both English and Amharic versions of the handout were posted on the Resources section of Association of Food and Drug Officials' website *(2)*.
- In 2020, CDPHE reported one death and two illnesses in Colorado from botulism toxin associated with home-canned chili peppers that were improperly processed *(6, 15)*. In response to this event, public health professionals from CDPHE worked with outreach educators at CSU to provide resources in English and Spanish for canning safely at home. In addition, news releases and social media posts were created to provide information related to safe home food preservation methods. In 2021, Home Canning and Botulism Risk was presented to 350 registered participants as part of a series of five botulism webinars offered by the Colorado Food Safety CoE *(10)*.
- In 2018, 541 cases of giardiasis were reported in Colorado, a 66% increase since 2013 *(9)*. Recreational water is a common source of *Giardia*, but many campers and hikers may not be aware of the risk. In Colorado, recreational areas are often more than 6500 feet above sea level, and a longer boiling time to inactivate *Giardia* is required at higher elevations *(5)*. A need was recognized to provide a water treatment resource for recreational users in the backcountry. A Guide to Treating Water in the Backcountry, a downloadable information guide *(13)*, was developed by a CSU graduate student in 2022 with guidance provided by CDPHE water specialists and CSU faculty.

CONCLUSIONS

The common goals of food safety–focused university programs and state health agencies offer a logical base for building functional connections between these entities. These partnerships bring together complementary and supportive strengths to address critical food safety needs across states and regions. Participating in joint health meetings and local public health conferences can facilitate communication between academic and agency partners. Building these networks optimizes joint efforts and helps provide critical outreach education. Outcomes from collaborations of CDPHE, CSPH, and CSU have included the development and dissemination of educational resources and opportunities for university students to participate in research and expanded areas of outreach.

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